# 53A-416 HIGH-VOLTAGE OPEN-COLLECTOR DISCRETE OUTPUT CARD

# OPERATING MANUAL

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## DISCRETE OUTPUT CARD

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# 53A-416 OPEN-COLLECTOR DISCRETE OUTPUT CARD

## DESCRIPTION

The 53A-416 Open-Collector Discrete Output Card is a printed circuit board assembly for use in a CDS 53/63 Series System. The card enables the 53/63 System to control up to forty independent open-collector output lines on each 53A-416 card. The output lines may be independently set high or low by transmitting ASCII characters from the system controller to the 53/63 Series card cage. All forty output lines may also be set simultaneously to any random pattern using the card's parallel load feature.

Each output line can be pulled-up to either an on-card +5 V bus or an external user supplied voltage (0 to +30 V) using an on-card 10 K ohm pull-up resistor. The pull-up resistors are contained in 16 pin DIP packages that are socket mounted for user removal or value change, if desired.

On-card LED indicators provide an indication of the state of each output line (High or Low).

## CONTROLS AND INDICATORS

The following controls and indicators are provided to display and select the functions of the 53A-416 Card's operating environment.

### Address Select Switch
The 53A-416 Card has a miniature 10-position switch that selects the 53A-416 Card's address (0-9) in the 53/63 Series System. Open the switch's cover and use a screwdriver with a narrow, flat blade to turn the cam-action wiper to the desired address position.

### Power LED
The Power LED provides a valuable diagnostic tool by giving the system programmer a visual indication of the action which the system is currently taking. Whenever the 53A-416 Card is addressed by the system controller, the Power LED goes out. The LED remains out until another function card is addressed. Since only one function card can be addressed at a time, an unlit Power LED indicates the function card with which the system controller is currently communicating. The Power LED being lit not only indicates that the 53A-416 Card is unaddressed, but that all required dc power (5 V dc) is being supplied.

### Fuse
The fuse on the 5 volt power bus protects the system from overload conditions. If the fuse has blown, the Power LED will not light.

### Pull-up Resistors
As received from the factory, each output line is pulled-up to +5 V through an on-card 10 K ohm pull-up resistor. The pull-up resistors are contained in 16 pin DIP packages that are socket mounted for removal or value change. If desired, the pull-up resistors can be pulled up to an external user-supplied voltage (0 to +30 V) by using front edge connector pins 1 and A.

If an external pull-up voltage is to be used, the zero ohm resistor connecting the common side of all pull-up resistors to on-card +5 V power must first be removed. The zero ohm resistor, labeled +5 V Pull-Up Resistor, is located directly below the Power LED and in front of the Range LEDs.

**CAUTION:**
> Failure to remove the zero ohm resistor prior to applying a pull-up voltage to front edge connector pins 1 and A will result in damage to the 53A-416 Card.

## Function LEDS and Switches

### Range LEDs (0, 10, 20, 30)
One of the four Range LEDs will be lit to display the range of the Units' LEDs. The Range LEDs will step each time the Step switch is depressed.

### Units' LEDs (0 through 9)
The Range and Units' LEDs together are used to display the state of any output control line.

### Example:
> The output control lines are numbered 0 through 39. To view the state of Line 27, depress the Step switch until Range LED 2 is lit. Now the Units' LEDs are displaying Lines 20 through 29. If Units' LED 7 was lit, this would indicate that Line 27 was high.

### Halt Switch
This slide switch is located near the card's backplane edge connector. It selects the state of the 53A-416 Card after an @XH (Halt) or STOP command is received by the 53/63 Series System.

a.   In position C2, all output lines will be set to the Low state when a HALT command or STOP is received.

b.   In position C1, all output lines will Hold their present state after a HALT command or STOP has been received.

### Step Switch
You can view the state of any output control line (0-39) on the card's Range LEDs by stepping through the four output decades (0, 10, 20, 30) using the Step switch.

