# INTRODUCTION

This quick reference guide contains information on front panel operation and IEEE-488 programming of the Model 199 System DMM as well as the optional Model 1992 Scanner. Also included are programming examples for various IEEE-488 controllers.

# CONTENTS

# SAFETY PRECAUTIONS

1. Before operation, ground the instrument through a proper-
   ly earth grounded power receptacle.

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

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

4. Do not exceed the maximum input levels as stated in the
   specifications for the instrument (see the Model 199 In-
   struction Manual).

5. Use the special precautions listed in paragraph 2.6 of the
   Model 199 Instruction Manual when testing high-energy
   circuits.

# CONTROL SUMMARY

## TRIG SETUP

SHIFT/TRIG SETUP to enter menu.

NEXT to scroll to next menu option.

Trigger ▲/▼

    CONTINUOUS: Reading, scanning, and storing rates controlled by INTERVAL.

    ONE SHOT.

DELAY          0sec to 999.999sec

INTERVAL ▲/▼

    SELECT OFF: Interval ≥175msec, depending on other programmed parameters.

    SELECT ON: User-programmed interval (15msec to 999.999sec).

## DMM SETUP

SHIFT/DMM SETUP to enter menu.

NEXT to scroll to next menu option.

REV          Displays current software revision level.

MUX ▲/▼

    MUX OFF: Turns off autocal routines for faster reading rates.

    MUX ON: Recommended for best accuracy.

IEEE         Use numeric keys to program IEEE-488 primary address (0-30).

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FREQ    ▲/▼    ⌈   FREQ=50HZ. Line frequency.

               ⌊   FREQ=60HZ. Line frequency.

SAVE    ▲/▼    ⌈   SAVE     YES:     Saves     present configuration.

               ⌊   SAVE NO

LEDS    ▲/▼    ⌈   LEDS ON: Test front panel LEDs and annunciators.

               ⌊   LEDS OFF

DEBUG    ▲/▼    ⌈   DEBUG YES: Enter troubleshooting mode.

               ⌊   DEBUG NO

RESET    ▲/▼    ⌈   RESET YES: Returns unit to factory default configuration.

               ⌊   RESET NO

## SCAN SETUP

SHIFT/SCAN SETUP to enter menu.

NEXT to scroll to next menu option.

POLE    ▲/▼    ⌈   2 POLE

               ⌊   4 POLE

Mode    ▲/▼— MANUAL: Allows channel to be manually closed with SCANNER key.

STEP: Increments one channel per interval or trigger.

SCAN: Scans one set of channels per interval or trigger (minimum time between channels).

RATIO    ▲/▼ — ON: Channels 2 through 8 referenced to channel 1.

OFF

- Ratio operates only on a fixed range.
- Range changes will restart at channel 1.
- In MANUAL, at least one reading must be taken on channel 1 before attempting to display ratio on channels 2-8

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# DISPLAY MESSAGES

| Message | Description |
|---------|-------------|
| OVERFL | Overrange |
| NO RANGE | Pressing range button while in dB |
| NO FUNC | Invalid shifted function entry. |
| SHIFT | Shift mode in effect. |
| AC ONLY | Selecting dB with unit not in AC. |
| TRIGGER OVERRUN | Unit triggered before reading is done. |
| INTERVAL OVERRUN | Interval too short for present configuration. |
| UNCAL | EEPROM failure upon power up. |
| NO DATA | No data in data store when recalling. |
| NO SCANNER | Pressing SCANNER or SCAN SETUP with no scanner. |
| CAL LOCKED | Attempting calibration with calibration locked. |
| CHAN 4 MAX | Channel 4 limit (4-pole) |
| CHAN 8 MAX | Channel 8 limit (2-pole) |
| CONFLICT | Invalid state when calibrating. |
| NO REMOTE* | Unit not in remote when programming over bus. |
| IDDC* | Illegal device-dependent command. |
| IDDCO* | Illegal device-dependent command option. |
| BIG STRING* | String longer than 10 characters with D command. |
| TRANSERR* | Translator error. |

*IEEE-488 bus programming only.

