IBM

3271-3272 TO

DEVICE

INTERFACE

SPEC

PRODUCT ATTACHMENT MANUAL

The 3270 Control Unit to Device Interface is a single
wire type (RG62AU Coax, Characteristic Impedance 93 Ohms)
with serial by bit data transferred in either direction
but only one direction at a time. The Control Unit
operates as a master and the attached device as a slave.
Each device, attached directly to the Control Unit,
receives and sends data addressed to that device only.

Bits on the coax appear as negative-going pulses. The
center conductor of the coax, when measured at the Con-
trol Unit with reference to the outer conductor (shield),
will be +7.4 nominal (+1.1 - 2.2) volts with no signal
present and power on at each unit. For maximum coax
cable length (2000 feet) the signal from the Control Unit
on the coax will appear as follows at the device:

BITS 1 thru 10	BITS 11 and 12	BIT 13
1.050us ± 20ns	1.260us ± 20ns	1.470 us ± 20ns

3.2V Min

10%

90%

7.4V Nominal
+1.1V
-2.2V

DC RETURN

150ns Max

125ns Max

210ns
"0" Bit
-20ns.
+40ns

630ns
"1" Bit
-10ns
+40ns
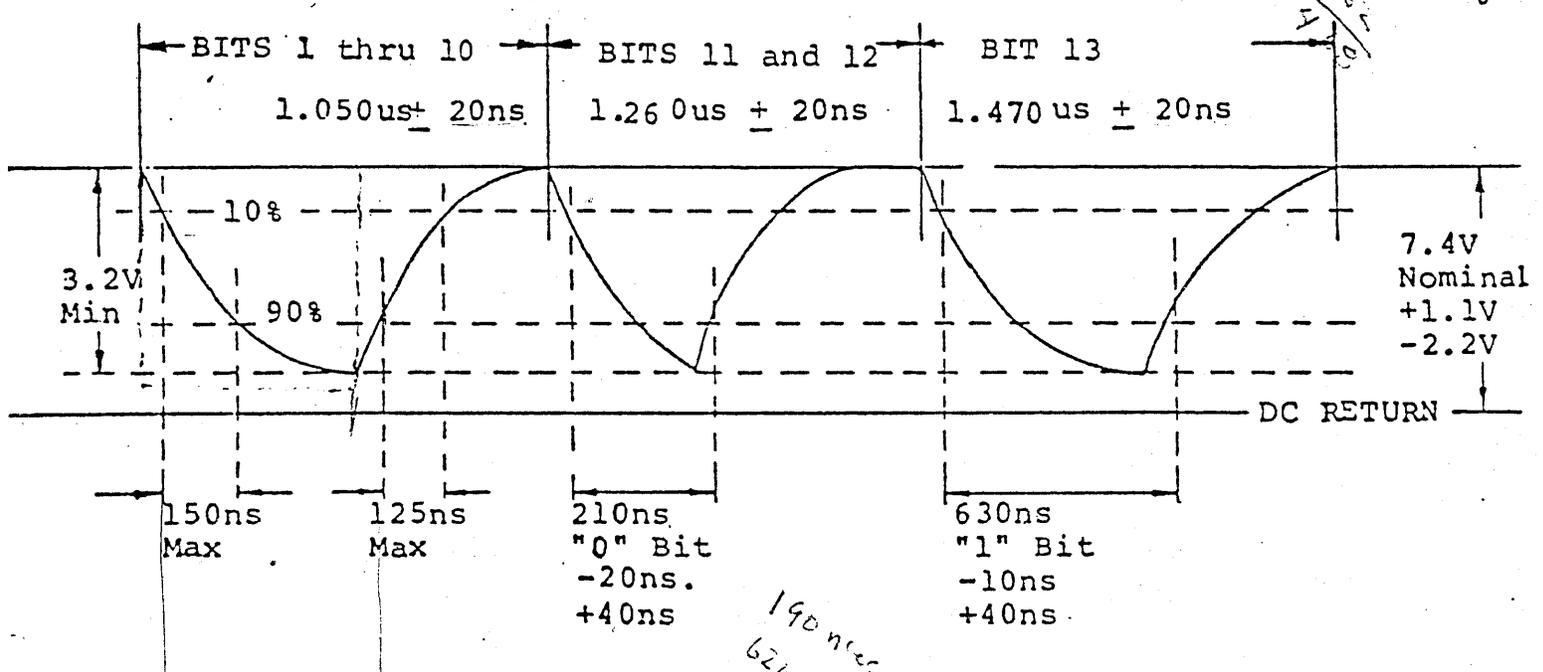
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Bit timings from the Device to the Control Unit will meet
the same requirements as from Control Unit to Device
except for bit rate. The bit rate from the Device will
be 630ns min. to 1.050us max. per bit. The minimum duration
of the "Up" level after 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 100ns.

