Reference & Program Instructions

Model 619 Electrometer/Multimeter

INTRODUCTION

This reference and programming guide contains information on condensed specifications, front panel operation, and IEEE-488 programming. Where applicable, typical uses and examples for the various operating modes are included.

IEEE-488 information includes a list of commands that can be used to program the instrument over the IEEE-488 bus, data format examples, and simple programs for popular IEEE-488 controllers.

CONTENTS

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CONDENSED SPECIFICATIONS

VOLTS		
Range	Resolution*	Accuracy 1YR., 23° ± 5°C ±(%rdg + counts)
200mV	1 μV	0.01% + 25
2 V	10 μV	0.01% + 10
20 V	100 μV	0.02% + 10
200 V	1mV	0.02% + 10

*5½ Digits.

INPUT IMPEDANCE: ≥ 20TΩ in parallel with ≤ 20pF.

AMPS			
Range	Resolution*	Accuracy 1YR., 23° ± 5°C ±(%rdg + counts)	Inverting Full Scale Analog Output
2 nA	10fA	0.35% + 65	0.2V
20 nA	100fA	0.35% + 35	2.0V
200 nA	1pA	0.15% + 25	0.2V
2 μA	10pA	0.15% + 10	2.0V
20 μA	100pA	0.15% + 25	0.2V
200 μA	1nA	0.15% + 10	2.0V
2mA	10nA	0.15% + 25	0.2V
20mA	100nA	0.15% + 10	2.0V
2 A	10μA	0.15% + 25	None

*5½ Digits.

INPUT VOLTAGE BURDEN: < 1mV at full scale except < 0.6V on 2A range.

OHMS				
Range	Resolution*	Accuracy 1YR., 23° ± 5°C ±(%rdg + counts)	Maximum Open-Circuit Voltage	Test Current
2 kΩ	10MΩ	0.2 % + 25	5V	100μA
20 kΩ	100MΩ	0.2 % + 10	5V	100μA
200 kΩ	1 Ω	0.15% + 25	5V	1μA
2MΩ	10 Ω	0.15% + 10	5V	1μA
20MΩ	100 Ω	0.35% + 25	5V	10nA
200MΩ	1 kΩ	0.35% + 10	5V	10nA
2GΩ	10 kΩ	0.35% + 10	300V	10nA
20GΩ	100 kΩ	1 % + 10	300V	100pA
200GΩ	1MΩ	4 % + 10	300V	100pA
2TΩ	10MΩ	10 % + 10	300V	100pA

*5½ Digits.

GENERAL

DISPLAY: Numeric; 0.56" LED digits, 4½-digit mantissa @ 6.2rdg/s (5½-digits @ 2.4rdg/s in high resolution mode), 2 digit exponent, decimal point, signed exponent and mantissa.
MAXIMUM ALLOWABLE INPUT: 250V rms DC to 60Hz sinewave.
INPUT CURRENT (18°-28°C): Less than 0.4pA.
MAXIMUM ALLOWABLE COMMON MODE VOLTAGES:
Input LO (Channel A) to line ground: 250V rms, DC to 60Hz sinewave.
Input LO (Channel B) to line ground: 250V rms, DC to 60Hz sinewave.
Input LO (Channel A) to Input LO (Channel B): 250V rms DC to 60Hz sinewave.
WARMUP: 1 hour to rated accuracy.
POWER: 90-110, 105-125, 180-220 or 210-250V, 50 or 60Hz (internal switch selected), 75W max., 100V•A max. (internally fan cooled).
ENVIRONMENTAL LIMITS: Operating: 0°-50°C, up to 35°C at 70% noncondensing R.H. **Storage:** -20°C to 70°C.

SAFETY PRECAUTIONS

1. Before operation, ground the instrument through a properly earth grounded power receptacle.
2. Disconnect the line cord and all other equipment from the instrument before servicing. Consult the Model 619 Instruction Manual for complete details.
3. Do not touch any terminals while the instrument is turned on or connected to other equipment.
4. Do not exceed maximum input levels as stated in the specifications.
5. Do not exceed the maximum common mode voltage stated in the specifications.
6. Good safety practice dictates that the current applied to the INPUT connector be limited by an external resistor, when necessary, to less than 20mA.

DISPLAY ANNUNCIATORS

DISPLAY FORMAT

DISPLAY MANTISSA

The display has a signed 4½ or 5½ digit mantissa to indicate reading values. The RESOLUTION button selects the 4½ or 5½ digit modes. The display updates at 6.2 readings per second (4½ digits), or 2.4 readings per second (5½ digits).

DISPLAY EXPONENT

The display exponent takes on a two-digit signed value, and increments or decrements in units of three: 0, ±3, ±6, ±9 and ±12.

DISPLAY STATUS INDICATORS

The VOLTS, AMPS and OHMS annunciators indicate the selected measuring function.

SCIENTIFIC-ENGINEERING UNITS CONVERSION

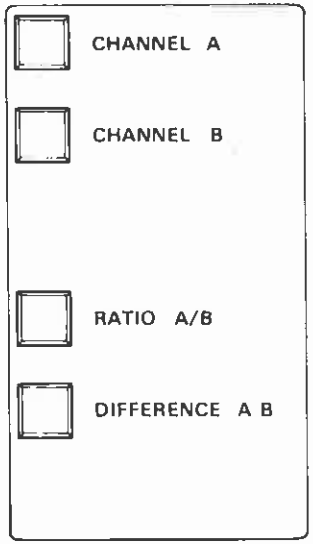
Exponent	Symbol	Prefix
10^{-12}	p	pico-
10^{-9}	n	nano-
10^{-6}	u	micro-
10^{-3}	m	milli-
10^{3}	k	kilo-
10^{6}	M	mega-
10^{9}	G	giga-
10^{12}	T	tera-

DISPLAY MESSAGES

The messages below may be displayed to indicate errors or conditions.