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# TRIGGERING

**Continuous**

1. Press SHIFT TRIG SETUP then uprange or downrange to select CONTINUOUS trigger mode.
2. Press NEXT and then program desired trigger delay (delay affects only first reading in continuous).
3. Press NEXT and then use uprange/downrange for SELECT OFF (175msec) or user-progammed (SELECT ON). Key in interval (15msec-999.999sec) if selected, then press NEXT.
4. Unit displays readings at programmed intervals. "INTER-VAL OVERRUN" message indicates programmed interval is too short for present instrument configuration (with data store or scanner only).

**One Shot**

1. Press SHIFT TRIG SETUP then uprange or downrange to select ONE SHOT trigger mode.
2. Press NEXT, and then program desired trigger delay (delay affects each reading in one shot).
3. Press NEXT to return to normal display.
4. Press TRIGGER or apply pulse to TRIGGER INPUT to initiate reading. One trigger per reading is required in one shot.

# DATA STORE

## Continuous Data Storage

1. Program the continuous trigger mode and desired interval using TRIG SETUP.
2. Press SHIFT STORE to enter data store..
3. Program the number of readings to store (size) in the range of 1 to 500, or select a size of 000 for wrap-around data store operation.
4. Press NEXT to return to normal display.
5. Press TRIGGER to initiate data storage. RCL will blink when all readings have been stored.
6. Press any function button to turn off data store.

## One-shot Data Storage

1. Program the one-shot trigger mode using TRIG SETUP.
2. Press SHIFT STORE to enter data store.
3. Program the number of readings (size) in the range of 1 to 500, or select a size of 000 for wrap-around storage.
4. Press NEXT to return to normal display.
5. Press TRIGGER to trigger reading and store it. One trigger per reading is required in the one-shot trigger mode.
6. RCL will flash when all readings have been stored.
7. Press a function key to cancel data storage.

**Recalling Data**

1. Press SHIFT RECALL to enter the recall mode. The unit will display the last stored reading number.
2. Press NEXT to display the reading.
3. Use uprange or downrange to scroll through readings. The scroll rate becomes more rapid after holding button in.
4. Press RECALL to display reading number, then press NEXT to return to reading.
5. Press NEXT to exit recall.

# DMM SETUP

Press SHIFT-DMM SETUP to access modes below. Use NEXT to scroll through setup menu.

REV—Briefly displays current software revision level.

MUX ON/OFF—Use uprange or downrange to select on/off. Operating unit in MUX OFF turns off autocal routines, which speeds up reading rate and minimizes noise spikes at input. Accuracy is reduced in MUX OFF.

IEEE—Use numeric keys to program IEEE-488 primary address (0-30). Use SAVE to permanently change address.

FREQ=50/60HZ—Use uprange or downrange to select operating frequency. Selected frequency must agree with power line frequency for optimum noise performance.

SAVE YES/NO—Select operating modes then SAVE YES to store present instrument configuration. Unit will assume the saved configuration upon power up, or after receiving IEEE-488 DCL or SDC commands.

LEDS ON/OFF—Use uprange or downrange then press NEXT to test front panel LEDS.

DEBUG ON/OFF—Use uprange or downrange then press NEXT to enter diagnostic program. Press any key except TRIGGER to exit program.

RESET YES/NO—Select RESET YES with uprange or downrange to return the unit to factory default conditions. Use SAVE after RESET to restore power up default to factory default conditions.

# SCANNER OPERATION

**Manual Channel Control**

1. Press SHIFT SCAN SETUP, then program 2/4-pole mode with uprange or downrange.
2. Press NEXT, then select MANUAL mode with uprange or downrange.
3. Press NEXT, then select ratio on/off with uprange or downrange.
4. Press NEXT to return to normal display.
5. Press SCANNER followed by the number of the channel to close (1-8). The unit will display the closed channel number in the right-most digit.
6. Press SCANNER 0 to open any closed channel and return to normal operation.