(630ns 100ns)

BITS 1 thru 13
0.630 to 1.05us

10%

3.2V
Min

90%

7.4V
Nominal
+1.1V
-2.2V

DC RETURN

150ns
Max

125ns
Max

210ns
"0" Bit
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"1" Bit
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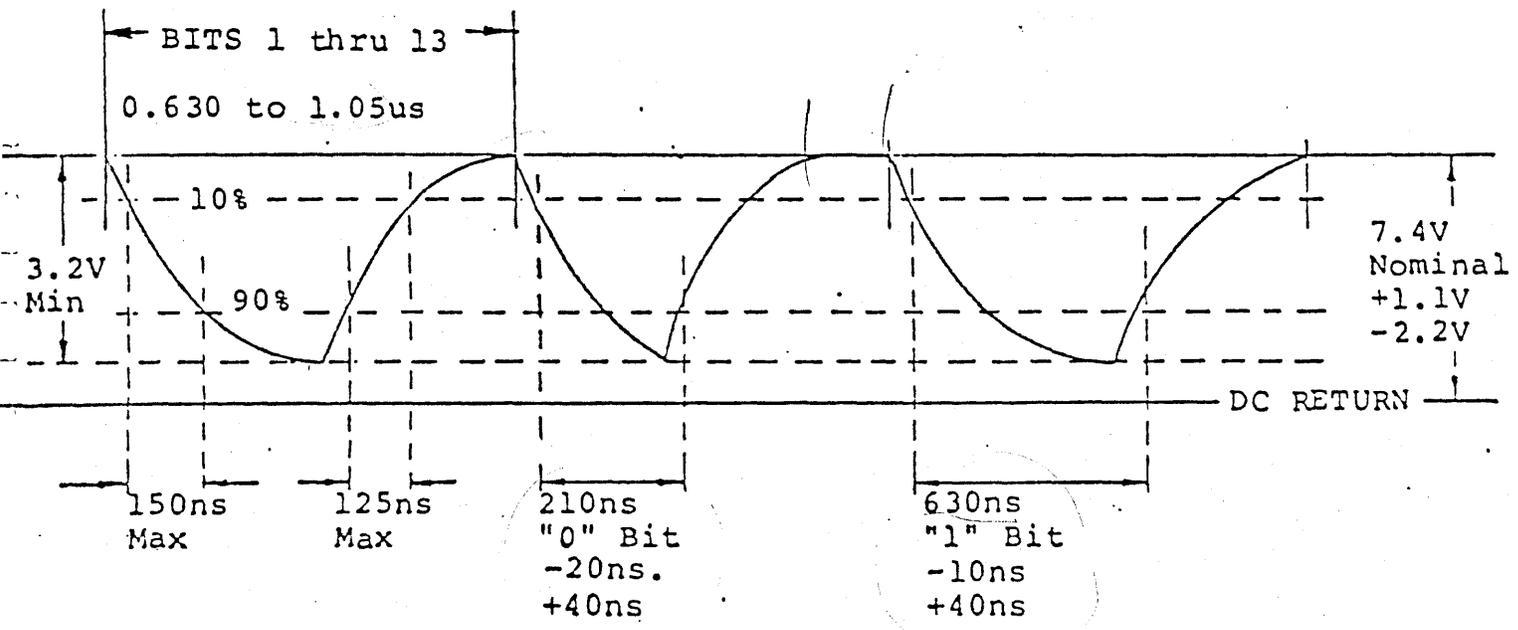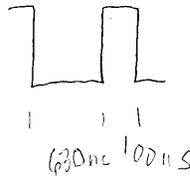
The following conditions for the coaxial cable must be observed:

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 Control Unit or Device (Fault Condition).

