

**KEITHLEY**

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**Model 220/230**  
**PROGRAMMABLE SOURCES**

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**QUICK REFERENCE GUIDE**

# **INTRODUCTION**

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The Keithley Model 220 Programmable Current Source and 230 Programmable Voltage Source are easily interfaced to common controllers using the IEEE-488 bus. These programs will set the current and voltage values using the following controllers:

HP 85; HP 9825A; HP 9845B; APPLE II (APPLE Interface); PET/CBM 2001; TEK 4052; IBM PC or XT Personal Computer, E-H 7000 Computer.

The programs accept a numeric input from the controller keyboard, program the Model 220 for autoranging and continuous operation, and set the instrument output to the values entered. All other parameters remain unchanged, but may be altered by including another input string variable. Programming for Model 230 follows the same format with only minor modifications as explained in a note at the end of each example.

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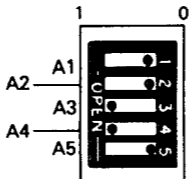
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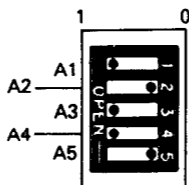
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### Model 220 Primary Address Switches



### Model 230 Primary Address Switches



## MODEL 220 PROGRAM CODES

<b>DISPLAY:</b>	D0 = Source D1 = Voltage Limit D2 = Dwell Time D3 = Memory Location
<b>FUNCTION:</b>	F0 = Standby 1. Set output current to zero on 2nA range. 2. Reduce voltage limit to less than 32V, 1V minimum. F1 = Operate Set output to value in memory location.
<b>PREFIX: (NDCI, V, W, B, L, I/O)</b>	G0 = Location with prefix is transmitted. NDCI + n.nnnnE + n, V + n.nn00E + n, W + n.nnnnE + n, L + n.nn00E + n G1 = Location without prefix is transmitted. + n.nnnnE + n, + n.nn00E + n, + n.nnnnE + n, + n.nn00E + n G2 = Buffer address with prefix is transmitted. NDCI + n.nnnnE + n, V + n.nn00E + n, W + n.nnnnE + n, B + n.nn00E + n G3 = Buffer address without prefix is transmitted. + n.nnnnE + n, + n.nn00E + n, + n.nnnnE + n, + n.nn00E + n G4 = Full buffer with prefix is transmitted. NDCI + n.nnnnE + n, V + n.nn00E + n, W + n.nnnnE + n, B + 1.0000E + 0, NDCI + n.nnnnE + n, V + n.nn00E + n, W + n.nnnnE + n, B + 2.0000E + 0, NDCI + n.nnnnE + n, V + n.nn00E + n, W + n.nnnnE + n, B + 3.0000E + 0,... NDCI + n.nnnnE + n, V + n.nn00E + n, W + n.nnnnE + n, B + 1.0000E + 2 G5 = Full buffer without prefix is transmitted. + n.nnnnE + n, + n.nn00E + n, + n.nnnnE + n, + 1.0000E + 0, + n.nnnnE + n, + n.nn00E + n, + n.nnnnE + n, + 2.0000E + 0 + n.nnnnE + n, + n.nn00E + n, + n.nnnnE + n, + 3.0000E + 0,... + n.nnnnE + n, + n.nn00E + n, + n.nnnnE + n, + 1.0000E + 2 NDCI + n.nnnnE + n for current V + n.nn00E + n for voltage limit

W + n.nnnnE + n for dwell time  
 B + n.nn00E + n for buffer address (IEEE  
 buffer)  
 L + n.nn00E + n for memory location  
 (display)  
 "N" is replaced with "0" if over voltage  
 condition exists.

Status Word: G0, G2, G4 status word with prefix  
 transmitted: 2200000020600:

G1, G3, G5 status word without  
 prefix transmitted: 0000020600:

I/O Status: G0, G2, G4 I/O status with prefix  
 transmitted: I/Oii,oo

G1, G3, G5 I/O status without prefix  
 transmitted: ii,oo

where i is the input from 0 to 15;  
 where o is the output from 0 to 15.

