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53A-171 CONTROL CARD

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NOTICE

The Smart Hardware System will NOT operate unless the Step/Normal Switch is in the NORMAL position !!!!!!!!!!!!!

53A-171 CONTROL CARD

OPERATING MANUAL

DESCRIPTION

The 53A-171 Card is a printed circuit board assembly used in the 53A/63A System. The 53A-171 Card performs a hardware function for the 53A/63A System analogous to a software executive in a computer. The 53A-171 Card identifies system level commands, provides address control, initiates timing signals, provides a central interrupt register for vectored priority interrupts and reports interrupts back to the system controller (calculator or computer). The 53A-171 Card also provides "Built-In Test Equipment" (BITE) for the 53A/63A System.

ADDRESS SELECT SWITCH

The control card has a miniature 10-position switch, labeled ADDRESS. The switch is used to select the address (0 - 9) of the 53A-171 Card and therefore the address of the mainframe which the 53A-171 Card is plugged into.

The cover of the switch hinges open to allow access for re-selecting the address. A small, flat-blade screwdriver should be used to turn the cam-action wiper to the desired position.

For the sake of a standard convention, it is recommended that the address of the 53A-171 Card in the first mainframe be set to 0, the second mainframe to 1, etc.

POWER LED

Each function card contains a power LED. The Power LED is larger than the other LEDs on the 53A-171 Card. When lit, this LED indicates all required DC power (5VDC, +15 VDC and -15 VDC) has been supplied. The power LED is also a valuable diagnostic tool. When the 53A/63A system first powers up, all power LEDs light. Besides indicating power is being supplied, these lit LEDs show all function cards are unaddressed. When the system controller (calculator or computer) addresses the 53A-171 Card, the power LED on the 53A-171 Card goes out. This LED remains out until another function card is addressed. Only one function card can be addressed at a time; an unlit power LED tells the programmer which function card is now communicating with the system controller.

FUSES

The 5-VDC power bus has a 2-A fuse that protects the system from overloads. If a fuse blows, the power LED does not light.

BUILT-IN TEST EQUIPMENT (BITE)

For most applications it is unnecessary for the user to read or understand this section. However, if the user intends to provide his own maintenance, or build a function card using a CDS 53A-450 Wire-Wrap Card, he must become familiar with this section.

The LEDs in the following sections are listed as they appear on the 53A-171 Card, from top to bottom. Following the LEDs are switches which are listed as they appear on the 53A-171 Card, from top to bottom.

TIMING LEDs

The top column of four LEDs display the current state of the backplane timing pulses. These 14 pulses are generated in a sequential order by the 53A-171 Card each time an input or output character is processed by the 53A/63A System. However, on the backplane only T3* through T14* are available. These pulses can be observed by placing the 53A-171 Card, Step/Normal Switch in the Step position, Timing/Character Switch in the Timing position, and stepping the Step Switch when input and output data are available.

The four LEDs are labeled, from top to bottom, T1, T2, T4, and T8 corresponding to the least through the most significant bits of the timing address. Example: The System would be at T5* if the following bit pattern were observed:

T1 - lit
T2 - out
T4 - lit
T8 - out

DATA LEDs

The eight Data LEDs are labeled from top to bottom, B0 through B7 (B - bit). These LEDs are used to display input data when the I/O LED is lit and output data when the I/O LED is out. Throughout the 53A/63A System the words "input" and "output" are referenced to the system controller - i.e., Input would be data from the 53A/63A System into the system controller (calculator or computer).

The ASCII character "?" would be represented by the following:

B0 - lit
B1 - lit
B2 - lit
B3 - lit
B4 - lit
B5 - lit
B6 - out
B7 - depends on parity

CONTROL LED

The Control LED, labeled "CT", represents the status of the CONTROL* line running from the Communications Card to all mainframe card slots. The function of this LED depends on whether the 53A/63A System is in input or output (See I/O LED). If the 53A/63A System is in input (sending data to the system controller) and CONTROL* is low (Control LED is lit), then the system controller is ready to receive data from the 53A/63A System, and an addressed function card may send data at this time.
If the 53A/63A System is in output (receiving data from the system controller) and CONTROL* is low (Control LED is lit), then the system controller has sent valid data to the backplane, and an addressed function card may read the data at this time.

