KEITHLEY

Model 263 Calibrator/Source
Quick Reference Guide

INTRODUCTION

This quick reference guide contains descriptions of various features and information concerning the operation of the Model 263. Also included are programming examples using various controllers.

TABLE OF CONTENTS

SAFETY PRECAUTIONS

1. Before operation, ground the instrument through a properly earth grounded power receptacle.

2. Before sevicing, disconnect the instrument from the power line and all other equipment, and consult the Model 263 Instruction Manual.

3. Do not touch any terminals while the instrument is connected to any other test equipment.

FRONT PANEL OPERATION

POWER—Controls AC line power to the instrument.
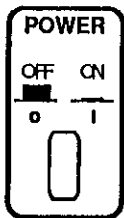
SHIFT—Several controls have secondary functions that are selected by first pressing SHIFT and then pressing the appropriate button.
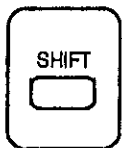
FUNCTION GROUP
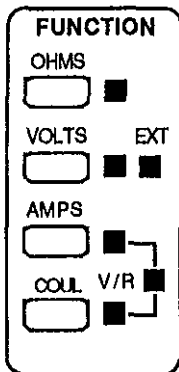
OHMS—Pressing the OHMS button configures the Model 263 as a resistance source. The value of the resistance will be displayed.

VOLTS—Pressing the VOLTS button configures the Model 263 as a voltage source. The voltage value will be displayed.

Pressing SHIFT VOLTS configures the Model 263 to output an external source applied to the EXT INPUT and COMMON terminals on the rear panel. The EXT indicator turns on and the message "USEr V" is displayed.

AMPS—Pressing the AMPS button configures the Model 263 as an active current source. The programmed current value will be displayed.

Pressing SHIFT AMPS turns on the V/R light indicating that the Model 263 is configured as a passive current source.

COUL—Pressing the COUL button configures the Model 263 as an active charge source. The currently selected range and programmed charge value will be displayed.

Pressing SHIFT COUL turns on the V/R light indicating that the Model 263 is configured as a passive charge source.

CONTROL GROUP
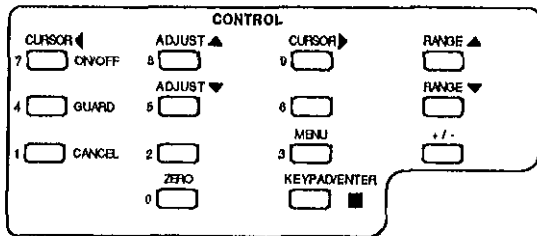
RANGE—These two buttons are used to select the range of the selected function. RANGE ▲ upranges the instrument and RANGE ▼ downranges.

CURSOR—These two buttons are used to position the cursor when using the Adjust Method to modify an output value. CURSOR ► moves the cursor from left to right and conversely, CURSOR ◄ moves the cursor from right to left. Not functional in OHMS.

Pressing SHIFT ON/OFF the first time displays the flashing cursor continually. Pressing it again disables the cursor. Not functional in OHMS.

ADJUST—These two buttons are used to modify the display reading using the Adjust Method. ADJUST ▲ increments the reading at the selected digit and ADJUST ▼ decrements the reading. Not functional in OHMS.

KEYPAD/ENTER—Pressing this button enables the keypad allowing an output value to be keyed in using the number (0 through 9) buttons and the ± button (Keypad Method). Pressing this button again enters the reading and disables the keypad. Not functional in OHMS.

SHIFT CANCEL—Pressing this button after keying in a reading (Keypad Method) cancels that reading and disables the keypad.

+/–   Toggles the displayed reading (except OHMS) between positive (+) and negative (−) polarity. Not functional in OHMS.

ZERO—Toggles the display between zero and the previously displayed reading.

SHIFT GUARD—Toggles the output configuration between guarded and unguarded.

MENU—Used to select front panel programs. Program parameters are modified by the ADJUST buttons. Pressing MENU after modifying a program parameter enters the new parameter and returns the instrument to normal operation.

OPERATE—Toggles the instrument between the standby and operate conditions.

