the european selection

MOTOROLA
Semiconductors

the european selection

INTRODUCTION

The total number of standard Semiconductor products available from Motorola exceeds 15 000 device types. To most of our customers this total presents an overwhelming choice, and after many years of Market Research in Europe we have determined that the 4 000 devices selected here will meet the vast majority of customers' needs.

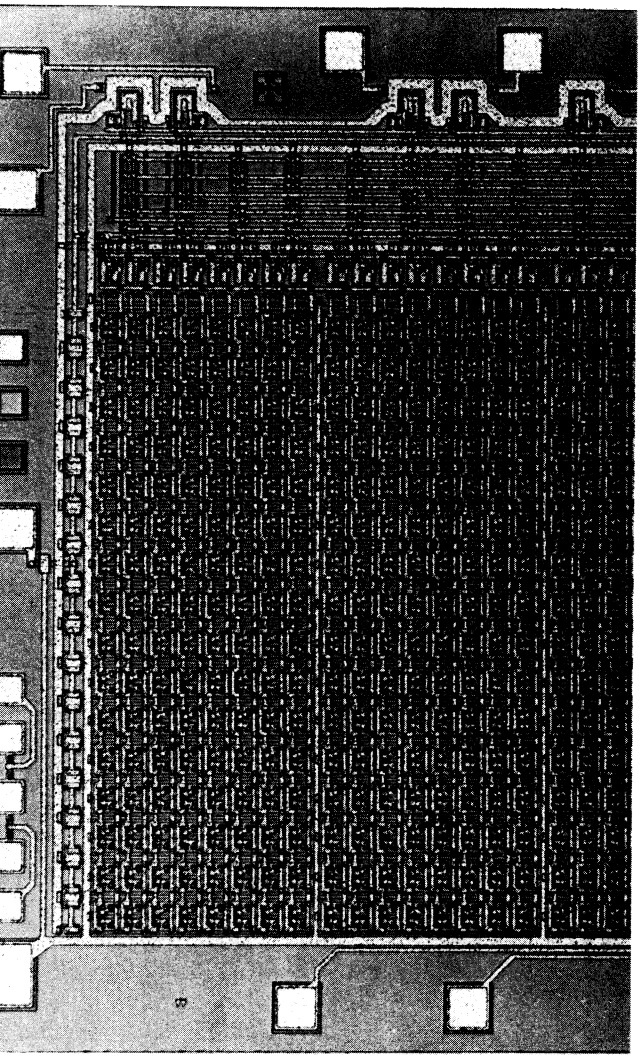
By concentrating on this *preferred product range* Motorola will also be able to provide better availability in all stocking locations, thus ensuring better deliveries and advantageous pricing to customers. Where possible, therefore, new designs should be based on devices selected from this catalogue, but please note that all our other products are still available and details can be obtained on request from your Motorola Sales Office or nearest Distributor.

CATALOG INDEX

A complete product Index with section and page number reference is added at the end of this catalogue.

Edition 1978

INTEGRATED CIRCUITS



IC Highlights

The galloping integrated circuit technology produces important new design tools so rapidly that the presentation of a total overview of available products is an illusive objective. Moreover, Motorola's pervasiveness in the various categories of integrated circuits is so widespread that the mere cataloging of new products in such an overview tends to obscure their relative significance. Hence, the following highlights of the more important developments in each of the major IC product segments...

Microcomputer Families

Of major significance is Motorola's expansion into three different families for a variety of applications:

1. The M6800 MOS Family for control and communication applications;
2. The bipolar M2900 Family for general-purpose computer and minicomputer development;
3. The bipolar *superspeed* M10800 Family for critical, real-time computer systems.

Supplementing the processor component families is a brand-new Motorola product offering – *Micromodules.* These new products offer MPU subsystems and systems of varying capabilities for those customers that want to speed-up their equipment development cycle.

Memories

The past 12 months have seen Motorola memory production expand to virtually unlimited availability of the MCM6604 4K RAMs, as well as introduction of the MCM4027 4K RAM and the MCM6616 16K RAM, and a selection of other MOS devices. Bipolar memory additions with major impact include the MCM10146 1K RAM.

In addition, Motorola now supplies *Memory Systems* for those, whose requirements go beyond the individual "chip" stage.

Logic Families

Most significant, for 1977, is Motorola's entry into low-power Schottky TTL competition. In complementary MOS, new devices in both MSI and LSI categories have been added to this explosive product line, with a major emphasis on B-series devices.

Interface Circuits

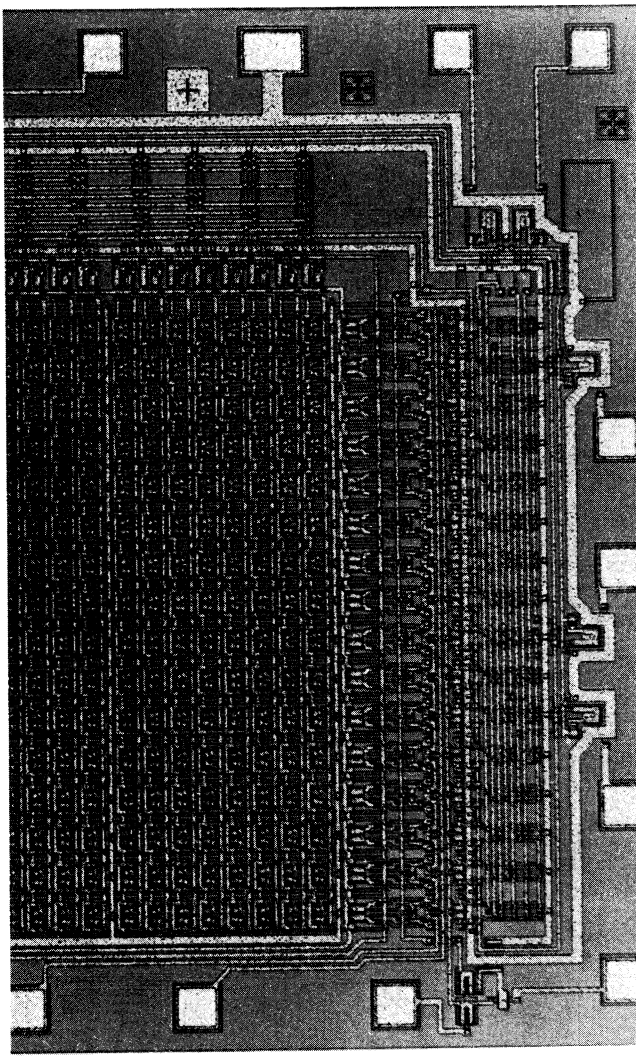
As IC technology spreads heavily into LSI, the need for the development of interface circuits with discrete components and SSI devices is a contradiction in scale. Motorola's large-scale effort on design of specialized single-chip interface circuits for computer and communications equipment has produced devices that satisfy a majority of requirements.

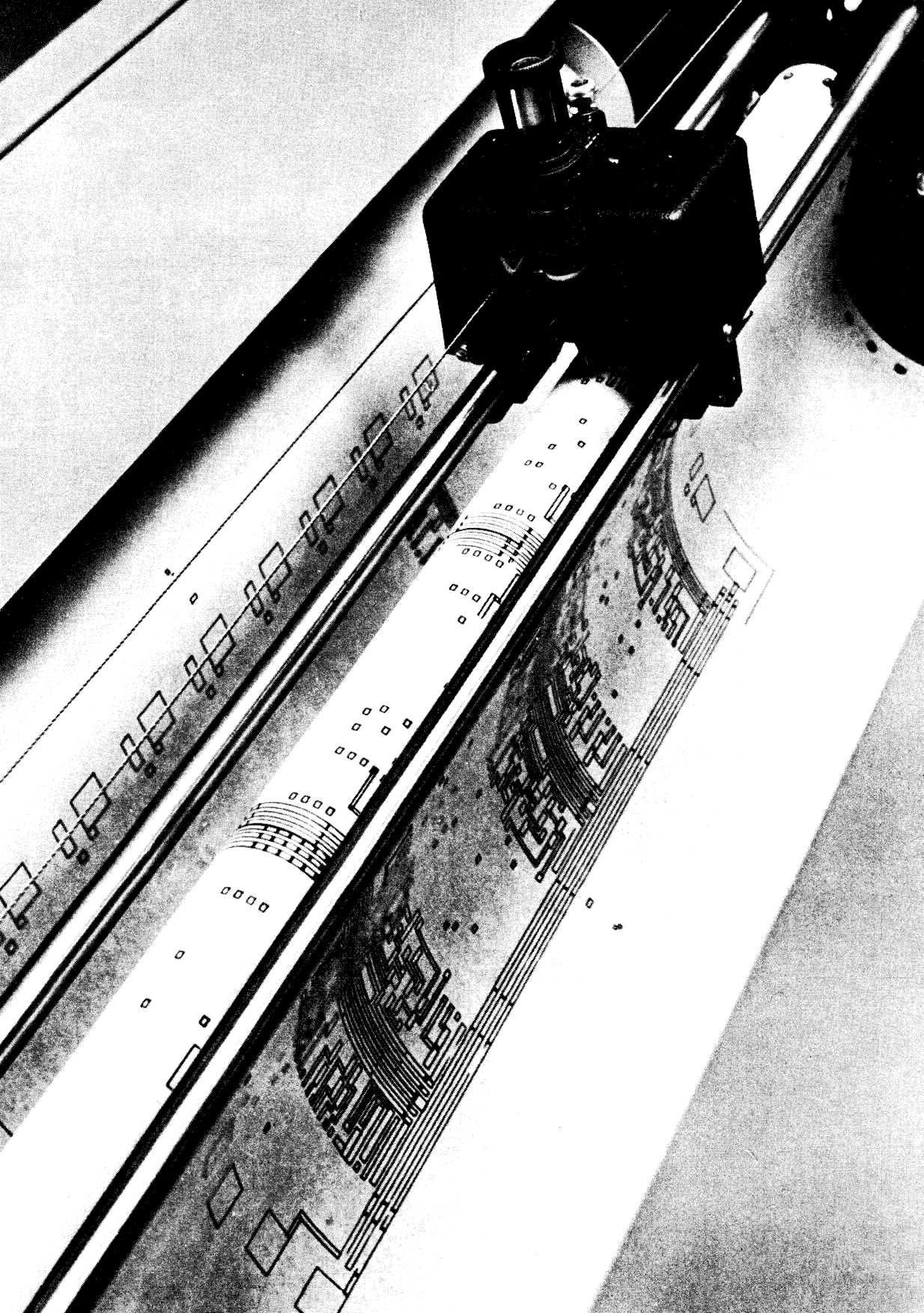
Linear Circuits

No area of integrated circuits is as widely diversified as that of Linear Circuits. Motorola's Linear leadership has established itself in virtually every category.

Phase-Locked Loop

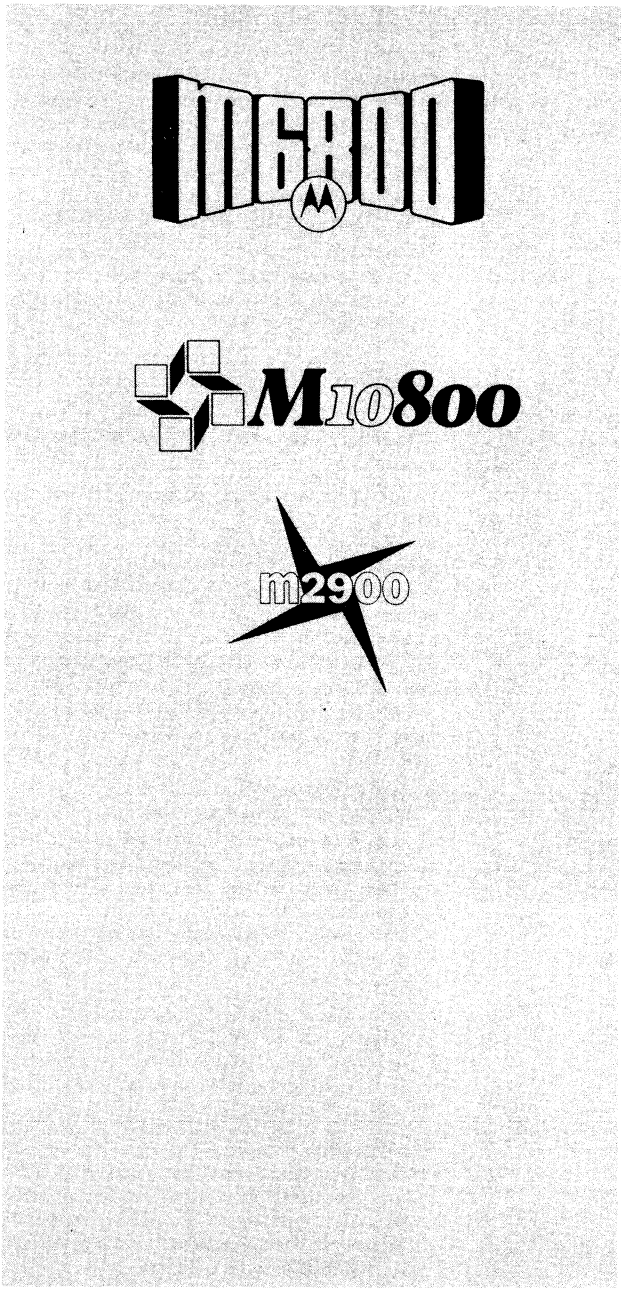
Expanding the choice of circuits designed for phase-locked loop applications are a number of CMOS Frequency Synthesizers for CB and FM transceivers.





MICROCOMPUTER FAMILIES

All you need for your microcomputer system



The M6800 Family is a pervasive set of computer circuits designed to handle most data processing, control and communication functions with a high degree of efficiency. Its NMOS LSI architecture optimizes process cost reduction without stifling system design flexibility. Its powerful instruction set minimizes memory requirements and enhances system speed. And as backup for these components, Motorola offers an extensive system of support products, design aids and services that can significantly reduce your system development costs.

Computer slices

For high performance computer systems, the "Slice" approach provides an excellent method for system design. With its "building block" expansion concept, it is possible to meet the end-use requirement of any computing system, from the simple to the most complex, while taking advantage of the cost and ease-of-design features of standard LSI components. The Motorola "Slice" family consists of two device lines. Both families have 4-bit architecture that is easily expandable to meet any system size and performance goal.

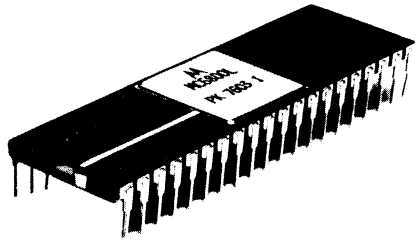
Microsystems

The difference between designing a system with microprocessors as opposed to hardwire is absolutely fundamental. With hardwired dedicated circuitry, once the components have been connected, the job is done. On the other hand, with microprocessors, when the hardware of the system has been emulated, that is when the real design work starts – the job of writing the programme to turn an uneducated computer into a functional system dedicated to a specific task.

Developing a dedicated MPU system and then manufacturing and servicing it requires an umbrella of support equipment. Already, the M6800 family is backed up by an array of user-orientated equipment, ranging from development aids to manufacturing, test and service instruments. And more instruments will be made and introduced as they are needed, so underlining Motorola's determination to keep THE FAMILY at the top of the systems designer's list.

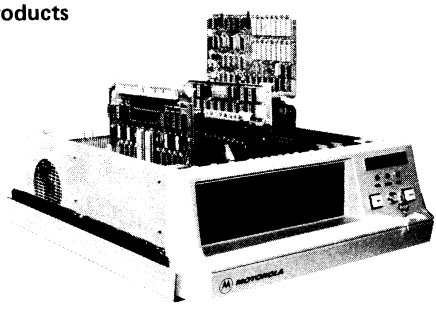
The Motorola M6800 microcomputer family

The Components

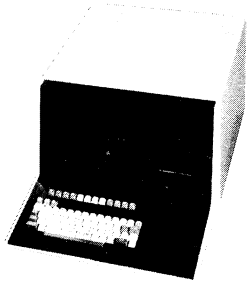


Support Software

Support Products



Support Peripherals



When you decide to abandon the time-tested wired design in favour of microprocessors, you will have made a decision that will influence your entire manufacturing operation. Whether you are designing a product for resale, or upgrading an existing control or processing system, the chances are you have opted to learn while developing a MPU-based product in return for the improved performance and cost reductions that are implicit in microprocessor designs.

Inherent in the formula for successful MPU-based designs is the selection of the most cost-effective processor family from among the many systems available today. The M6800 family ranks high in meeting the requirements.

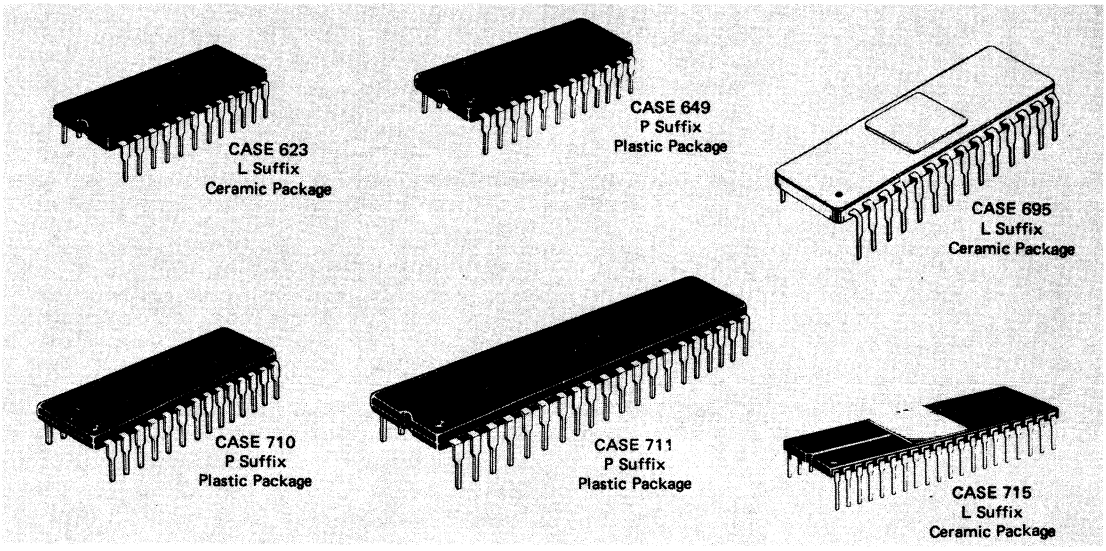
- Its 8-bit data word handles most data processing and communications functions very efficiently.
- Its NMOS LSI architecture optimizes process cost without stifling design flexibility.
- Its powerful instruction set minimizes memory requirements and enhances system speed.

But there are more considerations in the selection of the best MPU system than just technical capability. A reliable supply is of paramount importance especially if your production is dependent on a specific family of MPU components and its availability. So is the continuing flow of new related products to guard against system obsolescence and depreciation of your software investment. Your commitment to the Motorola M6800 system therefore takes on more than ordinary significance. Consider the following:

- The M6800 system includes not only a set of MPU components, but also an extensive system of support products and services such as software, design aids and test equipment. There is also a dedicated team of technical consultants who can reduce the cost of developing your system. All are available through our large European Distributor network.
- Motorola is dedicated to the continual expansion of the M6800 system with new products, designs and expanded peripherals – all tailored to increase the scope and value of your investment.
- Motorola is a world leader in semiconductor development and manufacture because it has the industry's most diversified line of semiconductor products. This proven solid-state capability offers the added insurance of continuing total-product support.

THE COMPONENTS

The M6800 family



The MPU

1.0 MHz FAMILY

Function	Type*	Case	Description
Microprocessor	MC6800L MC6800P	715 711	Monolithic 8-bit MPU forming the central control function for the M6800 family. Bi-directional data bus, 8-bit parallel processing 16-bit address bus capable of addressing 65K bytes of memory, 72 instructions. DMA and multiple processor capability.
	MC6802L MC6802P	715 711	Contains all the registers and accumulators of MC6800 plus an internal clock oscillator and 128 bytes of RAM. Completely software compatible with MC6800 as well as the entire MC6800 family of parts.
Peripheral Interface Adapter	MC6820L MC6820P	715 711	Interfaces MPU to peripherals through two 8 bit bi-directional peripheral data buses and four control lines. Programmed by the MPU during system initialization.
	MC6821L MC6821P	715 711	Functionally identical to MC6820 but with 2 TTL load capability on both A and B sides.
Priority Interrupt Controller PIC	MC6828L MC6828P (Equ: MC8507)	623 649	Adds to prioritized responses to interrupt system. It serves to eleminate polling routing and implement a mask feature.
Programmable Timer PTM	MC6840L MC6840P	695 710	Three 16 bit counters. Control register and status register. Frequency measurements, event counting, interval measuring.

Function	Type	Case	Description
Floppy Disk Controller FDC	MC6843L MC6843P	715 711	Performs the complex MPU/Floppy interface fuction. Can interface a wide range of drives with minimum of external hardware.
Direct Memory Access Controller DMAC	MC6844L MC6844P	715 711	For a peripheral to access memory directly, DMAC uses the HALT and/or Three State Control Function of the MPU.
CRT Controller CRTC	MC6845L MC6845P	715 711	Performs MPU to CRT interface function.
ROM-I/O-Timer (Combo)	MC6846L MC6846P	715 711	Provides the means, in conjunction with MC6802 to develop a 2 chip microcomputer. Consists of 2048 bytes of mask programmable ROM, an 8 bit bidirectional data port and an 16 bit programmable timer.
General Purpose Interface Adapter GPIA	MC68488L MC68488P	715 711	Provides the means to interface the IEEE 488 standard instrument bus and the MC6800.
Asynchronous Communications Interface Adapter	MC6850L MC6850P	716 709	Provides the data formating and control to interface serial asynchronous data communication information to bus organized systems. Programmable control register provides variable word lengths, clock division ratio, transmit control, receive control, and interrupt control.
Synchronous Serial Data Adapter	MC6852L MC6852P	716 709	Provides a bi-directional interface for simultaneously transmitting and receiving standard synchronous communications characters. Programmable control for variable word lengths, synchronization and interrupt.
Advanced Data Link Controller ADLC	MC6854L MC6854P	719 710	Performs MPU/Data communications link function for the "Advanced Data Communication Control Procedure" ADCCP.
Digital Modem	MC6860L MC6860P	716 709	Provides necessary modulation, demodulation and supervisory control to implement serial data communications link, over voice-grade channel, utilizing FSK at bit rates to 600 bps.
2400 bps Digital Modulator	MC6862L MC6862P	716 709	Provides necessary modulation and control to implement serial data communication link, over voicegrade channel, utilizing DPSK at bit rates of 1200 or 2400 bps.

*L Suffix = Ceramic Package, P Suffix = Plastic Package

1.5 MHz and 2.0 MHz FAMILY

The MC6800 family is available in extended operating frequency. The block diagrams and device operation are the same as for the basic MC6800 series and components.

1.5 MHz – "A" Suffix	2.0 MHz – "B" Suffix
MC68A00 P/L MC68A21 P/L MC68A50 P/L ⋮ etc	MC68B00 P/L MC68B21 P/L MC68B50 P/L ⋮ etc

EXTENDED TEMPERATURE RANGE

Suffix: CL/CP: −40 °C +85 °C (for 1 and 1.5 MHz)

CQCS: −55 °C +125 °C Mil 883 Class C
BQCS: −55 °C +125 °C Mil 883 Class B
(for 1 MHz only)

Memories

RANDOM ACCESS MEMORIES

Type	Description	Access Time	Case
MCM6810L MCM6810P	128 byte Static Random, Access memory. Single Power Supply. The Memory is compatible with MC6800 Microcomputer Series, providing random storage in byte increments.	450 ns 450 ns	716 709
MC68A10L MC68A10P	128 byte Static Random, Access memory. Single Power Supply. The Memory is compatible with MC6800 Microcomputer Series, providing random storage in byte increments.	360 ns 360 ns	716 709
MC68B10L MC68B10P	128 byte Static Random, Access memory. Single Power Supply. The Memory is compatible with MC6800 Microcomputer Series, providing random storage in byte increments.	250 ns 250 ns	716 709

READ-ONLY MEMORIES (ROM, EPROM)

Type	Function	Description	Case
MCM6830AL/AP MCM68A30AL/AP MCM68B30AL/AP	8K bit ROM	Mask-programmable, 1024 words by 8 bit, 3-state Data output for use in bus-organized systems: single power supply 5 volts 500 ns max. acc. time, 350 ns A Version, 250 ns B Version	716 709
MCM68308L/P* MCM68A308L/P MCM68B308L/P	8K bit ROM	Mask-programmable, 1024 words by 8 bit, 3-state Data output for use in bus-organized systems, single 5-volt power supply, 500 ns max. acc. time, 350 ns A Version, 250 ns B Version	716 709
MCM6832L/P*	16K bit ROM	Mask-programmable, 2048 words by 8 bit, 3-state data output for use with bus organized systems, power supplies (V) −12, −5, −5 max. acc. time 550 ns.	716 709
MCM68316EP/EL MCM68A316EP/EL	16K bit ROM	Mask-programmable. 2048 x 8 bits. Designed for use in bus organized system single power supply +5 V Temp: 0 to 70 °C, acc. time: 500 ns 350 ns A Version.	716 709
MCM68316EP1 EL1	16K bit ROM	Similar to MC68316E but temp. range: −40 to +85 °C.	716 709
MCM68332L/P MCM68A332L/P	32K bit ROM	Mask-programmable, 4096 x 8 bit. Designed for use in bus organized system single power supply +5 V Temp: 0 to 70 °C, acc. time: 500 ns, 350 ns A version	716 709
MCM68708L	8K bit Alterable ROM	Alterable, 1024 x 8 bit, 3-state output for system debug usage and similar applications, power supply (V) +12, +5, −5. Acc. time 450 ns. 2708 compatible.	716
MCM68A708L	8K bit Alterable ROM	Similar to MCM68708L but acc. time 300 ns.	716

Bus Interface

Type	Clock Speed	Function
MC6871A	921.6 KHz or 1 MHz	2-phase hybrid crystal clock with built-in crystal and buffer. **Input** — **Output** Hold — $\phi1$, $\phi2$, $\phi2$ TTL Memory Ready — 2x, Mem. clock
MC6875L Case 620 MC6875P Case 648	0 to 2.5 MHz	2-phase monolithic clock. Requires a crystal or an RC or LC network a 4 times the basic frequency. **Input** — **Output** XI, X2 — 4x DMA/REF REQ — 2x MEMORY READY — DMA/REF GRANT SYSTEM RESET — $\phi1$, $\phi2$ EXT. IN — Bus $\phi2$ Mem. clock Reset
MPQ6842 Case 646	0 to 300 MHz	Clock buffer. Quad dual in line silicon annular complementory transistors.

Clock Generators

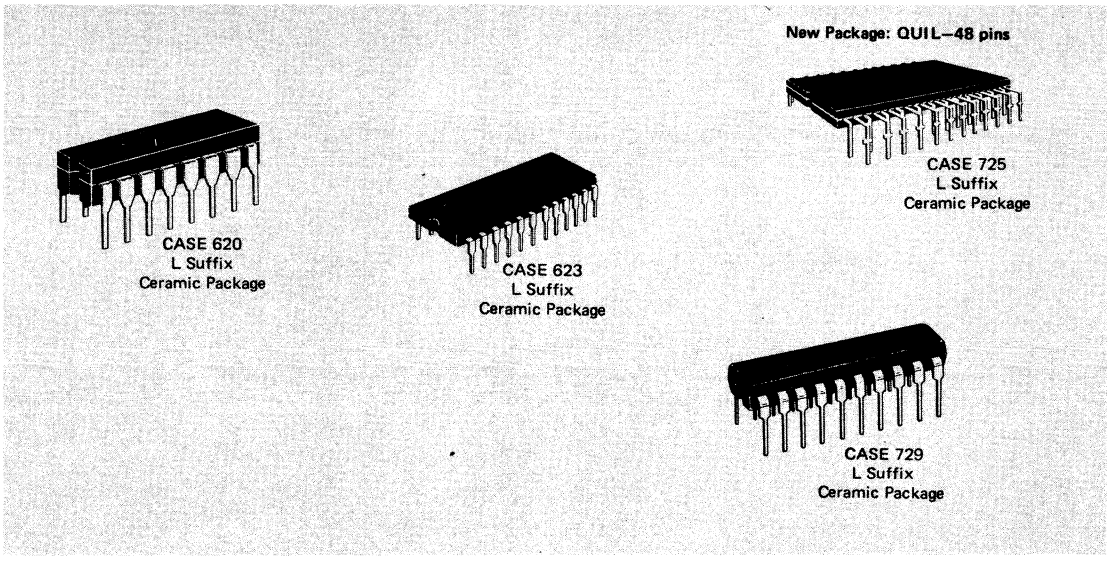
Type	Function	Case
MC6880L/P/CL (MC8T26)	Three-state Quad Transceiver for data bus. Inverting.	620, 648
MC6881L/P (=MC3449)	Triple Bus Switch for multiprocess applications.	620, 648
MC6885L/P (=MC8T95)	Three State Hex Buffer for Address Bus. Non inverting.	620, 648
MC6886L/P (=MC8T96)	Inverting	620,648
MC6887L/P (=MC8T97)	Non inverting	620,648
MC6888L/P (=MC8T98)	Inverting	620,648
MC6889L/P (=MC8T28)	Quad Data Bus Extender Non inverting.	620, 648

COMPUTER SLICES

The MECL 10800
ECL 4-bit slice processor family

LSI INTEGRATED CIRCUITS

MC10800 series (–30 °C to +85 °C)
MC10800 M series (–55 °C to +150 °C T_J)

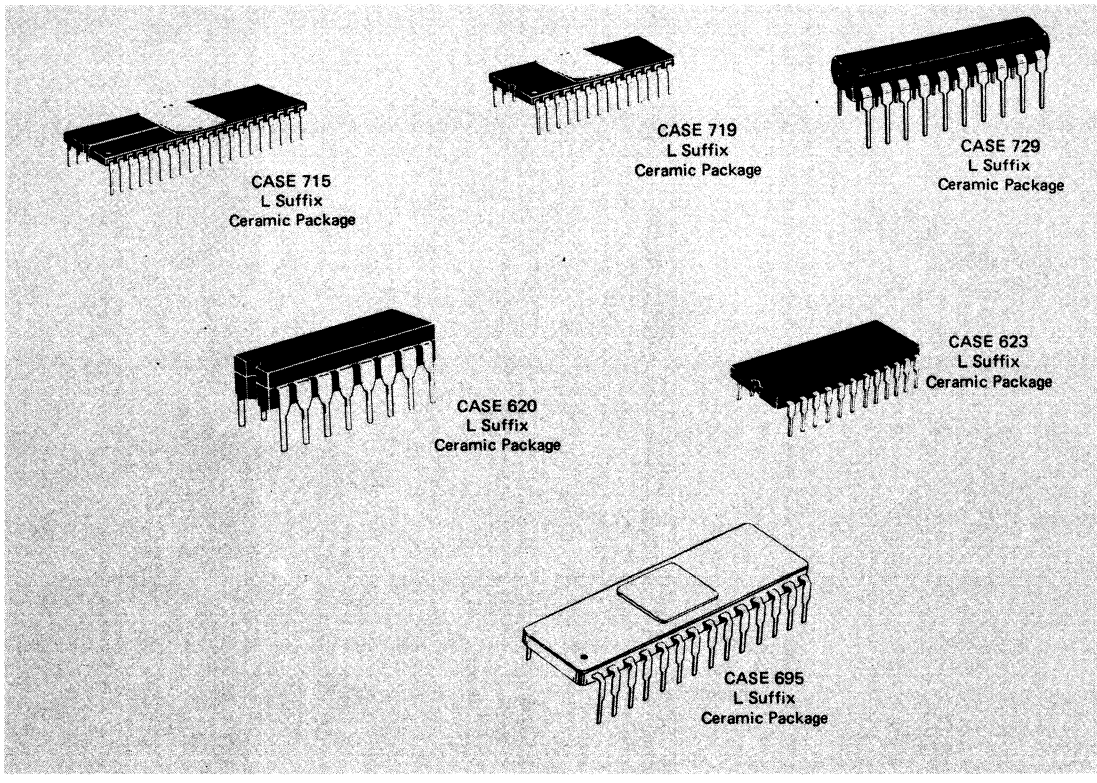


Function	Device Type	Case
4-bit Processor Slice	MC10800	725
Microprogram Control Function	MC10801	725
Timing Function	MC10802	623
Memory Interface Function	MC10803	725
4-bit Bidirectional Translator with Latch (ECL ↔ TTL)	MC10804	620
5-bit Bidirectional Translator with Latch (ECL ↔ TTL)	MC10805	729
Dual Access Stack	MC10806	725
5-bit Bidirectional MECL Transceiver with Latch	MC10807	620
Multibit Shifter (16 bits)	MC10808	725

The TTL 4-bit slice processor family M2900

LSI INTEGRATED CIRCUITS

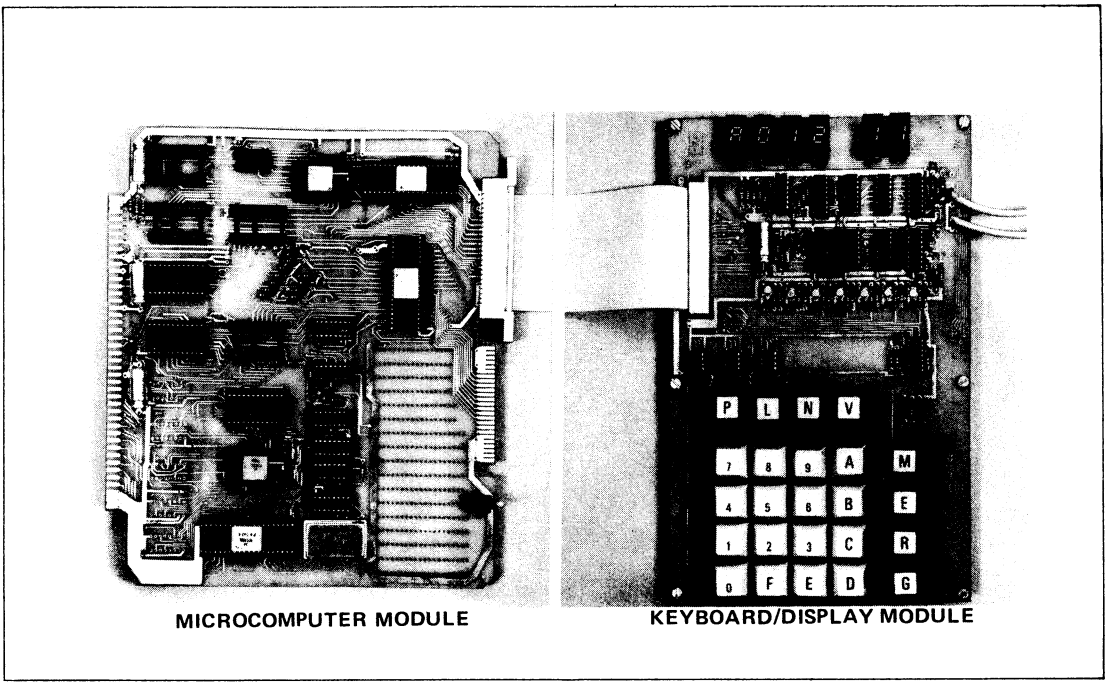
MC2900LC series (0 °C to +70 °C)
MC2900LM series (−55 °C to +125 °C)



Function	Device type		Case
	0 °C to +70 °C	−55 °C to +125 °C	
4-bit Processor Slice	MC2901LC	MC2901LM	715
4-bit Processor Slice (Faster)	MC2901ALC	MC2901ALM	715
Look Ahead Carry	MC2902LC	MC2902LM	620
Quad Bus Transceiver (OC)	MC2905LC	MC2905LM	623
Quad Bus Transceiver with parity (OC)	MC2906LC	MC2906LM	623
Quad Bus Transceiver with parity (OC)	MC2907LC	MC2907LM	729
Microprogram Sequencer	MC2909LC	MC2909LM	719
Microprogram Sequencer	MC2911LC	MC2911LM	729
Quad Bus Transceiver (TS)	MC2915ALC	MC2915ALM	623
Quad Bus with Parity (TS)	MC2916ALC	MC2916ALM	623
Quad Bus with Parity (TS)	MC2917ALC	MC2917ALM	729
4-bit Register	MC2918LC	MC2918ALM	620

MICROSYSTEMS

M6800 evaluation kit 2



MICROCOMPUTER MODULE

KEYBOARD/DISPLAY MODULE

MEK6800D2 provides an expandable kit that is ideal for those who wish to develop systems using the M6800 microprocessor, but who do not want to invest in expensive terminals.

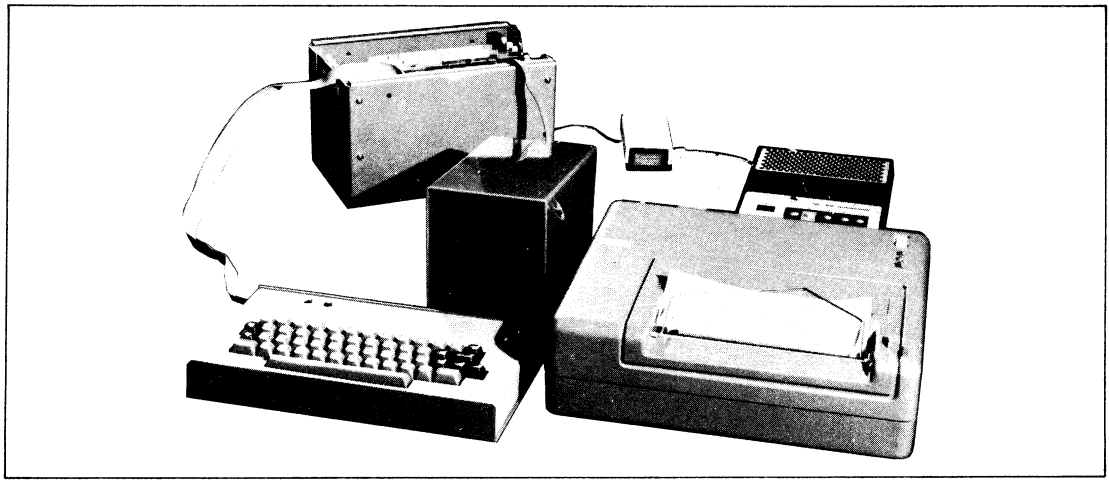
The kit includes a hexadecimal keyboard and display, 384 byte of RAM, 16 I/O lines, an ACIA, an audio cassette interface and 1K byte monitor with step-by-step and trace features, all built around the MC6800 MPU.

All parts to complete the system and get it operational are provided in the kit with exception of the power supply. In addition to the expansion of the microcomputer module, more RAM, ROM and I/O parts may be accommodated when implementing a more complex system. Machine language programmes can be entered through the system keyboard or the built-in audio-cassette interface. Hexadecimal LED displays are provided to monitor data and address information. A crystal-controlled clock is used to eliminate timing adjustments.

This system includes:

- on-board hexidecimal keyboard and displays;
- JBUG monitor to
  trace one instruction,
  set up to five breakpoints,
  examine and change memory content;
- parallel and serial interface capability;
- 16 I/O lines, 4 control lines;
- 256 byte of RAM available for the user's programme;
- built-in audio-cassette interface.

Polyvalent development family

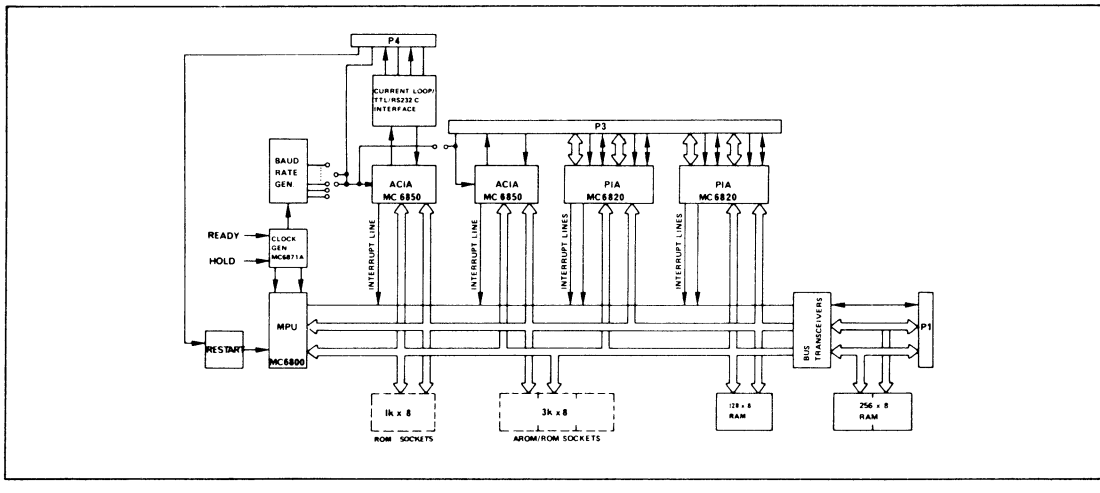


The Polyvalent Development System (PDS) fills the gap between low-cost and on-a-board microcomputers, and the sophisticated aids for designing microprocessor systems. Its design is flexible in order to meet the needs of the user as he evolves his system.

As its name suggests, the Polyvalent Development System is really a family of sub-systems that can be selected to provide the required options and can then be used to analyse the system.

These are the different configurations that may be implemented:

Stand-alone computer M68SAC1



The master-board may be used as a complete computer system, so significant savings in cost and size over multi-board systems can be made. The crystal-controlled clock provides the computer with the option of working with dynamic or slow memories. The clock circuit generates the timing signals used by the module's baud rate generator.

By setting jumpers, the user can tailor the module to work in different configurations to suit his needs cheaply.

Moreover the characteristics are designed to be flexible and include:

- four 8-bit parallel input/output ports and control lines for peripheral interfacing;
- two asynchronous input/output ports with one RS232.C/TTL/-TTY current loop interface;
- 384 byte of RAM;
- three MCM68708 or equivalent EPROM/ROM sockets;
- one MCM6830 ROM socket;
- 921.6kHz on-board crystal controlled clock;
- no restriction on interrupt capability;
- on board real-time clock;
- four-jumper selectable vector addresses;

- buffered three-state bus connector;
- fully compatible with all EXORciser modules and micromodules.

Microprocessor evaluation board M68MEB1

The master board provides an ideal means for evaluating the devices of the M6800 family especially when a monitor programme is stored in ROM or EPROM. The user can design his own debugging programme or simply plug the Motorola monitor, 'MINIBUG II' into one of the four ROM sockets.

In both cases, a tele-typewriter is likely to speed up the design cycle, compared with the use of a low-cost terminal consisting of some keyboard and 7-segment display.

The MINIBUG II firmware provides handling for serial communications through an ACIA. Thus a programme may be fed into and tested in the read-write storage. This configuration is used to test general-purpose routines as well as input/output handlers for control of the spare ACIA and PIAs contained on the master-board.

MINIBUG II features are:

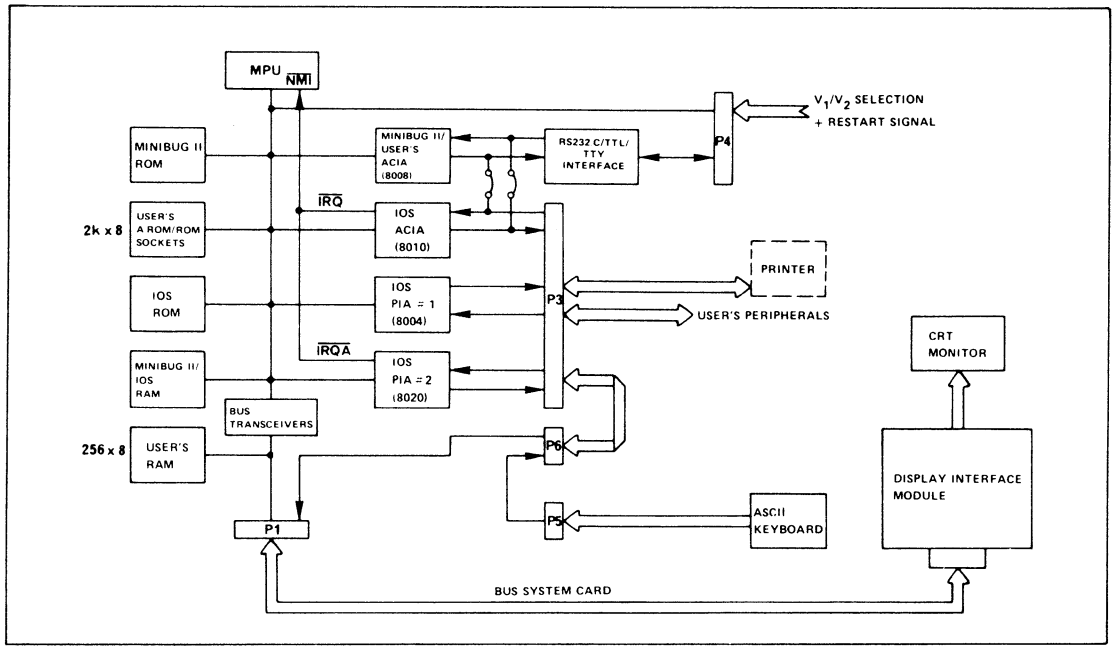
- memory load and punch/print (hexadecimal and binary);
- memory and registers examine and change;
- memory test function;
- go to user's program;
- select 1 or 2 stop bits.

Total Development System

M68ADS1 with 5-inch CRT (M68ADW1 without CRT)

The second version of the PDS described above requires that a tele-typewriter is hooked-up to the master-board. Such a communication link constitutes an expensive solution compared with the cost of the microcomputer itself.

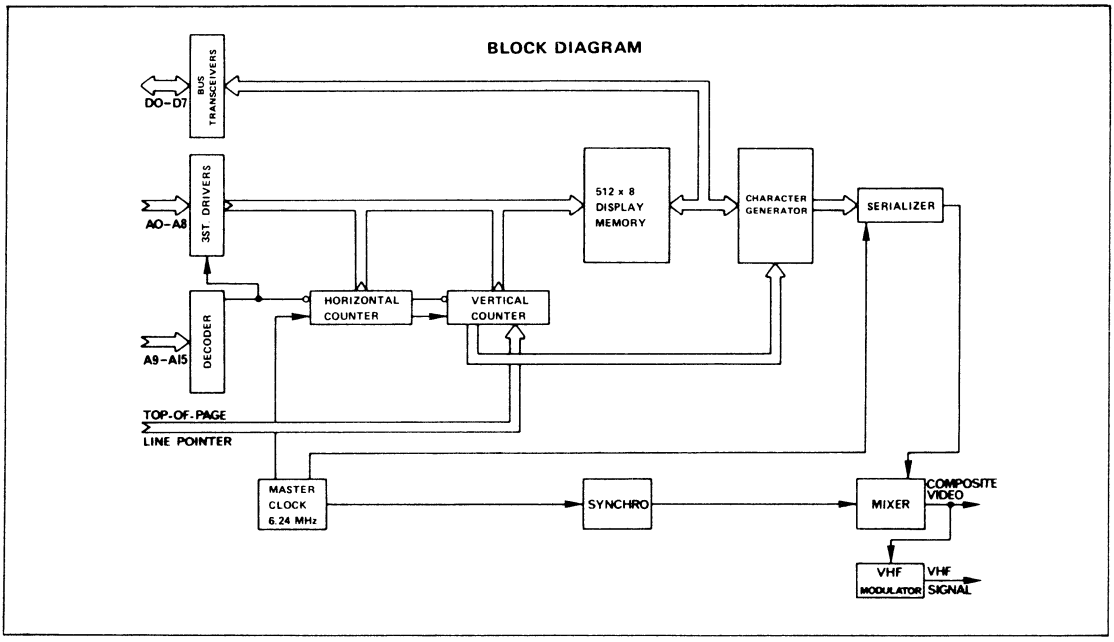
A logical step is to consider the conversion of PDS to an Autonomous Development System (ADS) which includes complete facilities for developing a hardware/software design. It provides a cost-effective terminal to avoid the use of the slow and noisy tele-typewriter. This feature combines the master-board with a video card, M68DIM1, used as interface to either a CRT monitor or an ordinary TV display on European Standards.



The display interface module includes a one-page memory, an ASCII character generator and a VHF modulator. While the one-page memory is automatically accessed by the character generator, it is normally accessed by a computer for reading and writing because the module emulates a standard 512-byte RAM module beginning at address COOO.

This system provides:

- 16 lines of 32 characters;
- 625 lines of positive or negative video signal;
- on-board 55MHz VHF modulator (channel 3);
- one-page memory (512 characters);
- black-on-white or white-on-black display;
- fully buffered three-state bus connector (EXORciser compatible);
- hardware top-of-page pointer;
- jumper selectable base address;
- fully transparent and independant display refresh;
- 128-character set.



The I/O operation performed by the MINIBUG II program are monitored, on an interupt basis, by special firmware stored in another ROM of the master-board and called 'input/output supervisor' (M68IOS1).

The firmware for the supervisor provides the user with an efficient interface to the PDS peripherals (CRT, keyboard, printer) and either the co-resident MINIBUG II firmware and user's software or an external asynchronous line such as the TTY connection of the EXORciser.

The firmware is designed to:

- be compatible with M68DIM1 32-line x 16-character display interface;
- provide for future display improvement;
- work with co-resident standard I/O routines;
- be standard to ACIA main system connection (8-bit word, 1-stop bit);
- have cursor control;
- have background control (white-on-black or black-on-white display).

When the display page is full, the next line will be displayed at the bottom, and the whole page is shifted up by one line losing the top line (scroll-up display).

The peripheral devices supplied with the ADS include:

- full ASCII keyboard;
- 127mm (5-inch) CRT monitor (with the M68ADS1).

An interface is provided on the ADS for an optional medium-speed printer (M68MPR1) to keep track of important data during the design phase. The printer works at 30 characters per second and accepts 64, 7-bit ASCII characters. This configuration offers several advantages over the other 'complete' development kits because it has:

- full keyboard to allow the programmer to type in any ASCII character for editing a program;
- CRT or TV screen to display status of registers or memory locations together, compared with one line of LED display. This saves time during software debugging;
- provision for a medium-speed printer to keep a record of important data during the debugging phase.

These features avoid the need for a terminal to develop a microcomputer.

Furthermore the design cycle is drastically shortened when operating the man-machine communication at 9.6K baud.

ORDERING INFORMATION

OPTION	DESCRIPTION
M68ADS1	completely assembled and tested system, with a 5" CRT 16-line x 32-character Display
M68ADS6	completely assembled and tested system, with a 5" CRT 16-line x 64-character Display
M68ADW1	completely assembled and tested system, with 16-line x 32-character Interface, without CRT-monitor (for use with a standard TV-receiver, VHF, 55.25 MHz channel E3)
M68ADW2	completely assembled and tested system, with 16-line x 32-character Interface, without CRT-monitor (for use with a standard TV-receiver, UHF, 591.25 MHz, channel E36)
M68ADW6	completely assembled and tested system, with 16-line x 64-character Interface, without CRT-monitor (for use with a M68MDM9 9" CRT-monitor)

OPTION	DESCRIPTION
M68TDS1	ADS6 complete development station in a cabinet with power supply, audio-cassette interface, 8K RAM and Editor/Assembler module
M68TDS2	ADS6 complete development station in a cabinet with power supply, audio-cassette interface, 8K RAM and Editor/Assembler/Basic module
M68TDS3	ADS6 complete development station in a cabinet with power supply, audio-cassette interface, 16K RAM and Editor/Assembler module
M68TDS4	ADS6 complete development station in a cabinet with power supply, audio-cassette interface, 16K RAM and Editor/Assembler/Basic module.

ACCESSORIES	DESCRIPTION
M68MDM9	9" CRT-monitor
M68MPR1	Motorola 30 chr/sec. Printer
M68MPP1	Electro-sensitive paper for MPR Printer
M68DMC1	Display Monitor Cabinet for 5" CRT Monitor
M68DMC9	Display Monitor Cabinet for 9" CRT Monitor
M68KBC1	Keyboard Cabinet for M68KBD1
M68EAM1	ROM resident Assembler/Editor Module
M68EAB1	ROM resident Assembler/Editor/BASIC Interpreter Module
MMS68103	16K-byte RAM module
MMS68103-1	8K-byte RAM module
M68CIM1	Audio Cassette Interface Module
M68PPR1	PDS PROM Programmer
M68MMLC2	Chassis with 10-slot card-cage and power-supply
M68MMSC2	Chassis with 5-slot card-cage and power-supply
M68MMCC05	5-slot card-cage
M68MMCC10	10-slot card-cage
MEC68MIN3E	MINIBUG 3E Firmware ROM, with Breakpoints capability.

Terminal for EXORciser (master-board & video-board)

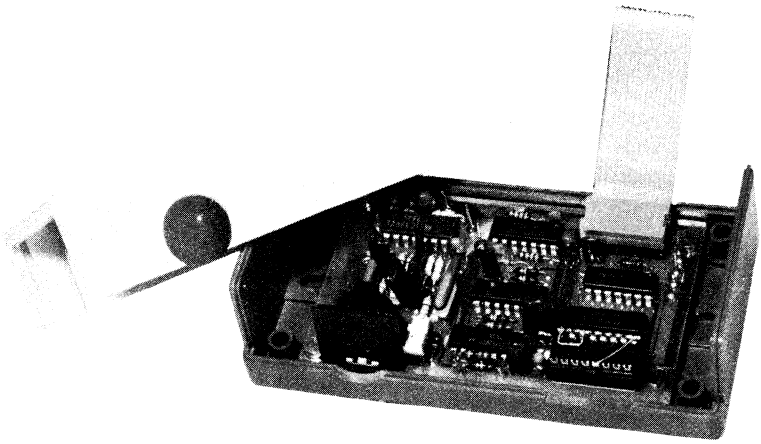
Should the user need sophisticated peripherals such as floppy disk and enhanced debugging services, he would find that Motorola has a top development tool in the EXORciser. The ADS may then be quickly converted to a terminal system for use with the EXORciser monitor EXBUG, or any file stored on diskette such as: macro-assembler, linking loader or user program.

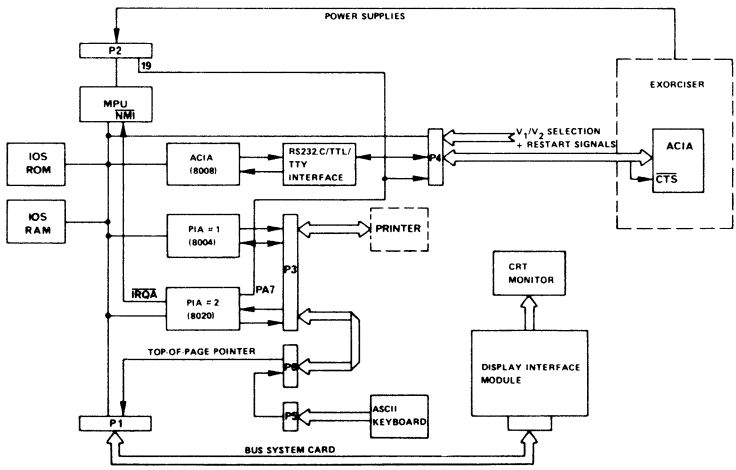
Again the medium-speed printer, M68MPR1 permits a record of debugging or assembly listing to be kept. The terminal does require the same firmware as before. A jumper allows access to the right section of the common ROM at the time of system's start-up.

PDS with editor and assembler

The ADS can be extended to include full editing and assembly. The ADS is then combined with an audio-cassette interface (M68CIM1), a ROM resident editor/assembler (M68EAM1), and an 8K or 16K RAM (MMS68103) providing the storage memory. A standard micromodule card-cage (M68MMCC05 or M68MMCC10) should be used to interconnect all these modules. Alternatively a complete chassis (M68MMSC2 or M68MMLC2) including the power supply can be used. Medium-speed printer (M68MPR1) may also be used to keep track of important programme assembly listings.

Audio-cassette interface module





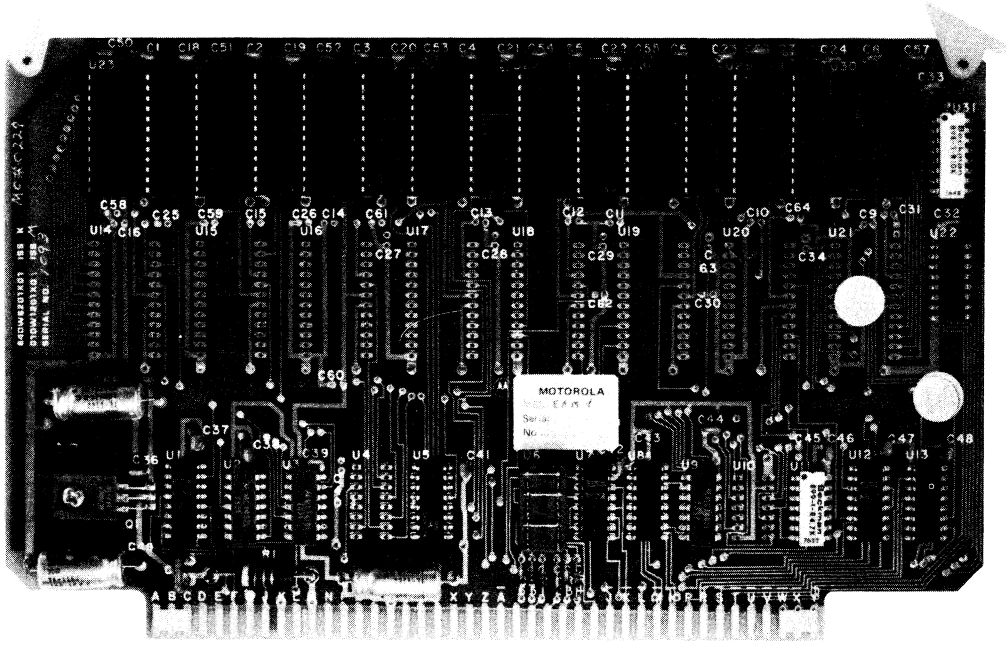
The MC68CIM1 is used to interface any ordinary audio-cassette recorder with any of the PDS configurations (SAC, MEB, ADS) apart from the terminal configuration. The audio cassette is used as a storage media for object programmes and data (dump and load), and for source programmes used with the assembler/editor in the ADS.

The data is recorded on the cassette according to the Kansas City Standard. In the playback mode, the clock is recovered from the signal and used to clock the receiving ACIA in the PDS. This feature copes with cassette speed variations of up to 30% without producing errors.

The characteristics of this device are:

- transmission rate: 300bit/s;
- logic '1': 2.4kHz signal;
- logic '0': 1.2kHz signal;
- clock frequency: 4.8kHz;
- C-60 cassette capacity: approximately 100K byte.

Editor/assembler module



The M68EAM1 is a 7K ROM module containing an adapted ROM co-resident editor/assembler, to be used on a PDS equipped with a single audio cassette.

The source and/or object code can be loaded from or dumped onto the cassette. Both editor and assembler are run from the ROM, leaving all RAM available as a buffer for source code and symbol table. The assembler requires that the source code has been loaded into the RAM by the editor before performing automatically the two-pass assembling. This feature allows non-incremental single-cassette system to be used.

The software is not dependent on any firmware monitor although it uses the MINIBUG II addressed ACIA as the communication device.

To summarize, the module:

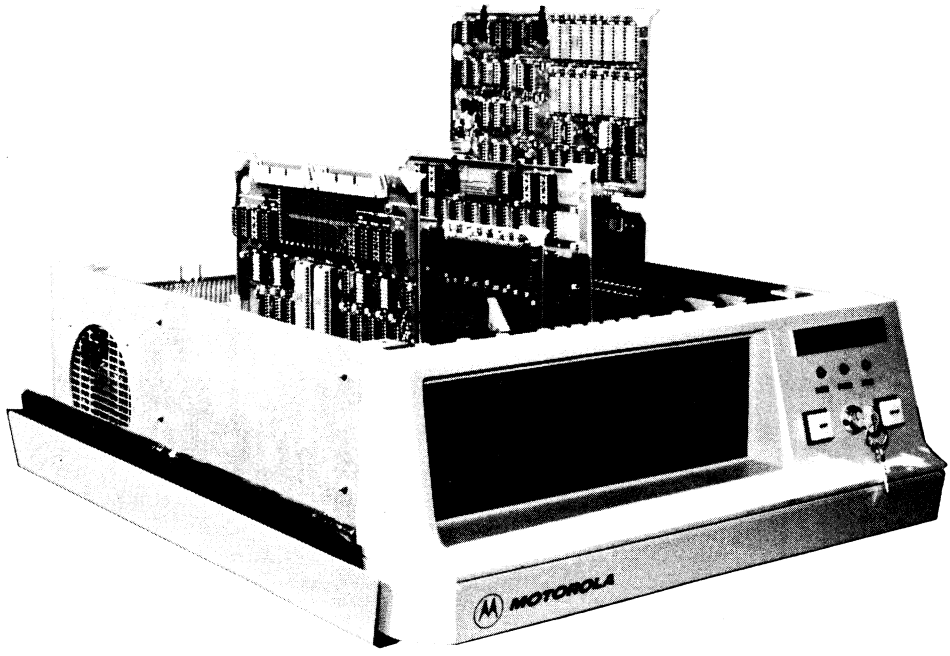
- is PDS plug-in compatible;
- is ROM resident;
- allows immediate access without software loading;
- assembles at high-speed directly from memory;
- requires only a non-incremental audio cassette;
- is independent of ROM monitor I/O routines.

For every 50 statements of users programme about 1.5K of RAM is required.

PDS PROM programmer (M68PPR1)

The PPR PROM programmer enables the PDS to programme 2704/2708 EPROM devices, verify the data in the EPROM and transfer data from the EPROM to the PDS RAM memory. The control firmware is contained in an on-board ROM and is compatible with the MINIBUG II firmware of the PDS.

The EXORciser



The EXORciser is an expandable system that allows emulation of any M6800 microcomputer configuration, from the simple to the elaborate. Built-in programming and diagnostic routines facilitate the development and debugging of the dedicated programmes for the system under design.

The EXORciser, M68SDTT2, contains a power supply and three functional modules – MPU, debug and baud-rate generator. Alternatively, in the USE-EXORciser, M68STTU2B, the MPU module is replaced by the User System Evaluation (USE) module which extends the capabilities of the EXORciser.

This microcomputer requires additional memory and interface circuitry to use the peripherals and these parts are added on as modules, so the designer may purchase only the modules he needs. The chassis accommodates up to 12 additional plug-in modules and the memory capacity may be increased to 65536 byte.

Memory modules

All these are bus-compatible with the EXORciser and plug into the main chassis. They extend the flexibility of the EXORciser.

Part number	Capacity (bit)	Organization	Refresh mode	Base address selection	ROM emulation	Battery back-up capability
MEX6812-1	2K x 8	2 x 1K byte	static	switches	X	
M68MM06	2K x 8	1 x 2K byte	static	jumpers		
MEX6815-3	8K x 8	2 x 4K byte	cycle stealing	switches	X	
MMS68102-1	8K x 8	2 x 4K byte*	cycle stealing	jumpers		X
MMS68103-1	8K x 8	1 x 8K byte	hidden	jumpers		
MMS68102A-1	8K x 9	2 x 4K word*	cycle stealing	jumpers		X
MMS68103A-1	8K x 9	1 x 8K word	hidden	jumpers		
MEX6816-1	16K x 8	1 x 16K byte	cycle stealing	switches		
MMS68102	16K x 8	4 x 4K byte*	cycle stealing	jumpers		X
MMS68103	16K x 8	2 x 8K byte	hidden	jumpers		
MMS68102A	16K x 9	4 x 4K word*	cycle stealing	jumpers		X
MMS68103A	16K x 9	2 x 8K word	hidden	jumpers		

* in the same 32K address boundary

MEX68RR EPROM/RAM module

This pre-wired memory card can mount up to 16 MCM68708 EPROM devices (or their equivalents) for up to 16K x 8-bit of available PROM plus four sockets for MCM6810 RAM devices. Memory devices are not supplied.

Interface modules

MEX6820 Input/Output module:

- four 8-bit input/output ports for parallel peripherals;
- eight controlled interrupt lines;
- each I/O port may be individually selected as a memory address;
- three-state TTL compatible I/O lines.

MEX6850 ACIA module:

- interfaces with TTY or RS232C data terminal;
- 8- or 9-bit transmission;
- programme-selectable odd, even or no parity;
- 8 switch-selectable baud rates of 110 to 9600 baud.

See also the Micromodule Family (P. 25)

Auxiliary modules

MEX68WW universal wirewrap module

- space for mounting up to 75, 14-pin wirewrap;
- sockets for user designed circuits.

MEX68XT Extender module

- permits access to any EXORciser module from outside the EXORciser chassis.

Aids for the system design/manufacturing and service

The EXORciser is the basis not only for system design, but also for the support of subsequent microprocessor manufacturing and testing.

Systems Analyser (MEX68SA)

This instrument is used to trouble-shoot M6800-based equipment or, in conjunction with the EXORciser, as a design tool.

In field service, the system analyser derives power and I/O signals directly from the system under test. It stops the system at any point in its programme, steps through the programme, changes the contents of the system memory, monitors and records the MPU's operation during a selected portion of the programme. It can even perform these functions without shutting down the operation of the system.

In EXORciser applications, it adds a variety of options to the system's inherent programme development capabilities. In conjunction with the EXORciser and USE, it offers a powerful combination of development and diagnostic tools.

EPROM/PROM programmer module 3 (MEX68PP3)

Once a programme for a microprocessor system is designed and debugged, it is entered into a read-only memory (ROM) which becomes part of the dedicated MPU-operated system. When an end system is manufactured in large quantities, these programmed ROMs are often purchased in quantity from the component supplier. When only a few end systems are to be produced, the equipment manufacturer may elect to use an electrically alterable PROM (EAPROM) and do the programming himself. The PROM programmer, in conjunction with the EXORciser will perform this function quickly, easily and cheaply.

The PROM programmer module 2 enables the the EXORciser to programme several types of MOS EPROM and bipolar PROM devices. This module plugs directly into the EXORciser. Its software is available on cassette (A), papertape (B), EDOS (E) and MDOS (M) diskettes.

Devices that can be programmed are:

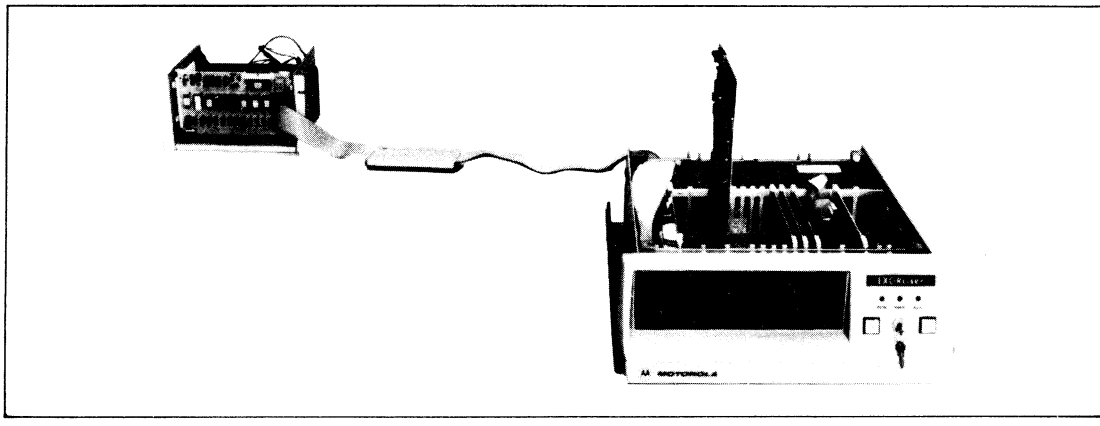
MCM68708/2708	1K x 8
MCM2716	2K x 8
MCM7640	512 x 8
MCM7641	512 x 8
MCM7660	1K x 8
MCM7661	1K x 8
INT2704	512 x 8
INT2708/58	1K x 8
INT2716	2K x 8
TMS2708	1K x 8
TMS2716	2K x 8
HM7610	256 x 4
HM7611	256 x 4
HM7620	512 x 4
HM7621	512 x 4
HM7640	512 x 4
HM7641	512 x 4
HM7644	1K x 4
MMI6305	512 x 4
MMI6306	512 x 4
MMI5305	512 x 4
MMI5306	512 x 4
MMI6301	256 x 4
MMI6300	256 x 4
MMI5301	256 x 4
MMI5300	256 x 4
MMI6335/6	256 x 4
MMI6340/1	512 x 8
MMI6384	1K x 8
MMI6380	1K x 8
82S126	256 x 4
82S129	256 x 4
82S130	512 x 4
82S131	512 x 4
82S140	512 x 8
82S141	512 x 8
82S180	1K x 8
82S181	1K x 8
82S2708	1K x 8

Systems performance monitor (MEX68SPM)

The systems performance monitor provides a means of monitoring the operation of MPU systems. Information is gathered on performance and a summary report is produced on the system's operation. The user can, by analysing this information, evaluate the performance of his software and determine how to make it more efficient.

The systems performance monitor periodically samples the address lines of the system. This information is collected to produce a map of the system addresses. At the completion of an operation, the monitor formats and prints a report on control terminal.

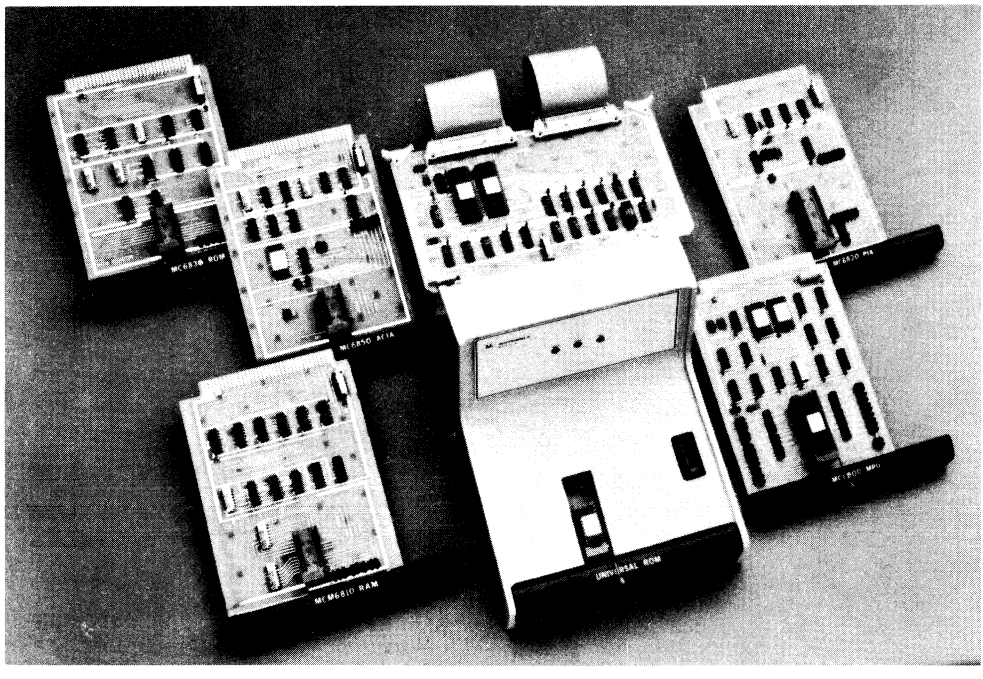
User System Evaluator (USE) (MEX68USEB)



This module extends the capabilities of the EXORciser in an existing user system.

Although the EXORciser permits design of a MPU system through emulation, the USE module allows the diagnostic and evaluation capabilities of the EXORciser to help an existing system. In conjunction with the system analyser and EXORciser it provides a diagnostic centre for all 6800/6802 based equipment.

Component Tester (MEX68CT)

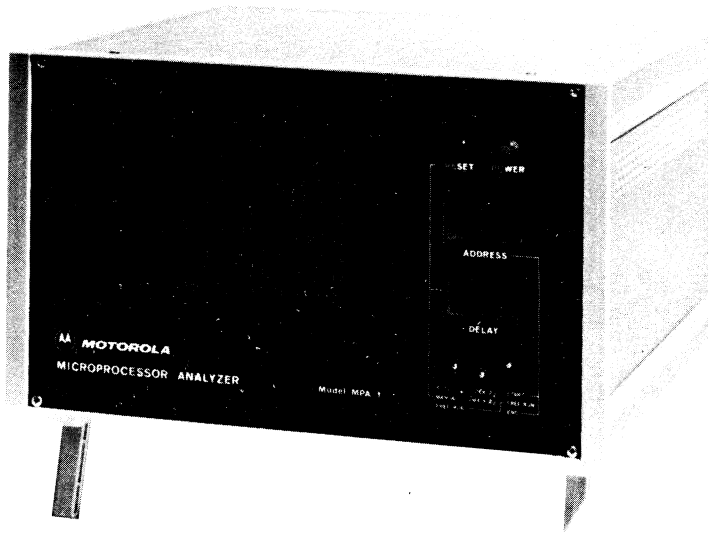


The practical way to test an LSI computer component is in a computer system. For the M6800 system, this is done quickly and easily with the component tester.

The component tester consists of a test head, an EXORciser control card a series of personality cards (one for each component in the M6800 family), and the associated test programms. In use, the test head is connected with the EXORciser, by the control card and interface cables. The appropriate personality card is inserted in the test head. Then, with the device under test plugged into the personality card, the appropriate test programme steps the component through its functions, using the firmware of the EXORciser. The entire test takes from 0.5 to 1.5 seconds, depending on the device under test, and indicator lamps on the test head show pass/fail for the component.

The component tester is an ideal instrument to be used for incoming inspection, or on the production line. A single EXORciser can handle as many as eight test heads simultaneously.

Microprocessor analyser M68MPA-1



The MPA-1 provides digital data measurement that is ideally suited to microprocessor hardware and software diagnostics. Using the thumbwheel switches on the front panel, a trigger word can be set to any location in the address space of the microprocessor.

Recognition of the trigger word can:

- start data capture;
- stop data capture and show processor activity which preceded triggering;
- start a counter to delay data capture by a preset number of clock cycles up to a maximum of 64K.

The MPA-1 is a self-contained analyser with its own 228mm (9-inch) CRT display. The display format is similar to a printed page. It is organized into 8 lines of 4 words each. The rows read from left to right and are ordered from top to bottom of the screen. The words displayed are in hexadecimal notation – 4 characters of address information followed by 2 characters of corresponding data.

Applications:

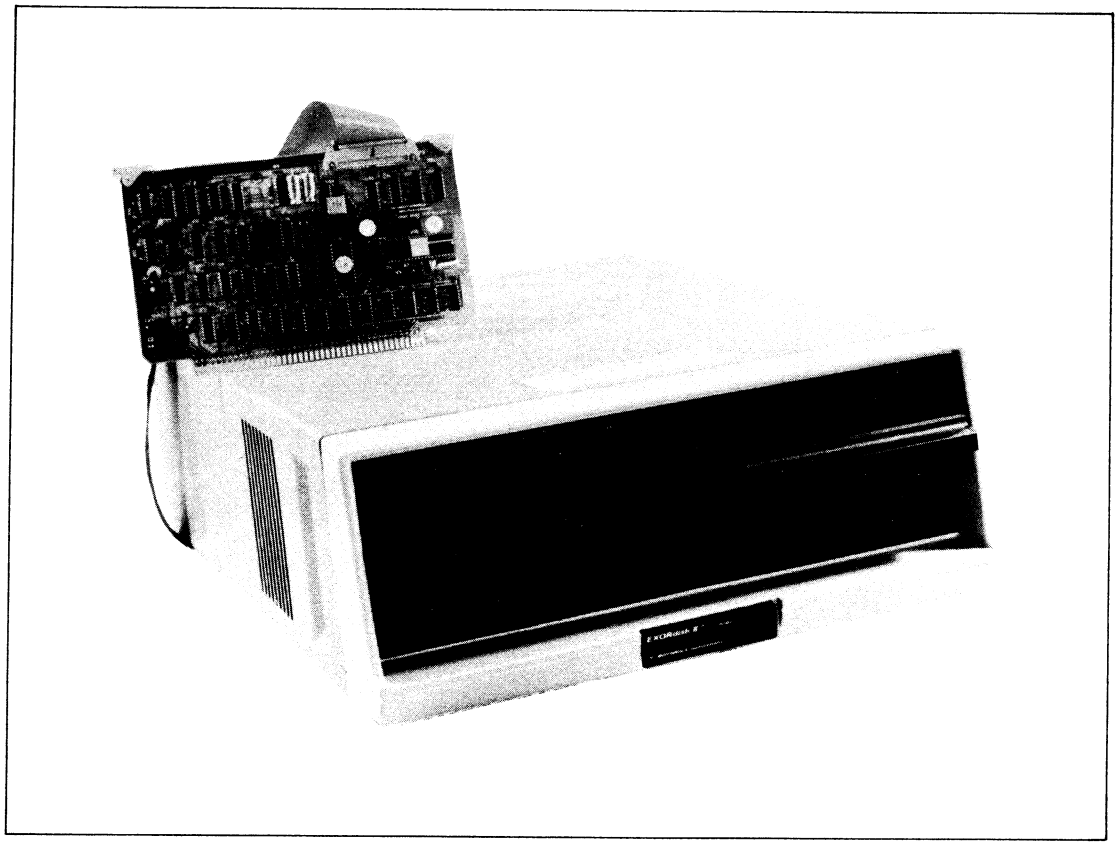
In addition to programme and data storage, the address space of the microcomputer may contain any number of I/O devices, registers, buffer regions or vectored locations for interrupt handling. All locations in this space can be used as trigger addresses – even locations with no device or memory assignments at all. This gives this MPA-1 a wide range of diagnostic power:

Programme, data, or illegal addresses . . . debugging
Sub-routine jumps and returns . . . stack operations
Interrupt vector locations . . . . . .real time
Interface registers or buffers . . . . . I/O

Support peripherals

Data loading peripherals are not necessarily an integral part of an MPU line but when designed for use in conjunction with a particular MPU system it is often possible to make savings by avoiding circuit redundancy. Motorola already supplies some dedicated peripherals for the M6800 system and has more under consideration.

EXORdisk II (M68SFD2000)



The EXORdisk II is a floppy disk storage system that extends the capacity of the EXORciser by up to 256 256 byte of memory per diskette and uses the latest version of Motorola dual floppy-disk drives. It allows high-speed transfers because of fast headsettling time and logical sector arrangement. An interface card connects it to the EXORciser. The new software, MDOS, is contained on a single diskette. Random or sequential file organization is permitted with MDOS, and so is multiple I/O file activity. MDOS also features: job control files for batch-type use, file expansion without recopy, user-defined commands, user access to system routines, high-speed programme loading, a unified I/O concept for device independence, and binary memory image files to conserve disk space. Eighteen MDOS commands provide the user with a comprehensive means to rapidly develop or modify software. The resident driver firmware is accessed by the MDOS to control disk operations – various entry points are available to a user to perform certain operations. Specifically, a user has access to initialization and error checking, diskette operation, line printer drive and diskette mini-diagnostic routines. The MDOS software requires 16K byte of RAM. Together with the EXORciser, the EXORdisk II provides a complete development system whose high-speed software capabilities can be matched only by much more expansive minicomputers.

Ordering information:
M68SFD2000: EXORdisk II, 220V, 50Hz, dual-drives, including:

- EXORciser interface module;
- MDOS disk operating system;
- co-resident editor/assembler;
- Macro-assembler and linking loader (requiring 24K byte of RAM).

EXORprint

EXORprint is a completely serl-contained printer housed in an attractive desktop cabinet. It produces lines of eighty to 132 characters at a maximum rate of 60 to 180 per second. EXORprint's impact head prints on 102 to 439 mm wide roll paper using a continous ribbon cartridge. Because the print head moves uniformly, vibration and wear are minimized. Reliable operation is further assured by a printing mechanism free of brakes, clutches, and dampers. Optoelectronic is used to accurately position each dot.