**EOI:** K0 = EOI transmitted on last byte out.  
 K1 = EOI is not transmitted.

**SRQ:** Mnn: nn = 0 to 31 base, 10 or  
 00000 to 11111 base 2.  
 0 = bit disabled  
 1 = bit enabled

Bits: SRQ mask

MSB7: N/A

6: N/A

5: N/A

4: Input Port Change

3: End of Dwell Time

2: End of Buffer

1: Over Voltage Limit

0: IDDC, IDDCo or -- REN (nor Remote)

<b>SRQ BYTE:</b>	<b>BITS: DATA</b>	<b>ERROR</b>
	MSB7 N/A	N/A
	6 SRQ	SRQ
	5 Data = 0	Error = 1
	4 N/A	N/A
	3 Input Port Change	N/A
	2 End of Dwell Time	--REN (No Remote)
	1 End of Buffer	IDDCO
	0 Over Voltage Limit	IDDC

**PROGRAM MODE:** P0 = Single  
 P1 = Continuous  
 P2 = Step

**RANGES:** R0 = Auto Range (force most significant number)  
 R1 = Full scale: 2 nA 2.0E-9 (preserve  
 R2 = 20 nA 2.0E-8 significance)  
 R3 = 200 nA 2.0E-7  
 R4 = 2  $\mu$ A 2.0E-6  
 R5 = 20  $\mu$ A 2.0E-5  
 R6 = 200  $\mu$ A 2.0E-4  
 R7 = 2mA 2.0E-3  
 R8 = 20mA 2.0E-2  
 R9 = 200mA 2.0E-1

**TRIGGER MODES:** T0 = Start on Talk  
 T1 = Stop on Talk  
 T2 = Start on Get  
 T3 = Stop on Get  
 T4 = Start on "X"  
 T5 = Stop on "X"  
 T6 = Start on External  
 T7 = Stop on External

#### IEEE TERMINATOR

**CHARACTER:** Yc = The (ASCII) byte contains an ASCII character which will be used as the terminator for all data until changed. The power up default is (CR) (LF). [NOTE: ASCII (DEL) indicates no terminator, ASCII (LF) indicates (CR)(LF), and ASCII (CR) indicates (LF) (CR).]

Terminators not allowed: All capital letters; all numbers; (blank); + - / , . e

**INPUTS:** I(sign)n.nnnE(sign)nn  
 Current source output value  
 Limits: 0 to 101.00mA  
 V(sign)n.nnnnE(sign)nn  
 Voltage limit  
 Limits: 1 to 105V  
 W(sign)n.nnnE(sign)nn  
 Dwell time  
 Limits: 0 to 999.9sec (1msec steps)  
 B(sign)n.nnnnE(sign)nn

Buffer address (IEEE buffer)

Limits: 1 to 100

L(sign)n.nnnnE(sign)nn

Memory location (display)

Limits: 1 to 100

**I/O PORT:**

On.nnnnEnn

Set control bits on "X"

n = 0 to 16 base 10 or

0000 to 1111 base 2

if 0 then bit low

if 1 then bit high

**OUTPUT STATUS STRING**

**ON TALK:**

U0 = Output status word on next read.

Format: 2 3 0 D F G J K P R T M Y

Default: 2 3 0 0 0 0 0 0 2 0 6 0 0 :

J is cleared to 0 after status word is read.

U1 = Output I/O status on next read.

Read input on X only.

I/O<sub>i,oo</sub> = I/O status

where i is the input from 0 to 15.

where o is the output from 0 to 15.

**DEBUGGING:**

J0 = ROM and LED test

Sets power up status byte, J to 1 in the status string.