**Step Mode**

1. Press SHIFT SCAN SETUP, and program 2/4 pole mode.
2. Press NEXT, then use uprange/downrange to select STEP mode.
3. Press NEXT, and select ratio on or off as desired.
4. Press NEXT to return to normal operation.
5. For interval scanning, use TRIG SETUP to select continuous trigger mode, delay, and to program the desired interval between channels.
6. For triggered scanning, use TRIG SETUP to select one-shot trigger mode and delay.
7. Press SCANNER, then program the desired channel limit (maximum limit = 4 for 4-pole mode).
8. If interval scanning was selected, the unit will begin scanning one channel per interval. The closed channel will appear in the display.

9. If triggered scanning was selected, press TRIGGER to start the scan. One trigger per channel will be required.
10. To exit the scan mode, press SCANNER 0.

**Scan Mode**

1. Press SHIFT SCAN SETUP, and program 2/4 pole mode.
2. Press NEXT, then use uprange/downrange to select SCAN mode.
3. Press NEXT, and select ratio on or off as desired.
4. Press NEXT to return to normal operation.
5. For interval scanning, use TRIG SETUP to select continuous trigger mode, delay, and to program the desired interval between sets of channels.
6. For triggered scanning, use TRIG SETUP to select one-shot trigger mode and delay.
7. Press SCANNER, then program the desired channel limit (maximum limit = 4 for 4-pole mode).
8. If interval scanning was selected, the unit will begin scanning one set of channels per interval. The closed channel will appear in the right-most digit of the display.
9. If triggered scanning was selected, press TRIGGER to start the scan. One trigger per set of channels will be required.
10. To exit the scan mode, press SCANNER 0.

**Interval Data Store Scanning**

1. Press SHIFT TRIG SETUP, and select CONTINUOUS trigger mode.
2. Press NEXT, and program desired trigger delay (0msec-999.999sec).

3. Press NEXT and choose SELECT OFF (default 175msec) or SELECT ON (user programmed interval, 15msec-999.999sec). For SELECT ON, key in desired interval, then press NEXT.

4. Press SHIFT SCAN SETUP, and select the 2/4 pole mode.

5. Press NEXT, and then use uprange or downrange to select the STEP or SCAN mode, as required.

6. Press NEXT, and program the ratio mode.

7. Press NEXT to return to normal display.

8. Press SHIFT STORE, then program the data store size.

9. Press NEXT to return to normal display.

10. Press Trigger to initiate scanning and storage on channel 1 simultaneously.

### One-shot Trigger Data Store Scanning

1. Press SHIFT TRIG SETUP, and select ONE SHOT trigger mode.

2. Press NEXT, and program desired trigger delay (0msec-999.999sec).

3. Press NEXT to return to normal display.

4. Press SHIFT SCAN SETUP, and select the 2/4 pole mode.

5. Press NEXT, and then use uprange or downrange to select the STEP or SCAN mode, as required.

6. Press NEXT, and program the ratio mode.

7. Press NEXT to return to normal display.

8. Press SHIFT STORE, then program the data store size.

9. Press NEXT to return to normal display.

10. Press TRIGGER to initiate scanning and storage on channel 1 simultaneously. One trigger per channel is required in the STEP mode, and one trigger per set of channels is required in the SCAN mode.

**Determining Scanning Interval**

- Scanning without selecting interval
  - Program INTERVAL SELECT to OFF.
  - Interval is ≥175msec, depending on other selected parameters.
  - INTERVAL OVERRUN message will not be displayed.
- Minimum Interval Time Calculation
  - Interval time is the sum of:
    1. (conversions per channel) × (conversion time)
    2. Programmed DELAY time per channel
    3. Break-before-make time (17msec)
    4. Auto range time (if used)
  - In STEP mode, calculated time above is the INTERVAL setting.
  - In SCAN mode, (sum of 1-4) × (number channels scanned) is the minimum interval setting.

**Scanner Operation Notes**

- When using the scanner with STEP or SCAN switching, the DMM will take readings on each channel as if it were in the one-shot mode whether programmed to CON-TINUOUS or ONE SHOT.
  - Conversions are automatically synchronized to chan-nel closures. Channels will not close in the middle of conversions.
  - Any programmed DELAY is inserted between channel closure and start of conversion (with scanner disabl-ed, DELAY is inserted between trigger and start of conversion).

—Readings on each channel consist of multiple conversions to fill the Running Average User Filter (30 conversions), or Running Average Internal Filter when active (5½d only, varies by range and function; see manual).