# SPECIFICATIONS

**Output Control Lines:**
Capacity: 40 high-voltage, open-collector outputs
Output Driver: SN7407
Max. sink current ($I_{OL}$): 40 mA
Max. source current ($I_{OH}$): 250 $\mu$A
Max. high-level output voltage ($V_{OH}$): 30 V

**Power Requirements:**
5-volt dc power is provided by the internal Power Supply in the 53/63 Series card cage.

**Voltage:**
4.75V to 5.25V DC.

**Current:**
0.75 amperes, maximum quiescent.
0.90 amperes, peak.

**Cooling:**
Provided by the fan in the 53/63 Series Card Cage.

**Temperature:**
-10°C to +65°C, operating (assumes ambient temperature of 55° and airflow to assure less than 10°C temperature rise).
-40°C to +85°C, storage.

**Humidity:**
Less than 95% R.H. noncondensing, -10°C to +30°C.
Less than 75% R.H. non-condensing, +31°C to +40°C.
Less than 45% R.H. non-condensing, +41°C to +55°C.

**Dimensions:**
197mm High, 220mm Deep, 13mm Wide.
(7.75" x 8.66" x 0.5")

**Dimensions, Shipping:**
When ordered with a 53/63 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:**
0.28 Kg.   (0.6 lbs)

**Weight, Shipping:**
When ordered with a 53/63 card cage, the card is installed in one of the card cage's function-card slots.

When ordered alone, the shipping weight is:
0.69 Kg.   (1.5 lbs.)

**Mounting Position:**
Any orientation.

**Mounting Location:**
Installs in any function-card slot of the 53/63 Series card cage.

**Required Equipment:**
53A-780 Hooded Connector or 53A-742 Data Cable.

<u>Equipment Supplied</u>:      53A-416 Open-Collector Discrete Output Card.
Spare fuse (Part #42202-52001)
Operating Manual (Part #00000-14160)
Service Manual (Part #00000-24160)

## OPERATION

The Open-Collector Discrete Output Card is programmed by ASCII characters issued from the system controller to the 53/63 Series System Communications Card. The card is interfaced to the communications card through the 53 Series or 63 Series card cage's backplane.

To address a function card for the first time, the system command @XY must be issued. X is the card cage address (0-9) selected on the 53A-171 Control Card in the addressed card cage; Y is the 53A-416 Card's address (0-9) within the addressed card cage. The 53A-416 Card's address is selected using the card's 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 53/63 Series System commands. After the 53A-416 Card is addressed, the commands listed below may be issued until another function card is addressed.

| Command | Action |
|---------|--------|
| $HZ_1Z_2S$ | |
| $LZ_1Z_2S$ | This command allows the system controller to set an individual output control line to either a High or Low output state. |

The "L" or "H" in the command sequence sets the output line defined by $Z_1Z_2$ to either the Low or High output state.

$Z_1Z_2$ represents a decimal number (0 to 39) which defines the output line to be set either Low or High.

The S in the command sequence strobes the indicated line High or Low.

Example:

The command sequence @14H1SH30SL9S would set output lines 1 and 30 High and 9 Low. In this example it was assumed that the Discrete Output Card had address 4 and was located in a card cage with address 1.

  Status:  Power LED - out.

$@XYZ_{10}...Z_1S$

The Parallel Strobe Command is used to randomly set High or Low all output lines simultaneously.

The $Z_{10}...Z_1$ characters represent ten ASCII characters which are converted to BCD format for output (See Table III). When the PARALLEL LOAD Command is used, all 10 characters must be output.

The S in the command sequence strobes the decimal data to the output lines.

Example:

The command sequence @049?76543211S will cause the Discrete Output Card
to parallel load the outputs with 9?76543210. To understand what output
control lines will be set High or Low by this command, refer to Tables II
and III. For example, referring to Tables II and III, the character 9, position
Z10, would cause the output control lines number 39 and 9 to be set high, the
character ?, position Z9, causes the output control line numbers 8, 18, 28 and
38 to be set High, etc.

Status: Power LED - out.

In this example, it was assumed that the Discrete Output Card had address
4 and was located in a card cage with address 0.

| Command | Action |
|---|---|
| @XYR | The Reset command is used to set all output control lines Low. |

Example:

The command sequence @04R will set all output control lines Low. All unit
LEDs will be out. In this example, it was assumed that the Discrete Output
Card had address 4 and was located in the card cage with address 0.

