

MB40874

CHANNEL 4-BIT D/A CONVERTER

1 CHANNEL 4-BIT D/A CONVERTER WITH LOOK-UP TABLE (50 MSPS)

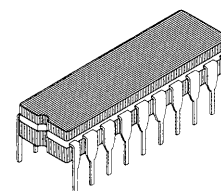
The Fujitsu MB40874 is a 50-MSPS (mega sample per second) 4-bit digital-to-analog converter with look-up table (LUT). The MB40874 is designed for high-speed video application with video RAM. The LUT is a 16-word, 4-bit memory to store luminance data. Instead of changing video RAM data, LUT data updating makes quick luminance changes in monochrome video application and quick color changes in color video application.

- Resolution: 4 bits
- Linearity : $\pm 1/2$ LSB maximum
- Operation frequency: 50 MSPS minimum
- Analog output voltage: 4.0V to 5.0V
- Digital input: TTL compatible
- Power supply voltage: +5V
- Power dissipation: 430 mW typical
- Package: 20-pin Cerdip (Suffix: -Z)
20-pin plastic DIP (Suffix: -P)

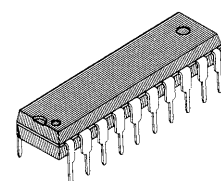
ABSOLUTE MAXIMUM RATINGS (see Note)

Rating	Symbol	Value	Unit
Power supply voltage	V_{CCA} V_{CCD}	-0.5 to +7.0	V
Digital input voltage	V_I	-0.5 to +7.0	V
Digital output voltage	V_{INA}	-0.5 to $V_{CC} + 0.5$	V
Storage temperature	Plastic	T_{STG}	°C
	Ceramic		
		-55 to +125	
		-65 to +150	

Note : Permanent device damage may occur if the above Absolute Maximum Ratings are exceeded. Functional operation should be restricted to the conditions as detailed in the operational sections data sheet. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

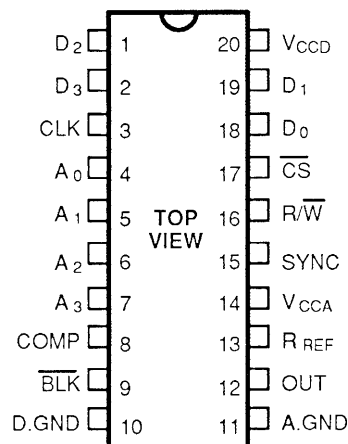


CERAMIC PACKAGE
DIP-20C-C01



PLASTIC PACKAGE
DIP-20P-M02

PIN ASSIGNMENT



This device contains circuitry to protect the inputs against damage due to high static voltages or electric fields. However, it is advised that normal precautions be taken to avoid application of any voltage higher than maximum rated voltages to this high impedance circuit.