The complete EXORprint package includes the line printer and the MEX68PIC printer interconnection cable assembly as well as the MEX68PI printer interface/IO module which is housed in the Micromodule, EXORciser, or other external system used to interface with the printer.

Polyvalent Development System (PDS)

The PDS can be used as input/output console for the EXORciser. The M68ADS1 Autonomous Development System (ADS) can be plugged into the EXORciser. It has full ASCII keyboard and CRT capability. An optional medium-speed printer, M68MPR1, can be connected to the ADS in the terminal configuration.

Motorola display terminal (M68SXD10200)

The MDT is a complete 304.8mm (12 inch) CRT/keyboard terminal. It displays 24 lines of 80 characters (7 x 9 dot matrix character representation) and accepts different fields attribute codes like blink, half-bright, underline. A full ASCII keyboard is provided. The user may easily add special functions by employing an expansion scheme that allows more control programme, data storage and hardware I/O parts to be incorporated on the basic package. The communications interface is RS232 compatible and provides an asynchronous link to connect directly to the EXORciser.

SUPPORT SOFTWARE

Human programmers speak one language: machines understand another. Hence, a number of programmes (software) have been developed to automatically translate from the programmer's language (source language) to machine language. Such a translation programme is called an assembler or a compiler.

The development of programmes that convert an uneducated microcomputer into a dedicated machine can be accomplished directly on the machine to be programmed (as with an EXORciser), or on other types of computer. The assembler used on the EXORciser is called a 'resident assembler'.

Going hand-in-hand with the assembler, for programme development, is the editor. This software routine permits the programmer to use a computer to make whatever changes are required to create, correct, or revise a programme. Each computer has an edit programme which is unique to that system.

Motorola provides a compatible family of software that permits M6800 microcomputer programme development.

Resident software

This software is designed for the EXORciser and PDS systems to provide the lowest programme-development cost where a number of M6800 microcomputer designs are contemplated over a period of time. It includes an editor, an assembler and a macro-assembler. The macro-assembler allows programme relocation using the linkage loader/editor, and conditional assembly. In addition, two high-level languages can now be used with the M6800 microprocessor: FORTRAN and BASIC.

The EXORciser resident FORTRAN compiler allows development of high-level language modules to be mixed through the linking loader with programme-modules developed in assembler language. A FORTRAN library is provided, containing mathematical sub-routines and run-time I/O routines.

The EXORciser-resident BASIC interpreter provides the M6800 family with the widely used BASIC language. It includes features such as decimal arithmetic, string variables and array, intrinsic functions, and can run either in calculator or programme modes.

Ordering information and minimum RAM requirements

Software	PDS	EXORciser	EXORciser + EXORdisk II
Co-resident editor/ assembler	M68EAM1 (4K) (ROM resident)	M68XAE6813 (A/B) (8K)	included (16K)
Macro-assembler/ linking loader	Not available	M68MASR010 (A/B) (16K)	included (24K)
Resident FORTRAN compiler	Not available	Not available	M68FTNR012M (24K)
Resident BASIC interpreter	M68EAB1 (8K) (ROM Resident)	M68BASR010 (A/B) (8K)	M68BASR010M (20K)
Resident MPL compiler	Not available	Not available	M68MPLR010M (56K)

A Suffix: cassette B Suffix: papertape M Suffix: MDOS diskette

Non-resident computer system

Our cross-software allows the in-house mainframe computer to simulate M6800 hardware during the development of microcomputer programmes.

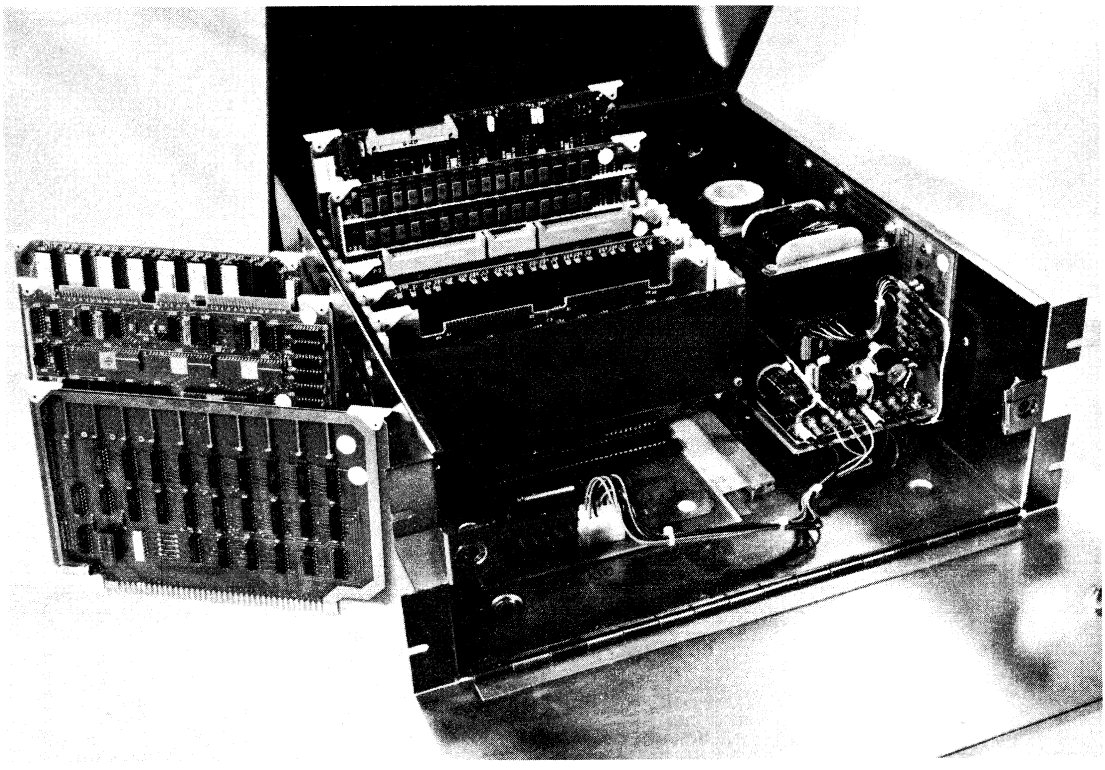
To simplify the use of other computers in the development of programmes for M6800 machines, additional software have been developed:

- cross-assembler – translates mnemonic language into M6800 machine language using a host computer.
- cross-simulator – duplicates on a host machine the execution of machine language instructions for the M6800 microprocessor and includes a count of the elapsed cycles of simulation.
- MPL cross-compiler – translates the high-level user-oriented language called MPL into M6800 mnemonic language. The MPL is a subset of PL/1 with features chosen for the microprocessor environment.

M6800 non-resident computer software options

DESCRIPTION	MEDIA	HOST COMPUTER						
		Sigma 9	HP2100	IBM360/370	Nova	Honeywell 6000	CDC6000	PDP11
Cross-assembler	Punch card	M68SAM0214E	M68SAM0413E	M68SAM0713E	M68SAM0814E	M68SAM0912E	M68SAM1014E	M68SAM1113E
	Magnetic tape	M68SAM0214F	M68SAM0413F	M68SAM0713F	M68SAM0814F	M68SAM0912F	M68SAM1014F	M68SAM1113F
MPL cross-compiler	Punch card	M68MPL0212E		M68MPL0712E		M68MPL0912E	M68MPL1012E	
	Magnetic tape	M68MPL0212F		M68MPL0712F		M68MPL0912F	M68MPL1012F	
Cross-simulator	Punch card	M68EML0211E	M68EML0411E	M68EML0711E	M68EML0812E	M68EML0911E	M68EML1012E	M68EML1111E
	Magnetic tape	M68EML0211F	M68EML0411F	M68EML0711F	M68EML0812F	M68EML0911F	M68EML1012F	M68EML1111F

Micromodules—
a new product line from Motorola



Microprocessors are changing a lot of design and manufacturing concepts as well as marketing philosphies that have become deeply entrenched. For example, Motorola, being a very broad based semiconductor manufacturer, has a long tradition of supplying a wide range of components for electronic equipment: but the design and manufacture of the equipment itself has always firmly been regarded as our customers' responsibility. Now the MPU has changed the very definition of 'equipment', raising it to a higher level of sophistication and introducing new building blocks of ever increasing complexity.

It started with support products for the M6800 microcomputer components. These are a series of development aids that permit the system designer to 'exercise' the MPU components and to 'exorcise' the user programme that converts the computer into a functional instrument. This development tool is, in essence, an expandable microcomputer designed to facilitate the debugging of a system. And it will encourage you to construct a system based on the modular concept.

Expanding the concept

The microprocessor is more than just another component: it's a viable, working computer that only needs auxiliary memory, interface and dedicated software. This makes it useful for an infinite variety of processing and control applications. How much memory? How much interface? The only factor that precludes a manufacturer of a general purpose microprocessor from putting all the memory and interface on the same chip as the MPU is that he cannot anticipate its eventual application. But wouldn't it be convenient if you could buy a microcomputer with just the right amount of circuitry, ready for programming to your needs?

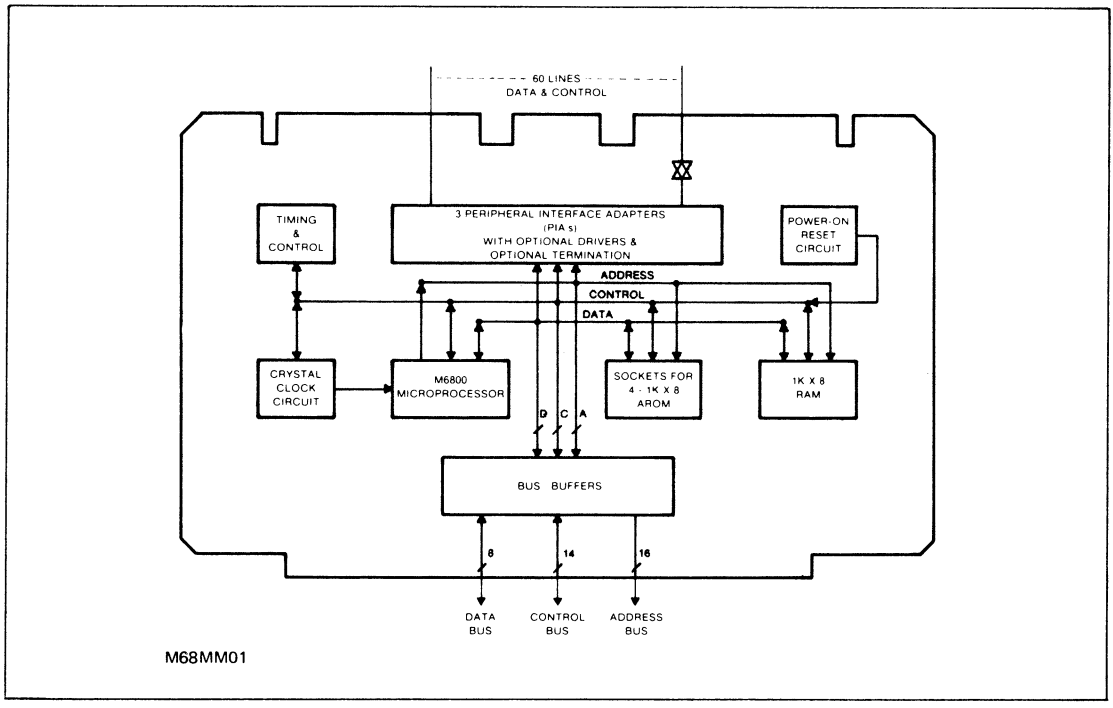
The Micromodules family elevates microcomputer system design from the package to the board level. It includes interactive modules ranging from complete, off-the-shelf microcomputers with specified capabilities ready for dedicated programming, to a variety of mix-and-match board assemblies that give the designer a large number of options. Options are supplemented by the existing complementary EXORciser modules which add memory and interface options to the system.

The Micromodule approach to microcomputer design is offered as an addition to, and not a substitute for, fundamental designing with basic components. It is suitable for those with small volume applications but who have limited development and manufacturing resources, or where design and development time-savings are important.

Details:

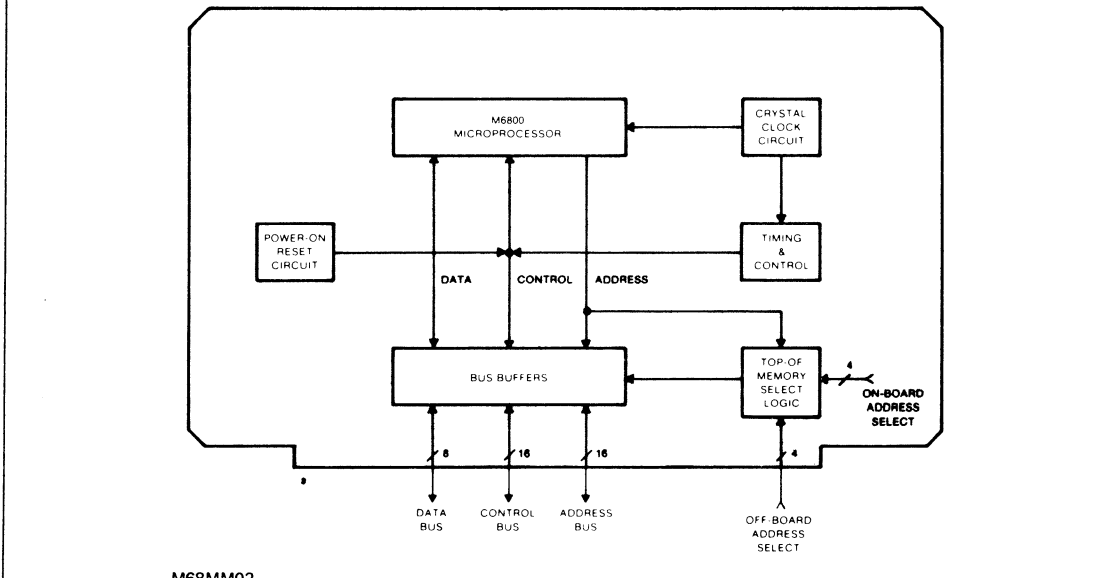
M68MM01 Monoboard microcomputer, including an MC6800 MPU, 1K byte RAM, 48 I/O lines, sockets for four 1K PROM or ROM.

M68MM01A Monoboard microcomputer, including an MC6800 MPU, 1K byte RAM, 32 I/O lines. 1 asynchronous communication interface adapter (ACIA), sockets for four 1K PROM or ROM.



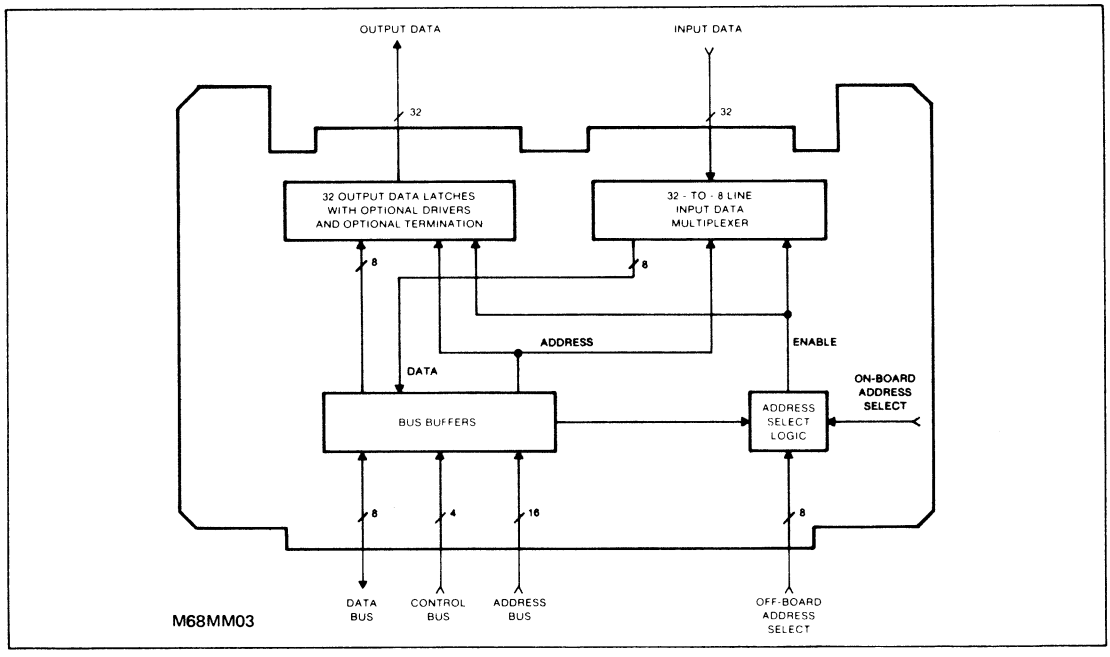
M68MM01

M68MM02 CPU module including an MC6800 MPU, the re-set circuitry and timing and control for three-state, halt, DMA and refresh operations.

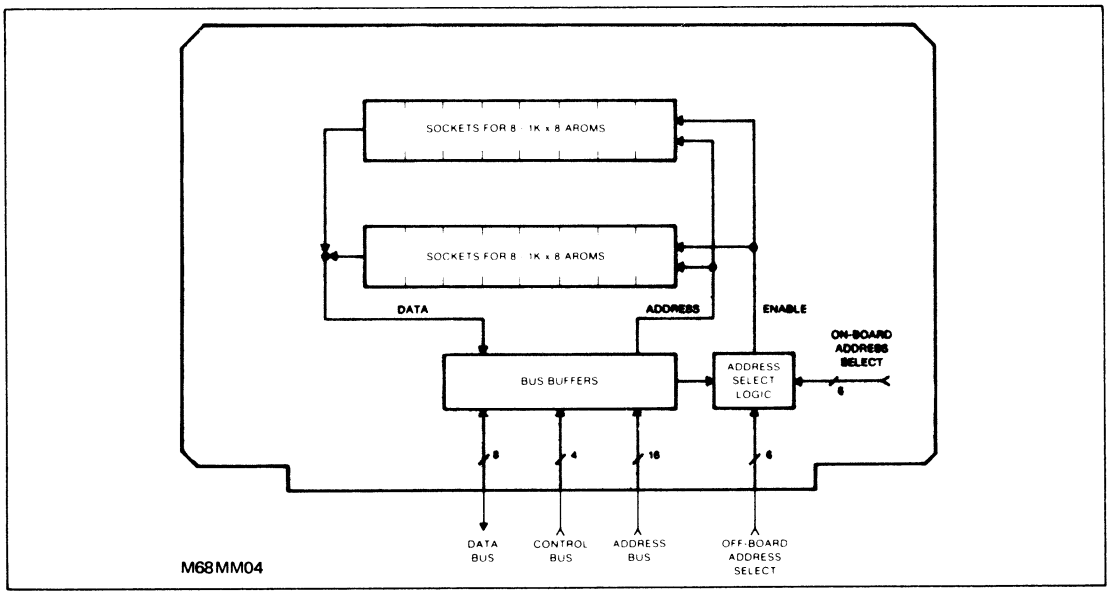


M68MM02

M68MM03 32 input/output module, TTL compatible with optional pull-up/pull-down terminations.



M68MM04 8K/16K PROM/ROM module providing sockets for one to sixteen, 1K x 8-bit PROM or ROM devices.



M68MM05A 8-channel differential 12-bit A/D module.
M68MM05B 16-channel single-ended 12-bit A/D module.
M68MM05C Quad 12-bit D/A module.
M68MM06 2K byte RAM module.
M68MMCC05/10 Micromodule card-cage for 5/10 micromodules.

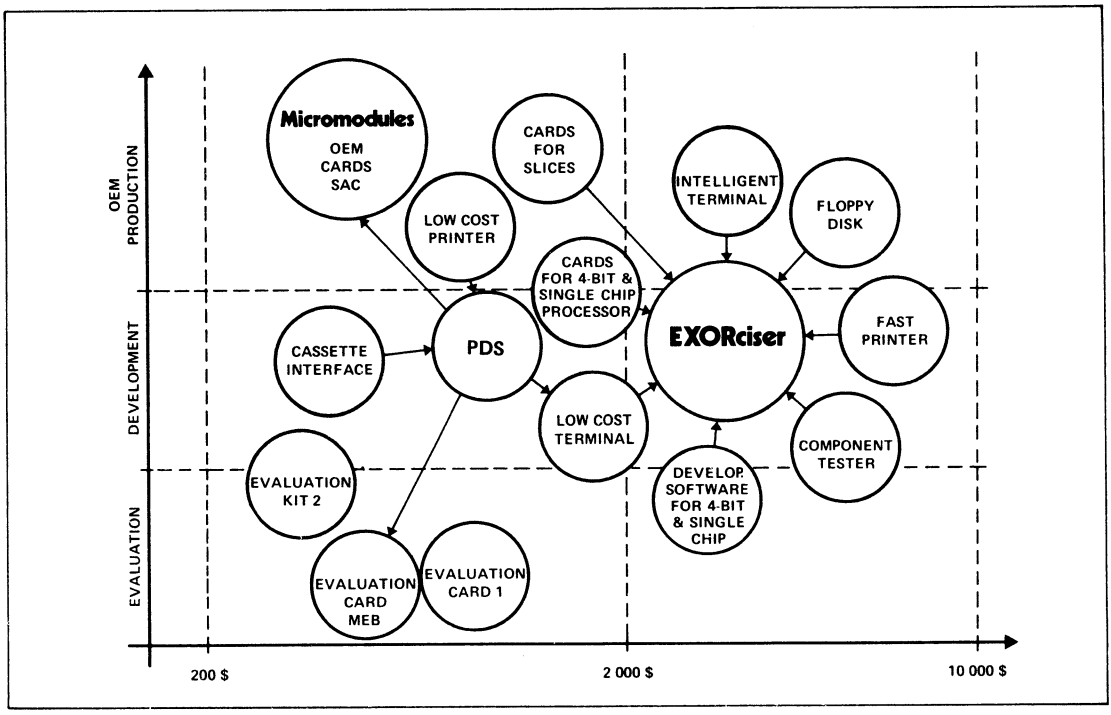
M68MMSC/LC Micromodule chassis including cage for 5/10 cards cabinet fan and power supply.
M68MMPS1-2 This 220V power supply has short-circuit and overload protection. It provides 5V dc at 15A, 12V dc at 2.5A, −12V dc at 1.5A and 8V dc at 0.1A. It features remote sensing and overvoltage protection for the 5V dc output.

Memory systems

Total systems complexity and demands on reliability are rising with each advance in technology and increasing user sophistication. More and more systems designers are looking for answers to the problems of reliability, complexity, and economy. Some of the answers are being provided by the power and flexibility of microcomputers. However, while microprocessors are helping to solve many of the old problems, systems designers are now having to address new problems associated with complex software. The demand for larger and faster mini and micro computer memory is growing are the costs of memory component selection, testing, board design, burn-in, and system testing. It is to this new problem that Motorola Memory Systems has set itself the task of providing answers and the tools to help you solve problems faster and with greater economy.

Part number	Organization (bit)	Description
MMS68100	16K x 8	Hidden refresh memory modules for M6800 systems (pseudo-static)
MMS68100-1	8K x 8	
MMS68100-2	4K x 8	
MMS68102	16K x 8	Memory modules for M6800 synchronous systems with battery back-up capability (Compatible with EXORciser/PDS/ Micromodules)
MMS68102-1	8K x 8	
MMS68102A	16K x 9	
MMS68102A-1	8K x 9	
MMS68103	16K x 8	Hidden refresh memory modules for M6800 systems (Pseudo-static) (Compatible with EXORciser/PDS/Micromodules)
MMS68103-1	8K x 8	
MMS68103A	16K x 9	
MMS68103A-1	8K x 9	
MMS68104	16K x 8	Memory module for kit 2 system
MMS1110	16K x 16	Add-in memory for LSI11
MMS1110-1	12K x 16	
MMS1110-2	8K x 16	
MMS1110-3	4K x 16	
MMS1110P	16K x 18	
MMS1116	16K x 16	Add-in memory for PDP-11/05, 10, 15, 35, 40, 45
MMS1116-1	12K x 16	
MMS1116-2	8K x 16	
MMS1116-3	4K x 16	
MMS1118	16K x 18	Add-in memory for PDP-11/04, 34
MMS1118-1	12K x 18	
MMS1118-2	8K x 18	
MMS3400	32K x 18	Plug-in memory module, compatible with MICRORAM 3400N memory system.
MMS80810	32K x 8	Add-in memory for 8080A based systems, compatible with SBC80/10 single board computer
MMS80810-1	16K x 8	
MMS80810A	32K x 9	
MMS80810A-1	16K x 9	

Application support



A support system that grows with your needs

Suppose you are going to use the M6800 MPU system for some of your future equipment design – how much design and support equipment will you need, and when will you need it? The flexibility of Motorola's support equipment lets you satisfy your requirements cheaply.

At the outset, you may want a minimum system that permits a fundamental development. Then, as your designs become more complicated, you may want to augment the equipment with faster development tools and their accompanying software. Certainly, you will want to expand the system's memory.

As you near the end of the design cycle, you will need production capability in the form of an EPROM/RAM card and a PROM programmer; you may also want the debug options that are available with the System Analyser and the USE modules. Finally, to test the various components in production, the MOTEST-1 component tester is a valuable addition.

These various groupings are itemized:

Minimum system . . .

Total development system	M68TDS2
Medium-speed printer	M68MPR1
(and paper)	(M68MPP1)

To add development speed

BASIC EXORciser	M68SDTT2
EXORdisk II with appropriate software	M68SFD2000
16K byte of additional RAM	MEX6816-1 or MMS63103

Options:

Peripheral I/O card	MEX6820
Resident FORTRAN compiler	M68FTNR012M
Resident BASIC interpreter	M68BASR010M

For firmware creation

EPROM/RAM card	MEX68RR
PROM programmer	MEX68PP2M

To improve debug capability

System analyser module	MEX68SA
User System Evaluator	MEX68USEB

For data-communication designs

ACIA I/O card	MEX6850

For on-line components and systems testing.

MOTEST 1 component tester	MEX68CTM with options
Microprocessor CRT analyser	M68MPA1-1

To go in medium volume production

Monoboard micromodule	M68MM01 or M68MM01A
or	
MPU micromodule	M68MM02

plus micromodules to suit your needs.

Design of MPU-based systems is not difficult. The nature of the required components reduces the hardware to a small number of easily compatible building blocks. However development of software to efficiently convert the computer into a dedicated machine is another matter. It demands a thorough knowledge of the interactive nature of the building block, as well as detailed knowledge of the processor's unique instruction set and its capabilities. Motorola's M6800 application support ranges from a literature library to personalized training and consultation.

User group library M6800UG

The M6800 user group library provides its members with a source of programmes that are of general interest to M6800 systems designers. The library is intended to reduce duplications of standard programme developments, such as arithmetic routines, input/output routines. (*Price on application*)

Support literature

Technical documentation

(*Prices on application*)

'M6800 Microprocessor Applications Manual'
A 700-page book discussing all aspects of the M6800 system from components to programming and applications.

'M6800 Microcomputer system design data'
Detailed technical specifications data sheets, for all semiconductor components in the M6800 programming.

'M6800 Programming reference manual'
A book of 112 pages discussing all aspects of M6800 programming and including short description of firmware commands set.

'From the computer to the microprocessor
An introductory book to computers and microprocessors available in English, French or German.

'Understanding microprocessors'
An introductory book to microprocessors covering aspects such as programming, system design and MPU market.

Application notes

R-29-3-10	MC6870A, MC6871A, MC6871B microprocessor clock applications in M6800 microprocessor systems.
AN320	Interfacing MPU-MC6800 with CMOS systems.
AN731	Low-speed modem fundamentals (see also AN747 and EB-49).
AN732A	A non-volatile microprocessor memory using 4K N-channel MOS RAMs.
AN740	The design of an N-channel 16K x 16-bit memory system for the PDP-11
AN747	Low-speed modem system design using MC6860 (see also AN731 & EB-49).
AN754	Device operation and system implementation of the Asynchronous Communications Interface Adapter (ACIA) MC6850.
AN757	Analogue-to-digital conversion techniques with the M6800 microprocessor system.
AN764	A floppy disk controller using the MC6852 SSDA and other M6800 microcomputer family parts.
AN770	Data acquisition networks with NMOS and CMOS.
AN771	MEK6800D2 microcomputer kit system expansion technique.
AN773	A CRT terminal using the M6800 clock generator/driver.
AN775	M6800 systems utilizing the M6875 clock generator/driver.
EB-49	Application performance of the MC6860 modem (see also AN731 & AN747).

Specific detailed descriptions

More than 50 different booklets describe different products of hardware, software, firmware and allow Motorola to ship with each part a technical document covering all aspects of the equipment. (*Available with product*)

Datasheets

Each part is described in a separate datasheet available from your local Distributor or the Motorola Sales Office.

System design courses and seminars

After more than two years of training sessions held in major cities all over Europe, Motorola's 3-day, hands-on microprocessor course has emerged as one of the most popular ways for engineers to master the design of M6800 systems. The course is taught by experienced instructors, well qualified in microprocessor techniques. It is given according to a pre-published schedule in all countries, but can be presented at specific factory locations at a nominal cost.

For the latest schedule, and additional information, please contact your local Distributor or the Motorola Sales Office

Engineering assistance for applications

Assistance for MPU applications is available to the M6800 user. An international network of consultants has been set up all over Europe to provide you with the design support you may need. (*Please call your Motorola Sales Office or Distributor for names and addresses.*)

MEMORIES

Memories are among the most important parts used in digital data-processing systems. In addition to Read Only and Random Access Memory devices, Motorola also is supplying Memory Systems and Micromodules for those whose requirements go beyond the individual "chip" stage.

Read Only Memories are available from Motorola in three ways:

1. In *Mask Programmable* (custom program) form; the customer defines the memory content before the final metallization step, permitting the devices to be designed for a specific application.

2. In *Programmable (PROM)* form; UV Erasable Memories provide flexibility in system development by permitting erasure of memory content and re-programming for current needs. Field-Programmable PROMs allow custom programs on a small-quantity basis through use of fusable nichrome links, bypassing the expense of a mask-program effort.

3. In *Pre-Programmed* form; these low-cost, off-the-shelf ROMs contain specific popular programs, particularly in code converter and character generator functions.

TABLE OF CONTENTS

NOTE
Memory Interface Circuits
are shown in the
section "Interface Circuits"

NMOS Memories

MCM6500 series: metal gate, low threshold, N-channel MOS (NOMS)
MCM6600 series: silicon gate, low threshold, N-channel MOS (NMOS)

READ ONLY MEMORIES (Metal Gate NMOS) 3 voltage suppliers +12, +5, −5 V

Type	Function	Description	Case
MCM6550L/P	16 patterns of 24 or 32 beats 7168 bits	mask programmable rhythm generator, 3 power supplies: +15 V, +5 V, −3 V. Max. access time 1 ms	699, 711
MCM6560L/P	8k-bit ROM	mask programmable: 1024 words by 8-bit, or 2048 words by 4 bit, 3-state output	684, 709
MCM6570L/P	8k-bit ROM, character generator (row) select)	mask programmable, 128 characters in a 7 x 9 matrix, character-shift capability, TTL compatible	684, 709
MCM6580L/P	8k-bit ROM, character generator (column select)	mask programmable, 128 characters in a 7 x 9 matrix, control command, characters are not shifted	684, 709
MCM6590L/P	16k-bit ROM	mask programmable, 2048 words by 8 bit, 3-state output	684
MCM6832L/P	16k-bit ROM	mask programmable, 2048 words by 8 bit, 3-state output	716, 709
MCM65308L/P	8k-bit ROM	mask programmable, 1024 words by 8 bit, 3-state output	716, 709
MCM65317L/P	16k-bit ROM	mask programmable, 2048 words by 8 bit, 3-state output	

READ ONLY MEMORIES (Silicon Gate NMOS) Single voltage supply 5 V

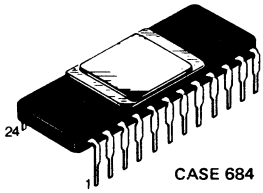
MCM6670L/P	8k-bit ROM, character generator (row select)	mask programmable, 128 characters in a 7 x 5 matrix	726, 707
MCM66700	8k-bit ROM, character generator (row select)	mask programmable, 128 characters in a 7 x 9 matrix, character-shift capability, TTL compatible	684, 709
MCM6830AL/P	8k-bit ROM	mask programmable, 1024 words bz 8 bit, 3-state output	716, 709
MCM68308L/P	8k-bit ROM	mask programmable, 1024 words by 8 bit, 3-state output	716, 709
MCM68316EL/P	16k-bit ROM	mask programmable, 2048 words by 8 bit, 3-state output −40 to +85 °C version available (E1)	716, 709
MCM68332L/P	32k-bit ROM	mask programmable, 4096 words by 8 bit, 3-state output	716, 709

UV ERASABLE PROGRAMMABLE READ ONLY MEMORIES (Silicon Gate NMOS) 3 voltage supplies +12, +5, −5 V

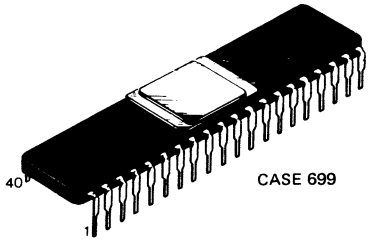
MCM2708L	8k-bit EPROM	electrically programmable, 1024 words by 8 bit, TTL compatible, 450 ns access time	716-03
MCM27A08L	8k-bit EPROM	electrically programmable, 1024 words by 8 bit, TTL compatible, 300 ns access time	716-03
MCM2708P	8k-bit PROM	electrically programmable, 1024 words by 8 bit, TTL compatible, 450 ns access time	709
MCM2716L	16k-bit EPROM	electrically programmable, 2048 words by 8 bit, TTL compatible, 450 ns access time	716-03
MCM2717L	16k-bit EPROM	electrically programmable, 2048 words by 8 bit, TTL compatible, 450 ns access time	716-03
MCM68708L	8k-bit EPROM	electrically programmable, 1024 words by 9 bit, M6800 family bus compatible, 450 ns access time	716-03
MCM68A708L	8k-bit EPROM	electrically programmable, 1024 words by 8 bit, M6800 family bus compatible, 300 ns access time	716-03

UV ERASABLE PROGRAMMABLE READ ONLY MEMORY (Silicon Gate MOS) Single voltage supply 5 V

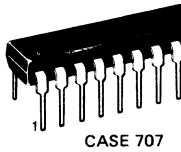
MCM2716AL	16k-bit EPROM	electrically programmable 2048 words by 8 bit, TTL compatible, 450 ns access time	716-03



CASE 684



CASE 699



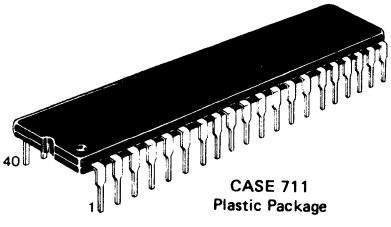
CASE 707
Plastic Package

FUNCTION GENERATORS

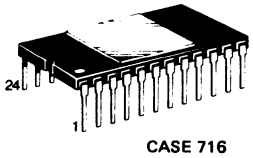
Pre-programmed ROMS

Type	Function	Description	Case
MCM6561L/P	8k-bit ROM code converter	pre-programmed MCM6560L, 1024 words by 8 bit, six conversion codes (ASCII, EBCDIC, Hollerith, Selectric)	684, 709
MCM6562L/P	8k-bit ROM code converter	modified version of the MCM6561L	684, 709
MCM6571L/P	8k-bit ROM character generator	pre-programmed MCM6570 or 66700, English and Greek	684, 709
MCM66710L/P	(row select)	alphabets various mathematical symbols and punctuation marks	
MCM6572L/P	8k-bit ROM character generator	same as MCM6571 or 66710 except that characters are	684, 709
MCM66720L/P	(row select)	not shifted	
MCM6573L/P	8k-bit ROM character generator	pre-programmed MCM6570 or 66700, English and	684, 709
MCM66730L/P	(row select)	Japanese alphabets, other symbols, characters are not shifted	
MCM6574L/P	8k-bit ROM character generator	pre-programmed MCM6570 or 66700, mod. ASCII code and	684, 709
MCM66740L/P	(row select)	TTY control symbols and other signs	
MCM6575L/P	8k-bit ROM character generator	pre-programmed MCM6570 or 66700, mod. ASCII code and	684, 709
MCM66750L/P	(row select)	TTY aophanumeric control characters	
MCM6576L/P	8k-bit ROM character generator	pre-programmed MCM6570 or 66700, English character	684, 709
MCM66760L/P	(row select)	generator	
MCM6577L/P	8k-bit ROM character generator	pre-programmed MCM6570 or 66700, German character	684, 709
MCM66770L/P	(row select)	generator	
MCM6578L/P	8k-bit ROM character generator	pre-programmed MCM6570 or 66700, French character	684, 709
MCM66780L/P	(row select)	generator	
MCM6579L/P	8k-bit ROM character generator	pre-programmed MCM6570 or 66700, European character	684, 709
MCM66790L/P	(row select)	generator	
MCM6581L/P	8k-bit ROM character generator (column select)	pre-programmed MCM6580L, English and Greek alphabets, various mathematical symbols and punct. marks	684, 709
MCM6583L/P	8k-bit ROM character generator (column select)	pre-programmed MCM6580L, English alphabet, Japanese characters, mathematical symbols and punct. marks	684, 709
MCM6591L/P	16k-bit ROM code converter plus character generator	pre-programmed MCM6590L, 6 character conversion codes and 128 characters in mixed font of 5 x 7 and 7 x 7 dot matrix with extra check bits	684
MCM6830L/P7	8k-bit ROM	pre-programmed MCM6830A MIKBUG and MINIBUG, Rev. 8, programs of M6800 Software support	716, 709
MCM6830L/P8	8k-bit ROM	pre-programmed MCM6830A MIKBUG and MINIBUG, Rev. 9	716, 709
MCM6832L/P91	16k-bit ROM code converter plus character generator	pre-programmed MCM6832, same program as MCM6591	716, 709
MCM65308L/P7	8k-bit ROM	pre-programmed MCM65308, same program as MCM6830L/P7	716, 709
MCM65317L/P91	16k-bit ROM code converter plus character generator	pre-programmed MCM65317, same program as MC6591	716, 709
MCM68308L/P7	8k-bit ROM	pre-programmed MCM68308, same program as MCM6830L/P7	716, 709
MCM68316EL/P91	16k-bit ROM code converter plus character generator	pre-programmed MCM68316E, same program as MCM6591	716, 709

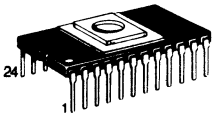
CASE 709
Plastic Package



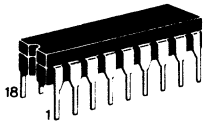
CASE 711
Plastic Package



CASE 716
Ceramic Package



CASE 716-3
Ceramic Package
UV erasable PROM only



CASE 726
Ceramic Package

RANDOM ACCESS MEMORIES

Type	Function	Description	Case
MCM4027L/C4	4k-bit Dynamic RAM (16 pin)	4096 words by 1 bit, 250 ns max. access time, page mode	690, 620
MCM4027L/C3	4k-bit Dynamic RAM (16 pin)	4096 words by 1 bit, 200 ns max. access time, page mode	690, 620
MCM4027L/C2	4k-bit Dynamic RAM (16 pin)	4096 words by 1 bit, 150 ns max. access time, page mode	690, 620
MCM4096L/C11	4k-bit Dynamic RAM (16 pin)	4096 words by 1 bit, 350 ns max. access time	690, 620
MCM4096L/C16	4k-bit Dynamic RAM (16 pin)	4096 words by 1 bit, 300 ns max. access time	690, 620
MCM4096L/C6	4k-bit Dynamic RAM (16 pin)	4096 words by 1 bit, 250 ns max. access time	690, 620
MCM6605AL	4k-bit Dynamic RAM (22 pin)	4096 words by 1 bit, 300 ns max. access time	677
MCM6605AL1	4k-bit Dynamic RAM (22 pin)	4096 words by 1 bit, 200 ns max. access time	677
MCM6605AL2	4k-bit Dynamic RAM (22 pin)	4096 words by 1 bit, 150 ns max. access time	677
MCM4116L/P25	16k-bit Dynamic RAM (16 pin)	16384 words by 1 bit, 250 ns access time, page mode	690, 648
MCM4116L/P20	16k-bit Dynamic RAM (16 pin)	16384 words by 1 bit, 200 ns access time, page mode	690, 648
MCM4116L/P15	16k-bit Dynamic RAM (16 pin)	16384 words by 1 bit, 150 ns access time, page mode	690, 648
MCM6616L/P5	16k-bit Dynamic RAM (16 pin)	16384 words by 1 bit, 300 ns access time, page mode	690, 648
MCM6616L/P4	16k-bit Dynamic RAM (16 pin)	16384 words by 1 bit, 250 ns access time, page mode	690, 648
MCM6616L/P3	16k-bit Dynamic RAM (16 pin)	16384 words by 1 bit, 200 ns access time, page mofe	690, 648
MCM6810AL/P	1k-bit Static RAM (24 pin)	128 words by 8 bit, 450 ns access time	716, 709
MCM68A10L/P	1k-bit Static RAM (24 pin)	128 words by 8 bit, 360 ns access time	716, 709
MCM68B10L/P	1k-bit Static RAM (24 pin)	128 words by 8 bit, 250 ns access time	716, 709
MCM2114L/P45	4k-bit Static RAM (18 pin)	1024 words by 4 bit, 450 ns access time	726, 707
MCM2114L/P30	4k-bit Static RAM (18 pin)	1024 words by 4 bit, 300 ns access time	726, 707
MCM2114L/P25	4k-bit Static RAM (18 pin)	1024 words by 4 bit, 250 ns access time	726, 707
MCM2114L/P20	4k-bit Static RAM (18 pin)	1024 words by 4 bit, 200 ns access time	726, 707
MCM2114L/P15	4k-bit Static RAM (18 pin)	1024 words by 4 bit, 150 ns access time	726, 707

CMOS Memories

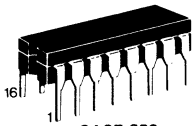
MCM14500 series: metal gate, low threshold, complementary MOS

RANDOM ACCESS MEMORIES

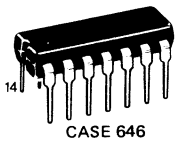
Type	Function	Description	Case
MCM14580A	4 x 4 Multiport Register 24 pin	1 μs access time	716
MCM14580C	4 x 4 Multiport Register 24 pin	1.5 μs access time	716, 709
MCM14505A	64-bit Static RAM 14 pin	64 words by 1 bit, 640 ns access time	632
MCM14505C	64-bit Static RAM 14 pin	64 words by 1 bit, 750 ns access time	632, 646
MCM14537A	256-bit Static RAM 16 pin	256 words by 1 bit, 4 μs access time	690
MCM14552A	256-bit Static RAM 24 pin	64 words by 4 bit, 3 μs access time	716
MCM14552C	256-bit Static RAM 24 pin	64 words by 3 bit, 6 μs access time	716, 709
MCM145101L/P	1024-bit Static RAM 22 pin	256 words by 4 bit, 650 ns access time	677, 708
MCM145101-1L/P	1024-bit Static RAM 22 pin	256 words by 4 bit, 450 ns access time	677, 708
MC145101-8L/P	1024-bit Static RAM 22 pin	256 words by 4 bit, 800 ns access time	677, 708

READ ONLY MEMORIES

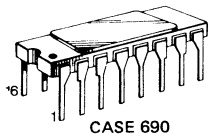
MCM14524A	1k-bit ROM 16 pin	mask programmable, 256 words by 8 bit, 2650 ns access time	620
MCM14524C	1k-bit ROM 16 pin	mask programmable, 256 words by 8 bit, 4000 ns access time	620, 648



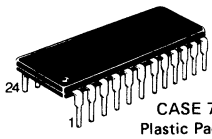
CASE 620
Ceramic Package



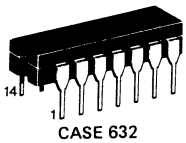
CASE 646
Plastic Package



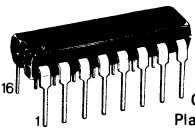
CASE 690
Ceramic Package



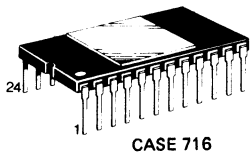
CASE 709
Plastic Packa



CASE 632
Ceramic Package



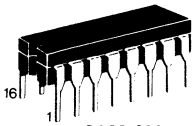
CASE 648
Plastic Package



CASE 716
Ceramic Package

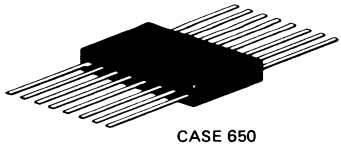
Bipolar Memories

MECL Memories



CASE 620
Ceramic Package

CASE 623
Ceramic Package


CASE 650
Ceramic Package

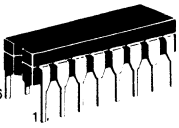
RANDOM ACCESS MEMORIES

Type	Function	Description	Case
MCM10143L	Multiport Register File (24 pin)	8 words by 2 bit, 10 na access time	623
MCM10144L/F	256 bit RAM (16 pin)	256 words by 1 bit, 26 ns access time	620, 650
MCM10145L/F	64-bit Register File (16 pin)	16 words by 4 bit, 15 ns access time	620, 650
MCM10146L/F	1k-bit RAM (16 pin)	1024 words by 1 bit, 24 ns access time	620, 650
MCM10147L	128-bit RAM (16 pin)	128 words by 1 bit, 15 ns access time	620
MCM10152L/F	256-bit RAM (16 pin)	256 words by 1 bit, 15 ns access time	620, 650

PROGRAMMABLE READ ONLY MEMORIES

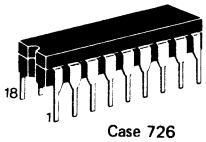
MCM10139L/F	256-bit PROM (16 pin)	32 words by 8 bit, 15 ns access time	620, 650
MCM10149L/F	1k-bit PROM (16 pin)	256 words by 4 bit, 25 ns access time	620, 650

TTL Memories

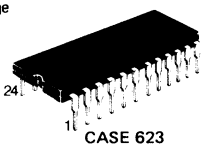


CASE 620
Ceramic Package

CASE 649
Plastic Package

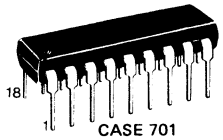


Case 726
Ceramic Package



CASE 623
Ceramic Package

CASE 648
Plastic Package



CASE 701
Plastic Package

RANDOM ACCESS MEMORIES

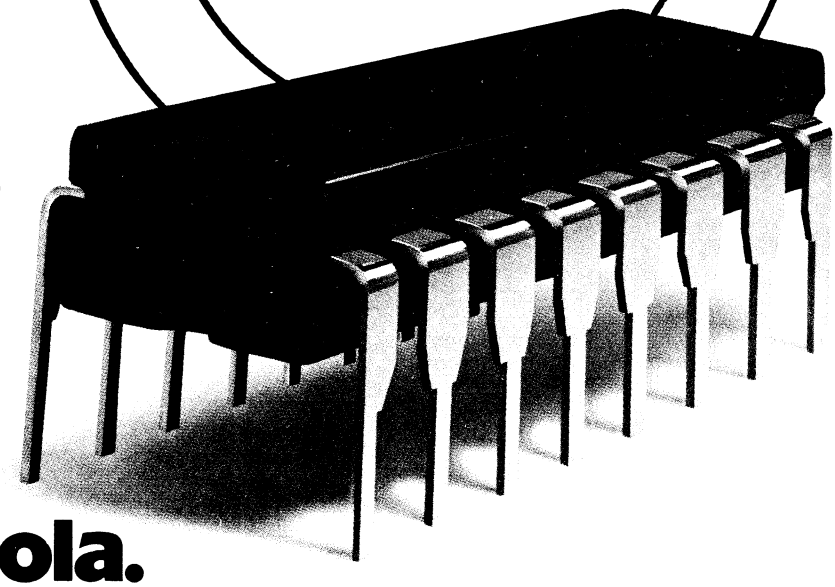
Type	Function	Description	Case
MCM93415DC/PC	1k-bit RAM (16 pin)	1024 words by 1 bit, 35 ns access time, open collector output	620, 648
MCM93425DC/PC	1k-bit RAM (16 pin)	1024 words by 1 bit, 35 ns access time, Tri state output	620, 648

PROGRAMMABLE READ ONLY MEMORIES

MCM5303/5003L	512-bit PROM (24 pin)	64 words by 8 bit, 75 ns access time, open collector output	623
MCM5304/5004L	512-bit PROM (24 pin)	64 words by 8 bit, 75 ns access time, active pull-up output	623
MCM7640L/P	4k-bit PROM (24 pin)	512 words by 8 bit, 40 ns access time, open collector output	623, 649
MCM7641L/P	4k-bit PROM (24 pin)	512 words by 8 bit, 40 ns access time, tri-state output	623, 649
MCM7642L/P	4k-bit PROM (18 pin)	1024 words by 4 bit, 40 ns access time, open collector output	701, 726
MCM7643L/P	4k-bit PROM (18 pin)	1024 words by 4 bit, 40 ns access time, tri-state output	701, 726
MCM7680L/P	8k-bit PROM (24 pin)	1024 words by 8 bit, 40 ns access time, open collector output	623, 649
MCM7681L/P	8k-bit PROM (24 pin)	1024 words by 8 bit, 40 ns access time, tri-state output	623, 649

MOTOROLA

NEW MEMORIES FROM MOTOROLA



16K RAMs.

Easy to get from Motorola.

The 16K RAM shortage is over.

Motorola has the industry standard 16K in volume production, now. Our MCM4116 is available in quantity, easy to get, and priced the way a volume memory should be priced.

And 4Ks, too.

The 4K RAMs are still in great demand. We've got the MCM4027 in volume quantities and off-the-shelf ...

... all speed selections, all priced the way you want them.

Our authorized Motorola distributors and Motorola sales offices can handle your order.

MOTOROLA

Semiconductor Group

LOGIC FAMILIES

Motorola carries a comprehensive inventory of standard components encompassing all major digital logic families and technologies.

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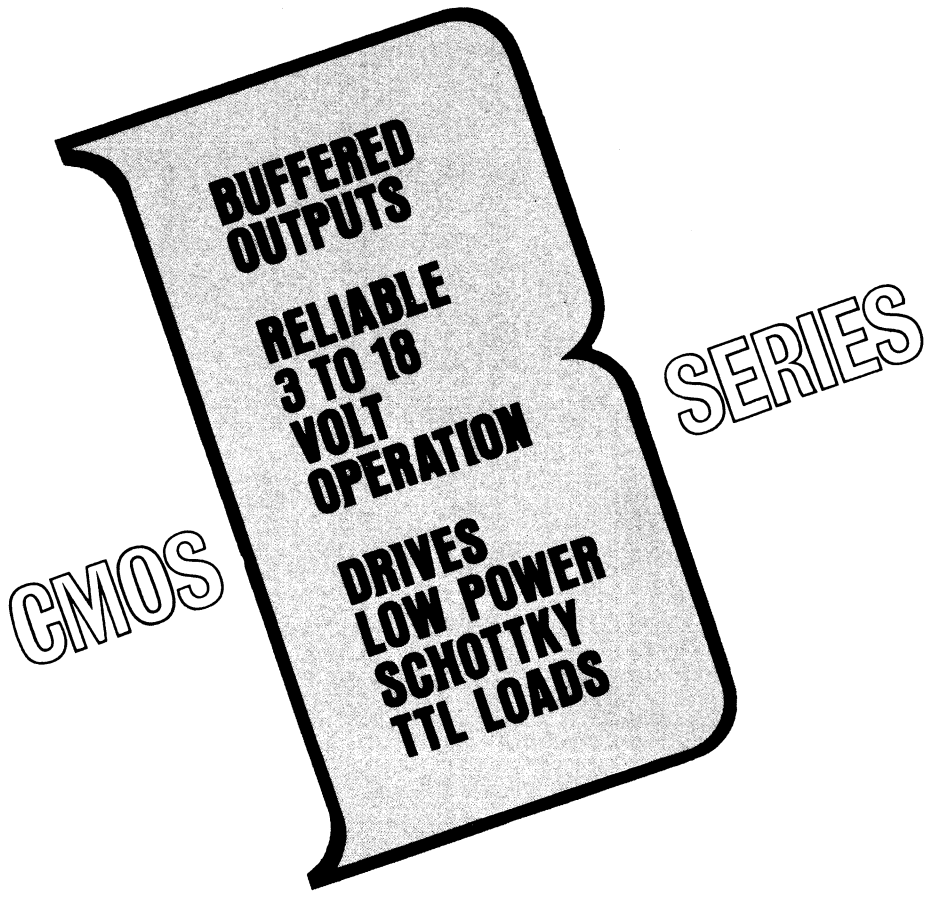

CMOS
BUFFERED OUTPUTS
RELIABLE 3 TO 18 VOLT OPERATION
DRIVES LOW POWER SCHOTTKY TTL LOADS
SERIES

Complementary MOS

Motorola's Complementary MOS (CMOS) Family offers a wide range of both analog and digital functions with the inherent system advantages of CMOS –low power dissipation, wide range of supply levels and high noise immunity. Standard functions and custom circuits are available in a variety of packages of proven reliability. Manufacturing is carried out in Austin, Texas and for Europe in East Kilbride, Scotland– the latter facility having BS9000 approval. High reliability screening is offered by these facilities for military and stringent industrial applications.

Motorola CMOS Family consists of:

OFF THE SHELF MSI/SSI CIRCUITS

MC14000/MC14500 SERIES

These standard lines of MSI/SSI circuits contain a large complement of devices manufactured to meet the JEDEC B-series specifications. This specification now includes both B-suffix (buffered) devices and UB-suffix (unbuffered gates). The broad range of available functions with the performance potential of both buffered and unbuffered gates allows complete system design with B-series components. Circuits are available in ceramic and top reliability plastic packages.

STANDARD MSI/LSI

Series MC14400

This series of highly complex devices consists of single chip subsystems tailored for specific applications. Designed to maximise efficiency in systems requiring large scale timing, control, conversion and interface functions, these circuits find wide potential use in industrial/commercial electronic systems.

CUSTOM CMOS

Motorola's European Design Organisation is based at the European head quarters in Geneva. Design capability includes both analog and digital functions in CMOS. It has completed many successful projects for European Customers in cooperation with the manufacturing unit in Scotland.

Motorola Sales Offices can supply specific information on our custom design capability.

HI-REL CMOS

All standard products in the MC14000 and MC14500 ranges are available to Hi-Rel specifications which include burn-in options, BS9000 qualified product, Mil Std 883 processing plus specific customer defined programmes. Flat pack and chip options are also available upon request.

B-SERIES FAMILY DATA

The CMOS Devices which have a B or UB suffix meet the minimum values for the industry-standardized* family specification (B suffix devices are buffered UB are unbuffered gates). Some of these standardized values are shown in the Maximum Ratings table.

The B suffix devices are compatible with the other devices in the CMOS product line. Features include:

- All buffered outputs
- 3-18 volt operational limits
- Capable of driving two low-power TTL loads, one low-power Schottky TTL load, or two HTL loads over the rated temperature range
- Maximum input current of ± 1 μA at 15 volt power supply over the temperature range
- Parameters specified at 5.0, 10, and 15 volt supply
- Noise margins of 1.0 V min @ 5.0 V supply
  2.0 V min @ 10 V supply
  2.5 V min @ 15 V supply

For the industry-standardized B-Series, the maximum ratings and recommended operating range are shown at the bottom of this page. Additional specification values are shown on the individual data sheets.

Switching characteristics for the B-Series devices are specified under the following conditions:

- Load Capacitance, C_L, of 50 pF
- Input pulse voltage equal to $+V_{DD}$ supply voltage
- Input pulse rise and fall times of 20 ns
- Propagation Delay times measured from 50% point of input voltages to 50% point of output voltage
- Three different supply voltages: 5, 10, and 15 V.

UB suffix devices are unbuffered gates which have the same maximum ratings and output specifications as B suffix devices but being unbuffered are faster. Their enhanced speed, lower AC gain and improved performance with slow risetime inputs gives more flexibility to the designer and offers opportunities for quasi-linear CMOS circuits. They feature:

- Same output drive capability as B suffix
- Same operational limits and maximum ratings
- V_{IL} and V_{IH} as follows:

V_{DD}	V_{IL}	V_{IH}
5 V	1 V	4 V
10 V	2 V	8 V
15 V	2.5 V	12.5 V

Exceptions to the B-Series Family Specification

There are a number of devices which have a B suffix whose input and/or outputs vary somewhat from the B-Series family specification because of functional requirements. Some categories of notable exceptions are:

- Inverting buffers with only one stage of buffering do not meet the input voltage specification.
- Devices with specialized outputs on the chip, such as NPN emitter-follower drivers or transmission gates, do not meet output specifications.
- Devices with specialized inputs, such as oscillator inputs, have unique input specifications.

Input Voltage

The input voltage specification is interpreted as the worst-case input voltage to produce an output level of "1" or "0". The "1" or "0" output level is defined as a deviation from the supply (V_{DD}) and ground (V_{SS}) levels. For a 5.0 V supply, this deviation is 0.5 V; for a 10 V supply, 1.0 V; and for 15 V, 1.5 V. As an example, in a device operating at a 5.0 V supply, the device with the input starting at ground is guaranteed to switch on or before 3.5 V and not to switch up to 1.5 V for B suffix devices. Switching and not switching are defined as within 0.5 V of the ideal output level for the example with a 5.0 V supply. The actual switching level referred to the input is between 1.5 V and 3.5 V.

Noise Margin

The values for input voltage and the given defined output deviation lead to minimum noise margins of 1.0 V, 2.0 V, and 2.5 V for a 5.0 V, 10 V, and 15 V supply, respectively for B suffix devices.

Output Device Current

Devices in the B-Series (B and UB suffix) are capable of sinking a minimum of 0.36 mA over the temperature range with a 5.0 V supply. This value guarantees that these CMOS devices will drive low-power Schottky TTL inputs which requires 0.36 mA maximum over the temperature range.

Compatibility

Other devices in the CMOS line not labeled with the B or UB suffix also have 3.0 to 18 volt operating limits. These devices are fully compatible with B-Series devices over the full voltage range.

MAXIMUM RATINGS (Voltages referenced to V_{SS})

Rating	Symbol	Value	Unit
DC Supply Voltage	V_{DD}	−0.5 to +18	Vdc
Input Voltage, All Inputs	V_{in}	−0.5 to V_{DD} +0.5	Vdc
DC Current Drain per Pin	I	10	mAdc
Operating Temperature Range – AL Device CL/PL Device	T_A	−55 to +125 −40 to +85	°C
Storage Temperature Range	T_{stg}	−65 to +150	°C
RECOMMENDED OPERATING RANGE			
DC Supply Voltage	V_{DD}	+3.0 to +15	Vdc

* Specifications coordinated by EIA/JEDEC Solid-State Products Council.

MOTOROLA FORMAT FOR CMOS INDUSTRY B-SERIES SPECIFICATIONS

Characteristic		Symbol	V_{DD} Vdc	T_{low}* Min.	T_{low}* Max.	25 °C Min.	25 °C Max.	T_{high}* Min.	T_{high}* Max.	Unit
Output Voltage	"0" Level	V_{OL}	5.0	–	0.05	–	0.05	–	0.05	Vdc
V_{in} = V_{DD} or 0			10	–	0.05	–	0.05	–	0.05	
			15	–	0.05	–	0.05	–	0.05	
	"1" Level	V_{OH}	5.0	4.95	–	4.95	–	4.95	–	Vdc
V_{in} = 0 or V_{DD}			10	9.95	–	9.95	–	9.95	–	
			15	14.95	–	14.95	–	14.95	–	
Input Voltage #	"0" Level	V_{IL}			B/UB		B/UB		B/UB	Vdc
(V_O = 4.5 or 0.5 Vdc)			5.0	–	1.5/1.0	–	1.5/1.0	–	1.5/1.0	
(V_O = 9.0 or 1.0 Vdc)			10	–	3.0/2.0	–	3.0/2.0	–	3.0/2.0	
(V_O = 13.5 or 1.5 Vdc)			15	–	4.0/2.5	–	4.0/2.5	–	4.0/2.5	
	"1" Level	V_{IH}		B/UB		B/UB		B/UB		Vdc
(V_O = 0.5 or 4.5 Vdc)			5.0	3.5/4.0	–	3.5/4.0	–	3.5/4.0	–	
(V_O = 1.0 or 9.0 Vdc)			10	7.0/8.0	–	7.0/8.0	–	7.0/8.0	–	
(V_O = 1.5 or 13.5 Vdc)			15	11.0/12.5	–	11.0/12.5	–	11.0/12.5	–	
Output Drive Current (AL Device)		I_{OH}								mAdc
(V_{OH} = 4.6 Vdc)	Source		5.0	−0.25	–	−0.2	–	−0.14	–	
(V_{OH} = 9.5 Vdc)			10	−0.62	–	−0.5	–	−0.35	–	
(V_{OH} = 13.5 Vdc)			15	−1.8	–	−1.5	–	−1.1	–	
(V_{OL} = 0.4 Vdc)	Sink	I_{OL}	5.0	0.64	–	0.51	–	0.36	–	mAdc
(V_{OL} = 0.5 Vdc)			10	1.6	–	1.3	–	0.9	–	
(V_{OL} = 1.5 Vdc)			15	4.2	–	3.4	–	2.4	–	
Output Drive Current (CL/CP Device)		I_{OH}								mAdc
(V_{OH} = 4.6 Vdc)	Source		5.0	−0.2	–	−0.16	–	−0.12	–	
(V_{OH} = 9.5 Vdc)			10	−0.5	–	−0.4	–	−0.3	–	
(V_{OH} = 13.5 Vdc)			15	−1.4	–	−1.2	–	−1.0	–	
(V_{OL} = 0.4 Vdc)	Sink	I_{OL}	5.0	0.52	–	0.44	–	0.36	–	mAdc
(V_{OL} = 0.5 Vdc)			10	1.3	–	1.1	–	0.9	–	
(V_{OL} = 1.5 Vdc)			15	3.6	–	3.0	–	2.4	–	
Input Current (AL Device)		I_{in}	15	–	±0.1	–	±0.1	–	±1.0	μAdc
Input Current (CL/CP Device)		I_{in}	15	–	±0.3	–	±0.3	–	±1.0	μAdc
Input Capacitance		C_{in}								pF
(V_{in} = 0)			–	–	–	–	7.5	–	–	
Gate Quiescent Current (AL Device)		I_{DD}	5.0	–	0.25	–	0.25	–	7.5	μAdc
(Per Package)			10	–	0.5	–	0.5	–	15	
			15	–	1.0	–	1.0	–	30	
	(CL/CP Device)	I_{DD}	5.0	–	1.0	–	1.0	–	7.5	μAdc
			10	–	2.0	–	2.0	–	15	
			15	–	4.0	–	4.0	–	30	
Flip-Flop and Buffer Quiescent Current		I_{DD}	5.0	–	1.0	–	1.0	–	30	μAdc
(Per Package)	(AL Device)		10	–	2.0	–	2.0	–	60	
			15	–	4.0	–	4.0	–	120	
	(CL/CP Device)	I_{DD}	5.0	–	4.0	–	4.0	–	30	μAdc
			10	–	8.0	–	8.0	–	60	
			15	–	16	–	16	–	120	
MSI Quiescent Current	(AL Device)	I_{DD}	5.0	–	5.0	–	5.0	–	150	μAdc
(Per Package)			10	–	10	–	10	–	300	
			15	–	20	–	20	–	600	
	(CL/CP Device)	I_{DD}	5.0	–	20	–	20	–	150	μAdc
			10	–	40	–	40	–	300	
			15	–	80	–	80	–	600	
LSI Quiescent Current		I_{DD}	See Individual Data Sheets							

* T_{low} = −55 °C for AL Device, −40 °C for CL/CP Device.
T_{high} = +125 °C for AL Device, +85 °C for CL/CP Device.
Noise immunity specified for worst case input combination.
Noise Margin for both "1" and "0" level = 1.0 Vdc min @ V_{DD} = 5.0 Vdc
2.0 Vdc min @ V_{DD} = 10 Vdc
2.5 Vdc min @ V_{DD} = 15 Vdc

Part Number	Function	Suffix*	Pins	Chips Available
MC14000UB	Dual 3-Input NOR Gate plus Inverter	AL, CL, CP	14	●
MC14001UB	Quad 2-Input NOR Gate	AL, CL, CP	14	●
MC14001B	Quad 2-Input NOR Gate	AL, CL, CP	14	●
MC14002UB	Dual 4-Input NOR Gate	AL, CL, CP	14	●
MC14002B	Dual 4-Input NOR Gate	AL, CL, CP	14	●
MC14006B	18-Bit Static Shift Register	AL, CL, CP	14	●
MC14007UB	Dual Complementary Pair plus Inverter	AL, CL, CP	14	●
MC14008B	4-Bit Full Adder	AL, CL, CP	16	●
MC14009	Hex Invertor Buffer	AL, CL, CP	16	●
MC14010	Hex Buffer	AL, CL, CP	16	●
MC14011UB	Quad 2-Input NAND Gate	AL, CL, CP	14	●
MC14011B	Quad 2-Input NAND Gate	AL, CL, CP	14	●
MC14012UB	Dual 4-Input NAND Gate	AL, CL, CP	14	●
MC14012B	Dual 4-Input NAND Gate	AL, CL, CP	14	●
MC14013B	Dual D Flip-Flop	AL, CL, CP	14	●
MC14014B	8-Bit Static Shift Register	AL, CL, CP	16	●
MC14015B	Dual 4-Bit Static Shift Register	AL, CL, CP	16	●
MC14016B	Quad Analog Switch/Quad Multiplexer	AL, CL, CP	14	●
MC14017B	Decade Counter/Divider	AL, CL, CP	16	●
MC14018B	Presettable Divide-by-N Counter	AL, CL, CP	16	●
MC14020B	14-Bit Binary Counter	AL, CL, CP	16	●
MC14021B	8-Bit Static Shift Register	AL, CL, CP	16	●
MC14022B	Octal Counter/Divider	AL, CL, CP	16	●
MC14023UB	Triple 3-Input NAND Gate	AL, CL, CP	14	●
MC14023B	Triple 3-Input NAND Gate	AL, CL, CP	14	●
MC14024B	Seven Stage Ripple Counter	AL, CL, CP	14	●
MC14025UB	Triple 3-Input NOR Gate	AL, CL, CP	14	●
MC14025B	Triple 3-Input NOR Gate	AL, CL, CP	14	●
MC14027B	Dual J-K Flip-Flop	AL, CL, CP	16	●
MC14028B	BCD-to-Decimal Decoder	AL, CL, CP	16	●
MC14032B	Triple Serial Adder (Positive Logic)	AL, CL, CP	16	●
MC14034B	8-Bit Universal Bus Register	AL, CL, CP	24	●
MC14035B	4-Bit Shift Register	AL, CL, CP	16	●
MC14038B	Triple Serial Adder (Negative Logic)	AL, CL, CP	16	●
MC14040B	12-Bit Binary Counter	AL, CL, CP	16	●
MC14042B	Quad Latch	AL, CL, CP	16	●
MC14043B	Quad NOR R-S Latch	AL, CL, CP	16	●
MC14044B	Quad NAND R-S Latch	AL, CL, CP	16	●
MC14046B	Phase-Locked Loop	AL, CL, CP	16	●
MC14049UB	Hex Inverter/Buffer	AL, CL, CP	16	●
MC14050B	Hex Buffer	AL, CL, CP	16	●
MC14051B	8-Channel Analog Multiplexer	AL, CL, CP	16	●
MC14052B	Dual 4-Channel Analog Multiplexer	AL, CL, CP	16	●
MC14053B	Triple 2-Channel Analog Multiplexer	AL, CL, CP	16	●
MC14066B	Quad Analog Switch	AL, CL, CP	14	●
MC14068B	8-Input NAND Gate	AL, CL, CP	14	●
MC14069UB	Hex Inverter	AL, CL, CP	14	●
MC14070B	Quad Exclusive OR Gate	AL, CL, CP	14	●
MC14071	Quad 2-Input OR Gate	AL, CL, CP	14	●
MC14071B	Quad 2-Input OR Gate	AL, CL, CP	14	●
MC14072B	Dual 4-Input OR Gate	AL, CL, CP	14	●
MC14073B	Triple 3-Input AND Gate	AL, CL, CP	14	●
MC14075B	Triple 3-Input OR Gate	AL, CL, CP	14	●
MC14076B	Quad D-Type Register	AL, CL, CP	16	●
MC14077B	Quad Exclusive NOR Gate	AL, CL, CP	14	●
MC14078B	8-Input NOR Gate	AL, CL, CP	14	●
MC14081	Quad 2-Input AND Gate	AL, CL, CP	14	●
MC14081B	Quad 2-Input AND Gate	AL, CL, CP	14	●
MC14082B	Dual 4-Input AND Gate	AL, CL, CP	14	●
MC14093B	Quad 2-Input NAND Schmitt Trigger	AL, CL, CP	14	●
MC14099B	8-Bit Addressable Latch	AL, CL, CP	16	●

Part Number	Function	Suffix*	Pins	Chips Available
MC14160B	Decade Counter (Asynchronous Clear)	AL, CL, CP	16	●
MC14161B	Binary Counter (Asynchronous Clear)	AL, CL, CP	16	●
MC14162B	Decade Counter (Synchronous Clear)	AL, CL, CP	16	●
MC14163B	Binary Counter (Synchronous Clear)	AL, CL, CP	16	●
MC14174B	Hex D Flip-Flop	AL, CL, CP	16	●
MC14175B	Quad D Flip-Flop	AL, CL, CP	16	●
MC14194B	4-Bit Universal Shift Register	AL, CL, CP	16	●
MC14408	Binary-to-Phone Pulse Converter	L, P	16	●
MC14409	Binary-to-Phone Pulse Converter	L, P	16	●
MC14410	2-of-8 Tone Encoder	L, P	16	●
MC14411	Bit-Rate Frequency Generator	L, P	24	●
MC14412	Universal Low-Speed Modem	FL, VL	16	●
MC14415	Quad Precision Timer/Driver	EFL, FL, FP EVL, VL, VP	16	●
MC14419	2-of-8 Keypad-to-Binary Encoder	L, P	16	●
MC14422	Remote Control Transmitter	P	16	–
MC14424	Remote Control Transmitter	L, P	16	–
MC14426	Tuning Memory Circuit	L, P	16	–
MC14429	Tuning Memory Control	L, P	18	–
MC14430	Input Addressing Encoder	L, P	16	–
MC14433	3½ Digit A/D Converter	L, P	24	●
MC14435	3½ Digit A/D Logic Subsystem	EFL, FL, FP, EVL, VL, VP	16	●
MC14440	LCD Watch/Clock Circuit	L, Z	40, 36	●
MC14450	Oscillator 2^{16} Divider/Buffer	L, P	6	●
MC14451	Oscillator/Divider/Buffer	L, P	16	●
MC14460	Automotive Speed Control Processor	P	16	●
MC14461	Smoke Detector Circuit	P	16	–
MC14462	Smoke Detector Circuit	P	16	–
MC14470	LED Watch Circuit – 6 Function	L, P	24	●
MC14479	LCD Watch Circuit – 5 Function		40	●
MC14480	LCD Watch Circuit – 5 Function		40	●
MC14481	LCD Watch Circuit – 6 Function		48	●
MC14482	LCD Watch Circuit – 6 Function		64	●
MC14490	Hex Contact Bounce Eliminator	EFL, FL, FP, EVL, VL, VP	16	●
MC14491	Multifunction Debounce Circuit	L, P	16	–
MC14492	Dual 2 x 2 Cross Point Matrix	L, P	16	–
MC14500B	Industrial Control Unit	AL, CL, CP	16	●
MC14501UB	Triple Gate	AL, CL, CP	16	●
MC14502B	Strobed Hex Inverter/Buffer	AL, CL, CP	16	●
MC14503B	Hex 3-State Buffer	AL, CL, CP	16	●
MC14506B	Dual Expandable AOI Gate	AL, CL, CP	16	●
MC14507	Quad Exclusive OR Gate	AL, CL, CP	14	●
MC14508B	Dual 4-Bit Latch	AL, CL, CP	24	●
MC14510B	BCD Up/Down Counter	AL, CL, CP	16	●
MC14511B	BCD-to-7 Segment Latch/Decoder/Driver	AL, CL, CP	16	●
MC14512	8-Channel Data Selector	AL, CL, CP	16	●
MC14513B	BCD-to-7 Segment Decoder/Driver	AL, CL, CP	18	●
MC14514B	4-Bit Latch/4-to-16 Line Decoder (High)	AL, CL, CP	24	●
MC14515B	4-Bit Latch/4-to-16 Line Decoder (Low)	AL, CL, CP	24	●
MC14516B	Binary Up/Down Counter	AL, CL, CP	16	●
MC14517B	Dual 64-Bit Static Shift Register	AL, CL, CP	16	●
MC14518B	Dual BCD Up Counter	AL, CL, CP	16	●
MC14519B	4-Bit AND/OR Selector	AL, CL, CP	16	●
MC14520B	Dual Binary Up Counter	AL, CL, CP	16	●
MC14521B	24-Stage Frequency Divider	AL, CL, CP	16	●
MC14522B	Programmable BCD Divide-by-N Counter	AL, CL, CP	16	●
MC14526B	Programmable Binary Divide-by-N Counter	AL, CL, CP	16	●
MC14527B	BCD Rate Multiplier	AL, CL, CP	16	●
MC14528B	Dual Monostable Multivibrator	AL, CL, CP	16	●
MC14529B	Dual 4-Channel Analog Data Selector	AL, CL, CP	16	●

NUMERICAL INDEX OF MOTOROLA CMOS FAMILY (continued)

Part Number	Function	Suffix*	Pins	Chips Available
MC14530B	Dual 5-Input Majority Logic Gate	AL, CL, CP	16	●
MC14531B	12-Bit Parity Tree	AL, CL, CP	16	●
MC14532B	8-Bit Priority Encoder	AL, CL, CP	16	●
MC14534B	Real Time 5-Decade Counter	AL, CL, CP	24	●
MC14536B	Programmable Timer	AL, CL, CP	16	●
MC14538B	Dual Precision Retriggerable/Resettable Monostable Multivibrator	AL, CL, CP	16	●
MC14539B	Dual 4-Channel Data Selector/Multiplexer	AL, CL, CP	16	●
MC14541B	Programmable Oscillator-Timer	AL, CL, CP	14	●
MC14543B	BCD-to-7 Segment Latch/Decoder/Driver	AL, CL, CP	16	●
MC14549B	Successive Approximation Register	AL, CL, CP	16	●
MC14553B	3-Digit BCD Counter	AL, CL, CP	16	●
MC14554B	2 x 2-Bit Parallel Binary Multiplier	AL, CL, CP	16	●
MC14555B	Dual Binary to 1-of-4 Decoder	AL, CL, CP	16	●
MC14556B	Dual Binary to 1-of-4 Decoder (inverting)	AL, CL, CP	16	●
MC14557B	1-to-64-Bit Variable Length Shift Register	AL, CL, CP	16	●
MC14558B	BCD-to-7 Segment Decoder	AL, CL, CP	16	●
MC14559B	Successive Approximation Register	AL, CL, CP	16	●
MC14560B	NBCD Adder	AL, CL, CP	16	●
MC14561B	9's Complementer	AL, CL, CP	14	●
MC14562B	128-Bit Static Shift Register	AL, CL, CP	14	●
MC14566B	Industrial Time Base Generator	AL, CL, CP	16	●
MC14568B	Phase Comparator/Programmable Counter	AL, CL, CP	16	●
MC14569B	Dual Programmable BCD/Binary Counter	AL, CL, CP	16	●
MC14572	Hex Gate	AL, CL, CP	16	●
MC14580B	4 x 4 Multiport Register	AL, CL, CP	24	●
MC14581B	4-Bit Arithmetic Logic Unit	AL, CL, CP	24	●
MC14582B	Look-Ahead Carry Block	AL, CL, CP	16	●
MC14583B	Dual Schmitt Trigger	AL, CL, CP	16	●
MC14584B	Hex Schmitt Trigger	AL, CL, CP	14	●
MC14585B	4-Bit Magnitude Comparator	AL, CL, CP	16	●
MC14597B	8-Bit Latch/Counter – Tristate Outputs	AL, CL, CP	16	●
MC14598B	8-Bit Addressable Latch – Tristate Outputs	AL, CL, CP	16	●
MC14599B	8-Bit Addressable Latch – with Bidirectional Inputs	AL, CL, CP	18	●
MC141000[1]	One Chip 4-Bit Microcomputer	L, P	18	●
MC141200[1]	One chip 4-Bit Microcomputer	L, P	24	●
MC145104	PLL Frequency Synthesiser	P	16	Use MCC145106
MC145106	PLL Frequency Synthesiser	P	18	●
MC145107	PLL Frequency Synthesiser	P	16	Use MCC145106
MC145109	PLL Frequency Synthesiser	P	16	Use MCC145106
MC145112	PLL Frequency Synthesiser	P	18	Use MCC145106
MCM14505	64-Bit Static Random Access Memory	AL, CL, CP	14	●
MCM14524	1024-Bit Read Only Memory	AL, CL, CP	16	●
MCM14537	256-Bit Static Random Access Memory	AL, CL	16	●
MCM14552	256-Bit Static Random Access Memory	AL, CL, CP	24	●

NMOS Devices Designed to work with the MC14422, 14424 CMOS devices:

MC6525	Remote Control Receiver	P	28	–
MC6526	Remote Control Receiver	P	28	–
MC6527	Remote Control Receiver	P	28	–
MC6529	Remote Control Receiver	P	28	–

[1] Software defined by one-chip mask programmed ROM. Assembler and simulator for system development will be available based on Motorola EXORciser.