FLAG LED

The Flag LED labeled "FL" represents the status of the FLAG* line from the function cards to the mainframe backplane. FLAG* will always follow a CONTROL* (see Control LED). FLAG* indicates to the system controller through the communications card that the cycle initiated by CONTROL* is completed.

FLAG* is such a short pulse that it normally cannot be observed on the Flag LED. A pulse-stretching circuit has been included to make the Flag LED visible.

I/O LED

The I/O LED labeled "I/O" represents the status of the I/O line from the communications card to the mainframe backplane. If the LED is lit the system is in input and if the LED is out the system is in output - i.e., data output from the system controller to the 53A/63A System.

BINARY LED

The Binary LED labeled "BI" represents the status of the BINARY* line, a line on the backplane from the communications card and function cards to the 53A-171 Card. The 53A/63A System will be in the Binary mode when the LED is lit.

In the Binary mode the 53A/63A System will not react to an @ character and therefore an addressed function card can't be unaddressed.

For example, the user may want to list a program stored in the system controller. If the listing device, a line printer, is connected to a function card, and an "@" character is in the program, the function card becomes unaddressed; the listing process ends when the "@" character is detected by the 53A-171 Card. But, if the 53A/63A System is in binary mode, the listing continues because the "@" character is ignored by the 53A-171 Card.

STOP LED

The STOP LED labeled "ST" represents that status of the STOP* line on the mainframe backplane. The STOP* line may be activated by either a hardware STOP command being issued from the system controller to the communications card or a user software @XH (Halt) command being detected by the 53A-171 Card. The STOP* line is used to initialize the function cards contained in a mainframe.

A discussion of the effect of either an @XH (Halt) or STOP command on function cards is contained in the Operation section of each function card's operating manual.

STATE LEDs

The three State LEDs display the state of the 53A-171 Card. The 53A-171 Card is changed from state to state as ASCII characters are output by the system controller. Input characters will not affect the state of the 53A-171 Card.

The LEDs are labelled, from top to bottom, S1, S2, and S4 corresponding to the least through the most significant bits of the state address. Example - The 53A-171 Card would be at S5 if the following bit pattern were observed:

S1 - lit
S2 - out
S4 - lit

The six valid states on the Control Card are:

State 0 - The 53A-171 Card is not addressed and the Power LED is lit. This state is always entered on power-up, and may be entered from state 1 or state 5. If the communications card pulls the STOP* line on the backplane low, the 53A-171 Card will exit any other states and enter state 0. The control card can only exit from state 0 to state 1.

State 1 - The 53A-171 Card has detected an "@" character being output by the system controller and will check the next ASCII character for its own address as selected by the control card's Address Select Switch. If its address isn't detected with the next character, the control card will return to state 0. If its address is detected, the control card will move to state 2.

State 2 - The 53A-171 Card has detected its address and its Power LED is out. The control card will continue to monitor all output data until it detects one of the characters described in states 3, 4, or 5 and will move to the corresponding state.

State 3 - The 53A-171 Card has detected a number 0 through 9 and has pulled the corresponding address line low on the backplane, thus address a function card 0 through 9. The Power LED on the addressed function card will be out at this time. When the control card leaves this state, the addressed function card will be unaddressed and its Power LED will be lit. The control card will exit this state to state 1 when an "@" character is detected.

State 4 - The 53A-171 Card has detected and ASCII "S" character and will now test for interrupts from the function cards. The control card accomplishes this by pulling Backplane Pin #76 INT-CHK low and reading the logic levels on the 10 address lines. If an address line has been pulled low by a function card, then the function card doing so has "interrupted". The control card will exit this state and move to state 1 when an "@" character is detected.

State 5 - The 53A-171 Card has detect an ASCII "H" character (Halt command) and will now pull the STOP* line on the backplane low. The STOP* line will remain low until the control card detects an ASCII "@" character and

exits this state to move to state 1. The minimum time the STOP* line will be low is 4 microseconds.