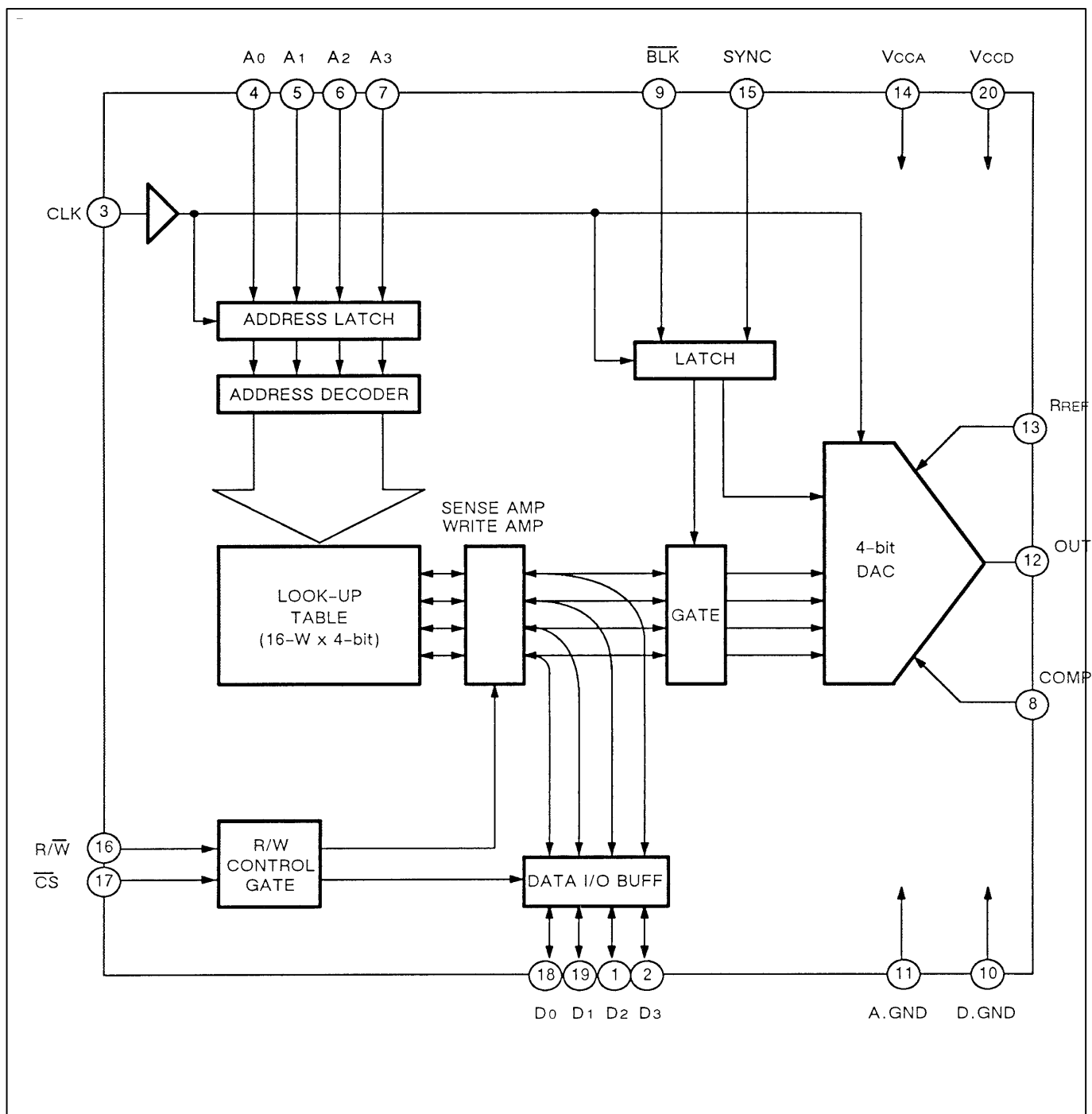


Figure 1. MB40874 Block Diagram

PIN DESCRIPTION

Pin No.	Pin Name	Description
1, 2, 18, 19	D0 to 03	Data input/output to read/write LUT data
3	CLK	Clock Input for digital-to-analog operation; operation speed is dependent on this input. At the rising edge of this input, A0 to A3, $\overline{\text{BLK}}$, and SYNC are latched, and converted signal outputs at OUT.
4 to 7	A0 to A3	Address input for LUT; during displaying time, dot data from VRAM is input. During display's flying line period, address is input in order to write or read the data of LUT.
8	COMP	Terminal for phase compensation capacitance; capacitance of 1 μF or more should be inserted between COMP and A.GND.
9	$\overline{\text{BLK}}$	Input to make OUT at blank level; when $\overline{\text{BLK}}$ is at low level, OUT is at blank level. When $\overline{\text{BLK}}$ is at high level, content of LUT is converted and outputs at OUT.
10	A. GND	Ground for analog circuit
11	D.GND	Ground for digital circuit
12	OUT	Output of digital-to-analog converter; load resistance should be inserted between OUT and V_{CC} .
13	R_{REF}	Terminal for reference resistance; reference resistor should be inserted between R_{REF} and V_{CCA} .
15	SYN	C-input for exclusive-ORed vertical/horizontal synchronous signal; this input is used to obtain composite output. SYNC input should be input while $\overline{\text{BLK}}$ is at low level.
16	$\text{R}/\overline{\text{W}}$	Mode switch for read/write of LUT. This input is effective when $\overline{\text{CS}}$ is at low level. When $\text{R}/\overline{\text{W}}$ is at high level, read mode is selected. When $\text{R}/\overline{\text{W}}$ is at low level, write mode is selected.
17	$\overline{\text{CS}}$	Chip select for LUT read/write mode
18	V_{CCA}	Power supply pin for analog circuit
20	V_{CCD}	Power supply pin for digital circuit

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Value			Unit
		Min	Typ	Max	
Power supply voltage ¹	V_{CC} V_{CCD}	4.75	5.00	5.25	V
Output high current	I_{OH}			-400	μA
Output low current	I_{OL}			8	mA
CLK frequency	f_{CLK}			50	MHz
Phase compensation capacitance	C_{COMP}^*	1			μF
Operating temperature	T_A	0		70	$^{\circ}C$

*Phase compensation capacitance should connect between COMP and A.GND.

ELECTRICAL CHARACTERISTICS

ANALOG DC CHARACTERISTICS

($V_{CC} = +5V \pm 5\%$, $T_A = 0$ to $70^{\circ}C$, unless otherwise noted)

Parameter	Symbol	Condition	Value			Unit
			Min	Typ	Max	
Resolution					4	bits
Linearity Error	LE				$\pm 1/2$	LSB
WHITE level output voltage	V_W		$V_{CCA} - 15$	V_{CCA}	$V_{CCA} + 15$	mV
BLACK level output voltage	V_B	$V_{CCA} = 5.000V$ $R_{REF} = 300\Omega$ Output is pulled up to V_{CCA} at 37.5Ω		4.357		V
BLANK level output voltage	V_{BLANK}			4.286		V
SYNC level output voltage	V_{SYNC}			4.000		V
DAC output voltage	ΔV_{DAC}		0.9	1.0	1.1	V
SYNC output voltage	ΔV_{SYNC}		236	286	336	mV
BLANK output voltage	ΔV_{BLANK}		5	10(71 mV)	15	IRE*
GRAY output voltage	ΔV_{GRAY}		85	90(634 mV)	95	IRE*

*IRE: The ratio of a reflection signal composition (V_{BLANK} to V_W) and a synchronous signal composition (V_{SYNC} to V_{BLANK}) is a 100:40 on EIA R5343A standard. 1/140 of the sum (reflection signal composition and synchronous signal composition) is named 1 IRE, which is used as unit of a reflection signal.