* Suffices have following significance:

AL	3 to 18 V, −55 to +125 °C, ceramic package
CL	3 to 18 V, −40 to +85 °C, ceramic package
CP	3 to 18 V, −40 to +85 °C, plastic package
L	Limited voltage range, limited temperature range, ceramic package
P	Limited voltage range, limited temperature range, plastic package
EFL	3 to 18 V, −55 to +125 °C, ceramic package
FL	3 to 18 V, −40 to +85 °C, ceramic package
FP	3 to 18 V, −40 to +85 °C, plastic package
EVL	3 to 6 V, −55 to +125 °C, ceramic package
VL	3 to 6 V, −40 to +85 °C, ceramic package
VP	3 to 6 V, −40 to +85 °C, plastic package
Z	Limited voltage range, limited temperature range, leadless ceramic package

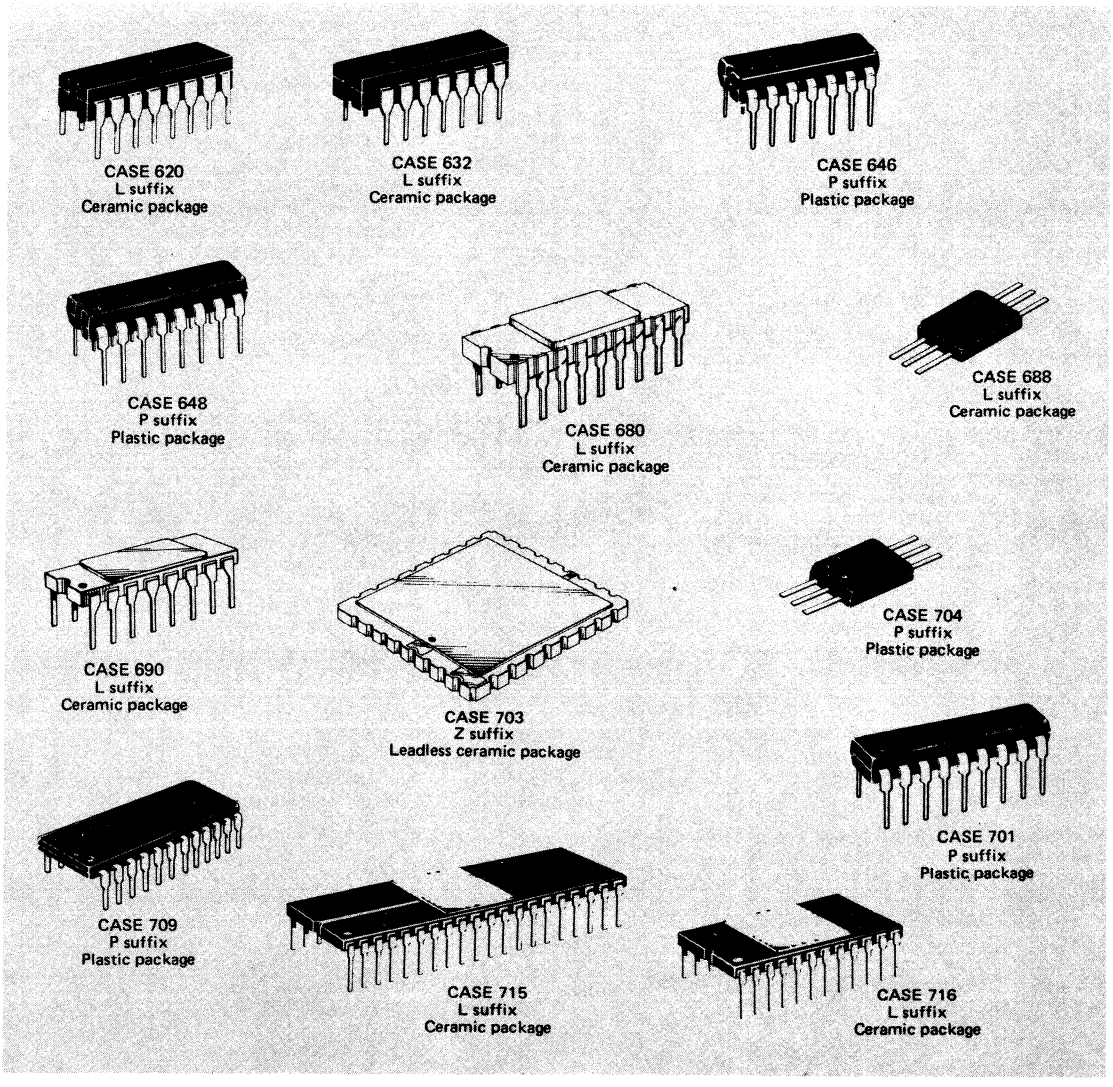
PRODUCTS TO BE INTRODUCED IN 1978

Part Number	Function
MC14029	Binary BCD Up/Down Counter
MC14094	8-Bit Latch
MC14405	Tone Encoder
MC14406	PCM Codec
MC14436	3½ Digit A/D Converter
MC14443	8-Bit μP controlled A/D Converter
MC14493	BCD + 1 to 7 segment Dec/Latch/Drive
MC14494	BCD to 7 segment Dec/Latch/Drive
MC14496	Remote Control Transmitter
MC14504	Level shift
MC14547	BCD to 7 segment Decoder/Driver
MC14573	Quad low power programmable Op-Amp
MC14574	Quad low power programmable Op-Amp
MC14595	BCD to Hexadecimal 7 segment Dec/Latch/Drive
MC144101	8 x 14 bits Static Memory for digital TV/Radio tuning systems
MC145101	256 x 4 Static RAM
MC146508	1024 x 1 Static RAM

Literature Available for Motorola CMOS Includes

- Semiconductor Data Library/CMOS Vol 5.
- Reliability Reports
  - "CMOS Life Stress Testing"
  - "CMOS Plastic Packaging System"
- Application Reports
  - "One Page Ideas"
  - "Application Notes"

Available from Motorola Sales Offices.



Device type	Function
NAND Gates	
MC14011UB MC14011B	Quad 2-Input NAND Gate
MC14093B	Quad 2-Input NAND Schmitt Trigger
MC14023UB MC14023B	Triple 3-Input NAND Gate
MC14012UB MC14012B	Dual 4-Input NAND Gate
MC14068B	8-Input NAND Gate
NOR Gates	
MC14001UB MC14001B	Quad 2-Input NOR Gate
MC14025UB MC14025B	Triple 3-Input NOR Gate
MC14000UB	Dual 3-Input NOR Gate plus Inverter
MC14002UB MC14002B	Dual 4-Input NOR Gate
MC14078B	8-Input NOR Gate
AND Gates	
MC14081 MC14081B	Quad 2-Input AND Gate
MC14073B	Triple 3-Input AND Gate
MC14082B	Dual 4-Input AND Gate
OR Gates	
MC14071 MC14071B	Quad 2-Input OR Gate
MC14075B	Triple 3-Input OR Gate
MC14072B	Dual 4-Input OR Gate
Complex Gates	
MC14070B	Quad Exclusive OR Gate
MC14077B	Quad Exclusive NOR Gate
MC14501UB	Triple Gate (Dual 4-Input NAND Gate and 2-Input NOR/OR Gate or 8-Input AND/NAND Gate)
MC14504*	Level shift
MC14506B	Dual Expandable AND-OR-INVERT Gate
MC14507	Quad Exclusive OR Gate
MC14519B	4-Bit AND/OR Selector (Quad 2-Channel Data Selector or Quad Exclusive NOR Gate)
MC14530B	Dual 5-Input Majority Logic Gate
MC14572UB	Hex Gate (Quad Inverter plus 2-Input NOR Gate plus 2-Input NAND Gate)
Inverters/Buffers	
MC14007UB	Dual Complementary Pair plus Inverter
MC14049UB	Hex Inverter/Buffer
MC14050B	Hex Buffer
MC14069UB	Hex Inverter
MC14502B	Strobed Hex Inverter/Buffer
MC14503B	Hex 3-State Buffer
MC14584B	Hex Schmitt Trigger
MC14009	Hex Inverter/Buffer
MC14010	Hex Inverter

* To be announced in 1978

Device type	Function
Decoders/Encoders	
MC14028B	BCD-to-Decimal/Binary-to-Octal Decoder
MC14514B	4-Bit Latch/4-to-16 Line Decoder (High)
MC14515B	4-Bit Latch/4-to-16 Line Decoder (Low)
MC14532B	8-Bit Priority Encoder
MC14555B	Dual Binary-to-1-of-4 Decoder/Demultiplexer
MC14556B	Dual Binary-to-1-of-4 Decoder/Demultiplexer (Inverting)
Display Decoders	
MC14493*	BCD +1-to-7 Segment Decoder/Latch/Driver
MC14494*	BCD-to-7 Segment Decoder/Latch/Driver
MC14511B	BCD-to-7 Segment Latch/Decoder/Driver
MC14513B	BCD-to-7 Segment Latch/Decoder/Driver
MC14543B	BCD-to-7 Segment Latch/Decoder/Driver
MC14547*	BCD-to-7 Segment Decoder/Driver
MC14558B	BCD-to-7 Segment Decoder
MC14595*	BCD-to-Hexadecimal 7 Segment Decoder/Latch/Driver
Multiplexers/Demultiplexers/Bilateral Switches	
MC14016B	Quad Analog Switch/Quad Multiplexer
MC14066B	Quad Analog Switch/Quad Multiplexer
MC14053B	Triple 2-Channel Analog Multiplexer/Demultiplexer
MC14052B	Dual 4-Channel Analog Multiplexer/Demultiplexer
MC14529B	Dual 4-Channel Analog Data Selector
MC14539B	Dual 4-Channel Data Selector/Multiplexer
MC14051B	8-Channel Analog Multiplexer/Demultiplexer
MC14512	8-Channel Data Selector
MC14519B	4-Bit AND/OR Selector
Schmitt Triggers	
MC14093B	Quad 2-Input NAND Schmitt Trigger
MC14583B	Dual Schmitt Trigger
MC14584B	Hex Schmitt Trigger
Flip-Flops/Latches	
MC14013	Dual Type-D Flip-Flop
MC14027B	Dual J-K Flip-Flop
MC14042B	Quad Latch
MC14043B	Quad NOR R-S Latch
MC14044B	Quad NAND R-S Latch
MC14076B	Quad D-Type Register
MC14094*	8-Bit Latch
MC14099B	8-Bit Addressable Latch
MC14175B	Quad Type-D Flip-Flop
MC14508B	Quad 4-Bit Latch
MC14174B	Hex Type-D Flip-Flop
MC14598B	8-Bit Addressable Latch – Tristate Output
MC14599B	8-Bit Addressable Latch – with bidirectional Inputs
Shift Registers	
MC14035B	4-Bit Parallel-In/Parallel-Out Shift Register
MC14194B	4-Bit Bidirectional Universal Shift Register
MC14015B	Dual 4-Bit Static Shift Register
MC14014B	8-Bit Static Shift Register (Synchronous)
MC14021B	8-Bit Static Shift Register (Asynchronous)
MC14034B	8-Bit Universal Bus Register
MC14006B	18-Bit Static Shift Register
MC14557B	1-to-64 Bit Variable Length Shift Register
MC14517B	Dual 64-Bit Static Shift Register
MC14562B	128-Bit Static Shift Register

Motorola CMOS family

Device Type	Function
Counters	
MC14024B	Seven-Stage Ripple Counter
MC14029*	Binary BCD Up/Down Counter
MC14017B	Decade Counter/Divider
MC14018B	Presettable Divide-bz-N Counter
MC14160B	Decade Counter (Asynchronous Clear)
MC14162B	Decade Counter (Synchronous Clear)
MC14510B	BCD Up/Down Counter
MC14522B	Programmable Divide-by-N 4-Bit Counter (BCD)
MC14040B	12-Bit Binary Counter
MC14020B	14-Bit Binary Counter
MC14022B	Octal Counter/Divider
MC14161B	4-Bit Binary Counter (Asynchronous Clear)
MC14163B	4-Bit Binary Counter (Synchronous Clear)
MC14516B	Binary Up/Down Counter
MC14526B	Programmagle Divide-by-N 4-Bit Counter (Binary)
MC14518B	Dual BCD Up Counter
MC14520B	Dual Binary Up Counter
MC14569B	Dual Programmable BCD/Binary Counter
MC14553B	Three-Digit BCD Counter
MC14534B	Real Time 5-Decade Counter
MC14566B	Industrial Time Base Generator
MC14597B	8-Bit Latch/Counter – Tristate Output
Oscillators/Timers	
MC14521B	24-Stage Frequency Divider
MC14536B	Programmable Timer
MC14541B	Programmable Oscillator/Timer
MC14450	Oscillator/2^{16} Divider/Buffer
MC14451	Oscillator/2^{11} to 2^{19} Divider/Buffered Duty Cycle Control
Phase-Locked Loops	
MC14046B	Phase-Locked Loop
MC14568B	Phase Comparator and Programmable Counter
MC145104	PLL Frequency Synthesiser
MC145106	PLL Frequency Synthesiser
MC145107	PLL Frequency Synthesiser
MC145109	PLL Frequency Synthesiser
MC145112	PLL Frequency Synthesiser
Multivibrators	
MC14528B	Dual Retriggerable/Resettable Monostable Multivibrator
MC14538B	Dual Precision Retriggerable/Resettable Monostable Multivibrator
Adders/Comparators	
MC14008B	4-Bit Full Adder
MC14032B	Triple Serial Adder (Positive Logic)
MC14038B	Triple Serial Adder (Negative Logic)
MC14560B	NBCD Adder
MC14561B	9's Complementer
MC14582B	Look-Ahead Carry Block
MC14585B	4-Bit Magnitude Comparator
Operational Amplifier	
MC14573*	Quad Low Power Programmable Op-Amp
MC14574*	Quad Low Power Programmable Op-Amp

* To be announced in 1978

Device type	Function
ALU Rate Multipliers	
MC14527B	BCD Rate Multiplier
MC14554B	2 x 2-Bit Parallel Binary Multiplier
MC14581B	4-Bit Arithmetic Logic Unit
Parity Checker	
MC14531B	12-Bit Parity Tree
Memories	
MC14580B	4 x 4 Multiport Register
MCM14505	64-Bit Static Random Access Memory
MCM14537	256-Bit (256 x 1) Static Random Access Memory
MCM14552	256-Bit (64 x 4) Static Random Access Memory
MCM14524	1024-Bit Read Only Memory
MC144101*	8 x 14 bits Static Memory
MC145101*	256 x 4 Static RAM
MC146508*	1024 x 1 Static RAM
Communications/Telephone Functions	
MC14405*	Tone Encoder
MC14406*	PCM Codec
MC14408	Binary to Phone Pulse Converter Subsystem
MC14409	Binary to Phone Pulse Converter Subsystem
MC14410	2-of-8 Tone Encoder
MC14411	Bit Rate Generator
MC14412	Universal Low-Speed Modem
MC14419	2-of-8 Keypad-to-Binary Encoder
MC14492	Dual 2 x 2 Crosspoint Matrix
A/D Converter/Logic Functions	
MC14433	3½ Digit A/D Converter
MC14435	3½ Digit A/D Logic Subsystem
MC14436*	3½ Digit A/D Converter
MC14443*	8-Bit Microprocessor Controlled A/D Converter
MC14549B	Successive Approximation Register
MC14559B	Successive Approximation Register
Other Complex Functions	
MC14415	Quad Precision Timer/Driver
MC14422	Remote Control Transmitter
MC14424	Remote Control Transmitter
MC14426	Tuning Memory Circuit
MC14429	Tuning Memory Control
MC14430	Input Addressing Encoder
MC14460	Automotive Speed Control Processor
MC14461	Smoke Detector Circuit
MC14462	Smoke Detector Circuit
MC14490	Hex Contact Bounce Eliminator
MC14491	Multifunction Debounce Circuit
Watch Circuits	
MC14440	LCD Watch/Clock Circuit
MC14470	LED Watch Circuit – 6 Function
MC14479	LCD Watch Circuit – 5 Function
MC14480	LCD Watch Circuit – 5 Function
MC14481	LCD Watch Circuit – 6 Function
MC14482	LCD Watch Circuit – 6 Function
Microprocessors	
MC14500B	Industrial Control Unit
MC141000	One Chip 4-Bit Microcomputer
MC141200	One Chip 4-Bit Microcomputer

BURNT-IN PRODUCTS

The following Burn-in options are available on all standard products in MC14000 and MC14500 ranges.

Suffix	Screening
R	48 hours burn-in at V_{DD} = 15 V, 125 °C
T	96 hours burn-in at V_{DD} = 15 V, 125 °C
D	168 hours burn-in at V_{DD} = 15 V, 125 °C

BS9000 PRODUCTS

BS9000 is a quality assurance sheme for electronic components operated by the British Standards Institute. It is associated with corresponding schemes in other European countries and is compatible with schemes being set up by CECC and IEC.

Components are intended for both professional and military use and can be supplied with a B.S. Release Certificate. Motorola is qualifying all Standard CMOS products under this scheme and maintains certified test records which are available to all users on request.

CMOS products are available in the following applications categories:

General Application Category — Components have electrical, mechanical, environmental and life performance to meet the majority of military and professional requirements.

Special Application Category — Components to be used where reliability is important, maintenance difficult and downtime must be low.

Products are Designed as follows:

Suffix	Category	Screening*
S	General Application Category	Full assessment Level
S1	Special Application Category S1	Level A
S2	Special Application Category S2	Level B
S3	Special Application Category S3	Level C

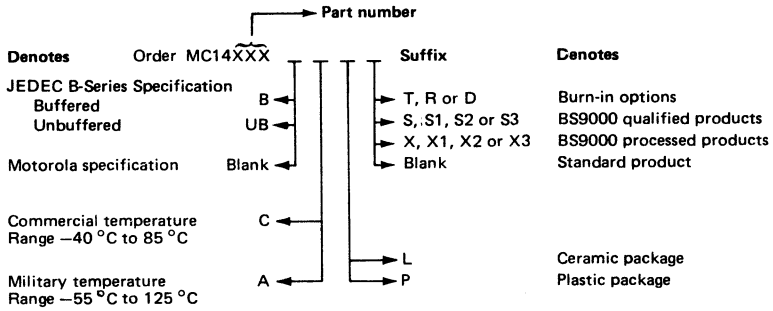
* Details of screening are given in booklet "McMOS PQR2" which is available through Sales Offices who also have information on qualified products.

As an interim stage to full qualification under the above scheme Motorola can supply components with European diffusion and assembly, screened to BS9000 tests. These are designated by suffices X, X2, X3, X1 in place of S, S2, S3, S1.

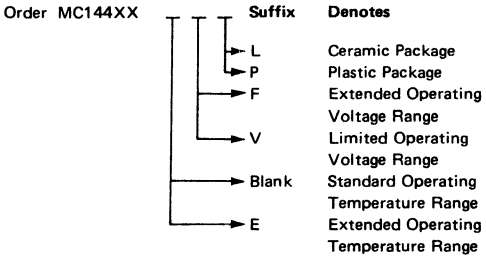
CMOS ORDERING INFORMATION

Select the package type, product specification, operating temperature range and hirel option required from the possibilities below. It is important to include all prefices and suffices.

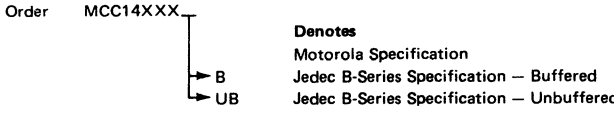
MC14000/MC14500 SERIES



MC14400 SERIES



CHIPS (ALL PRODUCT SERIES)



NOTE: Numerical index shows which specifications are available.

MECL MC10.000 Series

MC10 500/10 600 Series (−55 to +125 °C) MC10 100/10 200 Series (−30 to +85 °C)

MECL 10 000 has an excellent speed-power product, has relatively slow rise and fall times, and transmission-line drive capability. The combination of versatile logic functions and the 2.0 ns propagation delay make MECL 10 000 a versatile family for data handling and processing systems.

Circuit design with MECL 10 000 is unusually convenient. The differential amplifier input and emitter-follower output permit high fanout, the wired-OR option, and complementary outputs. MECL III is directly compatible with MECL 10 000, and can be used to extend the speed capability of the MECL 10 000 series.

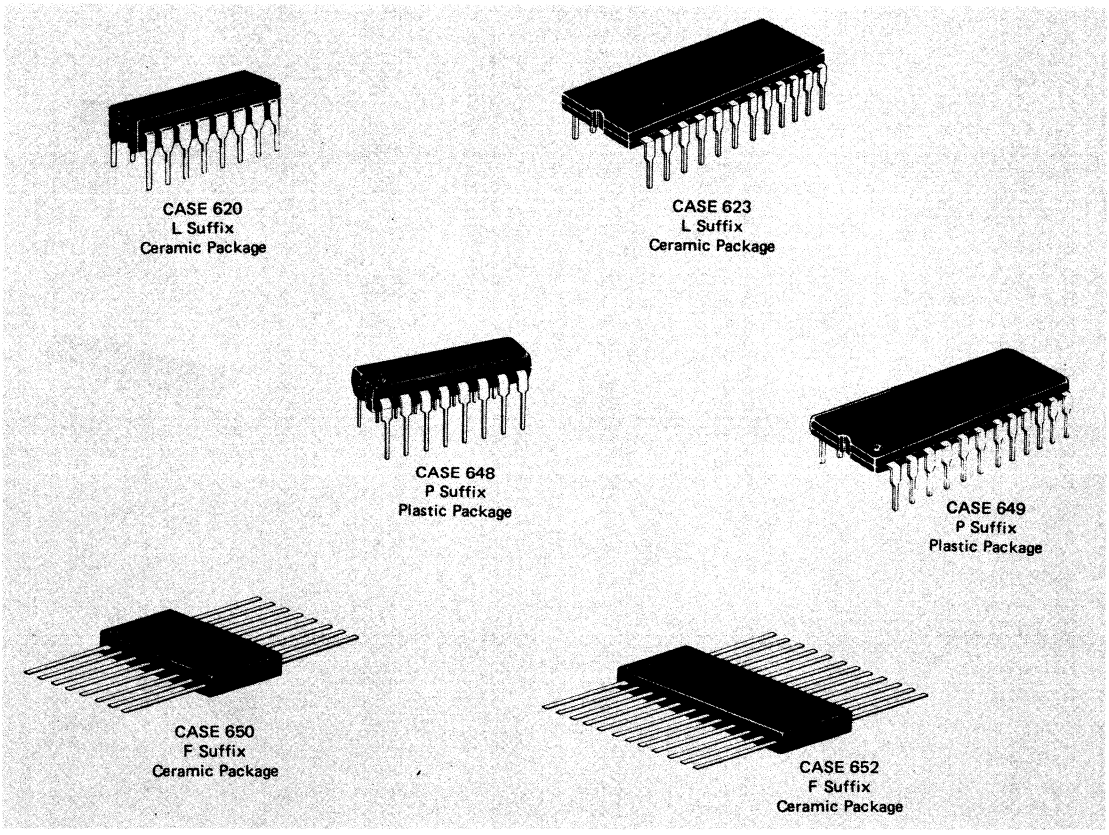
Function	Device Type		Case
	−30 to +85 °C	−55 to +125 °C	
NOR GATES			
Quad 2-Input with Strobe	MC10100	MC10500	620, 648, 650
Quad 2-Input	MC10102	MC10502	620, 648, 650
Triple 4-3-3-Input	MC10106	MC10506	620, 648, 650
Dual 3-Input 3-Output	MC10111	–	620, 648
(High Speed)	MC10211	MC10611	620, 648, 650
OR GATES			
Quad 2-Input	MC10103	MC10503	620, 648, 650
Dual 3-Input 3-Output	MC10110	–	620, 648
(High Speed)	MC10210	MC10610	620, 648, 650
AND GATES			
Quad 2-Input	MC10104	MC10504	620, 648, 650
Hex	MC10197	MC10597	620, 648, 650
COMPLEX GATES			
Quad OR/NOR	MC10101	MC10501	620, 648, 650
Triple 2-3-2-Input	MC10105	MC10505	620, 648, 650
Triple 2-Input Exclusive OR/Exclusive NOR	MC10107	MC10507	620, 648, 650
Dual 4-5-Input OR/NOR	MC10109	MC10509	620, 648, 650
Quad Exclusive OR	MC10113	–	620, 648
Dual 2-Wide 2-3-Input OR-AND/OR-AND-Invert	MC10117	MC10517	620, 648, 650
Dual 2-Wide 3-Input OR-AND	MC10118	MC10518	620, 648, 650
4-Wide 4-3-3-3-Input OR-AND Gate	MC10119	MC10519	620, 648, 650
OR-AND/OR-AND-INVERT Gate	MC10121	MC10521	620, 648, 650
Hex Inverter/Buffer	MC10195	MC10595	620, 648, 650
Dual 3-Input 3-Output OR/NOR (High Speed)	MC10212	MC10612	620, 648, 650
TRANSLATOR			
Quad MTTL to MECL	MC10124	MC10524	620, 648, 650
Quad MECL to MTTL	MC10125	MC10525	620, 648, 650
Triple MECL to NMOS	MC10177	–	620
Quad MST-to-MECL 10 000	MC10190	MC10590	620, 648, 650
Hex MECL 10 000-to-MST	MC10191	MC10591	620, 648, 650
RECEIVERS			
Triple Line	MC10114	MC10514	620, 648, 650
Quad Line	MC10115	MC10515	620, 648, 650
Triple Line	MC10116	MC10516	620, 648, 650
(High Speed)	MC10216	MC10616	620, 648, 650
Quad Bus	MC10129	–	620

MECL 10 000 INTEGRATED CIRCUITS (continued)

Function	Device Type		Case
	−30 to +85 °C	−55 to +125 °C	
FLIP-FLOP			
Dual Type D Master-Slave	MC10131	MC10531	620, 648, 650
(High Speed)	MC10231	MC10631	620, 648, 650
Dual J-K Master-Slave	MC10135	MC10535	620, 648, 650
Hex D Master-Slave	MC10176	MC10576	620, 648, 650
Hex D Master-Slave/with Reset	MC10186	MC10586	620, 648, 650
DRIVERS			
Triple 4-3-3 Input Bus Driver	MC10123	MC10523	620, 648, 650
Bus Driver	MC10128	–	620
Hex Buffer W/enable	MC10188	–	620, 648
Hex Inverter W/enable	MC10189	–	620, 648
PARITY CHECKER			
12-Bit Parity Generator-Checker	MC10160	MC10560	620, 648, 650
2 + 2-Bit Parity	MC10170	MC10570	620, 648, 650
ENCODER			
8-Input Encoder	MC10165	MC10565	620, 648, 650
DECODERS			
Binary to 1-8 (low)	MC10161	MC10561	620, 648, 650
Binary to 1-8 (high)	MC10162	MC10562	620, 648, 650
Dual Binary to 1-4 (low)	MC10171	MC10571	620, 648, 650
Dual Binary to 1-4 (high)	MC10172	MC10572	620, 648, 650
DATA SELECTORS/MULTIPLEXERS			
Dual Multiplexer with Latch and Common Reset	MC10132	MC10532	620, 648, 650
Dual Multiplexer with Latch	MC10134	MC10534	620, 648, 650
Quad 2-Input Multiplexer (non-inverting)	MC10158	MC10558	620, 648, 650
Quad 2-Input Multiplexer (inverting)	MC10159	MC10559	620, 648, 650
8-Line Multiplexer	MC10164	MC10564	620, 648, 650
Quad 2-Input Multiplexer/Latch	MC10173	MC10573	620, 648, 650
Dual 4 to 1 Multiplexer	MC10174	MC10574	620, 648, 650
LATCHES			
Quad (common clock)	MC10130	MC10530	620, 648, 650
Quad (negative transition)	MC10133	MC10533	620, 648, 650
Quad (positive transition)	MC10153	MC10553	620, 648, 650
Quad	MC10168	MC10568	620, 648, 650
Quint	MC10175	MC10575	620, 648, 650
SHIFT REGISTERS			
Four-Bit Universal	MC10141	MC10541	620, 648, 650
8-Bit parallel in Serial Out	MC10301	–	620, 648
ERROR DETECTION-CORRECTION			
IBM Code	MC10163	MC10563	620, 648, 650
Motorola Code	MC10193	MC10593	620, 648, 650
COUNTERS			
Universal Hexadecimal	MC10136	MC10536	620, 648, 650
Universal Decade	MC10137	MC10537	620, 648, 650
Bi-Quinary	MC10138	MC10538	620, 648, 650
Binary	MC10178	MC10578	620, 648, 650
Programmable 4-Decade ÷ N-Counter	MC10199	–	To Be Announced
BUS TRANSCEIVER			
Dual Simultaneous	MC10194	MC10594	620, 648, 650

Function	Device Type		Case
	−30 to +85 °C	−55 to +125 °C	
ARITHMETIC FUNCTIONS			
Look-Ahead Carry Block	MC10179	MC10579	620, 648, 650
Dual High Speed Adder/Subtractor	MC10180	MC10580	620, 648, 650
4-Bit Logic Unit/Function Generator	MC10181	MC10581	623, 649, 652
2-Bit Logic Unit/Function Generator	MC10182	MC10582	620, 648, 650
4 x 2 Multiplier	MC10183	–	623
2 x 1-Bit Array Multiplier (High Speed)	MC10287	MC10687	620, 648, 650
COMPARATOR			
5-Bit Magnitude	MC10166	–	620
MEMORIES			
8 x 2 Multiport Register File (RAM)	MCM10143	–	623
64-Bit Register File (RAM)	MCM10145	–	620
256-Bit Random Access	MCM10144	–	620
128-Bit Random Access	MCM10147	–	620
1024-Bit Random Access	MCM10146	–	620
1024-Bit Programmable Read Only	MCM10149	–	620
MONOSTABLE			
Programmable Multivibrator	MC10198	–	620

NOTE: Refer also to MECL LSI, MC10800 Family (page 13)

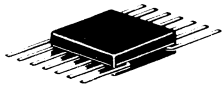


MECL III MC1600 Series

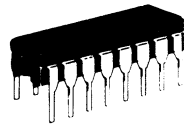
MC1600 Series (−30 to +85 °C)

The requirement for digital systems with ever higher performance has increased the need for high-speed integrated circuits. The industry has recognized that the only economical way to obtain high operating system speed is through the used of emitter-coupled logic. Motorola offers a state-of-the-art, emitter-coupled logic family with subnanosecond propagation delays – MECL III.

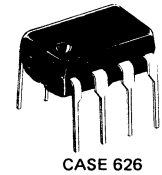
MECL III circuit design is similar to that used in the popular MECL 10 000 family. In the MECL III line, as well as MECL 10 000 advanced processing techniques are employed and the capability for driving low-impedance terminated lines is provided. MECL III is recommended for new designs.



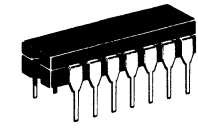
CASE 607
F suffix
Flat package



CASE 620
L suffix
Ceramic package

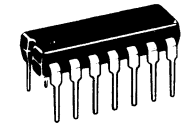


CASE 626
P suffix
Plastic package

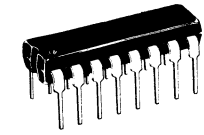


CASE 632
L suffix
Ceramic package

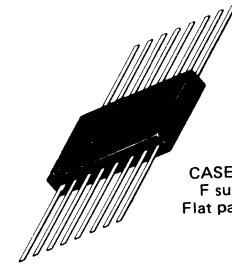
Function	Device Type −30° to +85 °C	Case
GATES		
Dual 4-Input OR/NOR	MC1660	620, 650
Dual 4-5 Input OR/NOR	MC1688	650
Quad 2-Input NOR	MC1662	620, 650
Triple 2-Input Exclusive NOR	MC1674	620, 650
Quad 2-Input OR	MC1664	620, 650
Triple 2-Input Exclusive OR	MC1672	620, 650
FLIP-FLOP		
Dual Clocked R-S	MC1666	620, 650
Dual Clocked Latch	MC1668	620, 650
Master-Slave Type D	MC1670	620, 650
UHF Prescaler Type D	MC1690	620, 650
COUNTERS		
Binary	MC1654	620
Bi-Quinary	MC1678	620
SHIFT REGISTER		
4-Bit Shift	MC1694	620
MULTIVIBRATOR		
Voltage-Controlled	MC1658	620, 648, 650
OSCILLATOR		
Emitter Coupled	MC1648	607, 632, 646
COMPARATOR		
Dual A/D	MC1650 / MC1651	620, 650
RECEIVER		
Quad Line	MC1692	620, 650
PRESCALER		
1 GHz Divide-by-Four	MC1697	626
1 GHz Divide-by-Four	MC1699	620, 650



CASE 646
P suffix
Plastic package



CASE 648
P suffix
Plastic package



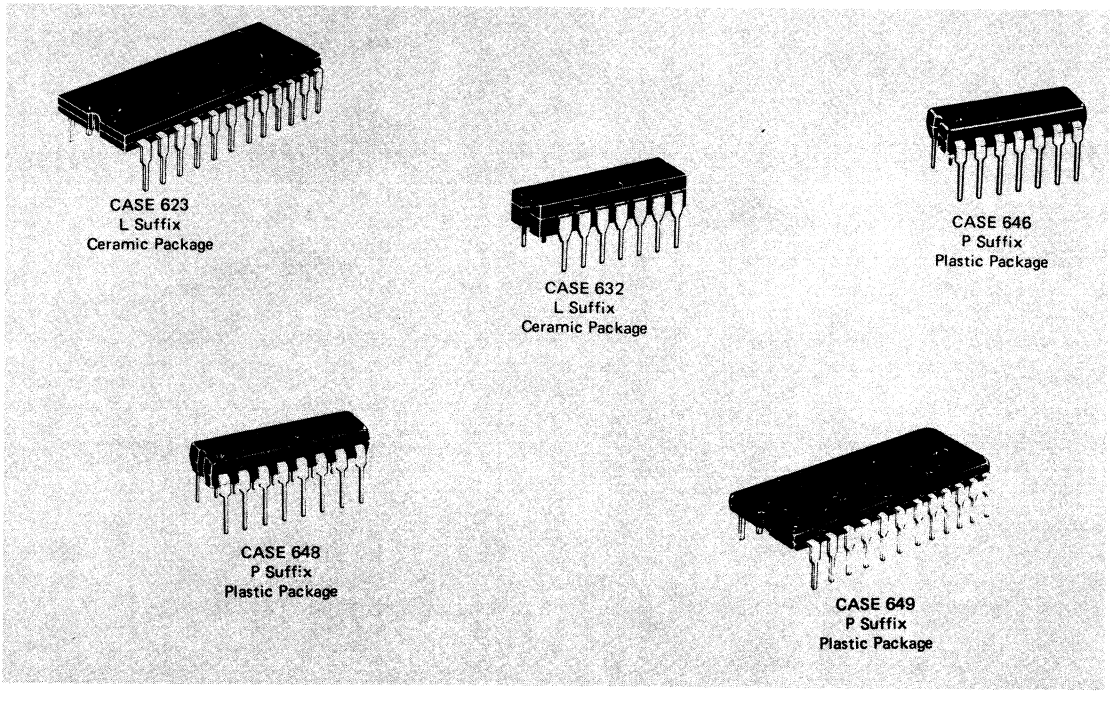
CASE 650
F suffix
Flat package

Megalogic LSI MC8500 Series

MC8500 Series (0 to +75 °C)

MEGALOGIC is a bipolar LSI family of low-cost products directed to the computer, industrial, and consumer markets, for both MPU and non-MPU applications. The family will include technologies such as TRL and I^2L, plus others that may be applicable. Design techniques will encompass the production-proven gate array technique plus other design approaches to provide the flexibility required for cost-effective, standard bipolar LSI functions.

Designers can now implement highly complex systems with only a few basic off-the-shelf LSI components. Benefits include lower system costs. off-the-shelf availability, improved reliability, lower system power drain, fewer parts to assemble and inspect, and more compact system architecture.



CASE 623
L Suffix
Ceramic Package

CASE 632
L Suffix
Ceramic Package

CASE 646
P Suffix
Plastic Package

CASE 648
P Suffix
Plastic Package

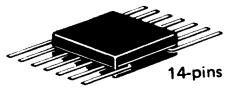
CASE 649
P Suffix
Plastic Package

Device	Function	Case	Applications
MC8500	CRCC Generator	623, 649	Megnetic tape drive controllers using NRZI or GCR recordings, 7 or 9 channels.
MC8501	Error Pattern Register	620, 648	
MC8502	LRCC/Data Register	623, 649	
MC8503	Universal Polynomial Generator (10-bit)	632, 646	Cassette, floppy disc, data communications
MC8504	Universal Presettable Polynomial Generator (4-bit, Cascadable)	620, 648	High-speed disc controllers, digital filtering
MC8505	MOS Dynamic Memory Refresh Logic Circuit	620, 648	Add-on memory, memory applications
MC8506	Polynomial Generator (16-bit)	620, 648	Floppy disc, SDLC terminals
MC8507 MC6828	Priority Interrupt Controller	623, 649	PIC in used to add prioritized responses to inputs to microprocessor systems
MC8520	Deskew/Queue Register	623	Magnetic tape drive controllers, phase encoded.

MTTL 54LS00/74LS00

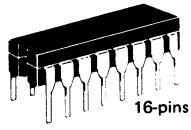
SN74LS00 Series (0 to +75 °C) SN54LS00 Series (−55 to +125 °C)

LS Low Power Schottky TTL family combines a current and power reduction by a factor 5 (compared to 7400 TTL) with anit-saturation Schottky diode clamping and advanced processing, using shallower diffusions and higher sheet resistivity to achieve circuit performance better than conventional TTL. A full complement of TTL functions will become available during 1977. Contact your Motorola representative for complete details.



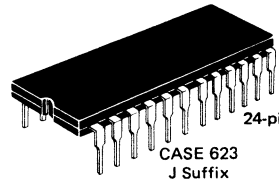
14-pins

CASE 607
W Suffix
Ceramic Package



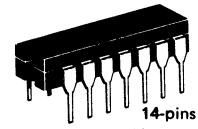
16-pins

CASE 620
J Suffix
Ceramic Package



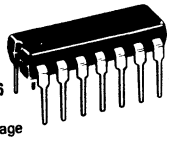
24-pins

CASE 623
J Suffix
Ceramic Package



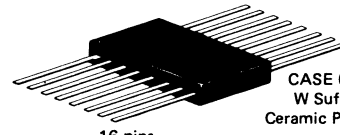
14-pins

CASE 632
J Suffix
Ceramic Package



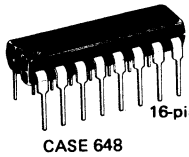
14-pins

CASE 646
N Suffix
Plastic Package



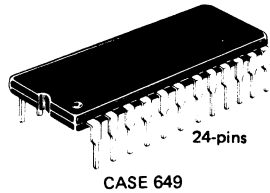
CASE 650
W Suffix
Ceramic Package

16-pins



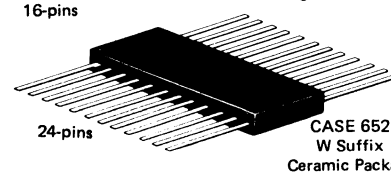
16-pins

CASE 648
N Suffix
Plastic Package



24-pins

CASE 649
N Suffix
Plastic Package



24-pins

CASE 652
W Suffix
Ceramic Package

Function	Operating Temperature Range		Packages Dual-in-Line		Flat
	−55 °C to +125 °C	0 °C to +75 °C	Plastic	Ceramic	Ceramic
NAND-Gates					
Quad 2-Input	SN54LS00	SN74LS00	646	632	607
Quad 2-Input (O.C.)	SN54LS01	SN74LS01	646	632	607
Quad 2-Input (O.C.)	SN54LS03	SN74LS03	646	632	607
Quad 2-Input High Volt.	SN54LS26	SN74LS26	646	632	607
Quad 2-Input (48 mA)	SN54LS37	SN74LS37	646	632	607
Quad 2-Input (O.C. 48 mA)	SN54LS38	SN74LS38	646	632	607
Triple 3-Input	SN54LS10	SN74LS10	646	632	607
Triple 3-Input (O.C.)	SN54LS12*	SN74LS12*	646	632	607
Dual 4-Input	SN54LS20	SN74LS20	646	632	607
Dual 4-Input (O.C.)	SN54LS22	SN74LS22	646	632	607
Dual 4-Input Buffer	SN54LS40	SN74LS40	646	632	607
8-Input	SN54LS30	SN74LS30	646	632	607
13-Input	SN54LS133	SN74LS133	648	620	650
Hex Inverter	SN54LS04	SN74LS04	646	632	607
Hex Inverter (O.C.)	SN54LS05	SN74LS05	646	632	607

* Introduction during 2nd Quarter 1978

Function	Operating Temperature Range		Packages Dual-in-Line		Flat
	−55 °C to +125 °C	0 °C to +75 °C	Plastic	Ceramic	Ceramic
AND-Gates					
Quad 2-Input	SN54LS08	SN74LS08	646	632	607
Quad 2-Input (O.C.)	SN54LS09	SN74LS09	646	632	607
Triple 3-Input	SN54LS11	SN74LS11	646	632	607
Triple 3-Input (O.C.)	SN54LS15	SN74LS15	646	632	607
Dual 4-Input	SN54LS21	SN74LS21	646	632	607
NOR-Gates					
Quad 2-Input	SN54LS02	SN74LS02	646	632	607
Quad 2-Input Buffer	SN54LS28	SN74LS28	646	632	607
Quad 2-Input (O.C.)	SN54LS33	SN74LS33	646	632	607
Triple 3-Input	SN54LS27	SN74LS27	646	632	607
Dual 5-Input	SN54LS260	SN74LS260	646	632	607
OR-Gates					
Quad 2-Input	SN54LS32	SN74LS32	646	632	607

Function	Operating Temperature Range		Packages Dual-in-Line		Flat
	-55 °C to +125 °C	0 °C to +75 °C	Plastic	Ceramic	Ceramic
AND-OR-INVERT-Gates					
Dual AOI	SN54LS51	SN74LS51	646	632	607
2-3-3-2 Input AOI	SN54LS54	SN74LS54	646	632	607
2-Wide 4-Input AOI	SN54LS55	SN74LS55	646	632	607
THREE-STATE Buffers/BUS-DRIVERS/-RECEIVERS					
Quad Buffer Low En.	SN54LS125	SN74LS125	646	632	607
Quad Buffer High En.	SN54LS126	SN74LS126	646	632	607
Hex Buffer Common En.	SN54LS365	SN74LS365	648	620	650
Hex Inverter Common En.	SN54LS366	SN74LS366	648	620	650
Hex Buffer 4 Bit & 2 Bit	SN54LS367	SN74LS367	648	620	650
Hex Inverter 4 Bit & 2 Bit	SN54LS368	SN74LS368	648	620	650
Octal Driver Non Inv.	SN54LS244*	SN74LS244*	20-pin package		
Octal Inv. Bus/Lin Dr.	SN54LS240*	SN74LS240*	20-pin package		
Octal Bus/Line Driver	SN54LS241*	SN74LS241*	20-pin package		
Quad Bus Transceiver Inv.	SN54LS242	SN74LS242	646	632	607
Quad Bus Transceiver Non Inv.	SN54LS243	SN74LS243	646	632	607
SCHMITT-TRIGGERS					
Dual 4-Input	SN54LS13	SN74LS13	646	632	607
Quad 2-Input	SN54LS132	SN74LS132	646	632	607
Hex 1-Input	SN54LS14	SN74LS14	646	632	607
DUAL FLIP-FLOPS/MONOSTABLES					
Dual JK	SN54LS73*	SN74LS73*	646	632	607
Dual D	SN54LS74	SN74LS74	646	632	607
Dual JK	SN54LS76*	SN74LS76*	648	620	650
Dual JK	SN54LS78*	SN74LS78*	646	632	607
Dual JK	SN54LS109	SN74LS109	648	620	650
Dual JK Edge Trig.	SN54LS112	SN74LS112	648	620	650
Dual JK Edge Trig.	SN54LS113	SN74LS113	646	632	607
Dual JK Edge Trig.	SN54LS114	SN74LS114	646	632	607
Retrig. Mono St.	SN54LS122	SN74LS122	646	632	607
Dual Retrig. Mono St.	SN54LS123	SN74LS123	648	620	650
Dual one Shot (Very Stable)	SN54LS221	SN74LS221	648	620	650
EXCLUSIVE OR/NOR-Gates					
Quad Ex. OR	SN54LS86	SN74LS86	646	632	607
Quad Ex. OR (O.C.)	SN54LS136	SN74LS136	646	632	607
Quad Ex. OR	SN54LS386*	SN74LS386*	646	632	607
Quad Ex. NOR (O.C.)	SN54LS266	SN74LS266	646	632	607

Function	Operating Temperature Range		Packages Dual-in-Line		Flat
	-55 °C to +125 °C	0 °C to +75 °C	Plastic	Ceramic	Ceramic
LATCHES/COMPLEX FLIP-FLOP/REGISTER FILES					
4-Bit Latch	SN54LS75*	SN74LS75*	648	620	650
4-Bit Latch	SN54LS77*	SN74LS77*	646	632	607
Quad Latch	SN54LS375*	SN74LS375*	648	620	650
Quad Latch Set/Reset	SN54LS279	SN74LS279	648	620	650
Dual 4-Bit Adr. Latch	SN54LS256	SN74LS256	648	620	650
4-Bit D Register (3-State)	SN54LS173	SN74LS173	648	620	650
4-Bit D Flip-Flop w/En.	SN54LS379*	SN74LS379*	648	620	650
Quad D Flip-Flop w/Cl.	SN54LS175	SN74LS175	648	620	650
Hex D Flip-Flop w/Cl.	SN54LS174	SN74LS174	648	620	650
Hex D Flip-Flop w/En.	SN54LS378*	SN74LS378*	648	620	650
Octal D Flip-Flop w/M.R.	SN54LS273*	SN74LS273*	20-pin package		
Octal D Flip-Flop w/En.	SN54LS377*	SN74LS377*	648	620	650
8-Bit Adr. Latch	SN54LS259	SN74LS259	648	620	650
4 x 4 Reg. File	SN54LS170	SN74LS170	648	620	650
4 x 4 Reg. File (3-State)	SN54LS670	SN74LS670	648	620	650
COUNTERS					
Decade Ctr	SN54LS90	SN74LS90	646	632	607
BCD Decade Ctr Asy. R-S	SN54LS160	SN74LS160	648	620	650
BCD Decade Ctr Syn. R-S	SN54LS162	SN74LS162	648	620	650
Decade Ctr	SN54LS196	SN74LS196	646	632	607
Decade Ctr	SN54LS290	SN74LS290	646	632	607
Dual Decade Ctr	SN54LS390	SN74LS390	648	620	650
Dual Decade Ctr	SN54LS490	SN74LS490	648	620	650
4-Bit Binary Ctr	SN54LS93	SN74LS93	646	632	607
4-Bit Binary Ctr Asy. R-S	SN54LS161	SN74LS161	648	620	650
4-Bit Binary Ctr Syn. R-S	SN54LS163	SN74LS163	648	620	650
4-Bit Binary Ctr	SN54LS197	SN74LS197	646	632	607
4-Bit Binary Ctr	SN54LS293	SN74LS293	648	620	650
Dual 4-Bit Binary Ctr	SN54LS393	SN74LS393	646	632	607
U/D Dec. Ctr	SN54LS168	SN74LS168	648	620	650
U/D Dec. Ctr	SN54LS190	SN74LS190	648	620	650
U/D Dec. Ctr	SN54LS192	SN74LS192	648	620	650
U/D Bin. Ctr	SN54LS169	SN74LS169	648	620	650
U/D Bin. Ctr	SN54LS191	SN74LS191	648	620	650
U/D Bin. Ctr	SN54LS193	SN74LS193	648	620	650
Divide by 12 Ctr	SN54LS92	SN74LS92	646	632	607

* Introduction during 2nd Quarter 1978

Function	Operating Temperature Range		Packages Dual-in-Line		Flat Ceramic
	-55 °C to +125 °C	0 °C to +75 °C	Plastic	Ceramic	
SHIFT REGISTERS					
4-Bit S.R.	SN54LS95B	SN74LS95B	646	632	607
4-Bit Left/Right S.R.	SN54LS194A	SN74LS194A	648	620	650
4-Bit S.R.	SN54LS195A	SN74LS195A	648	620	650
4-Bit S.R. (3-State)	SN54LS295A	SN74LS295A	646	632	607
4-Bit S.R. (3-State)	SN54LS395A	SN74LS395A	648	620	650
8-Bit S-I/P-O S.R.	SN54LS164*	SN74LS164*	648	620	650
8-Bit P-I/S-O S.R.	SN54LS165	SN74LS165	648	620	650
ARITHMETIC ELEMENTS					
4-Bit Full Adder	SN54LS83A	SN74LS83A	648	620	650
4-Bit Full Adder	SN54LS283	SN74LS283	648	620	650
4-Bit Alu	SN54LS181	SN74LS181	649	623	652
4-Bit Magn. Comp.	SN54LS85	SN74LS85	648	620	650
Quad Adder/Subtr.	SN54LS385*	SN74LS385*	20-pin package		
Carry Look Ahead Gen	SN54LS182*	SN74LS182*	648	620	650
DECODERS/DEMULTIPLEXERS					
1-of-10 Decoder	SN54LS42	SN74LS42	648	620	650
1-of-8 Dec/Demux	SN54LS138	SN74LS138	648	620	650
Dual 1-of-4 Dec/Demux	SN54LS139	SN74LS139	648	620	650
Dual 1-of-4 Decoder	SN54LS155	SN74LS155	648	620	650
Dual 1-of-4 Decoder (O.C.)	SN54LS156	SN74LS156	648	620	650

Function	Operating Temperature Range		Packages Dual-in-Line		Flat Ceramic
	-55 °C to +125 °C	0 °C to +75 °C	Plastic	Ceramic	
MULTIPLEXERS					
8-Input Multiplexer	SN54LS151	SN74LS151	648	620	650
8-Input Multiplexer (3-State)	SN54LS251	SN74LS251	648	620	650
Dual 4-Input Multiplexer	SN54LS153	SN74LS153	648	620	650
Dual 4-Input Multiplexer (3-State)	SN54LS253	SN74LS253	648	620	650
Quad 2-Input Mux. Non-Inv.	SN54LS157	SN74LS157	648	620	650
Quad 2-Input Mux. Non-Inv. (3-State)	SN54LS257	SN74LS257	648	620	650
Quad 2-Input Multiplexer Inv.	SN54LS158	SN74LS158	648	620	650
Quad 2-Input Multiplexer Inv. (3-State)	SN54LS258	SN74LS258	648	620	650
Quad 2-Input Multiplexer w/Output Reg.	SN54LS298	SN74LS298	648	620	650
Quad 2-Input Multiplexer w/Output Reg.	SN54LS398*	SN74LS398*	648	620	650
Quad 2-Input Multiplexer w/Q & $\overline{Q}$	SN54LS399*	SN74LS399*	648	620	650

* Introduction during 2nd Quarter 1978

Ordering Information — Package Style:

SN74LS00X

Package Style (Suffix J, N or W)

N = Plastic DIL
J = Ceramic DIL
W = Ceramic Flat Pack

INTERFACE CIRCUITS

The economics of today's marketplace dictate that electronic systems be developed largely with semiconductor devices that are designed and manufactured on a large-volume basis. This requirement, in turn, demands that these semiconductor components be "generic" in design, so that they can be used for a variety of systems with widely diversified capabilities and characteristics.

To a significant degree, the above prerequisites prohibit the tailoring of integrated circuits—even MSI and LSI components—to a specifically designated end-product. While specific families are engineered to work together harmoniously, it is often advantageous to mix functions from a number of families in order to derive performance or economic benefits. And, often, such conglomorates require matching, level translation or driver enhancement.

Even within a single family, interfacing in terms of fan-out enhancement or power boosting is often required.

Motorola's broad line of products, encompassing all popular device families and technologies, has generated a comprehensive insight into interface requirements. It has spawned a large and continuously expanding repertoire of interface circuits to meet the needs of the system designer.

TABLE OF CONTENTS

Bus Interface

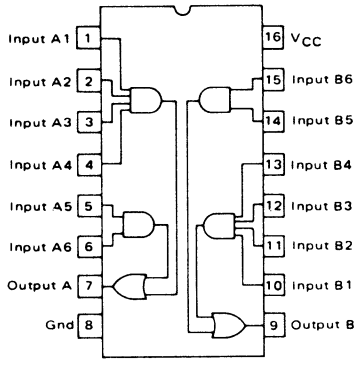
Computer Bus

Line drivers and receivers designed to operate compatibly. The MC8T13/MC8T14 combination is specified for general TTL system applications. The MC8T23/MC8T24 combination is specifically oriented toward IBM 360/370 system requirements.

DUAL LINE DRIVERS

MC8T13 – Open emitter driver; specified for general TTL systems.

MC8T23 – Open emitter driver; specified to meet IBM system requirements.



All four devices:
T_A = 0 to 75°C

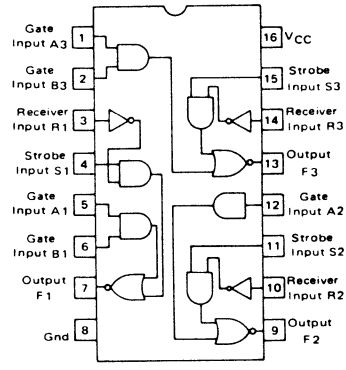
Packages:
L Suffix – Case 620
P Suffix – Case 648

Device Number	V_{OH} @ I_{OH} = -75 mA @ I_{OH} = -59.3 mA* Volts Max	I_{OS} @ V_O = 0 mA Max	t_{PLH} @ C_L = 15 pF ns Max
MC8T13	2.4	-30	20
MC8T23	3.11*	-30	20

TRIPLE LINE RECEIVERS

MC8T14 – Hysteresis-equipped receiver; specified for general TTL systems.

MC8T24 – Hysteresis-equipped receiver; specified to meet IBM system requirements.



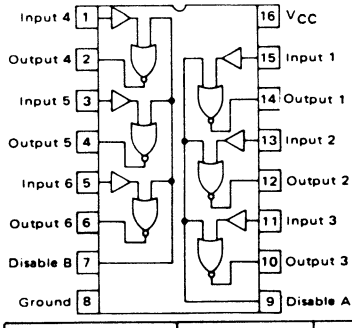
Device Number	$V_{H(R)}$ Volts Min	$I_{IH(R)}$ @ $V_{IH(R)}$ = 3.8 V @ $V_{IH(R)}$ = 3.11 V* mA Max	$t_{PLH(R)}$ @ C_L = 15 pF ns Max
MC8T14	0.3	0.17	30
MC8T24	0.2	0.17*	30

Minicomputer Bus

Transceivers and receivers for bus organized minicomputers employing 120-ohm terminated lines.

HEX RECEIVERS

MC3437 – Hysteresis-equipped for improved noise immunity. DS8837 equivalent.



All three devices:
T_A = 0 to 70°C

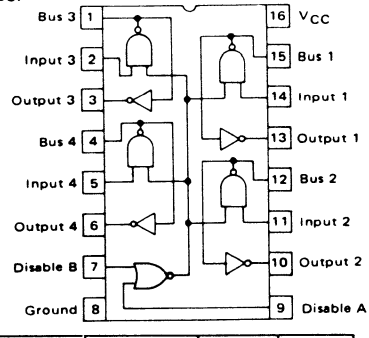
Packages:

MC3437
MC3438 DS8641
L Suffix – Case 620 – J Suffix
P Suffix – Case 648 – N Suffix

$I_{I(R)}$ @ $V_{I(R)}$ = 4.0 V µA Max	Hysteresis Volts Min	$t_{PLH(R)}$ @ C_L = 15 pF ns Max
50	0.5	30

QUAD TRANSCEIVERS

MC3438
DS8641 – Open collector driver outputs allow wire-OR connection. MC3438 has hysteresis-equipped receiver for improved noise immunity (not available with DS8641). MC3438 is equivalent DS8838.



Receiver Hysteresis Volts Min	$V_{L(BUS)}$ @ I_{BUS} = 50 mA Volts Max	I_{BUS} @ $V_{IH(BUS)}$ = 4.0 V µA Max	$t_{PLH(D)}$ @ C_L = 15 pF ns Max	$t_{PLH(R)}$ @ C_L = 15 pF ns Max
0.25*	0.7	100	25	30

*MC3438 only.

Microcomputer Bus

This family of devices is designed to extend the limited drive capabilities of today's standard 6800 and 8080 type NMOS microprocessors. All devices are fabricated with Schottky TTL technology for high speed.

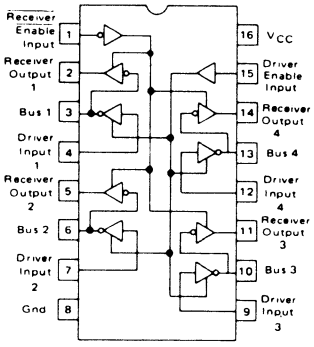
General features include:

- Single +5.0 V Power Supply Requirement
- Three-State Logic Output
- Low Input Loading – 200 μA Max.

DATA BUS EXTENDERS

Quad, Bidirectional, with 3-State Outputs

MC6880A/MC8T26A# – Inverting

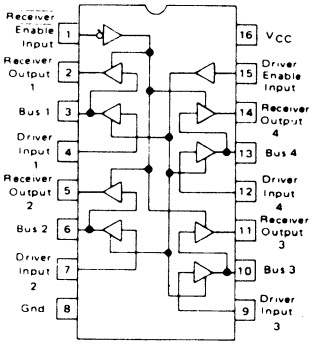


#These devices may be ordered by either of the paired numbers.

Both types:
T_A = 0 to 75°C

Packages:
L Suffix – Case 620
P Suffix – Case 648

MC6889/MC8T28# – Non-inverting

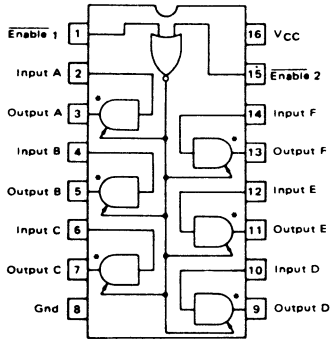


Device Number	Input Current I_{IH} μA Max	Input Current I_{IL} μA Max	I_{OHL} Output Disabled Leakage Current – High Logic State μA Max	t_{PLH}, t_{PHL} Propagation Delay Time – High to Low or Low to High ns Max
MC6880A/MC8T26A	25	-200	100	14
MC6889/MC8T28	25	-200	100	17

ADDRESS AND CONTROL BUS EXTENDERS

Hex, Unidirectional, with 3-State Outputs

MC6885/MC8T95# – Non-inverting
MC6886/MC8T96# – Inverting
Two-input Enable controls all six buffers.



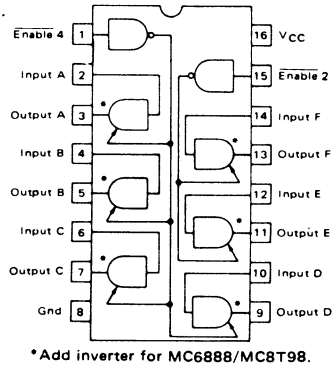
*Add inverter for MC6886/MC8T96.

#These devices may be ordered by either of the paired numbers.

All four types:
T_A = 0 to 75°C

Packages:
L Suffix – Case 620
P Suffix – Case 648

MC6887/MC8T97# – Non-inverting
MC6888/MC8T98# – Inverting
Two Enable inputs, one controlling four buffers and the other controlling the remaining two buffers.



*Add inverter for MC6888/MC8T98.

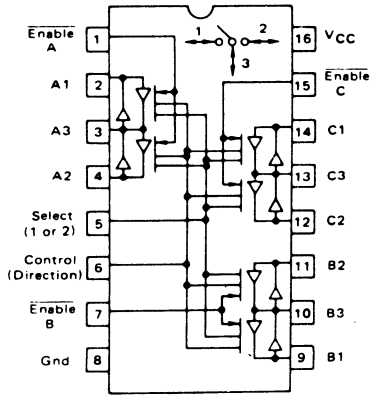
V_{OL} @ I_{OL} = 48 mA Volts Max	V_{OH} @ I_{OH} = -5.2 mA Volts Min	I_{OS} mA Typ	t_{PLH} ns Typ	$t_{P(Enable)}$ ns Typ
0.5	2.4	-80	6.0	11

Extended temperature range with CL suffix (T_A = −40 °C to 85 °C and MTL suffix (T_A = −55 °C to +125 °C) available.

Microcomputer Bus (continued)

BIDIRECTIONAL BUS SWITCH

MC6881/MC3449# – For exchanging TTL level digital information between selected pairs of ports in a 3-port network.



#This device may be ordered by either of the numbers.

Both types:
T_A = 0 to 70°C

Packages:
L Suffix – Case 620
P Suffix – Case 648

V_{OL} @ I_{OL} = 8.0 mA Volts Max	I_{OD} @ V_O = 2.7 V µA Max	I_{IL} @ V_{IL} = 0.4 V µA Max	I_{IH} @ V_{IH} = 2.7 V µA Max
0.5	25	-200	40

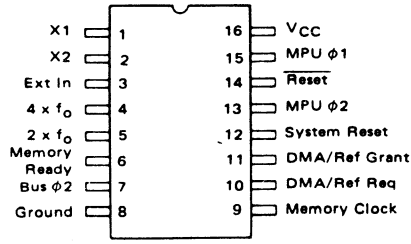
MC6881/MC3449 TRUTH TABLE

Enable	Select	Control	Data Flow
0	0	0	2→3
0	0	1	3→2
0	1	0	1→3
0	1	1	3→1
1	X	X	High Impedance

X - Don't Care

M6800 CLOCK GENERATOR

MC6875 – Provides the non-overlapping two-phase clock signals for M6800 MPU systems.



V_{OLC} = 0.3 V Max
V_{OHC} = V_{CC} – 0.3 V Min
f_{op} = 2.0 MHz Typ

Instrumentation Bus

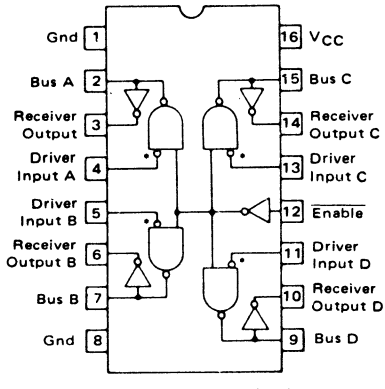
HIGH-CURRENT PARTY-LINE BUS TRANSCEIVERS

Devices for industrial control and data communication.

MC26S10 – Inverting
MC26S11 – Non-inverting
Quad transceivers with open-collector drivers and PNP-buffered inputs for MOS compatibility.

Both types:
T_A = 0 to 70°C

Packages:
L Suffix – Case 620
P Suffix – Case 648



*Inverter on MC26S11 only.

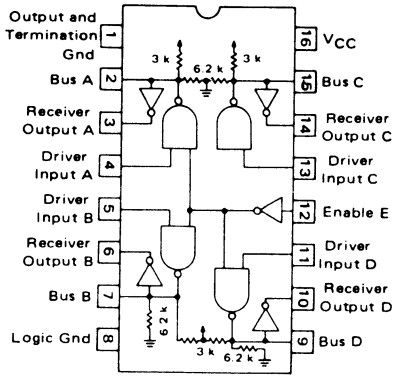
Test	Condition	Limits
V_{OL} (D)	I_{OL} = 100 mA	0.8 Volts Max
I_O (D)	V_{OH} = 4.5 V	100 µA Max
I_{O1}(D)	V_{CC} = 0 V, V_{OH} = 4.5 V	100 µA Max
I_{IH} (D)	V_{IH} = 2.7 V	30 µA Max
I_{IL} (D)	V_{IL} = 0.4 V	-0.54 mA Max
t_P (D)	MC26S10	15 ns Max
	MC26S11	19 ns Max
t_P (R)	Both Types	15 ns Max

Instrumentation Bus (continued)

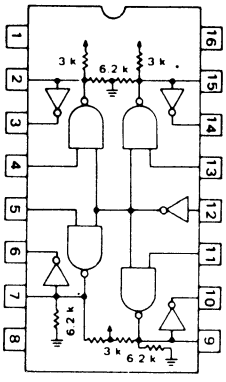
QUAD INTERFACE TRANSCEIVERS

These devices are designed to meet the HP-IB bus specification of IEEE Standard 488-1975, for the interconnection of Measurement Apparatus.

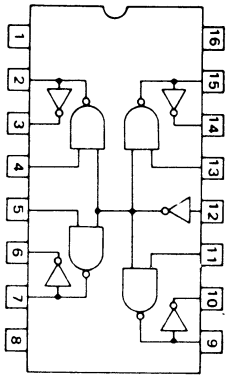
MC3440P – Three drivers with common Enable input; one driver without Enable.



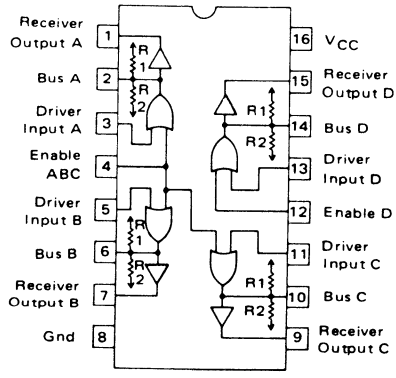
MC3441P – Four drivers with common Enable input.



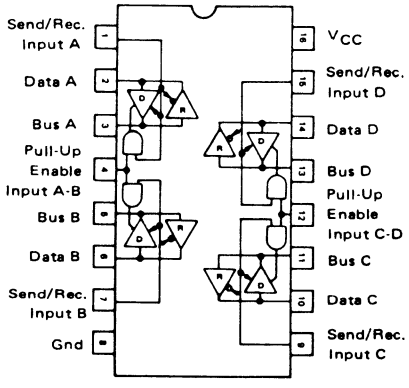
MC3443P – Four drivers with common Enable input; no termination resistors.



MC3446P – For low-power instruments, including MOS.



MC3448AP – For common Send-Receive bus; bidirectional.



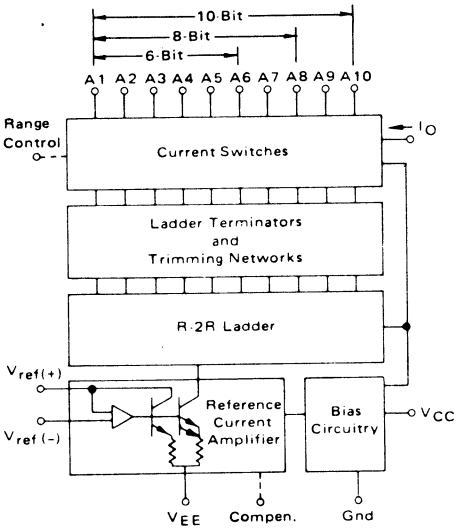
All types:
T_A = 0 to 70°C
Package – Case 648

Device Number	Receiver Input Hysteresis mV Min	Drive Output Voltage @ I_{OL} = 48 mA; Volts Max	Bus Divider Voltage Volts	t_{PHL} (Driver or Receiver) ns Max
MC3440P	400	0.4	2.6 to 3.75	30
MC3441P	400	0.4	2.6 to 3.75	30
MC3443P	400	0.4	–	25(D) 22(R)
MC3446P	400	0.4	2.5 to 3.7	50
MC3448AP	400	0.4	2.5 to 3.7	35

A-D/D-A Conversion

Low-cost building blocks for construction of D-A/A-D systems. Involves use of advanced technologies such as ion implantation, laser trimming and CMOS processing where necessary to achieve the required functional capability, operating accuracy and production repeatability.

D-A Converters



--- Dotted terminals available on 6- and 8-bit units only.

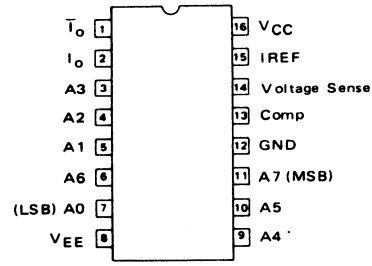
Multiplying D-A converters designed to supply an output current that is a linear product of an analog input reference voltage and a digital input word. Devices for 6-, 8- and 10-bit digital word inputs are available.

Device Number	Error % Max	P_D @ V_{EE} = -5 V mW Max	$t_{Settling}$ ns Typ	I_O @ V_{Ref} = 2 V mA	Suffix	Case
6-Bit						
MC1506*	±0.78	120	150	1.9 to 2.1	L	632
MC1406						
8-Bit						
MC1508L8*	±0.19	170	300	1.9 to 2.1	L	620
MC1408L8						
MC1408L7	±0.39				L, P	620, 648
MC1408L6	±0.78					
MC3408	±0.5				L	620
10-Bit						
MC3510*	±0.05	220	250	3.8 to 4.2	L	690
MC3410						
MC3410C	±0.1				L, P	690, 648

*T_A = -55 to 125°C,
Devices without asterisk: T_A 0 to 70°C.

MC10318 – HIGH-SPEED MECL DIGITAL-TO-ANALOG CONVERTER

Intended for applications in instrumentation, communication and television broadcasting, the MC10318 is an eight-bit accurate D/A converter operating at speeds above 10 MHz. The inputs are compatible with MECL 10K series logic while the complementary current sink outputs feature current of up to 50 mA. Devices are specified to be 8-bit (±½ LSB) accurate, monotonic and operate over a -30°C to 85°C temperature range.

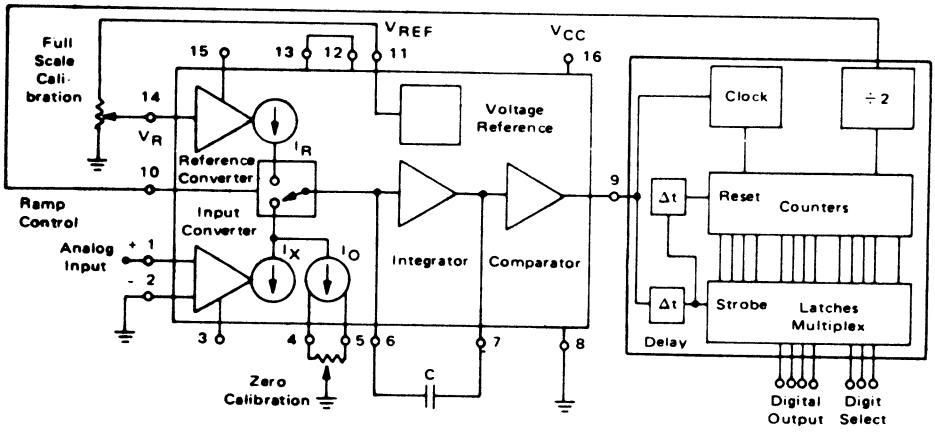


Package:
16 pin Ceramic DIP
to be introduced

A-D Subsystems

2-Chip A-D Converter System Functional Diagram

These devices are relatively complex subsystems. The bipolar, dual-ramp A-D converter has up to 4-1/2-digit conversion capability. The CMOS logic subsystem specifically adapts the A-D converter to a 3-1/2-digit DVM function.



MC1505/1405 – A-D Converter

MC1505L – T_A = -55 to 125°C – Case 620
MC1405L – T_A = 0 to 70°C – Case 620

MC14435 – Digital Logic
(See Semiconductor Data Library Vol. 5 for data.)

MC14435EFL/EVL* – T_A = -55 to 125°C – Case 620
MC14435FL/VL* – T_A = -40 to 85°C – Case 620
MC14435FP/VP* – T_A = -40 to 85°C – Case 648

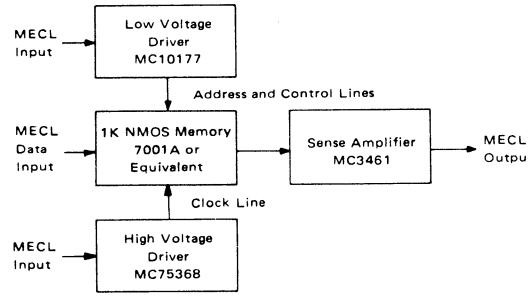
Linearity Error % Max	Voltage Reference Volts	Temperature Coefficient of Reference %/°C	I_{CC} @ V_{CC} = 5.0 V mA Max
±0.05	1.15 to 1.35	0.005	12

P_C(quiescent) @ V_{DD} = 5.0 V mW Max	I_{OL} @ V_{DD} = 5.0 V (Digit Selects) mA Min	I_{OL} @ V_{DD} = 5.0 V (BCD Outputs) mA Min	I_{OL} @ V_{DD} = 5.0 V (All Outputs) mA Min
1.75	1.6	1.6	-0.2

*MC14435EFL/FL/FP: V_{DD} = 3.0 to 18 Vdc
MC14435EVL/VL/VP: V_{DD} = 3.0 to 6.0 Vdc

NMOS Memories to MECL Systems

The high-speed capabilities of some NMOS memories (example: 7001A types) make them desirable for use in conjunction with MECL logic for some applications. Yet, the *positive* input requirements of NMOS memories are incompatible with the negative voltage levels characteristic of the MECL family. Hence, level conversion is required–for both input and output matching of the NMOS memory. The interface devices below include driver/translators to feed the memory inputs and a sense amplifier to match the output.

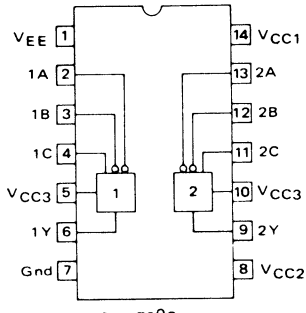


DRIVER/TRANSLATORS

MECL-to-MOS driver/translators convert standard MECL 10,000 input signals to suitable levels for NMOS memory systems. The MC75358 and MC75368 may also be used as positive logic NOR or non-inverting gates.

MC75368, MC75358 – Dual Clock Line Drivers suitable for driving address, control, and timing inputs.

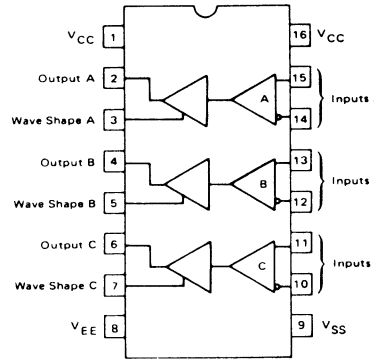
MC10177L – Triple Line Driver for driving address and control inputs.



Maximum Supply Voltage:
MC75368 = 18 V
MC75358 = 22 V

T_A = 0 to 70°C

Packages:
L Suffix – Case 632
P Suffix – Case 646



T_A = -30 to 85°C

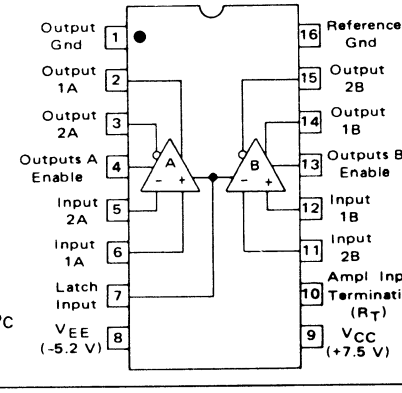
Package – Case 620

Device Number	V_{OH} Volts Min	@ I_{OH} mA	V_{OL} Volts Max	@ I_{OL} mA	t_{DHL} ns Max	@ C_L pF
MC75368	V_{CC2} - 0.3	0.1	0.3	10	26	300
MC75358	V_{CC2} - 0.3	0.1	0.3	10	24	390
MC10177	4.0	15	0.5	1.0	6.0	350

SENSE AMPLIFIER

MC3461L – Dual Sense Amplifier with MECL 10,000-compatible control inputs and complementary, open-emitter outputs. Designed for 7001 and 2105 type NMOS 1K RAMs.

I_{TH} µA Max	t_{PD} (Amplifier) ns Max	t_{PD} (Enable) ns Max
±200	10	5.0

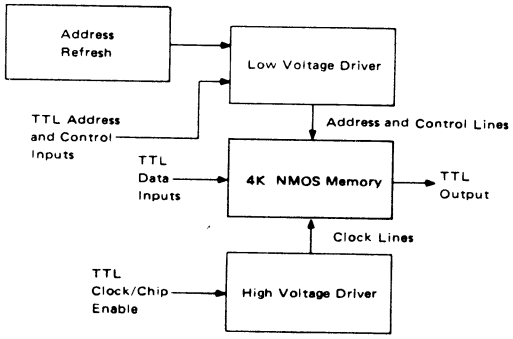


T_A = 0 to 75°C

Package – Case 620

NMOS Memories to TTL Systems

The highly capacitive loads represented by NMOS memories are, in themselves, incompatible with the drive capabilities of conventional TTL logic circuits. So, also, are some of the voltage levels. The devices shown are used to match TTL capabilities to various types of popular NMOS memories.

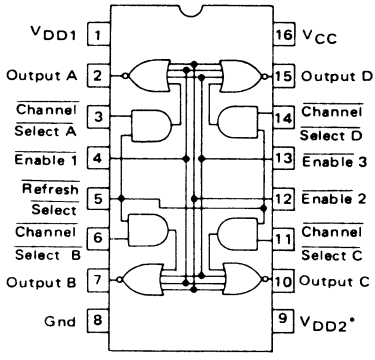


CLOCK AND CHIP ENABLE LINE DRIVERS (High Level)

MC3460, MC3466, MC3245 — Quad Clock Drivers with Refresh Select Logic

MC75365 — Quad Clock Driver or High-Current NAND Gate

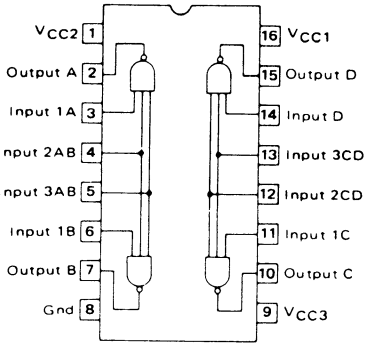
MMH0026, MMH0026C — Dual Clock Driver



*MC3245 — no connection; V_{DD2} not required.

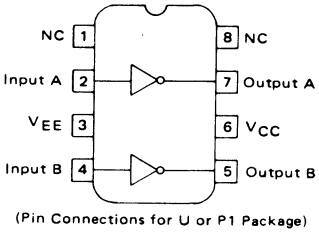
T_A = 0 to 70°C

Packages:
L Suffix — Case 620
P Suffix — Case 648



T_A = 0 to 70°C

Packages:
L Suffix — Case 620
P Suffix — Case 648



(Pin Connections for U or P1 Package)

T_A:
MMH0026 — -55 to 125°C
MMH0026C — 0 to 70°C

Packages
G Suffix — Case 601
L Suffix — Case 632
U Suffix — Case 693
P1 Suffix — Case 626 (For MMH0026C only)

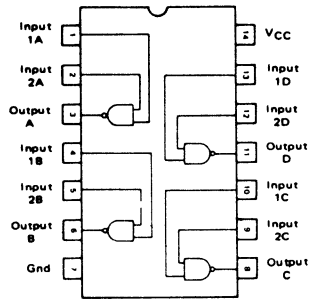
Device Number	V_{OH} Volts Min	@ I_{OH} mA	V_{OL} Volts Max	@ I_{OL} mA	t_{DHL} ns Max	@ C_L pF	Feature
MC3460	V_{DD1} - 1.0	-2.0	0.55	40	23	480	Specified for use with 4K NMOS dynamic memories.
MC3466	V_{DD1} - 1.3	-40	0.55	40	24	480	Specified for use with 1K NMOS dynamic memories (e.g., 7001A types).
MC3245	V_{DD} - 0.5	-1.0	0.45	5.0	32	250	Does not require second high voltage supply. Low input loading.
MC75365	V_{CC2} - 0.3	-0.1	0.3	10	18	200	Derives V_{CC1} power from TTL 5-V supply, and V_{CC2} and V_{CC3} from V_{SS} and V_{BB} supplies from NMOS memories.
MMH0026 MMH0026C	V_C - 1.0	0.4 V*	V_{EE} + 1.0	2.4 V*	12	1000	For very high capacitance loads.

*@ V_I - V_{EE}

NMOS Memories to TTL Systems (continued)

DATA AND ADDRESS LINE DRIVERS
(Low Level)

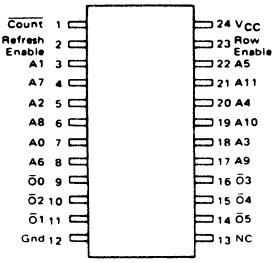
MC3459 – Quad Address Line Driver



T_A = 0 to 70°C

Packages:
L Suffix – Case 632
P Suffix – Case 646

MC3232A – Address multiplexer and refresh counter for 4K 16 pin RAM's

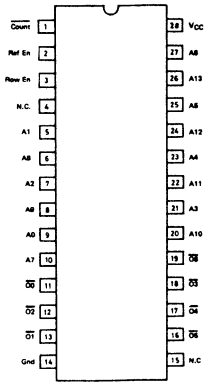


NOTE:
As through A5 are row addresses
A6 through A11 are colum addresses

T_A = 0 to 75°C

Packages
MC3232A: L Suffix – Case 649
P Suffix – Case 623

MC3242A* – Address Multiplexer and Refresh Counter for 16K 16 pin RAM's



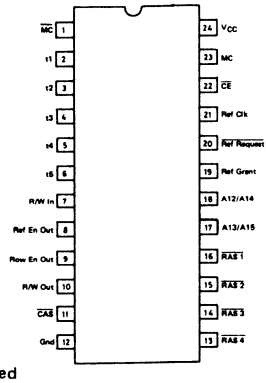
NOTE: A0 through A6 are row addresses
A7 through A13 are column addresses

T_A = 0 to 75 °C

* To be introduced

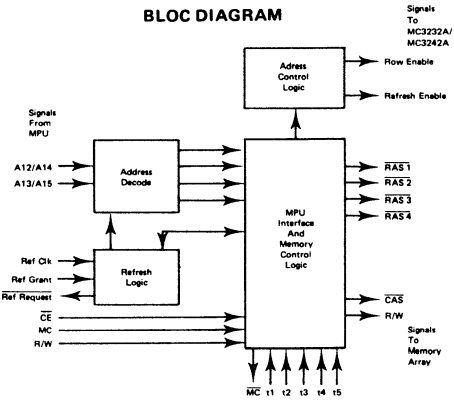
Device Number	V_{OH} Volts Min	@ I_{OH} mA	V_{OL} Volts Max	@ I_{OL} mA	Propagation Delay ns Max	@ C_L pF	Features
MC3459	2.4	-2.0	0.7	80	26	360	High fan-out capability.
MC3232A	2.8	-1.0	0.4	50	25	250	Multiplexes the 12 address bits to the 6 input address pins of 16-pin 4K RAMs.
MC3242A	3.0	–1.0	0.25	25	25	250	Multiplexes the 14 address bits to the 7 input address pins of 16-pin 16K RAMs.