CONNECTORS (Rear Panel)

OUTPUT—Output high is available at this triax connector (on the center conductor). Output low is available here (on the inner shield) or at the COMMON terminal depending on the configuration of the output (unguarded or guarded).

EXT INPUT—This banana plug is used to connect an external input (200V, 100mA peak) to the Model 263. The external input is then available at the output of the Model 263 when VOLTS EXT is selected.

COMMON—Output low is always available at this terminal regardless of the configuration of the output.

PREAMP OUT—This terminal along with COMMON can be used to monitor the voltage drop across a load when the instrument is sourcing current or charge. This terminal can also be used as an external guard drive when sourcing AMPS or COUL. PREAMP OUT is inoperative in AMPS V/R, COUL V/R, VOLTS and OHMS.

IEEE CONNECTOR—Used to connect the instrument to the IEEE-488 bus. IEEE interface functions are marked above the connector.

AC RECEPTACLE—Power is applied through the supplied power cord to the 3-terminal AC receptacle.

PROGRAMMING OUTPUT VALUES

For all functions, except OHMS, the following two data entry methods can be used to program the instrument for an output value. In general, use the Adjust Method to modify a value and the Keypad Method to enter a completely new value.

Adjust Method

1. Position Cursor. Using CURSOR ◄ and CURSOR ►, place the cursor on the digit to be changed. To continually display the cursor location, press SHIFT ON/OFF.
2. Adjust Display Reading. Use the ADJUST ▲ and ADJUST ▼ to increment or decrement the reading. Polarity of the reading is toggled by the +/− button.

Keypad Method

1. Enable Keypad. Enable the keypad by pressing KEYPAD/ENTER. Keypad LED turns on.
2. Key In Reading. Key in the reading by pressing the appropriate number button (0 through 9) at each cursor location. Polarity is toggled by the +/− button.

   Note: If it is desired to cancel the keyed in reading and return to the previously programmed value, press SHIFT CANCEL. The keypad will disable.
3. Enter Reading. Again press KEYPAD/ENTER to enter the displayed reading and disable the keypad. Keypad LED turns off.

SOURCING METHODS

Figures 1 through 5 show the basic methods that the Model 263 uses to source resistance, voltage, current and charge.
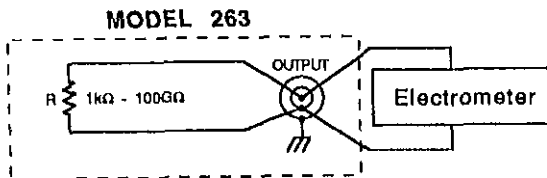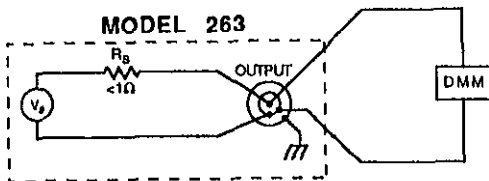
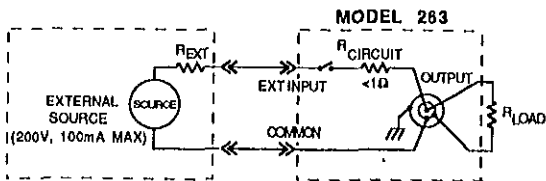

Figure 1. Ohms Source

Figure 2. Volts Source

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Figure 3. External Source
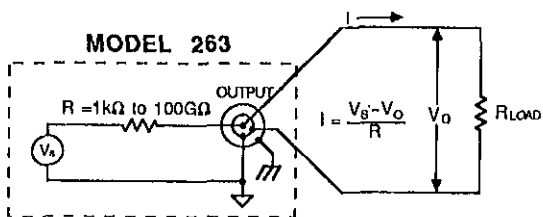
Figure 4. AMPS V/R and COUL V/R
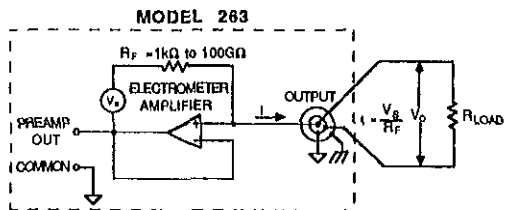
Figure 5. Amps and Coul Source