ELECTRICAL CHARACTERISTICS (Continued)

DIGITAL DC CHARACTERISTICS

($V_{CC} = +5V \pm 5\%$, $T_A = 0$ to 70°C , unless otherwise noted)

Parameter	Symbol	Condition	Value			Unit
			Min	Typ	Max	
Input high voltage	V_{IH}		2.0			V
Input low voltage	V_{IL}				0.8	V
Input cramp voltage	V_{IC}	$V_{CC} = 4.75V$, $I_I = -18mA$			-1.5	V
Input high current	I_{IH}	$V_{CC} = 5.25V$			100	μA
					20	
Input low current	I_{IL}	$V_{CC} = 5.25V$			0.4	V
Output high voltage ¹	V_{OH}	$V_{CC} = 4.75V$, $I_{OH} = -400 \mu A$	2.7	3.4		V
Output low voltage	V_{OL}	$V_{CC} = 4.75V$		0.25 ²	0.4	V
				0.35 ²	0.5	
Output short current	I_{OS}	$V_{CC} = 5.25V^3$	-20		-100	mA
Output current Off condition (Hi-Z)	I_{OZ}	$V_{CC} = 5.25V$			100	μA
					-20	
Power Supply Current	I_{CC}	$V_{CC} = 5.25V$			120	mA

¹ Except common I/O of D_0 to D_3

² $V_{CC} = +5V$, $T_A = 25^\circ\text{C}$

³ Time of output short should be within 1 second

SWITCHING CHARACTERISTICS

VIDEO OUTPUT

($V_{CC} = +5.0V \pm 5\%$, $T_A = 0^\circ\text{C}$ to $+70^\circ\text{C}$, unless otherwise noted.)

Parameter	Symbol	Value			Unit
		Min	Typ	Max	
CLK cycle time	t_{CLK}	20			ns
CLK high pulse width	t_{WCLK+}	7			ns
CLK low pulse width	t_{WCLK-}	7			ns
Address, BLK, SYNC high pulse width	t_{WV+}	18			ns
Address, BLK, SYNC low pulse width	t_{WV-}	18			ns
Address, BLK, SYNC setup time	t_{SV}	6			ns
Address, BLK, SYNC hold time	t_{HV}	3			ns
Propagation time	t_{PD}			25	ns

ELECTRICAL CHARACTERISTICS, continued

SWITCHING CHARACTERISTICS, continued

LUT Access (Read)

(V_{CC} = +5.0V ±5%, T_A = 0°C to +70°C, unless otherwise noted.)

Parameter	Symbol	Value			Unit
		Min	Typ	Max	
\overline{CS} pulse width low level time	t _{WCSR}	100			ns
R/ \overline{W} setup time	t _{SRWR}	10			ns
R/ \overline{W} hold time	t _{HRWR}	10			ns
\overline{BLK} setup time	t _{SBR}	2·t _{CLK} +6			ns
\overline{BLK} hold time	t _{HBR}	t _{CLK} +3			ns
Address setup time	t _{SAR}	2·t _{CLK} +6			ns
Address hold time	t _{HAR}	t _{CLK} +3			ns
Data setup time	t _{DEN}			50	ns
Data hold time	t _{DDIS}	15		50	ns

LUT Access (Write)

(V_{CC} = +5.0V ±5%, T_A = 0°C to +70°C, unless otherwise noted.)

Parameter	Symbol	Value			Unit
		Min	Typ	Max	
\overline{CS} pulse width low level time	t _{WCSW}	100			ns
R/ \overline{W} setup time	t _{SRWW}	10			ns
R/ \overline{W} hold time	t _{HRWW}	10			ns
\overline{BLK} setup time	t _{SBW}	2·t _{CLK} +6			ns
\overline{BLK} hold time	t _{HBW}	t _{CLK} +3			ns
Address setup time	t _{SAW}	2·t _{CLK} +6			ns
Address hold time	t _{HAW}	t _{CLK} +3			ns
Data setup time	t _{SD}	10			ns
Data hold time	t _{HD}	10			ns