MC3480* – Dynamic Memory Controller. This memory controller chip is designed to greatly simplify the interface logic required to control the popular 16 pin 4K or 16K NMOS RAMs in a microprocessor system such as the MC6800.



* To be introduced

BLOC DIAGRAM



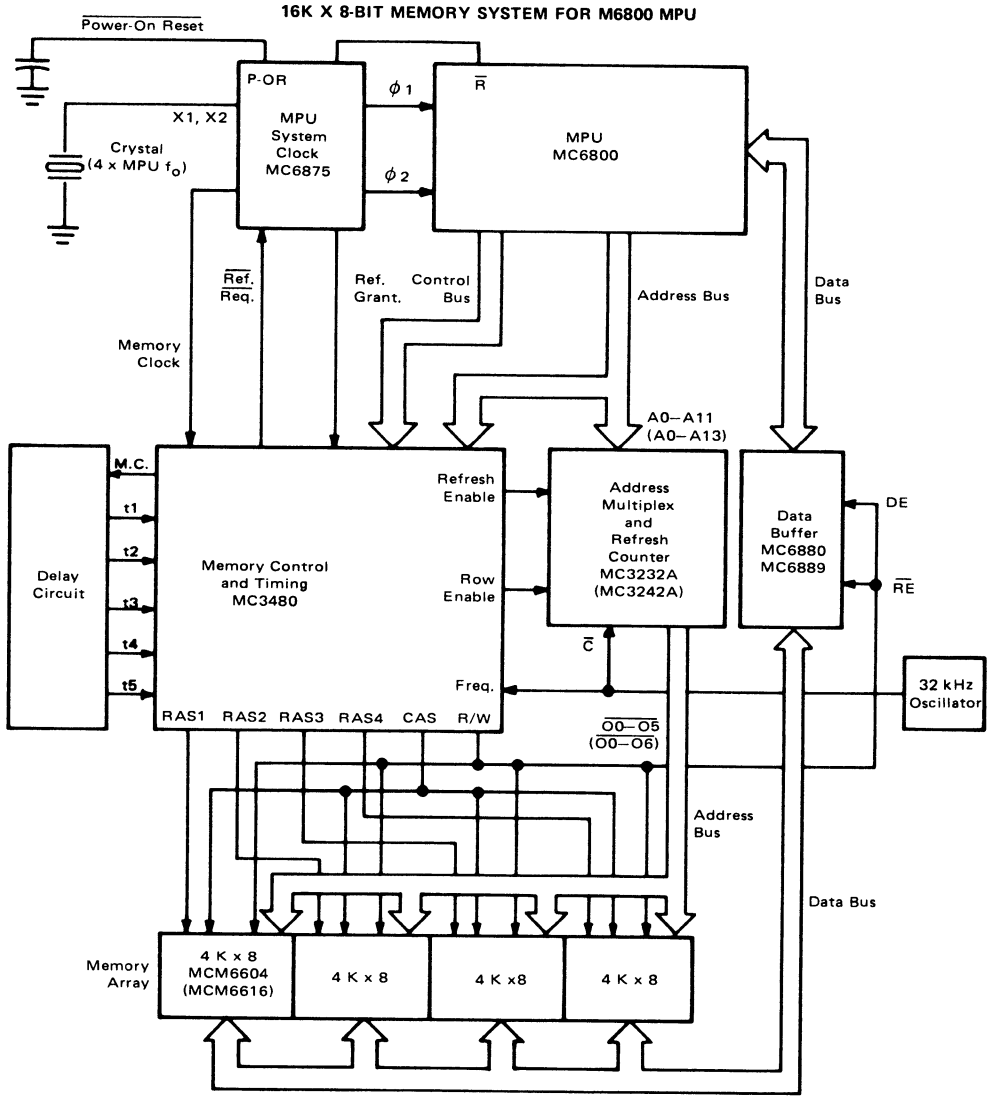
Several methods may be employed to generate the required time delay:

1. One shots
2. High frequency counters
3. High frequency shift registers
4. Delay lines
5. Signals from MPU clock

NMOS Memories to TTL Systems (continued)

Data and Address Line Drivers (Low Level) (continued)

TYPICAL APPLICATION

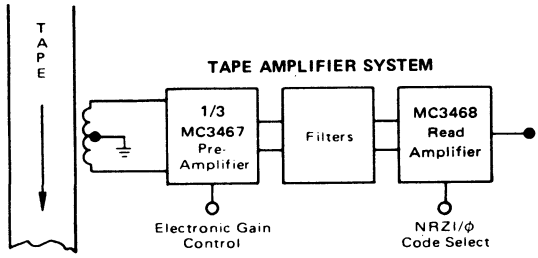


NOTE
Number in parenthesis indicate part types or values for 16 K x 1 RAMs.

Magnetic Memories to TTL Systems

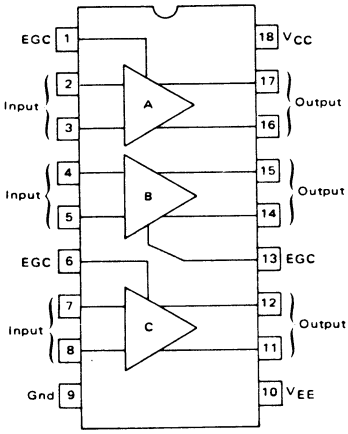
SENSE AMPLIFIERS

. . . for Magnetic Tape Memories, Floppy disc Memories



A two-component preamplifier/amplifier combination that provides the interface between magnetic tape heads and digital logic. Suitable for both open reel and cartridge tape systems. Triple preamp has individually adjustable gain controls. LSI Read Amplifier performs peak detection and threshold detection functions, as required for NRZI/phase encoded recording formats.

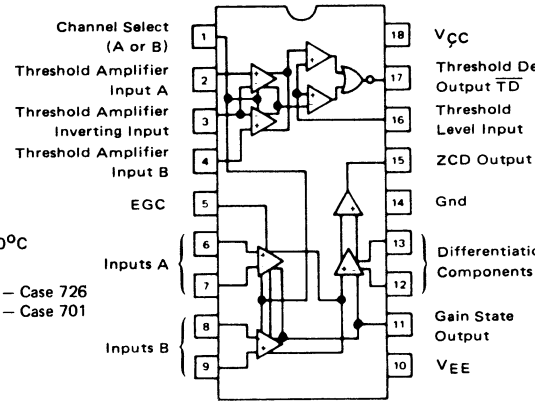
MC3467 – Triple Preamplifier

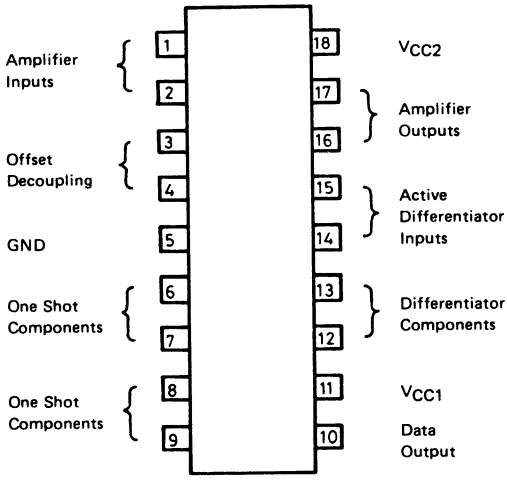


Both types:
T_A = 0 to 70°C

Packages:
L Suffix – Case 726
P Suffix – Case 701

MC3468 – Read Amplifier





MC3470 – Floppy disc read amplifier system. Monolithic read amplifier system for obtaining digital information from floppy disc storage.

T_A = 0 to 70°C

Packages:
L Suffix – Case 726
P Suffix – Case 701

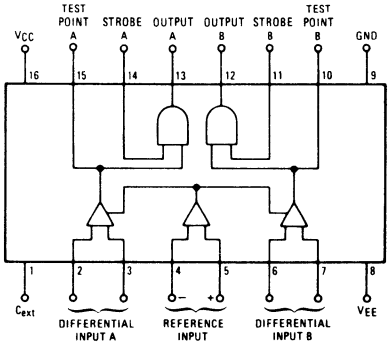
Magnetic Memories to TTL Systems (continued)

SENSE AMPLIFIERS (continued)

. . . for Core Memories

Feature adjustable threshold, time and amplitude signal discrimination, dual inputs with independent outputs, and a range of options.

Representative Diagram (MC5528/29)*



*Pin assignment slightly different for devices without test points.

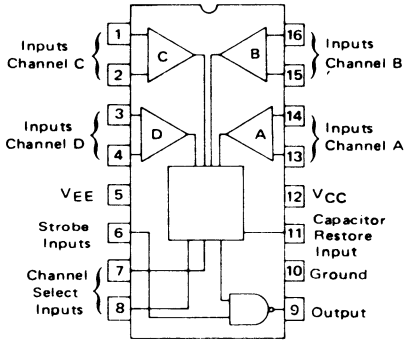
	T_A = -55 to 125°C		T_A = 0 to 70°C		Test Points
AND Output	MC5524	MC5525	MC7524	MC7525	No
	MC5528	MC5529	MC7528	MC7529	Yes
NAND Output	MC5534	MC5535	MC7534	MC7535	No
	MC5538	MC5539	MC7538	MC7539	Yes
V_{TH} @ V_{Ref} = 15 mV	10 to 20 mV	8 to 22 mV	11 to 19 mV	8 to 22 mV	
V_{TH} @ V_{Ref} = 40 mV	35 to 45 mV	33 to 47 mV	36 to 44 mV	33 to 47 mV	
Max I_{IB}	100 µA	100 µA	75 µA	75 µA	
Max t_{PLH} @ C_L = 15 pF	40 ns	40 ns	40 ns	40 ns	
Packages	L Suffix – Case 620		L Suffix – Case 620 P Suffix – Case 648		

. . . for Plated Wire and Thin-Film Memories and other low-level sensing applications.

MC1544 – T_A = -55 to 125°C
MC1444 – T_A = 0 to 70°C

Features 4-channel input with decoded channel selection and strobed output capability.

Packages:
MC1544
L Suffix – Case 620
F Suffix – Case 650
MC1444
L Suffix – Case 620



Device Number	V_{TH} mV	V_{OH} @ I_{OH} = -400 µA Volts Min	V_{OL} @ I_{OL} = 10 mA Volts Max	t_{PD} ns Max
MC1544	0.5 to 1.5	2.4	0.5	25
MC1444	0.3 to 2.3	2.4	0.5	25

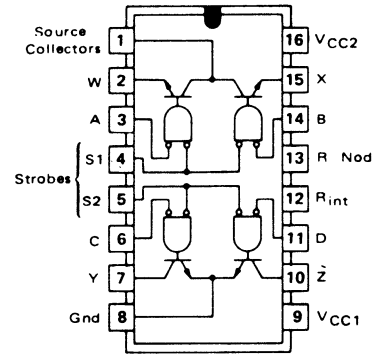
Magnetic Memories to TTL Systems (continued)

CORE DRIVER

MC55325 – T_A = -55 to 125°C
MC75325 – T_A = 0 to 70°C

Contains two source switches and two sink switches. Source and sink selection is determined by one of two logic inputs, and turn-on is determined by the appropriate strobe.

Packages:
L Suffix – Case 620
F Suffix – Case 650
P Suffix – Case 648 (MC75325 only)



Device Number	V_{sat} @ I_{sink} or I_{source} = 600 mA Volts Max	I_{off} @ V_{CC2} = 24 V μA Max	t_{PLH} (Source) ns Max	t_{PLH} (Sink) ns Max
MC55325	0.70	150	50	45
MC75325	0.75	200	50	45

Computer/Terminal Interface

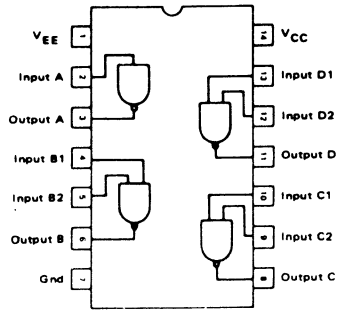
LINE DRIVERS AND RECEIVERS for Modem/Terminal Applications

Voltage Mode

RS-232C SPECIFICATION

DRIVER

MC1488 – Quad; output current limiting.



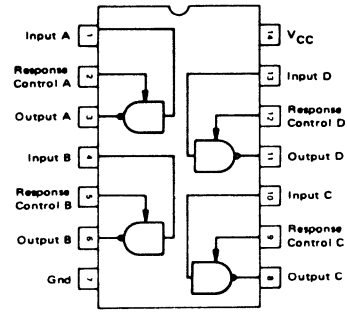
All devices:
T_A = 0 to 70°C

Package:
L Suffix – Case 632

V_{OH} @ V_{CC}/V_{EE} = ±9.0 V Volts Min	V_{OL} @ V_{CC}/V_{EE} = ±9.0 V Volts Max	I_{OS} mA	t_{PHL} @ C_L = 15 pF ns Max
6.0	-6.0	±6.0 to 12	175

RECEIVERS

MC1489 – Quad; 0.25 V input hysteresis.
MC1489A – Quad; 1.1 V input hysteresis.



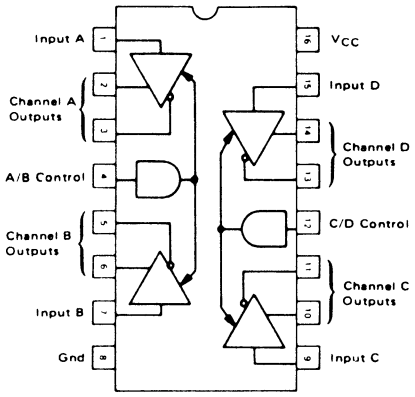
Device Number	Input V_{IHL} Volts	Input V_{ILH} Volts	t_{PHL} @ R_L = 390 Ω ns Max
MC1489	1.0 to 1.5	0.75 to 1.25	50
MC1489A	1.75 to 2.25	0.75 to 1.25	50

Line Drivers and Receivers for Modem/Terminal Applications (continued)
Voltage Mode (continued)

RS-422/423 SPECIFICATION

DRIVER

MC3487 – Quad; three-state outputs.



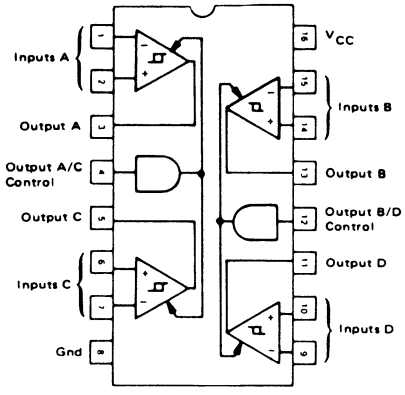
Both devices:
T_A = 0 to 70°C

Packages:
L Suffix – Case 620
P Suffix – Case 648

V_{OH} @ I_{OH} = 50 mA Volts Min	V_{OL} @ I_{OL} = 48 mA Volts Max	V_{OD}(Differential) @ R_L = 100 Ω Volts Min	t_{PLH}/t_{PHL} ns Typ
2.0	0.5	2.0	15

RECEIVER

MC3486 – Quad; three-state outputs and input hysteresis.

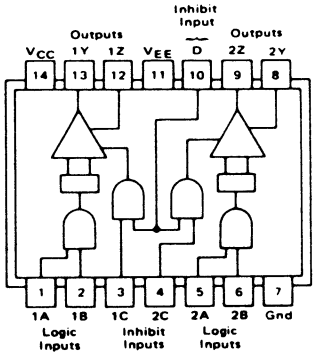


$V_{TH(D)}$ @ V_{ICM} = ±7.0 V Volts Max	I_{ID} @ V_{ID} = ±10 V V_{CC} = 0 to 5.25 V mA Max	t_{PHL}/t_{PLH} ns Typ	$t_{P(Control)}$ ns Typ
±0.2	±3.25	20/25	25

Differential Current Mode

DRIVERS

MC75110 – Dual; industry standard.

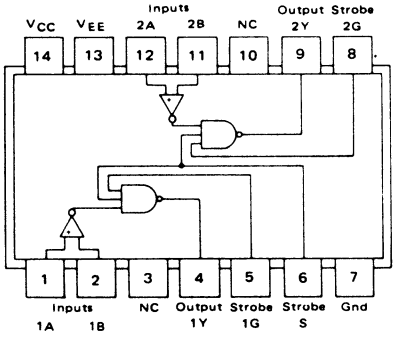


T_A = 0 to 70°C
(MC75xxx)
-55 to 125°C
(MC55xxx)

Packages:
L Suffix – Case 632
P Suffix – Case 646
(MC75xxx only)

RECEIVERS

MC75107/MC55107 – Dual; active pullup output.
MC75108/MC55108 – Dual; open collector output.

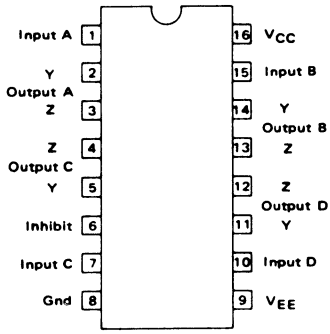


Line Drivers and Receivers for Modem/Terminal Applications (continued)

MC3453 – Quad; common inhibit input; current sink approximately 12 mA.

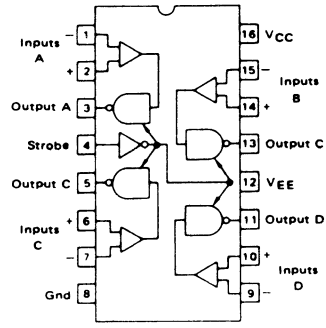
MC3450 – Quad; active pullup outputs; common three-state enable.

MC3452 – Quad; open collector outputs.



All three devices:
T_A = 0 to 70°C

Packages:
L Suffix – Case 620
P Suffix – Case 648



BOTH DRIVERS

I_O (on) mA Min	I_O (off) µA Max	t_{PHL} ns Max
6.5	100	15

ALL RECEIVERS

Input V_{TH} mV Max	I_{IH} @ V_{ID} = 0.5 V µA Max	I_{IL} @ V_{ID} = -2.0 V µA Max	t_{PLH} ns Max
±25	75	-10	25

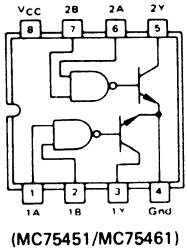
Peripheral Interface

Dual Drivers

. . . for relays, lamps, and other peripherals requiring more power than generally available from logic gates.

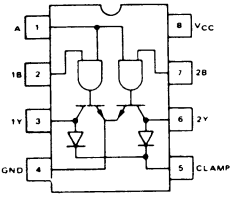
Representative Diagrams

MC754xx Series



(MC75451/MC75461)

MC147x Series



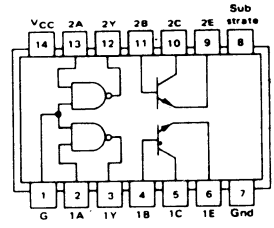
(MC1472)

Logic gates vary to provide output shown:

Logic Output (Including Transistor Inversion)	BV_{CER} 30 V	BV_{CER} 35 V	BV_{CER} 70 V Hi-Z Input
AND	MC75451	MC75461	MC1471#
NAND	MC75452	MC75462	MC1472
OR	MC75453	MC75463	MC1473#
NOR	MC75454	MC75464	MC1474#

#To be introduced.

MC75450 – Similar to MC75451, but with uncommitted output transistors.



All Devices
T_A = 0 to 70°C

Packaging:
MC75450
L Suffix – Case 632
P Suffix – Case 646
MC75451–54/MC75461–64
P Suffix – Case 626
U Suffix – Case 693
MC1471–74
P1 Suffix – Case 626
U Suffix – Case 693

Driver Arrays

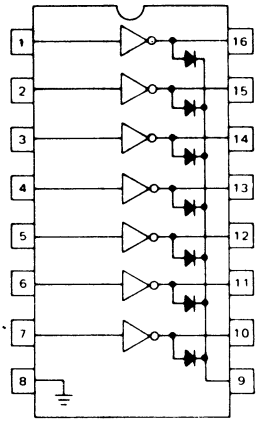
. . . Seven Darlington transistors with output clamp diodes.

Device Number	Application	Input Element
MC1411	General Purpose	Basic
MC1412	14 – 25 V PMOS	Zener and Series 10.5 kΩ resistor
MC1413	5 V CMOS or TTL	Series 2.7 kΩ resistor
MC1416	8 18 V MOS	Series 10.5 kΩ resistor

Higher Voltage Selection Available.

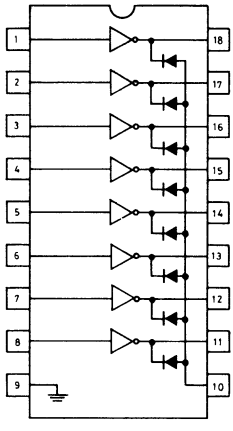
All Types:
V_{Max} = 50 V
I_{Max} = 500 mA
T_A = 0 to 85°C

Packages:
L Suffix – Case 620
P Suffix – Case 648



MC1417* – High voltage, high current 8 darlington transistor arrays.

The eight NPN Darlington connected transistors are intended for use as an interface between NMOS output and lamps, relays or printer hammers. Each driver shows on output stage capable of sourcing 250 mA.



T_A = 0 to 70 °C

Packages
L Suffix – Case 726
P_W Suffix – case 701

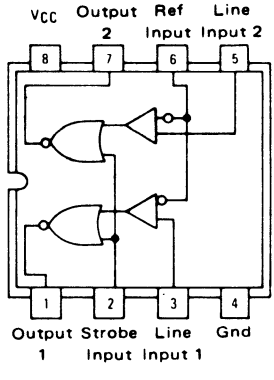
* To be introduced

Dual Receiver

MC75140P1 – Dual single-ended receiver with common strobe and reference inputs for maximizing noise immunity. Useful for bus-organized (party line) TTL systems.

V_{TH}	V_{Ref}	$t_{PLH(L)}$
±100 mV	1.5 to 3.5 V	35 ns

T_A = 0 to 70°C
Package – Case 626

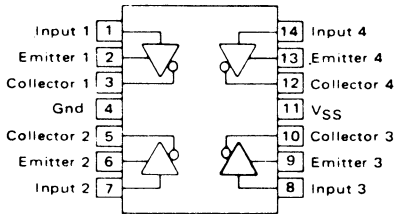


Numeric Display Interface

. . . for mating multiplexed LED or gas discharge numeric displays to MOS or TTL logic systems.

LED Drivers for Common-Cathode Displays

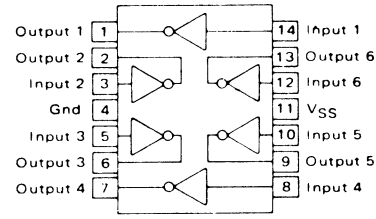
MC75491 – Quad segment driver



Both Devices:
T_A = 0 to 70°C

Packages:
L Suffix – Case 632
P Suffix – Case 646

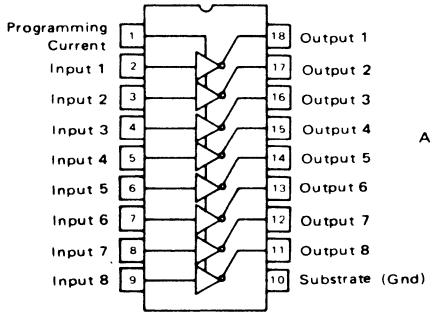
MC75492 – Hex digit driver



Device Number	I_I @ V_I = 10 V mA Max	V_{OL} Volts Max	@ I_{OL} mA	V_{SS} Volts Max
MC75491	3.3	1.2	250	10
MC75492	3.3	1.2	50	10

Gas Discharge Drivers

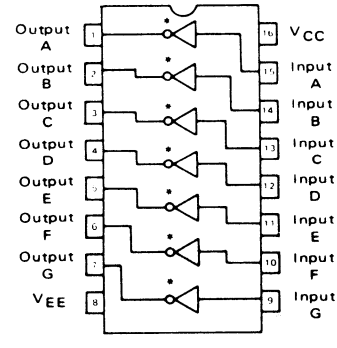
MC3491
MC3492 – Eight segment cathode drivers with programmable current.



All Devices:
T_A = 0 to 70°C

Package: P Suffix – Case 701

MC3490 – High Level
MC3494 – Low Level
Seven digit anode drivers



*Inverter on MC3494 only.
Package: P Suffix – Case 648

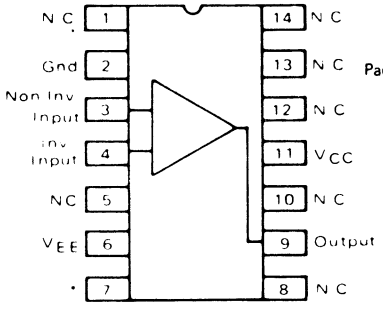
Device Number	Output ON Current mA Max	Breakdown Voltage Volts Min	Current Deviation (All 8 Outputs) % Max	Output Voltage Compliance Range Volts
MC3491	1.85	80	10	5.0 to 50
MC3492	5.25	80	10	5.0 to 50

Device Number	Breakdown Voltage Volts Min	Input Voltage (OFF-State) Volts	Input Voltage (ON-State) Volts	Input Current µA Max
MC3490	48	-5.0 Min	-2.0 Max	450
MC3494	48	-2.0 Max	-5.0 Min	-350

General Purpose Comparators

. . . for detecting the polarity relationship between two analog levels and giving a corresponding TTL output.

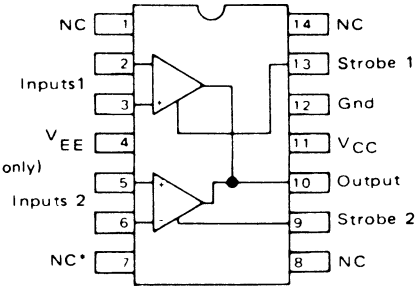
MC1710 – T_A = -55 to 125°C
MC1710C – T_A = 0 to 70°C
Single comparators



Packages:
G Suffix – Case 601
F Suffix – Case 606
L Suffix – Case 632
P Suffix – Case 646 (for MC1710C, MC1711C only)

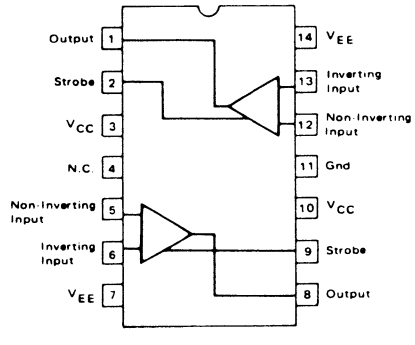
*Connected to pin 6 via the substrate on some plastic units.

MC1711 – T_A = -55 to 125°C
MC1711C – T_A = 0 to 70°C
Dual comparators with strobes and wire-ORed outputs



*Connected to pin 4 via the substrate on some plastic units.

MC1514 – T_A = -55 to 125°C
MC1414 – T_A = 0 to 70°C
Dual comparators with strobes.



Packages:
F Suffix – Case 607
L Suffix – Case 632
P Suffix – Case 646 (MC1414 only)

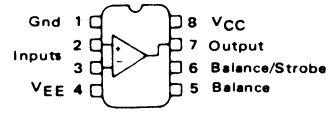
Device Number	V_{IO} mV Max	I_{IB} µA Max	A_{VOL} V/V Min
MC1710C	5.0	25	1000
MC1710	2.0	20	1250
MC1711C	5.0	100	700
MC1711	3.5	75	700
MC1514	2.0	20	1250
MC1414	5.0	25	1000

Precision Comparators

. . . featuring low input loading, high voltage gain, and a choice of either dual or single positive power supply operation.

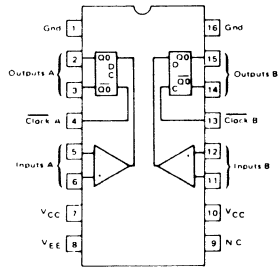
MLM111 – T_A = -55 to 125°C
MLM211 – T_A = -25 to 85°C
MLM311 – T_A = 0 to 70°C

Single comparators; high gain, high input impedance; strobe and balance inputs provided.



Packages:
G Suffix – Case 601
F Suffix – Case 606
L Suffix – Case 632
P1 Suffix – Case 626 (MLM311 only)

Device Number	V_{IO} mV Max	I_{IB} nA Max	V_{OL} @ I_{OL} = 50 mA Volts Max
MLM111	3.0	100	1.5
MLM211	3.0	100	1.5
MLM311	7.5	250	1.5



MC1650
MC1651

Ultra-High Speed Dual Comparators with Latches

-30 to 85°C

L Suffix – Case 620
F Suffix – Case 650

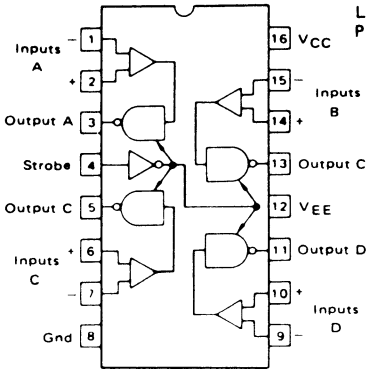
Device Number	V_{TH} mV Min.	Common Mode Range Volts Min.	t_{PD} (Differ. Inputs) ns Max.	t_{PD} (Clock) ns Max.
MC1650	±20	–2.5 to 3.0	5.0	4.7
MC1651	±20	–3.0 to 2.5	5.0	4.7

Quad Comparators . . . for applications requiring multiple comparators.

MC3430
MC3431
– High-speed quad comparators with three-state Enable common to all four devices; ±5 volt supply; T_A = 0 to 70°C.

MC3432
MC3433
– Quad comparators with open collector outputs, common strobe input; ±5 volt supply; T_A = 0 to 70°C.

Packages:
L Suffix – Case 620
P Suffix – Case 648



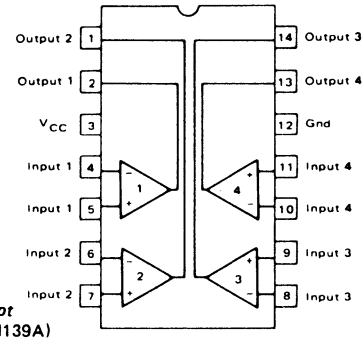
Device Number	V_{IS} mV Max	I_{IB} µA Max	t_{PHL} ns Max
MC3430	±6.0	20	45
MC3431	±10	20	45
MC3432	±6.0	20	50
MC3433	±10	20	50

MLM139
MLM139A
– T_A = -55 to 125°C

MC3302
MLM239
MLM239A
– T_A = -40 to 85°C

MLM339
MLM339A
– T_A = 0 to 70°C

Single supply voltage comparators.



Packages:
L Suffix – Case 632
P Suffix – Case 646 (For all devices *except* MLM139, MLM139A)

Device Number	V_{IO} @ 25°C mV Max	I_{IB} @ 25°C nA Max	I_{sink} @ V_{OL} = 500 mV mA Min	V_{OL} @ I_{OL} = 2.0 mA* @ I_{OL} = 4.0 mA mV Max
MC3302	20	1000	–	400*
MLM139	5.0	100	6.0	500
MLM139A	2.0	100	6.0	500
MLM239	5.0	250	6.0	500
MLM239A	2.0	250	6.0	500
MLM339	5.0	250	6.0	500
MLM339A	2.0	250	6.0	500

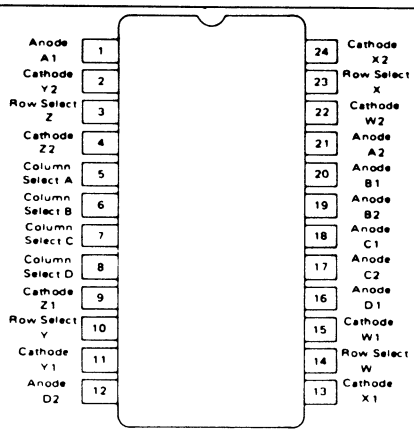
Crosspoint Switch

MC3416 – Low-cost solid-state crosspoint switch offers important advantages in modern telephone exchanges employing space-division switching. Features 4 x 4 two-wire monolithic structure for PABX applications. Select inputs are both CMOS and TTL compatible.

T_A = 0 to 70°C

Packages:
P Suffix – Case 649
L Suffix – Case 623

r_{off} @ V_{AK} = 10 V MΩ Min	r_{on} @ I_{AK} = 20 mA Ohms Max	BV_{AK} BV_{KA} Volts Min	V_{AK} @ I_{AK} = 20 mA Volts Max
100	10	25	1.1



Voice Encoding/ Decoding

Simplified voice encoding/decoding using continuous Variable Slope Delta Modulator (CVSD) technique.

MC3417 – 3-bit algorithm; for military secure communication applications.

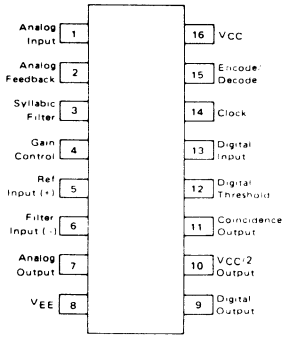
MC3418 – 4-bit algorithm; telephone quality.

T_A = 0 to 70°C*

Packages:
L Suffix – Case 620
P Suffix – Case 648

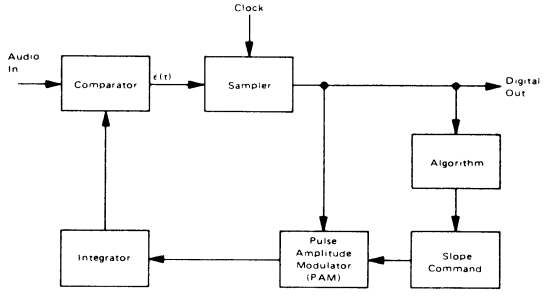
* Military temperature range devices (MC3517/18) to be offered later.

Device Number	Sample Rate Samples/s Typ	Total Loop Offset Voltage mV Max	t_{PD}, Clock Trigger to Output μs Max
MC3417	16 k	±5.0	2.5
MC3418	38 k	±2.0	2.5

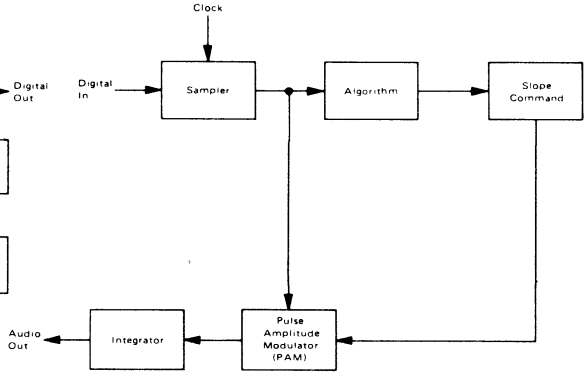


Block Diagrams

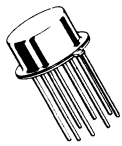
CVSD Encoder



CVSD Decoder

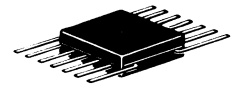


Interface circuits packages

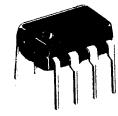


CASE 601
G Suffix
Metal Package

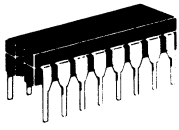
CASE 606
F Suffix
Ceramic Package



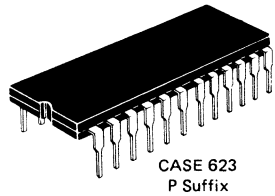
CASE 607
F Suffix
Ceramic Package



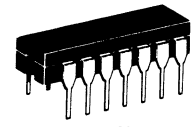
CASE 626
P Suffix
Plastic Package



CASE 620
L Suffix
Ceramic Package



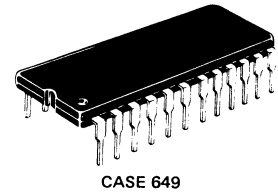
CASE 623
P Suffix
Plastic Package



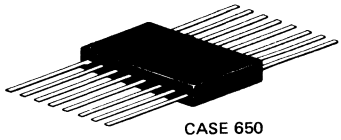
CASE 632
L Suffix
Ceramic Package

CASE 646
P Suffix
Plastic Package

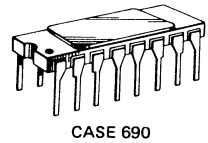
CASE 648
P Suffix
Plastic Package



CASE 649
P Suffix
Plastic Package

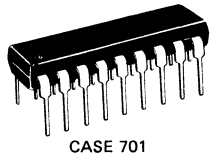


CASE 650
F Suffix
Ceramic Package

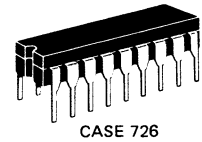


CASE 690
L Suffix
Ceramic Package

CASE 693
U Suffix
Ceramic Package



CASE 701
P Suffix
Plastic Package



CASE 726
L Suffix
Ceramic Package

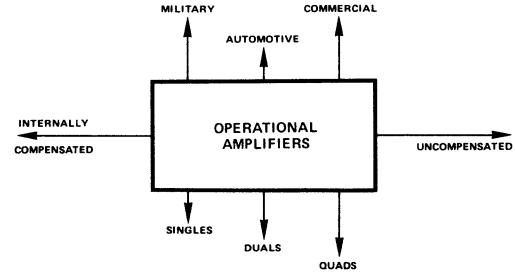
LINEAR INTEGRATED CIRCUITS

Starting with the now all pervasive operational amplifier, linear integrated circuit technology currently influences the design and architecture of equipment for all major markets. Amplifiers? Of coursel But that's only a starting point. Linear circuits have taken the erstwhile expensive and exclusive voltage regulator and turned it into a commodity item for all electronic equipment. They have reduced the myriad of discrete parts formerly involved in consumer products to just a handful of IC packages and they've brought electronic capabilities a giant step closer to widespread use by mass markets.

TABLE OF CONTENTS

Operational Amplifiers

Motorola offers a broad line of operational amplifiers to meet a wide range of usages. From lowcost, industry standard types to high precision circuits the span encompasses a large range of perforamnce capabilities. These linear integrated circuits are available as single, dual, and quad monolithic devices in a variety of package styles as well as standard and chips. The following guide is designed to highlight those Motorola operational amplifiers which we recommend as preferred types.



SINGLE OPERATIONAL AMPLIFIERS

INTERNALLY COMPENSATED

Device	Description	I_{IB} μA max.	V_{IO} mV max.	TC_{VIO} μV/°C typ.	I_{IO} nA max.	A_{vol} V/V min.	BW(Av=1) MHz typ.	SR(Av=1) V/μs typ.	Supply V min. typ.	Voltage V max. typ.	Packages
Military Temperature Range (−55 °C to +125 °C)											
MC1536	High Voltage Op Amp	0.02	5	10	3	100K	1	2.0	±15	±40	601, 693
MC1556	High Performance Op Amp	0.015	4	10	2	100K	1	2.5	±3	±22	601, 632, 693
MC1733	Differential Wideband Video Amp	20	–	–	3000	90	90	–	±4	±8	603, 632
MC1741	General Purpose Op Amp	0.5	5	15	200	50K	1	0.5	±3	±22	601, 606, 632, 693
MC1741S	High Slew Rate Op Amp	0.5	5	15	200	50K	1	10	±3	±22	601, 632, 693
MC1741N	Low Noise Op Amp	0.5	5	15	200	50K	1	0.5	±3	±22	601, 632, 693
MC1776	μPower Programmable Op Amp	0.0075	5	15	3	200K	1	0.2	±15	±18	601
MLM107	General Purpose	0.075	2	10	10	50K	1	0.5	±3	±22	601, 693
MLM110	Unity Gain Op Amp	0.003	4	12	–	Unity	20	30	±3	±18	601, 693
LF155A	FET Input Op Amp	50 pA	2	3	10 pA	50K	2.5	5	±5	±22	601, 693
LF155	FET Input Op Amp	100 pA	5	5	20 pA	50K	2.5	5	±5	±22	601, 693
LF156A	FET Input Op Amp	50 pA	2	3	10 pA	50K	5	12	±5	±22	601, 693
LF156	FET Input Op Amp	100 pA	5	5	20 pA	50K	5	12	±5	±22	601, 693
LF157A	Wideband FET Input Op Amp	50 pA	2	3	10 pA	50K	20	50	±5	±22	601, 693
LF157	Wideband FET Input Op Amp	100 pA	5	5	20 pA	50K	20	50	±5	±22	601, 693
Industrial Temperature Range (−25 °C to +85 °C)											
MLM207	General Purpose Op Amp	0.075	2	10	10	50K	1	0.5	±3	±22	601, 693
MLM210	Unity Gain Op Amp	0.003	4	12	–	Unity	20	30	±3	±18	601
LF255	FET Input Op Amp	100 pA	5	5	20 pA	50K	2.5	12	±5	±22	601, 626, 693
LF256	FET Input Op Amp	100 pA	5	5	20 pA	50K	5	12	±5	±22	601, 626, 693
LF257	FET Input Op Amp	100 pA	5	5	20 pA	50K	20	12	±5	±22	601, 626, 693
Industrial Temperature Range (0°C to 70 °C)											
MC1436	High Voltage Op Amp	0.04	10	12	10	70K	1.0	2.0	±15	±34	601, 693
MC1436C	High Voltage Op Amp	0.09	12	14	25	50K	1.0	2.0	±15	±30	601, 693
MC1456	High Performance Op Amp	0.03	10	12	10	70K	1.0	2.5	±3	±18	601, 632, 693, 626
MC1456C	High Performance Op Amp	0.09	12	14	30	25K	1.0	2.5	±3	±18	601, 632, 693, 626
MC1733C	Differential Wideband Video Amp	30	–	–	5000	80	90	–	±4	±8	603, 632, 646
MC1741C	General Purpose Op Amp	0.5	6	15	200	20K	1.0	0.5	±3	±18	601, 632, 626 646, 693, 606
MC1741SC	High Slew Rate Op Amp	0.5	6	15	200	20K	1.0	10	±3	±18	601, 632, 626 646, 693
MC1741NC	Lo Noise Op Amp (20μV/peak max.)	0.5	6	15	200	20K	1.0	0.5	±3	±18	601, 632, 626, 693
MC1776C	μPower, Programmable Op Amp	0.003	6	15	3	100K	1.0	0.2	±1.5	±18	601, 626
MC3476	Low Cost μPower, Programmable Op Amp	0.05	6	15	25	50K	1.0	0.2	±1.5	±18	601, 626
MLM307	General Purpose Op Amp	0.25	7.5	10	50	25K	1.0	0.5	±3	±18	601, 626, 693
MLM310	Unity Gain Op Amp	0.007	7.5	12	–	Unity	20	30	±3	±18	601, 626, 693
LF355A	FET Input Op Amp	50 pA	2	3	10 pA	50K	2.5	5	±5	±18	601, 626, 693
LF355B	FET Input Op Amp	100 pA	5	5	20 pA	50K	2.5	12	±5	±22	601, 626, 693
LF355	FET Input Op Amp	200 pA	10	5	50 pA	25K	2.5	5	±5	±18	601, 626, 693
LF356A	FET Input Op Amp	50 pA	2	3	10 pA	50K	5.0	12	±5	±18	601, 626, 693
LF356B	FET Input Op Amp	100 pA	5	5	20 pA	50K	5.0	12	±5	±22	601, 626, 693
LF356	FET Input Op Amp	200 pA	10	5	50 pA	25K	5.0	12	±5	±18	601, 626, 693
LF357A	Wideband FET Input Op Amp	50 pA	2	3	10 pA	50K	20	50	±5	±18	601, 626, 693
LF357B	Wideband FET Input Op Amp	100 pA	5	5	20 pA	50K	5.0	50	±5	±22	601, 626, 693
LF357	Wideband FET Input Op Amp	200 pA	10	5	50 pA	25K	3.0	50	±5	±18	601, 626, 693

NONCOMPENSATED

Device	Description	I_{IB} μA max.	V_{IO} mV max.	TC_{VIO} μV/°C typ.	I_{IO} nA max.	A_{vol} V/V min.	BW(Av=1) MHz typ.	SR(Av=1) V/μs typ.	Supply V min. typ.	Voltage V max. typ.	Packages
Military Temperature Range (−55 °C to +125 °C)											
MC1539	High Slew Rate Op Amp	0.5	3	15	60	50K	2	4.2	±4	±18	601, 632
MC1709A	High Performance MC1709	0.6	3	5	100	25K	1	0.5	±3	±18	601, 606, 632
MC1709	General Purpose Op Amp	0.5	5	15	200	25K	1	0.3	±3	±18	601, 606, 632, 693
MC1712	Wideband Op Amp	3.5	2	3	500	2K	7	0.5	±3	±18	601, 606, 632
MC1748	General Purpose Op Amp	0.5	5	15	200	50K	1	0.5	±3	±22	601, 693
MLM101A	General Purpose Op Amp	0.075	2	10	10	50K	1	0.5	±3	±22	601, 693
MLM108A	Precision Op Amp	0.002	0.5	1	0.2	80K	1	0.3	±3	±20	601, 606, 693
MLM108	Precision Op Amp	0.002	2	3	0.2	50K	1	0.3	±3	±20	601, 606, 693
Industrial Temperature Range (−25 °C to +85 °C)											
MLM201A	General Purpose Op Amp	0.075	2	10	10	50K	1	0.5	±3	±22	601, 693, 626
MLM208A	Precision Op Amp	0.002	0.5	1	0.2	80K	1	0.3	±3	±20	601, 693, 632
MLM208	Precision Op Amp	0.002	2	3	0.2	50K	1	0.3	±3	±20	601, 693, 632
Industrial Temperature Range (0 °C to +70 °C)											
MC1439	High Slew Rate Op Amp	1	7.5	15	100	15K	2	4.2	±6	±18	601, 626, 632, 646
MC1709C	General Purpose Op Amp	1.5	7.5	15	500	15K	1	0.3	±3	±18	601, 606, 626, 632
MC1712C	Wideband Op Amp	5	5	5	2000	2K	7	0.5	±3	±18	601, 606, 632, 646
MC1748C	General Purpose Op Amp	0.5	6	15	200	20K	1	0.5	±3	±18	601, 626, 693
MLM301A	General Purpose Op Amp	0.25	7.5	10	50	25K	1	0.5	±3	±18	601, 626, 693
MLM308A	Precision Op Amp	7	0.5	5	1	80K	1	0.3	±3	±18	601, 632, 626, 693
MLM308	Precision Op Amp	7	7.5	15	1	25K	1	0.3	±3	±18	601, 632, 626, 693

DUAL OPERATIONAL AMPLIFIERS

INTERNALLY COMPENSATED

Device	Description	I_{IB} μA max.	V_{IO} mV max.	TC_{VIO} μV/°C typ.	I_{IO} nA max.	A_{vol} V/V min.	BW(Av=1) MHz typ.	SR(Av=1) V/μs typ.	Supply V min. typ.	Voltage V max. typ.	Packages
Military Temperature Range (−55 °C to +125 °C)											
MC1558	Dual MC1741 Op Amp	0.5	5	10	200	50K	1.1	0.8	±3	±22	601, 632, 693
MC1558N	Dual Low Noise Op Amp	0.5	5	10	200	50K	1.1	0.8	±3	±22	601, 632, 693
MC1558S	High Slew Rate Dual Op Amp	0.5	5	10	200	50K	1	10	±3	±22	601, 632, 693
MC1747	Dual MC1741 Op Amp	0.5	5	10	200	50K	1	0.5	±3	±22	601, 632, 607
MC3558	Single Supply Dual Op Amp	0.5	5	10	50	50K	1	0.6	±1.5 +3	±18 +36	601, 693
MC4558	High Frequency Dual Op Amp	0.5	5	10	200	50K	4	1.5	±3	±22	601, 693
LM158	Single Supply Dual Op Amp (Low Power Consumption)	0.15	5	10	30	50K	1	0.6	±1.5 +3	±18 +36	601, 693
Industrial Temperature Range (−25 °C to +85 °C)											
LM258	Single Supply Dual Op Amp (Low Power Consumption)	0.25	6	7	50	25K	1	6	±1.5 +3	±18 +36	601, 626, 693
Automotive Temperature Range (−40 °C to +85 °C)											
MC3358	Single Supply Dual Op Amp	5	8	10	75	20K	1	0.6	±1.5 +3	±18 +36	626, 693
LM2904	Half of MLM2902	0.25	7	7	50	25K	1	0.6	±1.5 +3	±18 +36	601, 626, 693
Industrial Temperature Range (0 °C to +70 °C)											
MC1458	Dual MC1741 Op Amp	0.5	6	10	200	20K	1.1	0.8	±3	±18	601, 626, 632, 646, 693
MC1458C	Dual MC1741C Op Amp	0.7	10	12	300	20K	1.1	0.8	±3	±18	601, 693, 632, 626, 646
MC1458N	Dual Low Noise Op Amp	0.5	6	10	200	20K	1.1	0.8	±3	±18	601, 626, 632, 646, 693
MC1485S	High Slew Rate Dual Op Amp	0.5	6	10	200	20K	1	10	±3	±18	601, 626, 632, 646, 693
MC1747C	Dual MC1741 Op Amp	0.5	6	10	200	25K	1	0.5	±3	±18	603, 632, 646
MC3458	Single Supply Dual Op Amp (Low Crossover Distortion)	0.5	10	7	50	20K	1	0.6	±1.5 +3	±18 +36	601, 626, 693
MC4558C	Dual High Frequency Op Amp	0.5	6	10	200	20K	3	1.5	±3	±18	601, 626, 693
LM358	Single Supply Dual Op Amp (Low Power Consumption)	0.25	6	7	50	25K	1	0.6	±1.5 +3	±18 +36	601, 626, 693

NONCOMPENSATED

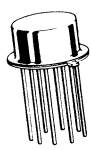
Device	Description	I_{IB} μA max.	V_{IO} mV max.	TC_{VIO} μV/°C typ.	I_{IO} nA max.	A_{vol} V/V min.	BW(Av=1) MHz typ.	SR(Av=1) V/μs typ.	Supply V min. typ.	Voltage V max. typ.	Packages
Military Temperature Range (−55 °C to +125 °C)											
MC1537	Dual MC1709 Op Amp	0.5	5	10	200	25K	1	0.25	±3	±18	632
Industrial Temperature Range (0 °C to 70 °C)											
MC1437	Dual MC1709 Op Amp	1.5	7.5	10	500	15K	1	0.25	±3	±18	632, 646

QUAD OPERATIONAL AMPLIFIERS

INTERNALLY COMPENSATED

Device	Description	I_{IB} μA max.	V_{IO} mV max.	TC_{VIO} μV/°C typ.	I_{IO} nA max.	A_{vol} V/V min.	BW(Av=1) MHz typ.	SR(Av=1) V/μs typ.	Supply V min. typ.	Voltage V max. typ.	Packages
Military Temperature Range (−55 °C to +125 °C)											
MC3503	Quad Op Amp	0.5	5	7	50	50K	1	0.6	±15 +3	±18 +36	632
MC3571*	Quad Active Filter Op Amp FET Input, High Frequency	200 pA	5	10	20 pA	50K	10	20	±3	±18	632
MC4741	Quad MC1741 Op Amp	0.5	5	15	200	50K	1	0.5	±3	±22	632
MLM124	Quad Op Amp (Low Power Consumption)	0.15	5	7	30	50K	1	0.6	±1.5 +3	±16 +32	632
LM148	Quad MC1741 Op Amp	0.10	5	15	25	50K	1	0.5	±3	±22	632
Industrial Temperature Range (−25 °C to +85 °C)											
MLM224	Quad Op Amp (Low Power Consumption)	0.15	5	7	30	50K	1	0.6	±1.5 +3	±16 +32	632, 646
LM248	Quad MC1741 Op Amp	0.20	6	15	50	25K	1	0.5	±3	±18	632, 646
Industrial Temperature Range (0 °C to 70 °C)											
MC3401	Low Cost Quad Op Amp	0.3	–	–	–	1K	5	0.6	±1.5 +3	±18 +36	632, 646
MC3403	Quad Op Amp (No Cross-over Distortion)	0.5	10	7	50	20K	1	0.6	±1.5 +3	±18 +36	632, 646
MC3471*	Quad Active Filter Op Amp FET Input, High Frequency	200 pA	6	10	20 pA	25K	10	20	±3	±18	632, 646
TCA3002	Quad Programmable Op Amp Low Power	0.1	5	10	10	10K	5	1.5	±1.5	±18	632, 646
MC4741C	Quad MC1741 Op Amp	0.5	6	15	200	20K	1	0.5	±3	±18	632, 646
MLM324	Quad Op Amp (Low Power Consumption)	0.25	6	7	50	25K	1	0.6	±1.5 +3	±16 +32	632, 646
LM348	Quad MC1741 Op Amp	0.20	6	15	50	25K	1	0.5	±3	±18	632, 646
Automotive Temperature Range (−40 °C to +85 °C)											
MC3303	Quad Diff. Op Amp	0.5	8	10	75	20K	1	0.6	±1.5 +3	±18 +36	632, 646
MLM2902	Quad Diff. Op Amp	0.5	10	–	50	–	1	0.6	±1.5 +3	±13 +26	646

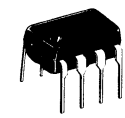
* To be introduced



CASE 601
Metal Package

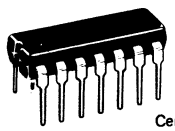
CASE 603
Metal Package

CASE 606
Ceramic Package

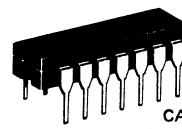


CASE 626
Plastic Package

CASE 607
Ceramic Package



CASE 632
Ceramic Package



CASE 646
Plastic Package

CASE 693
Ceramic Package

FIXED OUTPUT VOLTAGE REGULATORS

Low cost, monolithic circuits for positive and/or negative regulation at currents from 100 mA to 3 A. These circuits require no external add-on component, although an input capacitor should be used if the regulator is located an appreciable distance from the power supply filter, and an output capacitor could improve transient response They are ideal for on-card regulation of subsystems, affording possible economic advantages and performance improvement in applications where total system regulation is not required.

Most devices are available in metal and plastic packages. All employ internal current limiting, thermal shutdown and safe-area compensation — making them essentially blow-out proof. All are designed to operate over a 0 °C to 150 °C junction temperature range. (Consult the data sheets for more detailed specification.)

FIXED VOLTAGE, 3-TERMINAL REGULATORS FOR POSITIVE OR NEGATIVE POLARITY POWER SUPPLIES

Nominal Voltage	POSITIVE			NEGATIVE	
	MAXIMUM CURRENT			MAXIMUM CURRENT	
	1500 mA	500 mA	100 mA	1500 mA	100 mA
2	–	–	MC78L02AC	MC7902C	–
3	–	–	–	–	MC79L03C, AC
5	MC7805C	MC78M05C	MC78L05C, AC	MC7905C	MC79L05C, AC
5.2	–	–	–	MC7905.2C	–
6	MC7806C	MC78M06C	–	MC7906C	–
8	MC7808C	MC78M08C	MC78L08C, AC	MC7908C	–
12	MC7812C	MC78M12C	MC78L12C, AC	MC7912C	MC79L12C, AC
15	MC7815C	MC78M15C	MC78L15C, AC	MC7915C	MC79L15C, AC
18	MC7818C	MC78M18C	MC78L18C, AC	MC7918C	MC79L18C, AC
20	–	MC78M20C	–	–	–
24	MC7824C	MC78M24C	MC78L24C, AC	MC7924C	MC79L24C, AC
Voltage Tol.	C = ±5%	C = ±5%	C = ±10% C = ±5%	C = ±5%	C = ±10% C = ±5%
Package	TO-3, TO-220	TO-220, TO39	TO-92, TO-39	TO-220, TO-3	TO-92, TO-39

THE +5 VOLTS SERIES

Device Type	I_{out} (mA) Max.	V_{out} tol. (Volts)	V_{in} Min./Max.	Reg_{line} mV	Reg_{load} mV	$\Delta V_{out}/\Delta T$ mV/°C	Temp. Range T_J	Package
MC78L05C	100	±0.5	6.7/30	200	60	0.1	0 °C/+150 °C	TO-92, TO-39
MC78L05AC	100	±0.25	6.7/30	150	60	0.1	0 °C/+150 °C	TO-92, TO-39
MC78M05C	500	±0.25	7/35	100	100	0.1	0 °C/+150 °C	TO-220, TO-39
MC7805C	1500	±0.25	7/35	100	100	1.0	0 °C/+150 °C	TO-220, TO-3
MLM109	1500	±0.4	7/35	100	100	1.0	–55 °C/+150 °C	TO-3, TO-39
MLM209	1500	±0.4	7/35	100	100	1.0	–55 °C/+150 °C	TO-3, TO-39
MLM309	1500	±0.25	7/35	50	100	1.0	0 °C/+125 °C	TO-3
LM123*	3000	±0.3	7.5/20	25	100	1.0	–55 °C/+150 °C	TO-3
LM323*	3000	±0.2	7.5/20	25	100	1.0	0 °C/+125 °C	TO-3

* To be introduced

VARIABLE OUTPUT VOLTAGE REGULATORS

The regulators in the following tables can be tailored for any specific output voltage within the indicated ranges through the use of external resistors. The indicated output current is available directly from the device. Increased output current can usually be obtained through the use of external current – boosting circuits. All have internal provisions for current limiting, or are internally protected against excessive thermal or SOA overloads.

POSITIVE OUTPUT REGULATORS

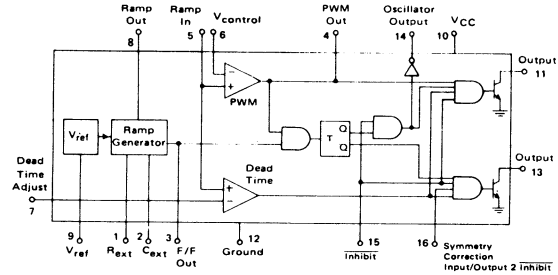
I_O mA Max	Device Type	SUFFIX	V_{out} Volts Min	V_{out} Volts Max	V_{in} Volts Min	V_{in} Volts Max	$V_{in} - V_{out}$ Differential Volts Max	P_D Watts Max T_A = 25 °C	P_D Watts Max T_C = 25 °C	Regulation % V_{out} @ T_A = 25 °C Typ Line	Regulation % V_{out} @ T_A = 25 °C Typ Load	TC V_{out} Typ % / °C	T_J = °C Max	Case
20	MLM305	G	4.5	40	8.5	50	3.0	0.4	1.3	0.06	0.1	0.007	85	601
	MLM205							0.68	1.6				100	
	MLM105			30					2.7				150	
150	MC1723	CP	2.0	37	9.5	40	3.0	0.66	–	0.1	0.3	0.003	150	646
		CG						0.8	2.1	0.1		0.003		603C
		G								0.2		0.002		
		CL						1.0	–	0.1		0.003	175	632
		L							–	0.2		0.002		
250	MC1469	G	2.5	32	9	35	3.0	0.68	1.8	0.03	0.13	0.002	150	603
	MC1569			37	8.5	40	2.7			0.015				
600	MC1469	R	2.5	32	9.0	35	3.0	3.0	14.0	0.03	0.05	0.002	150	614
	MC1569			37	8.5	40	2.7			0.015				
1500	LM317	T	1.2	37	5.0	40	3.0	Internally Limited		0.07	1.5	0.5	125	TO-220
	LM317	K, H												11, 79
	LM117	K, H								0.05	1.0		150	11,79

NEGATIVE OUTPUT REGULATORS

20	LM304	G	0.035	30	8.0	40	2.0	0.4	1.3	0.1	0.05	0.007	80	603
	LM204		0.015	40		50		0.68	1.6				100	
	LM104								2.7				150	
250	MC1463	G	3.8	32	9.0	35	3.0	0.68	1.8	0.03	0.05	0.002	150	603
	MC1563		3.6	33	8.5	40	2.7			0.015	0.13			
600	MC1463	R	3.8	34	9.0	35	3.0	2.4	9.0	0.03	0.05	0.002	175	614
	MC1463		3.6	37	8.5	40	2.7			0.015				

MC3520/3420 Switching Regulators

Used as the control circuit in PWM push pull, bridge and series type switchmode supplies. The device includes the reference oscillator, pulse width modulator, phase splitter and output sections frequency and duty cycle are indepently adjustable.



SWITCHING REGULATORS

I_O ±mA Max.	V_{CC} Volts Min.	V_{CC} Volts Max.	f_o kHz Min.	f_o kHz Max.	Device Number	SUFFIX	T_A °C	Case
40	10	30	2.0	100	MC3420	P	0 to +70	648
						L		620
					MC3520	L	−55 to +125	620

SPECIAL REGULATORS

FLOATING VOLTAGE AND CURRENT REGULATORS

Designed for laboratory type power supplies, these unique regulators can deliver hundreds of volts – limited only by the breakdown voltage of associated, external, series-pass transistors.

V_{out} Volts Min.	V_{out} Volts Max.	I_O mA Max.	Device Type	SUFFIX	V_{aux} Volts Min.	V_{aux} Volts Max.	P_D Watts Max.	$\Delta V_{ref}/V_{ref}$ % Line	$\Delta V_{ref}/V_{ref}$ % Load	$\Delta I_L/I_L$ % Max.	TCV_{out} %/°C Typ	Case
0	•	•	MC1466	L	21	30	0.75	0.015	0.015	0.2	0.01	632
			MC1566	L	20	35		0.004	0.004	0.1	0.006	

DUAL ±15 TRACKING REGULATORS

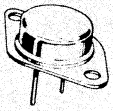
Dual polarity regulator designed to provide balanced positive and negative output voltages. Internally, the device is set for ±15 V, but an external adjustment can change both outputs simultaneously, from 8.0 V to 20 V.

V_{out} Volts Min.	V_{out} Volts Max.	I_O mA Max.	V_{in} Volts Min.	V_{in} Volts Max.	Device Type	SUFFIX	P_D Watts Max	Reg_{line} mV	Reg_{load} mV	TC %/°C (T_{low} to T_{high} Typ.	T_A °C	Case
14.8	15.2	±100	17	30	MC1468	G	0.8	10	10	3.0	0 to +75	603C
						L	1.0					632
						R	2.4					614
					MC1568	G	0.8				−55 to +125	603C
						L	1.0					632
						R	2.4					614

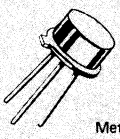
LOW TEMPERATURE DRIFT, LOW VOLTAGE REFERENCE

V_{out} Volts Type	I_O mA Max.	$\Delta V_{out}/\Delta T$ ppm/°C Max.	Device Type	SUFFIX	Reg_{line} (7.0 V ≤ V_I ≤ 30 V) Max.	Reg_{line} (4.5 V ≤ V_{in} ≤ 7.0 V) Max.	Reg_{load} (1.0 mA < I_O < 11 mA) mA Max.	T_A °C	Case
2.5 ± 25 mV	10	40	MC1403	U	6.0	3.0	10	0 to +70	693
		25	MC1403A						
		55	MC1503	U				−55 to +125	693
		25	MC1503A						

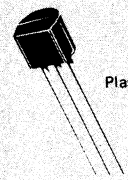
Voltage regulators packages



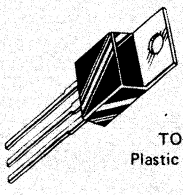
TO-3
Metal Package



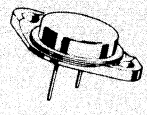
TO-39
Metal Package



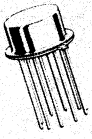
TO-92
Plastic Package



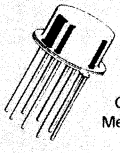
TO-220
Plastic Package



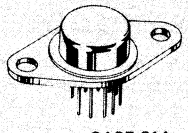
CASE 11
Metal Package



CASE 603
Metal Package

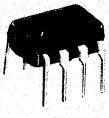


CASE 601
Metal Package

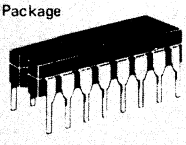


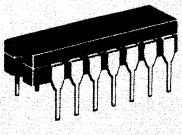
CASE 614
Metal Package

CASE 626
Plastic Package



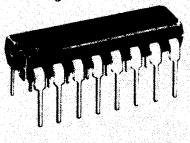
CASE 620
Ceramic Package

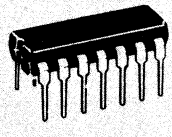




CASE 632
Ceramic Package

CASE 648
Plastic Package





CASE 646
Plastic Package

CASE 693
Ceramic Package

High Frequency Amplifiers

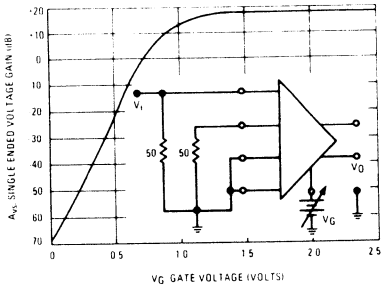
A variety of high-frequency circuits with features ranging from low-cost simplicity to multi-function versatility marks Motorola's line of integrated RF/IF amplifiers. Devices described here are intended for industrial and communications applications.

AGC AMPLIFIERS

MC1545/MC1445 – Gated 2-Channel Input

Differential input and output amplifier with gated 2-channel input for a wide variety of switching purposes. Typical 75 MHz bandwidth makes it suitable for high-frequency applications such as video switching, FSK circuits, multiplexers, etc. Gating circuit is useful for AGC control. See Application Notes AN-475 and AN-491 for design details.

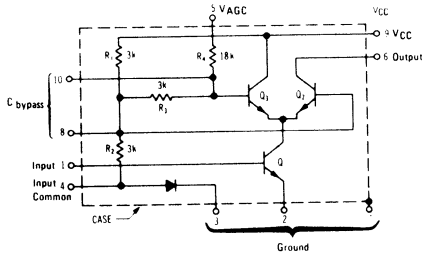
GATE CHARACTERISTICS



MC1550 – Low Cost Building Block

Single-stage cascade connected amplifier with delayed AGC characteristics, for operation at frequencies to 100 MHz. Has typical power gain of 25 dB @ 60 MHz. See Application Notes AN-215A, AN-247A and AN-299 for design details.

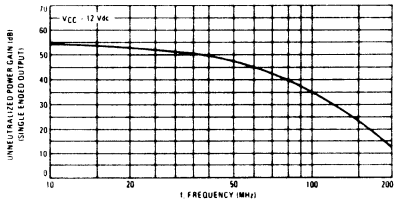
CIRCUIT SCHEMATIC



MC1590 – Wide-Band General Purpose

Has differential inputs and outputs with unneutralized power gain as high as 35 dB typical at 100 MHz in tuned amplifier serivce. Effective AGC voltage range from 5 to 7 volts for a 30 dB gain reduction. See Application Note AN-513 for design details.

UNNEUTRALIZED POWER GAIN versus FREQUENCY (Tuned Amplifier)



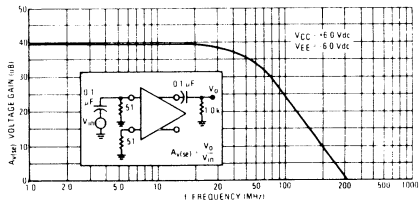
AGC AMPLIFIERS ELECTRICAL SPECIFICATIONS

Operating Temperature Range		A_V	Bandwidth	V_{CC}/V_{EE}		
−55 to +125 °C	0 to +75 °C	dB	MHz	Vdc	Case	Special Features
MC1550	—	22 Min	22	+6/-	603B	Low-Cost
MC1590	—	44 Typ @ 10 4 Typ @ 100		+12/-	601	Characterized as Video Amplifier and as High Frequency Tuned Amplifier
MC1545	MC1445	19 Typ @ 75		+5/−5	602A, 632	Gate Controlled 2-Channel Input

MC1510/MC1410 – General-Purpose Amplifier

Differential amplifier with flat response to 40 MHz. Provides excellent performance and simple design for most video and communications purposes.

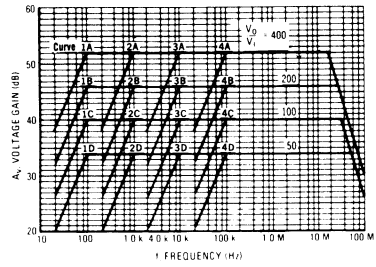
VOLTAGE GAIN versus FREQUENCY



MC1552/MC1553 – Low Distortion Amplifier

Extremely high performance amplifier with internal series feedback for stable voltage gain and low distortion. Temperature compensation stabilizes operating point. Has selectable gain option and well characterized data that permits accurate response shaping (see graph). Useful for critical applications such as wideband linear amplifiers or fast-rise pulse amplifiers.

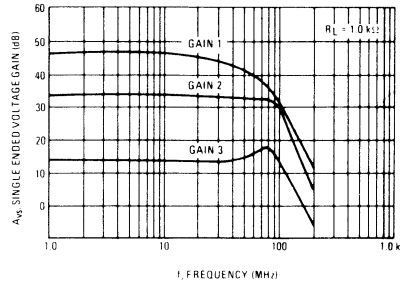
FREQUENCY RESPONSE



MC1733/MC1733C – Utility Amplifier

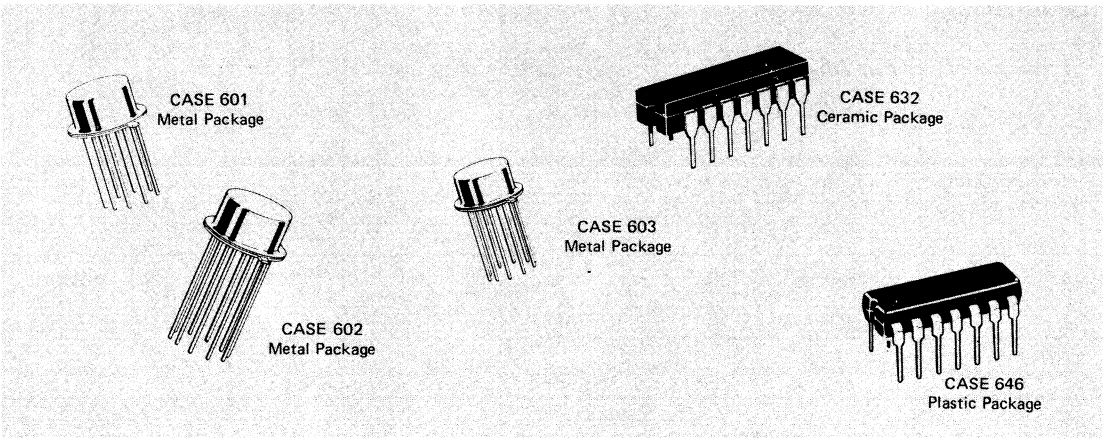
Differential input and output amplifier provides three fixed gain options with bandwidth to 120 MHz. External resistor permits any gain setting from 10 to 400 V/V. Extremely fast rise time (2.5 ns typ) and propagation delay time (3.6 ns typ) makes this unit particularly useful as pulse amplifier in tape, drum, or disc memory read applications.

GAIN versus FREQUENCY



SE/NE592 – Differential two stage video amplifiers. A monolythic, two state differential output, wideband video amplifier. It offers fixed gain of 100 and 400 without external components and adjustable gains from 400 to 0 with one external resistor. The input stage has been designed so that with the addition of a few external reactive elements between the gain select terminals, the circuit can function as a high pass, low pass or band pass filter. This feature makes the circuit ideal for use as a video or pulse amplifier in communications, magnetics memories, display and video recorder systems.

Operating Temperature Range		A_V		Bandwidth	V_{CC}/V_{EE}		
–55 to +125 °C	0 to +75 °C	dB		MHz	Vdc	Case	Special Features
MC1733	MC1733C	52	@	40	+6/–6	603, 632	3-Fixed Gain Options. Fast Rise
		40		90		646	Time and Propagation
		20		120			
MC1510	MC1410	40		40	+6/–6	601	
MC1553		46	@	35	+6/–6	603B	High and Low Gain Versions of
		52		15			precision amplifier with
MC1552		34	@	40	+6/–6	603B	distortion as low as 0.2% at 200 KHz.
		40	@	35			
SE592	NE592	55	@	40	+6/–6	603, 632	120 MHz bandwith pin compatible
		45	@	90			with the MC1733



Special Purpose Circuits

The linear-integrated-circuits listed in this section were developed bz Motorola for the system design engineer to fill special-purpose requirements as indicated by the subheadings. Temperature ranges and package availability are also tailored to provide versatility.

MULTIPLIERS

Function	Linearity Error Typ.	Input Voltage Range Vdc min.	Case	Type −55 to +125 °C	Type 0 to +70 °C
A Four-quadrant multiplier designed to operate with ±15 volt suppliers; has internal level-shift circuitry and voltage regulator.	±0.3%	±10	620	MC1594	
	±0.5%	±10	620		MC1494
Applications include multiply, devide, square root, mean square, phase detector, frequency doubler, balanced modulator/demodulator, electronic gain control.	X Input = 0.5% Y Input = 1.0%	±10	632	MC1595	
	X Input = 1.0% Y Input = 2.0%	±10	632		MC1495

BALANCED MODULATOR/DEMODULATOR

Function	Carrier Suppression dB @ f Typ.	MHz	Common Mode Rejection dB Typ.	Case	Type −55 to +125 °C	Type 0 to +75 °C
Balanced modulator designed for use where the output voltage is a product of an input voltage (signal and a switching function (carrier).	65	0.5	85	603, 632	MC1596	
	50	10		603, 632, 646		MC1496

LOW-FREQUENCY CIRCUITS

Function	Output Power W Typ.	Voltage Gain — Typ. V/V Typ.	Total Harmonic Distortion % Typ.	Case	Type −55 to +125 °C	Type 0 to +70 °C
A power amplifier device capable of single or split supply operation.	1.0	10, 18, 36	0.4	603B	MC1554	MC1454

TIMING CIRCUITS

Function	Supply Voltage V_{CC} Vdc – Max.	Initial Timing Error V_{CC} = 5 & 15 V C = 0.1 μF % Typ.	V_{OL} V_{CC} = 15 V I_{sink} = 50 mA Vdc – Max.	V_{OL} V_{CC} = 15 V I_{source} = 100 mA Vdc – Min.	Case	Type –55 to +125 °C	Type 0 to +75 °C
Wide range adjustable timers	16	1.0	0.75	12.75	601, 626, 693		MC1455
	18	0.5	0.5	13	601, 693	MC1555	
Dual Adjustable Timers	16	2.25	0.75	12.75	632, 646		MC3456
	18	1.5	0.5	13	632	MC3556	
Adjustable Timer with externally adjustable threshold level	16	1.0	1.0	12.75	626		MC1422

POWER CIRCUITS

Function	Temperature	Case	Type
Power Amplifier capable of ±300 mA driving	–55 to +125 °C	614	MC1538R
Typical Current gain of 3000	0 to +75 °C	614	MC1438R

POWER CONTROL CIRCUITS

Function	Temperature	Case	Type
Zero Voltage switch with output drive capable of triggering SCR's or triacs, for ON-OFF power control. Includes hysteresis voltage regulator and fail/safe amplifier.	–20 to +75 °C –55 to +125 °C	626 601	UAA1004DP UAA1004CM
Same as UAA1004: programmable hysteresis; external gain adjustment for the differential amplifier used as control error amplifier.	–20 to +75 °C –55 to +125 °C	648 620	UAA1006DP UAA1006DC

MC3422 – Current Limiter

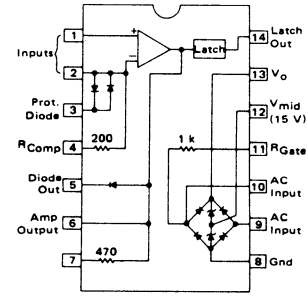
Intended to protect sensitive circuitry from excessive current flow this current limiter appears as a low impedance path with approximately 4.5 V drop until a current level of 225 mA is reached. At this point, the unit goes into a constant current mode preventing an increase in load current and protecting the loads.

MC3422 T (0 °C to 70 °C) Case TO-220
MC3422 R (0 °C to 70 °C) Case 80

MC3426 – Ground Fault Interrupter Circuit (latching)

This circuit provides ground fault and grounded neutral protection for AC lines. Useful in wall sockets and circuit breaker applications.
- trip times in accordance with UL
- high noise immunity
- resistance to false tripping
- minimum trip leakage current 5 mA ±1 mA
- trips for neutral GND
- resistance <2 Ω

PIN CONNECTIONS



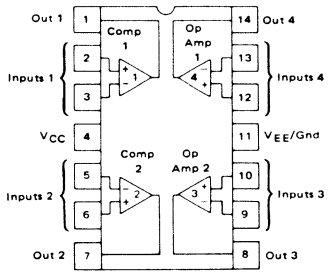
MC3426L (0 °C to 70 °C) Case 632

MC3505/3405 – Monolithic Dual Op Amp and Dual Comparator

This device contains two differential input operational amplifiers and two comparators each set capable of single supply operation. This op amp, comp circuit will find its applications as a general purpose product for automotive circuits and as an industrial building block.

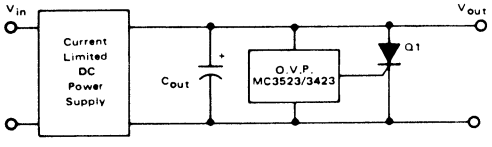
- op amp equivalent in performance to MC3403
- comparator similar in performance to MLM339
- op amps are internaly frequency compensated
- supply operation 3.0 V to 36 Volts
- dual supply operation also available.

PIN CONNECTIONS



MC3505 L (–55 °C to +125 °C) Case 632
MC3405 L (0 °C to +70 °C) Case 632
MC3405 P (0 °C to +70 °C) Case 646

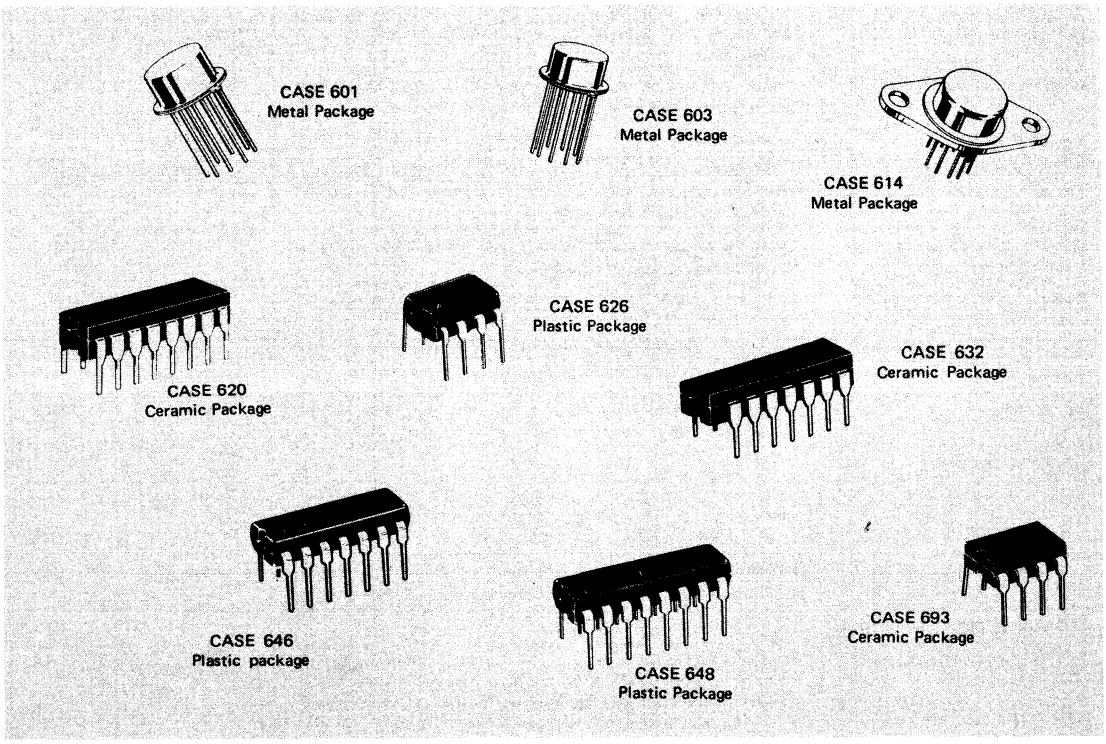
TYPICAL APPLICATION



MC3523 U (–55 °C to +125 °C) Case 693
MC3423 U (0 °C to +70 °C) Case 693
MC3423 P1 (0 °C to +70 °C) Case 626

MC3523/3423 – Overvoltage Protection Circuit

This overvoltage protection circuit protects sensitive electronic circuitry from overvoltage transients or regulator failure. it senses the overvoltage condition and quickly "crowbars" or short circuits the supply, forcing supply current limiting or opening the fuse or circuit breaker.