- Scanner switching is break-before-make. The time required to change channels is approximately 17msec, which includes break-before-make relay time settling time.
- When using the scanner with ACV or ACA, a DELAY time must be programmed to accomodate AC converter settling time (typically >1sec). See Model 199 specifications.
- The scanner operates with the set of instrument parameters programmed prior to start of scanning. Changing any of these parameters, range function, filter, etc., during scanning will restart the scanner at channel 1. Use autorange if range changes are required while scanning.

**Example of Fast Scanning**

1. Select 3V DC range and function, 4½-digit resolution, FLTR off.
2. Program ONE SHOT trigger.
3. Select SCAN mode.
4. Select SCANNER "8" to set limit to 8.
5. Use TRIGGER to initiate a scan of the set of eight channels.

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# TYPICAL READING TIMES

### Typical 5½ Digit Conversion Times

MUX ON, DCV, ACV, ACA: 110msec (133msec)
MUX OFF: 28msec (33msec)

MUX ON, OHMS, 300kΩ range and lower: 110msec (133msec)
MUX OFF: 63msec (78msec)
(Times in parenthesis are for 50Hz operation)

### Typical Autoranging Times

| | |
|---|---|
| DCV, DCA | 350msec |
| ACV, ACA | 1.4sec |
| OHMS (300kΩ range and lower) | 500msec |

(Times shown are to correct range and do not include conversion times for final reading.)

# DEVICE-DEPENDENT COMMANDS

| Execute | |
|---|---|
| X | Execute other device-dependent commands. |

| Function | |
|---|---|
| F0 | DC volts |
| F1 | AC volts |
| F2 | Ohms |
| F3 | DC current |
| F4 | AC current |
| F5 | ACV dB |
| F6 | ACA dB |

| Range | | | | |
|---|---|---|---|---|
| | DCV | ACV | DCA | ACA |
| R0 | Auto | Auto | Auto | Auto |
| R1 | 300mV | 300mV | 30mA | 30mA |
| R2 | 3V | 3V | 3A | 3A |
| R3 | 30V | 30V | 3A | 3A |
| R4 | 300V | 300V | 3A | 3A |
| R5 | 300V | 300V | 3A | 3A |
| R6 | 300V | 300V | 3A | 3A |
| R7 | 300V | 300V | 3A | 3A |

| Range (Cont.) | | | |
|---|---|---|---|
| | Ohms | ACV dB | ACA dB |
| R0 | Auto | Auto | Auto |
| R1 | 300Ω | Auto | Auto |
| R2 | 3kΩ | Auto | Auto |
| R3 | 30kΩ | Auto | Auto |
| R4 | 300kΩ | Auto | Auto |
| R5 | 3MΩ | Auto | Auto |
| R6 | 30MΩ | Auto | Auto |
| R7 | 300MΩ | Auto | Auto |

| Zero | |
|---|---|
| Z0 | Zero disabled |
| Z1 | Zero enabled |
| Z2 | Zero enabled using a zero value (V) |

| Filter | |
|---|---|
| P0 | Internal and front panel filter disabled |
| P1 | Internal filter enabled |
| P2 | Front panel filter enabled |

| Rate | |
|---|---|
| S0 | 4½-digit resolution, 2.59msec integration period |
| S1 | 5½-digit resolution, line cycle integration (16.67msec, 60Hz; 20msec, 50Hz) |

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| Trigger Mode | |
| --- | --- |
| 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 |
| T6 | Continuous on External Trigger |
| T7 | One-shot on External Trigger |

| Reading Mode | |
| --- | --- |
| B0 | Readings from A/D converter |
| B1 | Individual readings from data store |
| B2 | All readings from data store (buffer dump) |

| Data Store Size | |
| --- | --- |
| I0 | Wrap around data store mode |
| In | Data store of n (n=1 to 500) |

| Interval | |
| --- | --- |
| Q0 | Default interval, 175msec (SELECT OFF) |
| Qn | n=interval in milliseconds (15msec to 999999msec) |

| Value | |
| --- | --- |
| V±nn.nnnn or V±n.nnnnnnE+n | Calibration value, zero value |