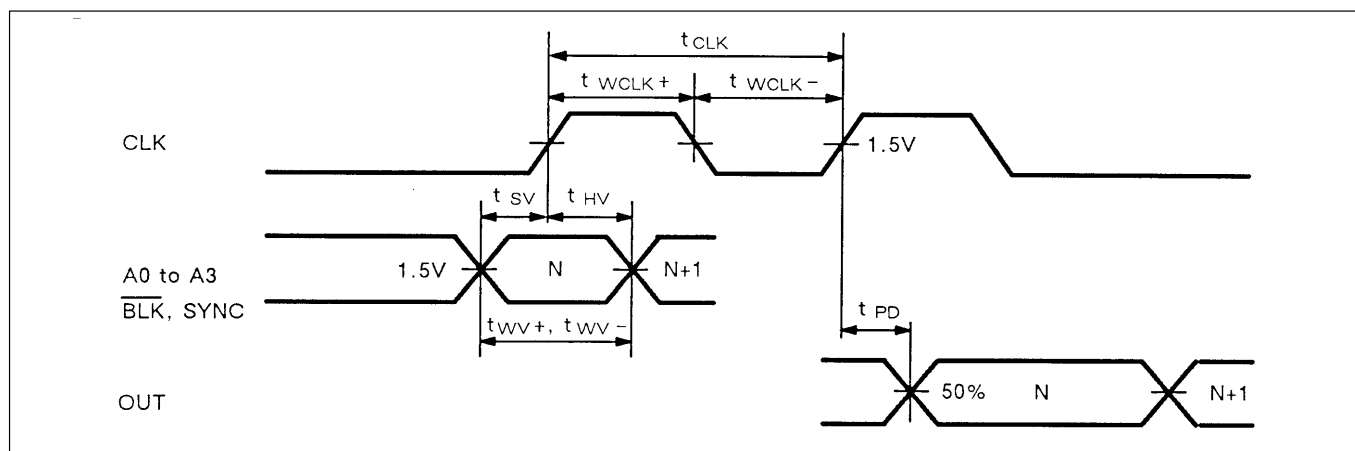


Figure 2. Video Output Timing Diagram

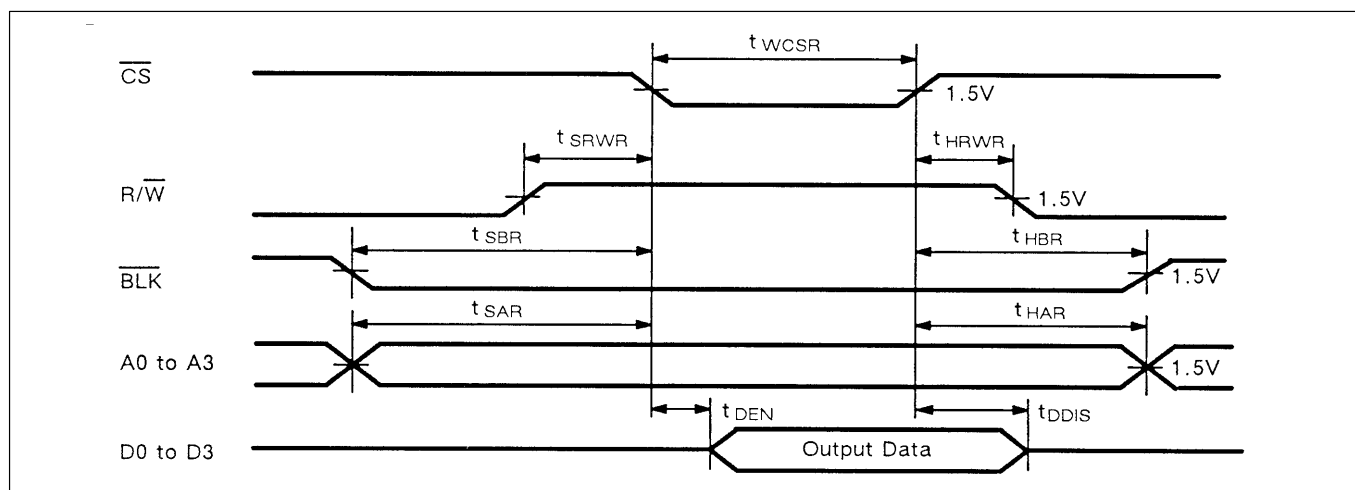