## MODEL 230 PROGRAM CODES

<b>DISPLAY:</b>	D0 = Source
	D1 = Current Limit
	D2 = Dwell Time
	D3 = Memory Location
<b>FUNCTION:</b>	F0 = Standby Set output voltage to zero.
	F1 = Operate Set output to value in memory location.
<b>PREFIX: (NDCI, V, W, B, L, I/O)</b>	G0 = Location with prefix is transmitted. NDCV + n.nnnnE + n, I + n.nn00E + n, W + n.nnnnE + n, L + n.nn00E + n
	G1 = Location without prefix is transmitted. + n.nnnnE + n, + n.nn00E + n, + n.nnnnE + n, + n.nn00E + n
	G2 = Buffer address with prefix is transmitted. NDCV + n.nnnnE + n, I + n.nn00E + n, W + n.nnnnE + n, B + n.nn00E + n
	G3 = Buffer address without prefix is transmitted. + n.nnnnE + n, + n.nn00E + n, + n.nnnnE + n, + n.nn00E + n
	G4 = Full buffer with prefix is transmitted. NDCV + n.nnnnE + n, I + n.nn00E + n, W + n.nnnnE + n, B + 1.0000E + 0, NDCV + n.nnnnE + n, I + n.nn00E + n, W + n.nnnnE + n, B + 2.0000E + 0, NDCV + n.nnnnE + n, I + n.nn00E + n, W + n.nnnnE + n, B + 3.0000E + 0,... NDCV + n.nnnnE + n, I + n.nn00E + n, W + n.nnnnE + n, B + 1.0000E + 2
	G5 = Full buffer without prefix is transmitted. + n.nnnnE + n, + n.nn00E + n, + n.nnnnE + n, + 1.0000E + 0, + n.nnnnE + n, + n.nn00E + n, + n.nnnnE + n, + 2.0000E + 0, + n.nnnnE + n, + n.nn00E + n, + n.nnnnE + n, + 3.0000E + 0,... + n.nnnnE + n, + n.nn00E + n, + n.nnnnE + n, + 1.0000E + 2 NDCV + n.nnnnE + n for voltage I + n.nn00E + n for current limit W + n.nnnnE + n for dwell time B + n.nn00E + n for buffer address (IEEE buffer)



L + n.nn00E + n for memory location  
(display)

"N" is replaced with "0" if over current  
condition exists.

Status Word: G0, G2, G4 status word with prefix  
transmitted: 2300000020600:  
G1, G3, G5 status word without prefix  
transmitted: 0000020600:

I/O Status: G0, G2, G4 I/O status with prefix  
transmitted: I/Oii,oo  
G1, G3, G5 I/O status without prefix  
transmitted: ii,oo  
where i is the input from 0 to 15;  
where o is the output from 0 to 15.

EOI: K0 = EOI transmitted on last byte out.  
K1 = EOI is not transmitted.

SRQ: Mnn: nn = 0 to 31 base 10, or  
0000 to 1111 base 2.  
0 = bit disabled  
1 = bit enabled  
Bits: SRQ mask  
MSB7: N/A  
6: N/A  
5: N/A  
4: Input Port Change  
3: End of Dwell Time  
2: End of Buffer  
1: Over Current Limit  
0: IDDC, IDDCo or -REN (no Remote)

SRQ BYTE:	BITS	DATA	ERROR
	MSB7	N/A	N/A
	6	SRQ	SRQ
	5	Data = 0	Error = 1
	4	N/A	N/A
	3	Input Port Change	N/A
	2	End of Dwell	-REN (No Remote)
	1	End of Buffer	IDDCO
	0	Over Current Limit	IDDC

<b>PROGRAM MODE:</b>	P0 = Single P1 = Continuous P2 = Step
<b>RANGES:</b>	R0 = Auto Range (force most significant number) R1 = Full scale: 200mV 2.0E-1 (preserve R2 = 2 V 2.0E+0 significance) R3 = 20 V 2.0E+1 R4 = 200 V 2.0E+2
<b>TRIGGER MODES:</b>	T0 = Start on Talk T1 = Stop on Talk T2 = Start on Get T3 = Stop on Get T4 = Start on "X" T5 = Stop on "X" T6 = Start on External T7 = Stop on External
<b>IEEE TERMINATOR CHARACTER</b>	Yc = The (ASCII) byte contains an ASCII character which will be used as the terminator for all data until changed. The power up default is (CR) (LF). [NOTE: ASCII (DEL) indicates no terminator, ASCII (LF) indicates (CR) (LF), and ASCII (CR) indicates (LF) (CR).]  Terminators not allowed: All capital letters; all numbers; (blank); + - / , . e
<b>INPUTS:</b>	V(sign)n.nnnnE(sign)nn Voltage source output value Limits: 0 to $\pm 101.00V$ I(sign)n.nnnnE(sign)nn Voltage limit Limits: 0 = 2mA 1 = 20mA 2 = 100mA W(Sign)n.nnnnE(sign)nn Dwell time Limits: 0 to 999.9sec (1msec steps) B(sign)n.nnnnE(sign)nn Buffer address (IEEE buffer) Limits: 1 to 100 L(sign)n.nnnnE(sign)nn

Memory location (display)  
Limits: 1 to 100

**I/O PORT:**      On.nnnnEnn  
Set control bits on "X"  
n = 0 to 16 base 10 or  
0000 to 1111 base 2  
if 0 then bit low  
if 1 then bit high

#### **OUTPUT STATUS STRING**

**ON TALK:**      U0 = Output status word on next read.  
Format: 2 2 0 D F G J K P R T M    Y  
Default: 2 2 0 0 0 0 0 2 0 6 0 0 :  
U1 = Output I/O status on next read.  
Read input on X only.  
I/Oi,oo = I/O status  
where i is the input from 0 to 15.  
where o is the output from 0 to 15.