Message	Description
OFLO	Overrange input applied.
no CH-A	Channel A not present or malfunctioning.
no ch-b	Channel B not present or malfunctioning.
no A/d	A/D or filter board not present or malfunctioning.
no ISO	Isolator board not present or malfunctioning.
Snd E	Data transmission error.
REC E	Data reception error.
no 2AC	No zero check on 2A range.
Corr IL	No zero correct allowed with zero check disabled.
no Au	No autoranging with this range or function.
IddC	Illegal device-dependent command.
IddCO	Illegal device-dependent command option.
ISbS	Invalid string with baseline store.

CHANNEL CONTROL GROUP



DESCRIPTION

These buttons allow selection of display channel, and ratio and difference functions for those units equipped with two Model 6194 Electrometer Modules. Each button has an associated light on the front panel to indicate the selected mode.

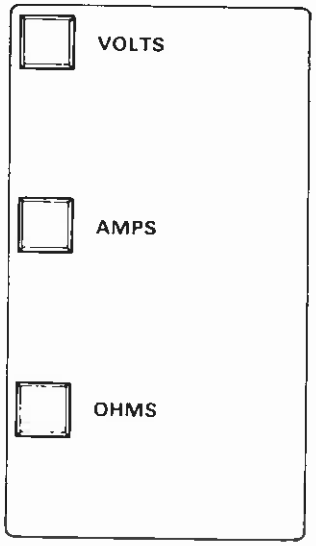
CHANNEL A—Selects Channel A for display. While Channel A is selected, operating modes for that channel can be changed by pressing the desired button.

CHANNEL B—Selects Channel B for display and front panel control. A "no ch-b" error will be displayed if pressed with no module in the Channel B location.

RATIO A/B—Displays the ratio of the Channel A reading to the Channel B reading. Display will show "OFLO" if Channel B reading is 0. The Model 6193 IEEE-488 option must be in the talk-only mode in order to use the ratio mode. The remaining front panel controls are inoperative when the ratio mode is enabled.

DIFFERENCE A/B—Displays the algebraic difference between Channel A and Channel B. The Model 6193 option must be in the talk-only mode in order to use the difference mode. The front panel controls are inoperative when the difference mode is enabled.

FUNCTION CONTROL GROUP



DESCRIPTION

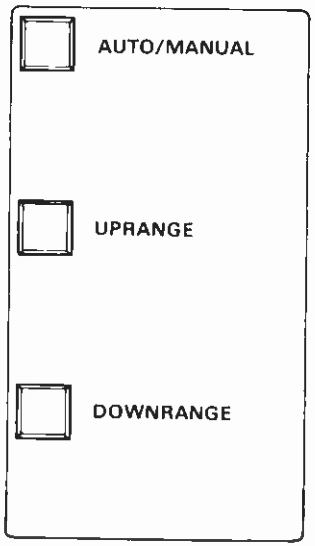
The VOLTS, AMPS and OHMS buttons are used to select the measuring function. The selected function is indicated by the display function status indicators.

VOLTS—Pressing VOLTS button sets up the unit to measure DC voltage with a resolution of 1μV and up to a maximum of 200V.

AMPS—In amps, the instrument can resolve currents as low as 10fA (10^{-14}A) and measure up to 2A. Inputs for the 2A range are applied to a separate input.

OHMS—Pressing OHMS button configures the instrument to measure resistance. Resolution in this mode is 0.01Ω, and the maximum measurable resistance is 2TΩ.

RANGE CONTROL GROUP



DESCRIPTION

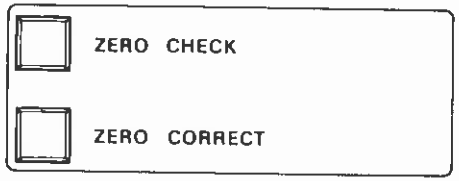
The range control buttons control which range the instrument is using, thus affecting the overall sensitivity of the measurement.

AUTO/MANUAL—Enables and disables the autorange mode. When enabled, the AUTO RANGE annunciator light will be on. The instrument will automatically choose the best range for the applied signal when autoranging is in effect. Autoranging is not available for external feedback, 2A current range, or the 2GΩ-2TΩ ranges. The "no Au" message will be displayed if AUTO/MANUAL is pressed while on one of these ranges.

UPRANGE—Moves the instrument up one range each time it is pressed. Once the maximum range is reached, pressing UPRANGE has no further effect. UPRANGE also cancels the autoranging mode if presently enabled.

DOWNRANGE—Moves the instrument down one range each time it is pressed. Once the lowest range is reached, it has no further effect. DOWNRANGE also cancels the autorange mode if presently enabled.

ZERO CHECK and ZERO CORRECT



DESCRIPTION

ZERO CHECK and ZERO CORRECT work together to cancel any internal offsets that might degrade accuracy.

ZERO CHECK—When zero check is enabled, the input amplifier is disconnected from the input signal, and a 500kΩ resistor appears across the input terminals. The ZERO CHECK annunciator will be on when zero check is enabled. Zero check is not available with the 2A range. The "no 2AC" message will occur in this case.

