IBM 3791 to 3277
Display Station Interface,
Product Attachment Manual

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Preface

This publication provides a description of the interface between the 3791 Controller and the 3277 Display Station. The data contained herein is current as of March, 1975 and should be of interest to designers and engineers of equipment to be attached to the 3791 Controller.

Additional information pertaining to the 3791 and the 3793 may be obtained from the following manuals:

- *An Introduction to the IBM 3790 Communication System,* GA27-2767.
- *IBM 3790 Communication System Configurator,* GA27-2768 or GA19-0111 (WT Version).
- *IBM 3790 Communication System Installation Manual, Physical Planning,* GA27-2769.
- *IBM 3790 Communication System Programming Statements Guide,* GC27-0015.
- *IBM 3790 Communication System Statements Reference,* GC27-0016.
- *IBM 3790 Communication System Host Services Guide,* GC27-0017.
- *IBM 3790 Communication System Host Services PLM,* SY27-7264.
- *IBM 3790 Communication System Host System Programmer's Guide,* GC27-0026.
- *IBM 3790 Communication System Control Operator's Guide,* GC27-2786.
- *IBM 3790 Communication System Operator's Guide for the 3277 Display Station,* GA27-2785.
- *IBM 3790 Communication System Operator's Guide for the 3793 Keyboard-Printer,* GA27-2784.
- *IBM 3790 Communication System Operator's Guide for the 2741 Communication Terminal,* GA27-2783.
- *IBM 3790 Communication System Messages,* GA27-2789.
- *IBM 3791/3792 to 3793 Keyboard-Printer Interface, Product Attachment Manual*
- *Form Design Reference Guide for Printers,* GA24-3488.
- *IBM Diskette OEMI,* GA21-9190.
- *IBM 3705/3705 Communications Controller OEMI,* GA27-3051.
- *IBM 2740/2741 Communication Terminal OEMI,* GA27-3002.
- *SDLC General Information Manual,* GA27-3003.

First Edition (March, 1975)

Changes are periodically made to the products described and the information contained herein; before using this publication as a reference to the operation of the IBM system, contact the Manager of Industry Relations for the editions that are applicable and current.

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The 3791 Controller to 3277 interface is a single coaxial cable with serial by bit data transferred in either direction but only one direction at a time.

Bits on the coax appear as negative-going pulses. The center conductor of the coax, with reference to the outer conductor (shield), will be +7.4 volts (nominal) with no signal present and power on at each unit. For maximum coax cable length the signal from the Controller on the coax will appear as shown in Figure 1 at the device.

The minimum duration of the "up" level after crossing the 10% point going in the positive direction for a "one" or "zero" bit until the start of the next consecutive bit will be 30 nanoseconds.

Bit timings from the device to the controller will meet the same requirements as from controller to the device except for bit rate. The bit rate from the device will be 840 nanoseconds minimum to 1.050 microseconds maximum per bit.

The following condtions for the coaxial cable must be observed:

1) DC and frame ground are isolated (coax shield is DC return).

2) Fifteen cable splices maximum with compatible coaxial cable connectors. Outside of connection to be insulated by shrink fit tubing or equivalent to prevent accidental short to earth ground.

3) Inner conductor and outer shield of coax may be shorted without circuit damage at the controller or device (fault condition).

4) A maximum of 20 milliamperes may flow in the center conductor of the coax (non-short condition) with device power off.

5) Device power-up and down sequences must not introduce noise on the coax cable that may be interpreted as data regardless of validity.

6) Shield currents on the coax will not cause more than ± 20 nanosecond pulse width modulation.

Serial bits sent across the coax cable between the controller and the device are assembled into 13-bit word groups when received. These words may be Control, Data, or Status. Each word will contain good parity, except that the first 39 bits from the controller will be all 0's. The first bit of each word thereafter is always a "one" (1) bit.

CONTROL WORD (See Figure 2)

Only one control word is required to contain all control-type functions directed to a selected device by the controller. Bit positions are assigned to the functions as follows:

1) Busy Bit - Always a 1 bit.

2) Always 1.

3) Always 0.

4) Poll - Causes device to respond with status word and causes device to be released to operator inputs.

5) Read - Causes information to transfer from device to controller.

4-5) Read Poll - Causes device to respond with status word and locks out further operator inputs.

6) Write - Signals device that information is to be transferred to the device.

7) System Available - Sent to the device during poll and lights System Available indicator.

8) Unlock Keyboard - Unlocks keyboard and clears AID bits.

9) Erase Unprotected.