4) A maximum of 20ma current may flow in the center conductor of the coax (Non-Short Condition) with Device power off. (This current will not trigger Control Unit Receiver.)

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 $\pm$ 20 ns pulse width modulation.

Up to 32 devices may be attached to one Control Unit.

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Since this System uses a master/slave communication
method between Control Unit and Device, a Polling Sequence
is used to interrogate one Device at a time by the Control
Unit to determine the status of each attached Device.
Sequential Polling continues from Device to Device as
determined by the number of adapter cards installed in the
Control Unit. One adapter card provides the interface for
four Devices. Each Device position on an adapter card will
be polled in sequence irrespective of Device status (i.e.,
Device on and responding with status, Device off and no
response, or no Device attached). This type of polling is
referred to as "Idle Poll". Idle Polling of Devices is
continuous when the Control Unit is attached to an operat-
ing System until the channel requests communication with a
specific Device or the poll response from the Device
requires System attention. At this point Idle Polling of
all devices stops; and the Control Unit selects and locks
on to the addressed Device. At the conclusion of
communications between the Channel and the addressed Device,
Idle Polling will resume.

Serial bits sent across the coax cable between the Control
Unit and Device are assembled into 13-bit word groups at
the Device or Control Unit when received. The first bit

of each word is always a "one" (1) bit unless it is the
first word sent from the Control Unit to Device of a
series of words. This unique word will be all zero (0)
bits and is used to condition the device input logic to
receive all following communications with the Device
until the selection is terminated. As each Device is
selected by the CU during Idle Polling, the first 13 bits
(all zeros) are followed directly by the Idle Poll word
(13 Bits).

Polling is one of many command-type control words sent from
a CU to a Device. Every control word sent to a Device must
be received with good parity. If bad parity is detected by
the Device, the Transmit Latch is set but no other function
is performed at the Device. If a parity error is detected
in a data stream as a result of the "Write" function, the
word or words with bad parity are dropped and a null
character is stored in place of each word containing bad
parity and Transmit Check is set at the Device.

Two control words are requried to contain all control-type
functions directed to a selected Device by the Control
Unit. Bit positions are assigned the functions as follows.

CU CONTROL WORDS

Control Word Number 1

BUSY BIT	1	0	POLL	READ	WRITE	SYSTEM AVAIL	UNLOCK KEYBOARD	ERASE UNPROTECTED	RESET XMIT CK	ACK	PARITY	0
1	2	3	4	5	6	7	8	9	10	11	12	13

Control Word Number 2

BUSY BIT	1	1	POLL	(READ)	FORMAT	START PRINT	SOUND ALARM	RESET XMIT CK	SPARE	PARITY	0
1	2	3	4	5	6 7	8	9	10	11	12	13

Control Word Number 1 & 2

Bits 4 and 5 set = "Read Poll"

Control Word Number 2

Bit 5 set without Bit 4 = SPARE

Bit combinations that may occur during normal operation (does not include combinations when running machine diagnostic programs) are:

Control Word 1:

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

Control Word 2: May include any combination of bits 4 thru 10

Either or both words may be transmitted to a selected Display or Printer.

Bit Meanings

1) Busy Bit - Always a 1 bit.

2) Differentiates between control and data words.

3) Differentiates between Control Word 1 and Control Word 2.

4) Poll - Causes Device to respond with status word and clears CU busy latch.

5) CW #1 - Read - Causes transfer of Device Buffer to Control Unit Buffer.

4-5) Read Poll - Causes Device to respond with status word and sets CU busy latch which locks out further operator inputs.

CW #2 - Spare

6) CW #1 - Write - Signals Device that CU Buffer is to be transferred to the Device.

7) CW #1 - System Available - Sent to the Device on a poll initiated by an I/O Command. Lights System Ready indicator if applicable.

6-7) CW #2 - Format - Specifies how the printed line will appear.

Bits 6&7 =	0, 0	variable Line-Length Format, Up to 132 Char/Line
=	0, 1	40 Char/Line Format
=	1, 0	64 Char/Line Format
=	1, 1	80 Char/Line Format

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8)   CW #1 - Unlock Keyboard. Sent to Device after Write

     if WCC specifies unlock keyboard and clears aid bits.