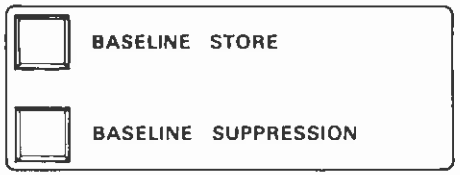
ZERO CORRECT—Six zero correction registers are available: Channel A volts, Channel A amps, Channel A ohms, Channel B volts, Channel B amps and Channel B ohms. Pressing ZERO CORECT with zero check enabled, will perform the correction process and store the value with the next triggered conversion. Pressing ZERO CORRECT with zero check disabled will result in the "Corr IL" error message.

OPERATION

Perform the zero correction process as follows:

1. Enable zero check.
2. Select the function, range and the channel to be corrected. Generally the instrument should be zero corrected on the lowest range of the selected function or the range to be used. Do not use autoranging when performing zero correct.
3. Press ZERO CORRECT and allow several seconds for the instrument to complete the process.
4. Repeat the above procedure for the remaining functions and the other channel, as required.

BASELINE STORE and BASELINE SUPPRESSION



DESCRIPTION

These buttons allow baseline values to be stored and recalled. The baseline values can be as small as the resolution the instrument will allow, or as large as full range. Note that using baseline suppression reduces the dynamic range by the amount of the stored baseline.

BASELINE STORE—Allows up to six baseline values to be stored, one for each function on both channels.

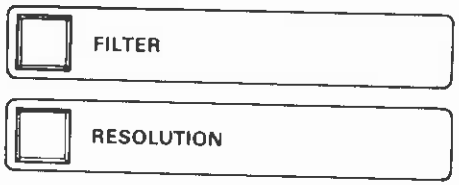
BASELINE SUPPRESSION—Enables or disables baseline suppression. When enabled, the SUPPRESSION annunciator will be on. Under these conditions, the previously stored baseline value will be subtracted from subsequent readings. For example, if 100mV was stored as a baseline, that value will be subtracted from the reading.

OPERATION

Store baseline values and use baseline suppression as follows:

1. Select the channel, function and range, as required according to the anticipated measurement.
2. Connect the signal to be used as a baseline to the instrument input.
3. Disable zero check.
4. Press the BASELINE STORE button to store the value.
5. Repeat the above steps for other functions and the other channel, if required.
6. Disconnect the baseline signal and apply the measured signal in its place.
7. Press the BASELINE SUPPRESSION button. The display will show the difference between the applied signal and the stored baseline.

FILTER and RESOLUTION



DESCRIPTION

FILTER—Used to enable/disable the analog filter, which adds an additional 25dB of line frequency filtering to the input signal. The FILTER annunciator will be on when the filter is enabled.

RESOLUTION—Toggles the display mantissa between the 4½ and 5½ digit modes. The nominal reading rates are: 6.2 readings per second (4½ digits) and 2.4 readings per second (5½ digits). Resolution does not affect the display exponent.

OPERATION

Use the basic procedure below to make measurements with the Model 619.

1. Turn on power to the instrument and allow a one-hour warm up period for rated accuracy.
2. Enable zero check if not already enabled.
3. Select the channel and a function consistent with the anticipated measurement.
4. Select the lowest range of the selected function and press the ZERO CORRECT button. Do not use autoranging when zero correcting the instrument.
5. Select an appropriate range or use autoranging, if desired.
6. Connect the signal to the instrument. Figure 1 shows connections for all functions except for the 2A current range. Figure 2 shows connections for the 2A current range.
7. Disable zero check and note the reading from the display.
8. Enable zero check before disconnecting the input signal.

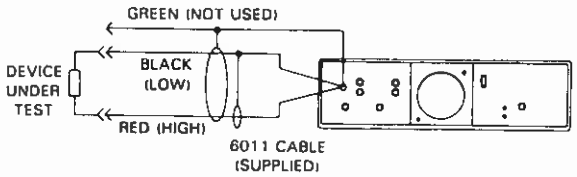


Figure 1. Input Connections for all Except 2A Range

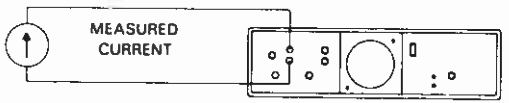


Figure 2. Input Connections for 2A Range

ANALOG OUTPUT

DESCRIPTION

The ANALOG OUTPUT terminals located on the rear panel, can be used to drive recording devices such as a chart recorder, for use with external feedback configuration in amps, or as a guard connection in volts or ohms.

The table below lists full range analog output voltages available at the ANALOG OUTPUT + and − terminals. The output is inverted when in amps.

WARNING
Hazardous voltage may be present at the ANALOG OUTPUT + terminal.

FULL RANGE ANALOG OUTPUT VALUES

Function	Range	Full Range Output
Volts	200mV	200mV
	2 V	2 V
	20 V	20 V
	200 V	200 V
Amps	2nA, 200nA, 20μA, 2mA,	200mV
	20nA, 2μA, 200μA, 20mA	2 V
	2A	None
Ohms	2kΩ, 200kΩ, 20MΩ	200mV
	20kΩ, 2MΩ, 200MΩ, 20GΩ	2 V
	2GΩ, 200GΩ	20 V
	2TΩ	200 V

EXTERNAL FEEDBACK—The ANALOG OUTPUT can be used to connect an external feedback element to the instrument, giving it capabilities to measure charge, logarithmic currents, or non-decade currents. Use the following basic procedure to use external feedback. For more detailed information, refer to the Instruction Manual.