Figure 3. LUT Access (Read) Timing Diagram

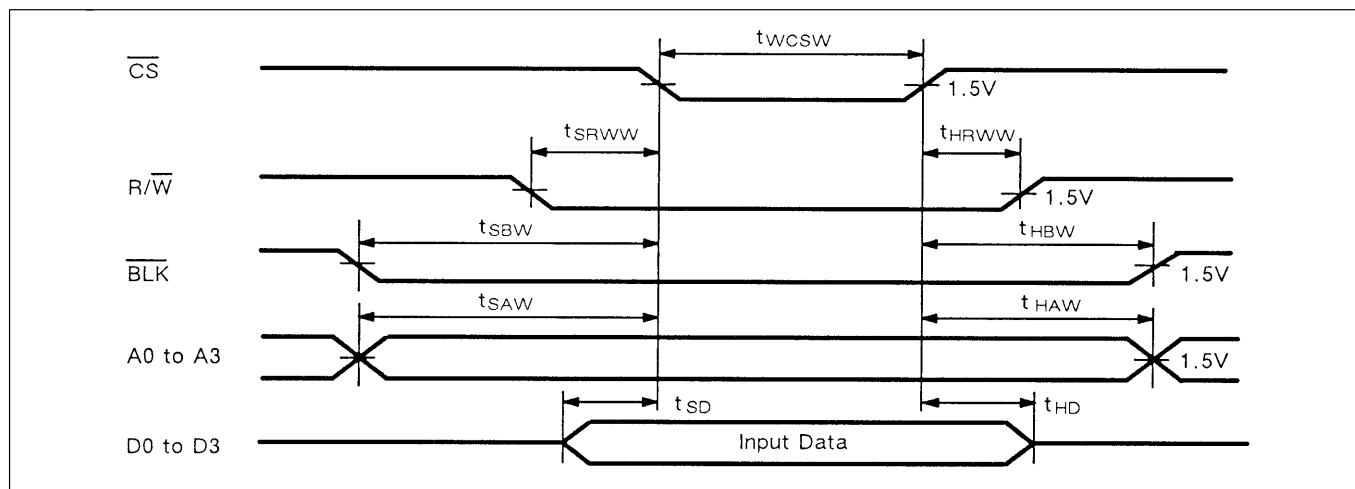
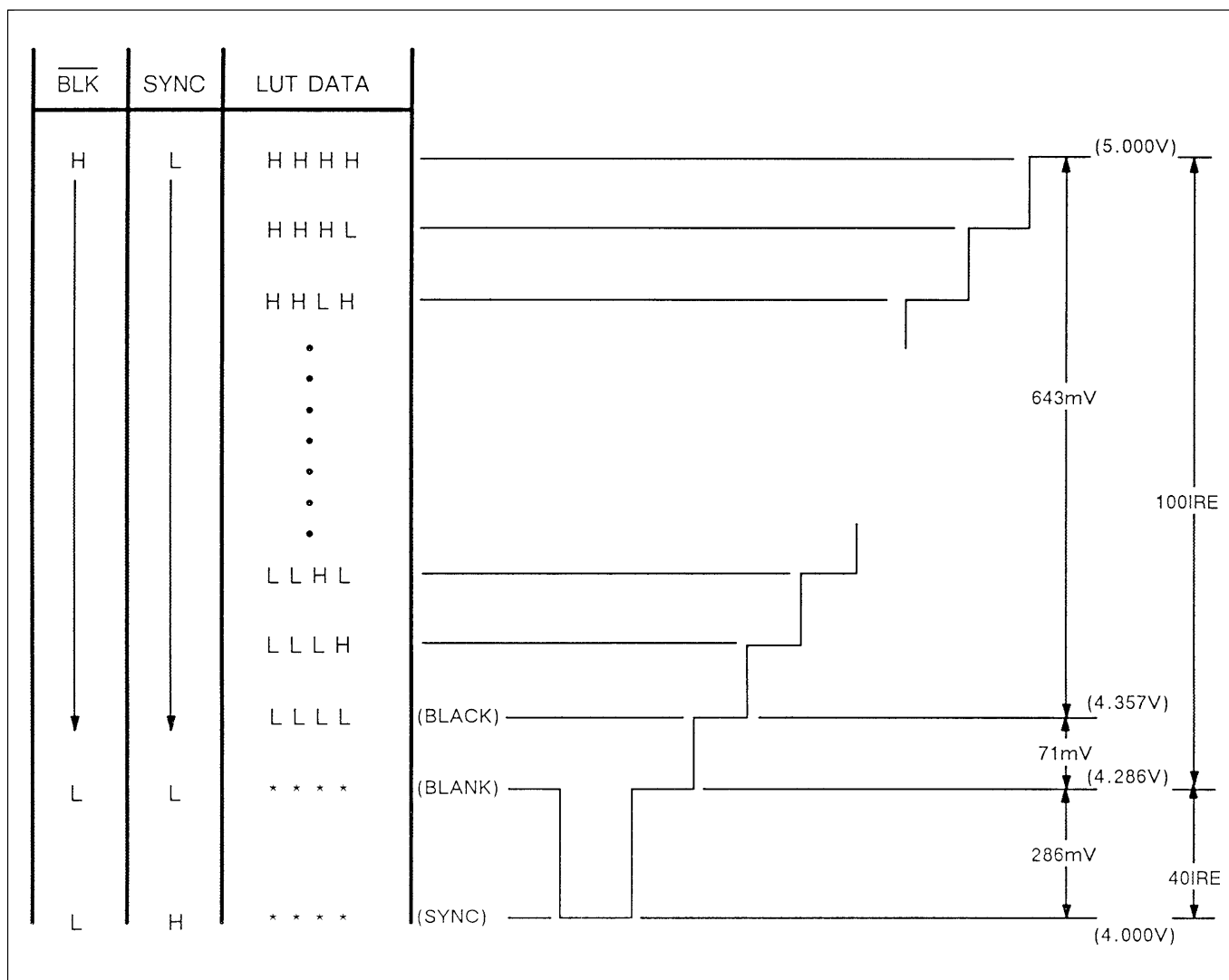