GUARD

In the normal unguarded output configuration, output high is connected to the center conductor of the triax OUTPUT connector and output low is connected to the inner shield (see Figure 6). When the output of the Model 263 is placed in the guarded configuration, by pressing SHIFT GUARD, output low is disconnected from the inner shield of the OUTPUT connector allowing a guard drive to be connected to it. In AMPS and COUL the guard drive is provided by the Model 263. On the other functions (AMPS V/R, COUL V/R, OHMS and VOLTS), the inner shield of the triax OUTPUT connector is floating unless a guard drive is supplied by the user. Figures 7 through 10 show the guarded output configurations for all functions.

Guarding is recommended for resistances ≥ 100MΩ. Guarding is not necessary when the Model 263 is sourcing current to a feedback picoammeter since this circuit is already guarded. The low input voltage burden of a feedback pico-ammeter results with virtually the same voltage on output high and low. Guarding is recommended when sourcing current or charge to a high impedance load. Guarding is unnecessary when sourcing voltage.
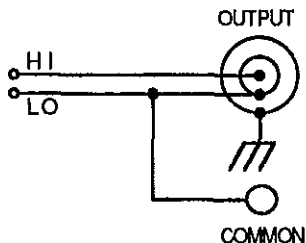
Figure 6. Normal (Unguarded) Output Configuration
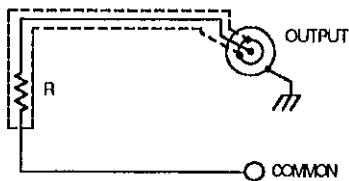
Figure 7. Guarded Ohms Output Configuration
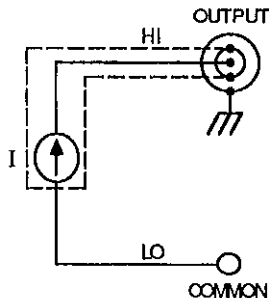
Figure 8. Guarded AMPS V/R and guarded COUL V/R Output Configuration
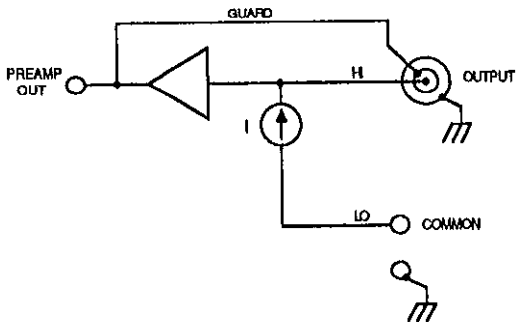
Figure 9. Guarded Amps and guarded Coul Output Configuration
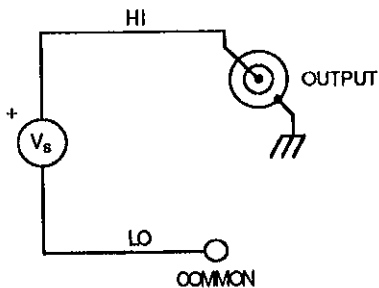
Figure 10. Guarded VOLTS Output Configuration

FRONT PANEL PROGRAMS

The available front panel programs are summarized in Table 1. Perform the following steps to use a program:

1. Display the desired program using the MENU button.
2. Use the ADJUST ▲ or ADJUST ▼ button to change the program parameter.
3. To enter the new program paramter, press the MENU button again. The instrument will return to normal operation.

Note: The IEEE address (Program IEEE) and the display mode (Program dISP) are stored in memory. Thus, the instrument will power-up to the programmed parameters. Temperature compensation status is not stored and will always power up enabled (1).

Table 1. Front Panel Programs

Program	Description
IEEE	Check or change IEEE-488 bus address (0 to 30).
dISP	Selects alternate display mode; engineering units (μ) or scientific notation (-6).
tc	Check or change temperature compensation status; Off (0) or On (1).