Circuits for Consumer Applications

. . . reflecting Motorola's continuing commitment to semiconductor products necessary for consumer system designs. This tabulation is arranged to simplify first-order selection of consumer integrated circuit devices that satisfy the primary functions for Television. Audio, Radio, Citizens Band, Automotive and Organ applications.

TELEVISION CIRCUITS

SOUND

Function	Features	Case	Type
Sound IF, detector, limiter	30 μV, 3 dB limiting at 5.5 MHz, 1 V (RMS) output, AM rejection 45 dB min. improved DC volume control.	646	TBA120C
Sound IF, detector, limiter	Same as TBA120C, but pin compatible with TBA120.	646	TBA120D
Sound IF, detector, limiter	Same as TBA120C, but additional audio input and constant audio output for connection of VTR or headphones available.	646	TBA120U
Complete sound system	4.0 Watt sound circuit includes IF limiting, IF amplifier, low pass filter, FM detector, DC volume control, audio preamplifier and audio power amplifier.	722A	TDA1190Z

VIDEO

1st and 2nd video IF amplifier	IF gain @ 45 MHz = 60 dB typ, AGC range = 70 dB min.	626	MC1349P
1st and 2nd video IF, AGC keyer and amplifier	IF gain @ 45 MHz = 53 dB typ, AGC range = 65 dB min, "Forward AGC" provided for tuner.	646	MC1352P
3rd IF, video detector, video buffer, and	Low-level detection, low harmonic generation, zero signal dc output voltage of 7.0 to 8.2 V.	626	MC1330A1P
AFC buffer	Same as MC1330A1 except zero signal dc output voltage of 7.8 to 9.0 V.	626	MC1330A2P

CHROMA

Dual chrome demodulator	Dual doubly balance demodulator with RGB output matrix and PAL switch.	646	MC1327AP
Chrominance PAL control	Internal supply line stabilization 20 dB AGC range. Designed to be used in conjunction with TBA396 and MC1327AP.	646	TBA395
Luminance and chrominance PAL control	DC control of brightness, contrast and saturation. Beam current limiting. Black level clamping.	646	TBA396
PAL chrome processing system	Internal supply stabilization, 30 dB AGC range. ±400 MHz min. oscillator pull in, 2 Vpp output	646	TDA3950A
Clamped chrominance demodulator and PAL switch	12 V operation, clamped RGB outputs, three RGB on-screen display inputs, accepts clamping pulse.	701	TDA3270
Luminance and chrominance control combination	12 V operation, video blanking for on-screen display, positive or negative brightness control. 0 – 5 V user control operation accepts clamping pulses.	701	TDA3960

DEFLECTION

Horizontal processor	Includes line oscillator, noise gated sync. separator, phase comparator loop gain and time constant switching.	648	TBA920, S

REMOTE CONTROL

Diode matrix encoder	Provides a 16 lines to 4 bit binary encoding for general purpose applications. Suitable to be used with the remote control receiver MC6525 series.	648	SAA1006
Low power FM/IF	Includes oscillator, mixer, limiting amplifier, quadrature discriminator, active filter, quelch, scan control and mute switch.	648	MC3357

TUNING MEMORY SYSTEM

Tuning system linear processor	Provides the interfacing between the digital section of the tuning memory and the TV set. In addition supplies the necessary fonctions and stabilized voltages for operating the complete system (used in conjunction with the MC14425 series).	724	UAA1008A

AUDIO CIRCUITS

PREAMPLIFIERS

Function	Features	Case	Type
Dual preamplifier	Dual internally compensated op amp with short circuit protection and low power consumption (power supply ±18 V max.)	626 646	MC1458C
Dual preamplifier	Same as MC1458 but with a low noise selection (20 μV peak max.)	626 646	MC1458N
Dual preamplifier	Same as MC1458 but with a high slew rate (10 V/μs min.)	626 646	MC1458S

AMPLIFIER

Power amplifier	8 Watt output power with internal thermal overload protection, internal short circuit, current limiting, supply overvoltage protection, wide supply voltage range (8-18 Volts).	314A,B	TDA2002

RADIO CIRCUITS

IF AMPLIFIERS

Function	Features	Case	Type
Sound IF, detector, limiter	30 μV, 3 dB limiting at 5.5 MHz, 1 V (RMS) output AM rejection 45 dB min. Improved DC volume control.	646	TBA120C
Sound IF, detector, limiter	Same as TBA120C but pin compatible with TBA120.	646	TBA120D
Sound IF, detector, limiter	Same as TBA120C but additional audio input and constant audio output for connection of VTR and headphones available.	646	TBA120U

DECODERS

FM multiplex stereo decoder	40 dB channel separation, 0.3% distortion.	646	MC1310P
FM multiplex stereo decoder	5 dB gain, 8 to 16 V supply, 0.3% distortion max., low input impedance 4.5 dB rejection of 57 KHz, 50 dB rejection of 114 KHz, no inductors needed, 40 dB min. channel separation.	648	TCA4500A
Four channel SQ* decoder	45 dB channel separation, 0.1% distortion.	646	MC1312P
Four channel SQ* gain and balance control	Master volume control LF/RF LB/RB, R/B balance control.	648	MC1314P
Four channel SQ* logic circuit	Interface with MC1314 and MC1315 to increase F/B separation and supply gain and balance control to MC1314.	648	MC1315P

* Trademark of CBS Inc.

TRANSCEIVER CIRCUIT

Function	Features	Case	Type
Low power narrow band FM/IF	Includes oscillator, mixer, limiting amplifier, quadrature discriminator, active filter, quelch, scan control and mute switch.	648	MC3357

ORGAN CIRCUITS

ATTENUATOR

Function	V_{CC} Range Vdc	THD %Typ	A_V dB Typ	Attenuation Range dB Typ	Case	Type
Electronic Attenuator	9.0 to 18	0.6	13	90	626	MC3340

TRANSISTOR ARRAYS

GENERAL PURPOSE

Function	I_C (max) mA	V_{CEO} Volts Max.	V_{CBO} Volts Max.	V_{EBO} Volts Max.	Case	Type
One Differentially Connected Pair and Three Isolated Transistor (CA3046)	50	15	20	5.0	646	MC3346 MC3386
Two Independant Differential Amplifiers with Associated Constant Current Transistors	50	15	20	5.0	646	CA3054

SPECIAL FUNCTIONS

Function	Features	Case	Type
Emitter-Coupled Astable Multivibrator	Useful as DC-DC Converter, Power Regulator or Multivibrator Toggle Freq. = 100 KHz (typ.)	626	MC3380
Phase-Locked Loop	Contains Voltage Controlled Oscillator and Double Balanced Phase Detector (500 KHz)	646	MLM565C
Programmable Frequency Switch	Wide Input Frequency Range (10 Hz to 100 KHz) Adjustable Hysteresis Wide Supply Operating Range (7 to 24 V)	646, 632	MC3344

AUTOMOTIVE CIRCUITS

COMPARATORS

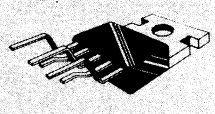
Function	V_{CC} Range Vdc	V_{IO} mV Max.	I_{IO} nA Max.	I_{IB} nA Max.	Sink Current mA Typ.	Case	Type
Quad Comparator	2.0–28	±20		500	6.0	646, 632	MC3302
		±7.0				646	MLM2901
	2.0–36	±5.0	±50	250	16.0	646, 632	MLM239
		±2.0				646, 632	MLM239A

VOLTAGE REGULATOR

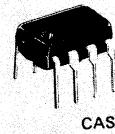
Function	Features	Case	Type
Automotive Voltage Regulator	Designed for use with NPN Darlington; Overvoltage Protection: "Open Sense" Shut Down; Selectable temperature Coefficient	646	MC3325

ELECTRONIC IGNITION

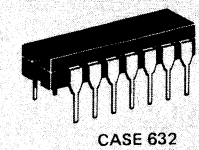
Function	Features	Case	Type
Electronic Ignition Circuit	Designed for use in High Energy-Variable Dwell Electronic Ignition Systems with Variable Reluctance Sensors. Dwell and Spark Energy Are Externally Adjustable.	646	MC3333



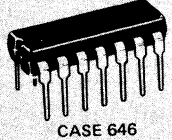
CASE 314A, B
Plastic Package



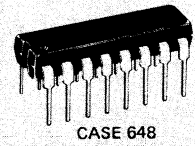
CASE 626
Plastic Package



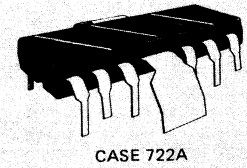
CASE 632
Ceramic Package



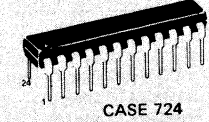
CASE 646
Plastic Package



CASE 648
Plastic Package



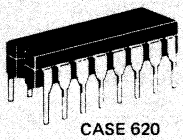
CASE 722A
Plastic Package



CASE 724
Plastic Package

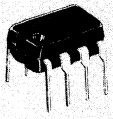
PHASE-LOCKED LOOP

CASE 607
Plastic Package

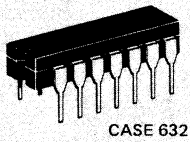


CASE 620
Ceramic Package

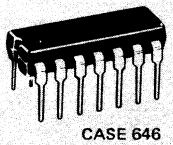
Motorola offers the designer a choice of specially designed integrated circuits for performing phase-locked loop functions: phase detection, frequency division, filtering, and voltage-controlled signal generation. In addition, the choice of circuits permits the designer to select TTL circuits where speed is not critical (<25 MHZ), or ECL circuits where high speed is required. The MC12000 series circuits will operate at either −5.0 V or −5.2 V, and translators are included where needed so that all functions are compatible.



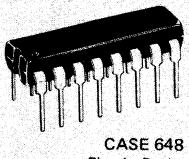
CASE 626
Plastic Package



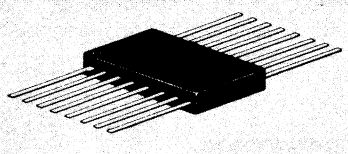
CASE 632
Ceramic Package



CASE 646
Plastic Package



CASE 648
Plastic Package



Logic Products for Phase-Locked Loop Applications

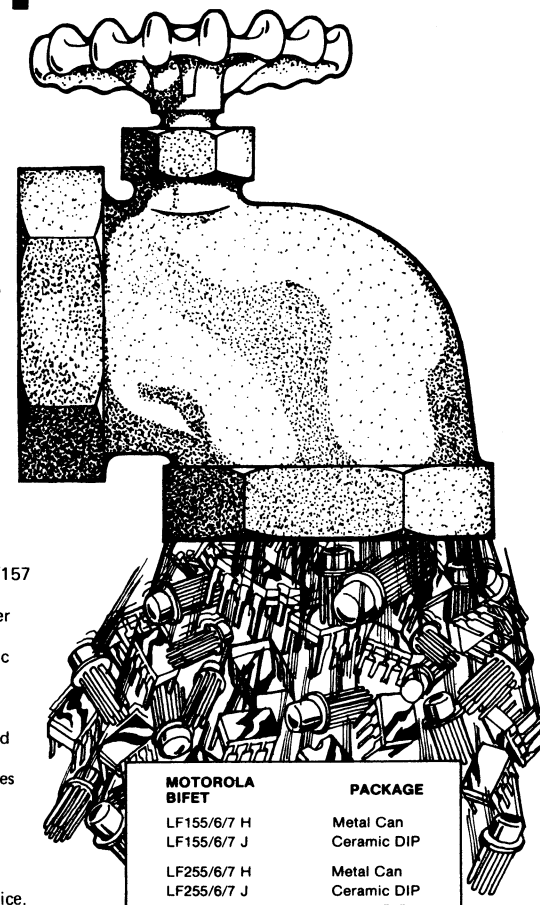
FUNCTIONS AND CHARACTERISTICS

	Temperature Range			Family	Frequency (MHz (typ.)	Power Dissip. mW (typ./pkg.)	Case
	0 to 75 °C	−30 to +85 °C	−55 to +125 °C				
Voltage Controlled Oscillator		MC1648	MC1648M	MECL	225	150	607, 632, 646
Voltage Controlled Multivibrator		MC1658		MECL	150	125	620, 648, 650
÷4 Prescaler (Low Cost)	MC1697			MECL	1200	320	626
÷4 Prescaler		MC1699		MECL	1200	320	620, 650
Dual Voltage Controlled Multivibrator	MC4024		MC4324	MTTL	30	150	607, 632, 646
Programmable ÷ N Decade (÷0-9)	MC4016		MC4316	MTTL	10	250	620, 648, 650
Two programmable ÷ N (÷0-1, ÷0-4)	MC4017		MC4317	MTTL	10	250	620, 648, 650
Programmable ÷ N Hexadecimal (÷0-15)	MC4018		MC4318	MTTL	10	250	620, 648, 650
Two programmable ÷ N (÷0-3, ÷0-3)	MC4019		MC4319	MTTL	10	250	620, 648, 650
Universal (÷2-12 except 7 and 11)	MC4023		MC4323	MTTL	30	200	632, 646, 607
Phase Frequency Detector	MC4044		MC4344	MTTL	8	85	607, 632, 646
Digital Mixer/Translator	MC12000			MECL	250	425	632, 646
Analog Mixer		MC12002	MC12502	MECL	300	60	632, 646
2-Modulus Prescaler (÷5, ÷6)		MC12009	MC12509	MECL	500	310	TBA* 620, 648
2-Modulus Prescaler (÷8, ÷9)		MC12011	MC12511	MECL	600	310	TBA* 620, 648
Prescaler (÷2 ÷5/6, ÷10/11, ÷10/12)	MC12012			MECL	200	495	620, 648
2-Modulus Prescaler (÷10, ÷11)		MC12013	MC12513	MECL	600	310	620, 648
Counter Control Logic	MC12014		MC12514	MECL	25	150	620, 648
Offset Control Logic		MC12020	MC12520	MECL		35	632, 646
Offset Programmer		MC12021	MC12521	MECL		35	620, 648
Analog Loop		MC12030	MC12530	MECL	50		TBA*
Phase Frequency Detector	MC12040		MC12540	MECL	70	520	632, 646, 607
Crystal Oscillator	MC12060		MC12560	MECL	0.1 to 2.0	175	620, 648
Crystal Oscillator	MC12061		MC12561	MECL	2.0 to 20	210	620, 648

*TBA: To be announced

– other parts for PLL Application are available in TTL-LS and C-MOS –

Motorola opens the pipeline on the very latest thing in BIFET technology.



Delivery.

The pipe is full and overflowing!

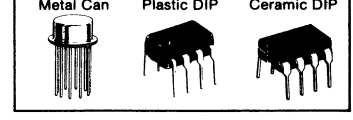
Supported by substantial inventory and a full production pipeline, Motorola now has major-source capability for supplying 12 variations of LF155/156/157 BIFET series *immediately.*

Because we intend to be your No. 1 BIFET supplier before others can say "where-did-they-come-from," we have ensured total warehouse availability of plastic and metal devices before turning on the valve. We're ready for those BIG orders that may choke our competitors' plumbing.

It looks like we'll be the only real supplier of 8-lead ceramics, too, while only one other source makes B-suffix types, two sources won't touch the '157 series and four manufacturers aren't supplying plastic. Motorola's got all three temperature versions, plus plastic DIP. And we'll have A-suffix versions soon.

We're out to flood the market with the best BIFETs the least money can buy! Contact your franchised Motorola distributor or Motorola sales office.

MOTOROLA BIFET	PACKAGE
LF155/6/7 H	Metal Can
LF155/6/7 J	Ceramic DIP
LF255/6/7 H	Metal Can
LF255/6/7 J	Ceramic DIP
LF255/6/7 N	Plastic DIP
LF355B/6B/7B H	Metal Can
LF355B/6B/7B J	Ceramic DIP
LF355B/6B/7B N	Plastic DIP
LF355/6/7 H	Metal Can
LF355/6/7 J	Ceramic DIP
LF355/6/7 N	Plastic DIP



MOTOROLA

Semiconductor Group

DISCRETE DEVICES

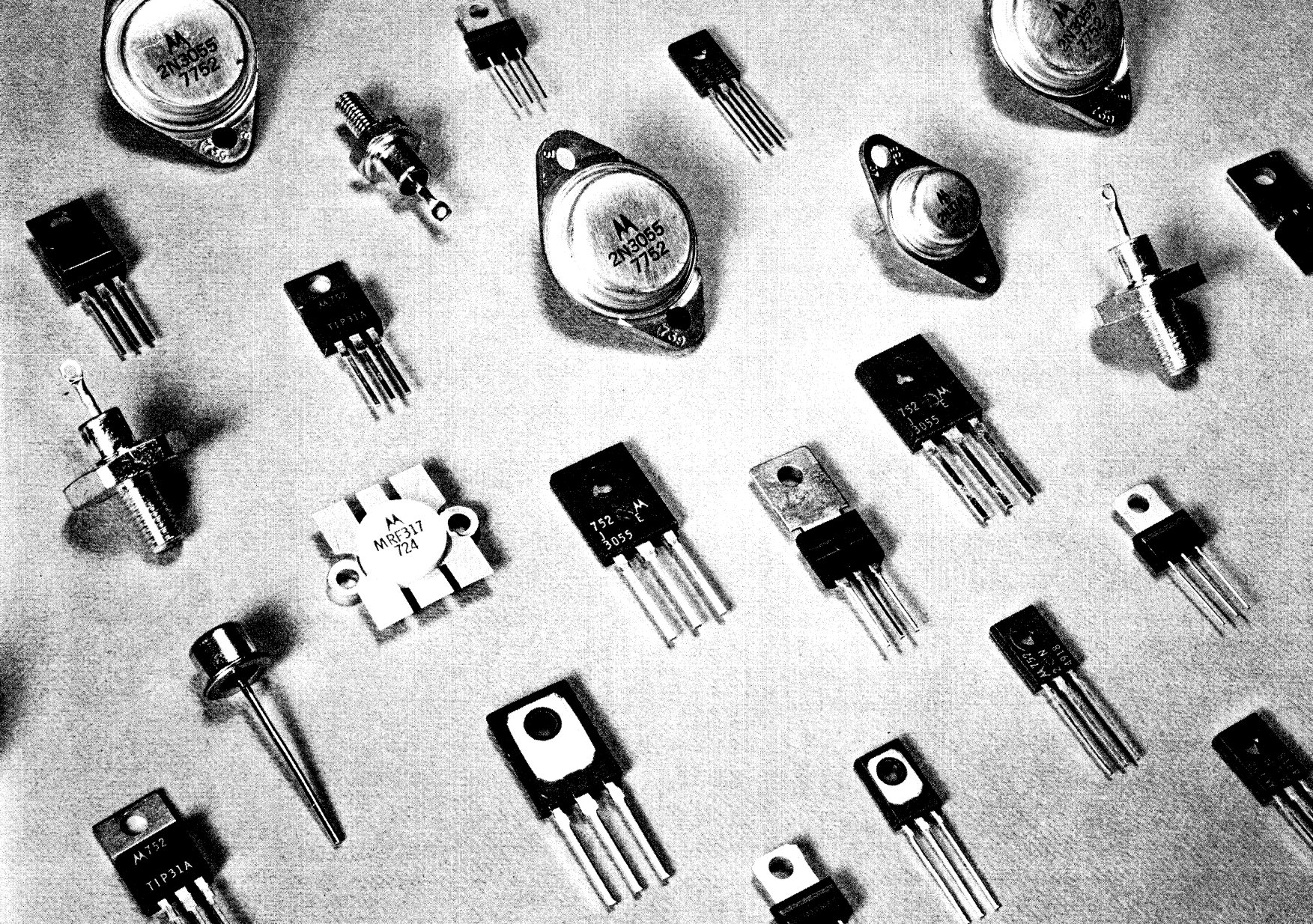
One-stop shopping for semiconductors

There's a lot to be said for "supermarket" shopping. Availability . . . Price . . . Variety . . . Quality! And for discrete semiconductors, Motorola has emerged as the industry's most complete one-stop product source. From Amplifier transistors to Zeners, they're all categorized in the following section—and with a large enough selection of specifications to meet almost any end-use application.

But don't be misled by the limited listings. They represent only the most popular off-the-shelf types—devices that meet the general cost and performance requirements for the majority of circuits. Beyond these are the hosts of "specials" that are computer-selectable to a customer's unique electrical requirements from the large production runs of the standard products.

Between standards and specials, there's hardly any product application that can't be satisfied—expeditiously and economically—with Motorola discrete semiconductors, and a pervasive network of sales offices and distributors are staffed to provide efficient customer service.

May we help you?


2N3055
7752
MRF317
724
752
3055
TIP31A

SILICON POWER TRANSISTORS

Motorola's extensive power transistor manufacturing facility encompasses a wide variety of technologies (epibase, double-, and triple-diffusion, etc.), packages, and geometric configurations to best meet the selective needs of the expanding applications. Devices with several thousand different specifications tables are being manufactured to specific order. Of these, some four hundred (+) devices have been selected as standard products for off-the-shelf delivery. These "standards", representing the most cost-effective devices for the vast majority of end uses, are described on the following pages.

TABLE OF CONTENTS

Motorola Power Transistor Packages

Motorola provides Silicon Power Transistors encased in several packages. Each package has advantages and trade-offs; the choice is left to the user.

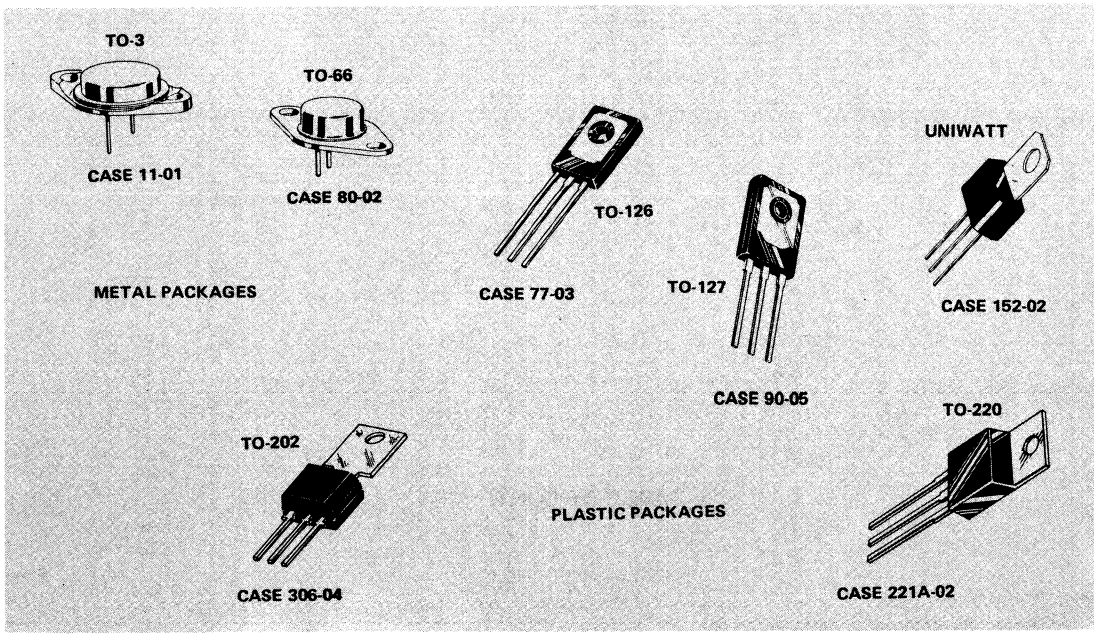
Metal cases are hermetic and capable of operating at 200 °C junction. These include the TO-5 and TO-39, intended for lead mounting with power dissipation less than 5 watts at 25 °C ambient. Press-on heat sinks will allow higher power dissipation.

For high power dissipation, packages designed expressly for use with heat sinks are available. These include the TO-66 for 20 to 90 watts and the TO-3 for 100 to 300 watts. Both of these are easily mounted on a heat sink and may be used with sockets, wire soldered, or PC board connection. Metal stud devices need only a single hole for mounting to a heat sink but must be solder wired to make connection at the terminals. Various stud packages are used in the industry with power dissipation ranging from 10 to greater than 300 watts. Motorola provides the TO-59 at 60 watts for standard devices but has capability in TO-61 and TO-63.

Plastic encapsulated power transistors offer extremely high package density per watt of power dissipation despite the restriction of 150 °C maximum junction temperature. In addition to compactness, these have a low silhouette and all three terminals are brought out in line so that electrical connection is easily made via a PC board or socket. Present day Plastic Power Transistors use silicon dioxide or special glass passivation on the die so these meet most of the "metal can" hermeticity tests.

Motorola produces several plastic encapsulated power transistor lines. Included in this selector guide are the Case 152 and TO-202 (Case 306) for up to 2 watts free air dissipation or 10 watts dissipation with heat sinking; TO-126* (Case 77) which ranges from 10 to 49 watts P_D; the TO-127 (Case 90) for 75 to 100 watts; the TO-220 for 40 to 100 watts. Motorola also has a "Case 199) which is similar to the TO-220 and has the same power handling range; this package eventually will be phased out, and is not included in this guide.

*There are two lead options with this case. The base and emitter leads on some lines are reversed from the majority of lines. These so called "reverse" leads are compatible with the TO-220.



Note: Mounting Hardware is available for all packages.

Metal Power Transistors

Quick Selector Guide

TO-3 GENERAL PURPOSE AMPLIFIER TRANSISTORS (Epibase Technology)

P_D 90 to 300 W

BV_{CEO} (V) / I_C max (A)	40 V		60 V		80 V		100 V		120 V		140 V	
	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP
5	2N5067 2N4913	2N4901 2N4904	2N5068 2N4914	2N4902 2N4915	2N5069 2N4906	2N4903						
10	BD342 (12 A)	BD343 (12 A)	2N5877 2N3713 2N3715 BD311	2N5875 2N3789 2N3791 BD312	2N5878 2N3714 2N3716 BD313	2N5876 2N3790 2N3792 BD314	2N5632	2N6229	2N5633	2N6230	2N5634	2N6231
15	BD142		2N3055 2N5881	MJ2955 2N5879	2N5882	2N5880					MJ15001	MJ15002
16					BD315	BD316	2N5629 BD317	2N6029 BD318	2N5630	2N6030	2N5631 MJ3773	2N6031
20			2N3772 MJ3772		2N5303	2N5745					MJ15003	MJ15004
25	BD364 (50 V) MJ3771 2N3771	BD365 (50 V)	BD366 2N5885	BD367 2N5883	BD368 2N5886	BD369 2N5884						
30	2N5301	2N4398	2N5302	2N4399			MJ802 (90 V)	MJ4502 (90 V)				
50			2N5685	2N5683	2N5686	2N5684						
70			MJ14000	MJ14001	MJ14002	MJ14003						

TO-3 GENERAL PURPOSE – HIGH SOA TRANSISTORS (Power Base Technology)

P_D 120 to 200 W

BV_{CEO} (V) / I_C max (A)	60 V		100 V		120 V		140 V		160 V		250 V	
	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP
10							2N3442				MJ15011	MJ15012
15	2N3055H 2N3055A	MJ2955A	BDW10 BDW10A		MJ15015 BDW12 BDW12A	MJ15016	BDW14 BDW14A		BDW16 BDW16A			
16							2N3773	2N6609				
30			BDW30		BDW32		BDW34		BDW36			

TO-3 GENERAL PURPOSE DARLINGTONS (Epibase Technology)

P_D 90 to 200 W

BV_{CEO} (V) / I_C max (A)	40 V		60 V		80 V		90 V		100 V		120 V	
	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP
8			MJ1000 2N6055	MJ900 2N6053	MJ1001 2N6056	MJ901 2N6054						
10	2N6383		MJ3000 2N6384	MJ2500	MJ3001 2N6385	MJ2501						
12			2N6057	2N6050	2N6058	2N6051			2N6059	2N6052		
15			2N6576				2N6577				2N6578	
16			MJ4033	MJ4030	MJ4034	MJ4031			MJ4035	MJ4032		
20			2N6282	2N6285	2N6283	2N6286			2N6284	2N6287		
30			MJ11012	MJ11011			MJ11014	MJ11013			MJ11016	MJ11015

TO-3 NPN HIGH VOLTAGE SWITCHING TRANSISTORS
(Triple Diffused and Epicollector Double Diffused)

P_D 50 to 175 W

BV_{CEX} (V) / I_C max (A)	200 V	225 V	300 V	375 V	400 V	450 V	475 V	500 V	600 V
5 to 6	MJ410		MJ411		2N5241 BU222		BU222A		
8					BUY29	BUY30		2N6306	2N6307
10					BU223 MJ413 MJ423 MJ431		BU223A	MJ13014 BUY69C	MJ13015
15		2N6249	2N6250	2N6251					

TO-3 NPN HIGH VOLTAGE SWITCHING TRANSISTORS
(Triple Diffused and Epicollector Double Diffused)

P_D 50 to 175 W

BV_{CEX} (V) / I_C max (A)	650 V	700 V	750 V	800 V	850 V	900 V	1000 V	1500 V	1700 V
3 to 4		2N3902 2N5157	BU126					BU205	
5 to 6	2N6542		BUX97	BU326 BUX82 BUX97A BUX97B	2N6543	BU326A	BUX83	BU208 BU208A BU500	BU209 BU209A
8	2N6544	2N6308		BUX80	2N6545		BUX81		
10				BUY69B			BUY69A	MJ12005	
15	2N6546				2N6547				

TO-3 NPN HIGH VOLTAGE DARLINGTONS (Triple Diffused Technology)

I_C max (A) \ BV_{CEX} (V)	400 V	475 V	500 V	550 V
7	MJ3040 MJ3041 BU322	BU322A	MJ3042	
10	BU323	BU323A		MJ10012

TO-3 NPN HIGH VOLTAGE SWITCHING DARLINGTONS (Epi Collector Double diffused)

I_C max (A) \ BV_{CEX} (V)	400 V	450 V	500 V	550 V	600 V	650 V	700 V
10		MJ10002 MJ10006*	MJ10003 MJ10007*			MJ100013*	MJ100014*
20		MJ10000 MJ10004*	MJ10002 MJ10005*			MJ10008*	MJ10009*
50					MJ100015*		MJ100016*

* With speed up diode.

TO-3 NPN HIGH SPEED TRANSISTORS (Double Diffused Technology)

I_C max (A) \ BV_{CEO} (V)	60 V	80 V	100 V	120 V	140 V	150 V
7.5	2N3447	2N3448				
25			2N6338	2N6339	2N6340	2N6341
50			2N6274	2N6275	2N6276	2N6277

TO-66 GENERAL PURPOSE AMPLIFIER & SWITCHING TRANSISTORS (Epibase and Planar Technologies)

I_C max (A) \ BV_{CEO}(V)	40 V		55 V		60 V		80 V	
	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP
4	2N4910	2N4898	2N3054A	2N6049	2N4911 2N3766	2N4899 2N3740	2N4912 2N3767	2N4900 2N3741
5	2N4231A	2N6312			2N4232A	2N6313	2N4233A	2N6314
7					2N6315	2N6317	2N6316	2N6318

TO-66 HIGH VOLTAGE SWITCHING & GENERAL PURPOSE TRANSISTORS (Triple Diffused Technology)

I_C max (V) \ BV_{CEO} (V)	175 V		225 V		250 V		300 V		350 V	
	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP
1	2N3583	2N6420	2N3738	2N6424			2N3739	2N6425		
2				2N6211	2N3584	2N6421	2N3585 2N4240	2N6422 2N6423 2N6212		2N6213

Short Form Specifications

TO-3 GENERAL PURPOSE AMPLIFIER & SWITCHING TRANSISTORS (Epibase Technology)

BV_{CEO} Volts	I_C Max. Amps	P_D $T_C = 25\,^{\circ}C$ Watts	NPN Type	PNP Type	H_{FE} Min.	Conditions I_C Amps	Conditions V_{CE} Volts
40	5	87.5	2N5067	2N4901	20	1	2
			2N4913	2N4904	25	2.5	2
	12	100	BD342	BD343	15	3	4
	15	117	BD142		12.5	4	4
	25	150	2N3771		15	15	4
	30	200	MJ3771		15	15	4
			2N5301	2N4398	15	15	2
50	20	200	BD364	BD365	20	10	4
60	5	87.5	2N5068	2N4902	20	1	2
			2N4914	2N4905	25	2.5	2
	10	117	BD311	BD312	25	5	4
		150	2N3713	2N3789	15 15	3 3	2 2
			2N3715	2N791	30 30	3 3	2 2
			2N5877	2N5875	20	4	4
	15	117	2N3055	MJ2955	20	4	4
		160	2N5881	2N5879	20	6	4
	20	150	2N3772		15	10	4
		200	MJ3772		15	10	4
			BD366	BD367	20	10	4
	25	200	2N5885	2N5883	20	10	4
	30	200	2N5302	2N4399	15	15	2
	50	300	2N5685	2N5683	15	25	2
	70	300	MJ14000	MJ14001	15	50	3

Conditions				
$V_{CE(sat)}$ Volts	I_C Amps	I_B Amps	F_T Min. MHz	Comments
0.4	1	0.1	4	
1	2.5	0.25	4	
1.5	4	0.4	1.5	
1.1	4	0.4	2	Gain ranges at 0.5 A available
2	15	1.5	–	
1	15	1.5	2	Switching specified
0.75	10	1	2	Switching specified
1	10	1	4	
0.4	1	0.1	4	
1	2.5	0.25	4	
1	5	0.5	4	Capable of I_C max. 15 A
1 1	5 4	0.5 0.4	4 4	h_{fe} at 1 MHz
0.8 1	5 5	0.5 0.5	4 4	h_{fe} at 1 MHz
1	5	0.5	4	Switching specified
1.1	4	0.4	4	
1	7	0.7	4	Switching specified
1.4	10	1	–	
0.8	10	1	2	Switching specified
1	10	1	4	
1	15	1.5	4	Switching specified
0.75	10	1	2	Switching specified
1	25	2.5	2	
3	70	14	–	

TO-3 GENERAL PURPOSE TRANSISTORS (Epibase Technology)

BV_{CEO} Volts	I_C Max. Amps	P_D T_C = 25 °C Watts	NPN Type	PNP Type
80	5	87.5	2N5069	2N4903
			2N4915	2N4906
	10	150	2N3714	2N3790
			2N3716	2N3792
			2N5878	2N5876
			BD313	BD314
	15	160	2N5882	2N5880
	16	200	BD315	BD316
	20	200	2N5303	2N5745
			BD368	BD369
	25	200	2N5886	2N5884
	50	300	2N5686	2N5684
	70	300	MJ14002	MJ14003
90	30	200	MJ802	MJ4502
100	10	150	2N5632	2N6229
	16	200	BD317	BD318
			2N5629	2N6029
120	10	150	2N5633	2N6230
	16	200	2N5630	2N6030
140	10	150	2N5634	2N6231
	15	200	MJ15001	MJ15002
	16	200	MJ3773	
			2N5631	2N6031
	20	200	MJ15003	MJ15004

Conditions			Conditions				
H_{FE} Min.	I_C Amps	V_{CE} Volts	$V_{CE(sat)}$ Volts	I_C Amps	I_B Amps	F_T Min. MHz	Comments
20	1	2	0.4	1	0.1	4	
25	2.5	2	1	2.5	0.25	4	
15 15	3 3	2 2	1 1	5 4	0.5 0.4	4 4	h_{fe} at 1 MHz
30 30	3 3	2 2	0.8 1	5 5	0.5 0.5	4 4	h_{fe} at 1 MHz
20	4	4	1	5	0.5	4	Switching specified
25	4	4	1	5	0.5	4	Capable of I_C max. 15 A
20	6	4	1	7	0.7	4	Switching specified
25	8	4	1	8	0.8	1	Capable of I_C max. 20 A
15	10	2	1	10	1	2	Switching specified
20	10	4	1	10	1	4	
20	10	4	1	15	1.5	4	Switching specified
15	25	2	1	25	2.5	2	
1	50	3	3	70	14	–	
25	7.5	2	0.8	7.5	0.75	2	
25	5	2	1	7.5	0.75	1	
25	5	4	1	8	0.8	1	Capable of I_C max. 20 A
25	8	2	1	10	1	1	
20	5	2	1	7.5	0.75	1	
20	8	2	1	10	1	1	
15	5	2	1	7.5	0.75	1	
25	4	2	1	4	0.4	2	
15	8	4	0.8	8	0.8	1	Switching specified
15	8	2	1	10	1	1	
25	5	2	1	5	0.5	2	

TO-3 GENERAL PURPOSE HIGH SOA TRANSISTORS (Power Base Technology)

BV_{CEO} Volts	I_C Max. Amps	P_D $T_C = 25\,^{\circ}C$ Watts	NPN Type	PNP Type
60	15	117	2N3055A 2N3055H	MJ2955A
100	15	180	BDW10	
	15	180	BDW10A	
	30	250	BDW30	
120	15	180	MJ15015	MJ15016
	15	180	BDW12	
	15	180	BDW12A	
	30	250	BDW32	
140	10	117	2N3442	
	15	180	BDW14	
	15	180	BDW14A	
	16	150	2N3773	2N6609
	16	250	BDW34	
160	15	180	BDW16	
	15	180	BDW16A	
	30	250	BDW36	
250	10	200	MJ15011	MJ15012

TO-3 GENERAL PURPOSE DARLINGTONS (Epibase Technology)

BV_{CEO} Volts	I_C Max. Amps	P_D $T_C = 25\,^{\circ}C$ Watts	NPN Type	PNP Type
40	10	100	2N6383	
60	8	90	MJ1000	MJ900
		100	2N6055	2N6053
	10	100	2N6384	
		150	MJ3000	MJ2500
	12	150	2N6057	2N6050
	15	120	2N6576	
	16	150	MJ4033	MJ4030
	20	160	2N6282	2N6285
	30	200	MJ11012	MJ11011
80	8	90	MJ1001	MJ901
		100	2N6056	2N6054
	10	100	2N6385	
		150	MJ3001	MJ2501
	12	150	2N6058	2N6051
	16	150	MJ4034	MJ4031
	20	160	2N6283	2N6286
90	15	120	2N6577	
	30	200	MJ11014	MJ11013
100	12	150	2N6059	2N6052
	16	150	MJ4035	MJ4032
	20	160	2N6284	2N6287
120	15	120	2N6578	
	30	200	MJ11016	MJ11015

Conditions			Conditions					
H_{FE} Min.	I_C Amps	V_{CE} Volts	$V_{CE(sat)}$ Volts	I_C Amps	I_B Amps	I_C Amps	V_{CE} Volts	F_T Min. MHz
20	4	4	1.1	4	0.4	1.95	60	0.8
20	5	4	1.5	8	1.6	3	60	1
25	5	4	1.2	8	1.6	3	60	1
20	10	4	1.7	16	3.2	4.17	60	1
20	4	4	1.1	4	0.4	3	60	1
20	5	4	1.5	8	1.6	3	60	1
25	5	4	1.2	8	1.6	3	60	1
20	10	4	1.7	16	3.2	4.17	60	1
20	3	4	1.0	3	0.3	1.46	80	0.8
20	5	4	1.5	8	1.6	3	60	1
25	5	4	1.2	8	1.6	3	60	1
15	8	4	1.4	8	0.8	1.5	100	–
20	10	4	1.7	16	3.2	4.17	60	1
20	5	4	1.5	8	1.6	3	60	1
25	5	4	1.2	8	1.6	3	60	1
20	10	4	1.7	16	3.2	4.17	60	1
20	2	2	0.8	2	0.2	4	50	–

Conditions			Conditions			Comments
H_{FE} Min.	I_C Amps	V_{CE} Volts	$V_{CE(sat)}$ Volts	I_C Amps	I_B Amps	
1000	5	3	2	5	0.01	
1000	3	3	2	3	0.012	
750	4	3	2	4	0.016	h_{fe} at 1 MHz = 4
1000	5	3	2	5	0.01	
1000	5	3	2	5	0.02	
750	6	3	2	6	0.024	h_{fe} at 1 MHz = 4
2000	4	3	2.8	10	0.1	Switching specified
1000	10	3	2.5	10	0.04	
750	10	3	2	10	0.04	h_{fe} at 1 MHz = 4
1000	20	5	3	20	0.2	
1000	3	3	2	3	0.012	
750	4	3	2	4	0.016	h_{fe} at 1 MHz = 4
1000	5	3	2	5	0.01	
1000	5	3	2	5	0.02	
750	6	3	2	6	0.024	h_{fe} at 1 MHz = 4
1000	10	3	2.5	10	0.04	
750	10	3	2	10	0.04	h_{fe} at 1 MHz = 4
2000	4	3	2.8	10	0.1	Switching specified
1000	20	5	3	20	0.2	
750	6	3	2	6	0.024	h_{fe} at 1 MHz = 4
1000	10	3	2.5	10	0.04	
750	10	3	2	10	0.04	h_{fe} at 1 MHz = 4
2000	4	3	2.8	10	0.1	Switching specified
1000	20	5	3	20	0.2	

TO-3 HIGH VOLTAGE SWITCHING & GENERAL PURPOSE TRANSISTORS (Triple Diffused & Epi Collector Double Diffused)

BV_{CEO} Volts	BV_{CEX} Volts	I_C Max. Amps	P_D T_C = 25 °C Watts	NPN Type	H_{FE} Min.	Conditions I_C Amps	Conditions V_{CE} Volts	$V_{CE(sat)}$ Max. Volts	Conditions I_C Amps	Conditions I_B Amps
200	200	5	100	MJ410	10	2.5	5	0.8	1	0.1
	225	15	175	2N6249	10	10	3	1.5	10	1
	400	8	125	BUY29	15	3	5	2	3.5	0.35
	500	10	100	BUY69C	15	2.5	10	3.3	8	2.5
250	450	8	125	BUY30	15	3	5	2	3.5	0.35
	500	8	125	2N6306	15	3	5	0.8	3	0.6
275	300	15	175	2N6250	8	10	3	1.5	10	1.25
300	300	5	100	MJ411	10	2.5	5	0.8	1	0.1
	600	8	125	2N6307	15	3	5	1	3	0.6
	650	5	100	2N6542	12	1.5	2	1	3	0.6
		8	125	2N6544	12	2.5	3	1.5	5	1
		15	175	2N6546	12	5	2	1.5	10	2
	750	4	50	BU126	15	1	5	5	4	1
		5	125	2N5241	10	3.5	5	2.5	5	1
325	400	10	125	MJ413	15	1	5	0.8	0.5	0.05
				MJ423	10	2.5	5	0.8	1	0.1
				MJ431	10	3.5	5	0.7	2.5	0.5
		6	100	BU222	5	4	1.3	2.3	6	2
		10	125	BU223	5	7	1.3	2.3	10	3
	800	10	100	BUY69B	15	2.5	10	3.3	8	2.5
350	375	15	175	2N6251	6	10	3	1.5	10	1.67
	550	10	150	MJ13014	12	2.5	5	1.4	5	1
	700	8	125	2N6308	12	3	5	1.5	3	0.6
	750	6	90	BUX97	5	1	1	3	4	1.25
	475	6	100	BU222A	5	4	1.3	2.3	6	2
		10	125	BU223A	5	7	1.3	2.3	10	3
375	800	6	75	BU326	10	2.5	10	3	4	1.25
400	600	10	150	MJ13015	12	2.5	5	1.4	5	1
	700	3.5	100	2N3902	30	1	5	2.5	2.5	0.5
	800	6	83	BUX82	5	2.5	1.5	3	4	1.25
		6	90	BUX97A	5	1	1	3	4	1.25
		10	114	BUX80	5	5	1.5	3	8	2.5
	850	5	100	2N6543	12	1.5	2	1	3	0.6
		8	125	2N6545	12	2.5	3	1.5	5	1
		15	175	2N6547	12	5	2	1.5	10	2
	900	6	75	BU326A	10	2.5	10	3	4	1.25
	1000	10	100	BUY69A	15	2.5	10	3.3	8	2.5
450	800	6	90	BUX97B	5	1	1	3	4	1.25
	1000	6	83	BUX83	5	2.5	1.5	3	4	1.25
		10	114	BUX81	5	5	1.5	3	8	2.5
500	700	3.5	100	2N5157	30	1	5	2.5	3.5	0.7
600	1300	7	90	BU207	2.25	4.5	5	5	4.5	2
	1500	7	90	BU207A	2.25	4.5	5	5	4.5	2
700	1500	3	36	BU205	2	2	5	5	2	1
		7	90	BU208	2.25	4.5	5	5	4.5	2
				BU208A	2.5	4.5	5	1	4.5	2
		6	78	BU500	3	4.5	5	1	4.5	2
750	1500	8	100	MJ12005	5	5	5	5	5	1
800	1700	7	90	BU209	2.25	3	5	5	3	1.3
		7	90	BU209A	2.25	3	5	5	3	1.3

** See test CCT

T_F Max. μs	Conditions I_C Amps	I_{B1} Amps	I_{B2} Amps	Comments
s,				F_T 2.5 MHz
1	10	1	1	
0.4	3	0.6	1.5	
1	8	2.5	2.5	
0.4	3	0.6	1.5	
0.4	3	0.6	1.5	
1	10	1.25	1.25	
				F_T 2.5 MHz
0.4	3	0.6	1.5	
0.8	3	0.6	0.6	Switchmode
1	5	1	1	Switchmode
0.8	10	2	2	Switchmode
0.15 typ.	2.5	0.25		TV Switchmode
1.7	2.5	0.25	0.5	
				F_T 2.5 MHz
				F_T 2.5 MHz
				F_T 2.5 MHz
				Automotive ignition F_T 7.5 MHz typ.
				Automotive ignition F_T 7.5 MHz typ.
1	8	2.5	2.5	
1	10	1.67	1.67	
0.5	5	1	1	Switchmode
0.4	3	0.6	1.5	
1	4	1.25	1.25	
				Automotive ignition F_T 7.5 MHz typ.
				Automotive ignition F_T 7.5 MHz typ.
1	2.5	0.5	1.0	
0.5	5	1	1	Switchmode
				Typ. switching as 2N5157
0.8	2.5	0.5	1.0	
1	4	1.25	1.25	
0.8	5	1	2	
0.8	3	0.6	0.6	Switchmode
1	5	1	1	Switchmode
0.8	10	2	2	Switchmode
1	2.5	0.5	1.0	
1	8	2.5	2.5	
1	4	1.25	1.25	
0.8	2.5	0.5	1.0	
0.8	5	1	2	
1.7	1	0.1	0.5	1.7 μS = T_f + T_s
1	4.5	1.8	–	TV deflection
1	4.5	1.8	–	1650 V Flashover test
1	2	1		TV horizontal deflection
1	4.5	1.8	**	Color TV Horizontal deflection
1	4.5	1.8	**	1650 V Flashover test
1	4.5	1.5	1.5	TV deflection
1	5	1	**	TV deflection
1	3	1.3	–	TV deflection
1	3	1.3	–	1850 V Flashover test

TO-3 HIGH VOLTAGE GENERAL PURPOSE DARLINGTONS

BV_{CEO} Volts	BV_{CEX} Volts	I_C Max. Amps	P_D $T_C = 25°C$ Watts	Type	H_{FE} Min.	Conditions I_C Amps	Conditions V_{CE} Volts
300	400	7	100	MJ3040	100	2	5
				MJ3041	250	2	5
350	400	7	100	BU322	50	4	1.7
		10	125	BU323	150	6	6
	475	7	100	BU322A	50	4	1.7
		10	125	BU323A	150	6	6
	500	7	100	MJ3042	250	2.5	5
400	550	10	175	MJ10012	300	3	6

TO-3 NPN HIGH VOLTAGE SWITCHMODE DARLINGTONS

BV_{CEO} Volts	BV_{CEX} Volts	I_C Max. Amps	P_D $T_C = 25°C$ Watts	Type	H_{FE} Min.	Conditions I_C Amps	Conditions V_{CE} Volts
350	450	10	150	MJ10002	30	5	5
				MJ10006	30	5	5
		20	175	MJ10000	40	10	5
				MJ10004	40	10	5
400	500	10	150	MJ10003	30	5	5
				MJ10007	30	5	5
		20	175	MJ10001	40	10	5
				MJ10005	40	10	5
	600	50	250	MJ10015	25	20	5
450	650	20	175	MJ10008	30	10	5
500	700	20	175	MJ10009	30	10	5
		50	250	MJ10016	25	20	5
550	650	10	175	MJ10013	20	5	5
600	700	10	175	MJ10014	20	5	5

(Triple Diffused Technology)

Conditions			Conditions				
$V_{CE(sat)}$ Volts	I_C Amps	I_B Amps	T_F Max. μS	I_C Amps	I_{B1} Amps	I_{B2} Amps	Comments
2.5	5	0.4					
2.5	5	0.4					
2.7	7	0.24					Auto ignition
1.7	6	0.12	15	6	0.3	0.3	Auto ignition
2.7	7	0.24					Auto ignition
1.7	6	0.12	15	6	0.3	0.3	Auto ignition
2.5	5	0.4					
2	6	0.6	15	6	0.3	0.3	General purpose and Auto ignition

(Epi Collector Double Diffused Technology)

Conditions			Conditions				
$V_{CE(sat)}$ Volts	I_C Amps	I_B Amps	T_F Max. μs	I_C Amps	I_B Amps	$V_{BE(off)}$ Volts	Comments
1.9	5	0.25	1.5	5	0.25	5	Switchmode
1.9	5	0.25	0.5	5	0.25	5	Switchmode with speed up diode
1.9	10	0.4	2.4	10	0.4	5	Switchmode
1.9	10	0.4	0.35	10	0.4	5	Switchmode with speed up diode
1.9	5	0.25	1.5	5	0.25	5	Switchmode
1.9	5	0.25	0.5	5	0.25	5	Switchmode with speed up diode
1.9	10	0.4	2.4	10	0.4	5	Switchmode
1.9	10	0.4	0.35	10	0.4	5	Switchmode with speed up diode
2.2	20	1	0.5	20	1	5	Switchmode with speed up diode
2	10	0.5	0.6	10	0.5	5	Switchmode with speed up diode
2	10	0.5	0.6	10	0.5	5	Switchmode with speed up diode
2.2	20	1	0.5	20	1	5	Switchmode with speed up diode
2.5	10	2	1	10	0.4	5	Switchmode with speed up diode
2.5	10	2	1	10	0.4	5	Switchmode with speed up diode

TO-3 NPN HIGH SPEED TRANSISTORS

BV_{CEO} Volts	BV_{CEX} Volts	I_C Max. Amps	P_D $T_C = 25\ °C$ Watts	Type	H_{FE} Min.	Conditions I_C Amps	Conditions V_{CE} Volts
60	80	7.5	115	2N3445	20	3	5
				2N3447	40	5	5
80	100	7.5	115	2N3446	20	3	5
				2N3448	40	5	5
100	120	25	200	2N6338	30	10	2
		50	250	2N6274	30	20	4
120	140	25	200	2N6339	30	10	2
		50	250	2N6275	30	20	4
140	160	25	200	2N6340	30	10	2
		50	250	2N6276	30	20	4
150	180	25	200	2N6341	30	10	2
		50	250	2N6277	30	20	4

TO-66 GENERAL PURPOSE AMPLIFIER & SWITCHING

BV_{CEO} Volts	I_C Max. Amps	P_D $T_C = 25\ °C$ Watts	NPN Type	PNP Type
40	4	25	2N4910	2N4898
	5	75	2N4231A	2N6312
55	4	75	2N3054A	2N6049
60	4	20	2N3766	
	4	25	2N4911	2N4899
				2N3740
	5	75	2N4232A	2N6313
	7	90	2N6315	2N6317
80	4	20	2N3767	
	4	25	2N4912	2N4900
				2N3741
	5	75	2N4233A	2N6314
	7	90	2N6316	2N6318

(Double Diffused Planar Technology)

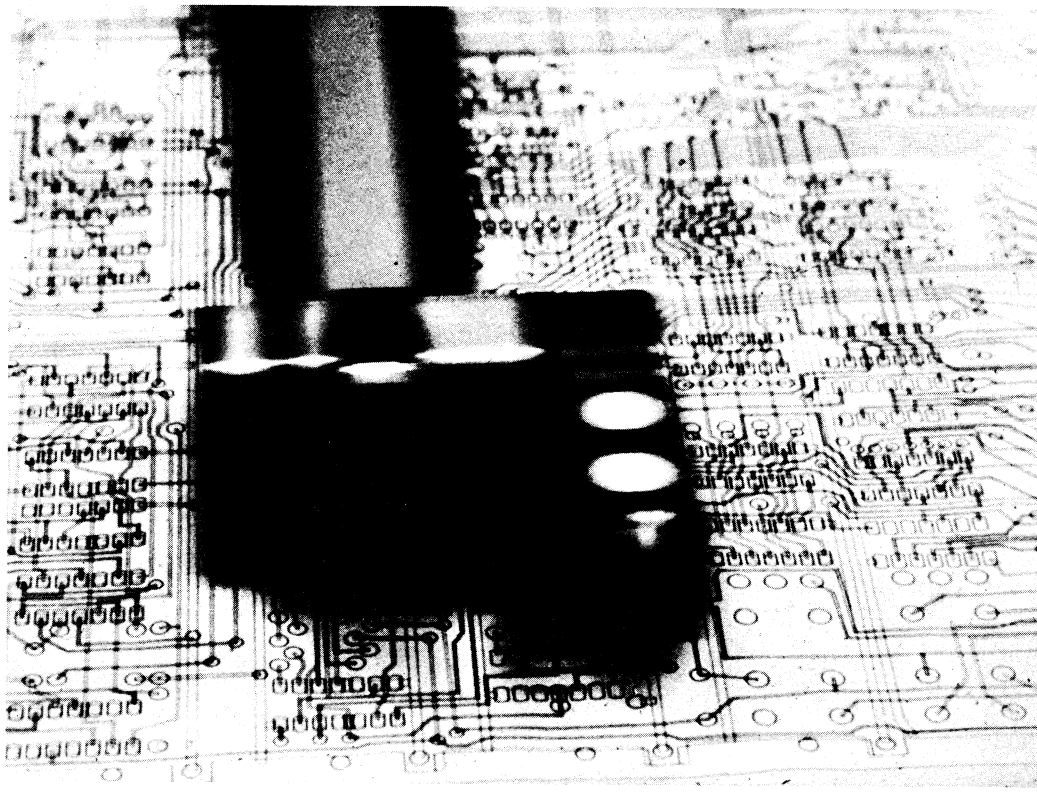
$V_{CE(sat)}$ Volts	Conditions I_C Amps	Conditions I_B Amps	T_F Max. μs	Conditions I_C Amps	Conditions I_{B1} Amps	Conditions I_{B2} Amps	Comments
1.5	3	0.3	0.35	5	0.5	0.5	
1.5	5	0.3	0.35	5	0.5	0.5	
1.5	3	0.3	0.35	5	0.5	0.5	
1.5	5	0.3	0.35	5	0.5	0.5	
1	10	1	0.25	10	1	1	
1	20	2	0.25	20	2	2	
1	10	1	0.25	10	1	1	
1	20	2	0.25	20	2	2	
1	10	1	0.25	10	1	1	
1	20	2	0.25	20	2	2	
1	10	1	0.25	10	1	1	
1	20	2	0.25	20	2	2	

TRANSISTORS (Epibase & Planar Technologies)

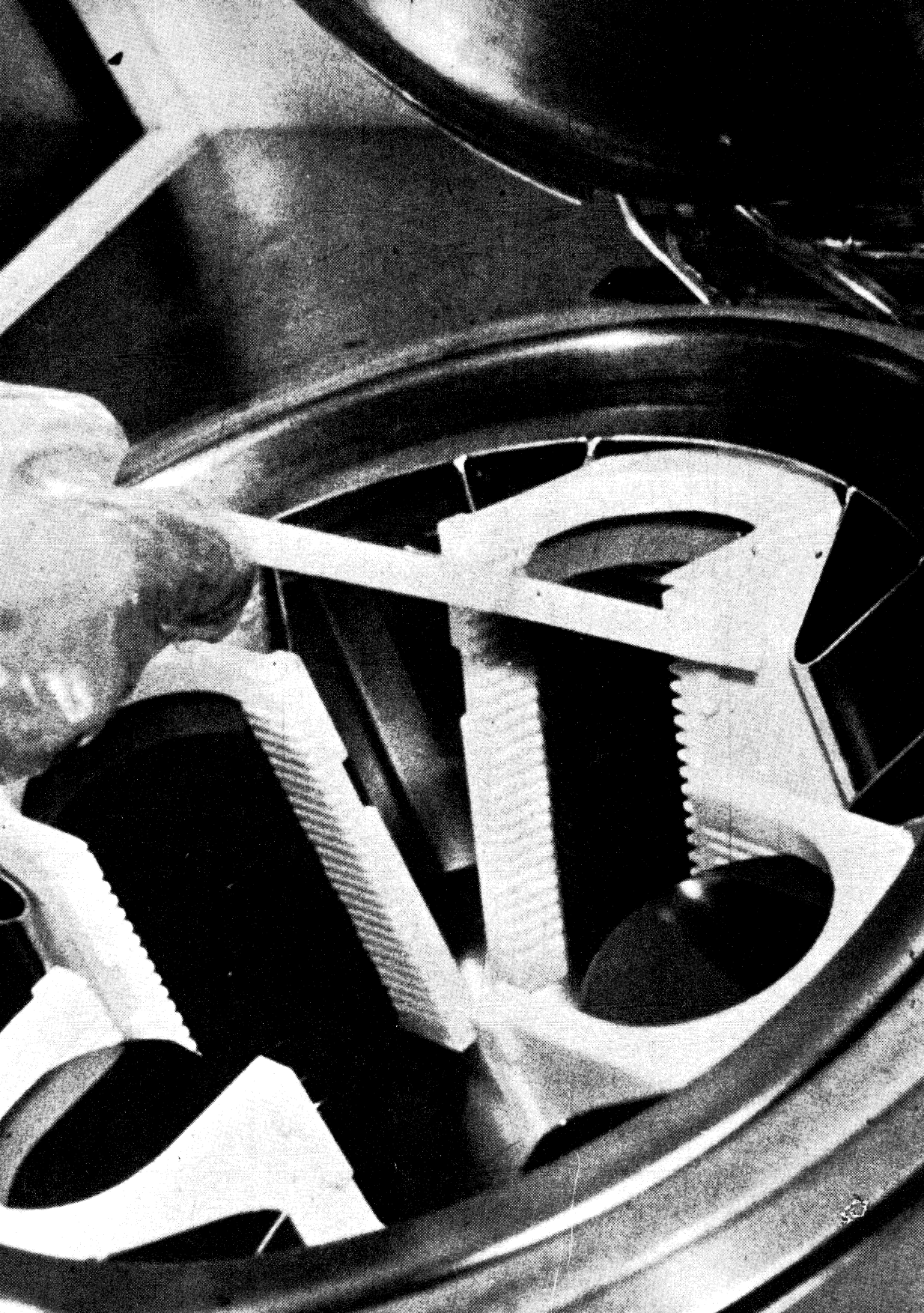
H_{FE} Min.	Conditions I_C Amps	Conditions V_{CE} Volts	$V_{CE(sat)}$ Volts	Conditions I_C Amps	Conditions I_B Amps	F_T Min. MHz	Comments
20	0.5	1	0.6	1	0.1	3	
25	1.5	2	2	3	0.3	4	
25	0.5	4	1	0.5	0.05	3	
40	0.5	5	2.5	1	0.1	10	Planar
20	0.5	1	0.6	1	0.1	3	
20	0.5	1	0.6	1	0.125	4	
25	1.5	2	2	3	0.3	4	
20	2.5	4	1	4	0.4	4	Switching specified
40	0.5	5	2.5	1	0.1	10	Planar
20	0.5	1	0.6	1	0.1	3	
20	0.5	1	0.6	1	0.125	4	
25	1.5	2	2	3	0.3	4	
20	2.5	4	1	4	0.4	4	Switching specified

TO-66 HIGH VOLTAGE GENERAL PURPOSE & SWITCHING TRANSISTORS (Triple Diffused Technology)

BV_{CEO} Volts	BV_{CEX} Volts	I_C Max. Amps	P_D T_C = 25 °C Watts	NPN Type	PNP Type	H_{FE} Min	Conditions I_C Amps	Conditions V_{CE} Volts
175	225	1	35	2N3583	2N6420	40	0.5	10
225	250	1	20	2N3738	2N6424	40	0.1	10
	275	2	35		2N6211	10	1	2.8
250	340	2	35	2N3584	2N6421	25	1	10
300	300	1	20	2N3739	2N6425	40	0.1	10
	350	2	35		2N6212	10	1	3.2
	450	2	35	2N3585	2N6422	25	1	10
				2N4240	2N6423	30	0.75	10
350	400	2	35		2N6213	10	1	4



Conditions				Conditions			
$V_{CE(sat)}$ Volts	I_C Amps	I_B Amps	T_F Max. μs	I_C Amps	I_{B1} Amps	I_{B2} Amps	Comments
5	1	0.125					F_T 10 MHz
2.5	0.25	0.025					F_T 10 MHz
1.4	1	0.125	0.6	1	0.125	0.125	
0.75	1	0.125	3	1	0.1	0.1	
2.5	0.25	0.025					F_T 10 MHz
1.6	1	0.125	0.6	1	0.125	0.125	
0.75	1	0.125	3	1	0.1	0.1	
1	0.75	0.075	3	0.75	0.075	0.075	
2	1	0.125	0.6	1	0.125	0.25	



Plastic Power Transistors

Quick Selector Guide

UNIWATT (Case 152) DUOWATT (Case 306/TO-202)

GENERAL PURPOSE AMPLIFIER AND SWITCHING TRANSISTORS (Planar Technology)

P_D $T_A = 25\,°C$ (W)	BV_{CEO} (V) / I_C max (A)	20 V		30 V		40 V		60 V		80 V		100 V	
		NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP
2	2							BD415 BD385	BD416 BD386	BD417 BD387	BD418 BD388	BD419 BD389	BD420 BD390
1	2	BD505	BD506	BD507 MPS-U01	BD508 MPS-U51	BD509 BD515 MPS-U01A	BD510 BD516 MPS-U51A	BD517 BD525 MPS-U05	BD518 BD526 MPS-U55	BD519 BD527 MPS-U06	BD520 BD528 MPS-U56	BD529 MPS-U07	BD530 MPS-U57

GENERAL PURPOSE DARLINGTONS (Planar Technology)

UNIWATT/DUOWATT

P_D $T_A = 25\,°C$ (W)	BV_{CEO} (V) / I_C max (A)	20 V		30 V		40 V		60 V		80 V		100 V	
		NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP
2	2					BD411 BD412	BD413 BD414						
1	2					MPS-U45	MPS-U95						

HIGH VOLTAGE SWITCHING TRANSISTORS (Planar Technology)

UNIWATT/DUOWATT

P_D $T_A = 25\,°C$ (W)	BV_{CEO} (V) / I_C max (A)	120 V		150 V		180 V		250 V		300 V		350 V	
		NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP
1	0.5					BF380		BF381		BF382 MPS-U10	MPS-U60		
2	0.5							BF757	BF760	BF758	BF761	BF759	BF762
2	1			BF466		BF467		BF468					
1	1	MPS-U03				MPS-U04							

TO-126 GENERAL PURPOSE TRANSISTORS (Epibase Technology) – Case 77

P_D $T_A = 25\,°C$ (W)	BV_{CEO} (V) / I_C max (A)	20 V		30 V		45 V		60 V		80 V	
		NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP
20	1.5					BD165	BD166	BD167	BD168	BD169	BD170
25	2					BD233	BD234	BD235	BD236	BD237	BD238
30	3			MJE520	MJE370	BD175 (-6, -10, -16) 2N4921	BD176 (-6, -10, -16) 2N4918	BD177 (-6, -10) 2N4922	BD178 (-6, -10) 2N4919	BD179 (-6, -10) 2N4923	BD180 (-6, -10) 2N4920
40	4	BD433	BD434	BD185 BD435	BD186 BD436	BD187 BD437 BD561 MJE521 2N5190	BD188 BD438 BD562 MJE371 2N5193	BD189 BD439 2N5191	BD190 BF440 2N5194	BD441 2N5192	BD442 2N5195

TO-126 GENERAL PURPOSE DARLINGTONS (Epibase Technology)

P_D $T_A = 25\,^\circ C$ (W)	BV_{CEO} (V) / I_C max (A)	20 V		45 V		60 V		80 V		100 V	
		NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP
40	4			BD675, A 2N6037	BD676, A 2N6034	BD677, A MJE800 MJE801 2N6038	BD678, A MJE700 MJE701 2N6035	BD679, A MJE802 MJE803 2N6039	BD680, A MJE702 MJE703 2N6036	BD681	BD682

TO-126 HIGH SPEED SWITCHING TRANSISTORS (Planar Technology)

P_D $T_A = 25\,^\circ C$ (W)	BV_{CEO} (V) / I_C max (A)	20 V		45 V		60 V		80 V		100 V	
		NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP
10	1.5			BD135 (-6, -10, -16)	BD136 (-6, -10, -16)	BD137 (-6, -10)	BD138 (-6, -10)	BD139 (-6, -10)	BD140 (-6, -10)		
15	4	BD361 BD361A	BD362 BD362A	BD785	BD786	BD787	BD788	BD789 MJE240 MJE241 MJE242	BD790 MJE250 MJE251 MJE252	BD791 MJE243 MJE244	BD792 MJE253 MJE254
15	5	MJE200	MJE210								

TO-126 HIGH SPEED DARLINGTONS (Planar Technology)

P_D $T_A = 25\,^\circ C$ (W)	BV_{CEO} (V) / I_C max (A)	20 V		45 V		60 V		80 V		100 V	
		NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP
15	4			BD775	BD776	BD777	BD778	BD779	BD780		

TO-126 HIGH VOLTAGE SWITCHING TRANSISTORS (Triple Diffused Technology and Planar)

P_D $T_A = 25\,^\circ C$ (W)	BV_{CEO} (V) / I_C max (A)	160 V		250 V		300 V		350 V		400 V	
		NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP
12.5	0.1	BF457		BF458		BF459					
20	0.5			BD157 2N5655		BD158 2N5656 MJE340 BD232	MJE350	BD159 2N5657			
40	1.5					MJE13002*				MJE13003*	

* Switchmode specifications (Case 77R)

TO-127 GENERAL PURPOSE TRANSISTORS (Epibase Technology) —Case 90

P_D $T_A = 25\,^\circ C$ (W)	BV_{CEO} (V) / I_C max (A)	30 V		45 V		60 V		80 V	
		NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP
65	5			MJE205	MJE105				
65	6	BD195	BD196	BD197	BD198	BD199	BD200		
90	10			BD205	BD206	BD207 MJE3055	BD208 MJE2955		
100	12			2N5989	2N5986	2N5990	2N5987	2N5991	2N5988
90	15			MJE1660	MJE1290	MJE1661	MJE1291		

TO-127 GENERAL PURPOSE DARLINGTONS (Epibase Technology)

P_D $T_A = 25\ °C$ (W)	BV_{CEO} (V) / I_C max (A)	30 V		45 V		60 V		80 V	
		NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP
70	5					MJE1100 MJE1101	MJE1090 MJE1091	MJE1102 MJE1103	MJE1092 MJE1093

TO-220 GENERAL PURPOSE TRANSISTORS (Epibase Technology)

P_D $T_A = 25\ °C$ (W)	BV_{CEO} (V) / I_C max (A)	30 V		45 V		60 V		80 V		100 V	
		NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP
30	1			TIP29	TIP30	TIP29A	TIP30A	TIP29B	TIP30B	TIP29C	TIP30C
	2			BD239	BD240	BD239A	BD240A	BD239B	BD240B	BD239C	BD240C
40	3			BD241 TIP31	BD242 TIP32	BD241A TIP31A	BD242A TIP32A	BD241B TIP31B	BD242B TIP32B	BD241C TIP31C	BD242C TIP32C
40 50	4			2N6121 BD533	2N6124 BD534	2N6122 BD535	2N6125 BD536	2N6123 BD537	2N6126 BD538		
65	6			BD243 TIP41	BD244 TIP42	BD243A TIP41A	BD244A TIP42A	BD243B TIP41B	BD244B TIP42B	BD243C TIP41C	BD244C TIP42C
	7	2N6288	2N6111	2N6290	2N6109	2N6292	2N6107				
	8			BD795	BD796	BD797	BD798	BD799	BD800	BD801	BD802
90 75	10			BD805	BD806	BD807 MJE3055T	BD808 MJE2955T	BD809	BD810		
75	15			2N6486	2N6489	2N6487	2N6490	2N6488	2N6491		

TO-220 GENERAL PURPOSE DARLINGTONS (Epibase Technology)

P_D $T_A = 25\ °C$ (W)	BV_{CEO} (V) / I_C max (A)	30 V		45 V		60 V		80 V		100 V	
		NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP
	2					TIP110	TIP115	TIP111	TIP116	TIP112	TIP117
60 70 80 65	8	2N6386		BDX53 BD895, A	BDX54 BD896, A	BDX53A BD897, A TIP100 TIP120	BDX54A BD898, A TIP105 TIP125	BDX53B BD899, A TIP101 TIP121	BDX54B BD900, A TIP106 TIP126	BDX53C BD901 TIP102 TIP122	BDX54C BD902 TIP107 TIP127
65 70	10			BDX33	BDX34	2N6387 BDX33A	BDX34A	2N6388 BDX33B	BDX34B	BDX33C	BDX34C
85	15			BDW39	BDW44	BDW40	BDW45	BDW41	BDW46	BDW42	BDW47

TO-220 HIGH VOLTAGE SWITCHING TRANSISTORS (Triple Diffused Technology)

P_D $T_A = 25\ °C$ (W)	BV_{CEO} (V) / I_C max (A)	165 V	200 V	250 V	300 V	350 V	400 V
		NPN	NPN	NPN	NPN	NPN	NPN
20	0.5				TIP63	TIP64	
40	1			TIP47	TIP48	TIP49	TIP50
80 80 75	4		2N6497	2N6498	2N6499 MJE51T MJE13004*	MJE52T	MJE53T MJE13005*
60	7	BU407	BU406				
80	8				MJE13006*		MJE13007*
100	12				MJE13008*		MJE13009*

* Switchmode specifications.

Short Form Specifications

UNIWATT (Case 152) DUOWATT (Case 306/TO-202)

BV_{CEO} Volts	I_C Max. Amps	P_D $T_A = 25\,^{\circ}C$ Watts	NPN Type	PNP Type	Conditions			$V_{CE(sat)}$ Volts	Conditions	
					H_{FE} Min.	I_C Amps	V_{CE} Volts		I_C Amps	I_B Amps
GENERAL PURPOSE AMPLIFIER & SWITCHING TRANSISTORS										
20	2	1	BD505	BD506	60	0.25	2	0.3	1	0.1
30	2	1	BD507	BD508	60	0.25	2	0.3	1	0.1
			MPS-U01	MPS-U51	60	0.1	1	0.5	1	0.1
40	2	1	BD509	BD510	60	0.25	2	0.3	1	0.1
			MPS-U01A	MPS-U51A	60	0.1	1	0.5	1	0.1
45	2	1	BD515	BD516	60	0.15	2	0.18	0.5	0.05
60	2	2	BD385	BD386	60	0.25	1	1	1	0.1
			BD415	BD416	60	0.10	1	0.05	0.25	0.1
		1	BD517	BD518	60	0.15	2	0.18	0.5	0.05
			BD525	BD526	60	0.15	2	0.18	0.5	0.05
			MPS-U05	MPS-U55	80	0.05	1	0.18	0.25	0.01
80	2	2	BD387	BD388	60	0.25	1	1	1	0.1
			BD417	BD418	60	0.10	1	0.05	0.25	0.1
		1	BD519	BD520	60	0.15	2	0.24	0.5	0.05
			BD527	BD528	60	0.05	2	0.15	0.25	0.025
			MPS-U06	MPS-U56	80	0.05	1	0.15	0.25	0.025
		2	BD389	BD390	60	0.25	1	1	1	0.1
			BD419	BD420	60	0.10	1	0.05	0.25	0.1
100	2	1	BD529	BD530	60	0.05	2	0.15	0.25	0.025
			MPS-U07	MPS-U57	80	0.05	1	0.15	0.25	0.025
GENERAL PURPOSE DARLINGTONS (Epibase Technology)										
40	2	2	BD411	BD413	25.000	0.2	5	1.5	1	0.002
			BD412	BD414	15.000	0.2	5	1.5	1	0.002
		1	MPS-U45	MPS-U95	25.000	0.2	5	1.2	1	0.002
HIGH VOLTAGE SWITCHING AND VIDEO TRANSISTORS (Planar Technology)										
120	1	1	MPS-U03		40	0.01	10	0.5	0.2	0.02
150	1	2	BF466		40	0.1	10	1.5	0.2	0.02
180	0.5	1	BF380*		25	0.03	10	0.3	0.03	0.006
	1	1	MPS-U04		40	0.01	10	0.5	0.2	0.02
200	1	2	BF467		40	0.1	10	1.5	0.2	0.02
250	0.5	1	BF381*		25	0.03	10	0.3	0.03	0.006
		2	BF757*	BF760*	40	0.03	10	0.6	0.03	0.003
	1	2	BF468		40	0.1	10	1.5	0.2	0.02
300	0.5	1	BF382*		25	0.03	10	0.3	0.03	0.006
		1	MPS-U10*	MPS-U60*	40	0.01	10	0.75	0.03	0.003
		2	BF758*	BF761*	40	0.03	10	0.6	0.03	0.003
350	0.5	2	BF759*	BF762*	40	0.03	10	0.6	0.03	0.003

[1] Typical.

* Video Output.