## TABLE I

### Pin Assignments - Discrete Output Control Lines

| Discrete Output Control Line | Output Connector Pin | Equivalent BCD Output Pin |
|---|---|---|
| 0 | 11 | $Z_1$ - B1 |
| 1 | 10 | $Z_2$ - B1 |
| 2 | 9 | $Z_3$ - B1 |
| 3 | 8 | $Z_4$ - B1 |
| 4 | 7 | $Z_5$ - B1 |
| 5 | 6 | $Z_6$ - B1 |
| 6 | 5 | $Z_7$ - B1 |
| 7 | 4 | $Z_8$ - B1 |
| 8 | 3 | $Z_9$ - B1 |
| 9 | 2 | $Z_{10}$ - B1 |
| 10 | M | $Z_1$ - B2 |
| 11 | L | $Z_2$ - B2 |
| 12 | K | $Z_3$ - B2 |
| 13 | J | $Z_4$ - B2 |
| 14 | H | $Z_5$ - B2 |
| 15 | F | $Z_6$ - B2 |
| 16 | E | $Z_7$ - B2 |
| 17 | D | $Z_8$ - B2 |
| 18 | C | $Z_9$ - B2 |
| 19 | B | $Z_{10}$ - B2 |
| 20 | 21 | $Z_1$ - B4 |
| 21 | 20 | $Z_2$ - B4 |
| 22 | 19 | $Z_3$ - B4 |
| 23 | 18 | $Z_4$ - B4 |
| 24 | 17 | $Z_5$ - B4 |
| 25 | 16 | $Z_6$ - B4 |
| 26 | 15 | $Z_7$ - B4 |
| 27 | 14 | $Z_8$ - B4 |
| 28 | 13 | $Z_9$ - B4 |
| 29 | 12 | $Z_{10}$ - B4 |
| 30 | Y | $Z_1$ - B8 |
| 31 | X | $Z_2$ - B8 |
| 32 | W | $Z_3$ - B8 |
| 33 | V | $Z_4$ - B8 |
| 34 | U | $Z_5$ - B8 |
| 35 | T | $Z_6$ - B8 |
| 36 | S | $Z_7$ - B8 |
| 37 | R | $Z_8$ - B8 |
| 38 | P | $Z_9$ - B8 |
| 39 | N | $Z_{10}$ - B8 |
| External Pull-Up Voltage Inputs | A,1 | |
| Ground Return | 22,23,24 Z,AA,BB | |

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TABLE II

*Pin Assignments - BCD*

| Digit | BCD BIT (See Table III) | Output Connector Pin | Equivalent Discrete Output Control Line |
|---|---|---|---|
| $Z_1$ | 1 | 11 | 0 |
|  | 2 | M | 10 |
|  | 4 | 21 | 20 |
|  | 8 | Y | 30 |
| $Z_2$ | 1 | 10 | 1 |
|  | 2 | L | 11 |
|  | 4 | 20 | 21 |
|  | 8 | X | 31 |
| $Z_3$ | 1 | 9 | 2 |
|  | 2 | K | 12 |
|  | 4 | 19 | 22 |
|  | 8 | W | 32 |
| $Z_4$ | 1 | 8 | 3 |
|  | 2 | J | 13 |
|  | 4 | 18 | 23 |
|  | 8 | V | 33 |
| $Z_5$ | 1 | 7 | 4 |
|  | 2 | H | 14 |
|  | 4 | 17 | 24 |
|  | 8 | U | 34 |
| $Z_6$ | 1 | 6 | 5 |
|  | 2 | F | 15 |
|  | 4 | 16 | 25 |
|  | 8 | T | 35 |
| $Z_7$ | 1 | 5 | 6 |
|  | 2 | E | 16 |
|  | 4 | 15 | 26 |
|  | 8 | S | 36 |
| $Z_8$ | 1 | 4 | 7 |
|  | 2 | D | 17 |
|  | 4 | 14 | 27 |
|  | 8 | R | 37 |
| $Z_9$ | 1 | 3 | 8 |
|  | 2 | C | 18 |
|  | 4 | 13 | 28 |
|  | 8 | P | 38 |
| $Z_{10}$ | 1 | 2 | 9 |
|  | 2 | B | 19 |
|  | 4 | 12 | 29 |
|  | 8 | N | 39 |
| External Pull-Up Voltage Inputs |  | 1,A |  |
| Ground Return |  | 22,23,24 |  |
| Ground Return |  | Z,AA,BB |  |