1. Connect the feedback element to the instrument as shown in Figure 3.
2. Select the amps functions on the desired channel.
3. Press the UPRANGE key repeatedly until the EXT FEEDBACK indicator turns on.
4. Disable zero check, if enabled.
5. The display will show the voltage appearing across the feedback element.

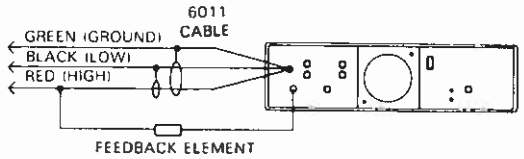
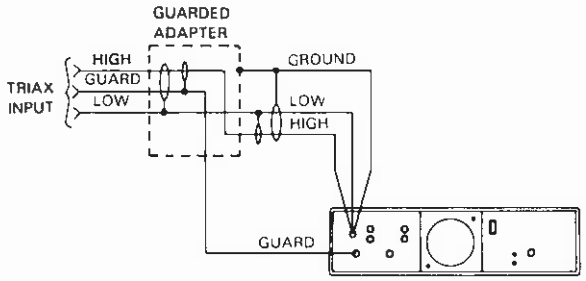


Figure 3. External Feedback Connections

GUARDED OPERATION—The ANALOG OUTPUT can be used to provide a guard connection in the volts or ohms modes to reduce the effects of input capacitance and leakage resistance when making high impedance measurements. Typical connections for guarded operation are shown in Figure 4. The optional Model 6191 Guarded Input Adapter is available from Keithley to make the necessary connections. The Model 6191 has a switch for guarded and unguarded operation and includes the necessary connectors to mate with the INPUT and ANALOG OUTPUT jacks on the instrument.



NOTE INPUT TRIAX CONNECTOR MUST BE INSULATED FROM GROUND

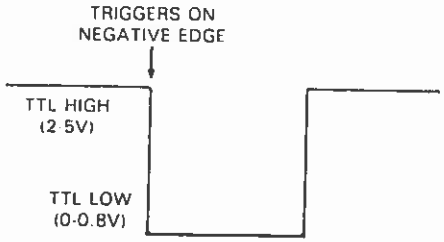
Figure 4. GUARDED Operation

EXTERNAL TRIGGER

DESCRIPTION

The instrument can be triggered to take a reading by applying an appropriate pulse to the EXTERNAL TRIGGER jack. Generally, the unit will be placed in the one shot trigger mode when using external triggering. To do so, an internal switch must be placed in the correct position, as discussed in the Instruction Manual.

Specifications for the trigger pulse are shown below.

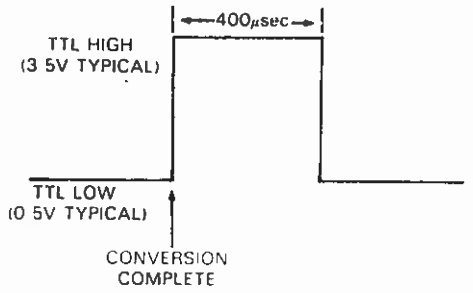


ELECTROMETER COMPLETE

DESCRIPTION

The ELECTROMETER COMPLETE output jack is a BNC connector that provides a 400μsec wide positive-going TTL compatible pulse when the instrument has completed a conversion. This pulse can be used to trigger other instrumentation. For example, if the Model 619 is used with a Model 705 Scanner, the Electrometer Complete pulse could be used to trigger the scanner to go to the next channel.

Typical specifications for the Electrometer Complete pulse are shown below.



IEEE-488 PROGRAMMING

DEVICE-DEPENDENT COMMANDS

FUNCTIONS	
F0	Volts
F1	Amps
F2	Ohms
Pwr On/DCL/SDC	Default F0

RANGES			
Ranges	Volts	Amps	Ohms
R0	Auto	Auto	Auto
R1	200 V	2 nA	2 k
R2	2 V	20 nA	20 K
R3	20 V	200 nA	200 k
R4	200 V	2 μA	2M
R5	*200 V	20 μA	20M
R6	*200 V	200 μA	200M
R7	*200 V	2mA	*2G
R8	*200 V	20mA	*20G
R9	*200 V	*2 A	*200G
R:	*200 V	*EXT Feedback	2T

*No auto range in these ranges.
Notes On Notation: n = 10^{-9}
μ = 10^{-6}
m = 10^{-3}
k = 10^{3}
M = 10^{6}
G = 10^{9}
T = 10^{12}

Pwr On/DCL/SDC = Default R4

BUS RESPONSE (SRQ)	
M0	SRQ off
M1	SRQ on
Pwr On/DCL/SDC	Default M0

TRIGGER MODES (Same for Channels A and B)	
T0	Continuous on talk
T1	One Shot on talk
T2	Continuous on GET
T3	One Shot on GET
T4	Continuous on "X"
T5	One Shot on "X"
Pwr On/DCL/SDC	Default T0

DATA FORMATS (Same for Channel A and B)	
D0	ASCII
D1	Binary
Pwr On/DCL/SDC	Default D0

DATA TERMINATORS	
Y <DEL>	No terminator
Y <CR>	<LF> CR> dual terminators
Y <LF>	< CR >< LF > dual terminators
Y <CHAR>	CHAR any 8 bit ASCII value except reserved letters, F, R, M, T, D, Q, Y, S, P, Z, N, U, X
Pwr On/DCL/SDC	Default Y <LF>
Note: <CR> = $0D_H$ <LF> = $0A_H$	

DATA STORAGE BUFFER	
Q0	Buffer No Readings
Q1	Buffer 10 Readings
Q2	Buffer 20 Readings
Q3	Buffer 30 Readings
Q4	Buffer 40 Readings
Q5	Buffer 50 Readings
Pwr On/DCL/SDC	Default Q0
Note: T5 not usable with buffer on.	

