60334400

CONTROL DATA CORPORATION

CDC® 6681-B/C/D/E/F, 6684-1/2 DATA CHANNEL CONVERTERS

HARDWARE REFERENCE MANUAL

New features, as well as changes, deletions, and additions to information in this manual are indicated by bars in the margins or by a dot near the page number if the entire page is affected. A bar by the page number indicates pagination rather than content has changed.

RECORD of REVISIONS

REVISION	NOTES
A	Manual released. This manual supersedes the 6681-B/C/D, 6684-A Data Channel Converters
(11-1-70)	section of the obsolete 6000 Series Peripheral Equipment Reference Manual, Pub. No. 60156100.
	The information contained herein is the same as that found in Rev. J of the obsolete manual.
B	Manual revised; includes Engineering Change Order 30913. 6684-2 information included. This
(3-9-72)	edition obsoletes all previous editions.
C	Manual revised; includes Engineering Change Order 32073. Pages v and 2-1 are revised.
(7-19-72)	
D	Manual revised; includes Engineering Change Order 33973. Page 2-3 and 2-4 are revised.
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PREFACE

This manual provides functional characteristics, operational characteristics, and programming information for the 6681-B/C/D/E/F and 6684-1/2 data channel converters.

Refer to the following publications for additional information. Consult the current issue of the Literature Distribution Services catalog for the latest revision.

Control Data Publication	Publication No.
6000 Series, CYBER 72/73/74 Data Channel Converters Customer Engineering Manual	60125000
6681-F Data Channel Converter Customer Engineering Manual	60440800

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GENERAL DESCRIPTION 1

FUNCTIONAL DESCRIPTION

The CONTROL DATA® 6681-B/C/D/E/F or 6684-1/2 Data Channel Converter is an interface which permits Control Data 6000 Series Computer Systems or CYBER 70 (Models 72, 73, and 74) or CYBER 170 (Models 172, 173, 174, and 175) Series Computer Systems to use standard Control Data 3000 Series peripheral equipment. (Reference to CYBER in the remainder of this manual is limited to CYBER Models 72, 73, 74, 172, 173, 174, and 175.)

PRODUCT DESCRIPTIONS

6681-B/C/D/E DATA CHANNEL CONVERTER

The 6681-B/C/D/E Data Channel Converter is the basic data channel converter (refer to functional description above). There is no data conversion feature or parity checking. Functionally, the 6681 B, C, D, and E models are identical. The basic data channel converter is used with 6000 or CYBER 70 Series Computer Systems.

6681-F DATA CHANNEL CONVERTER

The 6681-F Data Channel Converter is a parity enhanced version of the 6681-B/C/D/E Data Channel Converter. A switch on the 6681-F logic chassis allows the user to select parity checking (odd parity) or disable parity checking, whereby the 6681-F is functionally identical to the 6681-B/C/D/E Data Channel Converter. The parity enhanced data channel converter is used with 6000, CYBER 70, and CYBER 170 Series Computer Systems.

6684-1 DATA CHANNEL CONVERTER

The 6684-1 Data Channel Converter (Mode A) transfers data in both directions without modification as does the 6681 Data Channel Converter. There is no data conversion or parity checking. The 6684-1 Data Channel Converter (Mode B) converts incoming data from an internal BCD (IBCD) format to a display code (DPC) format. Otherwise,

the 6684-1 (Mode B) is functionally identical to the 6681-B/C/D/E and 6684-1 (Mode A) Data Channel Converter models.

6684-2 DATA CHANNEL CONVERTER

The 6684-2 Data Channel Converter (Mode A) is functionally identical to the 6684-1 (Mode A). The 6684-2 Data Channel Converter (Mode B) is functionally identical to the 6684-1 (Mode B) except that two of the internal BCD/display code relationships are different. Refer to model similarities description.

STANDARD OPTION 10281-1

Standard Option 10281-1 modifies a 6684-1 Data Channel Converter so that it is functionally identical to the 6684-2 Data Channel Converter.

MODEL SIMILARITIES

The 6684-2, unlike the 6684-1, changes the display/code internal BCD translations from $DPC00_8$ - $IBCD16_8$ to $DPC00_8$ - $IBCD12_8$ and from $DPC63_8$ - $IBCD12_8$ to $DPC63_8$ - $IBCD16_8$.

Figure 1-1 shows the placement of the 6681/6684 data channel converter in a 6000/CYBER Series Computer System. The converter attaches to a 6000/CYBER data channel of a peripheral processor unit. The converter may share the 6000/CYBER data channel with up to seven other 6000/CYBER Series peripheral equipments (for example, a magnetic tape controller, a console display, or another converter). As many as eight 3000 Series controllers can be attached to one converter.

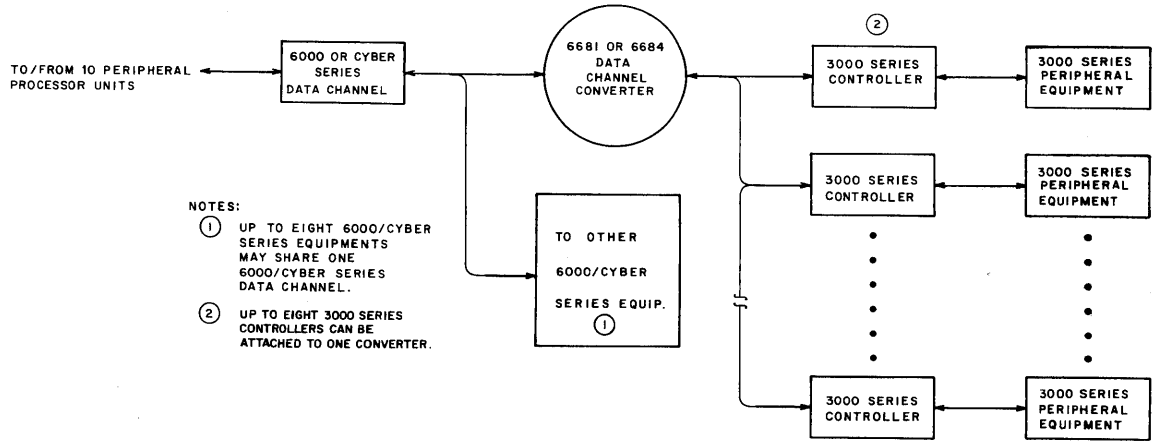

Figure 1-1. System Configuration

To prepare one of the 3000 Series equipments for operation, the converter must first be selected. Then the desired 3000 Series equipment is selected (connected). The two select operations are made by function codes sent from a peripheral processor unit via the 6000/CYBER data channel.