| Calibration | |
|---|---|
| C0 | Calibrate first point using value (V) |
| C1 | Calibrate second point using value (V) |
| C2 | Calibrate third point using value (V) |

| Default Conditions | |
|---|---|
| L0 | Restore factory default conditions and save (L1) |
| L1 | Save present machine states as default conditions |

| Data Format | |
|---|---|
| G0 | Reading with prefix. |
| G1 | Reading without prefix. |
| G2 | Reading and buffer location with prefix. |
| G3 | Reading and buffer location without prefix. |
| G4 | Reading and channel with prefix. |
| G5 | Reading and channel without prefix. |
| G6 | Reading, buffer location, and channel with prefix |
| G7 | Reading, buffer location, and channel without prefix |

| SRQ | |
|-----|-----|
| M0 | Disable |
| M1 | Reading overflow |
| M2 | Data store full |
| M4 | Data store half full |
| M8 | Reading done |
| M16 | Ready |
| M32 | Error |

| EOI and Bus Hold-off | |
|-----|-----|
| K0 | Enable EOI and bus hold-off on X |
| K1 | Disable EOI, enable bus hold-off on X |
| K2 | Enable EOI, disable bus hold-off on X |
| K3 | Disable both EOI and bus hold-off on X |

| Terminator | |
|-----|-----|
| Y0 | CR LF |
| Y1 | LF CR |
| Y2 | CR |
| Y3 | LF |

| Status | |
|-----|-----|
| U0 | Send machine status word |
| U1 | Send error conditions |
| U2 | Send Translator word list |
| U3 | Send buffer size |
| U4 | Send current value of "V" |
| U5 | Send input switch status (front/rear) |

| Multiplex | |
|---|---|
| A0 | Auto/Cal multiplex disabled |
| A1 | Auto/Cal multiplex enabled |

| Delay | |
|---|---|
| Wn | n=delay period in milliseconds, (0msec to 999999msec) |

| Self-test | |
|---|---|
| J0 | Test, ROM, RAM, E²PROM |

| Hit Button | |
|---|---|
| Hn | Hit front panel button number n |

| Display | |
|---|---|
| Da | Display up to 10 character message. a=character |
| D | Cancel display mode |

# SCANNER PROGRAMMING COMMANDS

| Scanner Setup | | |
|---|---|---|
| **MANUAL** | | |
| N0 | All channels open | |
| | 2-pole | 4-pole |
| N1 | 1 | 1 |
| N2 | 2 | 2 |
| N3 | 3 | 3 |
| N4 | 4 | 4 |
| N5 | 5 | CHAN 4 MAX ERROR |
| N6 | 6 | CHAN 4 MAX ERROR |
| N7 | 7 | CHAN 4 MAX ERROR |
| N8 | 8 | CHAN 4 MAX ERROR |
| N9 | CHAN 8 MAX ERROR | CHAN 4 MAX ERROR |
| **STEP** | | |
| N10 | Stop scan, all channels open | |
| | 2-Pole Limit | 4-Pole Limit |
| N11 | 1 | 1 |
| N12 | 2 | 2 |
| N13 | 3 | 3 |
| N14 | 4 | 4 |
| N15 | 5 | CHAN 4 MAX ERROR |
| N16 | 6 | CHAN 4 MAX ERROR |
| N17 | 7 | CHAN 4 MAX ERROR |
| N18 | 8 | CHAN 4 MAX ERROR |
| N19 | CHAN 8 MAX ERROR | CHAN 4 MAX ERROR |
| **SCAN** | | |
| N20 | Stop scan, all channels open | |
| | 2-Pole Limit | 4-Pole Limit |
| N21 | 1 | 1 |
| N22 | 2 | 2 |
| N23 | 3 | 3 |

| Scanner Setup (Cont.) | | |
|---|---|---|
| N24 | 4 | 4 |
| N25 | 5 | CHAN 4 MAX ERROR |
| N26 | 6 | CHAN 4 MAX ERROR |
| N27 | 7 | CHAN 4 MAX ERROR |
| N28 | 8 | CHAN 4 MAX ERROR |

| Pole/Ratio | |
|---|---|
| O0 | 2-pole |
| O1 | 4-pole |
| O2 | 2-pole ratio |
| O3 | 4-pole ratio |

| Scan Interval | |
|---|---|
| Q0 | Default 175msec interval (SELECT OFF) |
| Qn | n=interval in msec $(15 \leq 999999\text{msec})$ |

| Trigger Delay* | |
|---|---|
| Wn | n = delay in msec $(0 \leq 999999\text{msec})$ |