## TABLE III

### Parallel Load

| ASCII Character | BCD Bit Controlled |
|---|---|
| (Output from system controller) | (See Table II) |
| | BCD Bit Position |
| | 8 4 2 1 |
| 0 | 0 0 0 0 |
| 1 | 0 0 0 1 |
| 2 | 0 0 1 0 |
| 3 | 0 0 1 1 |
| 4 | 0 1 0 0 |
| 5 | 0 1 0 1 |
| 6 | 0 1 1 0 |
| 7 | 0 1 1 1 |
| 8 | 1 0 0 0 |
| 9 | 1 0 0 1 |
| : | 1 0 1 0 |
| ; | 1 0 1 1 |
| < | 1 1 0 0 |
| = | 1 1 0 1 |
| > | 1 1 1 0 |
| ? | 1 1 1 1 |

Legend:  1 = Output set High
         0 = Output set Low

# INSTALLATION

The 53A-416 Card is a function card; therefore, it may be plugged into any <u>blue</u> card slot. Setting the Address Select switch defines the card's programming address. To avoid confusion, it is recommended that the slot number and the programming address be the same.

CAUTION:
    To avoid plugging 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 <u>right</u> for a 53 Series Chassis and to the <u>top</u> for a 63 Series Chassis).

      b.     There are two ejectors on the card. Make sure the ejector marked "53A-416" is at the <u>top</u> for a 53 Series Chassis and to the <u>left</u> for a 63 Series Chassis.

CAUTION:
    The 53A-416 Card is a piece of electronic equipment and therefore has some susceptibility to electrostatic damage (ESD). ESD precautions must be taken whenever the module is handled.

# APPENDIX A

## 53/63 SERIES SYSTEM COMMANDS

| Command | Description |
| --- | --- |

**Command**

**Description**

@XY — The @XY (Address) command addresses a function card in the 53/63 Series System.

@ is a delimiter used by the 53/63 Series System.

X is a card cage address (0-9) defined by the address-select switch on the 53A-171 Control Card in the addressed card cage.

Y is a function-card address (0-9) defined by the address-select switch on the function card. Once a card cage/ function-card combination is addressed, it remains addressed until the 53/63 Series System detects a new @ character.

@XH — The @XH (Halt) command halts all function cards within the card cage defined by X. This command does not affect function cards in other card cages. How a function card reacts to the @XH command depends on the particular card. The HALT Command H effects only the function cards in the card cage defined by X. The effect of the HALT Command on the Discrete Output Card is determined by the card's Halt switch. 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. This command is hard-wired from the system controller to the 53/63 System's communications card in each card cage. When the system controller issues a STOP command, each function card (including the 53A-416 Card) reacts as if it had received the @XH command described above.

How the system controller executes a STOP command depends on the communications card used. For example, when using the 53A-128 IEEE-488 Communications Card, a STOP command is executed whenever the system controller asserts the IEEE-488 bus line IFC (Interface Clear) true.

# APPENDIX B

## INPUT/OUTPUT CONNECTIONS

| Discrete Output Control Line | Output Connector Pin |
|---|---|
| 0 | 11 |
| 1 | 10 |
| 2 | 9 |
| 3 | 8 |
| 4 | 7 |
| 5 | 6 |
| 6 | 5 |
| 7 | 4 |
| 8 | 3 |
| 9 | 2 |
| 10 | M |
| 11 | L |
| 12 | K |
| 13 | J |
| 14 | H |
| 15 | F |
| 16 | E |
| 17 | D |
| 18 | C |
| 19 | B |
| 20 | 21 |
| 21 | 20 |
| 22 | 19 |
| 23 | 18 |
| 24 | 17 |
| 25 | 16 |
| 26 | 15 |
| 27 | 14 |
| 28 | 13 |
| 29 | 12 |
| 30 | Y |
| 31 | X |
| 32 | W |
| 33 | V |
| 34 | U |
| 35 | T |
| 36 | S |
| 37 | R |
| 38 | P |
| 39 | N |