Some converter function codes may conflict with function codes assigned to other 6000/CYBER Series equipment on the same data channel. The converter differs from other 6000/CYBER Series equipment as follows:

1. The converter must be attached to the data channel ahead of all other 6000/CYBER Series devices.
2. The converter does not replay (pass on) information to other equipment on the same data channel when selected. This prevents unwanted activity in the other equipment caused by identical function codes.
3. The converter must be deselected (2100) before other 6000/CYBER Series equipment sharing the data channel can be selected.
4. A master clear (MC) signal on deadstart operations selects all converters in the computer system.

3000 SERIES INTERRUPT FEATURE

All 3000 Series peripheral equipment have an interrupt feature which enables them to notify the 6681/6684 data channel converter when specific operating conditions occur. Most of the peripherals use interrupt conditions which are selected or released in an equipment by function codes. They are:

1. Interrupt on ready, or interrupt on ready and not busy
2. Interrupt on end of operation
3. Interrupt on abnormal end of operation

The reference manual describing each 3000 Series equipment provides the interrupt select function codes and defines the interrupt conditions.

The 3000 equipment sends an interrupt signal to the data channel converter and sets a corresponding bit in the converter status word when one of the selected interrupt conditions occurs. Bits 3 through 10 of the 12-bit status word indicate interrupts from any one of the eight possible equipments served by the converter. The status bit set depends on the equipment number of the device sending the interrupt.

Equipment Number	Converter Status Bit
0	3
1	4
2	5
3	6
4	7
5	8
6	9
7	10

Peripheral equipment need not be connected to the converter to send an interrupt signal to the data channel converter. The interrupt feature thus provides a limited status check for an equipment even though it is not connected.

An interrupt status bit in the converter is present (set) as long as the equipment maintains the interrupt signal. An interrupt signal is cleared by any one of the following.

1. A converter master clear function (1700). This clears all 3000 Series equipments attached to the data channel converter and the converter itself.
2. A function code sent to the interrupting equipment (refer to the section describing the 3000 Series equipment for proper code).
3. A deadstart master clear signal from the 6000/CYBER data channel.

BUFFER FLUSHING

The buffer-flush feature allows the 6681/6684 data channel converter to terminate the peripheral processor input/output (I/O) buffer when an interrupt on abnormal end of operation condition exists in the peripheral equipment. To enable this, the peripheral equipment must be set to interrupt on an abnormal end of operation. This action sends an interrupt override signal to the 6681/6684. The interrupt override signal initiates the buffer-flush operation by forcing full or empty signals to the peripheral processor until the I/O buffer is terminated.

POWER FAIL FEATURE

The 6681-F provides hardware to deactivate and deselect when a power interruption occurs. The data channel converter is deactivated to reduce channel activity by allowing faster processing of power fail routines. The power fail mode signal is received from the power monitor box by the 3000 logic cable. This signal sets the PFM FF in the 6681-F which enables a deactivate signal to the channel when an input/output operation with deactivate code XX6X/XX4X is in progress. The PFM signal will deselect the DCC on any function signal received from the channel. The PFM FF sets status bit 02 (code XXX4). The PFM FF can be cleared and the DCC reselected only when the PFM signal is dropped. The PFM FF is cleared by a master clear or function signal.

OPERATION AND PROGRAMMING 2

OPERATION

The 6681-F Data Channel Converter has a switch for enabling and disabling parity checking. All other models of the 6681 and the 6684-1/2 models do not have switches/indicators. The cabinets containing the 6681/6684 units have a D.C. (direct current) POWER ON switch/indicator which energizes all units in the cabinet. The indicator is lighted when power is on. Some cabinets have a TEMP WARN (temperature warning) indicator which is lighted when the temperature of the air entering the cabinet exceeds $80^{o}F$ ($26.7^{o}C$). The D.C. POWER ON switch/indicator and TEMP WARN indicator are mounted on the outside of the cabinet at the top right-hand corner.

WARNING

The operator should not touch any switches or circuit breakers inside the cabinet.

CODES

Two sets of codes are required to operate a 3000 Series peripheral equipment via a data channel converter.

1. The function and status response codes for the converter.
2. The connect, function, and status codes for the specific 3000 Series equipment.

The converter function codes allow the 6000/CYBER Computer System to connect to the 3000 Series equipment and to transmit 3000 Series function codes to the connected equipment. Function codes also permit the sensing of both converter and external equipment status and enable the flow of data between the data channel and the 3000 Series equipment via the 6681/6684 data channel converter (refer to Table 2-1).

The 3000 Series codes include connect, function, and status reply. These codes prepare a connected equipment for an input/output operation. They do not affect unconnected equipment. The 3000 Series status codes monitor the operating conditions of several equipments (refer to 3000 Series equipment section for a complete list of these codes).

Table 2-1 lists the function codes applicable to the 6681/6684 data channel converter. Function codes are transmitted to the converter by 6000/CYBER peripheral processor FAN (76) and FNC (77) instructions. Bit 0 is rightmost in all codes. A description of each function code follows Table 2-1.

Table 2-4 lists the status reply codes for the converter. A description of each status code follows Table 2-4.