Figure 4. LOT Access (Write) Timing Diagram



* Don't Care
Output is pulled up to V_{CCA} at 37.5Ω

Figure 5. DAC Output Voltage

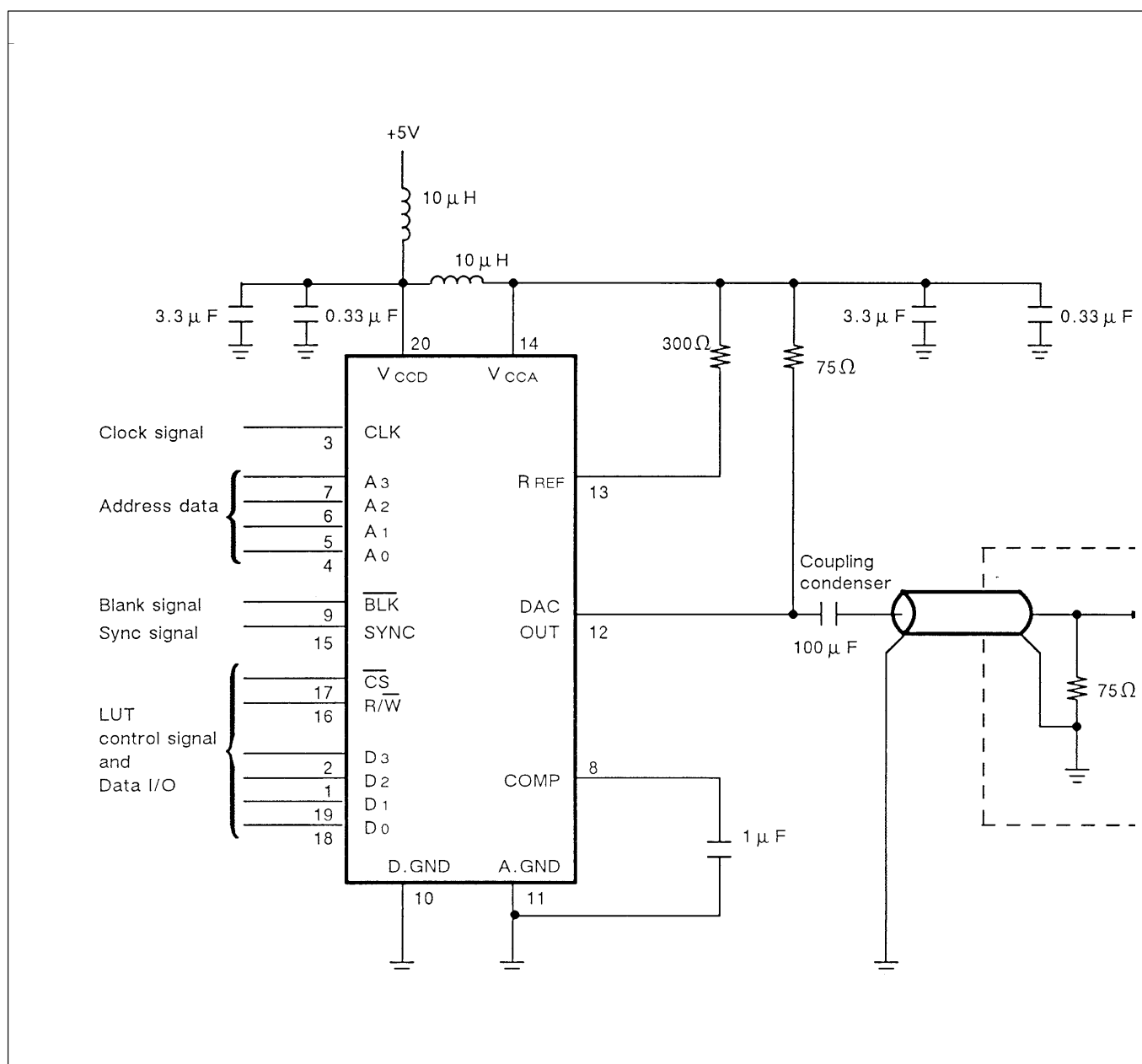


Figure 6. MB40874 Connection Circuit Example

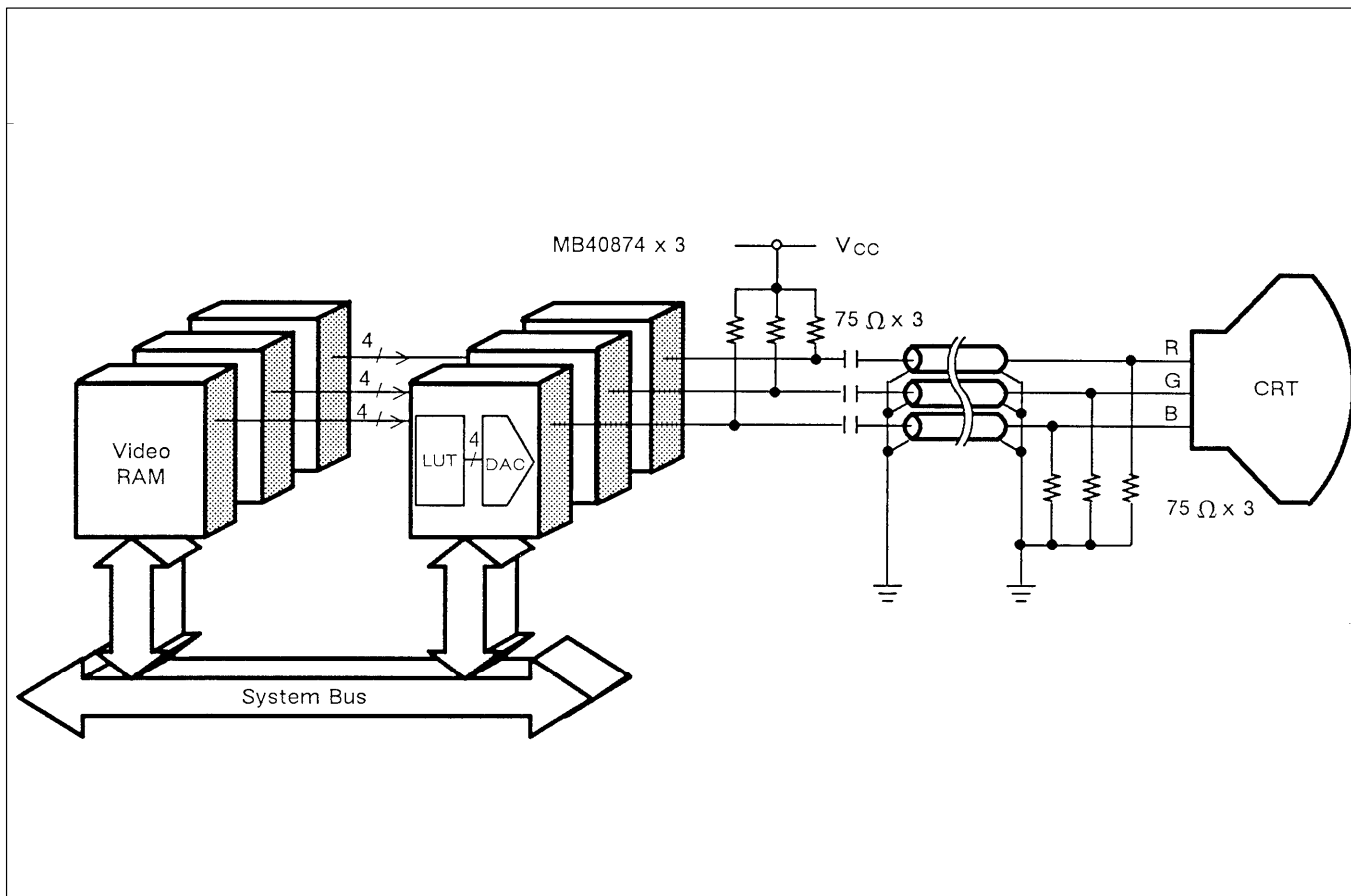
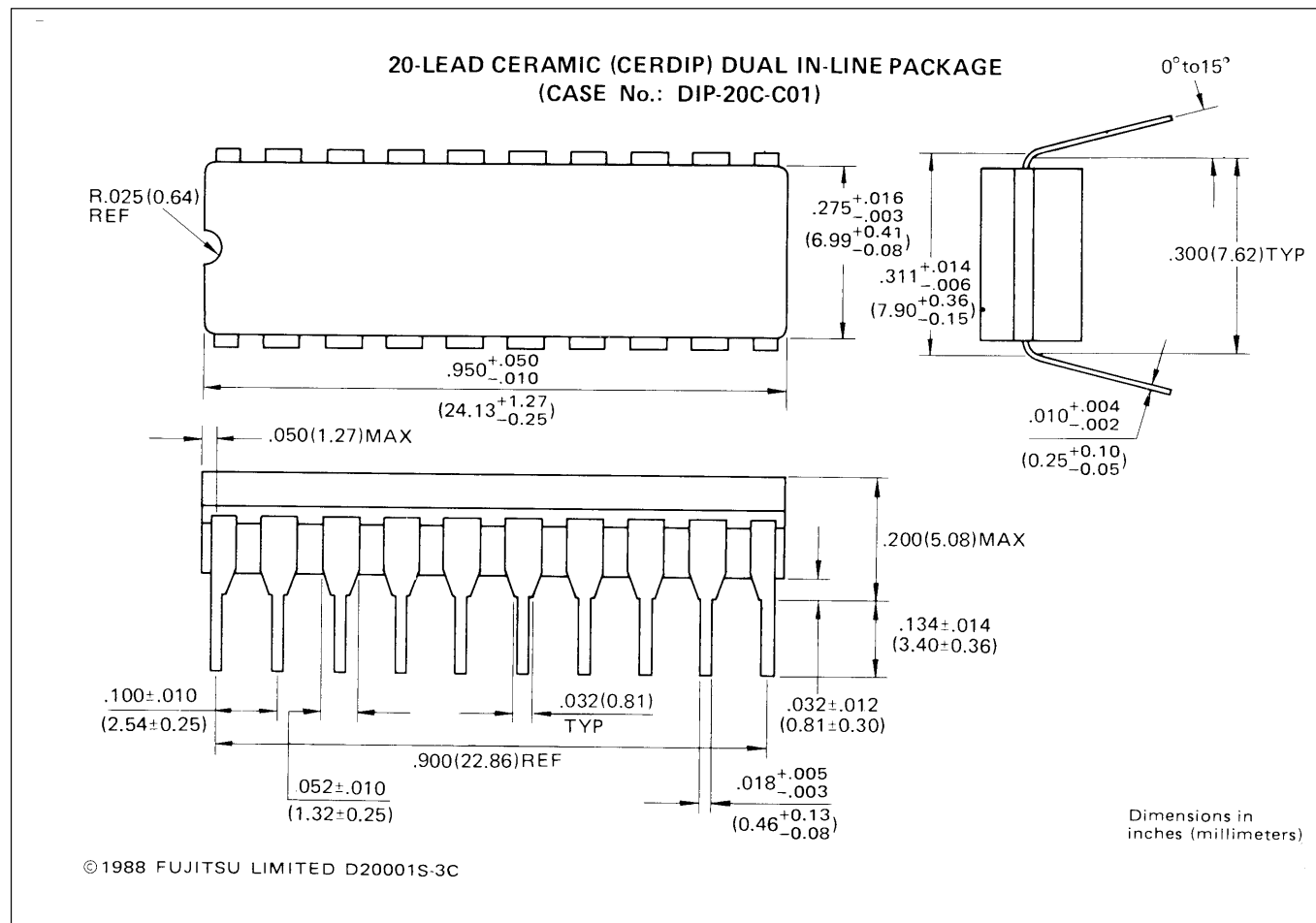