**DEBUGGING**    J0 = ROM and LED test  
Sets power up status byte, J to 1 in the  
status string.

# PROGRAMS

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The following programs are designed to be a simple aid to the user, and are not intended to suit specific needs. Detailed information can be found in the manual and on the programming card.

## HP 85

---

This program sets up the Model 220 output according to the values entered from the HP-85 keyboard, using the 82937A GPIB interface.

### DIRECTIONS

1. Set switches on the Model 220 to addressable mode, primary address 12.
2. Connect the Model 220 to the HP 85 and HP 82937A GPIB interface.
3. Enter the program below using the END LINE key after each line.
4. Type RUN and depress the END LINE key.
5. The display will read ENTER I = .
6. To program the Model 220 to  $1\mu\text{A}$  output, type 1E-6 and depress the END LINE key.
7. The display will read ENTER V = .
8. To program the Model 220 to 20V compliance limit, type 20 and depress END LINE key.
9. The programmed change can be verified by selecting one of the front panel DISPLAY pushbuttons and reading the display value.

### PROGRAM

10 REMOTE 712

20 DISP "ENTER I ="

30 INPUT I\$

40 DISP "ENTER V ="

50 INPUT V\$

60 OUTPUT 712;"R0P1F1X",  
"I",I\$,"V",V\$"X"

0 GO TO 20

80 END

### COMMENTS

Remote enable instrument at address 12.

Enter desired current.  
(Example:  $1\mu\text{A} = 1\text{E}-6$ )

Enter desired voltage.  
(Example:  $20\text{V} = 20$ ).

Output to IEEE bus, address 12.

Repeat

End of program.

NOTE: While the program illustrates Model 220 programming over the bus, the same program may be used with the Model 230 by simply changing the bus address to 13 and entering 0, 1 or 2 (2mA, 20mA or 100mA) current compliance in response to ENTER I.

## HP 9825A

---

This program sets up the Model 220 output according to the values entered from the HP 9825 keyboard, using the 98034A HPIB interface and a 9872A extended I/O ROM.

### DIRECTIONS

1. Set switches on the Model 220 to addressable mode, primary address 12.
2. Connect the Model 220 to HP 9825A and 98034A HPIB interface.
3. Enter the program below, using the STORE key after each line.
4. Depress the RUN key.
5. The display will read: enter i = ?.
6. To program the Model 220 to 1 $\mu$ A output, type 1E-6 and depress the STORE key.
7. The display will read: enter v = ?.
8. To program the Model 220 to 20V compliance limit, type 20 and depress the STORE key.
9. The programmed change can be verified by selecting one of the front panel DISPLAY pushbuttons and reading the display value.

### PROGRAM

```
0 dim A$(20),I$(20),V$(20)
1 dev "220", 712
2 ent "enter i = ?",I$
3 ent "enter v = ?",V$
4 "220" → A$
5 wrt A$,"R0P1F1X" ' "I",
  I$,"V",V$,"X"
6 gto 2
7 end
```

### COMMENTS

```
Dimension string variables.
Define bus address 12 as 220.
Enter desired current.
(Example: 1 $\mu$ A = 1E-6).
Enter desired voltage.
(Example: 20V = 20).
Set A$ = "220".
Output to IEEE bus, address 12.
Repeat
End of program.
```

NOTE: While the program illustrates Model 220 programming over the bus, the same program may be used with the Model 230 by simply changing the bus address to 13 and entering 0, 1 or 2 (2mA, 20mA or 100mA) current compliance in response to ENTER I.

## HP 9845B

This program sets up the Model 220 output according to the values entered from the HP-9845B keyboard using the 98034A HPIB interface and an I/O ROM.