## SAMPLE BASIC PROGRAM FOR THE 53A-416

The sample program below is written in Advanced BASIC (BASICA) for an IBM PC. The PC is connected to the CDS 53/63 Series Card Cage using a 53A-903 Card installed in the PC. The 53A-903 I/O Card provides an IEEE-488 interface between the PC and the CDS Card Cage. The 53A-416 Card has been set to address 9. The address of the 53/63 Card Cage containing the 53A-416 Card is address 1.

The following sample program first sets all output lines high using the Parallel Load command, and then sets all lines low using the Reset command. Finally, output control lines 12 and 28 are set high.

For this program, PCX is a variable containing the IEEE-488 address of the CDS 53/63 Series Card CAge and GPIB0 is a variable containing the IEEE-488 address of the 53A-903 I/O card. The 53A-903 commands used in this program are:

IBFIND, IBINIT1, IBINIT2, IBLOAD

    These commands load and initialize the software drivers for the 53A-903 card in the PC. The drivers are loaded from the software disk supplied with the 53A-903.

IBSIC    Resets the IEEE-488 interface, setting the interface IFC line true for 100 microseconds.

IBTMO    Defines the PC timeout for I/O operations to the 53A-903.

IBWRT    Writes the contents of a string variable to the 53/63 Series Card Cage.

IBRD    Reads data bytes from the 53/63 Series Card Cage and stores them in string variables. Note that the variable must first be filled with space characters equal to the maximum number of data bytes to be read.

### Sample BASIC Program

In this program listing, lines which are indented and not preceded by a line number are not part of the BASIC program. They are inserted here as comments to explain what the program is doing at each numbered line.

*NOTE:*    Lines 1 through 50 are included in the program to initialize the 53A-903 IEEE-488 interface card in the PC.

1    CLEAR ,60000!

2    IBINIT1 = 60000!

```
3       IBINIT2 = IBINIT1 + 3

4       IBLOAD "BIB.M",IBINIT1:KEY OFF

5       CALL IBINIT1(IBFIND,IBTRG,IBCLR,IBPCT,IBSIC,IBLOC,IBPPC,IBBNA,
        IBONL,IBRSC,IBSRE,IBRSV,IBPAD,IBSAD,IBIST,IBDMA,IBEOS,IBTMO,IBEOT,
        IBRDF,IBWRTF)

6       CALL  IBINIT2(IBGTS,IBCAC,IBWAIT,IBPOKE,IBWRT,IBWRTA,IBCMD,
        IBCMDA,IBRD,IBRDA,IBSTOP,IBRPP,IBRSP,IBDIAG,IBXTRC,IBRDI,IBWRTI,
        IBRDIA,IBWRTIA, IBSTA%,IBERR%,IBCNT%)

10      BDNAME$="PCX":CALL IBFIND (BDNAME$,PCX%)
            Find the IEEE-488 devices.

20      BDNAME$="GPIB0":CALL IBFIND(BDNAME$,GPIB0%)

30      CALL IBSIC(GPIB0%)
            Reset the IEEE-488 devices.

40      TIMEOUT%=0
            Disable the IEEE-488 device timeouts.

50      CALL IBTMO(PCX%,TIMEOUT%):CALL IBTMO(GPIB0%,TIMEOUT%)

60      WRT$="@19??????????S":CALL IBWRT(PCX%,WRT$)
            Initially address the card cage and the 53A-416 card, then set all output lines
            high with the Parallel Load command.

70      WRT$="R":CALL IBWRT(PCX%,WRT$)
            Reset all output lines of the 53A-416 using the Reset command.

80      WRT$="H12SH28S":CALL IBWRT(PCX%,WRT$)
            Set output control lines 12 and 28 high.  To view these lines, use the Step switch
            to advance Range LEDs to "10" range.
```