    CW #2 - Starts Print operation.

9)   CW #1 - Erase Unprotected. Sent to Device as a

     result of CPU initiated EAU command.

    CW #2 - Sounds Audible Alarm.

10) RESET XMIT CHK - Sent to a Device to reset Transmit

     Check Latch.

11) CW #1 - ACK sent to a Device to reset Bit 6 (Info

     Pending) when the Device responded to a poll

     with Bit 6 set in display or printer status word

     and accepted by the CU.

    CW #2 - Spare

12) Parity - Used to maintain ODD Parity on control and

     data words exchanged between Device and Control

     Unit. (Includes Busy Bit "1").

13) Always a zero in Control Unit control words.

When a poll is decoded at a Device with good parity, a
status word is sent from the Device to the Control Unit to
indicate any activity at the Device requiring System
attention. Status words are of two types--depending upon
the type of Device responding. These two status words are
identified by being either a Display Status Word or a
Printer Status Word.

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Bit assignment of the Display Status Word is:

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

Bit assignment of the Printer Status Word is:

BUSY	1	DEV BUSY	DEV CHECK	TRANSMIT CHECK	INFO PENDING	NOT READY	SPARE	EQUIP CHECK	SPARE	SPARE	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	SELECTOR PEN

800 DISABLE INT.
1000 ENABLE INT.

CHART 1

The following describes the purpose of each bit in these status words.

1) Busy Bit - Always a 1 bit.

2) Differentiates between Printer and Display Status Words. 0 = Display, 1 = Printer

3) Busy - Indicates that the Printer is printing or performing EAU function or that the Display is executing some Keyboard, Selector Pen, ID Card operation, or performing EAU function.

4) Device Check - Indicates that a Parity error in the Device Buffer was detected by the Device, or a Cursor Check was detected.

5) Transmit Check - Indicates that the Device detected a Parity error in data (Control or Data Words) received from the Control Unit.

6) Info Pending -
   a) Display Status Word - Indicates Device Check or that an AID has been generated by the display station operator. Bits 7 through 11 will contain the AID. (See Chart 1.)
   b) Printer Status Word - Info Pending set if Device Check and/or Equipment Check is set.

7-11) Display Status Word - Bits 7-11 contain the Attention Identifier (AID) that was originated at the display station.

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7)   Printer Status Word - Not Ready indicates that the
       Printer is out of paper and/or cover is open.

8)   Printer Status Word - Spare

9)   Printer Status Word - Equipment check indicates a
       mechanical malfunction at the Printer.

10) Printer Status Word - Spare

11) Printer Status Word - Spare

12) Parity - Used to maintain ODD parity in Printer or
       Display Status Words.

13) Differentiates between Model 1 (=0) and 2 (=1)
       Devices. (480 Character Device or 1920
       Character Device respectively.)

The exchange of data for storage between a Control Unit
and a Device is accomplished by transmitting thirteen bit
words on the coax connecting the two units.

The bit assignments of data words are:

A2 Control Unit Data Word

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

Bit

1)   Busy Bit - Always a 1 bit. Indicates first bit of an
        incoming word.

2)   0 - Set to 0 to indicate Data Word rather than Control
        Word.

3)   Cursor - Cursor Position.

4-11 7 Data or attribute bits. When defined as data by
     Bit 4, Bit 5 is high order bit and Bit 11 is low order
     bit (See Chart 2 for Code). When defined as an
     attribute by Bit 4:1

     Bit 5 =   Spare

     Bit 6 =   0 = Unprotected Field

                1 = Protected Field

     Bit 7 =   0 = Alpha Field

                1 = Numeric Field

     Bits 8&9= 00 = Normal Intensity - Non-Detect

                01 = Normal Intensity - Selector Pen Detect

                10 = High Intensity - Selector Pen Detect

                11 = Non-Display - Non-Print - Non-Detect

     Bit 10=   Escape (Not Used)

     Bit 11=   1 - Modified Data Tags for Previous Field

12) Parity - ODD parity, assigned by Sending unit.

13) 0/1 - Always 0, sent from a Control Unit.

            0 when sent from a 480 Character Device.