FILTER	
P0	Filter Off
P1	Filter On
Pwr On/DCL/SDC	Default P0

ZERO CHECK	
C0	Zero Check Off
C1	Zero Check On
Pwr On/DCL/SDC	Default C1

READING RATES

	Conversions Averaged	Integration Period (ms)	Display Digits
S0	1	4.1	3½
S1	1	16.66 (20ms, 50Hz)	4½
S2	2	16.66 (20ms, 50Hz)	4½
*S3	4	16.66 (20ms, 50Hz)	4½
S4	1	100	5½
*S5	2	100	5½
S6	4	100	5½
S7	8	100	5½
S8	16	100	5½
S9	32	100	5½

*Only ones available with front panel resolution switch.
Pwr On/DCL/SDC = Default S3
50/60Hz operation internally switch selected.

ZERO CORRECT	
Z0	No Correction
Z1	Make Correction
Pwr On/DCL/SDC	Default Z0

BASELINE STORE	
N0	No store
N1	Store reading
Pwr On/DCL/SDC	Default N0

BASELINE SUPPRESSION	
U0	Suppress off
U1	Suppress on
Pwr On/DCL/SDC	Default U0

EXECUTE	
X	EXECUTE COMMAND LINE

1. Only commands to be changed need to be programmed.
2. All commands are executed after X is given.

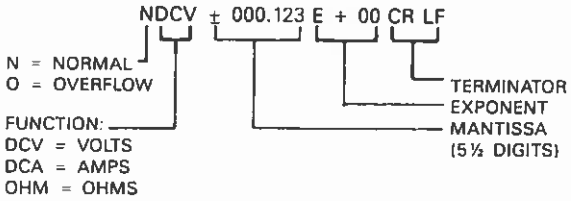
SAMPLE COMMAND STRINGS

1. Ohms, Filter on: F2P1X
2. One Shot on TALK, binary data: T1D1X
3. Auto Range with Zero Check off: R0C0X
4. Amps, buffer 20 readings, Trigger continuous on X, ASCII data: F1Q2T4D0X
5. Baseline suppress a reading: N1U1X

DEFAULT CONDITIONS (Power Up/DCL/DCS)

MODE	STATUS (see Machine status word)
Function	F0 = Volts
Range	R4 = 200V
Bus Response	M0 = SRQ off
Trigger	T0 = Continuous on talk
Data Format	D0 = ASCII format
Terminator	Y <LF> = CR LF
Data Storage	Q0 = Disabled
Filter	P0 = Filter off
Zero Check	C0 = Disabled
Reading Rate	S3 = 4½ Digits, 4 averaged conversions
Zero Correct	Z0 = No Correction
Baseline Store	N0 = No Storage
Baseline Suppression	U0 = Suppress off

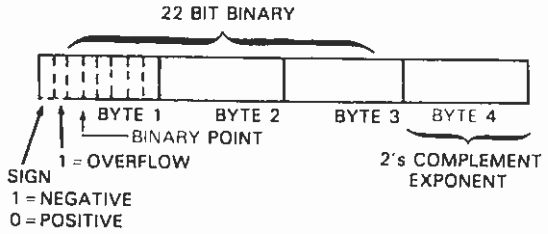
ASCII DATA FORMAT (D0)



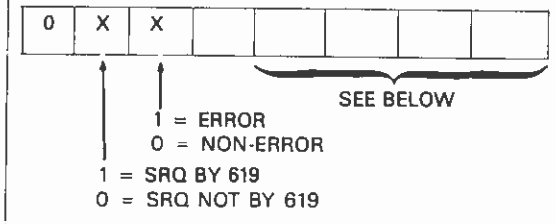
EXAMPLES:

1. D0, F0, Y<LF>: NDCV + 000.100E+00<CR><LF>
2. D0, F1, Y<LF>: NDCV - 00.2300E - 09<CR><LF>
3. D0, F2, Y<LF>: NOHM + 1.23456 + 12<CR>< F>
4. D0, F0, Y<LF>: ODCV + 000.190E + 00<CR>< F>

BINARY DATA FORMAT (D1)



SRQ STATUS BITS [Secondary Address (\$66)]



D6 = 1 (ERROR)

Value	Meaning	Display
0	Illegal device-dependent command.	iddC
1	Illegal device-dependent command option.	iddCO
2	Attempt to program when not in remote.	no rn
3	No zero check with 2A.	no 2AC
4	No zero correct without zero check.	Corr IL
5	Spare	
6	No autoranging in this range.	no AU
7	Spare	
8	Invalid string with baseline store.	ISbS

D6 = 0 (Non-error)

Value	Meaning	Display
0	Normal Reading	—
1	Overflow Reading	OFLO
2	Spare	—
3	Spare	—
4	Spare	—
5	Buffer Full	—

MACHINE STATUS CH. A [Secondary Address 3 (\$63)]