Figure 7. Application Information

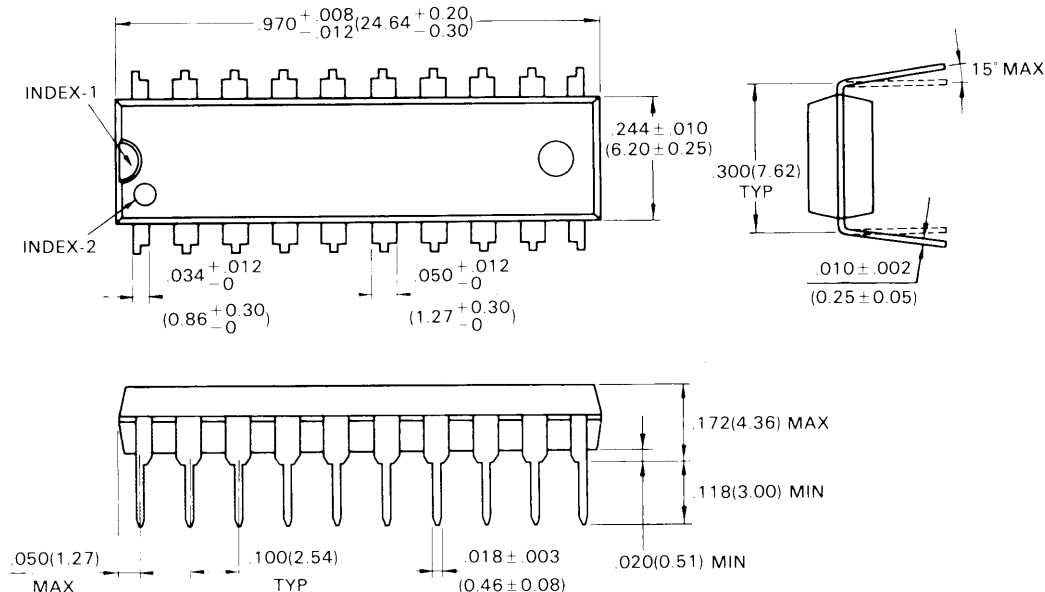
The above application is an example of RGB system using three pieces of MB40874. The system allows user to simultaneously display whole 4096 type of color defined by the bit number of LUT and D/A converter and promptly change color tone.

PACKAGE DIMENSIONS



20-LEAD PLASTIC DUAL IN-LINE PACKAGE

(Case No. : DIP-20P-M02)



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Dimensions in
inches (millimeters)

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FUJITSU LIMITED

For further information please contact:

Japan

FUJITSU LIMITED
Integrated Circuits and Semiconductor Marketing
Furukawa Sogo Bldg., 6-1, Marunouchi 2-chome
Chiyoda-ku, Tokyo 100, Japan
Tel: (03) 3216-3211
Telex: 781-2224361
FAX: (03) 3216-9771

North and South America

FUJITSU MICROELECTRONICS, INC.
Semiconductor Division
3545 North First Street
San Jose, CA 95134-1804 USA
Tel: 408-922-9000
Telex: 910-671-4915
FAX: 408-432-9044

Europe

FUJITSU MIKROELEKTRONIK GmbH
Arabella Centre 9.0G
Lyoner Strasse 44-48
D-6000 Frankfurt 71
F.R. Germany
Tel: (069) 66320
Telex: 411963 FAX: (069) 6632122

Asia

FUJITSU MICROELECTRONICS ASIA PTE LIMITED
51 Bras Basah Road,
Plaza By The Park,
#06-04/07,
Singapore 0718
Tel: 336-1600
Telex: 55573 FAX: 336-1609

Printed in Japan AV0040-908A