### DIRECTIONS

1. Set switches on the Model 220 to addressable mode, primary address 12.
2. Connect Model 220 to HP 9845B and 98034A interface.
3. Enter the program below using the STORE key after each line.
4. Depress the RUN key.
5. The display will read "ENTER I" in the lower left corner.
6. To program the Model 220 to  $1\mu\text{A}$  output, type 1E-6 and depress the STORE key.
7. The display will read ENTER V in the lower left hand corner.
8. To program the Model 220 to 20V compliance limit, type 20 and depress the STORE key.
9. The programmed change can be verified by selecting one of the front panel DISPLAY pushbuttons and reading the display value.

### PROGRAM

```
10 DIM I$(20), V$(20)
20 SRCE = 712
30 INPUT "ENTER I", I$
40 INPUT "ENTER V", V$
50 OUTPUT SRCE; "R0P1F1X";
  "I";I$;"V";V$;"X"
60 GO TO 30
70 END
```

### COMMENTS

```
Dimension string variables.
Define bus address 12 as SRCE.
Enter desired current.
(Example:  $1\mu\text{A} = 1\text{E}-6$ ).
Enter desired voltage.
(Example:  $20\text{V} = 20$ ).
Output to IEEE bus, address 12.
Repeat
```

NOTE: While the program illustrates Model 220 programming over the bus, the same program may be used with the Model 230 by simply changing the bus address to 13 entering 0, 1 or 2 (2mA, 20mA or 100mA) current compliance in response to ENTER I.

## APPLE II (APPLE Interface)

---

This program sets up the Model 220 output according to the values entered from the APPLE II keyboard.

### DIRECTIONS

1. Set switches on the Model 220 to addressable mode, primary address 12.
2. Connect the Model 220 to APPLE II and APPLE IEEE interface.
3. Enter the program below using the RETURN key after each line.
4. Type in RUN.
5. The display will read ENTER I.
6. To program the Model 220 to  $1\mu\text{A}$  output, type 1E-6 and depress the RETURN key.
7. The display will read ENTER V.
8. To program the Model 220 to 20V compliance limit, type 20 and depress the RETURN key.
9. The programmed change can be verified by selecting one of the front panel DISPLAY pushbuttons and reading the display value.

### PROGRAM

```
10 PRINT ENTER I
20 INPUT I$

30 PRINT ENTER V
40 INPUT V$

50 Z$ = CHR$(26)
60 PR#3
70 IN# 3
80 PRINT "RA"
90 PRINT "WT,";Z$;"R0P1F1X";
  "I";I$;"V";V$;"X"
100 PRINT "LF1"

110 PR# 0

120 IN# 0
130 GO TO 10
140 END
```

### COMMENTS

Enter desired current.  
(Example:  $1\mu\text{A} = 1\text{E}-6$ )

Enter desired voltage.  
(Example:  $20\text{V} = 20$ ).

Define Z\$ = CTRL-Z.  
Set to I/O on the IEEE bus.

Sent remote enable all.

Output to IEEE bus, address 12.

Send line feed after carriage return.

Set to I/O on the CRT & keyboard.

Repeat

End of program.

NOTE: While the program illustrates the Model 220 programming over the bus, the same program may be used with the Model 230 by simply changing the bus address to 13. Line 90 should read:

```
90 "WT-";Z$;"R0P1F1X";"I";
  I$;"V";V$;"X";
```

Enter 0, 1 or 2 (2mA, 20mA or 100mA) current compliance is response to ENTER I.

## PET/CBM 2001

---

This program sets up the Model 220 output according to the values entered from the PET/CBM 2001 keyboard.

### DIRECTIONS

1. Set switches on the Model 220 to addressable mode, primary address 12.
2. Connect Model 220 to PET/CBM 2001 IEEE interface.
3. Enter the program below using the RETURN key after each line.
4. Type RUN and depress the RETURN key.
5. The display will read ENTER I.
6. To program the Model 220 to  $1\mu\text{A}$  output, type 1E-6 and depress the RETURN key.
7. The display will read ENTER V.
8. To program the Model 220 to 20V compliance limit, type 20 and depress the RETURN key.
9. The programmed change can be verified by selecting one of the front panel DISPLAY pushbuttons and reading the display value.