BYTE POSITION 0	+1	+2	+3
ZERO CORRECT	FILTER	ZERO CHECK	FUNCTION
Z	P	C	F
+4	+5	+6	+7
RANGE	MODE	RATE TYPE	DATA
R	M	S	D
+8	+9	+10	+11
TRIGGER	BASELINE STORE	BASELINE SUPPRESS	AUTO RANGE
T	N	U	
+12	+13	+14	+15
INT PERIOD	TERMI–NATOR	50/60 Hz	#READINGS TO AVE.
Y			

MACHINE STATUS CH. B (Secondary Address 4 ($64)]

BYTE POSITION			
0	+1	+2	+3
ZERO CORRECT	FILTER	ZERO CHECK	FUNCTION
Z	P	C	F
+4	+5	+6	+7
RANGE	MODE	RATE TYPE	DATA
R	M	S	D
+8	+9	+10	+11
TRIGGER	BASELINE STORE	BASELINE SUPPRESS	AUTO RANGE
T	N	U	
+12	+13	+14	+15
INT PERIOD	TERMI– NATOR	BUFFER STATE	#READINGS TO AVE.
	Y	Q	

For example, after power on, Channel A status word would read in 60Hz operation in ASCII: 0010403000004:02; in 50Hz operation: 0010403000008:?2.

UNIVERSAL COMMANDS

DCL: Go To Default conditions.
LLO: Front panel switches no longer active.
SPD: Disable serial polling.
SPE: Enable serial polling.
UNT: Put 619 in talker idle state.
UNL: Put 619 in listener idle state.

ADDRESS COMMANDS

SDC: If addressed to listen, same as DCL.
GET: If addressed to listen, trigger conversion.

UNILINE COMMANDS

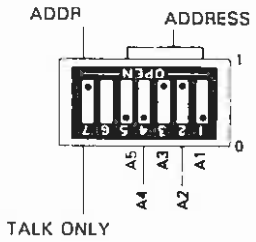
IFC: Asserted, go to talker, listener idle state.
REN: Asserted, go to remote programming state.
EOI: Asserted during last byte of multibyte transfer.
SRQ: Asserted to request service from controller.
ATN: Asserted when addressed or universal command on bus.

TALK-ONLY/ADDRESSABLE MODE SELECTION

DESCRIPTION

In the talk-only mode, the Model 619 may be used with a listen-only device such as a printer. To use the instrument in this manner, set the TALK ONLY/ADDR switch on the rear panel to the TALK ONLY position (see below).

To program the instrument over the bus, this switch must be in the ADDR position. Note that the switch is read only upon power up.



PRIMARY ADDRESS SELECTION

DESCRIPTION

The primary address of the Model 619 is set to 6 at the factory, but it may be changed to other values between 0 and 30 by setting the ADDRESS DIP switches to the correct values, as indicated below. Note that 31 is reserved for UNL (Unlisten) and UNT (Untalk) commands and must not be used, even though it is possible to set the DIP switches for that address.

Primary Address	Address Switches				
	A5	A4	A3	A2	A1
0	0	0	0	0	0
1	0	0	0	0	1
2	0	0	0	1	0
3	0	0	0	1	1
4	0	0	1	0	0
5	0	0	1	0	1
6*	0	0	1	1	0
7	0	0	1	1	1
8	0	1	0	0	0
9	0	1	0	0	1
10	0	1	0	1	0
11	0	1	0	1	1
12	0	1	1	0	0
13	0	1	1	0	1
14	0	1	1	1	0
15	0	1	1	1	1
16	1	0	0	0	0
17	1	0	0	0	1
18	1	0	0	1	0
19	1	0	0	1	1
20	1	0	1	0	0
21	1	0	1	0	1
22	1	0	1	1	0
23	1	0	1	1	1
24	1	1	0	0	0
25	1	1	0	0	1
26	1	1	0	1	0
27	1	1	0	1	1
28	1	1	1	0	0
29	1	1	1	0	1
30	1	1	1	1	0

*Factory Default

SECONDARY ADDRESSING

DESCRIPTION

A secondary address, when sent to the instrument, selects the channel to be programmed or accessed, obtains machine status from either channel, or obtains the instrument's status byte. Secondary addresses for these operations are summarized below.

SECONDARY ADDRESSING

Operation	Address	HEX
CHANNEL A LISTEN	1	61_H
CHANNEL A TAK	1	61_H
CHANNEL B LISTEN	2	62_H
CHANNEL B TALK	2	62_H
MACHINE STATUS CH. A	3	63_H
MACHINE STATUS CH. B	4	64_H
STATUS (SRQ) BYTE	6	66_H

NOTE: Address is value generally used in controller's programming language. Hex value is the byte actually sent over bus.

PROGRAMS

The following programs are written as a simple aid to the user and are not intended to suit specific needs. Detailed programming instructions may be found in the Model 619 Instruction Manual.

These programs allow you to send a device-dependent command string to the instrument and obtain and display the instrument data string on the computer CRT. Each program provides an ASCII string variable (A$) of the form:

NDCV + 0.00000E+00 CR LF

A note at the end of each program indicates modifications to convert the data string to a numeric variable (A) in exponential form:

+0.00000E+00

IBM XT or PC (Keithley 8573 GPIB Interface)

The following program sends a command string to the Model 619 and displays the reading on the computer CRT. The IBM PC computer must be equipped with the Keithley Model 8573 IEEE-488 interface and DOS 2.0. The Model 8573 software must be configured as described in the Model 8573 Instruction Manual.