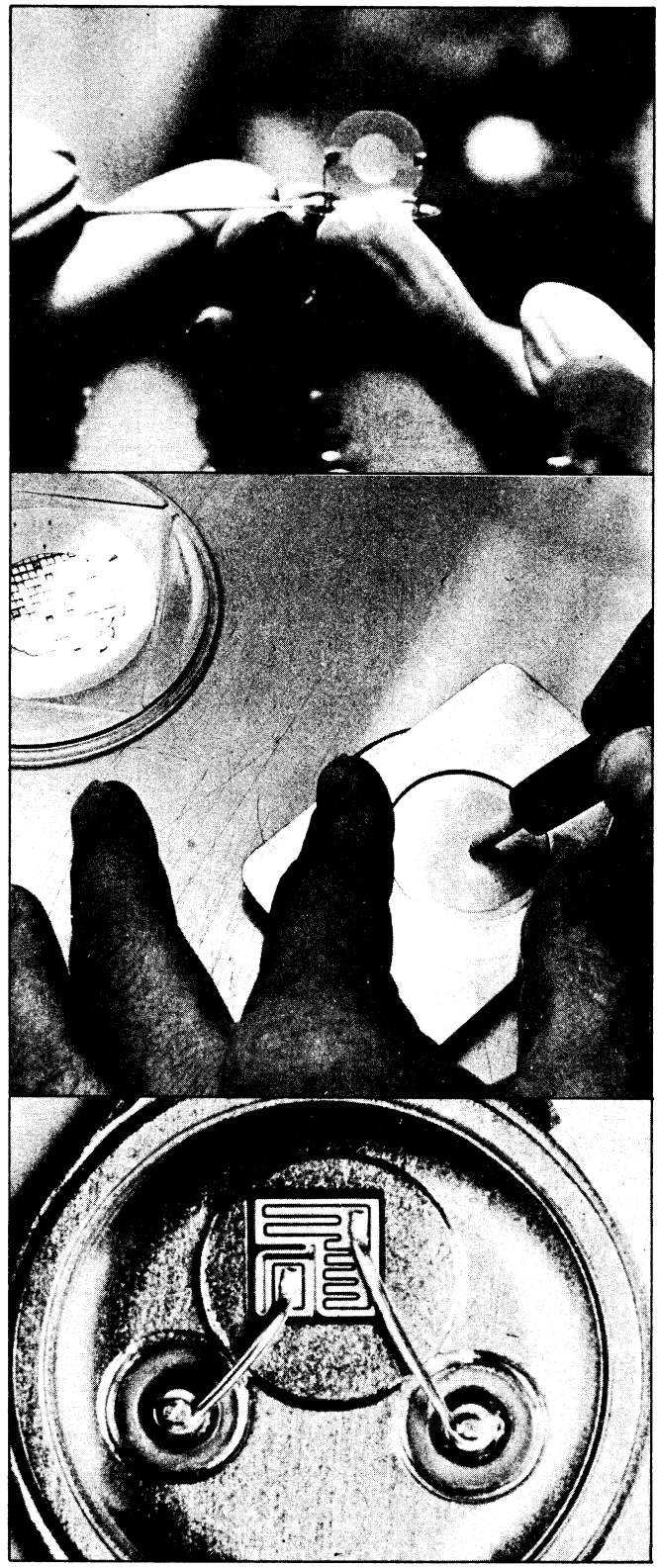
Conditions				
F_T MHz	f_{test} MHz	I_C Amps	V_{CE} Volts	Pinning
50	10	0.05	5	EBC
50	10	0.05	5	EBC
50	20	0.05	10	EBC
50	10	0.05	5	EBC
50	20	0.05	10	EBC
50	10	0.2	5	EBC
75	20	0.1	5	ECB
75	20	0.1	5	EBC
50	10	0.2	5	EBC
50	10	0.2	5	EBC
50	10	0.2	5	EBC
75	20	0.1	5	ECB
75	20	0.1	5	EBC
50	10	0.2	5	EBC
100	10	0.2	5	EBC
100	10	0.25	5	EBC
75	20	0.1	5	ECB
75	20	0.1	5	EBC
100	10	0.2	5	EBC
100	10	0.25	5	EBC

UNIWATT/DUOWATT

200[1]	100	0.2	5	EBC
200[1]	100	0.2	5	EBC
200[1]	100	0.2	5	EBC

UNIWATT/DUOWATT

100	100	0.05	20	EBC
100	20	0.05	20	EBC
90	100	0.015	10	EBC
100	100	0.05	20	EBC
100	20	0.05	20	EBC
90	100	0.015	10	EBC
45	20	0.01	20	ECB
100	20	0.05	20	EBC
90	100	0.015	10	EBC
60	20	0.01	20	EBC
45	20	0.01	20	ECB
45	20	0.01	20	ECB



TO-126 GENERAL PURPOSE TRANSISTORS (Epibase Technology) – Case 77

BV_{CEO} Volts	I_C Max. Amps	P_D T_C = 25 °C Watts	NPN Type	PNP Type	H_{FE} Min.	Conditions I_C Amps	Conditions V_{CE} Volts	V_{CEsat} Volts	Conditions I_C Amps	Conditions I_B Amps	F_T MHz	Conditions f_{test} MHz	Conditions I_C Amps	Conditions V_{CE} Volts
22	4	36	BD433	BD434	85	0.5	1	0.5	2	0.2	3	1	0.25	1
30	3	25	MJE520	MJE370	25	1	1	1	1	0.1	8[1]	2	0.2	10
	4	40	BD185	BD186	40	0.5	2	1	2	0.2	2	1	1	10
32	4	36	BD435	BD436	85	0.5	1	0.5	2	0.2	3	1	0.25	1
40	3	30	2N4921	2N4918	20	0.5	1	0.6	1	0.1	3	1	0.25	10
	4	40	BD561	BD562	60	0.5	1	0.6	1	0.1	7[1]	1	0.2	10
			MJE521	MJE371	40	1	1	0.6[1]	1	0.1	7[1]	2	0.2	10
			2N5190	2N5193	25	1.5	2	0.6	1.5	0.15	2	1	1	10
45	1.5	20	BD165	BD166	40	0.15	2	0.5	0.5	0.05	6	1	0.5	2
	2	25	BD233	BD234	40	0.15	2	0.6	1	0.1	3	1	0.25	10
	3	30	BD175,-6	BD176,-6	40	0.15	2	0.8	1	0.1	3	1	0.25	10
			BD175,-10	BD176,-10	63	0.15	2	0.8	1	0.1	3	1	0.25	10
			BD175,-16	BD176,-16	100	0.15	2	0.8	1	0.1	3	1	0.25	10
	4	40	BD187	BD188	40	0.5	2	1	2	0.2	2	1	1	10
		36	BD437	BD438	85	0.5	1	0.7	3	0.3	3	1	0.25	1
60	1.5	20	BD167	BD168	40	0.15	2	0.5	0.5	0.05	6	1	0.5	2
	2	25	BD235	BD236	40	0.15	2	0.6	1	0.1	3	1	0.25	10
	3	30	BD177,-6	BD178,-6	40	0.15	2	0.8	1	0.1	3	1	0.25	10
			BD177,-10	BD178,-10	63	0.15	2	0.8	1	0.1	3	1	0.25	10
			2N4922	2N4919	20	0.5	1	0.6	1	0.1	3	1	0.25	10
	4	40	BD189	BD190	40	0.5	2	1	2	0.2	2	1	1	10
		36	BD439	BD440	85	0.5	1	0.8	3	0.3	3	1	0.25	1
		40	2N5191	2N5194	25	1.5	2	0.6	1.5	0.15	2	1	1	10
80	1.5	20	BD169	BD170	40	0.15	2	0.5	0.5	0.05	6	1	0.5	2
	2	25	BD237	BD238	40	0.15	2	0.6	1	0.1	3	1	0.25	10
	3	30	BD179,-6	BD180,-6	40	0.15	2	0.8	1	0.1	3	1	0.25	10
			BD179,-10	BD180,-10	63	0.15	2	0.8	1	0.1	3	1	0.25	10
			2N4923	2N4920	20	0.5	1	0.6	1	0.1	3	1	0.25	10
	4	36	BD441	BD442	85	0.5	1	0.8	3	0.3	3	1	0.25	1
		40	2N5192	2N5195	25	1.5	2	0.6	1.5	0.15	2	1	1	10

TO-126 GENERAL PURPOSE DARLINGTONS (Epibase Technology) — Case 77

BV_{CEO} Volts	I_C Max. Amps	P_D T_C = 25 °C Watts	NPN Type	PNP Type	Conditions			Conditions			Conditions			
					H_{FE} Min.	I_C Amps	V_{CE} Volts	V_{CEsat} Volts	I_C Amps	I_B Amps	F_T MHz	f_{test} MHz	I_C Amps	V_{CE} Volts
40	4	40	2N6037	2N6034	750	2.0	3	2.5	1.0	0.008	2.5	1	0.75	10
45	4	40	BD675	BD676	750	1.5	3	2.5	1.5	0.03	1	1	1.5	3
			BD675A	BD676A	750	2.0	3	2.8	2.0	0.04	1	1	1.5	3
60	4	40	BD677	BD678	750	1.5	3	2.5	1.5	0.03	1	1	1.5	3
			BD677A	BD678A	750	2.0	3	2.8	2.0	0.04	1	1	1.5	3
			MJE800	MJE700	750	1.5	3	2.5	1.5	0.03	1	1	1.5	3
			MJE801	MJE701	750	2.0	3	2.8	1.5	0.04	1	1	1.5	3
			2N6038	2N6035	750	2.0	3	2.5	2.0	0.008	2.5	1	0.75	10
80	4	40	BD679	BD680	750	1.5	3	2.5	1.5	0.03	1	1	1.5	3
			BD679A	BD680A	750	2.0	3	2.8	2.0	0.04	1	1	1.5	3
			MJE802	MJE702	750	1.5	3	2.5	1.5	0.03	1	1	1.5	3
			MJE803	MJE703	750	2.0	3	2.8	2.0	0.04	1	1	1.5	3
			2N6039	2N6036	750	2.0	3	2.5	2.0	0.008	2.5	1	0.75	10
100	4	40	BD681	BD682	750	1.5	3	2.5	1.5	0.03	1	1	1.5	3

TO-126 HIGH SPEED SWITCHING TRANSISTORS (Planar Technology) — Case 77

BV_{CEO} Volts	I_C Max. Amps	P_D T_C = 25 °C Watts	NPN Type	PNP Type	Conditions			Conditions			Conditions			
					H_{FE} Min.	I_C Amps	V_{CE} Volts	V_{CEsat} Volts	I_C Amps	I_B Amps	F_T MHz	f_{test} MHz	I_C Amps	V_{CE} Volts
20	3	15	BD361	BD362	25	2.0	1	0.6	1.0	0.02	90[1]	20	0.1	10
			BD361A	BD362A	50	2.0	1	0.6	1.0	0.02	90[1]	20	0.1	10
25	5	15	MJE200	MJE210	45	2.5	1	0.3	0.5	0.05	65	10	0.1	10
45	1.5	10	BD135,-6	BD136,-6	40	0.15	2	0.5	0.5	0.05	70[1]	10	0.1	10
			BD135,-10	BD136,-10	63	0.15	2	0.5	0.5	0.05	70[1]	10	0.1	10
			BD135,-16	BD136,-16	100	0.15	2	0.5	0.5	0.05	70[1]	10	0.1	10
	4	15	BD785	BD786	40	0.2	3	0.4	0.5	0.05	50	10	0.1	10
60	1.5	10	BD137,-6	BD138,-6	40	0.15	2	0.5	0.5	0.05	70[1]	10	0.1	10
			BD137,-10	BD138,-10	63	0.15	2	0.5	0.5	0.05	70[1]	10	0.1	10
	4	15	BD787	BD788	40	0.2	3	0.4	0.5	0.05	50	10	0.1	10
80	1.5	10	BD139,-6	BD140,-6	40	0.15	2	0.5	0.5	0.05	70[1]	10	0.1	10
			BD139,-10	BD140,-10	63	0.15	2	0.5	0.5	0.05	70[1]	10	0.1	10
	4	15	BD789	BD790	40	0.2	3	0.5	0.5	0.05	40	10	0.1	10
			MJE240	MJE250	40	0.2	1	0.8	2.0	0.2	40	10	0.1	10
			MJE241	MJE251	40	0.2	1	0.6	1.0	0.1	40	10	0.1	10
			MJE242	MJE252	25	0.2	1	0.3	0.5	0.05	40	10	0.1	10
100	4	15	BD791	BD792	40	0.2	3	0.5	0.5	0.05	40	10	0.1	10
			MJE243	MJE253	40	0.2	1	0.8	1.0	0.1	40	10	0.1	10
			MJE244	MJE254	25	0.2	1	0.3	0.5	0.05	40	10	0.1	10

[1] Typical.

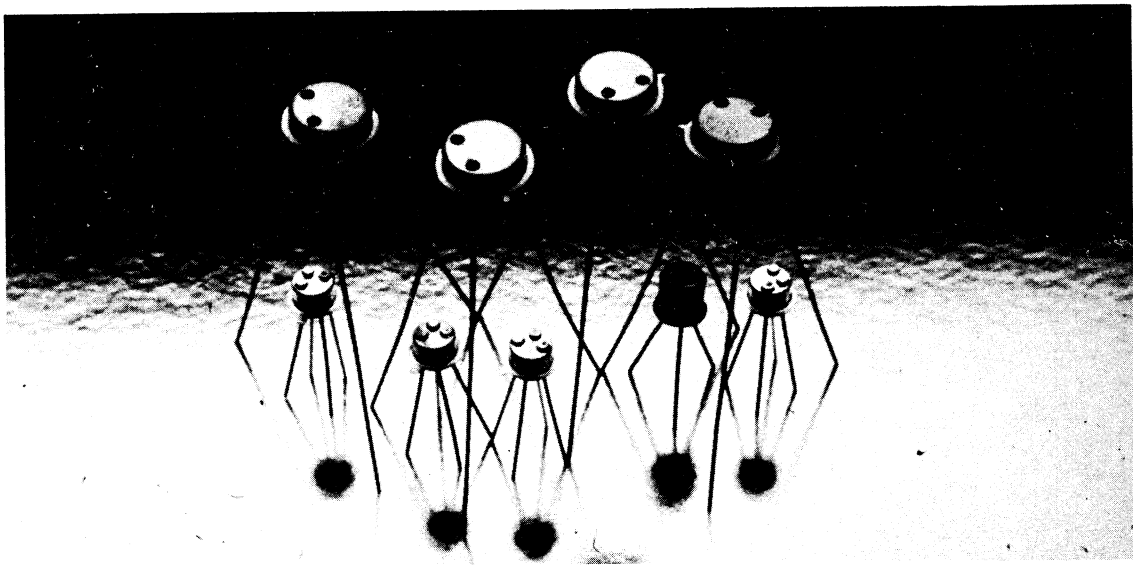
TO-126 HIGH SPEED DARLINGTONS (Planar Technology) — Case 77

BV_{CEO} Volts	I_C Max. Amps	P_D T_C = 25 °C Watts	NPN Type	PNP Type	Conditions			Conditions			Conditions			
					H_{FE} Min.	I_C Amps	V_{CE} Volts	V_{CEsat} Volts	I_C Amps	I_B Amps	F_T MHz	f_{test} MHz	I_C Amps	V_{CE} Volts
45	4	15	BD775	BD776	750	2	3	1.5	1.5	0.006	20	10	1	2
60	4	15	BD777	BD778	750	2	3	1.5	1.5	0.006	20	10	1	2
80	4	15	BD779	BD780	750	2	3	1.5	1.5	0.006	20	10	1	2

TO-126 HIGH VOLTAGE SWITCHING TRANSISTORS (Triple Diffused Technology and Planar) — Case 77

160	0.1	12.5	BF457[2]		25	0.03	10	1	0.03	0.006	90[1]	20	0.015	10
250	0.1	12.5	BF458[2]		25	0.03	10	1	0.03	0.006	90[1]	20	0.015	10
	0.5	20	BD157		30	0.05	20	0.5[1]	0.1	0.01	20[1]	10	0.1	10
			2N5655		30	0.1	10	1	0.1	0.01	10	10	0.05	10
300	0.1	12.5	BF459[2]		25	0.03	10	1	0.3	0.006	90[1]	20	0.015	10
	0.5	20	BD158		30	0.05	10	0.5[1]	0.1	0.01	20[1]	10	0.1	10
			BD232		25	0.05	5	1	0.15	0.015	30[1]	10	0.1	10
		20.8	MJE340	MJE350	30	0.05	10	0.5[1]	0.1	0.01	20[1]	10	0.1	10
		20	2N5656		30	0.1	10	1	0.1	0.01	10	10	0.05	10
	1.5	40	MJE13002*		8	0.5	2	0.5	0.5	0.01	4	1	0.1	10
350	0.5	20	BD159		30	0.05	10	0.5[1]	0.1	0.01	20[1]	10	0.1	10
			2N5657		30	0.1	10	1	0.1	0.01	10	10	0.05	10
400	1.5	40	MJE13003*		8	0.5	2	0.5	0.5	0.01	4	1	0.1	10

[1] Typical
[2] Video Output
* Switchmode specifications.



TO-127 GENERAL PURPOSE TRANSISTORS (Epibase Technology) – Case 90

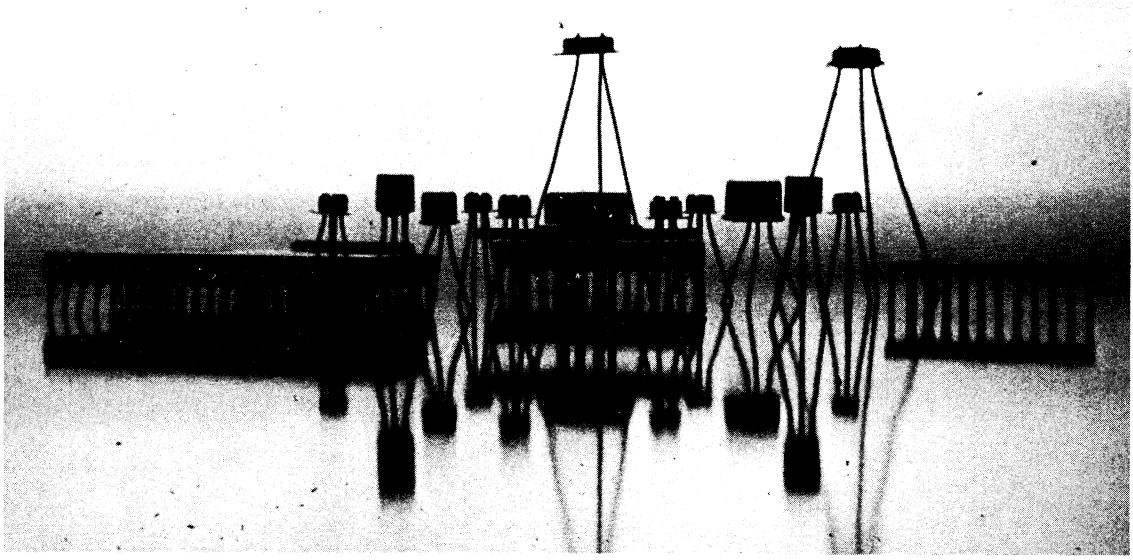
BV_{CEO} Volts	I_C Max. Amps	P_D $T_C = 25\,^{\circ}C$ Watts	NPN Type	PNP Type	H_{FE} Min.	Conditions I_C Amps	Conditions V_{CE} Volts	V_{CEsat} Volts	Conditions I_C Amps	Conditions I_B Amps	F_T MHz	Conditions f_{test} MHz	Conditions I_C Amps	Conditions V_{CE} Volts
30	6	65	BD195	BD196	30	1	2	1	3	0.3	2	1	1	10
40	12	100	2N5989	2N5986	40	1.5	2	0.7	6	0.6	2	1	0.5	10
	15	90	MJE1660	MJE1290	20	5	4	1.8	15	1.5	3	1	1	10
45	6	65	BD197	BD198	30	1	2	1	3	0.3	2	1	1	10
	10	90	BD205	BD206	30	2	2	1.1	4	0.4	1.5	1	1	10
50	5	65	MJE205	MJE105	25	2	2	0.5[1]	2.5	0.25	8[1]	2	0.5	10
60	6	65	BD199	BD200	30	1	2	1	3	0.3	2	1	1	10
	10	90	BD207	BF208	30	2	2	1.1	4	0.4	1.5	1	1	10
			MJE3055	MJE2955	20	4	4	1.1	4	0.4	2	0.5	0.5	10
	12	100	2N5990	2N5987	40	1.5	2	0.7	6	0.6	2	1	0.5	10
	15	90	MJE1661	MJE1291	20	5	4	1.8	15	1.5	3	1	1	10
80	12	100	2N5991	2N5988	40	1.5	2	0.7	6	0.6	2	1	0.5	10

[1] Typical

TO-127 GENERAL PURPOSE DARLINGTONS (Epibase Technology) – Case 90

60	5	70	MJE1100	MJE1090	750	3	3	2.5	3	0.012	8[1]	2	3	4
			MJE1101	MJE1091	750	4	3	2.8	4	0.016	8[1]	2	3	4
80	5	70	MJE1102	MJE1092	750	3	3	2.5	3	0.012	8[1]	2	3	4
			MJE1103	MJE1093	750	4	3	2.8	4	0.016	8[1]	2	3	4

[1] Typical



TO-220 GENERAL PURPOSE TRANSISTORS (Epibase Technology)

BV_{CEO} Volts	I_C Max. Amps	P_D $T_C = 25\,^{\circ}C$ Watts	NPN Type	PNP Type	H_{FE} Min.	Conditions I_C Amps	Conditions V_{CE} Volts	V_{CEsat} Volts	Conditions I_C Amps	Conditions I_B Amps	F_T MHz	Conditions f_{test} MHz	Conditions I_C Amps	Conditions V_{CE} Volts
30	7	65	2N6288	2N6111	30	3	4	3.5	7	3	4	1	0.5	4
40	1	30	TIP29	TIP30	40	0.2	4	0.7	1	0.125	3	1	0.2	10
	3	40	TIP31	TIP32	25	1	4	1.2	3	0.375	3	1	0.5	10
	6	65	TIP41	TIP42	30	0.3	4	1.5	6	0.6	3	1	0.5	10
	15	75	2N6486	2N6489	20	5	4	1.3	5	0.5	5	1	1	4
45	2	30	BD239	BD240	40	0.2	4	0.7	1	0.2	3	1	0.2	10
	3	40	BD241	BD242	25	1	4	1.2	3	0.6	3	1	0.5	10
	4	50	BD533	BD534	40	0.5	2	0.8	2	0.2	3	1	0.25	1
		40	2N6121	2N6124	25	1.5	2	0.6	1.5	0.15	2.5	1	1	4
	6	65	BD243	BD244	30	0.3	4	1.5	6	1	3	1	0.5	10
	8	65	BD795	BD796	40	1	2	1	3	0.3	3	1	0.25	10
	10	90	BD805	BD806	30	2	2	1.1	4	0.4	1.5	1	1	10
50	7	65	2N6290	2N6109	30	2.5	4	3.5	7	3	4	1	0.5	4
60	1	30	TIP29A	TIP30A	40	0.2	4	0.7	1	0.125	3	1	0.2	10
	2	30	BD239A	BD240A	40	0.2	4	0.7	1	0.2	3	1	0.2	10
	3	40	BD241A	BD242A	25	1	4	1.2	3	0.6	3	1	0.5	10
			TIP31A	TIP32A	25	1	4	1.2	3	0.375	3	1	0.5	10
	4	50	BD535	BD536	40	0.5	2	0.8	2	0.2	3	1	0.25	1
		40	2N6122	2N6125	25	1.5	2	0.6	1.5	1.5	2.5	1	1	4
	6	65	BD243A	BD244A	30	0.3	4	1.5	6	1	3	1	0.5	10
			TIP41A	TIP42A	30	0.3	4	1.5	6	0.6	3	1	0.5	10
	8	65	BD797	BD798	40	1	2	1	3	0.3	3	1	0.25	10
	10	90	BD807	BD808	30	2	2	1.1	4	0.4	1.5	1	1	10
		75	MJE3055T	MJE2955T	20	4	4	1.1	4	0.4	2	0.5	0.5	10
	15	75	2N6487	2N6490	20	5	4	1.3	5	0.5	5	1	1	4
70	7	65	2N6292	2N6107	30	2	4	3.5	7	3	4	1	0.5	4

TO-220 GENERAL PURPOSE TRANSISTORS (Epibase Technology) (continued)

BV_{CEO} Volts	I_C Max. Amps	P_D T_C = 25 °C Watts	NPN Type	PNP Type	H_{FE} Min.	Conditions I_C Amps	Conditions V_{CE} Volts	V_{CEsat} Volts	Conditions I_C Amps	Conditions I_B Amps	F_T MHz	Conditions f_{test} MHz	Conditions I_C Amps	Conditions V_{CE} Volts
80	1	30	TIP29B	TIP30B	40	0.2	4	0.7	1	0.125	3	1	0.2	10
	2	30	BD239B	BD240B	40	0.2	4	0.7	1	0.2	3	1	0.2	10
	3	40	BD241B	BD242B	25	1	4	1.2	3	0.6	3	1	0.5	10
			TIP31B	TIP32B	25	1	4	1.2	3	0.375	3	1	0.5	10
	4	50	BD537	BD538	40	0.5	2	0.8	2	0.2	3	1	0.25	1
		40	2N6123	2N6126	25	1.5	2	0.6	1.5	0.15	2.5	1	1	4
	6	65	BD243B	BD244B	30	0.3	4	1.5	6	1	3	1	0.5	10
			TIP41B	TIP42B	30	0.3	4	1.5	6	0.6	3	1	0.5	10
	8	65	BD799	BD800	30	1	2	1	3	0.3	3	1	0.25	10
	10	90	BD809	BD810	30	2	2	1.1	4	0.4	1.5	1	1	10
	15	75	2N6488	2N6491	20	5	4	1.3	5	0.5	5	1	1	4
100	2	30	TIP29C	TIP30C	40	0.2	4	0.7	1	0.125	3	1	0.2	10
			BD239C	BD240C	40	0.2	4	0.7	1	0.2	3	1	0.2	10
	3	40	BD241C	BD242C	25	1	4	1.2	3	0.6	3	1	0.5	10
			TIP31C	TIP32C	25	1	4	1.2	3	0.375	3	1	0.5	10
	6	65	BD243C	BD244C	30	0.3	4	1.5	6	1	3	1	0.5	10
			TIP41C	TIP42C	30	0.3	4	1.5	6	0.6	3	1	0.5	10
	8	65	BD801	BD802	30	1	2	1	3	0.3	3	1	0.25	10

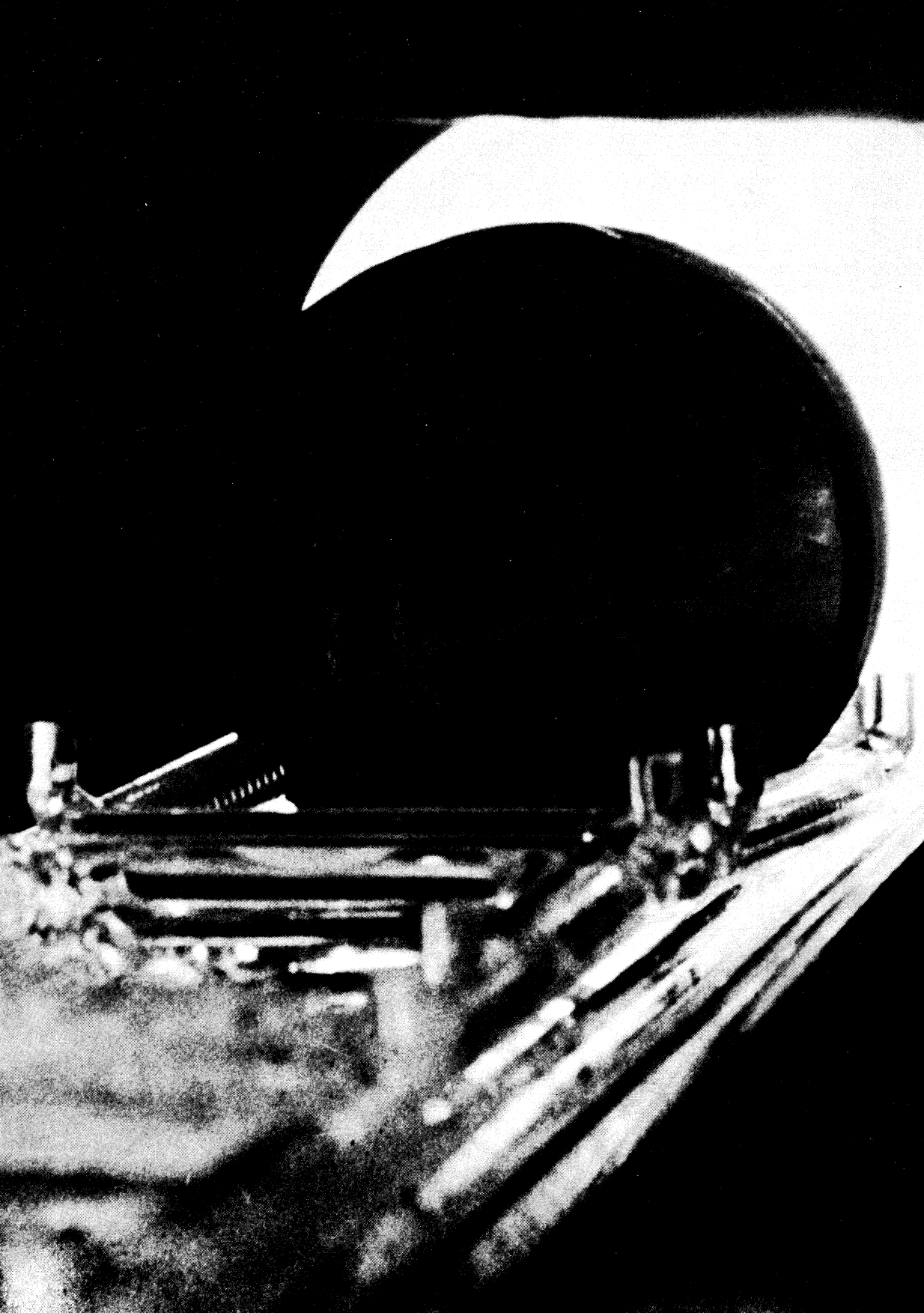
TO-220 GENERAL PURPOSE DARLINGTONS (Epibase Technology)

BV_{CEO} Volts	I_C Max. Amps	P_D T_C = 25 °C Watts	NPN Type	PNP Type	Conditions			Conditions			Conditions			
					H_{FE} Min.	I_C Amps	V_{CE} Volts	V_{CEsat} Volts	I_C Amps	I_B Amps	F_T MHz	f_{test} MHz	I_C Amps	V_{CE} Volts
40	8	65	2N6386		1000	3	3	2	3	0.006	2	1	1	5
45	8	60	BDX53	BDX54	750	3	3	2	3	0.012	4	1	3	4
		70	BD895	BD896	750	3	3	2.5	3	0.012	1	1	3	3
			BD895A	BD896A	750	4	3	2.8	4	0.016	1	1	3	3
	10	70	BDX33	BDX34	750	4	3	2.5	4	0.008	2	1	1	5
	12	85	BDW39	BDW44	1000	5	4	3	10	0.05	4	1	3	4
60	2	50	TIP110	TIP115	1000	1	4	2.5	2	0.008	2.5	1	0.75	10
	8	60	BDX53A	BDX54A	750	3	3	2	3	0.012	4	1	3	4
		70	BD897	BD898	750	3	3	2.5	3	0.012	1	1	3	3
			BD897A	BD898A	750	4	3	2.8	4	0.016	1	1	3	3
		80	TIP100	TIP105	1000	3	4	2	3	0.006	4	1	3	4
		65	TIP120	TIP125	1000	0.5	3	2	3	0.012	4	1	3	4
	10	70	BDX33A	BDX34A	750	4	3	2.5	4	0.008	2	1	1	5
		65	2N6387		1000	5	3	2	5	0.01	2	1	1	5
	12	85	BDW40	BDW45	1000	5	4	3	10	0.05	4	1	3	4
80	2	50	TIP111	TIP116	1000	1	4	2.5	2	0.008	2.5	1	0.75	10
	8	60	BDX53B	BDX54B	750	3	3	2	3	0.012	4	1	3	4
		70	BD899	BD900	750	3	3	2.5	3	0.012	1	1	3	3
		70	BD899A	BD900A	750	4	3	2.8	4	0.016	1	1	3	3
		80	TIP101	TIP106	1000	3	4	2	3	0.006	4	1	3	4
		65	TIP121	TIP126	1000	0.5	3	2	3	0.012	4	1	3	4
	10	70	BDX33B	BDX34B	750	3	3	2.5	3	0.006	2	1	1	5
		65	2N6388		1000	5	3	2	5	0.01	2	1	1	5
	12	85	BDW41	BDW46	1000	5	4	3	10	0.05	4	1	3	4
100	2	50	TIP112	TIP117	1000	1	4	2.5	2	0.008	2.5	1	0.75	10
	8	60	BDX53C	BDX54C	750	3	3	2	3	0.012	4	1	3	4
		70	BD901	BD902	750	3	3	2.5	3	0.012	1	1	3	3
		80	TIP102	TIP107	1000	3	4	2	3	0.006	4	1	3	4
		65	TIP122	TIP127	1000	0.5	3	2	3	0.012	4	1	3	4
	10	70	BDX33C	BDX34C	750	3	3	2.5	3	0.006	2	1	1	5
	12	85	BDW42	BDW47	1000	5	4	3	10	0.05	4	1	3	4

TO-220 HIGH VOLTAGE SWITCHING TRANSISTORS (Triple Diffused Technology)

BV_{CEO} Volts	I_C Max. Amps	P_D T_C = 25 °C Watts	NPN Type	Conditions H_{FE} Min.	Conditions I_C Amps	Conditions V_{CE} Volts	V_{CEsat} Volts	Conditions I_C Amps	Conditions I_B Amps	F_T MHz	f_{test} MHz	Conditions I_C Amps	Conditions V_{CE} Volts
165	7	60	BU407	10	5	1	1	5	0.5	10[1]	1	0.5	10
200	4	80	2N6497	10	2.5	10	1	2.5	0.5	5	1	0.25	10
	7	60	BU406	10	5	1	1	5	0.5	10[1]	1	0.5	10
250	1	40	TIP47	30	0.3	10	1	1	0.2	10	2	0.2	10
	4	80	2N6498	10	2.5	10	1.25	2.5	0.5	5	1	0.25	10
300	0.5	20	TIP63	30	0.05	10	0.6	0.25	0.05	15	2	0.05	10
	1	40	TIP48	30	0.3	10	1	1	0.2	10	2	0.2	10
	4	80	2N6499	10	2.5	10	1.5	2.5	0.5	5	1	0.25	10
			MJE51T	30	0.3	10	2	5	2	2.5	1	0.2	10
		75	MJE13004*	10	1	5	0.5	1	0.2	4	1	0.5	10
	8	80	MJE13006*	8	2	5	1.2	2	0.4	4	1	0.5	10
	12	100	MJE13008*	8	5	5	1.2	5	1	4	1	0.5	10
350	0.5	20	TIP64	30	0.05	10	0.6	0.25	0.05	15	2	0.05	10
	1	40	TIP49	30	0.3	10	1	1	0.2	10	2	0.2	10
	4	80	MJE52T	30	0.3	10	2	5	2	2.5	1	0.2	10
400	1	40	TIP50	30	0.3	10	1	1	0.2	10	2	0.2	10
	4	80	MJE53T	30	0.3	10	2	5	2	2.5	1	0.2	10
		75	MJE13005*	10	1	5	0.5	1	0.2	4	1	0.5	10
	8	80	MJE13007*	8	2	5	1.2	2	0.4	4	1	0.5	10
	12	100	MJE13009*	8	5	5	1.2	5	1	4	1	0.5	10

* Switchmode specifications.
[1] Typical.



SMALL-SIGNAL TRANSISTORS

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Metal Packaged Small-Signal Transistors

500 AND GROWING! That phrase aptly describes the number of different classifications in Motorola's line of small-signal transistors. And with this many device type numbers covering the small-signal transistor spectrum, it is apparent that the actual differences between some devices becomes quite small. Even when the line is divided into its two natural categories – plastic for lowest cost, and metal for hermeticity – the sheer number of devices in each category makes selection by spec-for-spec comparison a significant task. This selector guide, therefore, ignores the large bulk of general-purpose, small-signal type numbers and concentrates on those transistors that have emerged as the best values in various applications categories.

Since the devices highlighted here are the most popular in each category, it follows that they are among the most widely available, at the lowest cost. They are particularly well-suited for new designs where a continuous, off-the shelf supply of product is required.

The reader is reminded, however, that semiconductors are manufactured by "batch" process, and that each "batch" may yield devices with widely varying parameters. This creates device "families". While the various specifications limits assigned to "family members" have been selected on the basis of demonstrated industry need, modern testing methods have made the selection of devices with special characteristics simple and inexpensive. Where the specified characteristics of the devices listed in the following selector guides do not meet a particular design requirement, the designer is requested to contact his nearest Motorola sales representative for price quotations on special devices to fit his needs.

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TO-18 METAL TRANSISTORS (NPN TYPES)

TABLE 1 – GENERAL PURPOSE SWITCH AND AMPLIFIER

Device Type	Polarity	V_{CEO} V_{CER} (+) (V_{DC})	I_C max. (mA)	H_{FE} min.@	I_C (mA)	V_{CE} (V)	$V_{CE(sat)}$@ (Volts)	I_C (mA)	I_B (mA)
BC107	NPN	45	100	110	2	5	0.6	100	5
BC108	NPN	20	100	110	2	5	0.6	100	5
BCY58	NPN	32	200	120	2	5	0.7	100	2.5
BCY59	NPN	45	200	120	2	5	0.7	100	2.5
BSX51	NPN	25	200	75	2	4.5	0.3	50	3
BSX51A	NPN	50	200	75	2	4.5	0.3	50	3
BSX51B	NPN	60	200	75	2	4.5	0.3	50	3
BSX52	NPN	25	200	180	2	4.5	0.3	50	3
BSX52A	NPN	50	200	180	2	4.5	0.3	50	3
BSX52B	NPN	60	200	180	2	4.5	0.3	50	3
2N718	NPN	40(+)	–	40	150	10	1.5	150	15
2N718A	NPN	50(+)	–	40	150	10	1.5	150	15
2N2221	NPN	30	800	40	150	10	0.4	150	15
2N2221A	NPN	40	800	40	150	10	0.3	150	15
2N2222	NPN	30	800	100	150	10	0.4	150	15
2N2222A	NPN	40	800	100	150	10	0.3	150	15

LOW NOISE AMPLIFIER

Device type	Polarity	V_{CEO} (Vdc)	I_C max. (mA)	H_{FE} min.@	I_C (mA)	V_{CE} (Volts)	N_F max. (dB)	F = 1 KHz V_{CE} (Vdc)	F = 1 KHz I_C (mA)
BC109	NPN	20	30	200	2	5	4	5	0.2
2N929	NPN	45	30	40	0.01	5	4	5	0.2
2N930	NPN	45	30	100	0.01	5	4	5	0.2
2N2483	NPN	60	50	100	0.5	5	4	5	0.01
2N2484	NPN	60	50	200	0.5	5	3	5	0.01

TO-18 METAL TRANSISTORS (PNP TYPES)

TABLE 2 – GENERAL PURPOSE SWITCH AND AMPLIFIER

Device Type	Polarity	V_{CEO} (Volts)	I_C max. (mA)	H_{FE} min.@	I_C (mA)	V_{CE} (Volts)	$V_{CE(sat)}$@ Max. (V)	I_C (mA)	I_B (mA)
BC117	PNP	45	100	70	2	5.0	0.6	100	5
BC178	PNP	30	100	70	2	5.0	0.6	100	5
BCY70	PNP	40	200	50	10	10	0.5	50	5
BCY71	PNP	45	200	100	10	10	0.5	50	5
BCY72	PNP	25	200	50	10	10	0.65	50	5
BCY77	PNP	60	100	120	2	5.0	0.8	50	1.25
BCY78	PNP	32	200	120	2	5.0	0.8	100	2.5
BCY79	PNP	45	200	120	2	5.0	0.8	100	2.5
BFW31	PNP	50(V_{CBO})	600	70	100	10	0.4	100	10
BSW21A	PNP	50	200	75	2	4.5	0.5	50	3
BSW22	PNP	25	200	180	2	4.5	0.5	50	3
BSW22A	PNP	50	200	180	2	4.5	0.5	50	3
2N2906	PNP	40	600	40	150	10	0.4	150	15
2N2906A	PNP	60	600	40	150	10	0.4	150	15
2N2907	PNP	40	600	100	150	10	0.4	150	15
2N2907A	PNP	60	600	100	150	10	0.4	150	15

LOW NOISE AMPLIFIER

Device Type	Polarity	V_{CEO} (Volts)	I_C max. (mA)	H_{FE} min.@	I_C (mA)	V_{CE} (Volts)	N_F max.@ (dB)	F = 1 KHz I_C (mA)	R_S = 2 KΩ I_C (mA)
BC179	PNP	20	100	120	2	5	4	0.2	5

F_T min. (MHz)	I_C (mA)	Complementary Type	Comments
150	10	BC177	Exists in A, B, H_{FE} groups
150	10	BC178	Exists in A, B and C, H_{FE} groups
125	10	BCY78	Exists VII, VIII, IX, X, H_{FE} groups
125	10	BCY79	Exists VII, VIII, IX, X, H_{FE} groups
150	10	BSW21	
150	10	BSW21A	
150	10	BSW21B	
150	10	BSW22	
150	10	BSW22A	
150	10	BSW22B	
–	–		
60	50		
250	20	2N2906	
250	20	2N2906A	
250	20	2N2907	
300	20	2N2907A	

F_T min. (MHz)	I_C (mA)	Complementary Type	Comments
150	10	BC179	Exists in B, C, H_{FE} groups
30	0.5		Exists in A, version
30	0.5		Exists in A, version
12	0.05		
15	0.05		

F_T (MHz) + Type min.	I_C (mA)	Complementary Type	Comments
130	10	BC107	Exists VI, A, B, H_{FE} range
130	10	BC108	Exsits A, B, H_{FE} groups
250	10		
200	10		
200	10		
180 +	10	BCY58	Exists VII, VIII, IX, X groups
180 +	10	BCY59	Exists H_{FE} group VII, VIII, IX, X
180 +	10	BCY59	Exists H_{FE} groups VII, VIII, IX
200	50	BFW32	
150	10		
150	10		
150	10		
200	50	2N2221	
200	50	2N2221A	
200	50	2N2222	
200	50	2N2222A	

F_T (MHz)	I_C (mA)	Complementary Type	Comments
130	10	BC109	Exists A, B, C, H_{FE} groups

TO-18 TRANSISTORS

TABLE 3 – FAST SPEED SWITCH NPN

Device Type	Polarity	V_{CEO} V_{CER} (+) (Volts)	I_C max. (mA)	H_{FE}@	I_C (mA)	V_{CE} (Volts)
2N706	NPN	20 (+)		20	10	1
2N708	NPN	15		30	10	1
2N914	NPN	15	150	30	10	1
2N2368	NPN	15	200	20	10	1
2N2369	NPN	15	200	40	10	1
2N2369A	NPN	15	200	40	10	0.35
2N3227	NPN	20	200	100	10	1
BSX90	NPN	12	200	20	10	0.35

TABLE 4 – FAST SPEED SWITCH PNP

2N869A	PNP	18	200	40	30	0.5
2N2894	PNP	12	200	40	30	0.5
2N3012	PNP	12	200	30	30	0.5
2N3546	PNP	12		30	10	1.0
BSX29	PNP	12	200	30	30	0.5

TABLE 5 – CORE DRIVERS NPN

2N4013	NPN	30	1000	25	800	2
2N4014	NPN	50	1000	20	800	2

TABLE 6 – TO-18 HIGH VOLTAGE AMPLIFIERS NPN

Device Type	Polarity	V_{CEO} (Volts)	I_C max. (mA)	H_{FE} min.@	I_C (mA)
BSS71	NPN	200	500	40	30
BSS72	NPN	250	500	40	30
BSS73	NPN	300	500	40	30

TO-18 HIGH VOLTAGE AMPLIFIERS PNP

BSS74	PNP	200	500	35	30
BSS75	PNP	250	500	35	30
BSS76	PNP	300	500	35	30

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TABLE 7 – CHOPPERS PNP

Device Type	Polarity	V_{EBO} (V)	V_{CEO} (Volts)	I_C max. (mA)	H_{FE} min. @	I_C (mA)	V_{CE} (Volts)
2N2944	PNP	15	15	100	80	1.0	0.5
2N2945	PNP	25	25	100	40	1.0	0.5
2N2946	PNP	40	40	100	30	1.0	0.5
BCY92	PNP	20	20	100	40	1	6

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TABLE 8 – HIGH FREQUENCY RF

Device Type	Polarity	V_{CEO} (Volts)	I_C max. (mA)	H_{FE} min.	I_C (mA)	V_{CE} (Volts)
2N918	NPN	15	50	20	3	1
2N4260	PNP	15	30	30	10	1
2N4261	PNP	15	30	30	10	1

$V_{CE(sat)}$ max. (V)	I_C @ (mA)	I_B (mA)	T_{ON} (ns)	T_S (ns)	T_{OFF} @ (ns)	I_C (mA)	I_{B1} (mA)	I_{B2} (mA)	Comments
0.6	10	1	40	25	75	10	3.5	1.7	Exists A, B, Version
0.4	10	1	–	25	–	10	10	10	
0.7	200	20	40	–	40	200	40	20	
0.25	10	1	12	10	15	10	3	15	
0.25	10	1	12	13	18	100	10	10	
0.2	10	1	12	13	18	10	3	15	
0.25	10	1	23	13	28	100	10	10	
1.0	100	10	12	–	40	100	40	20	

0.25	30	1.5	50	65	80	30	1.5	1.5
0.2	30	3	60	–	90	30	1.5	1.5
0.2	30	3	60	–	75	30	1.5	1.5
0.25	50	5	40	20	30	50	5	5
0.5	100	10	60	18	90	30	3	3

0.42	500	50	35	50	60	500	50	50
0.52	500	50	35	50	60	500	50	50

V_{CE} (Volts)	$V_{CE(sat)}$@ (Volts)	I_C (mA)	I_B (mA)	$F_{T(typ)}$ @ (MHz)	I_C (mA)	Complementary Type
10	0.5	50	5	100	20	BSS74
10	0.5	50	5	100	20	BSS75
10	0.5	50	5	100	20	BSS76

10	0.5	50	5	100	20	BSS71
10	0.5	50	5	100	20	BSS72
10	0.5	50	5	100	20	BSS73

I_E = 0					I_E = 0			
$V_{EC(Ofs)}$ (Volts)	I_C (mA)	$H_{FE(Inv)}$ @ –	I_E (mAdc)	V_{EC} (Volts)	$R_{EC(On)}$ (Ohms)	I_B (mA)	I_C (A)	Comments
0.6	1.0	6.0	200	0.5	20	1.0	100	
1.0	1.0	4.0	200	0.5	35	1.0	100	Exists in A Version
2.0	1.0	3.0	200	0.5	45	1.0	100	
–	–							

F_T min. @ MHz	I_C (mA)	G_p@ (dB)	I_C (mA)	V_{CB} (Volts)	H_F max.@ (ns)	I_C (mA)	V_{CE} (Volts)	F MHz
600	4	15	6	12	6	10	6	80
1600	10	15	10	10	0.03	10	10	31.8
2000	10	15	10	10	0.06	10	10	31.8

TO-39 METAL TRANSISTORS (NPN TYPES)

TABLE 9 – AMPLIFIER AND SWITCH

Device Type	Polarity	V_{CEO} V_{CER} + (Vdc)	I_C max.	H_{FE} min.@ –	I_C (mA)	V_{CE} (Vdc)	$V_{CE(sat)}$ max. (Vdc)	I_C (mA)	I_B (mA)
2N1613	NPN	50+	800	40	150	10	1.5	150	15
2N1711	NPN	50+	–	100	150	10	1.5	150	15
2N2218	NPN	30	800	40	150	10	0.4	150	15
2N2218A	NPN	40	800	40	150	10	0.3	150	15
2N2219	NPN	30	800	100	150	10	0.4	150	15
2N2219A	NPN	40	800	100	150	10	0.3	150	15

MEDIUM CURRENT AMPLIFIER AND SWITCH/AUDIO DRIVERS

BFY50	NPN	35	1000	30	150	6	0.2	150	15
BFY51	NPN	30	1000	40	150	6	0.35	150	15
BFY52	NPN	20	1000	50	150	6	0.35	150	15
BSX45	NPN	40	1000	40	100	1	1.0	1000	100
BSX46	NPN	60	1000	40	100	1	1.0	1000	100
BSX47	NPN	80	1000	40	150	1	0.9	500	25
BC140	NPN	40	1000	40	100	1	1.0	1000	100
BC141	NPN	60	1000	40	100	1	1.0	1000	100
2N1893	NPN	80	1000	40	150	10	5.0	150	15
2N2405	NPN	90	1000	60	150	10	0.5	150	15
2N3019	NPN	80	1000	100	150	10	0.2	150	15
2N3020	NPN	80	1000	40	150	10	0.2	150	15
2N3053	NPN	80	700	50	150	10	1.4	150	15

TABLE 10 – VIDEO OUTPUT AND HIGH VOLTAGE AMPLIFIER AND SWITCH

Device Type	Polarity	V_{CEO} (Volts)	I_C max. (mA)	H_{FE} min.@	I_C (mA)	V_{CE} (Volts)	$V_{CE(sat)}$@ (Volts)	I_C (mA)	I_B (mA)
BF257	NPN	160	100	25	30	10	1	30	6
BF258	NPN	250	100	25	30	10	1	30	6
BF259	NPN	300	100	25	30	10	1	30	6
BSS77	NPN	200	500	40	30	10	0.4	30	3
BSS78	NPN	250	500	40	30	10	0.4	30	3

TABLE 11 – CORE DRIVERS

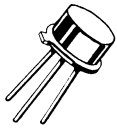
Device Type	Polarity	V_{CEO} (Vdc)	I_C max. (mA)	H_{FE}@ –	I_C (mA)	V_{CE} (Vdc)	$V_{CE(sat)}$@ max. (Vdc)	I_C (mA)	V_{CE} (Volts)
BSX32	NPN	40	1000	60	100	1	0.5	500	50
2N3725	NPN	50	1000	20	800	2	0.6	500	50

TO-39 METAL TRANSISTORS (PNP TYPES)

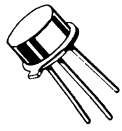
TABLE 12 – GENERAL PURPOSE AMPLIFIER AND SWITCH

Device Type	Polarity	V_{CEO} (Volts)	I_C max. (mA)	H_{FE} min.@ –	I_C (mA)	V_{CE} (Volts)	$V_{CE(sat)}$@ (Vdc)	I_C (mA)	V_{CE} (Volts)
2N2904	PNP	40	800	40	150	10	0.4	150	15
2N2904A	PNP	60	800	40	150	10	0.4	150	15
2N2905	PNP	40	800	100	150	10	0.4	150	15
2N2905A	PNP	60	800	100	150	10	0.4	150	15

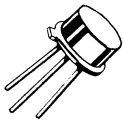
F_T min.@ (MHz)	I_C (mA)	Complementary Type	Comments
60	50		
70	50		
250	20	2N2904	
250	20	2N2904A	
250	20	2N2905	
250	20	2N2905A	



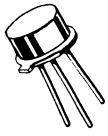
60	50		
50	50		
50	50		
50	50		Exists in -6, -10, -16 H_{FE} groups
50	50		Exists in -6, -10, -16 H_{FE} groups
50	50		
50	50		Exists in -6, -10, -16 H_{FE} groups
50	50		Exists in -6, -10, -16 H_{FE} groups
50	50		
—	—		
100	50		
80	50		
100	50	2N4890	Exists A Version



F_T Type@ (MHz)	I_C (mA)	C_{OB} max. (pF)
110	30	5.5
110	30	5.5
110	30	5.5
70	20	5.5
70	20	5.5



T_{ON} (ns)	T_S (ns)	T_{OFF} (ns)	I_C (mA)	I_{B1} (mA)	I_{B2} (mA)	Complementary Type
60	50	60	500	50	50	
35	50	60	500	50	50	2N3765



F_T min.@ (MHz)	I_C (mA)	Complementary Type
200	50	2N2218
200	50	2N2218A
200	50	2N2219
200	50	2N2219A

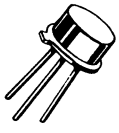


TABLE 13 – MEDIUM CURRENT AMPLIFIER, SWITCH AND AUDIO DRIVER

Device Type	Polarity	V_{CEO} (Volts)	I_C max. (mA)	H_{FE} min.@ –	I_C (mA)	V_{CE} (Volts)	$V_{CE(sat)}$@ (Vdc)	I_C (mA)	V_{CE} (Volts)
BC160	PNP	40	1000	40	100	1	1.0	1000	100
BC161	PNP	60	1000	40	100	1	1.0	1000	100
BFX38	PNP	55	1000	85	100	5	0.15	150	15
BFX39	PNP	55	1000	40	100	5	0.15	150	15
BFX40	PNP	75	1000	85	100	5	0.15	150	15
BFX41	PNP	75	1000	40	100	5	0.15	150	15
2N4032	PNP	60	1000	100	100	5	0.5	500	50
2N4033	PNP	80	1000	100	100	5	0.5	500	50
2N4404	PNP	80	1000	40	150	1	0.2	150	15
2N4405	PNP	80	1000	100	150	1	0.2	150	15
2N4406	PNP	80	2000	25	150	1	0.2	150	15
2N4407	PNP	80	2000	75	150	1	0.2	150	15
2N4890	PNP	40	700	50	150	10	0.4	150	15

TABLE 14 – HIGH VOLTAGE AMPLIFIER AND SWITCH

Device Type	Polarity	V_{CEO} (Volts)	I_C max. (mA)	H_{FE} min.@	I_C (mA)	V_{CE} (Volts)	$V_{CE(sat)}$@ (Volts)	I_C (mA)	I_B (mA)
2N3634	PNP	140	1000	50	50	10	0.5	50	5
2N3635	PNP	140	1000	100	50	10	0.5	50	5
2N3636	PNP	175	1000	50	50	10	0.5	50	5
2N3637	PNP	175	1000	100	50	10	0.5	50	5
2N3743	PNP	300	500	25	30	10	5	10	1
2N4929	PNP	150	500	25	10	10	0.5	10	1
2N4930	PNP	200	500	25	10	10	0.5	10	1
2N4931	PNP	250	500	20	10	10	0.5	10	1

TO-39 POWER TRANSISTORS

Device Type	Polarity	V_{CEO}	I_C max. (Amr)	P_D* (Watts)	H_{FE} min.@	I_C (mA)	V_{CE} (Volts)	$V_{CE(sat)}$@ (Volts)	I_C (mA)	I_B (mA)
2N3439	NPN	350	1	5	40	20	10	0.5	50	4
2N3440	NPN	250	1	5	40	20	10	0.5	50	4
2N5415	PNP	200	1	5	30	50	10	2.5	50	5
2N5416	PNP	300	1	5	30	50	10	2.5	50	5
2N5679	PNP	100	1	10	40	250	2	0.6	250	25
2N5680	PNP	120	1	10	40	250	2	0.6	250	25
2N5681	NPN	100	1	10	40	250	2	0.6	250	25
2N5682	NPN	120	1	10	40	250	2	0.6	250	25
2N4234	PNP	40	3	6	30	250	1	0.6	1000	125
2N4235	PNP	60	3	6	30	250	1	0.6	1000	125
2N4236	PNP	80	3	6	30	250	1	0.6	1000	125
2N4237	NPN	40	3	6	30	250	1	0.3	500	50
2N4238	NPN	60	3	6	30	250	1	0.3	500	50
2N4239	NPN	80	3	6	30	250	1	0.3	500	50

* P_D at 25 °C case temp.

TO-39 DARLINGTONS TRANSISTORS

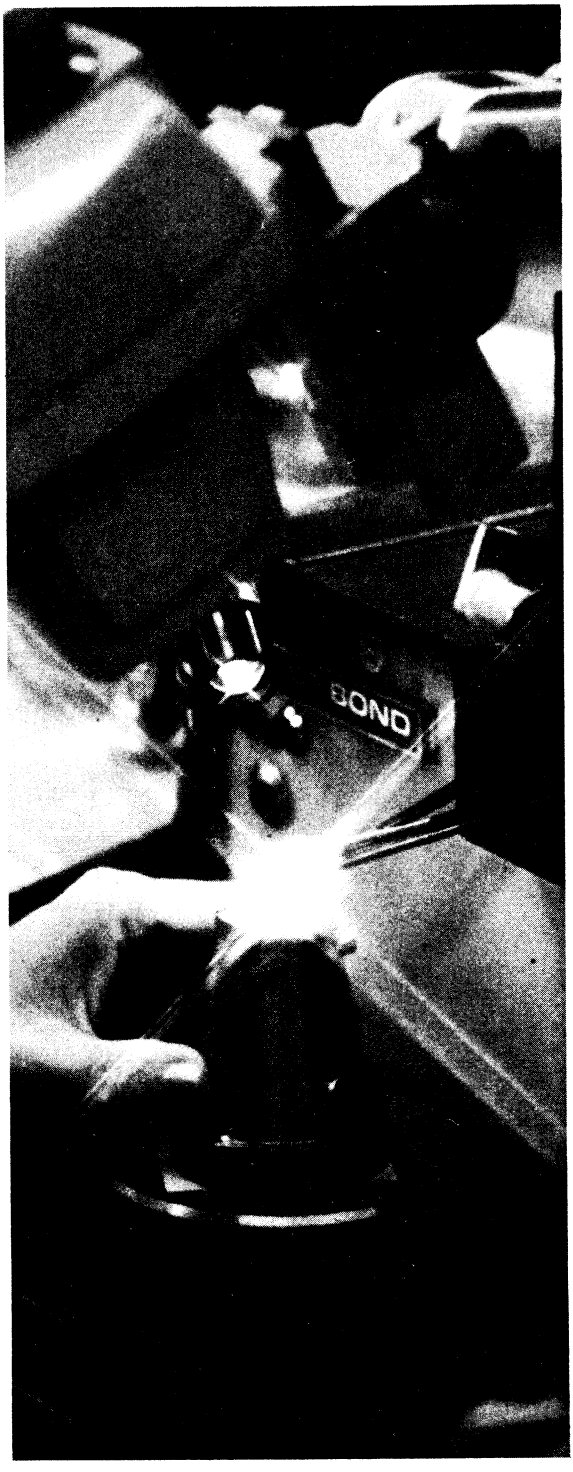
Device Type	Polarity	V_{CER} R = 100 (Volts)	I_C max. (mA)	H_{FE} =	I_C (mA)	V_{CE} (Volts)	$V_{CE(sat)}$ max. (Volts)	I_C (mA)	I_B (mA)
BSS50	NPN	45	1000	1500	500	10	1.6	1000	4
BSS51	NPN	60	1000	1500	500	10	1.6	1000	4
BSS52	NPN	80	1000	1500	500	10	1.6	1000	4

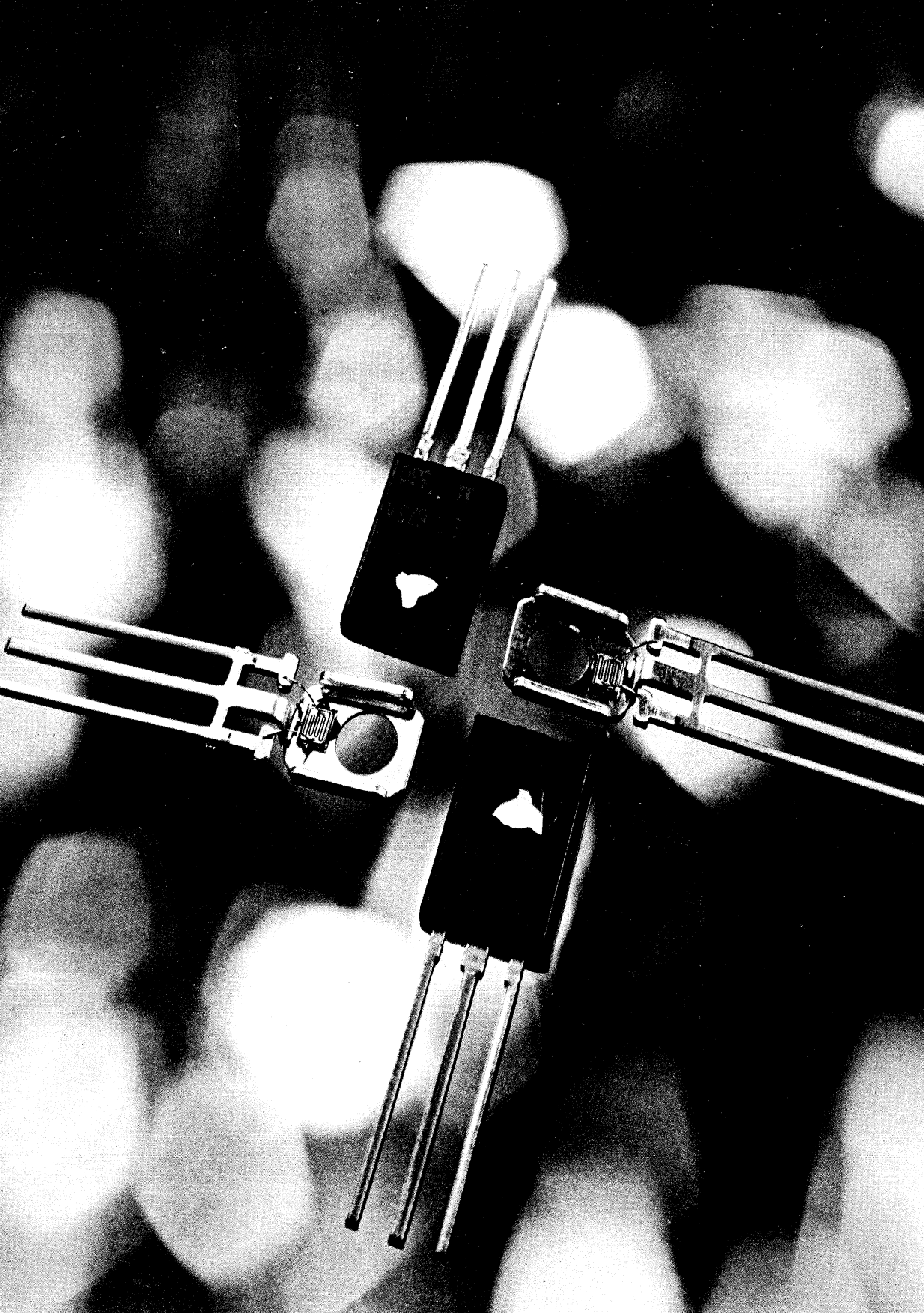
F_T min.@ (MHz)	I_C (mA)	Complementary Type
50	50	Exists in -6, -10, -16 H_{FE} groups
50	50	Exists in -6, -10, -16 H_{FE} groups
100	50	
100	50	BFY56A
100	50	
100	50	
100	50	
100	50	
200	50	
200	50	
150	50	
150	50	
100	50	2N3053

F_T (MHz)	I_C (mA)	T_{ON} max. (ns)	T_{OFF} max. (ns)
150	30	400	600
200	30	400	600
150	30	400	600
200	30	400	600
30	10	–	–
100	20	–	–
20	20	–	–
20	20	–	–

F_T (MHz)	I_C (mA)	Complementary Type	Comments
15	10	2N5416	
15	10	2N5415	High voltage
15	10	2N3440	
15	10	2N3439	
30	100	2N5681	
30	100	2N5682	Medium voltage
30	100	2N5679	
30	100	2N5680	
3	100	2N4237	
3	100	2N4238	
3	100	2N4239	Low voltage
2	100	2N4234	
2	100	2N4235	
2	100	2N4236	

$F_{T(Typ)}$ (MHz)	I_C (mA)
350	500
350	500
350	500





Plastic Encapsulated Small-Signal Transistors

The Small-Signal Plastic Transistors represent Motorola's broadest product line. From RF/VHF/UHF amplifiers, mixers, oscillators and switches to general-purpose amplifiers and switches, all are available as standard product or custom specials. Specialty devices for the industrial, computer or consumer market as well as a specialty package—the MiniBloc—are all available for unique high technology applications. The following list demonstrates the many applications possible with plastic transistors. If specific applications are not listed, consult your factory representative for assistance.

TABLE OF CONTENTS

SOT-23 Package

TABLE 1 – (NPN) GENERAL PURPOSE SWITCH & AMPLIFIER (SOT-23)

Device Type	Polarity	V_{CEO} (Vdc)	I_C max. (mA)	H_{FE}@ min.-max	I_C (mA)	V_{CE} (V)	$V_{CE(sat)}$@ V max.	I_C (mA)	I_B (mA)
BCW31	NPN	30	200	110-220	2	5	0.25	10	0.5
BCW32	NPN	30	200	200-450	2	5	0.25	10	0.5
BCW33	NPN	30	200	420-800	2	5	0.25	10	0.5
BCW60, A, B, C, D	NPN	32	200	120-630	2	5	0.35	10	0.25
MMBT3904	NPN	40	200	100-300	10	1	0.20	10	1.0
BCW71	NPN	45	200	110-220	2	5	0.25	10	0.5
BCW72	NPN	45	200	200-450	2	5	0.25	10	0.5
BCX70, G, H, J, K	NPN	45	100	120-630	2	5	0.35	10	0.25

TABLE 2 – (NPN) MEDIUM POWER & SWITCH (SOT-23)

Device Type	Polarity	V_{CEO} (Vdc)	I_C max. (mA)	H_{FE}@ min.-max.	I_C (mA)	V_{CE} (V)	$V_{CE(sat)}$@ (V)	I_C (mA)	I_B (mA)
BCW65, A, B, C	NPN	32	800	100-630	100	1	0.3	100	10
BCW66, F, G, H	NPN	45	800	100-630	100	1	0.3	100	10
MMBT2222	NPN	30	800	100-300	150	10	0.4	150	15
BCX20	NPN	20	1000	100-600	100	1	0.62	500	50
BCX19	NPN	45	1000	100-600	100	1	0.62	500	50
MMBTA06	NPN	80	500	50	100	1	0.25	100	10

TABLE 3 – (NPN) HIGH VOLTAGE AMPLIFIER (SOT-23)

Device Type	Polarity	V_{CEO} (Vdc)	I_C max. (mA)	H_{FE} min.@ min.	I_C (mA)	V_{CE} (V)	$V_{CE(sat)}$@ (V)	I_C (mA)	I_B (mA
MMBTA42	NPN	300	500	40	10	10	0.5	20	2.0

TABLE 4 – (NPN) DARLINGTON (SOT-23)

Device Type	Polarity	V_{CEO} (Vdc)	I_C max. (mA)	H_{FE}@ min.-max.	I_C (mA)	V_{CE} (V)	$V_{CE(sat)}$@ (V)	I_C (mA)	I_B (mA)
MMBTA13	NPN	30	500	5000	10	5.0	1.5	100	0.1
MMBTA14	NPN	30	500	10000	10	5.0	1.5	100	0.1

f_T@ + Typ min. (MHz)	I_C (mA)	Complementary Type	Comments
+300	10	BCW29	
+300	10	BCW30	
125	10		Available in different H_{FE} groups
125	10		
200	10	MMBT3906	
+300	10	BCW69	
+300	10	BCW70	
125	10		Available in different H_{FE} groups

f_T@ +Typ min. (MHz)	I_C (mA)	Complementary Type	Comments
100	20	BCW67	Available in different H_{FE} groups
100	20	BCW68	Available in different H_{FE} groups
250	20	MMBT2907	
+200	10	BCX18	
+200	10	BCX17	
100	10	MMBTA56	

f_T@ (MHz)	I_C (mA)	Complementary Type	Comments
50	10	MMBTA92	

f_T@ (MHz)	I_C (mA)	Complementary Type	Comments
125	10		
125	10		

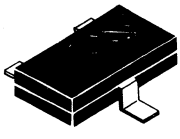


TABLE 5 – (NPN) HIGH FREQUENCY RF (SOT-23)

Device Type	Polarity	V_{CEO} (Vdc)	I_C max. (mA)	H_{FE}@ min.-max.	I_C (mA)	V_{CE} (V)	$V_{CE(sat)}$@ (V)	I_C (mA)	I_B (mA)
MMBT918	NPN	15	50	20	3.0	1.0	0.4	10	1

TABLE 6 – (NPN) HIGH SPEED SWITCH (SOT-23)

Device Type	Polarity	V_{CEO} (Vdc)	I_C max. (mA)	H_{FE}@ min.-max.	I_C (mA)	V_{CE} (V)	$V_{CE(sat)}$@ (V)	I_C (mA)	I_B (mA)
MMBT2369	NPN	15	200	40-120	10	1	0.25	10	1

TABLE 7 – (PNP) GENERAL PURPOSE AMPLIFIER & SWITCH (SOT-23)

Device Type	Polarity	V_{CEO} (Vdc)	I_C max. (mA)	H_{FE}@ min.-max.	I_C (mA)	V_{CE} (V)	$V_{CE(sat)}$@ (V)	I_C (mA)	I_B (mA)
BCW29	PNP	20	200	120-260	2	5	0.3	10	0.5
BCW30	PNP	20	200	215-500	2	5	0.3	10	0.5
BCW61, A, B, C, D	PNP	32	200	120-630	2	5	0.25	10	0.5
MMBT3906	PNP	40	200	100-300	10	1	0.25	10	1
BCW69	PNP	45	200	120-260	2	5	0.3	10	0.5
BCW70	PNP	45	200	215-500	2	5	–	–	–
BCX71, G, H, J, K	PNP	45	200	120-630	2	5	0.25	10	0.5

TABLE 8 – (PNP) MEDIUM POWER & SWITCH (SOT-23)

Device Type	Polarity	V_{CEO} (Vdc)	I_C max. (mA)	H_{FE}@ min.-max	I_C (mA)	V_{CE} (V)	$V_{CE(sat)}$@ (V)	I_C (mA)	I_B (mA)
BCW67, A, B, C	PNP	32	800	100-630	100	1	0.3	100	–
BCW68, F, G, H	PNP	45	800	100-630	100	1	0.3	100	–
MMBT2907	PNP	40	800	100-300	150	10	0.4	150	15
MMBT2907A	PNP	60	800	100-300	150	10	0.4	150	15
BCX17	PNP	45	1000	100-600	100	1	0.62	500	50
BCX18	PNP	25	1000	100-600	100	1	0-62	500	50
MMBTA56	PNP	80	500	50	100	1	0.25	100	10

TABLE 9 – (PNP) HIGH VOLTAGE AMPLIFIER (SOT-23)

Device Type	Polarity	V_{CEO} (V)	I_C max. (mA)	H_{FE} min.@ –	I_C (mA)	V_{CE} (V)	$V_{CE(sat)}$@ (V)	I_C (mA)	I_B (mA)
MMBTA92	PNP	300	500	40	10	10	0.5	20	2.0

f_T@ (MHz)	I_C (mA)
600	4.0

f_T@ (MHz)	I_C (mA)	t_{on} (ns)	t_{off} (ns)	t_s (ns)
500	10	12	18	13

f_T@ +Typ min. (MHz)	I_C (mA)	Complementary Type	Comments
+150	10	BCW31	
+150	10	BCW32	
+180	10	BCW60	Exists in different H_{FE} groups
250	10	MMBT3904	
+150	10	BCW71	
+150	10	BCW72	
+180	10	BCX70	Exists in different H_{FE} groups

f_T@ +Typ min. (MHz)	I_C (mA)	Complementary Type	Comments
100	80	BCW65	Available in several H_{FE} groups
100	80	BCW66	
200	50	MMBT2222	
200	50		
+100	10	BCX19	
+100	10	BCX20	
100	10	MMBTA06	

f_T@ (MHz)	I_C (mA)	Complementary Type
50	10	MMBTA42

TO-92 Package

TABLE 1 – GENERAL PURPOSE AMPLIFIER TRANSISTORS (TO-92)

The general purpose Transistors are designed for small-signal amplification from D.C. to low radio frequencies. They are also useful as oscillators and general purpose switches.

NPN	PNP	BV_{CEO} (Volts)	P_d (mW)	I_C max. (mA) Cont.	H_{FE}@		I_C	V_{CE}	F_T Typ. MHz	N_F Max. (dB)	Pin Out
					Min.	Max.	(mA)	(Volts)			
BC182	BC212	50	625	100	120	460	2.0	5.0	200	10	CBE
BC182A	BC212A	50	625	100	120	220	2.0	5.0	200	10	CBE
BC182B	BC212B	50	626	100	180	460	2.0	5.0	200	10	CBE
BC237	BC307	45	625	100	120	460	2.0	5.0	200	10	CBE
BC237A	BC307A	45	625	100	120	220	2.0	5.0	200	10	CBE
BC237B	BC307B	45	625	100	180	460	2.0	5.0	200	10	CBE
BC237C	BC307C	45	625	100	380	800	2.0	5.0	200	10	CBE
BC238	BC308	25	625	100	120	800	2.0	5.0	200	10	CBE
BC238A	BC308A	25	625	100	120	220	2.0	5.0	200	10	CBE
BC238B	BC308B	25	625	100	180	460	2.0	5.0	200	10	CBE
BC238C	BC308C	25	625	100	380	800	2.0	5.0	200	10	CBE
BC239	BC309	45	625	100	180	800	2.0	5.0	240	4	CBE
BC239A	BC309A	45	625	100	120	220	2.0	5.0	240	4	CBE
BC239B	BC309B	45	625	100	180	460	2.0	5.0	240	4	CBE
BC239C	BC309C	45	625	100	380	800	2.0	5.0	240	4	CBE
BC546	BC556	65	625	100	120	450	2.0	5.0	300	10	CBE
BC546A	BC556A	65	625	100	120	220	2.0	5.0	300	10	CBE
BC546B	BC556B	65	625	100	180	450	2.0	5.0	300	10	CBE
BC547	BC557	45	625	100	120	450	2.0	5.0	300	10	CBE
BC547A	BC557A	45	625	100	120	220	2.0	5.0	300	10	CBE
BC547B	BC557B	45	625	100	180	450	2.0	5.0	300	10	CBE
BC547C	BC557C	45	625	100	380	800	2.0	5.0	300	10	CBE
BC548	BC558	30	625	100	120	800	2.0	5.0	300	10	CBE
BC548A	BC558A	30	625	100	120	220	2.0	5.0	300	10	CBE
BC548B	BC558B	30	625	100	180	450	2.0	5.0	300	10	CBE
BC548C	BC558C	30	625	100	380	800	2.0	5.0	300	10	CBE

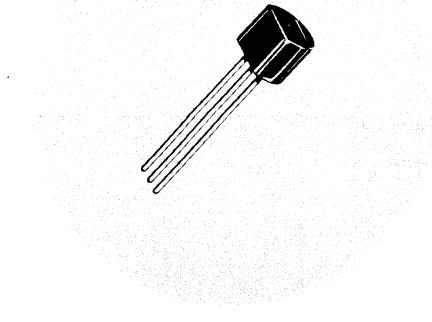


TABLE 2 – LOW NOISE AND GOOD H_{FE} LINEARITY

These devices are designed to use on applications where good H_{FE} linearity and low noise characteristics are required: Instrumentation, Hi-Fi Preamplifier.

NPN	PNP	BV_{CEO} (Volts) Amb.	P_d mW 25 °C Min.	H_{FE}@ (10 μA) I_C = 10 A, V_{CE} = 5 V Min.	Typ.	H_{FE}@ I_C = 2mA, V_{CE} = 5 V Min.	Max.	V_T 120 Hz[1] Typ.	mV Max.	N_F (dB)[2] Typ.	Max.	F_T Typ. (MHz)	Pinning
BC239	BC309	45	625	–	–	120	800	9.5	–	2	4	240	CBE
BC239A	BC309A	45	625	–	90	120	220	9.5	–	2	4	240	CBE
BC239B	BC309B	45	625	–	150	180	460	9.5	–	2	4	240	CBE
BC239C	BC309C	45	625	–	270	380	800	9.5	–	2	4	240	CBE
BC413	BC415	30	625	100	–	180	800	8	12	0.6	2.5	250	CBE
BC413B	BC415B	30	625	100	150	180	460	8	12	0.6	2.5	250	CBE
BC413C	BC415C	30	625	100	270	380	800	8	12	0.6	2.5	250	CBE
BC414	BC416	45	625	100	–	180	800	8	12	0.6	2.5	250	CBE
BC414B	BC416B	45	625	100	150	180	460	8	12	0.6	2.5	250	CBE
BC414C	BC416C	45	625	100	270	380	800	8	12	0.6	2.5	250	CBE
BC549	BC559	30	625	100	–	180	800	8	12	0.6	2.5	250	CBE
BC549B	BC559B	30	625	100	150	180	460	8	12	0.6	2.5	250	CBE
BC549C	BC559C	30	625	100	270	380	800	8	12	0.6	2.5	250	CBE
BC550	BC560	45	625	100	–	180	800	8	12	0.6	2.5	250	CBE
BC550B	BC560B	45	625	100	150	180	460	8	12	0.6	2.5	250	CBE
BC550C	BC560C	45	625	100	270	380	800	8	12	0.6	2.5	250	CBE
BC650	–	30	625	–	–	380	1400	–	7.6(6.8*)	–	1(§)	300	EBC
BC650C	–	30	625	–	–	380	820	–	7.6(6.8*)	–	1(§)	300	EBC
BC650D	–	45	625	–	–	680	1400	–	7.6(6.8*)	–	1(§)	300	EBC
BC651	–	45	625	–	–	380	1400	–	7.6(6.8*)	–	1(§)	300	EBC
BC651C	–	45	625	–	–	380	820	–	7.6(6.8*)	–	1(§)	300	EBC
BC651D	–	45	625	–	–	680	1400	–	7.6(6.8*)	–	1(§)	300	EBC
MPSA18	–	45	625	400	500	500	–	7	–	–	1.5	160	EBC

[1] V_T: Total Input Noise Voltage (see Application Note, BC413/BC414 and BC415/BC416 Data Sheets) at R_S = 2 KΩ, I_C = 200 μA, V_{CE} = 5 Volts.
[2] N_F: Noise Figure at R_S = 2K, I_C = 200 μA, V_{CE} = 5 Volts. F = 30 Hz to 15 KHz.
* "S" Version
§ @ 1 KHz.

TABLE 3 – HIGH CURRENT AMPLIFIER TRANSISTORS (TO-92)

Useful in Low Power Audio Output Stages and Medium Current Switches.

NPN	PNP	BV_{CEO} (Volts)	P_D mW 25 °C Amb.	I_C (mA) Cont.	Min.	H_{FE}@ Max.	I_C (mA)	V_{CE} (Volts)	F_T Typical (MHz)	Pinning
BC337	BC327	45	625	800	100	600	100	1	210	CBE
BC337-16	BC327-16	45	625	800	100	250	100	1	210	CBE
BC337-25	BC327-25	45	625	800	160	400	100	1	210	CBE
BC337-40		45	625	800	250	600	100	1	210	CBE
BC338	BC328	25	625	800	100	600	100	1	210	CBE
BC338-16	BC328-16	25	625	800	100	250	100	1	210	CBE
BC338-25	BC328-25	25	625	800	160	400	100	1	210	CBE
BC338-40		25	625	800	250	600	100	1	210	CBE
BC445	BC446	60	625	300	70	–	10	5	250/200[1]	CBE
BC447	BC448	80	625	300	70	–	10	5	250/200[1]	CBE
BC449	BC450	100	625	300	70	–	10	5	250/200[1]	CBE
BC485	BC486	45	625	1000	60	400	100	2	200/150[1]	CBE
BC485A	BC486A	45	625	1000	100	250	100	2	200/150[1]	CBE
BC487	BC488	60	625	1000	60	400	100	2	200/150[1]	CBE
BC487A	BC488A	60	625	1000	160	250	100	2	200/150[1]	CBE
BC489	BC490	80	625	1000	60	400	100	2	200/150[1]	CBE
BC489A	BC490A	80	625	1000	100	250	100	2	200/150[1]	CBE
MPSA05	MPSA55	60	625	500	50	–	100	1	150/175[1]	EBC
MPSA06	MPSA56	80	625	500	50	–	100	1	150/175[1]	EBC

TABLE 4 – HIGH VOLTAGE AMPLIFIER TRANSISTORS (TO-92)

These high-voltage transistors are designed for driving neon bulbs and Nixie® indicator tubes, for direct line operation, and for other applications requiring high-voltage capability at relatively low collector current. These devices are listed in order of decreasing breakdown voltage (BV_{CEO}).

Device Type	BV_{CEO} Volts Min.	I_C Amp Cont.	h_{FE} Min.	@ I_C mA	$V_{CE(sat)}$ Volts Max.	@ I_C mA	& I_B mA	f_T MHz Min.	@ I_C mA
NPN									
BF393	300	0.5	40	10	0.2	20	2	50	10
MPS-A42	300	0.5	40	30	0.5	20	2	50	10
BF392	250	0.5	40	10	0.2	20	2	50	10
BF391	200	0.5	40	10	0.2	20	2	50	10
MPS-A43	200	0.5	40	10	0.4	20	2	50	10
MPS-D01	200	0.1	20	30				40	10
2N5551	160	0.6	80	10	0.15	10	1	100	10
2N5550	140	0.6	60	10	0.15	10	1	100	10
MPS-D02	140	0.05	20	30				40	10
MPS-D03	100	0.05	50	10	0.2	10	1	60	10
MPS-L01	100	0.05	20	30				40	10
PNP									
BF493	300	0.5	40	10	0.2	20	2	50	10
MPS-A92	300	0.5	40	10	0.5	20	2	50	10
BF492	250	0.5	40	10	0.2	20	2	50	10
BF491	200	0.5	40	10	0.2	20	2	50	10
MPS-A93	200	0.5	40	10	0.4	20	2	50	10
MPS-D51	200	0.1	20	30				40	10
2N5401	150	0.6	60	10	0.2	10	1	100	10
MPS-D52	140	0.05	20	30				40	10
2N5400	120	0.6	40	10	0.2	10	1	100	10
MPS-D53	100	0.05	20	30				40	10
MPS-L51	100	0.6	40	50	0.25	10	1	60	10

TABLE 5 – INDUSTRIAL TRANSISTORS (TO-92)

These devices are special products ranges intended for use in applications wich require well specified high performing devices like high quality amplifier differential input, driver stage.

NPN	PNP	BV_{CEO} (Volts)	P_D mW 25 °C Amb.	I_C (mA) Cont.	H_{FE} Min.	H_{FE} Max.	@ I_C (mA)	V_{CE} (Volts)	F_T Typ. (MHz)	N_F Typ. (dB)	Pin Out	T_{ON} Typ. (nS)	T_{OFF} Typ. (nS)
BCX25	BCX26	60	625	200	70	400	10	5	250	2	CBE	70	1000/600
BCX27	BCX28	80	625	200	70	400	10	5	250	2	CBE	70	1000/600
BCX29	BCX30	100	625	200	70	400	10	5	250	2	CBE	70	1000/600
BCX45	BCX46	45	625	1000	50	–	100	2	150	2	CBE	30	380
BCX47	BCX48	60	625	1000	50	–	100	2	150	2	CBE	30	380
BCX49	BCX50	80	625	1000	50	–	100	2	150	2	CBE	30	380
BCX58	BCX78	32	625	200	120	630	2	5	250	2	CBE	75	600/350
BCX58-8	BCX78-8	32	625	200	180	310	2	5	250	2	CBE	75	600/350
BCX58-9	BCX78-9	32	625	200	250	460	2	5	250	2	CBE	75	600/350
BCX59	BCX79	45	625	200	120	630	2	5	250	2	CBE	75	600/350
BCX59-8	BCX79-8	45	625	200	180	310	2	5	250	2	CBE	75	600/350
BCX59-9	BCX79-9	45	625	200	250	460	2	5	250	2	CBE	75	600/350
BCX73	BCX75	32	625	800	100	630	100	1	100*	10[1]	CBE	60[1]	150[1]
BCX73-16	BCX75-16	32	625	800	100	250	100	1	100*	10[1]	CBE	60	150
BCX73-25	BCX75-25	32	625	800	160	400	100	1	100*	10[1]	CBE	60	150
BCX73-40		32	625	800	250	630	100	1	100*	10[1]	CBE	60	150
BCX74	BCX76	45	625	800	100	630	100	1	100*	10[1]	CBE	60	150
BCX74-16	BCX76-16	45	625	800	100	250	100	1	100*	10[1]	CBE	60	150
BCX74-25	BCX76-25	45	625	800	160	400	100	1	100*	10[1]	CBE	60	150
BCX74-40		45	625	800	250	630	100	1	100*	10[1]	CBE	60	150
	MPS2907	40	625	600	75	–	10	10	200*	–	EBC	26	70
MPS2222		30	625	600	75	–	10	10	250*	–	EBC	–	–

* f_T Min.
[1] Max.

TABLE 6 – RF TRANSISTORS (TO-92 AND MACRO T)

The RF transistors are designed for Small Signal amplification from RF to VHF/UHF frequencies. They are also used as mixers and oscillators in the same frequency ranges. Several types are AGC characterised.