### PROGRAM

```
10 OPEN 6, 12
20 INPUT "ENTER I"; I$
30 INPUT "ENTER V"; V$
40 PRINT #6, "R0P1F1X", "I",
    I$, "V", V$, "X"
50 GOTO 20
60 END
```

### COMMENTS

```
Open file 6, primary address 12.
Enter desired current.
(Example:  $1\mu\text{A} = 1\text{E}-6$ )
Enter desired voltage.
(Example:  $20\text{V} = 20$ )
Output to IEEE-488 bus, address 12.
Repeat
End of program.
```

NOTE: While the program illustrates Model 220 programming over the bus, the same program may be used with the Model 230 by simply changing the bus address to 13 and entering 0, 1 or 2 (2mA, 20mA or 100mA) current compliance in response to ENTER I.



## TEK 4052

---

This program sets up the Model 220 output according to the values entered from the TEK 4052 with an 4051 GPIB interface.

### DIRECTIONS

1. Set switches on the Model 220 to addressable mode, primary address 12.
2. Connect Model 220 to TEK 4051 IEEE interface.
3. Enter the program below using the RETURN key after each line.
4. Type in RUN.
5. The display will read "ENTER I".
6. To program the Model 220 to  $1\mu\text{A}$  output, type 1E-6 and depress the RETURN key.
7. The display will read ENTER V.
8. To program the Model 220 to 20V compliance limit, type 20 and depress the RETURN key.
9. The programmed change can be verified by selecting one of the front panel DISPLAY pushbuttons and reading the display value.

### PROGRAM

10 PRINT @ 37, 0: 10, 255, 13

20 INPUT "ENTER I"

30 INPUT I\$

40 PRINT "ENTER V"

50 INPUT V\$

60 PRINT @12:"R0P1F1X","I", Output to IEEE bus, address 12.  
I\$,"V",V\$"X"

70 GO TO 20

80 END

### COMMENTS

Enter desired output.  
(Example:  $1\mu\text{A} = 1\text{E}-6$ )

Enter desired compliance.  
(Example:  $20\text{V} = 20$ .)

Repeat  
End of program.

NOTE: While the program illustrates Model 220 programming over the bus, the same program may be used with the Model 230 by simply changing the bus address to 13 and entering 0, 1 or 2 (2mA, 20mA or 100mA) current compliance in response to ENTER I.

## IBM PC or XT Personal Computer (Capital Equipment Corp. 01000 IEEE-488 Interface)

The following program sends a command string to the Model 220/230 and displays the instrument data string on the IBM CRT. The equipment required for this program is the IBM PC or XT computer configured with DOS 2.0 and BASICA and the Capital Equipment Corp. (CEC) 01000 IEEE-488 interface. The interface board must be installed as per the CEC 01000 Instruction Manual (address = \$C0000).

### DIRECTIONS

1. Using the rear panel switches, set the Model 220/230 to the addressable mode with primary address 12.
2. Connect the instrument to the interface with power off.
3. Enter the program below into the computer, pressing the return key after each line is entered.
4. Press the F2 key to run the program. The CRT will display "COMMAND?".
5. Enter the desired command string and press the return key. For example, to program the Model 220 for a current of 10mA, key in I10E-3X. To program a voltage of 25V on the Model 230, type in V25X.
6. The entire reading string from the instrument will then appear on the computer CRT.

### PROGRAM

```
10 REM PROGRAM FOR MODEL 220 WITH CEC 01000
   INTERFACE
20 CLS:DEF SEG = &HC000 'INTERFACE IS AT ADDRESS
   $C0000
30 REM DEFINE INTERFACE PARAMETERS
40 INIT = 0:ADD% = 21:LEV% = 0: TRANSMIT = 3:RECEIVE
   = 6:REN$ = "REN":STATUS% = 0
50 R$ = SPACES$(100) ' DEFINE INPUT BUFFER
60 CALL INIT(ADD%,LEV%) 'INITIALIZE INTERFACE
70 CALL TRANSMIT(REN$,STATUS%) 'SET UP THE 220 FOR
   REMOTE
80 IF STATUS %< >0 THEN 190 ' IF BUS ERROR PROCESS IT
90 INPUT "COMMAND";C$ 'PROMPT FOR COMMAND
100 CMD$ = "MTA UNL LISTEN 12 DATA " + C$ + " " 13 10"
   'SET UP LISTEN COMMAND
110 CALL TRANSMIT (CMD$, STATUS%)' TRANSMIT
   COMMAND TO 220
120 IF STATUS%<>0 THEN 190
130 CMD$ = "MLA UNT TALK 12" 'SET UP TALK COMMAND
   STRING
140 CALL TRANSMIT (CMD$,STATUS%)'ADDRESS 220 TO
   TALK
```

```
150 IF STATUS%<>0 THEN 190
160 CALL RECEIVE(R$,L%,STATUS%) ' INPUT DATA STRING
    FROM 220
170 PRINT LEFT$(R$,L%) 'PRINT DATA STRING ON CRT
180 GOTO 90 'REPEAT
190 PRINT"IEEE ERROR #";STATUS%:END 'PROCESS IEEE
    ERROR
```