DIRECTIONS

1. Set the Model 619 to the addressable mode, primary address 6 with the rear panel DIP switches.
2. With the power off, connect the instrument to the IEEE-488 interface located in the IBM computer.
3. Boot the computer using the Model 8573 working disk (see instruction manual).
4. Type BASICA to enter the IBM BASIC interpretive language.
5. Load the DECL.BAS file from the Model 8573 software diskette and modify lines 1 and 2 in accordance with directions found in the instruction manual.
6. Add the lines below to the program now in memory.
7. Run the program and type in a command string when prompted to do so. For example, to program the instrument for the 2V range, type in F0R2X and press the return key.
8. The computer CRT will display the instrument reading string. For example, the display will show NDCV + 0.00000E+00 for 0 volts in.
9. Type in "EXIT" and press return to end the program.

PROGRAM	COMMENTS
10 NA$ = "GPIB0":CALL IBFIND (NA$,BRD0%)	Find the board number.
20 NA$ = "DEV6":CALL IBFIND (NA$,M619%)	Find the 619 number.
30 V% = &H61:CALL IBSAD (M619%,V%)	Set secondary address.
40 V% = 1:CALL IBSRE (BRD0%,V%)	Set REN true.
50 INPUT"COMMAND";CMD$	Prompt for command string.
60 IF CMD$ = "EXIT" THEN 140	See if program is to be halted.
70 IF CMD$ = "" THEN 50	If null command string go back and get another.
80 CALL IBWRT(M619%,CMD$)	Address 619 to listen and send command string.
90 RD$ = SPACE$(25)	Assign reading input buffer.
100 CALL IBRD(M619%,RD$)	Address 619 to talk and input reading string.
110 RD$ = LEFT$(RD$,IBCNT%)	Trim string to proper size.
120 PRINT RD$	Display the reading on the CRT.
130 GOTO 50	Repeat.
140 V% = 0:CALL IBONL (M619%,V%)	Close the instrument file.
150 CALL IBONL(BRD0%,V%)	Close the board file.
160 END	

NOTE: If conversion to numeric variable is required, change lines 110 and 120 as follows:

```
110 RD = VAL(MID$(RD$,5,16))
120 PRINT RD
```


APPLE II (APPLE Interface)

The program below obtains one reading from the Model 619 and displays the reading on the APPLE II screen, using an APPLE IEEE-488 interface.

DIRECTIONS

1. Set switches on the Model 619 to addressable mode, primary address 6.
2. Connect the Model 619 to APPLE II and APPLE IEEE-488 interface.
3. Enter the program below using the RETURN key after each line.
4. Type in RUN.
5. The display will read "TEST SETUP".
6. To program the Model 619 to the 2V range and take a reading, type in F0R2X and depress the RETURN key.
7. Display will read NDCV + 0.00000E+00 for "0" volts in.

PROGRAM	COMMENTS
10 Z$ = CHR$(26)	
20 INPUT "TEST SETUP?";B$	Enter programming command. (Example: 2V range = F0R2X.)
30 PR#3	Send output to IEEE bus.
40 IN#3	Get input from IEEE bus.
50 PRINT "RA"	Turn remote on.
60 PRINT "WT&";CHR$(97); Z$;B$	Output programming command to 619.
70 PRINT "LF1"	Linefeed on.
80 PRINT "RDF";CHR$(97); Z$;:INPUT" ";A$	Read data from 619.
90 PRINT "UT"	Untalk.
100 PR#0	Send output to CRT.
110 IN#0	Get input from keyboard.
120 PRINT A$	Display data string.
130 GO TO 20	Repeat

NOTE: If conversion to numeric variable is desired, add the following:

124 A = VAL(MID$(A$,5,16))	Convert string to numeric value.
126 PRINT A	

HP 85

The program below obtains one reading from the Model 619 and displays the reading on the HP 85 CRT screen, using the 82937A GPIB interface and an I/O ROM.

DIRECTIONS

1. Set switches on the Model 619 to addressable mode, primary address 6.
2. Connect the Model 619 to the HP 82937A IEEE interface.
3. Depress SHIFT SCRATCH and then depress END LINE to erase previous program.
4. Enter program below using the END LINE key after each line is typed. (Type in line numbers.)
5. Depress the RUN key.
6. The display will read "TEST SETUP".
7. To program the Model 619 to the 2V range and take a reading, type in F0R2X and depress the END LINE key.
8. Display will read NDCV + 0.00000E+00 for "0" volts in.

PROGRAM	COMMENTS
10 REMOTE 7	Set REN low.
20 DISP "TEST SETUP"	Prompt for test setup.
30 INPUT A$	
40 SEND 7; UNL MTA LISTEN 6 SCG 1	Address 619 to listen.
50 OUTPUT 7 USING "#,K";A$	Send command to 619.
60 SEND 7; UNT MLA TALK 6 SCG 1	Address to talk.
70 ENTER 7; B$	Get data string.
80 SEND 7; UNL UNT	Untalk, Unlisten bus.
90 DISP B$	Display data.
100 GO TO 20	Repeat
110 END	

NOTE: If conversion to numeric variable is needed, change lines 70 and 80 as follows:

```
70 ENTER 7; B
80 DISP B
```


HP 9825A

The program below obtains one reading from the Model 619 and displays the reading on the HP 9825A using a 98034A HPIB interface and a 9872A extended I/O ROM.

DIRECTIONS

1. Set switches on the Model 619 to addressable mode, primary address 6.
2. Connect the Model 619 to HP 9825A and 98034A HPIB interface.
3. Enter program below, using the STORE key after each line.
4. Depress the RUN key.
5. The display will read "TEST SETUP".
6. To program the Model 619 to the 2V range and take a reading, type in F0R2X and depress the CONT key.
7. Printer will read NDCV + 0.00000E+00 for "0" volts in.