TABLE 2-1. 6681/6684 DATA CHANNEL CONVERTER FUNCTION CODES

Select/Deselect	
Select converter	2000†
Deselect converter	2100
Connect	
Connect equipment - Mode I	NUUU††
Connect equipment - Mode II	1000
Function	
Function transmit - Mode I	0FFF†††
Function initiate - Mode II	1100
Data Input/Output	
Input EOR initiate	14XX††††
Input initiate	15XX
Output initiate	16XX
Deactivate option	XX4X/XX6X
Master Clear	
Function master clear	1700
Status Request	
Converter status request	1200
Equipment status request	1300

†One converter is assigned different select and deselect codes, such as 2200 and 2300 or 2400 and 2500, when two converters share a common data channel.
††N = 4-7 (equipment number) and UUU = lower nine bits of connect code.
†††FFF = lower nine bits of function code.
††††Initiate conditions are defined by XX.

FUNCTION CODES

SELECT CONVERTER (2000)

Function code 2000 selects the converter from among the 6000/CYBER Series equipments sharing the same data channel. One converter is assigned different select and deselect codes, such as 2200 and 2300 or 2400 and 2500, when two converters share a common data channel. A dead start master clear automatically selects all converters in the computer system.

DESELECT CONVERTER (2100)

Function code 2100 deselects the converter. The converter must be deselected before another 6000/CYBER Series equipment on the same data channel is used.

CONNECT EQUIPMENT, MODE I (NUUU)

Function code NUUU connects 3000 Series equipment 4, 5, 6, or 7 and units UUU, where N equals the equipment number (restricted to 4 through 7) and UUU (lower nine bits) equals the unit number.

CONNECT INITIATE, MODE II (1000)

Function code 1000, specifying a Mode II operation, causes the converter to send the next data word received to the 3000 Series equipment as a connect code. Code 1000 connects 3000 Series equipment 0 through 7. The 1000 function code should be followed by a one word data output. The data is the connect code.

FUNCTION TRANSMIT, MODE I (0FFF)

Function code 0FFF, specifying a Mode I operation, causes the converter to transmit the 12-bit function code (0FFF) to the connected 3000 Series equipment. FFF can be the lower nine bits of any 12-bit code whose upper three bits are zeros.

FUNCTION INITIATE, MODE II (1100)

Function code 1100, specifying a Mode II operation, causes the converter to send the next data word received to the connected 3000 Series equipment as a function code. This code can be used to transmit any 3000 Series function code to the connected equipment. The 1100 code should be followed by a one word data output. The data is the function code.

INPUT EOR INITIATE (14Xoox)

Function code 14Xoox prepares the converter for an input operation. It terminates the input by either an end of record signal from the 3000 Series equipment or by a channel disconnect from the 6000/CYBER peripheral processor. Initiate conditions are defined by XX.

Data passes through the 6684-1 or 6684-2 in Modes A and B and through the 6681 in Mode A only. Data passes through the converter (unaltered) in Mode A. Two 6-bit characters are translated from internal binary coded decimal to display code in Mode B. The mode of operation is determined by bit 3.† Mode A is selected when bit 3 is clear. Mode B is selected when bit 3 is set.

A negate BCD conversion line is enabled to the external equipment when bit 0 is set. Any combination of negate BCD conversion and Mode B selects is permissible. The negate BCD conversion remains in effect until a 14X0, 15X0, or 16X0 function code is received. Refer to Table 2-2 for Mode B translations when the 6684-1 is used. Refer to Table 2-3 for Mode B translations when the 6684-2 is used. Note the differences in these tables for the DPC 00 code and the DPC 63 code.

†Bits 4 and 5 are not translated.

INPUT INITIATE (15Xoox)

Function code 15Xoox prepares the converter for an input operation. It terminates the input by a channel disconnect only and should not be used for magnetic tape units. † Two 6-bit characters are translated from internal BCD to DPC in Mode B (6684 only). Refer to input EOR initiate description. A negate BCD conversion line is enabled to the external equipment when bit 0 of code 15Xoox is set. Any combination of negate BCD and Mode B selects is permissible. The negate BCD conversion remains in effect until a 14X0, 15X0, or 16X0 function code is received.

OUTPUT INITIATE (16XX)

Function code 16XX prepares the converter for an output operation. It terminates the output by a channel disconnect. Two 6-bit characters are translated from DPC to internal BCD in Mode B (6684 only). Refer to input EOR initiate description. A negate BCD conversion line is enabled to the external equipment when bit 0 of code 16XX is set. Any combination of negate BCD and Mode B selects is permissible. The negate BCD conversion remains in effect until a 14X0, 15X0, or 16X0 function code is received.

† A magnetic tape transport stops tape motion when it senses the end of a record. However, when code 15XX is in effect, the converter does not disconnect the data channel on end-of-record. Thus, the peripheral processor hangs up on the input instruction.

TABLE 2-2. MODE B TRANSLATIONS (6684-1 ONLY)

Character	DPC Code	IBCD Code	Character	DPC Code	IBCD Code
None Assigned†	00	16	5	40	05
A	01	21	6	41	06
B	02	22	7	42	07
C	03	23	8	43	10
D	04	24	9	44	11
E	05	25	+	45	20
F	06	26	-	46	40
G	07	27	*	47	54
H	10	30	/	50	61
I	11	31	(	51	74
J	12	41	)	52	34
K	13	42	$	53	53
L	14	43	=	54	13
M	15	44	space	55	60
N	16	45	,	56	73
O	17	46	.	57	33
P	20	47	≡	60	76
Q	21	50	[	61	17
R	22	51	]	62	72
S	23	62	:	63	12
T	24	63	≠	64	14
U	25	64	→	65	75
V	26	65	∨	66	52
W	27	66	∧	67	77
X	30	67	↑	70	55
Y	31	70	↓	71	56
Z	32	71	<	72	32
0	33	00	>	73	57
1	34	01	≤	74	15
2	35	02	≥	75	35
3	36	03	¬	76	36
4	37	04	;	77	37

† DPC code 00 and IBCD code 16 are translated for future use. A character has not been assigned to these codes.