STEP/NORMAL SWITCH

This is the top switch on the front edge of the control card. The switch has two positions -- Step (up position) and Normal (down position) for normal system operation. The switch should only be in the Step position if the user wants to step timing pulses or ASCII characters.

TIMING/CHARACTER SWITCH

This switch has two positions -- Timing (up position) and Character (down position). When the switch is in the Timing position the user is able to step through the timing pulses associated with each ASCII character, either input or output. When the switch is in Character position the user is able to step through a string of ASCII characters one character at a time, either input or output.

STEP SWITCH

The Step Switch, labelled "ST" is below the Timing/Character Switch on the front edge of the 53A-171 Card. This is a momentary push-button switch. Each time the switch is pushed, the control card advances to the next timing pulse or ASCII character, depending on the setting of the Timing/Character Switch.

SPECIFICATIONS

Functions:

Identifies system level commands.
Initiates timing signals.
Provides address control.
Provides a central interrupt register for vectored priority interrupts.
Provides BITE for the entire 53A/63A System.
This card is required with each 53A-002 or 63A-012 Card Cage.

Power-Up:

When power is turned on, the control card goes to the following known states:
Card unaddressed (Power LED - lit).
Timing LEDs - T1 lit, all others out.
Data LEDs - depends on the system controller.
Control LED - depends on the system controller.
Flag LED - out.
I/O LED - out.
Binary LED - depends on the system controller.
STOP LED - will momentarily turn on.
State LEDs - all out.

Power Requirements:

Power from the 53A-060, 53A-062, or 63A-070 Power Supply in the 53A-002 or 63A-012 Card Cage.
Voltage: 4.75 to 5.25 VDC.
Current: 0.9A, maximum quiescent.
0.9A, peak.

Cooling:

Provided by the fan in the 53A-002 or 63A-012 Card Cage.

Temperature Ambient:

0°C to 50°C - operation.
-40°C to +70°C - storage.

Humidity:

Less than 95% R.H. Dimensions:
197mm high, 220mm deep, 13mm wide.
(7.5"x 8.66"x 0.8").

Dimensions, Shipping:

When ordered with a 53A-002 or 63A-012 Card Cage, the card is installed in one of the card cage's function card slots.

When ordered alone, the shipping dimensions are:
254mm x 254mm x 127mm. (10" x 10" x 5").

Weight:

0.23 kg. (0.5 lbs).

Weight, Shipping:

When ordered with a 53A-002 or 63A-012 Card Cage, the card is installed in one of the card cage's function card slots.

When ordered alone, the shipping weight is: 0.64 kg. (1.4 lbs).

Mounting Position:

Any orientation.

Mounting Location:

Plugs into the Control slot of the 53A-002 or 63A-012 Card Cage.

Equipment Supplied:

53A-171 Control Card.
Spare fuse (Part #42202-52001).
Operating Manual (Part #00000-11710).
Service Manual (Part #00000-21710).

OPERATION

OVERVIEW

The 53A-171 Card is programmed by ASCII characters issued from the system controller (calculator or computer) to the 53A/63A System communications card. The 53A-171 Card is connected to the communications card via the 53A/63A Card Cage backplane.

To address a function card for the first time, the system command "@XY" must be issued. "X" is the mainframe address (0-9) selected on the 53A-171 Card for that mainframe; "Y" is the card address (0-9) within that mainframe. The card address is selected on the address-select switch. Once a function card is addressed, it remains addressed until the system receives another "@" character. Appendix A fully discusses the "@XY" command and the other 53A/63A System commands.

Command	Description

@XY The "@XY" command addresses a control card or function card in the 53A/63A System.

The "@" is a delimiter used by the 53A/63A System. The "X" is a mainframe address (0-9); the "Y" is a function card slot address (0-9) in that mainframe. Once a mainframe and function card combination is addressed, it remains addressed until the 53A/63A System detects a new "@" character.

@XS The "@XS" (Status) command statuses all function cards within the mainframe defined by "X". The interrupt status of all cards in the addressed mainframe is latched into the 53A-171 Control Card when the "@XS" command is used. All function cards in all mainframes become unaddressed after the "@XS" command.

