KEITHLEY

Model 220/230
PROGRAMMABLE SOURCES

QUICK REFERENCE GUIDE

INTRODUCTION

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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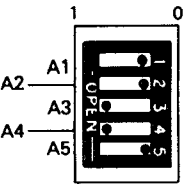
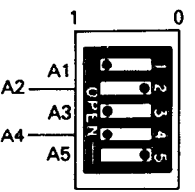
Model 220 Primary Address Switches



Model 230 Primary Address Switches



MODEL 220 PROGRAM CODES

DISPLAY:

D0 = Source
D1 = Voltage Limit
D2 = Dwell Time
D3 = Memory Location

FUNCTION:

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.

PREFIX: (NDCI, V, W, B, L, I/O)

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)

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 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 μA 2.0E−6
R5 = 20 μA 2.0E−5
R6 = 200 μA 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: 0n.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/Oii,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.

MODEL 230 PROGRAM CODES

DISPLAY:

D0 = Source
D1 = Current Limit
D2 = Dwell Time
D3 = Memory Location

FUNCTION:

F0 = Standby
Set output voltage to zero.
F1 = Operate
Set output to value in memory location.

PREFIX: (NDCI, V, W, B, L, I/O)

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, 1 + 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

PROGRAM MODE:

P0 = Single
P1 = Continuous
P2 = Step

RANGES:

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

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:

V(sign)n.nnnnE(sign)nn
Voltage source output value
Limits: 0 to ±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: 0n.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 0 2 0 6 0 0 :

U1 = Output I/O status on next read.
Read input on X only.
I/Oii,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

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 1μA 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	COMMENTS
10 REMOTE 712	Remote enable instrument at address 12.
20 DISP "ENTER I ="	
30 INPUT I$	Enter desired current. (Example: 1μA = 1E-6)
40 DISP "ENTER V="	
50 INPUT V$	Enter desired voltage. (Example: 20V = 20).
60 OUTPUT 712;"R0P1F1X", "I",I$,"V",V$"X"	Output to IEEE bus, address 12.
0 GO TO 20	Repeat
80 END	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 1μA 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	COMMENTS
0 dim A$[20],I$[20],V$[20]	Dimension string variables.
1 dev "220", 712	Define bus address 12 as 220.
2 ent "enter i=?",I$	Enter desired current. (Example: 1μA = 1E-6).
3 ent "enter v=?",V$	Enter desired voltage. (Example: 20V = 20).
4 "220"→ A$	Set A$ = "220".
5 wrt A$,"R0P1F1X" & "I", I$, "V",V$,"X"	Output to IEEE bus, address 12.
6 gto 2	Repeat
7 end	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 1μA 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		COMMENTS
10	DIM I$(20), V$(20)	Dimension string variables.
20	SRCE = 712	Define bus address 12 as SRCE.
30	INPUT "ENTER I", I$	Enter desired current. (Example: 1μA = 1E-6).
40	INPUT "ENTER V",V$	Enter desired voltage. (Example: 20V = 20).
50	OUTPUT SRCE; "R0P1F1X"; "I";I$;"V";V$;"X"	Output to IEEE bus, address 12.
60	GO TO 30	Repeat
70	END	

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 addressabe 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 1μA 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	COMMENTS
10 PRINT ENTER I	
20 INPUT I$	Enter desired current. (Example: 1μA = 1E-6)
30 PRINT ENTER V	
40 INPUT V$	Enter desired voltage. (Example: 20V = 20).
50 Z$ = CHR$(26)	Define Z$ = CTRL-Z.
60 PR#3	Set to I/O on the IEEE bus.
70 IN# 3	
80 PRINT "RA"	Sent remote enable all.
90 PRINT "WT,";Z$;"R0P1F1X"; "I";I$;"V";V$;"X"	Output to IEEE bus, address 12.
100 PRINT "LF1"	Send line feed after carriage return.
110 PR# 0	Set to I/O on the CRT & keyboard.
120 IN# 0	
130 GO TO 10	Repeat
140 END	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 1μA 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	COMMENTS
10 OPEN 6, 12	Open file 6, primary address 12.
20 INPUT "ENTER I"; I$	Enter desired current. (Example: 1μA = 1E-6)
30 INPUT "ENTER V";V$	Enter desired voltage. (Example: 20V = 20)
40 PRINT #6,"R0P1F1X","I", I$,"V",V$,"X"	Output to IEEE-488 bus, address 12.
50 GOTO 20	Repeat
60 END	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 1μA 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	COMMENTS
10 PRINT @ 37, 0: 10, 255, 13	
20 INPUT "ENTER I"	
30 INPUT I$	Enter desired output. (Example: 1μA = 1E-6)
40 PRINT "ENTER V"	
50 INPUT V$	Enter desired compliance. (Example: 20V = 20.)
60 PRINT @12:"R0P1F1X","I", I$,"V",V$"X"	Output to IEEE bus, address 12.
70 GO TO 20	Repeat
80 END	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$ = SPACE$(100) ' DEFINE INPUT BUFFER
 60  CALL INIT(ADD%,LEV%) 'INITIALIZE INTERFACE
 70  CALL TRANSMIT(REN$,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

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	COMMENTS
10 CLS	
20 GOSUB 65010	'Initialize Handler Software
30 CALL PORT1	'Initialize Port 1
40 CALL INIT	'Initialize Interface
50 DEV$ = "12 "	'Primary Address = 12
60 INPUT "COMMAND"; C$	'Prompt for Command String
70 IF C$="" THEN 60	' If Null Input Go Back
80 IN$ = SPACE$(60)	' Define Reading Buffer
90 CALL SNDSTR(DEV$,C$)	' Send Command String to 220
100 CALL RCVSTR(DEV$, IN$)	'Get Reading From 220
110 PRINT IN$	'Display Reading String on CRT
120 GOTO 60	'Repeat

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