TABLE 2-3. MODE B TRANSLATIONS (6684-2 ONLY)

Character	DPC Code	IBCD Code	Character	DPC Code	IBCD Code
None assigned†	00	12	5	40	05
A	01	21	6	41	06
B	02	22	7	42	07
C	03	23	8	43	10
D	04	24	9	44	11
E	05	25	+	45	20
F	06	26	-	46	40
G	07	27	*	47	54
H	10	30	/	50	61
I	11	31	(	51	74
J	12	41	)	52	34
K	13	42	$	53	53
L	14	43	=	54	13
M	15	44	Space	55	60
N	16	45	,	56	73
O	17	46	.	57	33
P	20	47	≡	60	76
Q	21	50	[	61	17
R	22	51	]	62	72
S	23	62	:	63	16
T	24	63	≠	64	14
U	25	64	→	65	75
V	26	65	∨	66	52
W	27	66	∧	67	77
X	30	67	↑	70	55
Y	31	70	↓	71	56
Z	32	71	<	72	32
0	33	00	>	73	57
1	34	01	≤	74	15
2	35	02	≥	75	35
3	36	03	¬	76	36
4	37	04	;	77	37

† DPC code 00 and IBCD code 12 are translated for future use. A character has not been assigned to these codes.

DEACTIVATE OPTION (XX6X) AND (XX4X)

Function codes XX6X and XX4X allow two additional methods of generating an inactive signal in the 6681/6684 data channel converter during a read or write operation.

1. Deactivate option code XX6X must be sent to the 6681/6684, with input or output function code 1460, 1560, or 1660. This enables an inactive signal to the 6000/CYBER data channel when this option is selected in the 6681/6684. An interrupt override signal is generated in the 3000 peripheral controller when interrupt on abnormal end of operation is selected and an abnormal condition exists. The interrupt override signal is returned to the 6681/6684 where an inactive signal is generated and sent to the 6000/CYBER data channel. Deactivate option code XX6X may be used for any 3000 Series peripheral controller that has the interrupt override signal feature.
2. The second method of generating an inactive signal includes 3000 Series peripheral controllers that do not have the interrupt override feature. Deactivate option code XX4X must be sent to the 6681/6684, combined with input or output function code 1440, 1540, or 1640. Abnormal end of operation status code 1XXX is returned to the 6681/6684 when abnormal end of operation is selected in the 3000 Series peripheral controller and an abnormal condition exists. The 6681/6684 senses for status code 1XXX and generates an inactive signal that is sent to the data channel.

FUNCTION MASTER CLEAR (1700)

Function code 1700 master clears all 3000 Series equipment attached to the converter, as well as all the conditions within the converter.

CONVERTER STATUS REQUEST (1200)

Function code 1200 permits the 6000/CYBER Series peripheral processor to input converter status. A one word input must follow to read in the status response.

EQUIPMENT STATUS REQUEST (1300)

Function code 1300 permits the 6000/CYBER Series peripheral processor to input the status response from the connected 3000 Series equipment. A one word input must follow to read in the status word.

NOTE

Any 1XXX function code sent to the data channel converter clears the previous 1XXX function condition.

STATUS REPLY CODES

Two types of status codes are available from the converter.

1. Converter status codes
2. Equipment status codes

The 12-bit converter status responses (Table 2-4) are reply, internal/external reject, transmission parity error, and equipment interrupt signals from the attached 3000 Series equipment. Function code 1200 makes the converter status response available to the 6000/CYBER peripheral processor. A one word data input must follow to read in the status word.

TABLE 2-4. STATUS REPLY CODES

Code	Description
XXX0	Reply
XXX1	Reject (internal or external)
XXX2	Internal reject
XXX4	Transmission parity error (detected by 3000 peripheral controller)
XX1X-2XXX	Equipment interrupts

Every 3000 Series peripheral equipment provides a 12-bit status response. The response code is available at the time the equipment is connected to the converter, or after the peripheral equipment rejects a connect code. Each bit in the response code indicates a condition within the peripheral equipment, such as ready, busy, or end of tape. A 6000/CYBER peripheral processor makes a status request to the connected 3000 Series equipment by sending a 1300 function code to the converter. The peripheral processor then makes a one word input to read in the response.

Equipment status codes differ for each equipment. The codes are listed in the manual describing the individual equipment. The converter status codes are defined in the following paragraphs.

REPLY (XXX0)

Bits 0 through 2 are clear when the 3000 Series equipment returns a reply signal to the converter in response to a connect or function code.

REJECT, INTERNAL OR EXTERNAL (XXXxx1)

Bit 0 is set when the 3000 Series equipment returns a reject signal to the converter in response to a connect or function code. An internal reject signal sets both bit 0 and bit 1.

INTERNAL REJECT (XXXx1x)

Bit 1 is set, after a delay of 100 microseconds, if the 3000 Series equipment fails to return a reply or a reject signal to the converter in response to a connect or function code.

TRANSMISSION PARITY ERROR (XXX1xx)

Bit 2 is set when the connected 3000 Series equipment senses a parity error on a function code or output data. A parity error may also occur during an input operation with some 3000 Series equipment. A parity error on a connect code does not set bit 2.

EQUIPMENT INTERRUPTS (XX1X-2XXX)

Bits 3, 4, ... 9, and 10 indicate the interrupt signal from one of eight possible 3000 Series equipments. If equipment N sends an interrupt, status bit N + 3 is set and remains set until the equipment drops the interrupt signal.

SELECTING THE CONVERTER

The converter must be selected from among the other 6000/CYBER Series equipment that share the same data channel before it communicates with 3000 Series peripheral equipment. The select (2000) function code, transmitted by a peripheral processor FAN (76) or FNC (77) instruction, selects the converter.† Selection activates the converter and renders inactive all other 6000/CYBER Series input/output equipment on the data channel attached beyond the data channel converter.

†One converter is assigned different select and deselect codes, such as 2200 and 2300 or 2400 and 2500, when two converters share a common data channel.

A deadstart master clear automatically selects all converters in the computer system.

DESELECTING THE CONVERTER

Once selected, the converter remains selected until it is deselected by function code 2100.† The converter must always be deselected before any other 6000/CYBER Series input/output equipment on the same data channel can be used.