IEEE-488 PROGRAMMING

DEVICE-DEPENDENT COMMANDS

Execute	
X	Execute other device-dependent commands

Function	
F0	Ohms
F1	Amps
F2	Volts
F3	Coulombs
F4	V/R Amps
F5	External Input
F6	Ladder
F7	V/R Coulombs

Range					
	Ohms	**Amps**	**Volts**	**Coul**	**Ladder**
R0	Auto On	Auto On	Auto On	Auto On	Auto On
R1	1 kΩ	2 pA	200mV	20pC	1ML
R2	10 kΩ	20 pA	2 V	200pC	10ML
R3	100 kΩ	200 pA	20 V	2nC	100ML
R4	1MΩ	2 nA	20 V	20nC	1GL
R5	10MΩ	20 nA	20 V	200nC	10GL
R6	100MΩ	200 nA	20 V	2μC	100GL
R7	1GΩ	2 μA	20 V	20μC	100GL
R8	10GΩ	20 μA	20 V	200μC	100GL
R9	100GΩ	200 μA	20 V	200μC	100GL
R10	100GΩ	2mA	20 V	200μC	100GL
R11	100GΩ	20mA	20 V	200μC	100GL
R12	Auto Off	Auto Off	Auto Off	Auto Off	Auto Off

Zero	
Z0	Zero off
Z1	Zero on

Temperature Compensation	
C0	Temperature compensation off
C1	Temperature compensation on

Guard	
W0	Guard Off
W1	Guard On

Self-Test	
J0	Perform self-test

Status	
U0	Send machine status word
U1	Send error conditions
U2	Send data conditions

EOI	
K0	Enable EOI
K1	Disable EOI

SRQ	
M0	Disable
M2	Charge done
M16	Ready
M32	Error

Calibration Value	
An	Calibrate using value

Calibration Value	
Ln	Calibrate low temperature cal point

Output Value	
Vn	Program output using value

Prefix	
G0	Reading with prefix
G1	Reading without prefix

Operate	
O0	Standby
O1	Operate

Terminator	
Y0	CR LF
Y1	LF CR
Y2	CR
Y3	LF
Y4	None

DATA FORMAT

PREFIX — MANTISSA (5 1/2 DIGITS)

N D C A   ± 1. 90000   E - 12

EXPONENT

N = NORMAL
S = STANDBY
O = OVER COMPLIANCE
(AMPS AND COUL)

OHM = OHMS
DCA = AMPS
DCV = VOLTS
DCC = COULOMBS
VRA = V/R AMPS
DCX = EXTERNAL VOLTS
LDR = LADDER
VRC = V/R COULOMBS
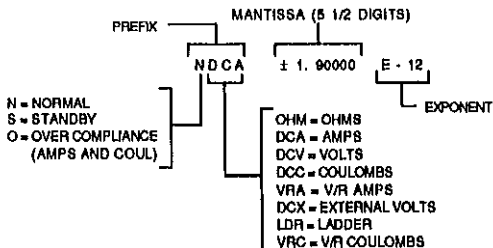
SRQ MASK and STATUS BYTE FORMAT

BIT POSITION	B7	B6	B5	B4	B3	B2	B1	B0
VALUE	0	0/1	0/1	0/1	0	0	0/1	0
DECIMAL WEIGHTING	128	64	32	16	8	4	2	1

1 = SRQ BY 263
(SERIAL POLL BYTE ONLY)

1 = ERROR

1 = READY

1 = CHARGE DONE
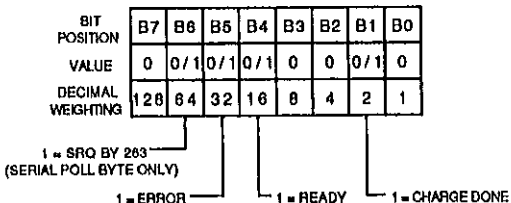
U0 MACHINE STATUS WORD

263   F 2 R Ø Ø 1 Z Ø C 1 W Ø G Ø Ø Ø M Ø Ø R Ø Y Ø

U1 ERROR STATUS WORD

MODEL NO.	IDDG	IDDC0	NO REMOTE	NUMBER	SELF-TEST	
263	1/0	1/0	1/0	1/0	1/0	0000<TERM>

U2 DATA STATUS WORD

MODEL NO.	UNCALIBRATED	COMPLIANCE OVERLOAD	CALIBRATION SWITCH ENABLED	
263	0/1	0/1	0/1	000000<TERM>

PROGRAMS

IBM PC or AT
(CEC PC < > 488 Interface)

The following program sends a command string to the Model 263 from an IBM PC or AT computer and displays the instrument reading string on the CRT. The computer must be equipped with the CEC Interface and the DOS 2.00 (or later revision) operating system.