AM/FM NPN	PNP	Pin Out	BV_{CEO} min. Volts	P_d max. mW	I_C max. mA	H_{FE} Min.	@ I_C mA	V_{CE} Volts	F_T min. MHz	C_{RE} C_{RB} pF	C_{OB} pf	P_G Typ. dB	N_F dB	F MHz
BF198 (+)		CEB	30	625	25	27	4	10	800(§)	0.2(§)			3.0(§)	36
BF199		CEB	25	625	100	40	7	10	750(§)	0.28(§)				
BF241/240		CEB	20	625	100	65	1	10	260(§)	0.95(§)			1.7(§)	1
BF254		CEB	40	625	25	35	1	10	400	0.34				
BF254-3		CEB	20	625	100	65	1	10	260(§)	0.95(§)			1.7(§)	1
BF254-4		CEB	20	625	100	100	1	10	260(§)	0.95(§)			1.7(§)	11
BF255		CEB	20	625	100	35	1	10	200(§)	0.95(§)			1.7(§)	1
BF255-2		CEB	20	625	100	35	1	10	200(§)	0.95(§)			1.7(§)	1
BF255-3		CEB	20	625	100	65	1	10	200(§)	0.95(§)			1.7(§)	1
BF368		EBC	15	625	50	35	1	10	250	0.95(§)			4.0	100
BF369		EBC	20	625	50	70	1	10	400	0.95(§)	1.7		4.0	100
BF371		BEC	30	625	100	40	1	10	500	0.23(§)	1.7			
BF373		BEC	45	625	100	40	1	10	720(§)	0.32				
BF224		CEB	30	625	25	30	7	10	300	28(§)			2.5(§)	100
													3.5(§)	200
MPS918		EBC	15	625	100	20	3.0	10	600		1.7	15	6.0	60
MPSH05		EBC	80	625	100	30	1.5	10	180(§)	1.6			1.7	1
VHF														
	MPSH54	EBC	80	625	100	30	1.5	10	185(§)	1.6			2.0	1
BF366		EBC	25	625	25	75	3	10	400	0.3		30	3.2	100
BF374		BEC	25	625	100	70			800	0.6		20	4.0(§)	100
BF375		BEC	25	625	100	35			800	0.6		20	4.0(§)	100
BF375C		BEC	25	625	100	70			800	0.6		20	4.0(§)	100
BF375D		BEC	25	625	100	35	1	10	800	0.6		20	4.0(§)	100
	UHF													
	BF506	CBE	35	625	50	20	3	10	400	0.25		22	4	200
	BF509	CBE	35	625	50	20	3	10	600	0.25		22	2.5	200
	BF479*		30	350		20	1.0	10	1900(§)	0.67(§)		22	6	800
	BF679*		35	350		35	3	10	850(§)	0.4(§)		17	5	800
	BF680*		35	350		35	3	10	850(§)	0.4(§)		17	5(§)	800

(+) AGC Characteristics (§) Typical * Macro "T"

TABLE 7 – HIGH-SPEED SATURATED SWITCHING TRANSISTORS

The transistors listed in this table are specially optimized for high-speed saturated switches. They are heavily gold doped and processed to provide very short switching times and low output capacitance (below 6 pF). The transistors are listed in order of decreasing turn-on time (t_{on}).

Device Type	t_{on} ns Max.	& t_{off} ns Max.	@ I_C mA	BV_{CEO} Volts Min.	h_{FE} Min.	@ I_C mA	$V_{CEO(sat)}$ Volts Max.	@ I_C mA	& I_B mA	f_T MHz Min.	@ I_C mA
NPN											
2N3904	70	250	10	40	100	10	0.2	10	1	300	10
2N3903	70	225	10	40	50	10	0.2	10	1	250	10
2N4400	35	255	150	40	50	150	0.4	150	15	200	20
MPS3646	18	28	300	15	30	30	0.2	30	3	350	30
MPS3013	15	25	300	15	15	300	0.5	300	30	350	30
MPS2369	12	18	10	15	40	10	0.25	10	1	500	10
PNP											
MPS404	265*	385*	10	12[1]	30	12	0.2	24	1	–	–
MPS404A	265*	385*	10	25[1]	30	12	0.2	24	1	–	–
2N3906	70	250	10	40	100	10	0.25	10	1	250	10
2N3905	70	225	10	40	100	10	0.25	10	1	200	10
2N4402	35	255	150	40	50	150	0.4	150	15	150	20
MPS3640	25	35	50	12	30	10	0.2	10	1	500	10
MPS4257	15	15	10	6	30	50	0.15	10	1	500	10
MPS4258	15	20	10	12	30	50	0.15	10	1	700	10

TABLE 8 – DARLINGTON TRANSISTORS (TO-92)

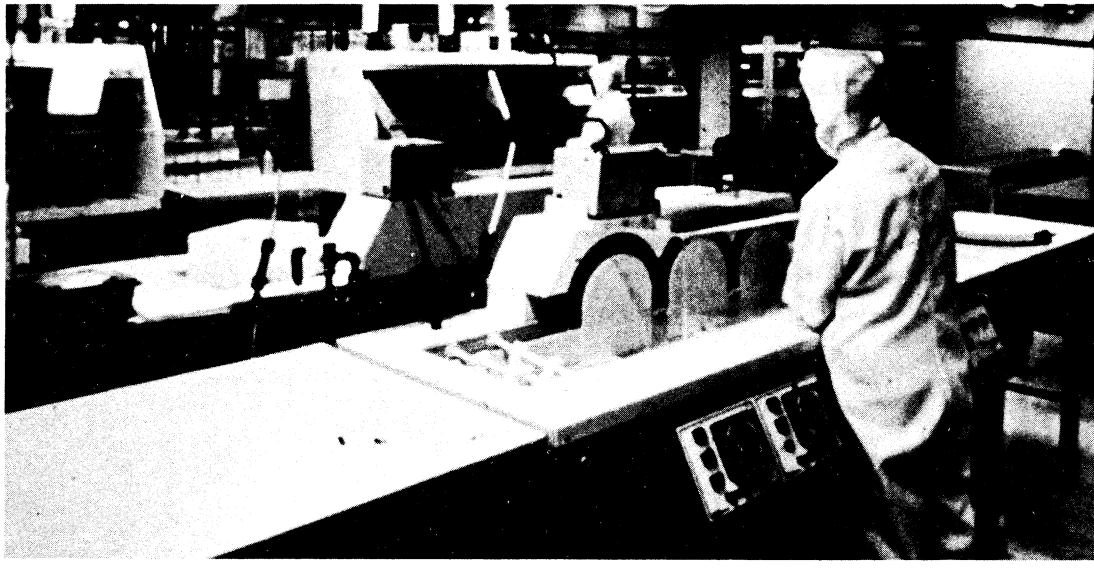
Darlington amplifiers are cascade transistors used in applications requiring very high gain and input impedance. These devices have monolithic construction and are listed in order of decreasing voltage (BV_{CEO}).

Device and Polarity NPN	PNP	BV_{CEO} Volts Min.	h_{FE} @ I_C Min.	mA	I_C mA Cont.	f_T MHz @ I_C Min.	mA	NF dB	$V_{CE(sat)}$ Volts @ I_C Max.	mA	& I_B mA
BC372		100	5000	1000	1000	100	100	2(typ)	1	250	0.25
BC373		80	5000	1000	1000	100	100	2(typ)	1	250	0.25
2N6426		40	30000	100	500	150	10	10	1.5	500	0.5
2N6427		40	20000	100	500	130	10	10	1.5	500	0.5
MPS-A14	MPS-A64	30	20000	100	500	125	10	2(typ)	1.5	100	0.1
MPS-A13	MPS-A63	30	10000	100	500	125	10	2(typ)	1.5	100	0.1
MPS-D04	MPS-D54	25	1000	100	300	100	10		1.0	100	0.1
MPS-A12	MPS-A62	20	20000	10	500			2(typ)	1.0	10	0.01

TABLE 9 – DUAL DIODES

Dual diodes designed for use in low cost biasing, steering and voltage doubler applications including series, common cathode and common anode diodes.

Device Type	$V_{(BR)}$ Volts Min.	@ $I_{(BR)}$ μA	I_R μA Max.	@ V_R Volts	V_F @ Volts Min./Max.	I_F mA	$C_{VR=0}$ pF Max.	t_{rr} ns Max.	Description
MSD6100	100	100	0.1	50	0.67/0.82	10	1.5	4.0	Switching
MSD6101	50	100	0.1	40	0.67/0.82	10	2.0	10	Discrimmator
MSD6102	70	100	0.1	50	0.76/1.0	10	3.0	100	Common Cathode
MSD6150	70	100	0.1	50	—/1.0	10	8.0	100	Common Cathode



Micro-T Transistors and Diodes

Micro-T devices combine high performance with extremely small physical size. The devices shown in these tables are available from stock; all other Motorola small-signal transistors may be obtained in Micro-T packages on special order.

How to Use These Selection Tables

The tables in this section divide the off-the-shelf Micro-T transistors and diodes into major applications categories. In each category, the first delineation is by NPN/PNP (or anode/cathode) device types. Under each of these classifications, the prime devices—those devices designed to a particular set of electrical parameters—are highlighted. Associated with each of the prime devices is a listing of the basic design parameters. Most categories also provide tabulation of other device types utilizing the same basic chip but having relaxed specifications.

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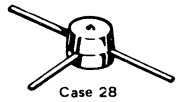
RF AMPLIFIER/HIGH SPEED SWITCHING TRANSISTORS

Standard RF devices in Micro-T packages are designed for applications where limited space is critical. This package is particularly attractive from a pre-testing and cost point of view as the RF parameters can be 100% tested for high performance. For complete design data, consult the prime device data sheet. For other RF devices not listed, contact your nearest Motorola sales representative or distributor. Ceramic pacakges with a cold sealing process are also available.

	NPN Types			
Prime Devices	**MMT2857, A**	**MMT8006, 07, 08**	**MMT3960**	**MMT5031, A**
Design Parameters				
BV_{CEO}	15 V	To 8.0 V	3.0 V	To 14 V
Operating h_{FE} Range	1.0 to 20 mA	0.010 to 10 mA	1.0 to 30 mA	1.0 to 5.0 mA
f_T (Typ)	1400 MHz @ 5.0 mA	2200 MHz @ 2.0 mA	2250 MHz @ 10 mA	2.0 GHz @ 5.0 mA
NF (Typ)	4.0 dB @ 1.5 mA	2.5 dB @ 1.0 mA	–	2.0 dB @ 1.0 mA
G_{pe} (Typ)	12 dB @ 450 MHz	25 dB @ 200 MHz	–	20 dB @ 450 MHz
t_{on} (Typ)	–	–	3.0 ns @ 10 mA	–

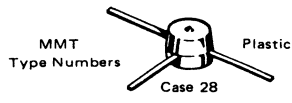


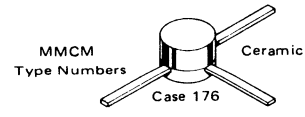
Case 28

	PNP Types	
Prime Devices	**MMT918**	**MMT4261**
Design Parameters		
BV_{CEO}	15 V	15 V
Operating h_{FE} Range	3.0 mA	10 mA
f_T (Typ)	600 MHz @ 4.0 mA	1000 MHz @ 10 mA
NF (Typ)	6.0 dB @ 1.0 mA	–
G_{pe} (Typ)	15 dB @ 200 MHz	–
t_{on} (Typ)	–	–

GENERAL-PURPOSE AND SWITCHING TRANSISTORS

For general-purpose applications and for designs requiring fast switching, the Micro-T packaged transistors are available in either economy plastic or hermetically sealed ceramic. Complete data sheets are available for prime devices; equivalent data sheets may be obtained when the same die is used in other 2N – standard devices. For devices not listed, contact your nearest Motorola representative or distributor.

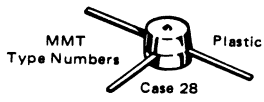


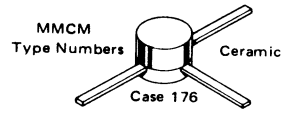


	NPN Types		PNP Types	
Prime Devices	**MMT2222 MMCM2222**	**MMT3904 MMCM3904**	**MMT2907 MMCM2907**	**MMT3906 MMCM3906**
Design Parameters				
BV_{CEO}	To 60 V	To 40 V	To 60 V	To 40 V
Operating h_{FE} Range	100 μA to 500 mA	100 μA to 100 mA	100 μA to 500 mA	100 μA to 100 mA
f_T (Typ)	300 MHz @ 20 mA	300 MHz @ 10 mA	350 MHz @ 50 mA	350 MHz @ 10 mA
t_{on} (Typ)	25 ns @ 150 mA	40 ns @ 10 mA	30 ns @ 150 mA	45 ns @ 10 mA
t_{off} (Typ)	250 ns	140 ns	100 ns	160 ns
	Ceramic Package	Plastic Package		Plastic Package
Derivatives from Prime Devices	MMCM2221	MMT3903 MMT76 Ceramic Package MMCM3903		MMT3905 MMT75 Ceramic Package MMCM3905

LOW NOISE/HIGH GAIN AMPLIFIER TRANSISTORS

Two types of specialty transistors complement Motorola's micro-transistor amplifier selection. The combination of high-gain and low-noise have made these standards popular for many years. The Micro-T package coupled with performance permits space premium designs to become a reality. Other high voltage and Darlington transistors are also available as specials.

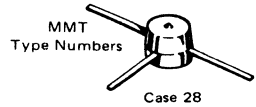


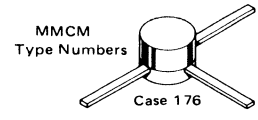


	NPN Types		PNP Types	
Prime Devices	**MMT2484 MMCM2484**		**MMT3799 MMCM3799**	
Design Parameters BV_{CEO} Operating h_{FE} Range f_T (Typ) NF (Typ)	To 60 V 100 μA to 10 mA 90 MHz @ 500 μA 2.0 dB @ 10 μA		To 60 V 10 μA to 10 mA 140 MHz @ 1.0 mA 1.5 dB @ 100 μA	
Derivatives from Prime Devices	Ceramic Package MMCM930	Plastic Package MMT930 MMT70	Ceramic Package MMCM3798	Plastic Package MMT3798 MMT71

LOW CURRENT SWITCHING TRANSISTORS

These high speed switching transistors can be used in circuits where space limitations are critical. For design data, consult prime device data sheet or the 2N JEDEC equivalent. For devices not listed, consult your nearest Motorola sales representative or distributor.





	NPN Types		PNP Types
Prime Devices	**MMT2369 MMCM2369**	**MMT3014**	**MMT3546**
Design Parameters BV_{CEO} Operating h_{FE} Range f_T (Typ) t_{on} (Typ) t_{off} (Typ)	To 15 V 10 mA to 100 mA 650 MHz @ 10 mA 2.0 ns 15 ns @ 10 mA	To 20 V 10 mA to 100 mA 400 MHz @ 30 mA 12 ns 13 ns @ 300 mA	To 12 V 10 mA to 100 mA 850 MHz @ 10 mA 15 ns 25 ns @ 50 mA
Derivatives from Prime Devices		Plastic Package MMT72	

SWITCHING DIODES

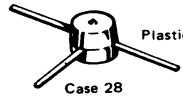
The Micro-T product line includes single and double diodes for voltage doubling or bias control functions. Zener diodes are also available as specials. For lead times and availability, contact your nearest distributor or Motorola's sales representative.

Plastic
Case 28

	Single	Common Cathode	Common Anode	Series
Prime Devices	**MMD6050**	**MMD6100**	**MMD6150**	**MMD7000**
Design Paremeters				
V_{BR}	To 100 V	To 100 V	To 100 V	To 100 V
I_R (Typ)	10 mA	10 mA	10 mA	10 mA
V_F (Typ)	0.6 V @ 1.0 mA	0.6 V @ 1.0 mA	0.6 V @1.0 mA	0.6 V @ 1.0 mA
t_{rr} (Typ)	10 ns	20 ns	20 ns	20 ns
Derivatives from Prime Devices	MMD70			MMD7001

FIELD-EFFECT TRANSISTORS

Technologies other than bipolar transistors are available in the Micro-T package. One example is the popular J-FET. Also available are other J-FET and MOSFET devices requiring up to four leads and having a chip size less than 25 mils per side. For lead time and availability, contact your nearest Motorola sales representative.



Plastic
Case 28

	N-Channel J-FET
Prime Device	**MMT3823**
Design Parameters	
BV_{GSS}	To 35 V
I_{DSS} (surge)	5.0 mA to 20 mA
C_{iss} (Typ)	4.0 pF
NF (Typ)	2.0 dB @ 100 MHz, R_S = 1000 Ohms

Note: Other FETs are available as specials.

Multiple Devices

SMALL-SIGNAL
MULTIPLE TRANSISTORS AND DARLINGTON TRANSISTORS

The trend in electronic system design is toward the use of integrated circuits – to reduce component cost, assembly cost, and equipment cost. But ICs still aren't all things to all people, and for those circuit designs where ICs are not available, there is a noticeable swing towards the use of multiple devices*.

Motorola is reacting to this expanding market requirement by making available a very large selection of Quad, Dual and Darlington transistors for off-the-shelf delivery. The chips used in the Quad and Dual transistors are those that have emerged as the most popular ones for discrete transistor applications. But even beyond that, Motorola offers its entire vast repertoire of discrete small-signal transistors for multiple-device packaging. For special applications where the devices listed may not quite fit the design requirements, special configurations can be supplied with quick turnaround time and low premiums.

* Multiple devices, as described here, encompass two or more transistor chips in a single package. Included in this definition are the Darlington transistors which consist of two interconnected devices functioning as a single-stage amplifier.

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KEY TABLE

TYPE NO	ID	P_D Watts One Die Only (Ref. Point)	V_{CE} Volts (Subscript)	I_C Amp Max.	h_{FE} @ I_C Min. (Unit)	f_T MHz Min.	C_{ob} pF Max.	h_{FE1}/h_{FE2} t_{on} ns Max.	ΔV_{BE} mV Max. t_{off} ns Max.	Gp dB Min. V_{CE} (sat) Volts Max.	NF @ f dB Max. I_C/I_B & I_C (Unit)	PACKAGE TO-No. / Case No.
Alphanumeric listing type numbers					Common-emitter DC Current Gain. Units for test current: A – ampere, m – mA, u – μA	Current-Gain-Bandwidth Product				G_p – Power Gain; NF – Noise figure; f – Test Frequency; AUD – 10-15k Hz; Frequency Units: H - Hertz, K - kHz, M - MHz, G - GHz; $V_{CE(sat)}$ – Collector-Emitter Saturation Voltage; I_C – Test Current; Current Units: u – μA, m – mA, A – Amp		JEDEC Outline/ Motorola Package Outline.

Identification Code
1st Letter: Polarity
C – both types in multiple device
N – NPN
P – PNP
2nd Letter: Use
A – General Purpose Amplifier
E – Low Noise Audio Amplifier
F – Low Noise RF Amplifier
G – General Purpose Amplifier and Switch
H – Tuned RF/IF Amplifier
M – Differential Amplifier
S – High Speed Switch

Power Dissipation specified at 25°C Single die rating.
Ref. Point: A - Ambient temperature; C - Case temperature

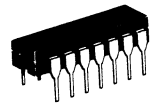
Rated maximum Collector-Emitter Voltage. Subscript letter identifies base termination listed below in order of preference.
SUBSCRIPT:
0 – V_{CEO}, open

Continuous (DC) Collector Current

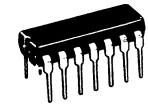
h_{FE1}/h_{FE2} – Current Gain Ratio
ΔV_{BE} – Differential Base Voltage $|V_{BE1} - V_{BE2}|$. Differential Amplifiers
t_{on} – turn-on time
t_{off} – turn-off time

Output Capacitance, common-base. Shown without distinction:
C_{cb} – Collector-Base Capacitance
C_{re} – Common-Emitter Reverse Transfer Capacitance

CASE 632 (TO-116)
Ceramic Package
MHQ Devices



CASE 646
Plastic Package
MPQ Devices



QUAD TRANSISTORS

Type No.	ID	P_D Watts One Die Only	Ref. Point	V_{CE} Volts	Subscript	I_C Amp Max.	h_{FE} @ Min.	I_C	Unit	f_T MHz Min. Typ*	C_{ob} pF Max. Typ*	h_{FE1}/h_{FE2} t_{on} ns Max. Typ*	ΔV_{BE} mV Max. t_{off} ns Max. Typ*	Gp dB Min. V_{CE} (sat) @ Volts Max.	NF @ f dB Max. I_C/I_B	& I_C	Unit	Package TO-No.	Case No.
MHQ2222	NG	0.65	A	40	O	0.5	100	150	m	200	8.0	25*	250*	0.4	10	150	m	116	632
MHQ2907	PG	0.65	A	40	O	0.6	100	150	m	200	8.0	30*	100*	0.4	10	150	m	116	632
MHQ3467	PS	0.9	A	40	O	1.0	20	500	m	125	25	40	90	0.5	10	500	m	116	632
MHQ4014	NS	0.75	A	45	O	1.5	35	500	m	200	10	35	60	0.52	10	500	m	116	632
MHQ6001	CA	0.65	A	30	O	0.5	40	150	m	200	8.0	30*	225*	0.4	10	150	m	116	632
MHQ6002	CA	0.65	A	30	O	0.5	100	150	m	200	8.0	30*	225*	0.4	10	150	m	116	632
MPQ2222	NA	0.65	A	40	O	0.5	100	150	m	200	8.0	25*	250*	0.4	10	150	m		646
MPQ2369	NS	0.5	A	15	O	0.5	40	10	m	450	4.0	9.0*	15*	0.25	10	10	m		646
MPQ2907	PA	0.65	A	40	O	0.6	100	150	m	200	8.0	30*	100*	0.4	10	150	m		646
MPQ3467	PS	0.75	A	40	O	1.0	20	500	m	125	25	40	90	0.5	10	500	m		646
MPQ3725	NS	1.0	A	40	O	1.0	25	500	m	250	10	35	60	0.45	10	500	m		646
MPQ3725A	NS	1.0	A	50	O	1.0	30	500	m	200	10	3.5	60	0.45		500	m		646
MPQ6001	CG	0.65	A	30	O	0.5	40	150	m	200	8.0	30*	225*	0.4	10	150	m		646
MPQ6002	CG	0.65	A	30	O	0.5	100	150	m	200	8.0	30*	225*	0.4	10	150	m		646
MPQ6842[1]	CA	0.5	A	40	O	0.2	70	10	m	200	4.5			0.25	4.0	1.0	m		646

Some columns show 2 different types of data indicated by either bold or italic typefaces. See key and headings.
[1] See section MOS Integrated Circuits.

DUAL TRANSISTORS

Type No.	ID	P_D Watts One Die Only	Ref. Point	V_{CE} Volts	Subscript	I_C Amp Max.	h_{FE} (@ I_C Min.	Unit	f_T MHz Min. Typ*	C_{ob} pF Max. Typ*	h_{FE1} / h_{FE2}	ΔV_{BE} mV Max.	Gp dB Min.	NF (@ f dB Max.
											t_{on} ns Max. Typ*	t_{off} ns Volts Typ*	V_{CE} (sat) (@ I_B Max.	I_C / I_B & I_C Unit
MD918	NF	0.55	A	15	O	0.05	50	3.0 m	600	1.7				6.0 60 M
MD918A	NM	0.55	A	15	O	0.05	50	3.0 m	600	1.7	0.9	5.0		6.0 60 M
MD918AF	NM	0.35	A	15	O	0.05	50	3.0 m	600	1.7	0.9	5.0		6.0 60 M
MD1129F	NM	0.35	A	30	O	0.5	100	10 m	200	8.0	0.9	5.0	0.15	10 10 m
MD2219	NG	0.575	A	30	O	0.5	100	150 m	200	8.0	60	350	0.4	10 150 m
MD2219A	NG	0.575	A	30	O	0.5	100	150 m	200	8.0	45	310	0.3	10 150 m
MD2219AF	NG	0.350	A	30	O	0.5	100	150 m	200	8.0	45	310	0.3	10 150 m
MD2219F	NG	0.350	A	30	O	0.5	100	150 m	200	8.0	60	350	0.4	10 150 m
MD2369	NS	0.55	A	15	O	0.5	40	10 m	500	4.0	15	20	0.25	10 10 m
MD2369A	NM	0.55	A	15	O	0.5	40	10 m	500	4.0	0.9	5.0	0.25	10 10 m
MD2369AF	NM	0.35	A	15	O	0.5	40	10 m	500	4.0	0.9	5.0	0.25	10 10 m
MD2905	PG	0.575	A	40	O	0.6	100	150 m	200	8.0	45	130	0.4	10 150 m
MD2905A	PG	0.575	A	60	O	0.6	100	150 m	200	8.0	45	130	0.4	10 150 m
MD2905AF	PG	0.35	A	60	O	0.6	100	150 m	200	8.0	45	130	0.4	10 150 m
MD3251	PA	0.575	A	40	O	0.20	100	1.0 m	250	6.0			0.25	10 10 m
MD3251A	PM	0.575	A	40	O	0.20	100	1.0 m	250	6.0	0.9	5.0	0.25	10 10 m
MD3251AF	PM	0.35	A	40	O	0.20	100	1.0 m	250	6.0	0.9	5.0	0.25	10 10 m
MD6003	CA	0.575	A	30	O	0.5	70	150 m	200	8.0			0.4	10 150 m
MD7000	NA	0.575	A	30	O	0.5	70	150 m	200	8.0			0.4	10 150 m
MD7002	NA	0.575	A	40	O	0.03	40	100 u	200	6.0			0.35	10 10 m
MD7003	NA	0.55	A	40	O	0.05	50	10 m	200	6.0			0.35	10 1.0 m
MD7003A	NM	0.55	A	40	O	0.05	50	10 m	200	6.0	0.75	25	0.35	10 1.0 m
MD8001	NM	0.575	A	40	O	0.03	100	1.0 m	260*	2.6*		15		
MD8002	NM	0.575	A	50	O	0.03	100	1.0 m	260*	2.6*		15		
MD8003	NM	0.575	A	60	O	0.03	100	1.0 m	260*	2.6*		15		
2N2060	NM	0.5	A	60	O	0.5	30	100 u	60	15	0.9	5.0		8.0 1000 H
2N2060A	NM	0.5	A	60	O	0.5	30	100 u	60	15	0.9	3.0	0.6	10 50 m
2N2223	NM	0.5	A	60	O	0.5	25	100 u	50	15	0.8	15	1.2	10 50 m
2N2223A	NM	0.5	A	60	O	0.5	25	100 u	50	15	0.9	5.0	1.2	10 50 m
2N2642	NM	0.3	A	45	O	0.03	100	10 u	80	8.0	0.9	5.0		4.0 AUD
2N2913	NE	0.3	A	45	O	0.03	60	10 u	60	6.0				4.0 AUD
2N2915	NM	0.3	A	45	O	0.03	60	10 u	60	6.0	0.9	5.0		4.0 AUD
2N2917	NM	0.3	A	45	O	0.03	60	10 u	60	6.0	0.8	10		4.0 AUD
2N2919	NM	0.3	A	60	O	0.03	60	10 u	60	6.0	0.9	5.0		4.0 AUD
2N2920	NM	0.3	A	60	O	0.03	150	10 u	60	6.0	0.9	5.0		3.0 AUD
2N3810	PM	0.5	A	60	O	0.05	150	0.1 m	100	4.0	0.9	3.0		7.0 100 H
2N3817A	PM	0.5	A	60	O	0.05	300	0.1 m	100	4.0	0.95	1.5		4.0 100 H
2N4854	CE	0.3	A	40	O	0.6	100	150 m	200	8.0	60	350		8.0 1000 H
2N5794	NG	0.5	A	40	O	0.6	100	150 m	200	8.0	45	310	0.3	10 150 m

Type No.	ID	Package TO-No.	Package Case No.
MD918	NF		654
MD918A	NM		654
MD918AF	NM	89	610
MD1129F	NM	89	610
MD2219	NG		654
MD2219A	NG		654
MD2219AF	NG	89	610
MD2219F	NG	89	610
MD2369	NS		654
MD2369A	NM		654
MD2369AF	NM	89	610
MD2905	PG		654
MD2905A	PG		654
MD2905AF	PG	89	610
MD3251	PA		654
MD3251A	PM		654
MD3251AF	PM	89	610
MD6003	CA		654
MD7000	NA		654
MD7002	NA		654
MD7003	NA		654
MD7003A	NM		654
MD8001	NM		654
MD8002	NM		654
MD8003	NM		654
2N2060	NM	78	654
2N2060A	NM	78	654
2N2223	NM	78	654
2N2223A	NM	78	654
2N2642	NM	78	654
2N2913	NE		654
2N2915	NM		654
2N2917	NM		654
2N2919	NM		654
2N2920	NM		654
2N3810	PM		654
2N3817A	PM	89	610
2N4854	CE		654
2N5794	NG		654

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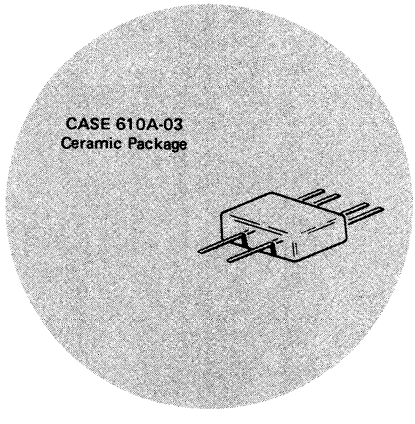
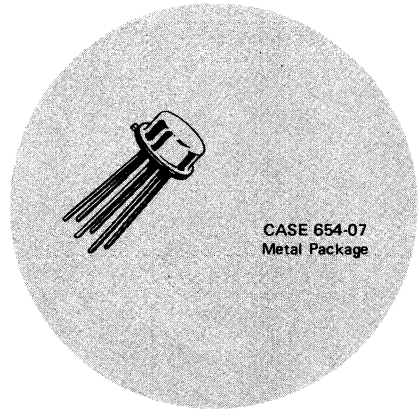




Field-Effect Transistors

Motorola offers a line of field-effect transistors that encompasses the latest technology and covers the full range of FET applications. Included is a wide variety of junction FETs and MOSFETs, with N-or P-channel polarity with both single and dual gates. These FETs include devices developed for operation across the frequency range from dc to UHF in switching and amplifying applications. Package options from low-cost plastic to metal TO-72 packages are available.

How to Use These Selection Tables

The selector guides on the following pages are designed to emphasize the preferred FET devices—those whose specifications groupings have proved to be the most popular, resulting in a combination of good performance and low cost. The major specifications of these devices are given for easy comparison.

TABLE OF CONTENTS

GENERAL PURPOSE

Preferred Types Types	Technology	Package	Y_{fs} (mmhos) Min.	Y_{fs} (mmhos) Max.	I_{DSS} (mA) Min.	I_{DSS} (mA) Max.	$V_{GS(off)}$ (V) Min.	$V_{GS(off)}$ (V) Max.	I_{GSS} (nA) Max.	C_{RSS} (pF) Max.	N_F (db) Max.	$V_{(BR)GSS}$ (V) Min.	Applications Remarks
2N3821	N-ch. Junction	TO-72	1.5	4.5	0.5	2.5	–	4	0.1	3	5	50	Audio, Low Noise
2N3822	N-ch. Junction	TO-72	3	6.5	2	10	–	6	0.1	3	5	50	Audio, Low Noise
2N3993	P-ch. Junction	TO-72	6	12	10	–	4	9.5	–	4.5	–	25	Amplifier, also
2N3994	P-ch. Junction	TO-72	4	10	2	–	1	5.5	–	5	–	25	switch
2N4117	N-ch. Junction	TO-72	0.07	0.21	0.03	0.09	0.6	1.8	0.01	1.5	–	40	Low input
2N4118	N-ch. Junction	TO-72	0.08	0.25	0.08	0.24	1	3	0.01	1.5	–	40	current DC
2N4119	N-ch. Junction	TO-72	0.1	0.33	0.2	0.6	2	6	0.01	1.5	–	40	Amplifier
2N4220	N-ch. Junction	TO-72	1	4	0.5	3	–	4	0.1	2	2.5	30	Amplifier, also
2N4221	N-ch. Junction	TO-72	2	5	2	6	–	6	0.1	2	2.5	30	switch
2N4222	N-ch. Junction	TO-72	2.5	6	5	15	–	8	0.1	2	2.5	30	
2N5457	N-ch. Junction	TO-92	1	5	1	5	0.5	6	1	3	–	25	Audio, N-ch.
2N5458	N-ch. Junction	TO-92	1.5	5.5	2	9	1	7	1	3	–	25	complement of
2N5459	N-ch. Junction	TO-92	2	6	4	6	2	8	1	3	–	25	2N5460/61/62
2N5460	P-ch. Junction	TO-92	1	4	1	5	0.75	6	5	2	2.5	40	Amplifier, P-ch.
2N5461	P-ch. Junction	TO-92	1.5	5	2	9	1	7.5	5	2	2.5	40	complement of
2N5462	P-ch. Junction	TO-92	2	6	4	16	1.8	9	5	2	2.5	40	2N5457/58/59
BF245A	N-ch. Junction	TO-92	3	6.5	2	6.5	0.4	2.2[1]	5	0.7 typ	1.5 typ	30	Amplifier
BF245B	N-ch. Junction	TO-92	3	6.5	6	15	1.6	3.8[1]	5	0.7 typ	1.5 typ	30	Amplifier
BF245C	N-ch. Junction	TO-92	3	6.5	12	25	3.2	7.5[1]	5	0.7 typ	1.5 typ	30	Amplifier
BF246A	N-ch. Junction	TO-92	8	–	30	80	1.5	4[1]	5	3.3 typ	–	25	Amplifier, also
BF246B	N-ch. Junction	TO-92	8	–	60	140	0.3	7[1]	5	3.3 typ	–	25	Chopper, VHF
BF246C	N-ch. Junction	TO-92	8	–	110	250	5.5	12[1]	5	3.3 typ	–	25	Ampl. Mixer
MPF102	N-ch. Junction	TO-92	2	7.5	2	20	–	8	2	3	–	25	Ampl. Mixer

[1] V_{GS} at 200 μA

CHOPPERS AND SWITCHES

Preferred Types	Technology	Package	$R_{DS(on)}$ (Ohms) Max.	I_{DSS} (mA) Min.	I_{DSS} (mA) Max.	$V_{GS(Th)}$** $V_{GS(off)}$ (V) Min.	$V_{GS(Th)}$** $V_{GS(off)}$ (V) Max.	I_{DSS}** $I_{D(off)}$ (nA) Max.	C_{RSS} (pF) Max.	$V_{(BR)DS}$* $V_{(BR)GS}$ (V) Min.	Applications Remarks
2N3824	N-ch. Junction	TO-72	250	–	–	–	–	0.1	3	50	Chopper
2N3923	P-ch. Junction	TO-72	150	10	–	4	9.5	1.2	4.5	25	Switch
2N3994	P-ch. Junction	TO-72	300	2	–	1	5.5	1.2	5	25	Switch
2N4091	N-ch. Junction	TO-18	30	30	–	5	10	0.2	5	40	Switch
2N4092	N-ch. Junction	TO-18	50	15	–	2	7	0.2	5	40	Switch
2N4093	N-ch. Junction	TO-18	80	8	–	1	5	0.2	5	40	Switch
2N4351	N-ch. Enh. MOS	TO-72	300	–	–	1	5	10	1.3	25	Low power switching
2N4352	P-ch. Enh. MOS	TO-72	600	–	–	1	5	10	1.3	25	Complementary Types
2N4391	N-ch. Junction	TO-18	30	50	150	4	10	0.1	3.5	40	Chopper
2N4392	N-ch. Junction	TO-18	60	25	75	2	5	0.1	3.5	40	Chopper
2N4393	N-ch. Junction	TO-18	100	5	30	0.5	3	0.1	3.5	40	Chopper
2N4856	N-ch. Junction	TO-18	25	50	–	4	10	0.25	8	40	High Speed
2N4857	N-ch. Junction	TO-18	40	20	100	2	6	0.25	8	40	Switch,
2N4858	N-ch. Junction	TO-18	60	8	80	0.8	4	0.25	8	40	Chopper
2N4859	N-ch. Junction	TO-18	25	50	–	4	10	0.25	8	30	
2N4860	N-ch. Junction	TO-18	40	20	100	2	6	0.25	8	30	
2N4861	N-ch. Junction	TO-18	60	8	80	0.8	4	0.25	8	30	
2N5555	N-ch. Junction	TO-92	150	15	–	–	–	10	1.2	25	High Speed Switch
2N5638	N-ch. Junction	TO-92	30	50	–	–	12	1	4	30	High Speed
2N5639	N-ch. Junction	TO-92	60	25	–	–	8	1	4	30	Switch
2N5640	N-ch. Junction	TO-92	100	5	–	–	6	1	4	30	Chopper
3N169	N-ch. Enh. MOS	TO-72	200	–	–	0.5	1.5	10	1.3	25	Low power switch
MFE3002	N-ch. Enh. MOS	TO-72	100	–	–	–	3	10	1	15	complementary
MFE3003	P-ch. Enh. MOS	TO-72	200	–	–	–	4	10	1	15	types
MPF970	P-ch. Enh. MOS	TO-92	100	15	60	5	12	10	5	30	High speed switch
MPF971	P-ch. Junction	TO-92	250	2	30	1	7	10	5	30	chopper
MPF4391	N-ch. Junction	TO-92	30	60	130	4	10	1	3.5	30	high speed
MPF4392	N-ch. Junction	TO-92	60	25	75	2	5	1	3.5	30	switch
MPF4393	N-ch. Junction	TO-92	100	5	30	0.5	3	1	3.5	30	chopper

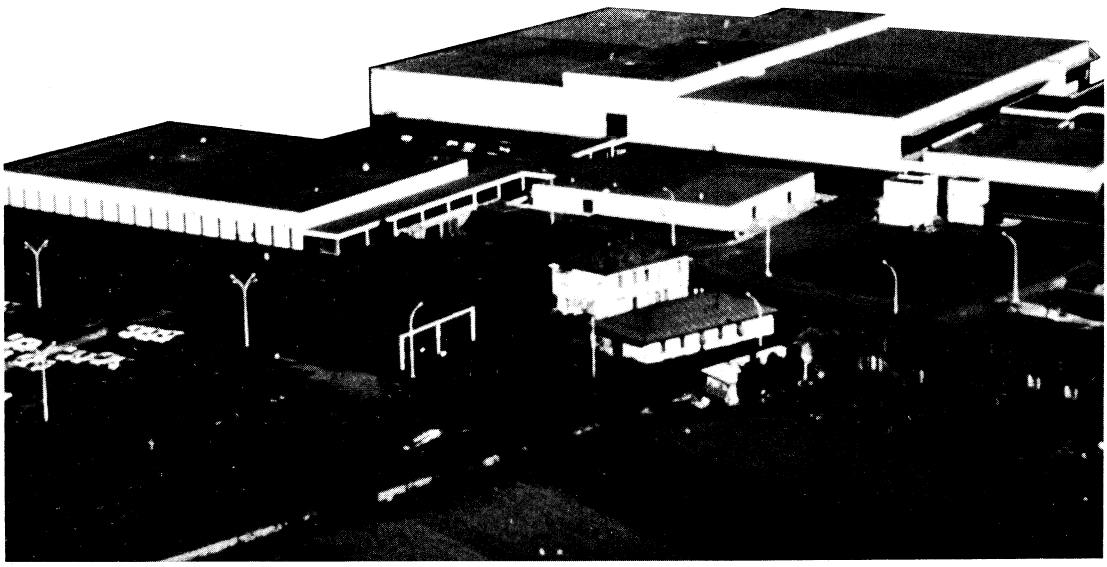
* For MOS FET's

** For Enhancement MOS FET's

HIGH FREQUENCY

Preferred Parts	Technology	Package	Y_{fs} mmhos Min.	Y_{fs} mmhos Max.	Y_{os} μmhos Max.	Test Frequency MHz	G_C G_{PS} dB Min.	C_{RSS} pF Max.	NF dB Max.	$V_{(BR)DS}$* $V_{BR)GSS}$ V Min.	Applications Remarks
2N3823	N-ch. Junction	TO-72	3.5	6.5	35	100	–	2	2.5	30	VHF Ampl. Mixer
2N4416	N-ch. Junction	TO-72	4.5	7.5	50	400	10	0.8	2.0	30	VHF/UHF Ampl.
2N5484	N-ch. Junction	TO-92	2.0	6.0	50	100	16	1.0	3.0	25	VHF/UHF Ampl.
2N5485	N-ch. Junction	TO-92	3.5	7.0	60	400	10	1.0	4.0	25	VHF/UHF Ampl.
2N5486	N-ch. Junction	TO-92	4.0	8.0	75	400	10	1.0	4.0	25	VHF/UHF Ampl.
3N128	N-ch. Depl. MOS	TO-72	5.0	12.0	500	200	13.5	0.28	5.0	20/50	VHF Ampl. Oscil.
3N201	N-ch. Depl. DG MOS	TO-72	8.0	20.0	–	200	15.0	0.03	4.5	25	VHF Ampl.
3N211	N-ch. Depl. DG MOS	TO-72	17	40	–	200	24.0	0.05	3.5	27	VHF Ampl.
3N212	N-ch. Depl. DG MOS	TO-72	17	40	–	45	21.0	0.05	4.0	27	VHF Mixers
3N213	N-ch. Depl. DG MOS	TO-72	15	35	–	45	27.0	0.05	4.0	35	IF Ampl.
BF256A	N-ch. Junction	TO-92	4.5	–	40 typ	800	11 typ	0.7 typ	7.5 typ	30	VHF/UHF Ampl.
BF256B	N-ch. Junction	TO-92	4.5	–	40 typ	800	11 typ	0.7 typ	7.5 typ	30	VHF/UHF Ampl.
BF256C	N-ch. Junction	TO-92	4.5	–	40 typ	800	11 typ	0.7 typ	7.5 typ	30	VHF/UHF Ampl.
J308	N-ch. Junction	TO-92	8.0	20	200	100	16 typ	2.5[1]	1.5 typ	25	VHF/UHF Ampl. Mixer
J309	N-ch. Junction	TO-92	10	20	150	100	16 typ	2.5[1]	1.5 typ	25	VHF/UHF Ampl. Mixer
J310	N-ch. Junction	TO-92	8	18	200	100	16 typ	2.5[1]	1.5 typ	25	VHF/UHF Ampl. Mixer
MFE130	N-ch. Depl. DG MOS	TO-72	8	20	–	105	17	0.05	5	25	RF Amplifier
MFE131	N-ch. Depl. DG MOS	TO-72	8	20	–	60	20	0.05	5	25	RF Amplifier
MFE132	N-ch. Depl. DG MOS	TO-72	8	20	–	200	12	0.05	5	25	Mixer
MFE140	N-ch. Depl. DG MOS	TO-72	10	20	–	100	20	0.05	3.5	25	FM Ampl. Mixer
U306	N-ch. Junction	TO-52	10	20[2]	150[3] typ	450	11 typ	2.5[1]	3 typ	25	VHF/UHF Ampl. Mixer
U309	N-ch. Junction	TO-52	10	20[2]	150[3] typ	450	11 typ	2.5[1]	3 typ	25	VHF/UHF Ampl. Mixer
U310	N-ch. Junction	TO-52	10	18[2]	150[3] typ	450	11 typ	2.5[1]	3 typ	25	VHF/UHF Ampl. Mixer

[1] C_{GD} Gate Drain Capacitance
[2] g_{fg} Common Gate Forward Transconductance
[3] G_{og} Common Gate Output Conductance
* For MOS FET's



Toulouse factory.

HIGH-FREQUENCY DEVICES

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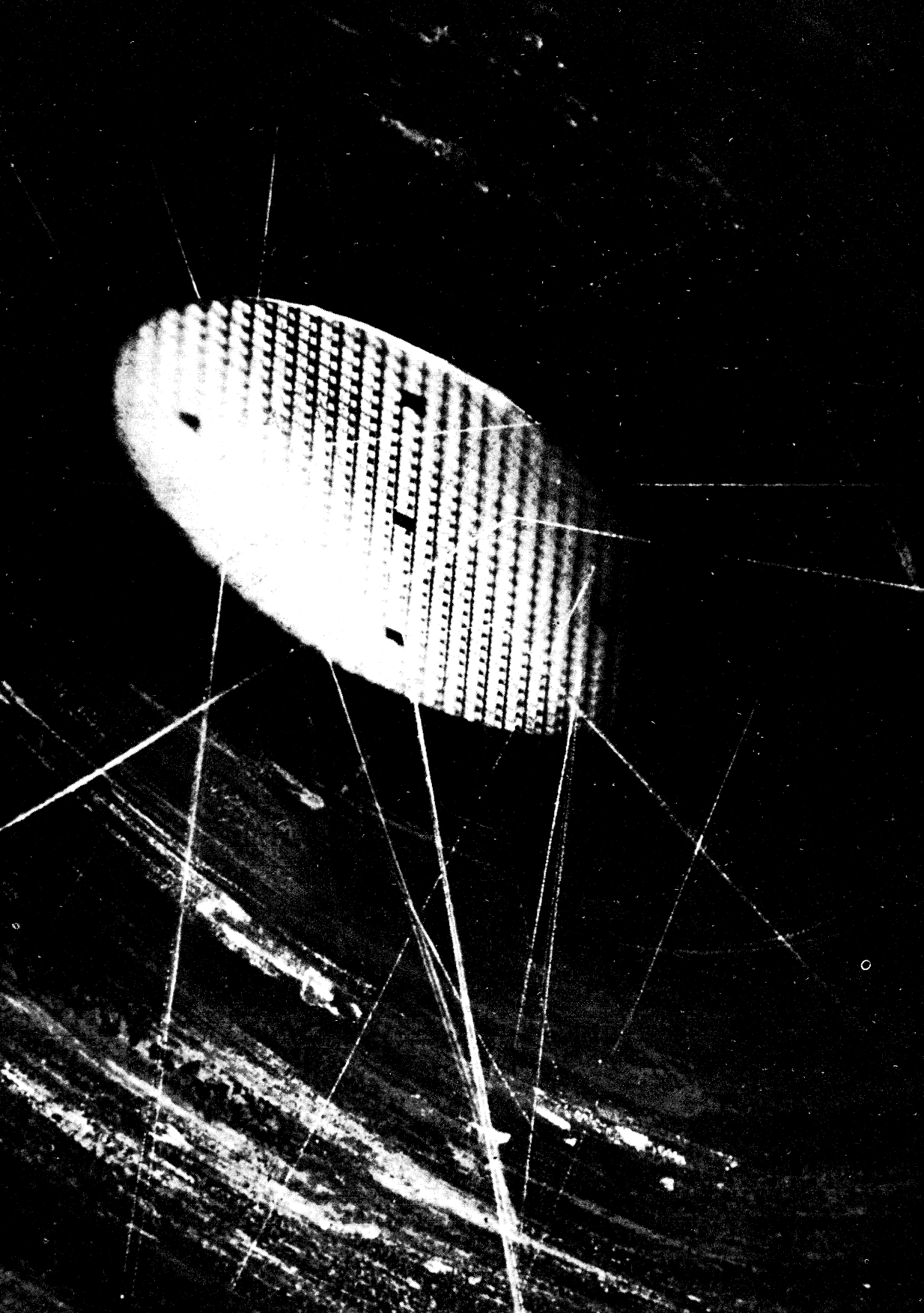


RF Transistors and Modules

This selection guide contains the preferred registered and non-registered RF parts available. From more than 500 total individual available devices, Motorola has selected 16 transistor/module chains from 1.5 to 300 W (PEP) output. All devices are designed, tested and optimized for frequency ranges from 2.0 to 900 MHz. These devices are designed for your advanced RF engineering concepts.

TALBE OF CONTENTS

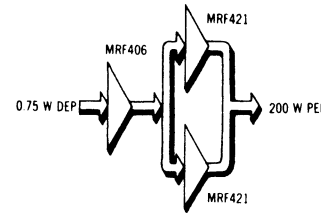
High Frequency, Low Voltage Amplifier Transistors/Modules

The transistors listed in this table are specified for operation in RF Power amplifiers and are listed by specific application at a given test frequency. Arrangement within each application group is in the order of increasing output power. Modulation type is given in each application headling.

Device Type	P_{out} Output Power Watts	G_{PE} Power Gain dB Min	V_{CC} Supply Voltage Volts	Package
2-30 MHz, SSB TRANSISTORS				
MRF475	12 PEP	10	13.6	TO-220
MRF406	20 PEP	12	12.5	211-07
MRF460	40 PEP	12	12.5	211-10
MRF454	80 PEP	12	12.5	211-11
MRF454A	80 PEP	12	12.5	145A-08
MRF421	100 PEP	10	12.5	211-04

Chain 1 — 12.5 V, 2-30 MHz

Off-road vehicles/Oil tankers/Fishing fleets



1-30 MHz, HF/AMATEUR TRANSISTORS				
MRF8004	3.5	10	12.5	TO-39
MRF472	4.0	10	12.5	77-03
MRF482	4.0	10	12.5	77-03
MRF449	30	10	13.6	211-07
MRF449A	30	10	13.6	145A-07
MRF450	50	11	13.6	211-07
MRF450A	50	11	13.6	145A-07
MRF453	60	11	13.6	211-10
MRF453A	60	11	13.6	145A-04
MRF455	60	11	13.6	211-07
MRF455A	60	11	13.6	145A-07

HIGH FREQUENCY, LOW VOLTAGE AMPLIFIER TRANSISTORS/MODULES (continued)

Device Type	P_{out} Output Power Watts	G_{PE} Power Gain dB Min	V_{CC} Supply Voltage Volts	Package
40-100 MHz, MIDBAND FM TRANSISTORS				
MRF229**	1.5	10	12.5	TO-39
MRF230	1.5	10	12.5	TO-39
MRF231	3.5	10	12.5	145A-07
MRF232	7.5	9.0	12.5	145A-07
MRF233	15	9.5	12.5	145A-07
MRF234	25	10	12.5	145A-07

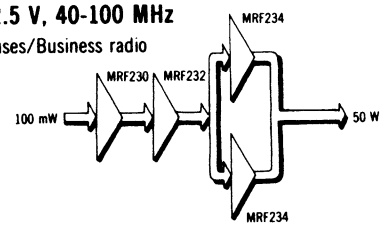
**Grounded emitter TO-39 package

Chain 2 — 12.5 V, 40-100 MHz

European taxis/Off-shore oil rigs

Chain 3 — 12.5 V, 40-100 MHz

European buses/Business radio

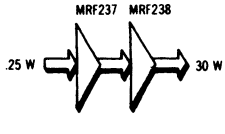


156-162 MHz, VHF MARINE RADIO FM TRANSISTORS/MODULE

MRF237**	4.0	12	12.5	TO-39
MRF238	30	9.0	13.6	145A-07
MHW603	30	21.7	13.6	297-02

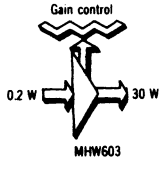
**Grounded emitter TO-39 package. See EB-29

Chain 4 — 13.6 V, 160 MHz



Chain 5 — 13.6 V, 160 MHz

Marine radio/Pleasure craft/Fishing boats/2 meter "ham band"



HIGH FREQUENCY, LOW VOLTAGE AMPLIFIER TRANSISTORS/MODULES (continued)

Device Type	P_{out} Output Power Watts	G_{PE} Power Gain dB Min	V_{CC} Supply Voltage Volts	Package
130-175 MHz, HIGH BAND/VHF FM TRANSISTORS				
MRF604	1.0	10	12.5	TO-46
2N4427	1.0	10	12	TO-39
MRF607	1.75	12.5	12.5	TO-39
2N6255	3.0	7.8	12.5	TO-39
2N5589	3.0	8.2	13.6	144B-06
MRF237**	4.0	12	12.5	TO-39
2N6080	4.0	12	12.5	145A-07
2N5590	10	5.2	13.6	145A-07
MRF212	10	9.0	12.5	145A-07
MRF603	10	10	12.5	145A-07
2N6081	15	6.3	12.5	145A-07
MRF221	15	6.3	12.5	211-07
MRF215*	20	8.2	12.5	278-06
2N5591	25	4.4	13.6	145A-07
2N6082	25	6.2	12.5	145A-07
MRF222	25	6.2	12.5	211-07
2N6083	30	5.7	12.5	145A-07
MRF223	30	5.7	12.5	211-07
MRF238	30	9.0	13.6	145A-07
2N6084	40	4.5	12.5	145A-07
MRF224	40	4.5	12.5	211-07
MRF216*	40	6.7	12.5	278-06
MRF243*	60	7.0	12.5	278-06
MRF245*	80	6.4	12.5	278-06

*Controlled "Q" transistor. See EB-19

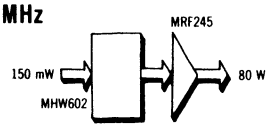
**Grounded emitter TO-39 package. See EB-29

146-175 MHz, HIGH BAND/VHF FM MODULES

MHW601	13	21	12.5	297-02
MHW602	20	21	12.5	297-02
MHW603	30	21.7	13.6	297-02

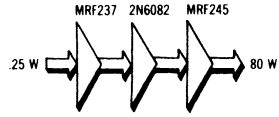
See EB-23 for applications information

Chain 6 — 12.5 V, 175 MHz



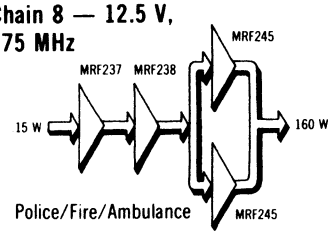
Construction vehicles/
Oil fields/
Business band

Chain 7 — 12.5 V, 175 MHz



Business band/Truck dispatch

Chain 8 — 12.5 V, 175 MHz



Police/Fire/Ambulance

HIGH FREQUENCY, LOW VOLTAGE AMPLIFIER TRANSISTORS/MODULES (continued)

Device Type	P_{out} Output Power Watts	G_{PE} Power Gain dB Min	V_{CC} Supply Voltage Volts	Package
407-512 MHz, UHF FM TRANSISTORS				
MRF626	0.5	10	12.5	305-01
MRF627	0.5	10	12.5	305A-01
MRF628	0.5	10	12.5	249-05
MRF515	0.75	8.0	12.5	TO-39
2N3948	1.0	6.0	13.6	TO-39
MRF629**	2.0	8.0	12.5	TO-39
2N5944	2.0	9.0	12.5	244-04
2N5945	4.0	8.0	12.5	244-04
2N5946	10	6.0	12.5	244-04
MRF618*	15	6.0	12.5	278-06
MRF644*	25	6.2	12.5	278-06
MRF646*	40	4.8	12.5	278-06
MRF648*	60	4.8	12.5	278-06

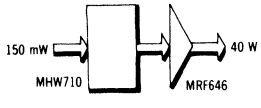
*Controlled "Q" transistor. See EB-19
**Grounded emitter TO-39 package

Device Type	P_{out} Output Power Watt	f MHz	G_{PE} Power Gain dB Min	V_{DC} Supply Voltage	Package
407-512 MHz, UHF FM MODULES					
	MHW401-1	1.5	400-440	15	7.5
MHW401-1	1.5	400-440	15	7.5	301-01
MHW401-2	1.5	440-470	15	7.5	301-01
MHW401-3	1.5	470-512	15	7.5	301-01
MHW412-1	1.5	400-440	15	12.5	301-01
MHW412-2	1.5	440-470	15	12.5	301-01
MHW709-1	7.5	400-440	18.8	12.5	700-01
MHW709-2	7.5	440-470	18.8	12.5	700-01
MHW709-3	7.5	470-512	18.8	12.5	700-01
MHW710-1	13	400-440	19.4	12.5	700-01
MHW710-2	13	440-470	19.4	12.5	700-01
MHW710-3	13	470-512	19.4	12.5	700-01

See EB-8 for applications information.

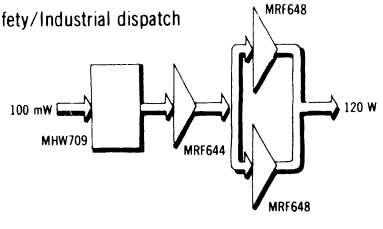
Chain 9 — 12.5 V, 512 MHz

Agricultural communications/Base stations/Repeaters



Chain 10 — 12.5 V, 470 MHz

Public safety/Industrial dispatch



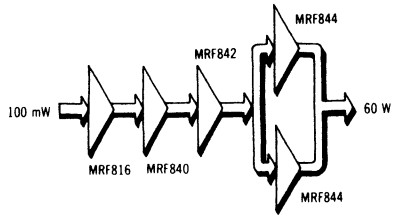
HIGH FREQUENCY, LOW VOLTAGE AMPLIFIER TRANSISTORS/MODULES (continued)

Device Type	P_{out} Output Power Watts	G_{PE} Power Gain dB Min	V_{CC} Supply Voltage Volts	Package
806-947 MHz, UHF FM TRANSISTORS				
MRF816	0.75	10	12.5	249-05
MRF817	2.5	6.2	13.6	244-04
MRF840*	8.0	7.0	12.5	319-01
MRF842*	20	6.5	12.5	319-01
MRF844*	30	5.7	12.5	319-01
MRF846*	40	6.0	12.5	319-01

*To be introduced

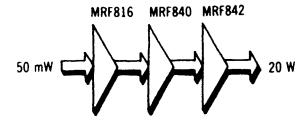
Chain 11 — 12.5 V, 870 MHz

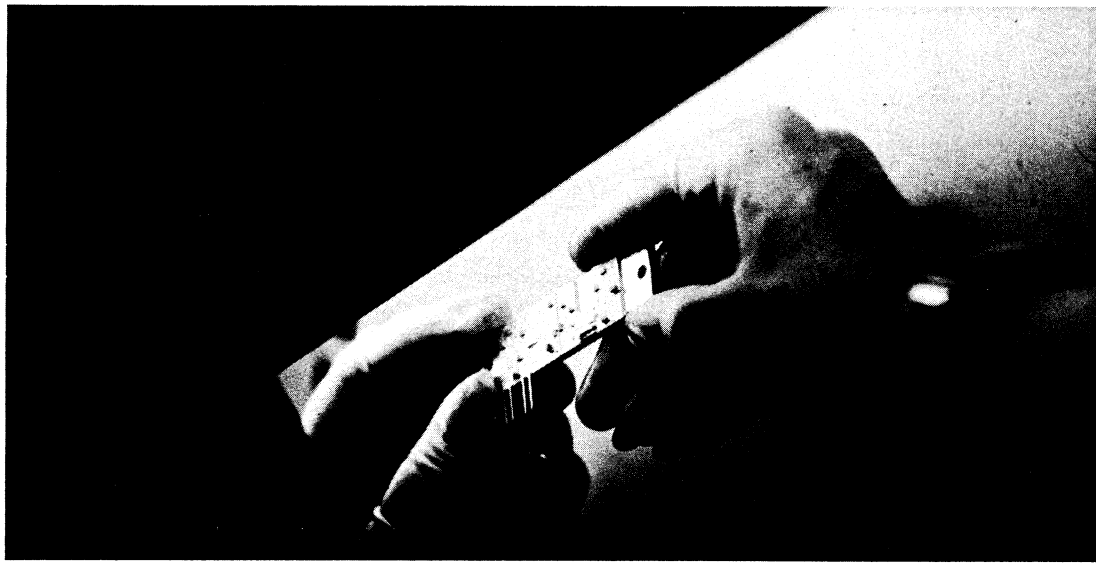
Base station/Industrial dispatch



Chain 12 — 12.5 V, 850 MHz

Cellular radio telephone





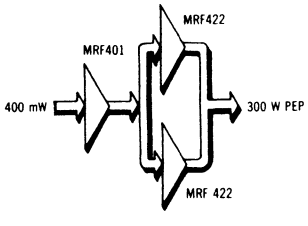
High Frequency, High Voltage, Power Amplifier Transistors

The transistors listed in this table are specified for operation in RF Power amplifiers and are listed by specific application at a given test frequency. Arrangement within each application group is in the order of increasing output power. Modulation type is given in each application headling.

Device Type	P_{out} Output Power Watts	G_{PE} Power Gain dB Min	V_{CC} Supply Voltage Volts	Package
2-30 MHz, SSB TRANSISTORS				
MRF401	25 PEP	13	28	145A-07
MRF427	25 PEP	12	50	211-11
MRF427A	25 PEP	12	50	145A-08
MRF464	80 PEP	15	28	211-11
MRF464A	80 PEP	15	28	145A-08
MRF422	150 PEP	10	28	211-11
MRF422A	150 PEP	10	28	307-01
MRF428	150 PEP	13	50	211-11
MRF428A	150 PEP	13	50	307-01

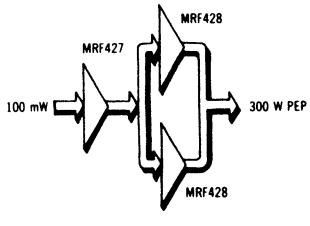
Chain 13 — 28 V, 2-30 MHz

Merchant ships/Land-base stations/Government vehicles/ Marine base stations



Chain 14 — 50 V, 2-30 MHz

Commercial ships/Military base stations



HIGH FREQUENCY, HIGH VOLTAGE POWER AMPLIFIER TRANSISTORS (continued)

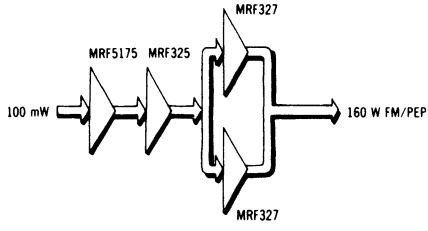
Device Type	P_{out} Output Power Watts	G_{PE} Power Gain dB Min	V_{CC} Supply Voltage Volts	Package
106-175 MHz, VHF AM TRANSISTORS				
2N3866	1.0	10	28	TO-39
2N3553	2.5	10	28	TO-39
2N5641	7.0	8.4	28	144B-04
2N5642	20	8.2	28	145A-07
MRF314	30	10	28	145A-07
2N5643	40	7.6	28	145A-07
MRF315	45	9.0	28	145A-07
MRF316	80	10	28	278-06
MRF317	100	9.0	28	278-06
225-400 MHz, UHF AM TRANSISTORS				
2N3866	1.0	10	28	TO-39
MRF313	1.0	16 (typ)	28	305-01
MRF313A	1.0	16 (typ)	28	305A-01
MRF517A	2.0	12	28	244-04
MRF5175	5.0	11	28	244-04
MRF321**	10	12	28	244-04
MRF5176	15	10	28	244-04
MRF323**	20	10	28	244-04
MRF325*	30	8.5	28	278-06
MRF326**	40	9.0	28	278-06
2N6439**	60	8.0	28	278-06
MRF327**	80	7.3	28	278-06

*Controlled "Q" transistor. See EB-19

**Gold metallization, double matched controlled "Q" transistor. See EB-26, EB-19

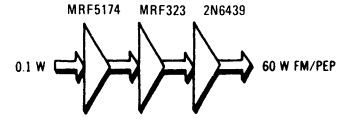
Chain 15 — 28 V, 400 MHz

Fixed/Mobile/Aircraft radio



Chain 16 — 28 V, 400 MHz

Aircraft radio



UHF and Microwave Oscillators

The transistors listed below are for UHF and microwave oscillator applications as initial signal sources or as output stages of limited range transmitters. Devices are listed in order of increasing test frequency.

Device Type	Test Conditions f MHz	Test Conditions V_{CC} Volts	P_{out} mW Typ* Min	f_T MHz Typ* Min	Package
2N3866	400	15	1000	500	TO-39
2N5179	500	10	20	900	TO-72
2N2857	500	10	30	1000	TO-72
MRF905	1680	20	500*	2200*	TO-46

Low-Noise Transistors

The low-noise devices listed are produced with carefully controlled r_b' and f_T to optimize device noise performance. Devices listed in the matrix are classified according to noise figure performance versus frequency.

NF dB	FREQUENCY MHz 60	100	200	450	1000	2000	Polarity
1.5	2N5829	2N5829					PNP
	2N5031	2N5031	MRF904				NPN
2.0	2N4957	2N4957	2N5829				PNP
	2N5031	2N5031	2N5031	MRF904	MRF901		NPN
2.5	2N4957	2N4957	2N4957	2N5829			PNP
	2N5031	2N5031	2N5031	2N5031	MRF901		NPN
3.0	2N4959	2N4959	2N4958	2N4957	2N5829		PNP
	2N2857	2N2857	2N5031	2N5031	MRF901	MRF902	NPN
3.5	2N4959	2N4959	2N4959	2N4957	2N4957		PNP
	2N5179	2N5179	2N2857	2N5031	2N5031	MRF901	NPN
4.0	2N4959	2N4959	2N4959	2N4959	2N4958		PNP
	2N5179	2N5179	2N5179	2N2857	2N5031		NPN
4.5	2N4959	2N4959	2N4959	2N4959	2N4959		PNP
	2N5179	2N5179	2N5179	2N2857	2N5031		NPN

General-Purpose Amplifier Transistors

The behavior of f_T as a function of I_C is critical in most Class A amplifier applications. The devices listed in the matrix form below are classified according to F_T versus I_C.

f_T GHz Min	COLLECTOR CURRENT mA							Polarity
	0.10	1.0	5.0	10	20	50	100	
6.0				BFR90	BFR91			NPN
5.5					BFR91	BFR96		NPN
					BFR91	BFR96	BFR96	NPN
4.5					MM4049			PNP
			BFR90	MRF901	MRF901	BFR96	BFR96	NPN
4.0					MM4049			PNP
		MRF931	MRF901		MRF901	BFR96	BFR96	NPN
3.5				MM4049	MM4049			PNP
		MRF931	MRF901	MRF901	MRF901	BFR96	BFR96	NPN
3.0		MRF931	MRF901	MRF904	MRF904	BFR96	MRF515	NPN
2.5		MRF931	MRF901				MRF515	NPN
2.0			2N4957	2N4957			2N5583	PNP
		MRF901	2N5031			MRF515	2N5837	NPN
1.5					2N5583	2N5583	2N5583	PNP
		2N5031	2N2857	2N6304	2N6304	2N5943	2N5109	NPN
1.0		2N4957			2N5160	2N5160	2N5160	PNP
	MRF931	2N5179	2N5179	2N2857	2N3866	MM8001	2N5108	NPN
	2N4957				MRF532*	MRF532*	MM4019	PNP
0.5	MRF931	MRF501	MRF501	MRF501	MRF531**	MRF531**	2N3553	NPN

* BV_{CEO} = 80 Vdc ** BV_{CEO} = 100 Vdc

CATV, MATV, and Class A Linear Transistors

The devices listed below are excellent for Class A linear CATV/MATV applications. The new MRF511 is gaining wide industry acceptance. The devices are listed according to increasing Current-Gain (f_T). More information concerning the device for your specific linear design needs can be obtained through your local Motorola Sales Office or Motorola distributor.

Device Type	Nominal Test Conditions V_{CE}/I_C Volts/mA	f_T MHz Min. Typ*	Noise Figure Max. or / Freq. Typ* MHz	Distortion Specifications 2 nd Order IMD	3 rd Order IMD	12 ch. Cross-Mod.	Output Level dbMV	Package
MRF501	6/2-5	600	4.5*/200					TO-72
MRF502	6/2-5	800	4.0*/200					TO-72
2N5179	6/1.5-2	900	4.5/200					TO-72
BFY90	5/2	1000	5.0/500					TO-72
BFX89		1200	6.5/500					TO-72
2N5109	15/10-50	1200	3.0*/200					TO-39
2N5943	15/30-50	1200	6.8*/200	−50		−42	+50	TO-39
2N6304	5/2-10	1400	4.5/450					TO-72
MRF511	20/50-80	1500	7.2*/200	−50	−65	−57	+50	144D-04
MRF517	15/20-60	2200	7.5/300	−60	−72	−57	+45	TO-39
BFR90	10/14	5000*	2.4*/500					302A-01
BFR91	5/35	5000*	1.9*/500					302A-01
BFR96	10/50	5000*	3.3*/500					302A-01
MRF961	10/50	5000*	3.3*/500					302A-01

Hybrid Amplifier Modules

The Hybrid Modules listed are specified for amplifier applications in CATV distribution equipment but are applicable wherever broadband (HF/VHF) low distortion, low-noise amplification is required. These modules are also specified as wideband amplifiers for use in communications/instrumentation equipment operating in bands from 1 MHz to 400 MHz.

CATV HYBRID MODULES

Device Type	Gain 40-300 MHz dB Min./Typ.	Maximum Distortion Specifications				Noise Figure @ 300 MHz dB
		Output Level dBmV	2 nd Order Test Note 1 dB	35 Channel Triple Beat dB	35 Channel Cross Modulation dB	
MHW594	16.6/17	+50	−68	−51	−51	7.0
MHW595	16.6/17	+50	−70	−56	−56	8.0
MHW588	18.0/18.5	+50	−72	−80#	−57##	7.0
MHW585	21.4/22	+50	−64	−51	−51	6.0
MHW586	21.4/22	+50	−66	−55	−56	7.0
MHW580	33/34	+48	−70	−57	−57	7.0

Note 1. Channels (2+13) @ R
* Operating frequency range = 5 to 120 MHz
\# 3 Channel triple beat
12 Channels @ P_{out} = +54 dB mV

GENERAL PURPOSE 50 Ω – 100 Ω WIDEBAND MODULES

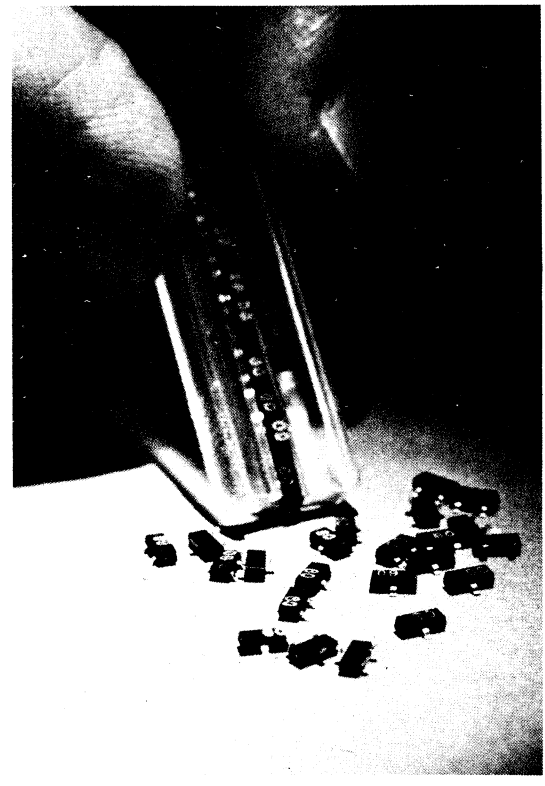
Device Type	Frequency Range MHz	Gain dB Min./Typ.	Supply Voltage Vdc	Output Level 1 dB Compression mW/f (MHz)	Noise Figure @ 250 MHz dB
MHW590	10-400	32.5/34	24	800/200	5.0
MHW591	1.0-250	35/36.5	13.6	700/100	5.0
MHW592	1-0-250	34.5/36	24	900/100	5.0
MHW593	10-400	34/35.5	13.6	600/200	4.5

MiniBloc

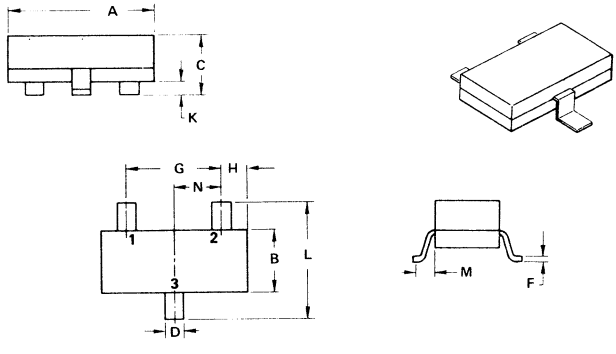
Unencapsulated semiconductors, used extensively in hybrid circuits, require careful handling and interconnection techniques to ensure a high level of product reliability. To minimize problems during hybrid circuit assembly, Motorola will be offering small-signal semiconductors in a miniature plastic package called the MiniBloc. This small, rectangular package is ideally-suited for use in thick-film and thin-film hybrid circuits. The MiniBloc is also used in certain PC board applications.

The new MiniBloc package and Motorola's existing wide array of products, will satisfy most of your RF hybrid semiconductor requirements. Contact your local Motorola Sales Office or Motorola distributor for more information.

The following devices are the first RF ones offered in the MiniBloc package:



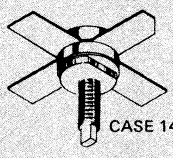
Device	Polarity	Similar to
RF Transistors		
MMBR901	NPN	MRF901
MMBR930	NPN	BFR91
MMBR2060	NPN	FMT2060
MMBR6304	NPN	2N6304
MMBR4957	PNP	2N4957



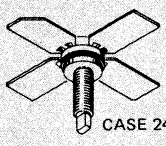
	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	2.80	3.05	0.110	0.120
B	1.20	1.40	0.047	0.055
C	0.85	1.20	0.034	0.047
D	0.37	0.43	0.015	0.017
F	0.076	0.127	0.003	0.005
G	1.78	2.04	0.070	0.080
H	0.51	0.61	0.020	0.024
K	0.10	0.25	0.004	0.010
L	2.10	2.50	0.083	0.098
M	0.45	0.61	0.018	0.024
N	0.89	1.02	0.035	0.040

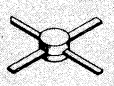
CASE 318-02
TO-236AA

RF TRANSISTORS AND MODULES


CASE 145A-08

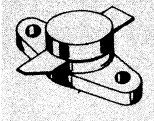

CASE 20-03
TO-72


CASE 244-04

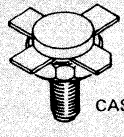

CASE 305A-01


CASE 26-03
TO-46


CASE 22-03
TO-18

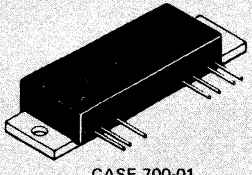

CASE 215-01

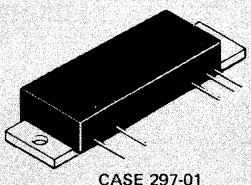

CASE 79-02
TO-39

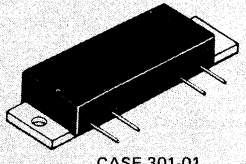

CASE 307-01

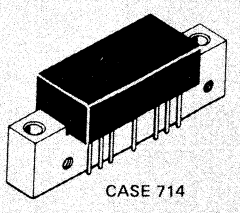

CASE 302-01

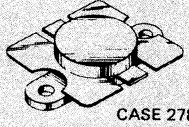

CASE 36-03
TO-60

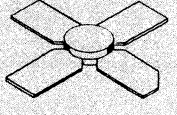

CASE 700-01


CASE 297-01


CASE 301-01

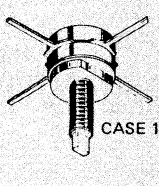

CASE 714


CASE 278-06

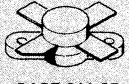

CASE 249-05


CASE 302A-01

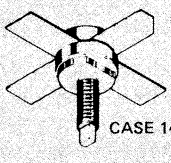

CASE 303-01

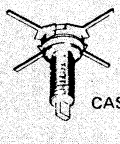

CASE 144B-04

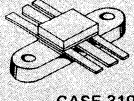

CASE 211-10

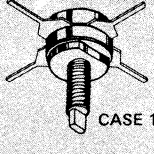

CASE 211-07

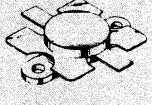

CASE 211-11

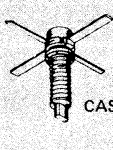

CASE 145A-07

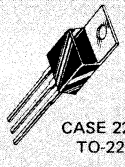

CASE 144D-05


CASE 319-01


CASE 144A-03

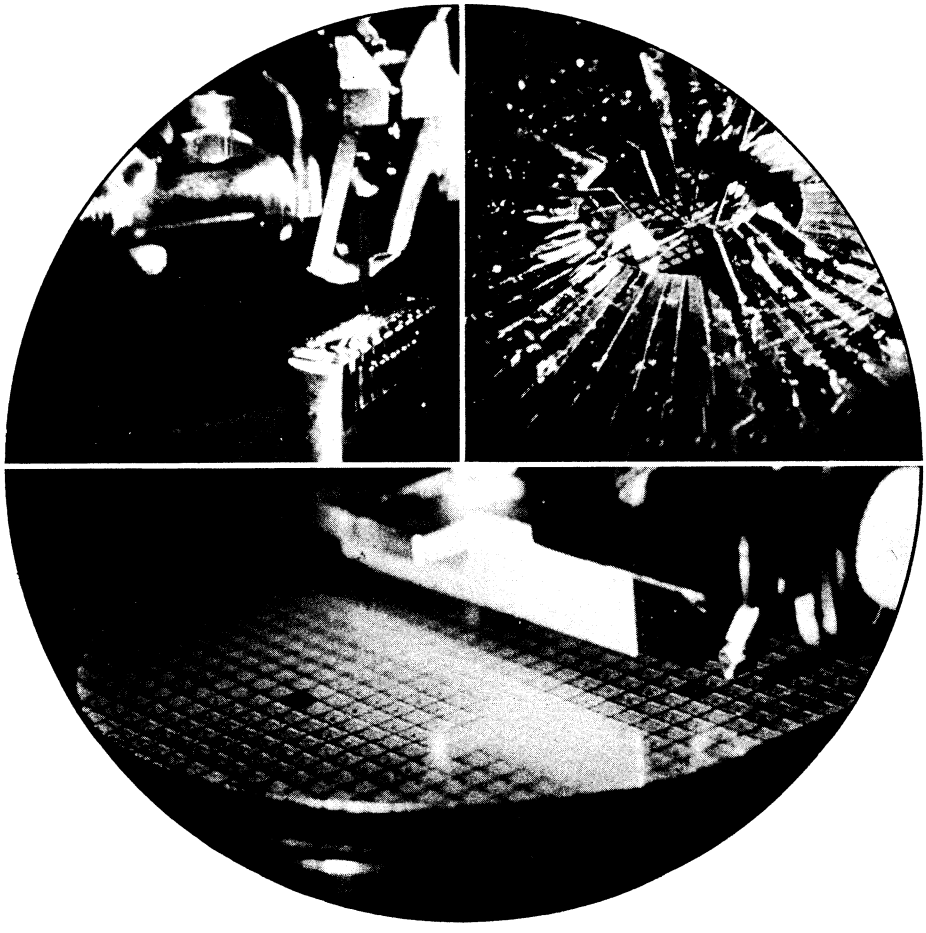

CASE 278-05


CASE 305-01


CASE 221A-01
TO-220 AB

PACKAGE INFORMATION

Silicon High Frequency products are available in a variety of packages for many applications. Information on devices in non-standard packaging may be obtained through your local Motorola Sales Office or Motorola distributor.



TUNING DIODES
HOT-CARRIER DIODES
PIN DIODES

The age of electronic tuning and frequency control is here! Mechanical tuning systems are being outdated by the following advantages of electronic tuning systems:

- Mechanical linkage and contacts are eliminated.
- Channel or station changes can easily be made by push button, continuous tuning, signal search or sweep methods.
- Faster response time.
- Remote tuning is simplified.
- Tuning components are much smaller than mechanical components.
- The designer is released from the mechanical and size restrictions dictated by mechanical tuning methods.

Three parameters are of prime consideration in choosing the proper tuning diode.

CT (Nominal capacitance) — Measure of the capacitance at one specified voltage.

CR (Capacitance ratio) — Ratio of the capacitance at two separate voltages usually at the operating ends of the CV curve. Measure of the magnitude of capacitance change as the reverse voltage is varied across the operating range.

Q (Figure fo Merit) — The same figure of merit that is widely used for capacitance and coils and is an indicator of how "good" a capacitor the tuning diode is.

These parameters are highlighted in the following selector guide and organized by package style to permit selection of the required specifications and package.