## **IBM PC or XT Personal Computer (Tecmar IEEE-488 Interface and Version 4.0 Software)**

The following program sends a command string to the Model 220/230 and displays the instrument data string on the IBM CRT. The equipment required for this program is the IBM PC or XT computer configured with DOS 2.0 and BASICA and the Tecmar interface with version 4.0 software. The interface and associated software must be installed as per the Tecmar IEEE-488 Instruction Manual (board address = &H310).

### **DIRECTIONS**

1. Using the rear panel switches, set the Model 220/230 for the addressable mode with primary address 12.
2. While power is off, connect the instrument to the interface.
3. Insert the Tecmar software disk in the default drive and load the program called "IEEE488".
4. Add the lines below to the front of the program, pressing return after each line is entered.
5. Press the F2 key to run the program. The CRT will display "COMMAND?".
6. Enter the desired command string and press return. For example, to program a current of 10mA on the Model 220, enter I10E-3X. To program a voltage of 25V on the Model 230, type in V25X.
7. The entire reading string from the instrument will then appear on the CRT.

### **PROGRAM**

```
5 CLS ' PROGRAM FOR MODEL 220 AND TECMAR INTERFACE  
  WITH 4.0 SOFTWARE  
10 PARAM$="INIT/1/&H310/P/":GOSUB 10000 'INITIALIZE  
  INTERFACE  
20 PARAM$="ADTR/":GOSUB 10000 ' SET UP 220 FOR  
  REMOTE  
30 INPUT"COMMAND";CMD$:IF CMD$="" THEN 30 'PROMPT  
  FOR COMMAND  
40 DATA.STRING$=CMD$ 'SET UP INTERFACE COMMAND  
  STRING  
50 PARAM$="WR.STR/12//EOS/":GOSUB 10000 'SEND  
  COMMAND STRING TO INSTRUMENT  
60 PARAM$="RD.STR/12/10/EOS/":GOSUB 10000 'READ  
  DATA STRING FROM 220  
70 PRINT DATA.STRING$ 'PRINT DATA STRING ON CRT  
90 GOTO 30 'REPEAT
```

## E-H 7000 Computer

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The following program sends a data string from the E-H 7000 computer to the Model 220/230 and then displays the instruments reading on the computer CRT. The E-H 7000 must be configured with MS-DOS, IO-SYS and BASICA as outlined in its instruction manual.

### DIRECTIONS

1. Using the rear panel switches, set the Model 220/230 for the addressable mode with primary address 12.
2. While the power is off connect the Model 220/230 to PORT 1 of the computer.
3. While in BASICA, type LOAD "EHE488.CMP" to load the GPIB handler software.
4. Add the lines below to the front of the program now in memory; press the return key after each line is typed. The complete program may now be saved in the usual manner.
5. Press the computer F2 key to run the program. The CRT will prompt with "COMMAND?".
6. Type in the desired command. For example, to program a current of 10mA on the Model 220, enter I10E-3X. To program a voltage of 25V on the Model 230 type in V25X and press the return key.
7. The entire reading string from the instrument will then appear on the CRT.

### PROGRAM

```
10 CLS
20 GOSUB 65010
30 CALL PORT1
40 CALL INIT
50 DEV$ = "12 "
60 INPUT "COMMAND"; C$

70 IF C$ = "" THEN 60
80 IN$ = SPACE$(60)
90 CALL SNDSTR(DEV$,C$)

100 CALL RCVSTR(DEV$,
    IN$)
110 PRINT IN$
120 GOTO 60
```

### COMMENTS

```
'Initialize Handler Software
'Initialize Port 1
'Initialize Interface
'Primary Address = 12
'Prompt for Command
String
' If Null Input Go Back
' Define Reading Buffer
' Send Command String to
220
'Get Reading From 220
'Display Reading String on
CRT
'Repeat
```

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