DIRECTIONS

1. Using the front panel program feature, set the primary address of the Model 263 to 8.
2. With the power off, connect the Model 263 to the IEEE-488 interface installed in the IBM computer.
3. Type in BASICA on the computer keyboard to get into the IBM interpretive BASIC language.
4. Enter the lines below using the return key after each line.
5. Run the program and type in the desired command string. For example, to place the instrument in the current function and 200μA range, type in F1R9X and press the return key.
6. The instrument reading string will then appear on the display.

PROGRAM	COMMENTS
10 DEF SEG=&HC400	' Memory address.
20 INITIALIZE=0	
30 SEND=9 : ENTER=21	' Routine addresses.
40 MY.ADDRESS%=21	' PC < > 488 address.
50 INST.ADDRESS%=8	' 263 address.
60 CONTROLLER%=0	' System controller.
70 CALL INITIALIZE (MY.ADDRESS%, CONTROLLER%)	' Initialize system.
80 INPUT ''ENTER COMMAND STRING'';CMD$	' Prompt for string.
90 CALL SEND (INST.ADDRESS%, CMD$, STATUS%)	' Send command string.
100 READING$=SPACE$(16)	' Make room for data.
110 CALL ENTER (READING$, LENGTH%, INST.ADRESS%, STATUS%)	' Get reading from 263.
120 PRINT READING$	' Display reading.
130 GOTO 80	' Repeat.
140 END	

NOTE: For conversion to numeric variable, make the following changes:

```
120 READNG=VAL(MID$
    (READING$,5,14))
125 PRINT READING
```

IBM PC or AT
(National GPIB PC Interface)

The following program sends a command string to the Model 263 from an IBM PC or AT computer and displays the instrument reading string on the CRT. The computer must be equipped with the National GPIB PC Interface and the DOS 2.00 (or later revision) operating system. Interface software must be installed and configured as described in the instruction manual.

DIRECTIONS

1. Using the front panel program feature, set the primary address of the Model 263 to 8.
2. With the power off, connect the Model 263 to the IEEE-488 interface installed in the IBM computer.
3. Type in BASICA on the computer keyboard to get into the IBM interpretive BASIC language.
4. Place the interface software disk in the default drive, type LOAD"DECL", and press the return key.
5. Add the lines below to lines 1-6 which are now in memory. Modify the address in lines 1 and 2, as described in the National instruction manual.
6. Run the program and type in the desired command string. For example, to place the instrument in the current function and 200μA range, type in F1R9X and press the return key.
7. The instrument reading string will then appear on the display.
8. To exit the program, type in EXIT at the command prompt and press the return key.

PROGRAM	COMMENTS
10 CLS	Clear screen.
20 NA$=''GPIB0'' : CALL IBFIND(NA$, BRD0%)	Find board descriptor.
30 NA$=''DEV1'' : CALL IBFIND(NA$, M263%)	Find instrument descriptor.
40 V%=8 : CALL IBPAD (M263%, V%)	Set primary address to 8.
50 V%=&H102 : CALL IBPOKE (BRD0%, V%)	Set timeouts.
60 V%=1 : CALL IBSRE (BRD0%, V%)	Set REN true.
70 INPUT''COMMAND STRING'' ; CMD$	Prompt for command.
80 IF CMD$=''EXIT'' THEN 150	See if program is to be halted.
90 IF CMD$='' '' THEN 70	Check for null input.
100 CALL IBWRT(M263%, CMD$)	Address 263 to listen, send string.
110 RD$=SPACE$(100)	Define reading input buffer.
120 CALL IBRD(M263%, RD$)	Address 263 to talk, get reading.
130 PRINT RD$	Display the string.
140 GOTO 70	Repeat.
150 V%=0 : CALL IBONL (M263%, V%)	Close the instrument file.
160 CALL IBONL(BRD0%, V%)	Close the board file.
170 END	

NOTE: For conversion to numeric variable, make the following changes:

```
130 RD=VAL(MID$(RD$,5,
   14))
135 PRINT RD
```

APPLE II
(Apple II IEEE-488 Interface)

The following program sends a command string to the Model 263 from an Apple II computer and displays the instrument reading string on the computer CRT.