If two converters on the same data channel have been selected by a deadstart master clear, the first converter must be deselected before the second converter can be deselected because a converter does not relay codes sent from the data channel to more distant equipment.

CONNECTING TO 3000 SERIES EQUIPMENT

One of eight possible 3000 Series controllers attached to the data channel converter may be connected after the converter is selected. The connect operation activates one controller and automatically deactivates the other seven controllers so that only one of eight possible controllers can be connected at a given time.

A 12-bit connect code of the following format connects a 3000 Series controller to a data channel converter.

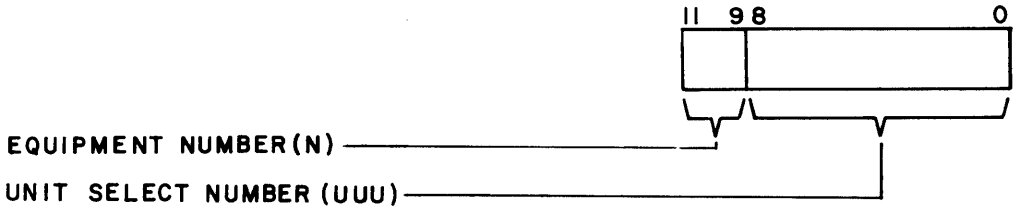

Figure 2-1. Connect Code Format

Bits 9 through 11 indicate the equipment number of the device to be connected. Each 3000 Series equipment is assigned a number (0 through 7) via an eight position Equipment Number switch. Bits 0 through 8 designate one of several possible units which are subordinate to the equipment. For example, a tape controller ranks as an equipment. Each of the attached tape transports is a unit designated by a unit select number.

† One converter is assigned different select and deselect codes, such as 2200 and 2300, or 2400 and 2500, when two converters share a common data channel.

Bits 0 through 8 are not used with equipments having no subordinate units (such as a card reader).

A connect code is sent from a 6000/CYBER peripheral processor, via the data channel converter, to an attached 3000 Series controller. There are two methods of sending a connect code: Mode I connect and Mode II connect. A Mode I connect operation requires only one converter function code from the peripheral processor, but is restricted to connecting only equipments 4 through 7. A Mode II connect operation requires a converter function code followed by a one word data output. Mode II can connect any of the eight possible equipments, 0 through 7.

A connect is broken only by connecting to another equipment, by a deadstart master clear, or by a converter function master clear (1700). Deselecting the converter or disconnecting the data channel does not clear a connect.

MODE I CONNECT

The data channel converter performs a Mode I connect operation whenever the peripheral processor sends a function code in the form 4UUU through 7UUU. The converter forwards the function code to the attached 3000 Series equipment as a connect code. Normally, the equipment corresponding to the upper octal digit (4 through 7) connects and any previously connected equipment automatically disconnects.

If an equipment connects successfully, it returns a reply signal to the converter which sends an inactive signal to the 6000/CYBER data channel. The reply signal disconnects the data channel, making it available for another operation.

Some 3000 Series equipment may not be able to connect under certain conditions. In such cases, the equipment returns a reject signal to the data channel converter. The reject signal acts as a reply, causing the converter to send an inactive signal to the 6000/CYBER data channel. In addition, the reject signal sets status bit 0 in the converter, indicating that the connect code was rejected. The conditions which cause the 3000 Series equipment to reject a connect code are listed in the reference manual for each equipment. Neither a reply or a reject signal is returned to the converter if a connect code addresses a nonexistent equipment or if a malfunction occurs in the equipment. In such cases, the converter generates an internal reject signal after a delay of 100 microseconds. An internal reject signal causes the data channel converter to send an inactive signal to the 6000/CYBER data channel. The internal reject signal also sets reject status bit 0 and internal reject status bit 1 in the converter.

The 3000 Series equipment checks each connect code sent from the data channel converter for parity. If a parity error occurs, no equipment connects and neither a reply or a reject signal is returned to the converter. The data channel converter generates an internal reject signal after a delay of 100 microseconds.

Refer to Programming Examples (Mode I) at the end of this section.

MODE II CONNECT

A Mode II connect operation requires two steps.

1. Function code 1000 (connect initiate) is sent to the data channel converter by a FAN (76) or FNC (77) instruction. This code conditions the converter for a Mode II connect operation. Function code 1000 is not sent to the 3000 Series equipment. The converter returns an inactive signal to release the 6000/CYBER data channel.
2. A one word output, containing the connect code, is sent to the converter by output instruction OAM (73) or OAN (72) from the peripheral processor. The converter forwards this output word to the 3000 Series equipment as a connect code.

There are three possible responses to the connect code.

1.	Reply	Indicates addressed equipment successfully connected.
2.	Reject	Indicates addressed equipment could not connect. Reject status bit 0 is set in the converter.
3.	No response	The converter generates an internal reject signal after a delay of 100 microseconds. Internal reject status bit 1 and reject status bit 0 are both set.

Any of the three responses just described causes the converter to send an empty signal to the 6000/CYBER data channel, indicating receipt of the output word. A full jump instruction (FJM, 66) should follow the data output to delay the program until the converter accepts the output word if an OAN (72) instruction has been executed. A disconnect channel instruction (DCN, 75) should follow to deactivate the 6000/CYBER data channel.

The 3000 Series equipment checks each connect code sent from the data channel converter for parity (identical to Mode I connect operation). If a parity error occurs, no equipment connects and neither a reply or a reject signal is returned to the converter. The data channel converter generates an internal reject signal after a delay of 100 microseconds.

Check the converter status response for a reject after a Mode II connect operation is complete.

NOTE

A status check should follow only after the Mode II connect operation is complete. There is no response from the 3000 Series equipment when the connect initiate code (1000) is sent to the converter. Thus, a status check at this time is not significant.

Refer to Programming Examples (Mode II) at the end of this section.

SENDING FUNCTION CODES TO 3000 SERIES EQUIPMENT

A 3000 Series equipment accepts 12-bit function codes from the converter after it is connected. Function codes establish operating conditions within an equipment or initiate operations, such as tape rewind. The function codes applicable to the 3000 Series equipment are listed in the reference manual for each equipment.