This command is used to test for interrupts within a mainframe.

The @X characters are defined above.

The Status command affects only the function cards in the mainframe defined by "X".

To test for interrupts, the system controller (calculator or computer) would output "@XS" to the 53A/63A System and then go to input. The system controller would receive these ASCII characters from the 53A/63A System. These ASCII characters have the following meaning:

?

The question mark, input to the system controller from the 53A/63A system, would mean that there has been a power-down since the last time interrupts were tested.

0, 1, 2, 3, 4, 5, 6, 7, 8, or 9

The integers, 0 through 9, input to the system controller from the 53A/63A System, are the addresses of the interrupting function cards.

:

The colon, input to the system controller from the 53A/63A System, will follow the integers 0 through 9 and indicates to the user's application program that all interrupts have been reported.

Each of the above characters input by the system controller will be followed by a carriage-return and line-feed <CR/LF>. This allows the characters to be input and tested, by the application program, one character at a time. This avoids the application program having to read 11 characters as a data block and then take the data block apart.

Example - Assume function cards with addresses 5 and 7 have caused an interrupt in the mainframe with address 9. The user's application program would test for an interrupt by outputting "@ØS" to the 53A/63A System. The system controller would request input and receive "?", indicating that this is the first test for interrupt since the system was powered-up. This, of course, could indicate an unexpected power failure.

The system controller would again request input and receive an ASCII "5" indicating that address 5 interrupted. The user could, at this time, break off and service interrupt 5 or could continue checking the interrupts.

Note: The interrupts will be returned 0 through 9 which provides a priority scheme.

The system controller would again request input and receive an ASCII "7" indicating that address 7 interrupted.

The system controller would again request input and receive and ASCII ":" character, indicating that there were no other interrupts.

The colon will continue to be sent back to the system controller for as long as the system controller requests input. To again test for interrupts a new "@XS" command be must issued.

@XH The "@XH" (Halt) command halts all function cards within the mainframe defined by "X". The command does not affect function cards in other mainframes. How a function card reacts to the "@XH" command depends on the card. In all cases, an addressed function card (power LED out) becomes unaddressed (power LED lit).

STOP The STOP command is not a string of ASCII characters. The command is hard-wired from the system controller (calculator or computer) to the 53A/63A System communications card in each mainframe.

When the system controller issues a STOP command, each function card, including the 53A-171 Card, reacts as if it received the "@XH" command described above.

How the system controller executes the STOP command depends on the communications card used. With the 53A-127 IEEE-488 Card, for example, a

STOP command is executed when the system controller asserts the IEEE-488 bus line IFC (Interface Clear) true.

BINARY The BINARY command is not a string of ASCII characters. The command is hard-wired from the system controller (calculator or computer) to the 53A/63A System communications card in each mainframe.

The BINARY command cause the 53A-171 Card to ignore all ASCII commands sent to it. This prevents the selection of a new address even if an "@" character is transmitted.

The BINARY command is normally used when the programmer wants to output ASCII or binary data which may contain an "@" character.

For information on how to issue this command, consult the operating manual for the particular 53A/63A System communications card and, in some cases, function cards being used.

Table I - LED ASSIGNMENTS

T1	Timing LED	lit when true
T2	Timing LED	lit when true
T4	Timing LED	lit when true
T8	Timing LED	lit when true
B0	Data LED	lit when true
B1	Data LED	lit when true
B2	Data LED	lit when true
B3	Data LED	lit when true
B4	Data LED	lit when true
B5	Data LED	lit when true
B6	Data LED	lit when true
B7	Data LED	lit when true
CT	Control LED	lit when true
FL	Flag LED	lit when true*
I/O	I/O LED	lit for input
BI	Binary LED	lit when true
ST	Stop LED	lit when true
S1	State LED	lit when true
S2	State LED	lit when true
S4	State LED	lit when true

* FLAG* is such a short pulse that it normally cannot be observed on the Flag LED. A pulse-stretching circuit has been included to make the Flag LED visible. However, if FLAG* remains true, the Flag LED remains lit.