The computer must be equipped with the Apple II IEEE-488 Interface installed in slot 3.

DIRECTIONS

1. Using the front panel program feature, set the primary address of the Model 263 to 8.
2. With the power off, connect the Model 263 to the IEEE-488 interface installed in the Apple II computer.
3. Enter the lines in the program below, using the RETURN key after each line.
4. Run the program and type in the desired command string at the command prompt. For example, to place the instrument in the current function and $200\mu A$ range, type in F1R9X and press the return key.
5. The instrument reading string will then appear on the CRT.

PROGRAM	COMMENTS
10 Z$=CHR$(26)	Terminator.
20 INPUT''COMMAND	Prompt for and enter string.
STRING'';B$	
30 PR#3	Set output to IEEE bus.
40 IN#3	Define input from IEEE bus.
50 PRINT ''RA''	Enable remote.
60 PRINT ''WT('';Z$;B$	Address 263 to listen, send string.
70 PRINT ''LF1''	Line Feed on.
80 PRINT ''RDH'';Z$;:	Address 263 to talk, input
INPUT'' '';A$	data.
90 PRINT ''UT''	Untalk the 263.
100 PR#0	Define output to CRT.
110 IN#0	Define input from keyboard.
120 PRINT A$	Display reading string.
130 GOTO 20	Repeat.

NOTE: If conversion to numeric variable is required, make the following changes:

```
120 A=VAL(MID$(A$,5,16))
125 PRINT A
```

HP 85

The following program sends a command string to the Model 263 from an HP-85 computer and displays the instrument reading string on the computer CRT. The computer must be equipped with the HP82937 GPIB interface and an I/O ROM.

DIRECTIONS

1. Using the front panel program feature, set the primary address of the Model 263 to 8.
2. With the power off, connect the Model 263 to the HP82937A GPIB interface installed in the HP-85 computer.
3. Enter the lines in the program below, using the END LINE key after each line.
4. Press the HP-85 RUN key and type in the desired command string at the command prompt. For example, to place the instrument in the current function and 200μA range, type in F1R9X and press the END LINE key.
5. The instrument reading string will then appear on the CRT.

PROGRAM	COMMENTS
10 DIM A$[40];B$[40]	Dimension strings.
20 REMOTE 708	Place 263 in remote.
30 DISP''COMMAND STRING'';	Prompt for command.
40 INPUT A$	Input command string.
50 OUTPUT 708; A$	Address 263 to listen, send string.
60 ENTER 708; B$	Address 263 to talk, input reading.
70 DISP B$	Display reading string.
80 GOTO 30	Repeat
90 END	

NOTE: For conversion to numeric variable, change line 70 as follows:

```
70 DISP VAL(B$[5])
```

HP SERIES 300 and 9816

The following program sends a command string to the Model 263 from a Hewlett-Packard Series 300 or Model 9816 computer and displays the instrument reading string on the computer CRT. The computer must be equipped with the HP82937 GPIB Interface and BASICA 4.0.

DIRECTIONS

1. Using the front panel program feature, set the primary address of the Model 263 to 8.
2. With the power off, connect the Model 263 to the HP82937A GPIB interface installed in the computer.
3. Enter the lines in the program below, using the ENTER key after each line.
4. Press the RUN key and type in the desired command string at the command prompt. For example, to place the instrument in the current function and 200μA range, type in F1R9X and press the ENTER key.
5. The instrument reading string will then appear on the CRT.