The function codes sent from the data channel converter to the 3000 Series equipment are distinct from function codes transmitted from the peripheral processor to the converter (refer to Table 2-1).

There are two methods of transmitting function codes to a 3000 Series equipment.

1. Mode I — A Mode I function operation requires only a single peripheral processor function instruction (FAN or FNC), but is restricted to a 9-bit function code.
2. Mode II — A Mode II function operation requires a function instruction followed by a one word data output. A full 12-bit function code can be sent to the 3000 Series equipment by Mode II procedures.

MODE I FUNCTION

A Mode I function operation is similar to a Mode I connect operation. The converter performs a Mode I function operation whenever the 6000/CYBER peripheral processor sends a 0FFF function code to the converter. The quantity FFF can be any 9-bit 3000 Series function code. The converter forwards the 0FFF code to the connected equipment as a function code.

The converter receives one of three possible responses to a function code from the 3000 Series equipment.

1.	Reply	Indicates that the 3000 equipment accepted the code.
2.	Reject	Indicates that the 3000 equipment did not accept the code. This signal sets reject status bit 0 in the converter.
3.	No response	If, after a delay of 100 microseconds, neither a reply nor a reject signal is received, the converter generates an internal reject signal that sets reject status bits 0 and 1.

A status check should follow a Mode I function operation to test for a reject signal or a parity error at the 3000 Series peripheral controller. An example of a Mode I function procedure is given in the sample program at the end of this section.

MODE II FUNCTION

A Mode II function operation is similar to a Mode II connect operation. Two steps are necessary.

1. Function code 1100 (function initiate) is sent to the converter by a FAN (76) or FNC (77) instruction. This code conditions the data channel converter for a Mode II function operation and is not forwarded to the 3000 Series equipment. The converter returns an inactive signal to release the 6000/CYBER data channel.

2. A one word output containing the desired 12-bit function code is sent to the converter by output instruction OAM (73) or OAN (72). The converter forwards this output word to the 3000 Series equipment as a function code.

The responses to a Mode II function operation are the same as for a Mode I function operation.

1.	Reply	Indicates that the 3000 equipment accepted the code.
2.	Reject	Indicates that the 3000 equipment could not accept the code. Reject status bit 0 is set in the data channel converter.
3.	No response	The converter generates an internal reject signal after a delay of 100 microseconds. Internal reject status bit 1 and reject status bit 0 are both set.

Any one of the three responses just described causes the converter to send an empty signal to the 6000/CYBER data channel, indicating receipt of the output word. A full jump instruction (FJM, 66) should follow the data output to delay the program until the converter accepts the output word if the OAN (72) instruction has been executed. A disconnect channel instruction (DCN, 75) should follow to deactivate the 6000/CYBER data channel.

A status check should follow a Mode II function operation to test for a reject signal or a parity error at the 3000 peripheral controller. An example of a Mode II function procedure is given in the sample program at the end of this section.

DATA TRANSFER

An input or output operation can proceed only after the desired equipment is connected to the data channel converter and after the converter is selected.

INPUT OPERATION

There are three steps to an input operation.

1. Send an input initiate or an input EOR initiate function code to the converter. This code conditions the converter for an input operation.
2. Send an execute channel activate instruction to the converter. This signals the equipment (via the converter) to begin sending data. For example, it starts tape motion or initiates a card cycle.
3. Issue an input instruction to read in the data from the sending device.

The basic input function codes are 14XX and 15XX. Each code prepares the converter for a specific input operation.

Input function code 1400 terminates the input operation either when the 3000 Series peripheral equipment reaches an end-of-record or when a data channel disconnect is received from the 6000/CYBER peripheral processor. An end-of-record sensed by the 3000 equipment causes the converter to send an inactive signal which disconnects the 6000/CYBER data channel. The peripheral processor then exits to the next instruction.

Input function code 1401 suppresses the internal-to-external BCD conversion that normally takes place in some 3000 Series equipment. Code 1401 is identical to code 1400 in other respects.

Bit 3 (6684 only) in both the 14XX and 15XX input function codes determines the mode of operation. Mode A passes data through the converter unaltered and is selected when bit 3 is clear. Mode B translates two 6-bit characters from internal BCD to DPC when bit 3 is set (6684 only).

On some 3000 Series equipment there may be a significant delay between the channel activate instruction that signals the start of an input operation and the time the first data word is available from the 3000 equipment. For example, in the 3248 Card Reader Controller there is a delay of 20 milliseconds between the start of card motion and the availability of the first card column. During this period the 6000/CYBER peripheral processor can perform another task. The latent period is different for each 3000 Series equipment. Its length can be found in the reference manual describing the device. An input instruction should immediately follow the channel activate instruction if the delay is unknown.

The data channel converter does not deactivate the data channel on end-of-record if input initiate code 15XX is used. A channel disconnect instruction must immediately follow the input instruction to notify the equipment of the end of operation.

Input function codes 14XX and 15XX remain in effect until the next converter function code is received. The negate internal-to-external BCD condition, established by codes 14X1 and 15X1, is cleared when the peripheral processor sends a new input/output function with bit 0 clear. An input operation is followed normally by a status request function code. Thus, each input operation usually requires a new input initiate code.

OUTPUT OPERATION

There are four steps to an output operation.

1. Send an output initiate function code to the data channel converter to prepare it for an output operation.
2. Execute a channel activate instruction. This action notifies the 3000 equipment (via the converter) that an output operation is about to begin. The connected device prepares to receive data. For example, it starts card motion or tape motion.
3. Perform an output instruction to send data to the 3000 equipment.
4. Cause the peripheral processor to execute a disconnect channel instruction (DCN, 75). This step releases the data channel and notifies the 3000 equipment of the end of the record.

The output initiate code is 16XX. Output function code 1601 suppresses the internal-to-external BCD conversion that normally takes place in some 3000 Series equipment. Code 1601 is identical to code 1600 in other respects. Data passes through the data channel converter unaltered (Mode A) if bit 3 is clear. If bit 3 is set (6684 Mode B only), two 6-bit characters are translated from internal BCD to DPC.