10) Reset Xmit Chk - Reset Transmit Check Status bit.

11) ACK to reset status bit 6 (Info Pending).

12) Parity - Used to maintain odd parity on 13-bit word.

13) Always zero.

STATUS WORD (See Figure 3)

When a poll is decoded at a device with good parity, a status word is sent from the device to the controller to indicate any activity at the device requiring attention. Bit positions in the status word have the following meaning:

1) Busy Bit - Always a 1 bit.

2) Always 0.

3) Busy - Indicates that the device is executing some function.

4) Device Check - Indicates that an internal parity error was detected by the device, or that a "cursor check" was detected.

5) Transmit Check - Indicates that the device detected a parity error on information received from the controller.

6) Info Pending - Indicates Device Check or that an AID has been generated by the device operator. Bits 7 through 11 will contain the AID.

7-11) Bits 7-11 contain the Attention Identifier (AID) that was originated at the device.

12) Parity - Used to maintain odd parity in status words (includes bits 1-12 only).

13) Differentiates between Model 1 (=0) and 2 (=1) devices. (480-character device or 1920-charater device respectively.)

DATA WORD (See Figure 4)

The bit assignment of data words are:

1) Busy Bit - Always a 1 bit.

2) Always 0.

3) Cursor - Cursor position.

4) 0 - Defines bits 5-11 as data
1 - Defines bits 5-11 as attributes

5-11) Data or attribute bits; when these bits define data, see Figure 5 for code.

When bits 5-11 define an attribute, they have the following meaning:

Bit 5 = Spare

Bit 6 = 0 = Unprotected Field
1 = Protected Field

Bit 7 = 0 = Alpha Field
1 - Numeric Field

Bit 8 & 9 = Always 00.

Bit 10 = Always 0.

Bit 11 = 1 - Modified data tags for previous field.

12) Parity - odd parity is assigned by the sending unit (includes bits 1 - 12).

13) 0/1 - Always 0, sent from the controller.

0 when sent from a 480-character device.
1 when sent from a 1920-character device.

CONTROL WORD FUNCTIONS

Control Word Function	Expected Action By Device	Action By Controller	Timing Concern at Controller	Timing Concern at Device
POLL	Respond with 13 bit status word. Clear keyboard to allow operator inputs.		Must receive status word in less than 31 us.	None
POLL (READ)	Respond with 13 bit status word. Lock out operator inputs.		Must receive status word in less than 31 us.	Lock out operator inputs before status word is transmitted.
WRITE	Clear if set: Transmit check bit device check bit.	Send 480 or 1920 bytes of data to device.	None	First data word will immediately follow the write function control word. Byte timing will be consecutive bits (bit 1 following bit 13 of previous byte. A POLL (READ) will be received at the device immediately following last data byte.

Control Word Function	Expected Action By Device	Action By Controller	Timing Concern at Controller	Timing Concern at Device
READ	Send 480 or 1920 bytes of data to controller.		Must receive first data word in less than 80 ms. Time for full message must be less than 175 ms.	None
SYSTEM AVAILABLE	Will only be received with POLL (READ). Turns on SYSTEM AVAILABLE indicator.	None	None	None
UNLOCK KEYBOARD	Unlocks keyboard. Clears AID code.	None	None	None
ERASE INPUT (POLL, READ, AND SYSTEM AVAILABLE bits also set)	Erase all unprotected fields in device storage. Clear all modified data tags to 0's. Lock keyboard until complete, then unlock and clears AID code.	Controller continues to poll device until busy indicator is no longer present.	Busy in status word must be received within 31 ms.	None
RESET TRANSMIT CHECK	Clears TRANSMIT CHECK bit.	None	None	Must clear before poll received.
ACKNOWLEDGE (ACK)	Clears information pending bit.	None	None	Info pending bit must be clear before next poll received.