            1 when sent from a 1920 Character Device.

Low Order Bits 8,9,10,11	Bit 5 Bits 6&7 Hex	High Order							
		0				1			
		00	01	10	11	00	01	10	11
		0	1	2	3	4	5	6	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	o	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					.	$	,	≠
1100	C			DUP		<	*	%	@
1101	D					(	)	_	'
1110	E			FM		+	;	>	=
1111	F						7	?	"

NU = not used.

Only those data characters shown within bold outline can be displayed and printed on 3270 Devices. Lowercase alphabetic characters are displayed or printed as uppercase characters. Storage still retains all codes which were entered via Control Unit or Keyboard.

NL, EM, DUP, and FM Control Characters (uniquely stored) are displayed or printed as 5, 9, * and ; characters, respectively; except by the Printer under Format Control, in which case NL and EM do not result in a character being printed.

CHART 2

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| CONTROL WORD FUNCTION | RESULT | | TIMING CONCERN AT | | EFFECT ON SYSTEM (SEE IBM PUBLICATION GA27-2749 – IBM 3270 IDS COMPONENT DESCRIPTION |
	AT SELECTED DEVICE	AT CU AS RECEIVED FROM DEVICE	THE CU	THE DEVICE	
IDLE POLL	Respond with 13 Bit Status Word (Clear CU busy latch)	1) 13 Bit Status Word. No Error Conditions or Info Pending	Must Receive Status Word <40 us. *Bit 13 to "11"*	None	None
		2) 13 Bit Status Word. Info Pending Set. Aid Code Set	"	"	Asynchronous Attention Status will be presented.
		3) 13 Bit Status Word. Bad Parity (1 Hardware Retry)	"	"	None
		13 Bit Status Word. Again Bad Parity	"	"	Asynchronous Attention plus Unit Check Status will be presented. Equipment Check will be presented as a response to next sense command.

CONTROL WORD FUNCTION	RESULT		TIMING CONCERN AT		EFFECT ON SYSTEM (SEE IBM PUBLICATION GA27-2740 - IBM 3270 IDS COMPONENT DESCRIPTION
	AT SELECTED DEVICE	AT CU AS RECEIVED FROM DEVICE	THE CU	THE DEVICE	
IDLE POLL	Respond with 13 Bit Status Word (Clear CU busy latch)	4) 13 Bit Status Word. Info Pending Set. Device Check Set	Must Receive Status Word <40 us.	None	Asynchronous Attention Unit Check will be presented. Data Check and Unit Specify will be presented as a response to the next sense command.
		5) 13 Bit Status Word. Device Busy Set	"	"	None
		6) 13 Bit Status Word. Transmit Check Set	"	"	None (Used only to verify correct transfer of data between CU and Device) on a Write.)
	Printer Only	7) 13 Bit Status Word. Not Ready Set or Info Pending and Equipment Check Set	"	"	See Referenced Publication

CONTROL WORD FUNCTION	RESULT		TIMING CONCERN AT		EFFECT ON SYSTEM (SEE IBM PUBLICATION GA27-2749 - IBM 3270 IDS COMPONENT DESCRIPTION
	AT SELECTED DEVICE	AT CU AS RECEIVED FROM DEVICE	THE CU	THE DEVICE	
IDLE POLL (Clear CU Busy Latch)	Power Off or Disconnected or No Response due to Malfunction	8) No Data Received	After 40 us. a Retry of Idle Poll is made	None	None
		No Data Received Again	After 40 us. a Not Available Condition is Logged at the CU Next Device is Polled	None	None
READ POLL See Special Conditions when following Write Function	Respond with 13 Bit Status Word Set CU Busy Latch (Locks out operator inputs) at a Display Unit	Same as #1	Must Receive Status Word <40 us.	CU Busy Latch Set before Poll Response is sent from Device	None
		Same as #2	"	"	None
		Same as #3 Including Retry	"	"	A Channel End, Device End, Unit Check will be presented as ending status. (If CE had been sent in initial status, not sent at this time) Data Check is sent as response to sense command