There is a delay in some 3000 equipment between the channel activate instruction that flags the start of an output operation and the time that the 3000 equipment is ready to accept the first data word. During this period, the 6000/CYBER peripheral processor can perform another task. The output instruction should immediately follow the channel activate instruction if the delay is unknown.

Output initiate code 1600 remains in effect until the next converter function code is received. The negate internal-to-external BCD condition established by code 16X1 is cleared when the peripheral processor sends a new input/output function with bit 0 clear. An output operation is normally followed by a status request function code which clears the output condition in the data channel converter. Thus, each output operation usually requires a new output initiate code.

PARITY CHECKING

6681 -B/C/D/E AND 6684-1/2 DATA CHANNEL CONVERTERS

The 3000 controller checks parity on all connect and function codes and data bytes received from the 6681-B/C/D/E and 6684-1/2 Data Channel Converters. The controller also responds to parity errors on function codes and data transfers from the converter but it does not respond to parity errors on the connect code. There is no parity checking on information going from the 3000 controller to the data channel converter or between the data channel converter and the 6000/CYBER data channel.

6681/6684 TO 3000 CONTROLLER CONNECT CODE

The 6681/6684 data channel converter appends an odd parity bit to each 12-bit connect code† it receives from the 6000/CYBER data channel. The converter sends the connect code and parity bit to the 3000 controller. The controller checks each connect code it receives for odd parity. If the controller detects a parity error, the following occurs:

1. The 3000 external equipment does not connect.
2. Neither a reply or a reject signal is sent to the converter.
3. The converter generates an internal reject signal after a delay of 100 microseconds which sets reject status bits 0 and 1.

6681/6684 TO 3000 CONTROLLER FUNCTION CODE

The 6681/6684 data channel converter appends an odd parity bit to each 12-bit function code †† it receives from the 6000/CYBER data channel. The converter sends the function code and parity bit to the 3000 controller. The controller checks each function code it receives for odd parity. If the controller detects a parity error, the following occurs:

1. The controller sets parity error status bit 2 (channel status).
2. The controller sends an external reject signal to the converter.
3. The 3000 external equipment does not accept the function code.

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† Peripheral processor function code.
†† The usable code is either 9 or 12 bits.

4. If there is no external reject signal, the converter generates an internal reject signal after a delay of 100 microseconds which sets reject status bits 0 and 1.

6681/6684 TO 3000 CONTROLLER DATA TRANSFER

The 6681/6684 data channel converter appends an odd parity bit to each 12-bit data byte it receives from the 6000/CYBER data channel. The converter sends the data byte and parity bit to the 3000 controller. The controller checks each data byte it receives for odd parity. If the controller detects a parity error, it responds to that error by setting parity error status bit 2 (channel status). The output operation is allowed to complete.

NOTE

Follow each output operation with a status check to ensure that no parity error occurred.

3000 CONTROLLER TO 6681/6684 TRANSFER

The 6681/6684 converter does not check parity on the information it receives from the 3000 controller.

6681-F DATA CHANNEL CONVERTER

NOTE

The 6681-F operates functionally as a 6681-B/C/D/E (without parity checking) when the parity check switch located on the 6681-F logic chassis is in the down position.

The 6681-F Data Channel Converter checks parity on all function codes and data received from the CYBER 170 data channel or the connected 3000 Series controllers. The converter also generates parity for status words sent to the CYBER 170 data channel.

CYBER 170 TO 6681-F FUNCTION CODES

The CYBER 170 data channel appends an odd parity bit to each 12-bit function code it sends to the 6681-F Data Channel Converter. The converter checks each function code it receives for odd parity. If the converter detects a parity error, the following occurs:

1. The connect or function signal to the 3000 peripheral controller is blocked.
2. The 6681-F converter does not send an inactive signal to the CYBER 170 data channel.
3. Parity error status bits 2 and 11 in the CYBER 170 channel status word remain clear.
4. The function register in the 6681-F converter is cleared. Therefore, the function is not executed.†

DATA SENT FROM CYBER 170 TO 6681-F

The CYBER 170 data channel appends an odd parity bit to each 12-bit data byte†† it sends to the 6681-F converter. The converter checks each data byte it receives for odd parity. If the converter detects a parity error, the following occurs:

1. Parity error status bits 2 and 11 in the CYBER 170 channel status word set.†††
2. The data byte is used as normal.
3. The parity bit received from the CYBER 170 channel is sent, unchanged, to the 3000 peripheral controller with the data byte. The 3000 controller also detects the parity error and responds (refer to 3000 data channel description).
4. The response to a Mode II functional data byte is either an external or internal reject signal.

The 6684-1/6684-2 (Mode B) converts each DPC character to a corresponding IBCD character (refer to Table 2-2). Each 12-bit output word that the 6000/CYBER data channel sends to the 6684-1/6684-2 (Mode B) contains two 6-bit IBCD characters.

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† Although a function parity error is detected, the select/deselect functions will execute.

†† Includes functional data on Mode II connect or function operation.

††† These parity error status bits are cleared when converter status is read or by a master clear.

DATA SENT FROM 6681-F TO CYBER 170

The 3000 Series controller appends an odd parity bit to each 12-bit data byte it sends to the 6681-F converter. The converter checks each data byte it receives for odd parity. If the converter detects a parity error, the following occurs:

1. Parity error status bit 2 sets in the CYBER 170 channel status word.
2. The data byte and the parity bit received from the 3000 controller are sent, unchanged, to the CYBER 170 data channel.
3. Operations proceed as normal.

6681-F TO CYBER 170 STATUS WORDS

There is no parity on status words sent from the 3000 peripheral controller to the 6681-F. The converter appends an odd parity bit to each 12-bit status word it sends to the CYBER 170 data channel. The CYBER channel checks each status word it receives for odd parity. The CYBER 170 data channel sets channel bit X in its status and control register if a parity error is detected.