TABLE OF CONTENTS

Epicap Tuning

HIGH Q

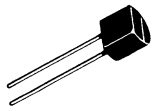
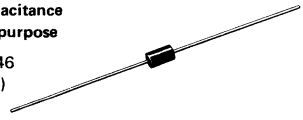
Cap. tolerance 10%, resp. 5%
Popular series
Professional equipment

CASE 51
(DO-7)

B_{VR} min. 60 V $C_t = C_t$ nom. ± 10% @ V_r = 4 V, f = 1 MHz				B_{VR} min. 60 V $C_t = C_t$ nom. ± 5% @ V_r = 4 V, f = 1 MHz			B_{VR} min. 30 V $C_t = C_t$ nom. ± 10% @ V_r = 4 V, f = 1 MHz		
C_t nom. pF V_r = 4 V f = 1 MHz	Cap. ratio 4-60 V Min.	Q @ 4 V 50 MHz Min.	Device Type	Cap. ratio 4-60 V Min.	Q @ 4 V 50 MHz Min.	Device Type	Cap. ratio 2-30 V Min.	Q @ 4 V 50 MHz Min.	Device Type
6.8	2.7	350	1N5139	2.7	350	2N5139A	2.5	450	1N5441A
8.2							2.5	450	1N5442A
10	2.8	300	1N5140	2.8	300	1N5140A	2.6	400	1N5443A
12	2.8	300	1N5141	2.8	300	1N5141A	2.6	400	1N5444A
15	2.8	250	2N5142	2.8	250	1N5142A	2.6	400	1N5445A
18	2.8	250	1N5143	2.8	250	1N5143A	2.6	350	1N5446A
20							2.6	350	1N5447A
22	3.2	200	1N5144	3.2	200	1N5144A	2.6	350	1N5448A
27	3.2	200	1N5145	3.2	200	1N5145A	2.6	350	1N5449A
33	3.2	200	1N5146	3.2	200	1N5146A	2.6	350	1N5450A
39	3.2	200	1N5147	3.2	200	1N5147A	2.6	300	1N5451A
47	3.2	200	1N5148	3.2	200	1N5148A	2.6	250	1N5452A
56							2.6	200	1N5453A
68							2.7	175	1N5454A
82							2.7	175	1N5455A
100							2.7	175	1N5456A
120									
150									
180									
200									
220									
250									
270									
330									

FM Radio Abrupt and TV Hyper-Abrupt Tuning

Device Type	C_t V_r = 3 V f = 1 MHz pF		Cap. ratio 3-25 V		Q @ 3 V f = 100 MHz Min.	Package	Application and comments
	Min.	Max.	Min.	Max.			
BB105B	2.0	2.3	4.5	6.0	225	MINI-L	VHF–UHF
BB105G	1.8	2.8	4.0	6.0	150	MINI-L	Tuners
BB105A	2.3	2.8	4.0	5.0	225	MINI-L	Consumer
BB205B	1.9	2.2	5.0	6.0	225	MINI-L	Application
BB205G	1.8	2.6	4.3	6.0	150	MINI-L	
MV104, BL MV204B	37	42	2.5[7]	2.8[7]	100	TO-92	Dual FM Radio
MV104G, GL MV204G	34	39	2.5[7]	2.8[7]	100	TO-92	Dual FM Radio
MV109, BB109	26	32	5	6.5	280[1]	MINI-L	VHF Tuners
MV209	26	32	5	6.5	280[1]	TO-92	VHF Tuners
MV1401	468[3]	633	14[5]		200[2]	DO-14	High C_t, high tuning ratio
MV1403	140[4]	210	10[6]		200[2]	DO-7	professional
MV1404	96[4]	144	10[6]		200[2]	DO-7	application
MV1405	200[4]	300	10[6]		200[2]	DO-7	

Low cost high volume plastic package CASE 182 	General purpose CASE 51 (DO-7) 	High capacitance General purpose CASE 146 (DO-14) 
B_{vr} min. 30 V $C_t = C_t$ nom. ± 10% @ V_r = 4 V, f = 1 MHz	B_{vr} min. 20 V $C_t = C_t$ nom. ± 10% @ V_r = 4 V, f = 1 MHz	B_{vr} min. 20 V $C_t = C_t$ nom. ± 10% @ V_r = 4 V, f = 1 MHz

Cap. ratio 2-30 V Min.	Q @ 4 V 50 MHz Min.	Device Type	Cap. ratio 2-20 V Min.	Q @ 4 V 50 MHz Min.	Device Type	Cap. ratio 2-20 V Min.	Q @ 4 V 20 MHz Min.	Device Type
2.5	450	MV2101	2.0	300	MV1620			
2.5	450	MV2102	2.0	300	MV1622			
2.5	400	MV2103	2.0	300	MV1624			
2.5	400	MV2104	2.0	300	MV1626			
2.5	400	MV2105	2.0	250	MV1628			
2.5	350	MV2106	2.0	250	MV1630			
			2.0	250	MV1632			
2.5	350	MV2107	2.0	250	MV1634			
2.5	300	MV2108	2.0	200	MV1636			
2.5	200	MV2109	2.0	200	MV1638			
2.5	150	MV2110	2.0	200	MV1640			
2.5	150	MV2111	2.0	200	MV1642			
2.6	150	MV2112	2.0	150	MV1644			
2.6	150	MV2113	2.0	150	MV1646			
2.6	100	MV2114	2.0	150	MV1648			
2.6	100	MV2115	2.0	150	MV1650			
						2.6	250	MV1652
						2.6	250	MV1654
						2.6	200	MV1656
						2.6	200	MV1658
						2.6	150	MV1660
						2.3*	150	MV1662**
						2.3*	100	MV1664**
						2.3*	100	MV1666**

* Capacitance 2-15 V

** B_{vr} min. 15 V

[1] Q @ V_r = 3 V, f = 50 MHz
[2] Q @ V_r = 2 V, f = 1 MHz
[3] C_t @ V_r = 1 V, f = 1 MHz
[4] C_t @ V_r = 2 V, f = 1 MHz
[5] Cap. Ratio 1-10 V
[6] Cap. Ratio 2-10 V
[7] Cap. Ratio 3-30 V

AM Tuning

. . . designed for electronic tuning of AM radios, receivers, and general AM frequency control.

Device Type	Ct. V_r = 1 V, f = 1 MHz pF		Cap. Ratio 1-25 V Min.	Q @ 1 V f = 1 MHz Min.	Package	Comments
	Min.	Max.				
MVAM109	400	520	12[2]	150	182	Single, matching avail.
MVAM115	440	560	15[1]	150	182	Single, matching avail.
MVAM125	440	560	15	150	182	Single, matching avail.

[1] C1 –15 V
[2] C1 – 9 V

Hot-Carrier

Hot-Carrier diodes are ideal for VHF and UHF mixer and detector applications as well as many higher microwave frequency applications. They provide stable electrical characteristics by eliminating the point-contact diode presently used in many applications. Motorola has the capability of supplying these devices in a variety of packages.

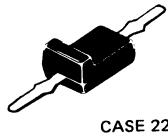
Device Type	B_{vr} @ I_r = 10 μA V. Min.	C_t [1] V_r = 0 V, f = 1 MHz [2] V_r = 15 V, f = 1 MHz [3] V_r = 20 V, f = 1 MHz pF Max.	V_f @ I_f = 10 mA V. Max.	I_r [4] V_r = 3 V [5] V_r = 15 V [6] V_r = 25 V [7] V_r = 35 V nA Max.	Package Case
MBD101	4	1.0[1]	0.6	250[4]	182.02 TO-92
MBD102	4	1.0[1]	0.6	250[4]	226 MINI-L
MBD201	20	1.5[2]	0.6	200[5]	182.03 TO-92
MBD301	30	1.5[2]	0.6	200[5]	182.03 TO-92
MBD501	50	1.0[3]	1.2	200[6]	182.02 TO-92
MBD502	50	1.0[3]	1.2	200[6]	226 MINI-L
MBD701	70	1.0[3]	1.2	200[7]	182.02 TO-92
MBD702	70	1.0[3]	1.2	200[7]	226 MINI-L

Pin Switching

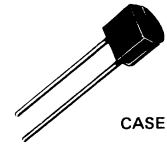
. . . designed for VHF band switching and general purpose switching.

Device Type	B_{vr} @ I_r = 10 μA Volts Min.	C_t V_r = 20 V, f = 1 MHz pF Max.	R_s I_f = 10 mA Ohms	L_s f = 250 MHz nH Typ.	Package Case
BA243	20	2.0[1]	1.0	2.0	DO-35
BA244	20	2.0[1]	0.5	2.0	DO-35
MPN3401	35	1.0	0.7	3.0	226 MINI-L
MPN3402	35	2.0	0.6	3.0	226 MINI-L
MPN3403	20	2.0	0.7	3.0	226 MINI-L
MPN3404	20	2.0	0.85	6.0	182.03 TO-92

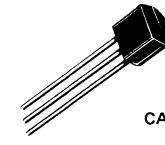
[1] C_t @ V_r = 15 Vdc



CASE 226



CASE 182



CASE 29-02
TO-92

REGULATOR AND REFERENCE DEVICES

In every language under the sun, the name most commonly associated with solidstate regulator and reference devices is Motorola. A pioneer in Zener diode development, Motorola has consistently led the industry in parameter improvements, packaging proliferation and specifications innovation. Today, Motorola serves the industry with an incomparable line of zener and avalanche regulator diodes, temperature compensated reference devices, and a host of integrated circuits, designed to provide the exact degree of regulation required, at the point in the circuit or system where it can be used most conveniently at the lowest cost.

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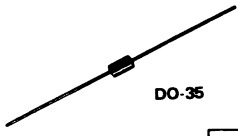
Zener Diodes



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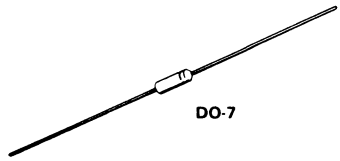

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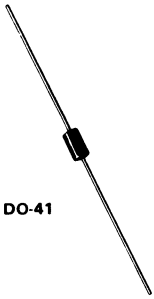

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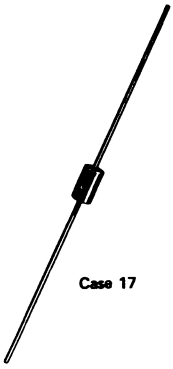


Case 17

POWER	500 mW					
PACKAGE	DO-35 Glass			DO-7 Glass	DO-35 Glass	
Zener Volts	European specifications				JEDEC Specifications	
2.4			BZX79C2V4		1N4370A	
2.5						
2.7	BZX83C2V7	M-ZPD2.7	BZX79C2V7	BZY88C2V7	1N4371A	
2.8						
3.0	BZX83C3V0	M-ZPD3.0	BZX79C3V0	BZY88C3V0	1N4372A	
3.3	BZX83C3V3	M-ZPD3.3	BZX79C3V3	BZY88C3V3	1N746A	
3.6	BZX83C3V6	M-ZPD3.6	BZX79C3V6	BZY88C3V6	1N747A	
3.9	BZX83C3V9	M-ZPD3.9	BZX79C3V9	BZY88C3V9	1N748A	
4.3	BZX83C4V3	M-ZPD4.3	BZX79C4V3	BZY88C4V3	1N749A	
4.7	BZX83C4V7	M-ZPD4.7	BZX79C4V7	BZY88C4V7	1N750A	
5.1	BZX83C5V1	M-ZPD5.1	BZX79C5V1	BZY88C5V1	1N751A	
5.6	BZX83C5V6	M-ZPD5.6	BZX79C5V6	BZY88C5V6	1N752A	
6.0						
6.2	BZX83C6V2	M-ZPD6.2	BZX79C6V2	BZY88C6V2	1N753A	
6.8	BZX83C6V8	M-ZPD6.8	BZX79C6V8	BZY88C6V8	1N754A	1N957B
7.5	BZX83C7V5	M-ZPD7.5	BZX79C7V5	BZY88C7V5	1N755A	1N968B
8.2	BZX83C8V2	M-ZPD8.2	BZX79C8V2	BZY88C8V2	1N756A	1N959B
8.7						
9.1	BZX83C9V1	M-ZPD9.1	BZX79C9V1	BZY88C9V1	1N757A	1N960B
10	BZX83C10	M-ZPD10	BZX79C10	BZY88C10	1N758A	1N961B
11	BZX83C11	M-ZPD11	BZX79C11	BZY88C11		1N962B
12	BZX83C12	M-ZPD12	BZX79C12	BZY88C12	1N759A	1N963B
13	BZX83C13	M-ZPD13	BZX79C13	BZY88C13		1N964B
14				BZY88614		
15	BZX83C15	M-ZPD15	BZX79C15	BZY88C15		1N965B
16	BZX83C16	M-ZPD16	BZX79C16	BZY88C16		1N966B
17						
18	BZX83C18	M-ZPD18	BZX79C18	BZY88C18		1N967B
19						
20	BZX83C20	M-ZPD20	BZX79C20	BZY88C20		1N968B
22	BZX83C22	M-ZPD22	BZX79C22	BZY88C22		1N969B
24	BZX83C24	M-ZPD24	BZX79C24	BZY88C24		1N970B
25						
27	BZX83C27	M-ZPD27	BZX79C27	BZY88C27		1N971B
28						
30	BZX83C30	M-ZPD30	BZX79C30	BZY88C30		1N972B
33	BZX83C33	M-ZPD33	BZX79C33	BZY88C33		1N973B
36			BZX79C36	BZY88C36		1N974B
39			BZX79C39			1N975B
43			BZX79C43			1N976B
47			BZX79C47			1N977B
51			BZX79C51			1N978B
56			BZX79C56			1N979B
60						
62			BZX79C62			1N980B
68			BZX79C68			1N981B
75			BZX79C75			1N982B
82			BZX79C82			1N983B
87			BZX79C87			
91			BZX79C91			1N984B
100						1N985B
110						1N986B
120						1N987B
130						1N988B
140						
150						1N989B
160						1N990B
170						
180						1N991B
190						
200						1N992B

NOTE

Proelectron and most European series are specified under pulsed conditions and follow the E-24 International series of voltages. JEDEC series are usually specified under thermal equilibrium conditions and are exactly within the stated tolerance. Please consult individual data sheets for full conditions.

QUALITY AND RELIABILITY

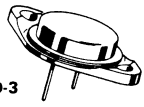
Computerized diffusion and testing. Oxide passivation. Laser scribing. Automatic inspections. MOS-inspired processes. All these processes lead to the utmost in Reliability.
Motorola also has the largest qualified range to Military specifications (JAN, JTX, JTXV), which is the result of our long experience in supplying high quality zener diodes.

1.3 W		5 W
DO-41 Plastic		Case 17 Plastic
European	JEDEC	
	1N4728A	1N5333B
	1N4729A	1N5334B
MZD3.9	1N4730A	1N5335B
MZD4.3	1N4731A	1N5336B
MZD4.7	1N4732A	1N5337B
MZB5.1	1N4733A	1N5338B
MZD5.6	1N4734A	1N5339B
		1N5340B
MZD6.2	1N4735A	1N5341B
MZD6.8	1N4736A	1N5342B
MZD7.5	1N4737A	1N5343B
MZD8.2	1N4738A	1N5344B
		1N5345B
MZD9.1	1N4739A	1N5346B
MZD10	1N4740A	1N5347B
MZD11	1N4741A	1N5348B
MZD12	1N4742A	1N5349B
MZD13	1N4743A	1N5350B
		1N5351B
MZD15	1N4744A	1N5352B
MZD16	1N4745A	1N5353B
		1N5354B
MZD18	1N4746A	1N5355B
		1N5356B
MZD20	1N4747A	1N5357B
MZD22	1N4748A	1N5358B
MZD24	1N4749A	1N5359B
		1N5360B
MZD27	1N4750A	1N5361B
		1N5362B
MZD30	1N4751A	1N5363B
MZD33	1N4752A	1N5364B
MZD36	1N4753A	1N5365B
MZD39	1N4754A	1N5366B
MZD43	1N4755A	1N5367B
MZD47	1N4756A	1N5368B
MZD51	1N4757A	1N5369B
MZD56	1N4758A	1N5370B
		1N5371B
MZD62	1N4759A	1N5372B
MZD68	1N4760A	1N5373B
MZD75	1N4761A	1N5374B
MZD82	1N4762A	1N5375B
		1N5376B
MZD91	1N4763A	1N5377B
MZD100	1N4764A	1N5378B
MZD110		1N5379B
MZD120		1N5380B
MZD130		1N5381B
		1N5382B
MZD150		1N5383B
MZD160		1N5384B
		1N5385B
MZD180		1N5386B
		1N5387B
MZD200		1N5388B

DO-4

DO-5

TO-3



POWER	10 W	50 W	
PACKAGE	DO-4 Metal	TO-3 Metal	DO-5 Metal
Zener Volts			
3.9	1N3993A	1N4557B	1N4549B
4.3	1N3994A	1N4558B	1N4550B
4.7	1N3995A	1N4559B	1N4551B
5.1	1N3996A	1N4560B	1N4552B
5.6	1N3997A	1N4561B	1N4553B
6.2	1N3998A	1N4562B	1N4554B
6.8	1N2970B	1N2804B	1N3305B
7.5	1N2971B	1N2805B	1N3306B
8.2	1N2972B	1N2806B	1N3307B
9.1	1N2973B	1N2807B	1N3308B
10	1N2974B	1N2808B	1N3309B
11	1N2975B	1N2809B	1N3310B
12	1N2976B	1N2810B	1N3311B
13	1N2977B	1N2811B	1N3312B
14	1N2978B	1N2812B	1N3313B
15	1N2979B	1N2813B	1N3314B
16	1N2980B	1N2814B	1N3315B
17	1N2981B	1N2815B	1N3316B
18	1N2982B	1N2816B	1N3317B
19	1N2983B	1N2817B	1N3318B
20	1N2984B	1N2818B	1N3319B
22	1N2985B	1N2819B	1N3320B
24	1N2986B	1N2820B	1N3321B
25	1N2987B	1N2821B	1N3322B
27	1N2988B	1N2822B	1N3323B
30	1N2989B	1N2823B	1N3324B
33	1N2990B	1N2824B	1N3325B
36	1N2991B	1N2825B	1N3326B
39	1N2992B	1N2926B	1N3327B
43	1N2993B	1N2827B	1N3328B
45	1N2994B	1N2828B	1N3329B
47	1N2995B	1N2829B	1N3330B
50	1N2996B	1N2830B	1N3331B
51	1N2997B	1N2831B	1N3332B
52	1N2998B		1N3333B
56	1N2999B	1N2832B	1N3334B
62	1N3000B	1N2833B	1N3335B
68	1N3001B	1N2834B	1N3336B
75	1N3002B	1N2835B	1N3337B
82	1N3003B	1N2836B	1N3338B
91	1N304B	1N2837B	1N3339B
100	1N3005B	1N2838B	1N3340B
105	1N3006B	1N2839B	1N3341B
110	1N3007B	1N2840B	1N3342B
120	1N3008B	1N2841B	1N3343B
130	1N3009B	1N2842B	1N3344B
140	1N3010B		1N3345B
150	1N3011B	1N2843B	1N3346B
160	1N3012B	1N2844B	1N3347B
175	1N3013B		1N3348B
180	1N3014B	1N2845B	1N3349B
200	1N3015B	1N2846B	1N3350B

Temperature Compensated Reference Diodes

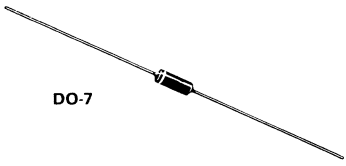
For applications where output voltage must remain within narrow limits during changes in input voltage, load resistance and temperature. Motorola guarantees all Reference Devices to fall within the specified maximum voltage variations, ΔV_Z, at the specifically indicated test temperatures and test current (JEDEC Standard #5). Temperature Coefficient is also specified but should be considered as a reference only – not a maximum rating.

The low voltage devices are hermetically sealed, all-glass structure. Includes JAN; JANTX and radiation hardened device types. These temperature compensated Zener Reference Diodes have low dynamic impedance and silicon-oxide-passivated junctions for long term stability.

Metal – DO-13
POWER = 9.3 V
TEMPERATURE RANGE (°C)

0, 25, 75	Max. ΔVZ mV	−55, 0, 25 75, 100	Max. ΔVZ mV	−55, 0, 25 75, 100, 150	Max. ΔVZ mV
1N2620	70	1N2620A	144	1N2620B	191
1N2621	35	1N2621A	72	1N2621B	95
1N2622	14	1N2622A	29	1N2622B	38
1N2623	7	1N2623A	14	1N2623B	19
1N2624	3	1N2624A	7	1N2624B	10

DO-13



DO-7

DO-7 GLASS

6.2 V	9.0 V			11.7 V		
TEMPERATURE RANGE (°C)						
−55, 0, 25 75, 100	0, 25, 75	−55, 0, 25 75, 100	−55, 0, 25 75, 100, 150	0, 25, 75	−55, 25 75, 100	−55, 0, 25 75, 100, 150
24,, Max. ΔVZ mV	Max. ΔVZ mV	Max. ΔVZ mV	Max. ΔVZ mV	Max. ΔVZ mV	Max. ΔVZ mV	Max. ΔVZ mW
1N821 96	1N936 67	1N935A 139	1N935B 184	1N941 88	1N941A 181	1N941B 239
1N823 48	1N936 33	1N936A 69	1N936B 92	1N942 44	1N942A 90	1N942B 120
1N826 19	1N937 13	1N937A 27	1N937B 37	1N943 18	1N943A 36	1N943B 47
1N827 9	1N938 6	1N938A 13	1N938B 18	1N944 9	1N944A 18	1N944B 24
1N829 5	1N939 3	1N939A 7	1N939B 9	1N945 4	1N945A 9	1N945B 12

Non Suffix = 15 Ohms

A Suffix = 10 Ohms

ULTRA STABLE, PRECISION REFERENCE DIODES

6.2 Volt			
MZ605	5 PPM	MZ620	20 PPM
MZ610	10 PPM	MZ640	40 PPM

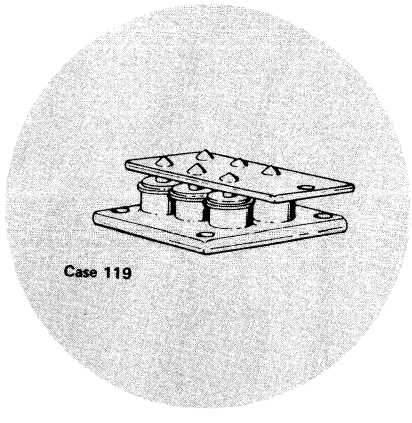
Power Transient Suppressors

Motorola Power Transient Suppressors protect voltage sensitive devices and circuits which may be in danger of destruction by high energy voltage transients.

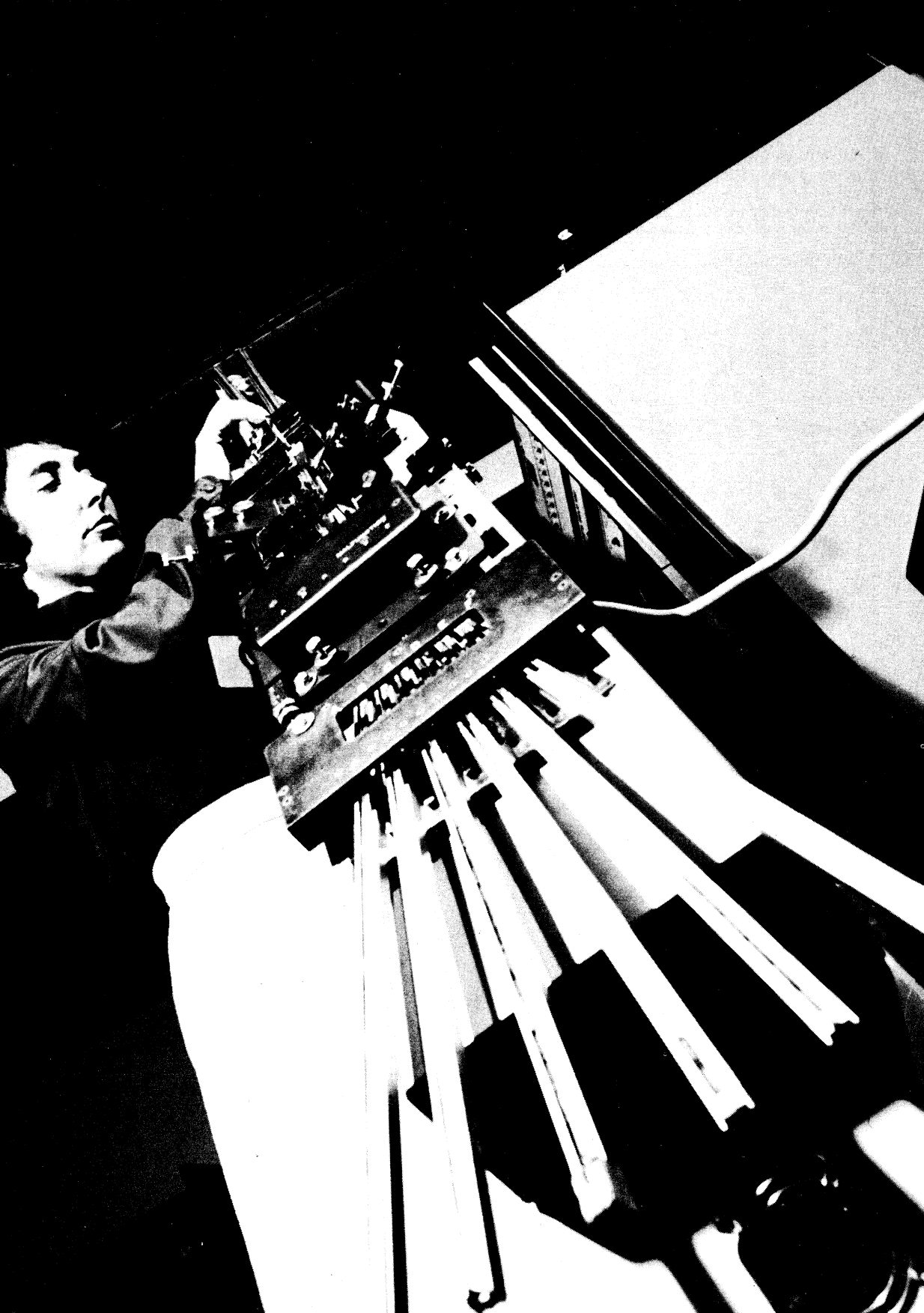
Standard factory available types cover most requirements for protection.

Suppressors to meet specific needs can be designed by paralleling cells. Non-standard options such as special voltages can be supplied-consult your Motorola Sales Office or nearest Distributor.

V_R Operating Voltage		I_R Reverse Current at V_R	V_Z Breakdown Volt @		Maximum Zener Voltage Pulse width = 1 ms		V_F Forward Voltage @			
Nom Vdc	$V_{(RMS)}$	Nom μA	Min. Volts	I_{ZT} A	V_Z max. Volts	I_Z pulse Amp.	Volts	I_F Amp.	Device Type	Case
14	10	50	16	0.4	24	200	1.5	10	MPZ5-16A	119
14	10	50	16	0.4	20	200	1.5	10	MPZ5-16B	119
28	20	50	32	0.2	50	100	1.5	10	MPZ5-32A	119
28	20	50	32	0.2	45	100	1.5	10	MPZ5-32B	119
28	20	50	32	0.2	40	100	1.5	10	MPZ5-32C	119
165	117	50	180	0.03	250	20	1.5	10	MPZ5-180A	119
165	117	50	180	0.03	225	20	1.5	10	MPZ5-180B	119
165	117	50	180	0.03	205	20	1.5	10	MPZ5-180C	119



Case 119



RECTIFIERS

From miniature, lead-mounted low current rectifiers to single-phase rectifier bridges, from conventional diode junctions to Schottky Barrier rectifiers for specific applications, Motorola's extensive line of rectifiers meet wide range of requirements for electronic equipment.

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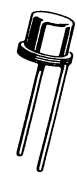
Standard Recovery Rectifiers

Low and Medium Current

Wide variety of low-cost devices to fit any mounting requirements. These lines are also available with anode-to-case connection by adding "R" suffix to the standard part number.

I_O AVERAGE RECTIFIED FORWARD CURRENT (Amperes)						
Case / V_{RRM} Volts	1.0	3.0			6.0	12
	59-04 Plastic	60 Metal	70 Metal	267 Plastic	194 Plastic	(DO-4) Metal
						
50	1N4001*	1N4719	1N4797	MR500	MR750	MR1120
100	1N4002*	1N4720	1N4998	MR501	MR751	MR1121
200	1N4003*	1N4721	1N4999	MR502	MR752	MR1122
400	1N4004*	1N4722	1N5000	MR504	MR754	MR1124
600	1N4005*	1N4723	1N5001	MR506	MR756	MR1126
800	1N4006*	1N4724	1N5002	MR508	MR758	MR1128
1000	1N4007*	1N4725	1N5003	MR510	MR760	MR1130
I_{FSM} (Amps)	30	300	300	100	400	300
T_A @ Rated I_O (°C)	75	75	75	95	60	
T_C @ Rated I_O (°C)						150
T_J (Max.) (°C)	175	175	175	175	175	190

* Package Size: 0.120 "Max. Diameter by 0.260" Max. Length

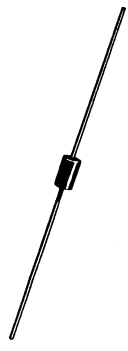
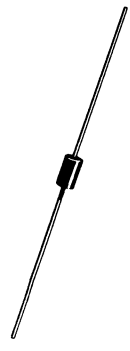
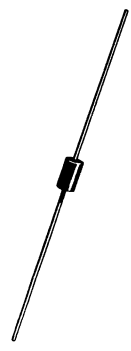
C.M.: Consult Marketing

I_O AVERAGE RECTIFIED FORWARD CURRENT (Amperes)							
20		25			35	40	50
DO-5 Metal	283-01 (DO-4) Low-Cost Plastic	283-01 (DO-4) Low-Cost Plastic	193-03 Low-Cost Plastic	43 (DO-21) Metal	DO-5 Metal		43-04 Metal
							
1N1191	MR2000S	MR2500S	MR2500	1N3491	1N1183	1N1183A	MR5005
1N1192	MR2001S	MR2501S	MR2501	1N3492	1N1184	1N1184A	MR5010
1N1194	MR2002S	MR2502S	MR2502	1N3493	1N1186	1N1186A	MR5020
1N1196A	MR2004S	MR2504S	MR2504	1N3495	1N1188	1N1188A	MR5040
1N1198A	MR2006S	MR2506S	MR2506	MR328	1N1190	1N1190A	C.M.
C.M.	MR2008S	MR2508S	MR2508	MR330	C.M.	C.M.	C.M.
C.M.	MR2010S	MR2510S	MR2510	MR331	C.M.	C.M.	C.M.
350	400	600	400	300	400	800	600
150	150	150	150	130	140	150	150
190	175	175	175	175	190	190	195

C.M. Consult Marketing

Pro Electron Devices

For general purpose consumer and industrial applications requiring high surge current and peak performance at elevated temperature.

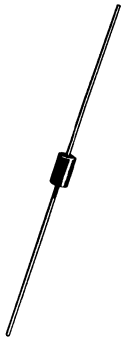
I_O AVERAGE RECTIFIED FORWARD CURRENT (Amperes)				
Case / V_{RRM} Volts	0.50	1.0	1.5	3.0
	59-04 	59-04 	59-04 	267 
50			BY601	
100			BY602	
150		BY135		
200			BY603	BY251
400			BY604	BY252
600		BY126/134	BY605	BY253
800			BY606	BY254
1000			BY607	
1250		BY127	BY608	
1300		BY133		BY255
1600	BYX10			
I_{FSM} (Amps)	30	40	50	100
T_A @ Rated I_O (°C)	75*	75	75	85
T_{JRRM}[1] (°C)	150	150	175	175

[1] T_J (Max.)

High Voltage Diodes

Low-current, high-voltage diodes in current ranges of 250 mA to 1.0 A and in voltage from 1000 to 5000 V.

250 mA HIGH VOLTAGE DIODES	
Case / V_{RRM} Volts	169-02 Plastic 
1000	MR250-1
2000	MR250-2
3000	MR250-3
4000	MR250-4
5000	MR250-5
I_{FSM} (Amps)	15
T_A @ Rated I_O (°C)	75
T_J (Max.) (°C)	150

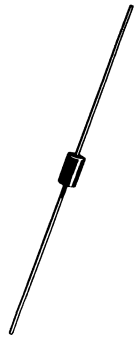
1.0 AMPERE TELEVISION	
Case / V_{RRM} Volts	59-04 Plastic 
1000	MR1-1000
1200	MR1-1200
1400	MR1-1400
1600	MR1-1600
I_{FSM} (Amps)	30
T_A @ Rated I_O (°C)	75*
T_J (Max.) (°C)	175
t_{rr} (μs)	25

* Must be derated for reverse power dissipation (see Data Sheet).

Fast/Soft Recovery Rectifiers

Fast Recovery Rectifiers

Available for designs requiring a power rectifier having maximum switching times ranging from 200 ns to 750 ns. These devices are offered in current ranges of 1.0 to 50 A and in voltages to 600 V. Higher voltages are available upon request, but a necessary trade-off against switching speeds results. Reverse polarity (anode to case) obtained by adding an "R" suffix.

I_O AVERAGE RECTIFIED FORWARD CURRENT (Amperes)						
Case / V_{RRM} Volts	1.0		3.0			
	59-04 Plastic 		60 Metal 	70 Metal 	267-01 Plastic 	
50	1N4933[2]	MR810	MR830	MR800	MR850	MR910
100	1N4934[2]	MR811	MR831	MR801	MR851	MR911
200	1N4935[2]	MR812	MR832	MR802	MR852	MR912
400	1N4936[2]	MR814	MR834	MR804	MR854	MR914
600	1N4937[2]	MR816	MR836	MR806	MR856	MR916
800		MR817				MR917
1000		MR818				MR918
I_{FSM} (Amps)	30	30	100	100	100	100
T_A @ Rated I_O (°C)	75	75			90[1]	90[1]
T_C @ Rated I_O (°C)			100	100		
T_J (Max.) (°C)	150	150	150	150	175	175
t_{rr} (μs)	0.2	0.75	0.2	0.2	0.2	0.75

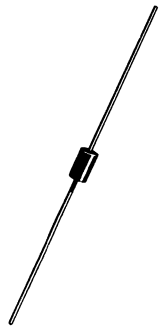
[1] Must be derated for reverse power dissipation. See Data Sheet

[2] Package size: 0.120" max. diameter by 0.260" max. length

I_O AVERAGE RECTIFIED FORWARD CURRENT (Amperes)						
5.0	**6.0**	**12**	**20**	**30**	**40**	**50**
194 Plastic	(DO-4) Metal		(DO-5) Metal			
						
MR820	1N3879	1N3889	1N3899	1N3909	MR860	MR870
MR821	1N3880	1N3890 JAN JTX	1N3900	1N3910 JAN JTX	MR861	MR871
MR822	1N3881	1N3891 JAN JTX	1N3901	1N3911 JAN JTX	MR862	MR872
MR824	1N3883	1N3893 JAN JTX	1N3903	1N3913 JAN JTX	MR864	MR874
MR826	MR1366	MR1376	MR1386	MR1396	MR866	MR876
350	150	200	250	300	350	400
55[1]						
	100	100	100	100	100	100
175	150	150	150	150	160	160
0.2	0.2	0.2	0.2	0.2	0.2	0.2

Pro-Electron Devices

Broad range of industry standard devices featuring non-snap off characteristics intended for use in switchmode power supplies, TV scan circuits and HF applications.

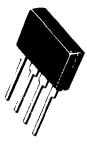
	I_O AVERAGE RECTIFIED FORWARD CURRENT (Amperes)						
Case / V_{RRM} Volts	0.4	0.5	1.0		1.2		2
			59-04 Plastic 				267-01 Plastic 
50				BY330			
100				BY331	BY196		BY296
200				BY332	BY197		BY297
400	BA157	BY206	BY210/4	BY334	BY198	BYX55-350	BY298
600	BA158	BY207	BY210/6	BY336		BYX55-600	
800			BY210/8	BY337	BY199		BY299
1000	BA159			BY338			
1300							BY400
1500				BY339			
I_{FSM} (Amps)	30	30	30	40	70	40	100
T_A @ Rated I_O (°C)	45	45	75	75	50	50	90
T_C @ Rated I_O (°C)							
T_J (Max.) (°C)	150	150	175	175	150	150	150
t_{rr}[1] (ns)	500	600	750	750	500	600	500

1 See Data Sheet conditions

Rectifier Bridges

Low to Medium Current Single Phase Bridges

Single-phase rectifier bridges with a wide variety of packaging options. Standard devices are made with standard recovery rectifiers but similar configurations can be made with special rectifier-cells (i.e. fast recovery cells) on special order.

	I_O DC OUTPUT CURRENT (Amperes)						
	1.8	1.0	2.0	4.0/8.0[1]	15	25	35
Case	109-03	312-02		117	309-01	309A-03	309-01
							
V_{RRM} Volts							
25	MDA920A1						
50	MDA920A2	3N246 MDA100A	3N253 MDA200	MDA970-1	BYW20	BYT25-50	BYW60
100	MDA920A3	3N247 MDA101A	3N254 MDA201	MDA970-2	BYW21	BYT25-100	BYW61
200	MDA920A4	3N248 MDA102A	3N255 MDA202	MDA970-3	BYW22	BYT25-200	BYW62
400	MDA920A6	3N249 MDA104A	3N256 MDA204	MDA970-5	BYW24	BYT25-400	BYW64
600	MDA920A7	3N250 MDA106A	3N257 MDA206		BYW26	C.M.	BYW66
800	MDA920A8	3N251 MDA108A	3N258 MDA208		BYW28	C.M.	BYW68
1000	MDA920A9	3N252 MDA110A	3N259 MDA210		BYW79	C.M.	BYW89
I_{FSM} (Amps)	45	30	60	100	300	400	400
T_A @ Rated I_O (°C)	50	75	55	[1]			
T_C @ Rated I_O (°C)				[1]	55	55	55
T_J (Max.) (°C)	175	150	165	150	175	175	175

[1] I_O = 4 A @ T_A = 25 °C
I_O = 8 A @ T_A = 55 °C
C.M.: Consult Marketing

Schottky Barrier Rectifiers

Schottky barrier devices, ideal for use in low voltage, high frequency power supplies and as free-wheeling diodes. These units feature very low forward voltages and switching times estimated at less than 10 ns. They are offered in current ranges of 0.5 to 75 A and in voltages to 45 V. Reverse polarity (anode to case) is NOT available.

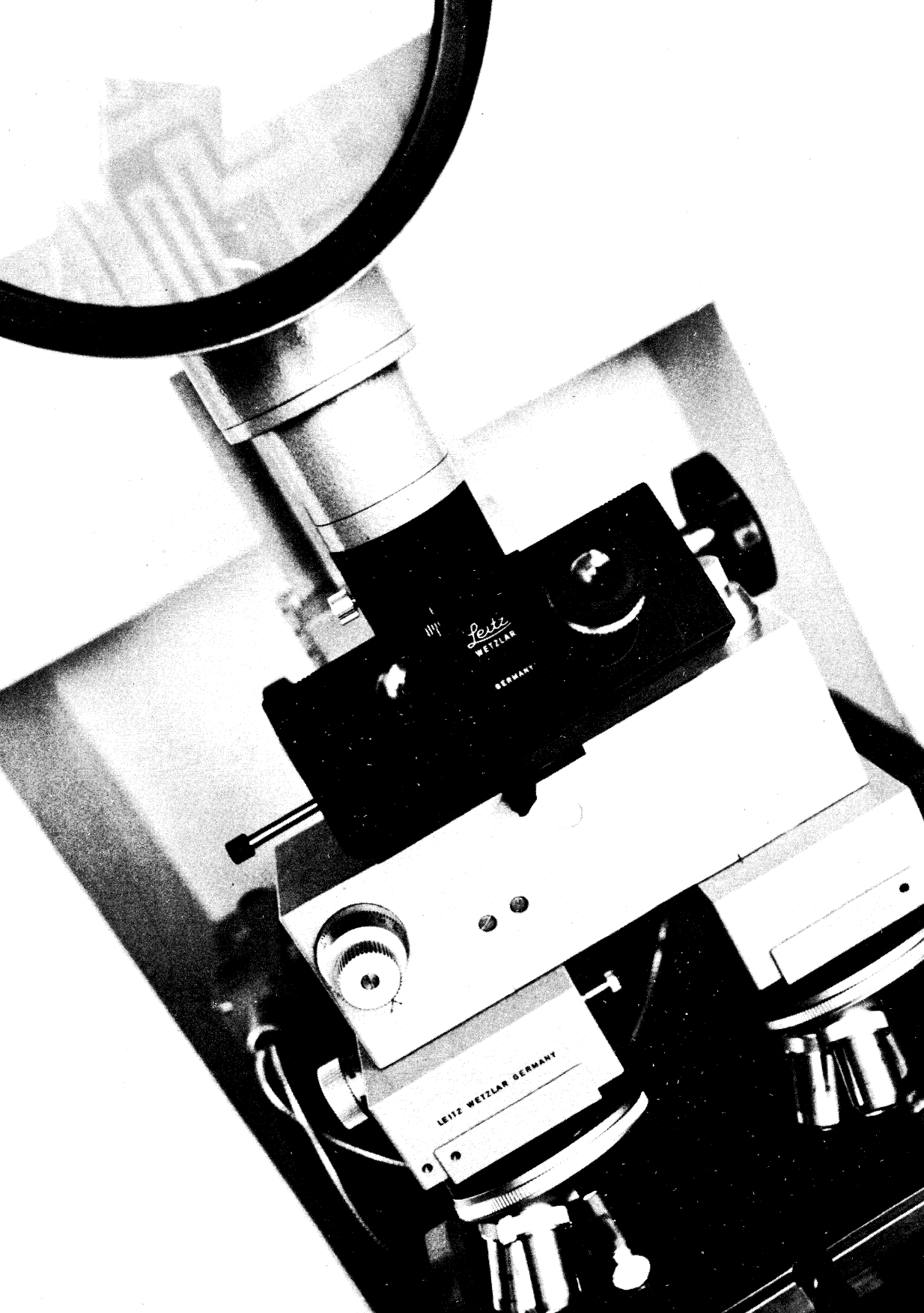
I_O AVERAGE RECTIFIED FORWARD CURRENT (Amperes)							
Case / V_{RRM} Volts	0.5	1.0		3.0		3.0	5.0
	51-02 (DO-7) Glass	59-04 Plastic		267 Plastic		60 Metal	
							
20	MBR020	1N5817	MBR120P	1N5820	MBR320P	MBR320M	1N5823
30	MBR030	1N5818	MBR130P	1N5821	MBR330P	MBR330M	1N5824
35			MBR135P		MBR335P	MBR335M	
40		1N5819	MBR140P	1N5822	MBR340P	MBR340M	1N5825
45							
I_{FSM} (Amps)	5.0	100	100	250	250	500	500
T_L or T_C at rated I_O (°C)	C.M.	90	80	95	85	90	80
T_J (Max.) (°C)	125	125	125	125	125	125	125
Max. V_F @ $I_{FM} = I_O$	0.50	0.60	0.70	0.525[1]	0.625[1]	0.45 @ 5 A	0.38[1]

* T case.

[1] Values are for the 40 volts units. The lower voltage parts provide lower limits.

C.M. Consult Marketing.

I_O AVERAGE RECTIFIED FORWARD CURRENT (Amperes)												
15		25			35		40			60		75
		245 (DO-4) Metal 					257 (DO-5) Metal 		430-2 (DO-21) 	257-01 (DO-5) Metal 		
1N5826	MBR1520	1N5829	MBR2520		MBR3520		1N5832	MBR4020	MBR4020 PF	MBR6020		MBR7520
1N5827	MBR1530	1N5830	MBR2530	1N6095			1N5833	MBR4030	MBR4030 PF	1N6097		MBR7530
	MBR1535		MBR2535		MBR3535			MBR4035		MBR6035		MBR7535
1N5828	MBR1540	1N5831	MBR2540	1N6096		SD41	1N5834	MBR4040	MBR4040 PF	1N6098	SD51	MBR7540
					MBR3545					MBR6045		MBR7545
500	500	800	800	400	600	600	800	800	800	800	800	1000
85*	80*	85*	80*	70*	90*		75*	70*	50*	90*		90*
125	125	125	125	125	150	150	125	125	125	150	150	150
0.50[1]	0.55	0.48[1]	0.55	0.58	0.55	0.55	0.59[1]	0.63	0.63	0.65	0.62	0.62


Leitz
WETZLAR
GERMANY
LEITZ WETZLAR GERMANY

THYRISTORS
AND TRIGGERS

Motorola's extensive line of thyristors consists of two generic component categories – SCRs and Triacs. Within each of these categories are two basic packaging divisions, plastic and metal – plastic for lowest cost and metal hermetically sealed packages for applications requiring highest reliability. Combined, these divisions include a large number of individual devices covering a forward-current range from 0.8 to 80 Amperes and a blocking voltage range from 15 to 800 Volts.

But the availability of devices for a wide range of current and voltage requirements doesn't begin to tell the whole story. For within the large selection of different series numbers are device families with characteristics designed for specifically designated applications. Here are some examples of preferred device families for the more high-volume applications, and for special unique purposes.

TABLE OF CONTENTS

SCRs in Plastic Packages

		ON-STATE (RMS) CURRENT							
		0.8 AMP	4.0 AMP		8.0 AMP		12 AMP	16 AMP	25 AMP
									
		Case 29-02 TO-92 Style 10	Case 77-03 TO-126 Style 2		Case 90-05 Style 1	Case 221-02 TO-220AB Style 2	Case 221-02 TO-220AB Style 1		
V_{DRM} V_{RRM} Blocking Voltage (DC or peak) Volts		MCR101	–	–	–	–	–	–	–
	25 V	–	–	–	MCR3000-1	–	–	–	–
	30 V	MCR102 2N5060	2N6236	MCR106-1	–	–	–	–	–
	50 V	–	2N6237	–	2N4441 MCR3000-2	C122F1 S2800F	2N6394	2N6400	2N6504
	60 V	MCR103 2N5061	–	MCR106-2	–	–	–	–	–
	100 V	MCR104 2N5062	2N6238	MCR106-3	MCR3000-3	C122A1 S2800A	2N6395	2N6401	2N6505
	150 V	MCR115 2N5063	–	–	–	–	–	–	–
	200 V	MCR120 2N5064	2N6239	MCR106-4	2N4442 MCR3000-4	C122B1 S2800B	2N6396	2N6402	2N6505
	300 V	MCR100-5	–	MCR106-5	MCR3000-5	C122C1 S2800C	MCR220-5	MCR221-5	–
	400 V	MCR100-6	2N6240	MCR106-6	2N4443 MCR3000-6	C122D1 S2800D	2N6397	2N6403	2N6507
	500 V	MCR100-7	–	MCR106-7	MCR3000-7	C122E1 S2800E	MCR220-7	MCR221-7	–
	600 V	MCR100-8	2N6241	MCR106-8	2N4444 MCR3000-8	C122M1 S2800M	2N6398	2N6404	2N6508
	700 V	–	–	MCR106-9	MCR3000-9	C122S1 S2800S	MCR220-9	MCR221-9	–
	800 V	–	–	–	MCR3000-10	C122N1 S2800N	2N6399	2N6405	2N6509
ELECTRICAL CHARACTERISTICS	I_{TSM} (Amp)	6.0	25	25	80	90	100	160	300
	I_{GT} @ 25° C (mA) Max	0.2	0.2	0.2	30	25	30	30	40
	V_{GT} @ 25° C (V) Max	0.8	0.8	1.0	1.5	1.5	1.5	1.5	1.5
	I_H @ 25° C (mA) Max	5.0	3.0	5.0	40	30	40	40	40

TRIAC's in Plastic Packages

# Denotes 2N6346 through 2N6349 and MAC221 Series only.

		ON-STATE (RMS) CURRENT											
		0.6 AMP	4.0 AMP			6.0 AMP	8.0 AMP	10 AMP		12 AMP		15 AMP	
													
		Case 29-02 TO-92 Style 12	Case 77-03 Style 5			Case 221-02 TO-220AB Style 2		Case 90-05 Style 4		Case 221-02 TO-220AB Style 2			
V_{DRM} Blocking Voltage (DC or Peak) Volts	25 V	–	2N6068	2N6068A	–	–	–	MAC11-1	MAC10-1	–	–	–	–
	20 V	MAC92-1	–	–	–	–	–	–	–	–	–	–	–
	50 V	–	2N6069	2N6069A	2N6069B	–	MAC220-2 MAC221-2	MAC11-2	MAC10-2	–	–	–	–
	60 V	MAC92-2	–	–	–	–	–	–	–	–	–	–	–
	100 V	MAC92-3	2N6070	2N6070A	2N6070B	SC141A T2500A	MAC220-3 MAC221-3	MAC11-3	MAC10-3	–	–	–	–
	200 V	MAC92-4	2N6071	2N6071A	2N6071B	SC141B T2500B	2N6342 2N6346	2N6154 MAC11-4	2N6151 MAC10-4	2N6342A	2N6346A	MAC15-4	MAC15A-4
	300 V	MAC92-5	2N6072	2N6072A	2N6072B	SC141C T2500C	MAC220-5 MAC221-5	MAC11-5	MAC10-5	–	–	MAC15-5	MAC15A-5
	400 V	MAC92-6	2N6073	2N6073A	2N6073B	SC141D T2500D	2N6343 2N6347	2N6155 MAC11-6	2N6152 MAC10-6	2N6343A	2N6347A	MAC15-6	MAC15A-6
	500 V	MAC92-7	2N6074	2N6074A	2N6074B	SC141E T2500E	MAC220-7 MAC221-7	MAC11-7	MAC10-7	–	–	MAC15-7	MAC15A-7
	600 V	MAC92-8	2N6075	2N6075A	2N6075B	SC141M T2500M	2N6344 2N6348	2N6156 MAC11-8	2N6153 MAC10-8	2N6344A	2N6348A	MAC15-8	MAC15A-8
	700 V	–	–	–	–	SC141S T2500S	MAC220-9 MAC221-9	–	–	–	–	MAC15-9	MAC15A-9
	800 V	–	–	–	–	SC141N T2500N	2N6345 2N6349	–	–	2N6345A	2N6349A	MAC15-10	MAC15A-10
ELECTRICAL CHARACTERISTICS	I_{GT} @ 25°C (mA) MT2(+), G(+) (Maximum)	5.0	30	5.0	3.0	50	50	50	50	50	50	50	50
	MT2(+), G(–)	–	–	5.0	3.0	50	75#	–	75	–	75	–	75
	MT2(–), G(+)	5.0	30	5.0	3.0	50	50	50	50	50	50	50	50
	MT2(–), G(+)	–	–	10	5.0	50	75#	–	75	–	75	–	75
	V_{GT} @ 25°C (V) MT2(+), G(+) (Maximum)	2.0	@ –40°C 2.5	@ –40°C 2.5	@ –40°C 2.5	2.5	2.0	2.0	2.0	2.0	2.0	2.0	2.0
	MT2(+), G(–)	–	–	2.5	2.5	2.5	2.5#	–	2.5	–	2.5	–	2.5
	MT2(–), G(–)	2.0	2.5	2.5	2.5	2.5	2.5	2.0	2.0	2.0	2.0	2.0	2.0
	MT2(–), G(+)	–	–	2.5	2.5	2.5	2.5#	–	2.5	–	2.5	–	2.5
	I_{TSM} (Amp)	6.0	30	30	30	60/80	100	100	100	120	120	150	150

TRIACS especially designed for power control using zero voltage switching techniques

		ON-STATE (RMS) CURRENT	
		8.0 AMP	12 AMP
			
		Case 221-02 TO-220AB Style 2	
V_{DRM} Blocking Voltage (DC or Peak) Volts	400 V	BT158-400	BT162-400
	500 V	–	–
	600 V	BT158-600	BT162-600
ELECTRICAL CHARACTERISTICS	I_{GT} @ 25°C (mA) MT2(+), G(+) (Maximum)	–	–
	MT2(+), G(–)	40	40
	MT2(–), G(–)	40	40
	MT2(–), G(+)	–	–
	V_{GT} @ 25°C (V) MT2(+), G(+) (Maximum)	–	–
	MT2(+), G(–)	1.5	1.5
	MT2(–), G(–)	1.5	1.5
	MT2(–), G(+)	–	–
	I_{TSM} (Amp)	80	120

Recommended Zero Voltage Switch Integrated Circuits

Part Nr.	Usage	Package
UAA 1004	On-Off Applications, high volume	DIL 8 pin
UAA 1006	Proportional Applications; variable duty cycle modulator	DIL 16 pin

SCRs in Metal Packages

NOTES :
1. Also available with flattened and pierced terminations.
2. Also available with solder lug terminations.

		ON-STATE (RMS								
		0.5 AMP	1.6 AMP				8.0 AMP		12.5 AMP	16 AMP
										Note 1 
		Case 22-03 TO-18 Style 6	Case 79-02 TO-39 Style 3				Case 86 Style 1	Case 87L Style 1	Case 54 Style 2	Case 263-0 Style 1
V_{DRM} V_{RRM} Blocking Voltage (DC or Peak) Volts	15 V	MCR201	–	–	–	–	–	–	–	–
	25 V	–	–	2N2322	2N4212	MCR1906-1	2N4167	2N4183	–	2N1842 2N1842A
	30 V	MCR202	–	–	–	–	–	–	–	–
	50 V	–	2N1595	2N2323	2N4213	MCR1906-2	2N4168	2N4184	–	2N1843 2N1843A
	60 V	MCR203	–	–	–	–	–	–	–	–
	100 V	MCR204	2N1596	2N2324	2N4214	MCR1906-3	2N4169	2N4185	2N3668	2N1844 2N1844A
	150 V	MCR205	–	2N2325	2N4215	–	–	–	–	2N1845 2N1845A
	200 V	MCR206	2N1597	2N2326	2N4216	MCR1906-4	2N4170	2N4186	2N3669	2N1846 2N1846A
	250 V	–	–	2N2327	2N4217	–	–	–	–	2N1847 2N1847A
	300 V	–	2N1598	2N2328	2N4218	MCR1906-5	2N4171	2N4187	–	2N1848 2N1848A
	400 V	–	2N1599	2N2329	2N4219	MCR1906-6	2N4172	2N4188	2N3670	2N1849 2N1849A
	500 V	–	–	–	–	MCR1906-7	2N4173	2N4189	–	2N1850 2N1850A
	600 V	–	–	–	–	MCR1906-8	2N4174	2N4190	2N4103	–
	700 V	–	–	–	–	–	–	–	–	–
	800 V	–	–	–	–	–	–	–	–	–
ELECTRICAL CHARACTERISTICS	I_{TSM} (Amp)	6.0	15	15	15	15	← 100 →		200	125
	I_{GT} @ 25°C (mA) Max	0.2	10	0.2	0.1	1.0	← 30 →		40	80
	V_{GT} @ 25°C (V) Max	1.0	3.0	0.8	0.8	1.0	← 1.5 →		2.0	2.0
	I_H @ 25°C (mA) Max	2.0	5.0 Typ	2.0	3.0	5.0	← 30 →		20 Typ	–

TRIAC's in Metal Package

CURRENT

20 AMP						25 AMP		35 AMP			63 AMP		
Note 1	Note 2	Note 1		Note 2	Note 2		Note 2	Note 2	Note 2	Note 1	Note 1	Note 2	Note
													
Case 310-01 Style 1	Case 263-03 Style 1	Case 311-01 Style 1 (Isolated)	Case 54 Style 2	Case 174-03 Style 3	Case 175-02 Style 1	Case 61 TO-41 Style 1	Case 263-03 Style 1	Case 174-03 Style 3	Case 175-02 Style 1	Case 311-01 Style 1 (Isolated)	Case 310-01 Style 1	Case 263-03 Style 1	Case 311-01 Style 1 (olated)
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	MCR649AP-1	MCR3818-1	MCR3918-1	2N2573	2N681	MCR3835-1	MCR3935-1	C228U3	MCR63-1	MCR64-1	MCR65-1
–	–	–	–	–	–	–	–	–	–	–	–	–	–
2N5164	2N5168	S6220F	MCR649AP-2	MCR3818-2	MCR3918-2	2N2574	2N682	MCR3835-2	MCR3935-2	C228F3	MCR63-2	MCR64-2	MCR65-2
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	2N6167	MCR649AP-3	MCR3818-3	MCR3918-3	2N2575	2N683	2N3870	2N3896	2N6171	MCR63-3	MCR64-3	MCR65-3
–	–	–	–	–	–	–	2N684	–	–	–	–	–	–
2N5165	2N5169	2N6168	MCR649AP-4	MCR3818-4	MCR3918-4	2N2576	2N685	2N3871	2N3897	2N6172	MCR63-4	MCR64-4	MCR65-4
–	–	–	–	–	–	–	2N686	–	–	–	–	–	–
–	–	S6220C	MCR649AP-5	MCR3818-5	MCR3918-5	2N2577	2N687	MCR3835-5	MCR3935-5	C228C3	MCR63-5	MCR64-5	MCR65-5
2N5166	2N5170	2N6169	MCR649AP-6	MCR3818-6	MCR3918-6	2N2578	2N688	2N3872	2N3898	2N6173	MCR63-6	MCR64-6	MCR65-6
–	–	S6220E	MCR649AP-7	MCR3818-7	MCR3918-7	2N2579	2N689	MCR3835-7	MCR3935-7	C228E3	MCR63-7	MCR64-7	MCR65-7
2N5167	2N5171	2N6170	MCR649AP-8	MCR3818-8	MCR3918-8	MCR649-8	2N690	2N3873 MCR3835-8	2N3899 MCR3935-8	2N6174	MCR63-8	MCR64-8	MCR65-8
–	–	S6220S	MCR649AP-9	MCR3818-9	MCR3918-9	MCR649-9	2N691	MCR3835-9	MCR3935-9	C228S3	MCR63-9	MCR64-9	MCR65-9
–	–	S6220N	MCR649AP-10	MCR3818-10	MCR3918-10	MCR649-10	2N692	MCR3835-10	MCR3935-10	C228N3	MCR63-10	MCR64-10	MCR65-10
240 →			260	240	240	260	200	← 350 →			← 600 →		
40 →			40	40	40	40	40	← 40 →			← 40 →		
1.5 →			3.5	1.5	1.5	3.5	3.0	← 1.6 →			← 3.0 →		
50 →			20 Typ	50	50	20 Typ	20 Typ	← 50 →			← 60 →		

OTES :
Also available with
ttened and pierced
minations.
Also available with
der lug terminations.
Case 235-02, Style 2;
th flattened and pierced
minations, also
ilable with solder lug
minations).

		ON-STATE (RMS) CURRENT											
		10 AMP			15 AMP			30 AMP			40 AMP		
		Note 2	Note 2	Note 2	Note 2	Note 2	Note 1	Note 1	Note 2	Note 1	Note 1	Note 2	Note 1
				 (Isolated)			 (Isolated)			 (Isolated)			 (Isolated)
			Case 175-02 Style 3	Case 235-02 Style 2	Case 174-03 Style 3	Case 175-02 Style 3	Case 311-01 Style 1	Case 310-01 Style 1	Case 263-03 Style 1	Case 311-01 Style 1	Case 310-01 Style 1	Case 263-03 Style 1	Case 311-01 Style 1
V_{DRM} Blocking Voltage (DC or Peak) Volts	200 V	2N5567	2N5569	T4121B	2N5571	2N5573	2N6145	2N6157	2N6160	2N6163	2N5441	2N5444	T6420B
	400 V	2N5568	2N5570	T4121D	2N5572	2N5574	2N6146	2N6158	2N6161	2N6164	2N5442	2N5445	T6420D
	600 V	SC246M	SC245M	T4121M	SC251M	SC250M	2N6147	2N6159	2N6162	2N6165	2N5443	2N5446	T6420M
	800 V	SC246N	SC245N	T4121N	SC251N	SC250N	T4120N*	T6401N	T6411N	T6421N	T6400N	T6410N	T6420N
CHARACTERISTICS Maximum	I_{GT} @ 25 °C (mA) MT2(+), G(+)	25	25	25	50	50	50	60	60	60	70	70	70
	MT2(+), G(−)	40	40	40	80	80	80	70	70	70	70	70	70
	MT2(−), G(−)	25	25	25	50	50	50	70	70	70	70	70	70
	MT2(−), G(+)	40	40	40	80	80	80	100	100	100	100	100	100
	V_{GT} @ 25 °C (V) MT2(+), G(+)	2.5	2.5	2.5	2.5	2.5	2.5	2.0	2.0	2.0	2.0	2.0	2.0
	MT2(+), G(−)	2.5	2.5	2.5	2.5	2.5	2.5	2.1	2.1	2.1	2.0	2.0	2.0
	MT2(−), G(−)	2.5	2.5	2.5	2.5	2.5	2.5	2.1	2.1	2.1	2.0	2.0	2.0
	MT2(−), G(+)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	I_{TSM} (Amp)	100	100	100	150	150	150	250	250	250	300	300	300

Pulse Modulators in Metal Packages

Especially designed for applications in radar and similar equipment.

		ON-STATE PULSE CURRENT		
		100 AMP		1000 AMP
				
		Case 63-03 Style 1 TO-64		Case 263-03 Style 1
V_{DRM} V_{RRM} Blocking Voltage (Volts)	300 V	2N4199 2N4199JAN	MCR729-5	MCR1718-5
	400 V	2N4200 2N4200JAN	MCR729-6	MCR1718-6
	500 V	2N4201 2N4201JAN	MCR729-7	MCR1718-7
	600 V	2N4202 2N4202JAN	MCR729-8	MCR1718-8
	700 V	2N4203 2N4203JAN	MCR729-9	–
	800 V	2N4204 2N4204JAN	MCR729-10	–
ELECTRICAL CHARACTERISTICS	I_{GT} @ 25°C (mA) Max	50	50	50
	V_{GT} @ 25°C (V) Max	1.5	1.5	1.5
	I_H @ 25°C (mA) Typ	3.0 Min	25	15
	t_{gt} (μs) Typ	0.4	0.5 0.4 Max	–
	t_{off} (μs) Typ	20 Max	6 15	20
	dv/dt (V/μs) Max	250	50	100 Typ

Trigger Devices

PROGRAMMABLE UNIJUNCTION TRANSISTORS – (PUT)

Package	Device Type	I_P R_G = 10kΩ μA Max	I_P R_G = 1.0MΩ μA Max	I_{GAO} @ 40V nA Max	I_V R_G = 10kΩ μA Min	I_V R_G = 1.0MΩ μA Max
Plastic Case 29-02 TO-92 	2N6027	5.0	2.0	10	70	50
	2N6028	1.0	0.15	10	25	25
	MPU131	5.0	2.0	5.0	70	50
	MPU132	2.0	0.3	5.0	50	50
	MPU133	1.0	0.15	5.0	50	25
Metal Case 22-03 TO-18 	2N6116*	5.0	2.0	5.0	70	50
	2N6117*	2.0	0.3	5.0	50	50
	2N6118*	1.0	0.15	5.0	50	25

* Also available as JAN and JANTX devices

BILATERAL TRIGGERS – (DIACs)

Package	Device Type	V_S Volts Nom* Min	V_S Volts Nom* Max	I_S μA Max	I_H mA Max
Plastic Case 182-02 TO-92 	1N5758	20 ± 4.0*		100	
	1N5759	24 ± 4.0*		100	
	1N5760	28 ± 4.0*		100	
	1N5761	32 ± 4.0*		100	
	1N5762	36 ± 4.0*		100	
	1N5758A	20 ± 2.0*		25	
	1N5759A	24 ± 2.0*		25	
	1N5760A	28 ± 2.0*		25	
	1N5761A	32 ± 2.0*		25	
	1N5762A	36 ± 2.0*		25	

SILICON BIDIRECTIONAL SWITCH – (SBS)

Plastic Case 29-02 TO-92 	MBS4991	6.0	10	500	1.5
	MBS4992	7.5	9.0	120	0.5

SILICON UNDIRECTIONAL SWITCH – (SUS)

Plastic Case 29-02 TO-92 	MUS4987	6.0	10	500	1.5
	MUS4988	7.5	9.0	150	0.5

UNIJUNCTION TRANSISTORS – (UJT)

Package	Device Type	η Min	η Max	I_P μA Max	I_{EB20} μA Max	I_V mA Min
Plastic Case 29-02 (TO-92) 	MU10	0.50	0.85	5.0	1.0	1.0
	2N4870	0.56	0.75	5.0	1.0	2.0
	2N4871	0.70	0.85	5.0	1.0	4.0
	MU2646	0.56	0.75	5.0	12	4.0
	MU4891	0.55	0.82	5.0	0.01	2.0
	MU4892	0.51	0.69	2.0	0.01	2.0
	MU4893	0.55	0.82	2.0	0.01	2.0
	MU4894	0.74	0.86	1.0	0.01	2.0
Metal Case 22A-01 	MU20	0.56	0.85	2.0	0.2	1.0
	2N2646	0.56	0.75	5.0	12	4.0
	2N2647	0.68	0.82	2.0	0.2	8.0
	2N3980	0.68	0.82	2.0	0.01	1.0
	2N4851	0.56	0.75	2.0	0.1	2.0
	2N4852	0.70	0.85	2.0	0.1	4.0
	2N4853	0.70	0.85	0.4	0.05	6.0
	2N4948*	0.55	0.82	2.0	0.01	2.0
	2N4949*	0.74	0.86	1.0	0.01	2.0
	2N5431*	0.72	0.80	0.4	0.01	2.0

* Also available as JAN and JANTX devices

OPTOELECTRONIC DEVICES

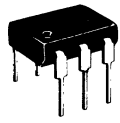
Optoelectronic devices are designed for use in computer, industrial and consumer equipment. Motorola's standard line of optoelectronic products include optical couplers, infrared light emitters and light detectors. Compactness, reliability and compatibility with integrated circuits keynote advantages.

TABLE OF CONTENTS

Optical Isolator/Couplers

Couplers are designed to provide isolation protection from hihg-voltage transients, surge voltage or low level noise that would otherwise damage the input or generate erroneous information. They allow interfacing systems of different logic levels, different grounds, etc., that would otherwise be incompatible. Motorola offers 7500 volts isolation voltage for all DIP optocouplers.

Motorola also offers a wide array of standard devices that have a wide range of specifications (including the first series of DIP transistors and darlington couplers to achieve JEDEC registration: transistors – 4N25 thru 4N28/darlingtons – 4N29 thru 4N33).

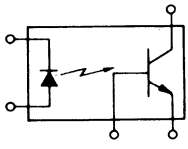


Actual Size  CASE 730-01

Transistor Output

The Transistor Coupler is probably the most popular form of isolator, since it offers moderate speed (approximately 300 kHz), sensitivity, and economy. In addition, the collector-base junction can be used as a photodiode to achieve higher speeds. The output in the diode mode is lower, requiring amplification for more usable output levels.

For High Speed, Moderate Efficiency



Device Type	House/JEDEC Registered Isolation* Voltage Volts Min	Motorola Tested Isolation* Voltage Volts Min	DC Current Transfer Ratio % Min	BV_{CEO} Volts Min	Collector Output Current @ I_F = 10 mA Typ mA
4N28	500	7500	10	30	2.0
4N26	1500	7500	20	30	3.5
4N27	1500	7500	10	30	2.0
4N38	1500	7500	20	80	3.5
4N37	1500	7500	100	30	2.0
4N36	2500	7500	100	30	2.0
4N25	2500	7500	20	30	3.5
4N25A**	2500	7500	20	30	3.5
4N38A**	2500	7500	20	80	3.5
4N35	3550	7500	100	30	2.0
MOC1005	5000	7500	20	30	5.0
MOC1006	5000	7500	10	30	3.0
H11A1	2500	7500	50	30	5.5
H11A2	1500	7500	20	30	3.5
MCT2	1500	7500	20	30	3.5
TIL111	1500	7500	20	30	3.5

*AC peak voltage, sine wave 60 Hz – 5 sec.
**Underwriters' Laboratories Recognition.

File No. E54915.

Device Type	House/JEDEC Registered Isolation* Voltage Volts Min	Motorola Tested Isolation* Voltage Volts Min	DC Current Transfer Ratio % Min	BV_{CEO} Volts Min	Collector Output Current @ I_F = 10 mA Typ mA
4N30 (MOC1200)	1500	7500	100		30
4N31	1500	7500	50	30	10
4N33	1500	7500	500	30	60
MOC119	1500	7500	300	30	45
MOC8030	1500	7500	300	80	45
MOC8050	1500	7500	500	80	60
4N29	2500	7500	100	30	30
4N29A**	2500	7500	100	30	30
4N32	2500	7500	500	30	60
4N32A**	2500	7500	500	30	60
MCA230	3550	7500	100	30	20
MCA255	3550	7500	100	55	20

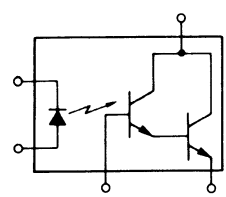
*AC peak voltage, sine wave 60 hz – 5 sec.
**Underwriters' Laboratories Recognition.

File No. E54915.

Darlington Output

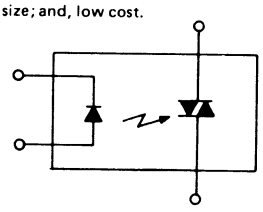
The Darlington Transistor Coupler is used when high transfer ratios and increased output current capability are needed. The speed, approximately 30 kHz, is slower than the transistor type, but the transfer ratio can be as much as twenty times as high as the single transistor type.

For High Efficiency, Moderate Speed



Bilateral Switch Output

The Optically Isolated Triac Driver is a gallium-arsenide LED, optically coupled to a silicon bilaterial switch designed for applications requiring isolated triac triggering such as interface from logic to 110 V RMS line voltage. These devices offer low current, isolated ac switching; high output blocking voltage; small size; and, low cost.



Bilateral Switch Output

Device Type	Isolation Voltage Volts (Min)*	Typ LED Trigger Current I_{FT} (mA)	Peak Blocking Voltage (Volts)
MOC3010**	7500	8	250
MOC3011**	7500	5	250

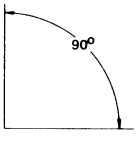
*AC peak sine wave 60 Hz – 5 sec.
**Underwriters' Laboratories Recognition. File No. E54915.

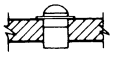
Infrared-Emitting Diodes

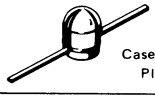
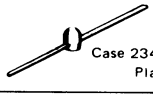
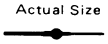
Infrared (900 nm) gallium arsenide emitters are available from Motorola for use in light modulators, shaft or position encoders, punched card and tape readers, optical switching and logic circuits. They are spectrally matched for use with silicon detectors.

Peak Emission Wavelength = 900 nm (Typ.)
Forward Voltage

Emission Angle – Angle at which I_R emission is 50% of maximum intensity.





Package	Device Type	Emission Angle α	Instantaneous Power Output Typ μW
 Case 81A-10 Metal — Actual Size	MLED910	30°	150 @ 50 mA
 Case 209-01 Metal — Actual Size 	MLED930	30°	650 @ 100 mA
 Case 171 Plastic — Actual Size 	MLED900	30°	550 μW @ 50 mA
 Case 234-02 Plastic — Actual Size 	MLED60 MLED90	65° 65°	550 @ 50 mA 350 @ 50 mA
 Case 29-02 Plastic — Actual Size 	MLED92	110°	650 @ 100 mA

Photodetectors

A variety of silicon photodetectors are available for a wide range of light detecting applications. Devices are available in packages offering choices of viewing angle and size in either low cost, economical, plastic cases or rugged, hermetic, metal cans. Advantages over phototubes are high sensitivity, good temperature stability, and proven silicon reliability. Applications include card and tape readers, pattern and character recognition, shaft encoders, position sensors, counters, and others. Maximum sensitivity occurs at approximately 800 nm.

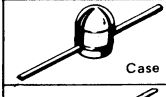
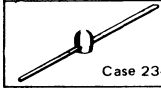
PIN Photodiodes

Photodiodes are used where high speed is required (1.0 ns).

Package	Type Number	Light Current @ H		BV_R Volts	Dark Current	
		Typ μA	mW/cm²	Min	nA Max @	Volts
 Actual Size  Case 209-01 Metal Convex Lens	MRD500	9.0	5.0	100	2.0	20
 Actual Size  Case 210-01 Metal Flat Lens	MRD510	2.0	5.0	100	2.0	20

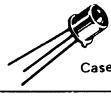
Phototransistors

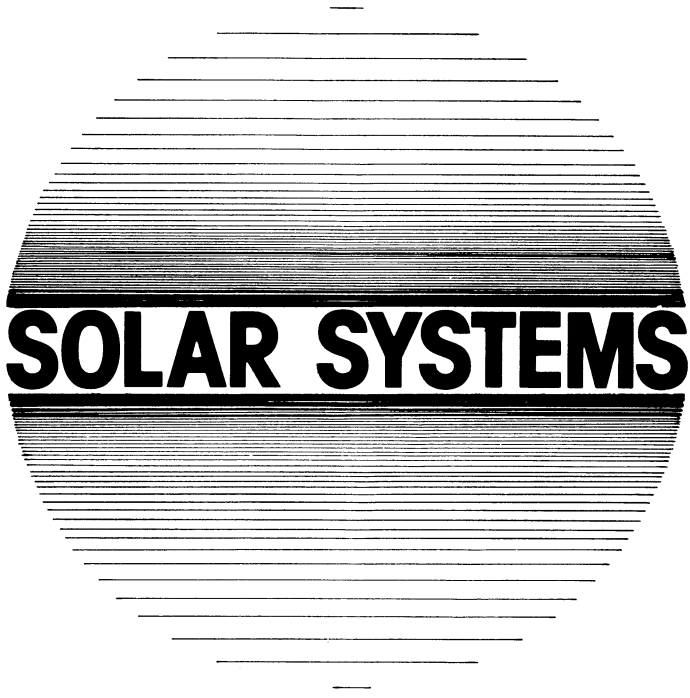
Phototransistors are used where moderate sensitivity and medium speed (2.0 μs) are required.

Package	Type Number	Light Current @ H		BV_{CEO} Volts	Dark Current @	V_{CE}
		Typ mA	mW/cm²	Min	nA Max	Volts
 Actual Size Case 81A-01 Metal	MRD604	8.5	20	50	25	30
	MRD603	6.0	20	50	25	30
	MRD602	3.5	20	50	25	30
	MRD601	1.5	20	50	25	30
 Actual Size  Case 82-01 Metal	MRD310	2.5	5.0	50	25	20
	MRD300	7.5	5.0	50	25	20
 Actual Size  Plastic Case 29-02	L14H4	0.5	10	30	100	10
	L14H1	0.5	10	60	100	10
	L14H2	2.0	10	30	100	10
	L14H3	2.0	10	60	100	10
 Actual Size  Case 82-01 Metal	MRD3054	1.2	5.0	30	100	20
	MRD3056	2.5	5.0	30	100	20
	MRD3055	1.8	5.0	30	100	20
	MRD3051	0.2	5.0	30	100	20
	MRD3050	0.2	5.0	30	100	20
 Actual Size  Case 171 Plastic	MRD450	4.0	5.0	40	100	20
 Actual Size  Case 234-02 Plastic	MRD160	1.5	5.0	40	100	20

Photodarlingtons

Photodarlingtons are used where maximum sensitivity is required with typical rise and fall times of 50 μs.

Package	Type Number	Light Current @ H		BV_{CEO} Volts	Dark Current	
		Typ mA	mW/cm²	Min	nA Max @	Volts
 Actual Size  Case 82-01 Metal	MRD360	20	0.5	40	100	10
	MRD370	10	0.5	40	100	10
 Actual Size  Case 29-01 Plastic	2N5780	8.0	2.0	40	100	12
	2N5779	8.0	2.0	25	100	12
	2N5778	4.0	2.0	40	100	12
	2N5777	4.0	2.0	25	100	12
	MRD14B	2.0	2.0	12	100	12



SOLAR ENERGY

In recent years society has become aware of the diminishing stock of fossil fuels.
The pollution associated with increasing fossil fuel use,
as well as the misgivings about increased use of nuclear energy, are also factors provoking new interest in alternatives such as solar energy.

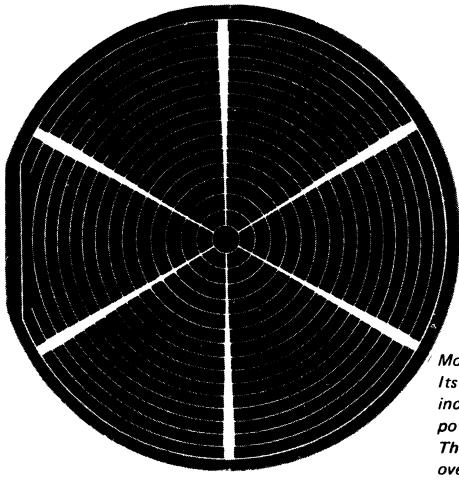
In just 15 minutes, enough sunlight strikes Earth
to satisfy our total energy consumption from all sources for an entire year.

Conscious of the need to develop utilisation of solar power, Motorola researchers
have applied silicon expertise to the development of state-of-the-art photovoltaic cell design
interconnection and encapsulation techniques.

MOTOROLA SOLAR CELLS

Motorola solar cells are prepared from 3-inch silicon wafers. A high conversion efficiency is obtained by a unique textured surface, and redundancy in the metallization interconnects provide for increased reliability.

Close-up, angled view of Motorola's pyramidal textured solar cell surface magnified 2 000 times by a scanning electron microscope.



Motorola solar photovoltaic cell (actual size: 3" = 7.62 cm Ø). Its distinctive rings-and-spokes pattern ensures high reliability, increases efficiency, and guards against any significant power loss with a unique combination of redundant connections. The cell's typical peak power output is over three quarters of a watt.

MOTOROLA SOLAR MODULES

Modules are fabricated with a corrosion-resistant stainless-steel frame. Glass glazing provides for high transmittance of solar irradiation and reliable environmental protection. Cells are encapsulated in void-free silicone to increase protection from shock and vibration and sealed to exclude moisture and atmospheric contamination.

Modules are configured in various series/parallel combinations of 36 or 48 cell arrays, depending on required output voltage. Peak power output from a 48 cell array is typically 24 watts.

APPLICATIONS

While solar energy electricity cannot compete cost-effectively with that generated by our utility companies today, its current prices do economically justify its everyday use in a wide range of remote or isolated location applications where conventional power sources are unavailable.

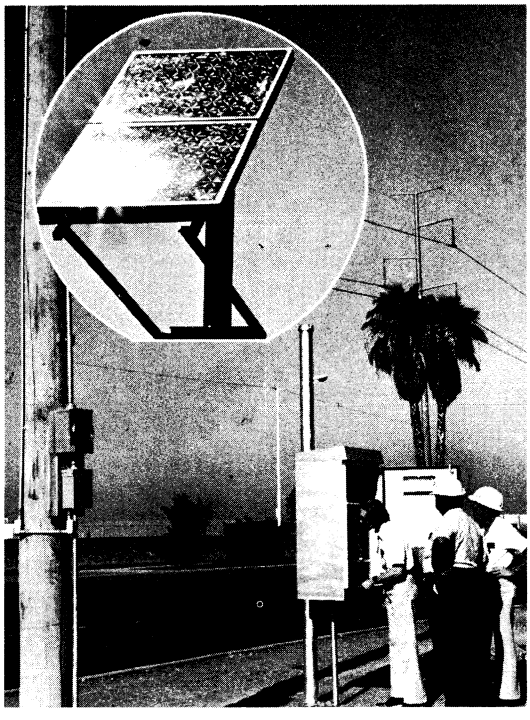
Some of the applications where solar modules are already proving themselves are:

- Microwave relay
- Telephone repeater
- Cathodic protection
- Offshore equipment
- Navigational aids
- Portable equipment
- Weather monitors
- Airport equipment
- Forestry equipment
- Fire phones
- Emergency phones
- Boats
- Cabins

APPLICATIONS SUPPORT

The Motorola staff of solar energy application engineers is available to assist in system definition, determination of module size requirements, battery selection, and regulator design.

Please contact your nearest Motorola sales office for assistance and further information on Motorola solar products.



Motorola solar powered traffic counter tested in Arizona.

3 CATALOG INDEX

A complete index of type numbers in alphanumerical order for instant device identification. Devices are referred by page number to more comprehensive tables in this book.

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