PROGRAM	COMMENTS
0 dim A$[20], B$[20]	To dimension data string.
1 dev "Emma",70601	Define Model 619 Channel A address.
2 rem "Emma"	Set to remote.
3 ent "TEST SETUP",A$	Enter programming command. (Example: 2V range = F0R2X.)
4 wrt "Emma",A$	Output program command to Model 619 via IEEE bus.
5 red "Emma",B$	Read data from Model 619 via IEEE bus.
6 prt B$	Print data on hard copy printer.
7 gto 3	Repeat

NOTE: If conversion to numeric variable is desired, omit line 6 and substitute:

6 "e"-B$[13,13];flt5	Convert to numeric value.
7 prt val(B$[5])	
8 gto 3	Repeat

HP 9816

The following program sends a command string to the Model 619, obtains a reading, displays it on the HP 9816 screen, using BASIC 2.0.

DIRECTIONS

1. Set switches on the Model 619 to addressable mode, primary address 6.
2. With power off, connect the Model 619 to the HP 9816.
3. Type EDIT and press the EXEC key.
4. Type in the program below using the ENTER key after each line is typed.
5. Press the RUN key.
6. The display will read "TEST SETUP".
7. To program the Model 619 to the 2V range and take a reading, type in F0R2X and depress the ENTER key.
8. The display will read NDCV + 0.00000E+00 for "0" volts in.

PROGRAM	COMMENTS
10 REMOTE 7	Set up Model 619 to remote.
20 INPUT "TEST SETUP",A$	Get command string.
30 SEND 7;UNL MTA LISTEN 6 SEC 1	Address 619 to listen.
40 OUTPUT 7 USING"#,K";A$	Send command string to 619.
50 SEND 7;UNT MLA TALK 6 SEC 1	Address 619 to talk.
60 ENTER 7;B$	Get reading string from 619.
70 SEND 7;UNT UNL	Untalk and unlisten the bus.
80 PRINT B$	Display reading.
90 GOTO 20	Repeat
100 END	End of program.

NOTE: For conversion to numeric variable, change line 60 and 80 to:

```
60 ENTER 7;B
80 PRINT B
```


DEC LSI 11

The program below obtains one reading from the Model 619 and displays the reading on the DEC LSI 11 microcomputer CRT terminal. The LSI 11 must be hardware configured with 16k words of RAM and an IBV 11 IEEE interface. The software must be configured with IB software as well as the FORTRAN and the RT 11 operating system.

DIRECTIONS

1. Set switches on the Model 619 to addressable mode, primary address 6.
2. Connect the Model 619 to the IBV 11 IEEE cable.
3. Enter the program below, using the editor under RT 11 and the name IPHILD.
4. Compile using the FORTRAN compiler as follows: FORTRAN IPHILD
5. Link with the system and IB libraries as follows: LINK IPHILD, IBLIB
6. Type RUN IPHILD and depress the RETURN key.
7. The display will read "ENTER ADDRESS". (Enter 6, 1 for channel A address.)
8. To program the Model 619 to the 2V range and take a reading, type in F0R2X and depress RETURN key.
9. Display will read NDCV + 0.00000E+00 for "0" volts in.

PROGRAM IPHILD	COMMENTS
INTEGER*2 PRIADR, SECADR	
LOGICAL*1 MSG(80), INPUT(80)	
DO 2I = 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 sec. bus timeout.
CALL IBTERM ("10)	!Set LF as terminator.
CALL IBREN	!Turn remote on.
4 TYPE 5	
5 FORMAT (1X,'ENTER ADDRESS',$) ACCEPT 10, PRIADR SECADR	!Input the address 6.
10 FORMAT (214)	
12 TYPE 15	
15 FORMAT (1X, 'TEST SETUP',$)	!Prompt for the test setup.
SECADR = SECADR + 200	
CALL GETSTR (5,MSG,72)	!Get the test setup.
CALL IBSEOI (MSG, – 1), PRIADR, SECADR)	!Program the 619.
18 I = IBRECV (INPUT,80), PRIADR,SECADR)	!Get the data from the 619.
INPUT (I + 1) = 0	
CALL PUTSTR (7, INPUT, '0')	
CALL IBUNT	!Untalk the 619
GO TO 12	!Repeat
END	

PET/CBM 2001

The program below obtains one reading from the Model 619 and displays the reading on the PET/CBM 2001 Series.

DIRECTIONS

1. Set switches on the Model 619 to addressable mode, primary address 6.
2. Connect the Model 619 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 "TEST SETUP".
6. To program the Model 619 to the 2V range and take a reading, type in F0R2X and depress the RETURN key.
7. Display will read NDCV + 0.000000E+00 for "0" volts in.

PROGRAM	COMMENTS
10 OPEN 6,6,1	Open file 6, primary address 6, secondary address 1.
20 INPUT "TEST SETUP";B$	Enter programming command. (Example: 2V range = F0R2X.)
30 PRINT #6,B$	Output to the IEEE bus.
40 INPUT #6,A$	Read data from Model 619 via IEEE bus.
50 IF ST = 2 THEN 40	If time out, input again.
60 PRINT A$	Print data.
70 GO TO 20	Repeat

NOTE: If conversion to numeric variable is desired, omit line 60 and type the following:

70 A = VAL(MID$(A$,5,16))	Convert string to numeric value.
80 PRINT "A = ";A	
90 GO TO 20	Repeat