CLEARING A PARITY ERROR

A converter function master clear (1700) or a connect function must be executed to clear a parity error condition in the 3000 Series equipment if a status check reveals that a parity error occurred. The converter parity error status bits 2 and 11 will be cleared when the converter status is read by the PPU or by a master clear.

One must wait until the slowest equipment completes its operation before issuing the master clear code if the converter is alternately operating two 3000 Series equipments on a time-sharing basis. This procedure assures that the master clear code does not cause a loss of data.

DATA CONVERSION

6681-B/C/D/E/F AND 6684-1/6684-2 (MODE A) DATA CHANNEL CONVERTERS

There is no data conversion for the 6681/6684 (Mode A) models. Data bytes are transferred in both directions without modification.

6684-1/6684-2 (MODE B) DATA CHANNEL CONVERTER

The 6684-1/6684-2 (Mode B) treats each 12-bit byte as two 6-bit characters.

INPUT OPERATION

The 6684-1/6684-2 (Mode B) converts input data from an internal binary coded decimal format to a display code format. All data from the 3000 Series peripheral equipment is coded in IBCD. There are two 6-bit IBCD characters per 12-bit byte. The 6684-1/6684-2 (Mode B) converts each IBCD character to a corresponding DPC character (refer to Table 2-2). Each 12-bit input word that the 6684-1/6684-2 (Mode B) sends to the 6000/CYBER data channel contains two 6-bit DPC characters.

OUTPUT OPERATION

The 6684-1/6684-2 (Mode B) converts output data from a display code format to an internal binary coded decimal format. All data from the 6000/CYBER data channel is coded in DPC. There are two 6-bit DPC characters per 12-bit byte.

6684-2 (MODE B) DATA CHANNEL CONVERTER

The 6684-2 (Mode B) functions identically to the 6684-1 (Mode B) except for two DCP/IBCD code relationships shown below.

6684-1 (Mode B)	6684-2 (Mode B)
DPC00 - $IBCD16_8$	DPC00 - $IBCD12_8$
$DPC63_8$ - $IBCD12_8$	$DPC63_8$ - $IBCD16_8$

PROGRAMMING EXAMPLES

Table 2-5 shows the steps in programming a converter input and output operation. Connect and function procedures for both Mode I and Mode II are illustrated.

TABLE 2-5. MODE I AND II INPUT/OUTPUT OPERATION

MODE I			
Mnemonic	Instruction	Explanation	
AJM	Active jump	Wait for inactive channel	
FAN or FNC	Function	Select converter (2000) †	
FAN or FNC	Function	Equipment connect (NUUU)	Mode I Connect
FAN or FNC	Function	Converter status request (1200)	
ACN	Activate channel	Initiate input	
IAN	Input one word to A	Input converter status reply	
DCN	Disconnect channel	Release data channel for another operation	
	Status check	Check for reject	
FAN or FNC	Function	Equipment function (0FFF)	
FAN or FNC	Function	Converter status request (1200)	
ACN	Activate channel	Initiate input	
IAN	Input one word to A	Input equipment status reply	Mode I Function
DCN	Disconnect channel	Release data channel for another operation	
	Status check	Check for reject or parity error	
FAN or FNC	Function	Prepare converter for input (15XX)	
ACN	Activate channel	Initiate input (start tape motion, etc.)	
IAM	Input instruction	Read a block of data	
DCN	Deactivate Channel	Terminate input	
FAN or FNC	Function	Converter status request (1200)	
ACN	Activate channel	Initiate input	
IAN	Input one word to A	Input converter status	
	Status check	Check for parity error or interrupt	
DCN	Deactivate channel	Terminate input	
FAN or FNC	Function	Deselect converter (2100) ††	

† This step is necessary only if the converter has not been previously selected.

†† The converter must be deselected only if another 6000 or CYBER Series device on the same data channel is to be used.

TABLE 2-5. MODE I AND II INPUT/OUTPUT OPERATION (Cont'd)

MODE II			
Mnemonic	Instruction	Explanation	
AJM	Active jump	Wait for inactive channel	
FAN or FNC	Function	Select converter (2000) †	
FAN or FNC	Function	Equipment connect initiate (1000)	Mode II Connect
ACN	Activate channel	Initiate output of connect code	
OAM or OAN	Output one word	Output equipment connect code (NUUU)	
FJM	Full jump	Wait for acceptance of connect code	
DCN	Disconnect channel	Terminate output	
FAN or FNC	Function	Converter status request (1200)	
ACN	Activate channel	Initiate input of status reply	
IAN	Input one word	Input status reply	
DCN	Disconnect channel	Terminate input	
	Status check	Check for reject	
FAN or FNC	Function	Equipment function initiate (1100)	Mode II Function
ACN	Activate channel	Initiate output of function code	
OAM or OAN	Output one word	Output equipment function code (0FFF)	
FJM	Full jump	Wait for acceptance of function code	
DCN	Disconnect channel	Terminate output	
FAN or FNC	Function	Converter status request (1200)	
ACN	Activate channel	Initiate input of status reply	
IAN	Input one word	Input status reply	
DCN	Disconnect channel	Terminate input	
	Status check	Check for reject or parity error	
FAN or FNC	Function	Prepare converter for output (16XX)	
ACN	Activate channel	Initiate output of data (start tape motion, etc.)	

† This step is necessary only if the converter has not been previously selected.

TABLE 2-5. MODE I AND II INPUT/OUTPUT OPERATION (Cont'd)

MODE II		
Mnemonic	Instruction	Explanation
OAM or OAN	Output data	Output block of data words
AJM	Active jump	Wait for completion of output
DCN	Disconnect channel	Terminate output
FAN or FNC	Function	Converter status request (1200)
ACN	Activate channel	Initiate input of status reply
IAN	Input one word	Input status reply
	Status check	Check for parity error or interrupt
DCN	Disconnect channel	Terminate
FAN or FNC	Function	Deselect converter (2100) †

† The converter must be deselected only if another 6000 or CYBER Series device on the same data channel is to be used.

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