CONTROL WORD FUNCTION	RESULT		TIMING CONCERN AT		EFFECT ON SYSTEM (SEE IBM PUBLICATION GA27-2749 – IBM 3270 IDS COMPONENT DESCRIPTION
	AT SELECTED DEVICE	AT CU AS RECEIVED FROM DEVICE	THE CU	THE DEVICE	
POLL (READ) READ Bit will be set. See Special Conditions when following Write Function	Respond with 13 Bit Status Word. Set CU Busy Latch (Locks out operator inputs) at a Display Unit	Same as #4 (IDLE POLL)	Must Receive Status Word <40 us.	CU Busy Latch Set before Poll Response is sent from Device	A Channel End, Device End, Unit Check will be presented as ending status. (If CE had been sent in initial status, not sent at this time) Data Check is sent as response to sense command. Sense response will also include Unit Specify
		Same as #5	"	"	Same as above--except for Unit Exception not UC. No sense command
		Same as #6	"	"	None
		Same as #7	"	"	See Referenced Publication
	POWER OFF or No Response	Same as #8	Same as Idle Poll #8--except next Device is not polled until command is complete and Idle Polling resumes	"	Ending status will be presented as Channel End, Device End, and Unit Check. Sense will present Control Check

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| CONTROL WORD FUNCTION | RESULT | | TIMING CONCERN AT | | EFFECT ON SYSTEM (SEE IBM PUBLICATION GA27-2749 – IBM 3270 IDS COMPONENT DESCRIPTION) |
	AT SELECTED DEVICE	AT CU AS RECEIVED FROM DEVICE	THE CU	THE DEVICE	
POLL (READ) Directly following WRITE	Respond with 13 Bit Status Word	Same as for Poll (READ) -- except If Transmit Check is set a Rewrite is performed. After Rewrite Transmit Check is set again.	Same as Idle Poll #8 except next Device is not polled until command is complete and Idle Polling resumes	CU Busy Latch set before Poll Response is sent from Device	Ending status will be presented as Unit Check, Channel End, and Device End. Sense will present Data Check, Unit Specify
READ	Send 480 or 1920 Bytes of Data to Control Unit from storage	480 or 1920 Bytes of Data	Must receive first Data Word <80 ms. Time between Data Bytes must not exceed 40 us. If failure of either a Retry is performed	None	None for successful READ

| CONTROL WORD FUNCTION | RESULT | | TIMING CONCERN AT | | EFFECT ON SYSTEM (SEE IBM PUBLICATION GA27-2749 – IBM 3270 IDS COMPONENT DESCRIPTION |
	AT SELECTED DEVICE	AT CU AS RECEIVED FROM DEVICE	THE CU	THE DEVICE	
READ	Send 480 or 1920 Bytes of Data to Control Unit	480 or 1920 Bytes of Data	Failure of previous item on Retry	None	Ending status will be presented as Channel End, Device End, and Unit Check. Sense will present Control Check.
		If Bad Parity, Retry. Again Bad Parity received.	"	None	Ending status will be presented as Channel End, Device End, and Unit Check. Sense will present Data Check
WRITE	Clear if set: Transmit Check, Device Check	No response to CU	None	First Data Word will follow the WRITE Function Control Word in no greater than 40 us. Maximum time between Data Bytes is 40 us. Minimum time will be con- secutive Bits (Bit 1 following Bit 13 of pre- vious Byte). A Poll (READ) will be received at the Device in no more than 40 us after the last Data Byte.	None

CONTROL WORD FUNCTION	RESULT		TIMING CONCERN AT		EFFECT ON SYSTEM (SEE IBM PUBLICATION GA27-2749 - IBM 3270 IDS COMPONENT DESCRIPTION
	AT SELECTED DEVICE	AT CU AS RECEIVED FROM DEVICE	THE CU	THE DEVICE	
SYSTEM AVAILABLE	Will only be received with a Poll (READ) Turns on System Available Indicator	No response to CU	None	None	None
UNLOCK KEYBOARD	Unlocks Keyboard Clears AID Code	No response to CU	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 Ø's. Lock Keyboard until complete--then unlock and clears AID Code	CU continues to Poll Device until Busy Indication is no longer present.	Busy In Status Word must be received in <40 us, but not be present after 80 ms.	None	None
RESET TRANSMIT CHECK	Clears Transmit Check Latch	No response to CU	None	Must be clear before next poll received	None