INSTALLATION

The 53A-171 Control Card must be plugged into the BLACK mainframe card slot marked "Control."

CAUTION

Do not plug the card in backwards. Observe the following:

a. Match the keyed slot on the card to the key in the backplane connector (the component side should be to the right).

b. There are two ejectors on the card. Make sure the ejector marked "53A-171" is at the top.

APPENDIX A

SYSTEM COMMANDS

Command	Description

@XY The "@XY" command addresses a function card in the 53A/63A System.

The "@" is a delimiter used by the 53A/63A System. The "X" is a mainframe address (0-9); the "Y" is a function card slot address (0-9) in that mainframe. Once a mainframe and function card combination is addressed, it remains addressed until the 53A/63A System detects a new "@" character.

@XS The "@XS" (Status) command statuses all function cards within the mainframe defined by "X". The interrupt status of all cards in the addressed mainframe is latched into the 53A-171 Control Card when the "@XS" command is used. All function cards in all mainframes become unaddressed after the "@XS" command.

This command is used to test for interrupts within a mainframe.

The @X characters are defined above.

The Status command affects only the function cards in the mainframe defined by "X".

To test for interrupts the system controller (calculator or computer) would output "@XS" to the 53A/63A System and then go to input. The system controller would receive from the 53A/63A System, ASCII characters which have the following meaning:

?

The question mark, input by the system controller from the 53A/63A system, would mean that there has been a power-down since the last time interrupts were tested.

0, 1, 2, 3, 4, 5, 6, 7, 8, or 9

The integers, 0 through 9, input by the system controller from the 53A/63A System, are the addresses of the function cards interrupting.

:

The colon, input by the system controller from the 53A/63A System, will follow the integers 0 through 9 and indicates to the user's application program that all interrupts have been reported.

Each of the above characters input by the system controller will be followed by a carriage-return and line-feed <CR-LF>. This allows the characters to be input and tested, by the application program, one character at a time. This avoids the application program having to read 11 characters as a data block and then take the data block apart.

Example - Assume function cards with addresses 5 and 7 have caused an interrupt in the mainframe with address 9. The user's application program would test for an interrupt by outputting "@0S" to the 53A/63A System. The system controller would request input and receive "?" indicating that this is the first test for interrupt since the system was powered-up. This, of course, could indicate an unexpected power failure.

The system controller would again request input and receive an ASCII "5" indicating that address 5 interrupted. The user could, at this time, break off and service interrupt 5 or could continue checking the interrupts.

Note: The interrupts will be returned 0 through 9 which provides a priority scheme.

The system controller would again request input and receive an ASCII "7" indicating that address 7 interrupted.

The system controller would again request input and receive and ASCII ":" character, indicating that there were no other interrupts.

The colon will continue to be sent back to the system controller for as long as the system controller requests input. To again test for interrupts a new "@XS" command be must issued.

@XH The "@XH" (Halt) command halts all function cards within the mainframe defined by "X". The command does not affect function cards in other mainframes. How a function card reacts to the "@XH" command depends on the card. In all cases, an addressed function card (power LED out) becomes unaddressed (power LED lit).

STOP The STOP command is not a string of ASCII characters. The command is hard-wired from the system controller (calculator or computer) to the 53A/63A System communications card in each mainframe.

When the system controller issues a STOP command, each function card, including the 53A-171 Card, reacts as if it received the "@XH" command described above.

How the system controller executes the STOP command depends on the communications card used. With the 53A-127 IEEE-488 Card, for example, a STOP command is executed when the system controller asserts the IEEE-488 bus line IFC (Interface Clear) true.

BINARY The BINARY command is not a string of ASCII characters. The command is hard-wired from the system controller (calculator or computer) to the 53A/63A System communications card in each mainframe.

The BINARY command causes the 53A-171 Card to ignore all ASCII commands sent to it. This, therefore, prevents the selection of a new address even if an "@" character is transmitted.

The BINARY command is normally used when the programmer wants to output ASCII or binary data which may contain an "@" character.

For information on how to issue this command, consult the operating manual for the particular 53A/63A System communications card and, in some cases, function cards being used.

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