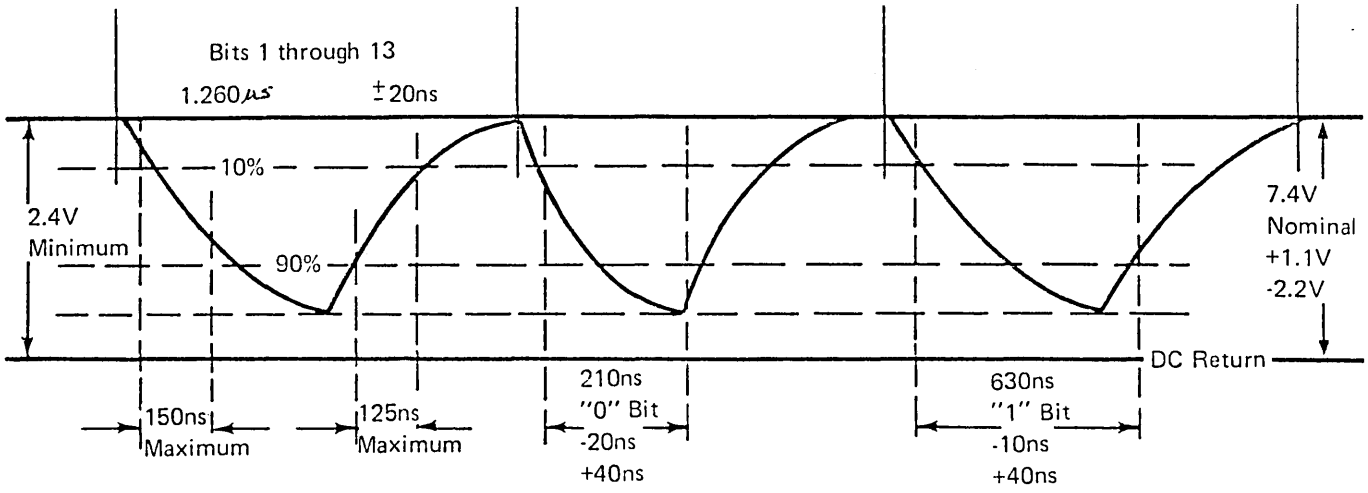

Figure 1. Signal on Coax

BUSY Bit	1	0	POLL	READ	WRITE	SYSTEM AVAIL	UNLOCK KEY-BOARD	ERASE UNPRO-TECTED	RESET XMIT CK	ACK	PARITY	0
1	2	3	4	5	6	7	8	9	10	11	12	13

Notes:

Bits 4 and 5 set = Read Poll

Bits 4 and 5 set (Read Poll) may include any combination of the following:

Bit 7, 8, 9, 10, and 11.

Bit 5 set (Read) may include bit 7.

Bit 6 set (Write) may include bit 7.

Bit 4 set (Poll) may include bit 11.

Figure 2. Control Word

		DEV	DEV	TRANSMIT	INFO								
BUSY	0	BUSY	CHECK	CHECK	PENDING		AID*					PARITY	0/1
Bit 1	2	3	4	5	6	7	8	9	10	11	12		13

*Attention Identification Code

Hex	Set by:	Hex	Set by:
00	No AID Generated	13	PF 3 Key
06	Insert (Operator ID Card Reader)	14	PF 4 Key
09	Reserved	15	PF 5 Key
0A	Reserved	16	PF 6 Key
0B	PA 3 Key	17	PF 7 Key
0C	PA 1 Key	18	PF 8 Key
0D	Clear Key	19	PF 9 Key
0E	PA2 Key (Cancel)	1A	PF 10 Key
0F	Extract (Operator ID Card Reader)	1B	PF 11 Key
10	Test Req Key	1C	PF 12 Key
11	PF 1 Key	1D	ENTER Key
12	PF 2 Key	1E	Reserved

Figure 3. Status Word

Data Word

	Busy	0	Cursor	Data or Attributes								Parity	0
Bit	1	2	3	4	5	6	7	8	9	10	11	12	13

Figure 4. Data Word

Low Order Bits 8, 9, 10, 11	Bit 5 Bits 6 & 7 Hex	High Order 0 00 0	01 1	10 2	11 3	1 00 4	01 5	10 6	11 7
0000	0					SP	&	-	0
0001	1	a	j			A	J	/	1
0010	2	b	k	s		B	K	S	2
0011	3	c	l	t		C	L	T	3
0100	4	d	m	u		D	M	U	4
0101	5	e	n	v	NL	E	N	V	5
0110	6	f	0	w		F	O	W	6
0111	7	g	p	x		G	P	X	7
1000	8	h	q	y		H	Q	Y	8
1001	9	i	r	z	EM	I	R	Z	9
1010	A					¢	!		:
1011	B					.	S	,	#
1100	C		DUP			<	*	%	@
1101	D					(	)	_	'
1110	E		FM			+	;	>	=
1111	F						¬	?	"

Only those data characters shown within the bold outline can be displayed on 3277 Display Stations. Lowercase alphabetic characters are displayed as uppercase characters. Storage retains all codes which were entered via the Controller or the Keyboard.

NL, EM, DUP, and FM Control Characters (uniquely stored) are displayed as 5, 9, * and ; characters, respectively.

Figure 5. Data Code Chart