PROGRAM	COMMENTS
5 DIM B$[50]	
10 REMOTE 708	Place 263 in remote.
20 INPUT''COMMAND STRING'',A$	Prompt for and input command.
30 OUTPUT 708, A$	Address 263 to listen, send string.
40 ENTER 708; B$	Address 263 to talk, input reading.
50 PRINT B$	Display reading string.
60 GOTO 20	Repeat.
70 END	

NOTE: For conversion to a numeric variable, change the program as follows:

```
40 ENTER 708;B
50 PRINT B
```

HP 9825A

Use the following program to send a command string to the Model 263 from a Hewlett-Packard Model 9825A and display the instrument reading string on the computer printer. The computer must be equipped with the HP98034A HPIB Interface and a 9872A extended I/O ROM.

DIRECTIONS

1. From the front panel, set the primary address of the Model 263 to 8.
2. With the power off, connect the Model 263 to the 98034A HPIB Interface installed in the 9825A.
3. Enter the lines in the program below, using the STORE key after each line. Line numbers are automatically assigned by the 9825A.
4. Press the 9825A RUN key and type in the desired command string at the command prompt. For example, to place the instrument in the current function and 200μA range, type in F1R9X and press the CONT key.
5. The instrument reading string will then appear on the computer print out.

PROGRAM	COMMENTS
0 dim A$[25];B$[20]	Dimension data strings.
1 dev''263'',708	Define 263 at address 8.
2 rem''263''	Place 263 in remote.
3 ent''COMMAND STRING'',	Prompt for command
B$	string.
4 wrt''263'',B$	Address 263 to listen, send string.
5 red''263'',A$	Address 263 to talk, input data.
6 prt A$	Print data string on printer.
7 gto 3	Repeat.

NOTE: For conversion to numeric variable, modify the program as follows:

```
6 prt val(A$[5])
```

DEC LSI 11

The following program sends a command string to the Model 263 from a DEC LSI 11 minicomputer and displays the instrument reading string on the DEC CRT terminal. The LSI 11 must be configured with 16K words of RAM and an IBV 11 IEEE-488 interface. The software must be configured with the IB software as well as FORTRAN and the RT 11 operating system.

DIRECTIONS

1. Using the front panel program feature, set the primary address of the Model 263 to 8.
2. With the power off, connect the Model 263 to the IBV 11 IEEE-488 interface cable.
3. Enter the program below, using the editor under RT 11 and the name IEEE.FOR.
4. Compile using the FORTRAN compiler as follows: FOR-TRAN IEEE.
5. Link with the system and IB libraries as follows: LINK IEEE,IBLIB.
6. Type RUN IEEE and press the RETURN key.
7. The display will read "ENTER ADDRESS".
8. Type in 8 and press the RETURN key.
9. The display will read "TEST SETUP".
10. Type in the desired command string and press the RETURN key. For example, to program the instrument for the current function and 200μA range, type in F1R9X and press RETURN.
11. The instrument data string will appear on the computer display.

PROGRAM	COMMENTS

```
      PROGRAM IEEE
      INTEGER*2 PRIADR
      LOGICAL*1 MSG(80),
      INPUT(80)
      DO 2 I = 1,10
      CALL IBSTER(I,0)          Turn off IB errors.
    2 CONTINUE
      CALL IBSTER(15,5)         Allow 5 error 15's.
      CALL IBTIMO(120)          Allow 1 second bus
                                timeout.
      CALL IBTERM(10)           Set line feed as
                                terminator.
      CALL IBREN                Turn on remote.
    4 TYPE 5
    5 FORMAT (1X,'ENTER         Input primary address.
      ADDRESS:',$)
      ACCEPT 10,PRIADR
   10 FORMAT (I2)
   12 TYPE 15
   15 FORMAT (1X,'TEST SETUP    Prompt for command
      :',$)                     string.
      CALL GETSTR (5,MSG,72)    Program instrument.
      CALL IBSEOI (MSG,-1,      Address 263 to listen,
      PRIADR)                   send string.
   18 I=IBRECV (INPUT,80,       Get data from
                                instrument.
      PRIADR)
      INPUT (I+1) = 0
      CALL PUTSTR (7,INPUT,
      '0')
      CALL IBUNT               Untalk the 263.
      GOTO 12                  Repeat.
      END
```

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