*Delay to be used as channel settling time

# DATA FORMAT

## Figure 1. Data Format



Figure 1. Data Format
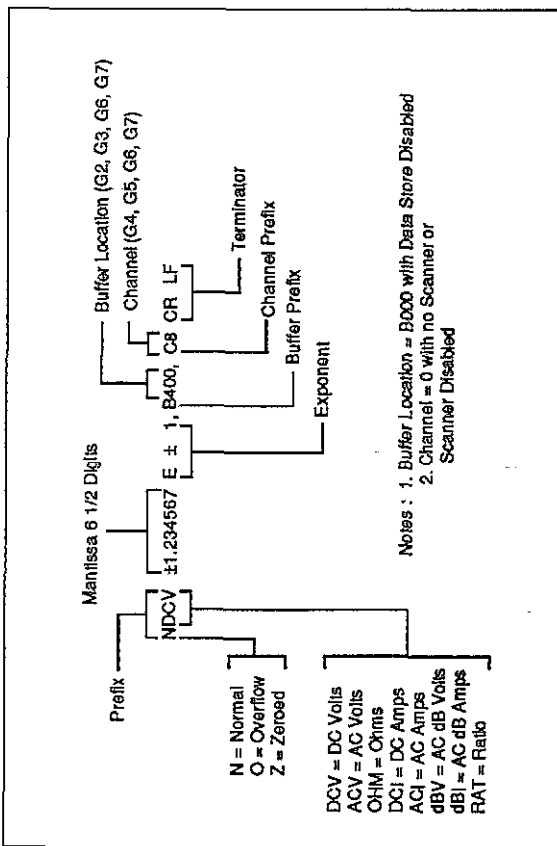
# STATUS WORD FORMATS

**Figure 2. U0 Status Word Format**



Model
Number

```
    199 ABFGJKMMNNOPQQQQQRSTWWWWWYZXX   ┐ 1 = Cal Enabled
Default 199100 0000 00010000000041600000000XX  ┘
                                1 = Scanner Present
```
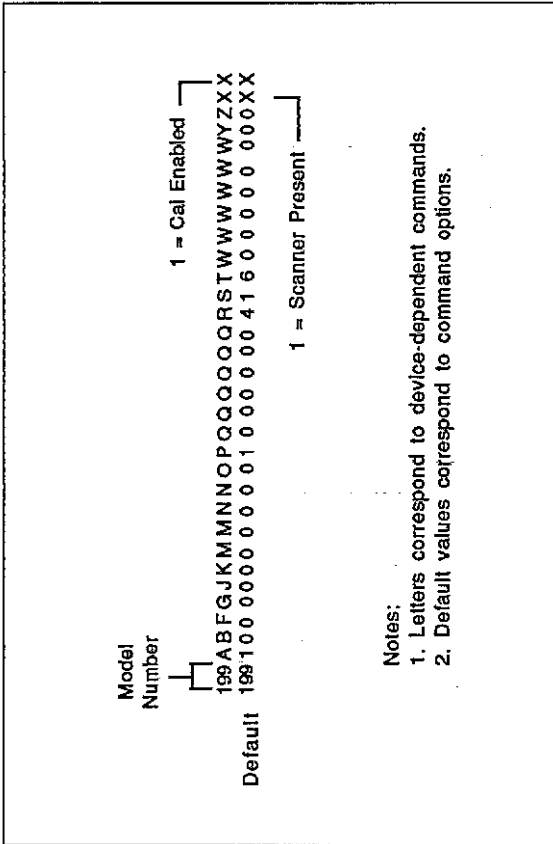
Notes:
1. Letters correspond to device-dependent commands.
2. Default values correspond to command options.
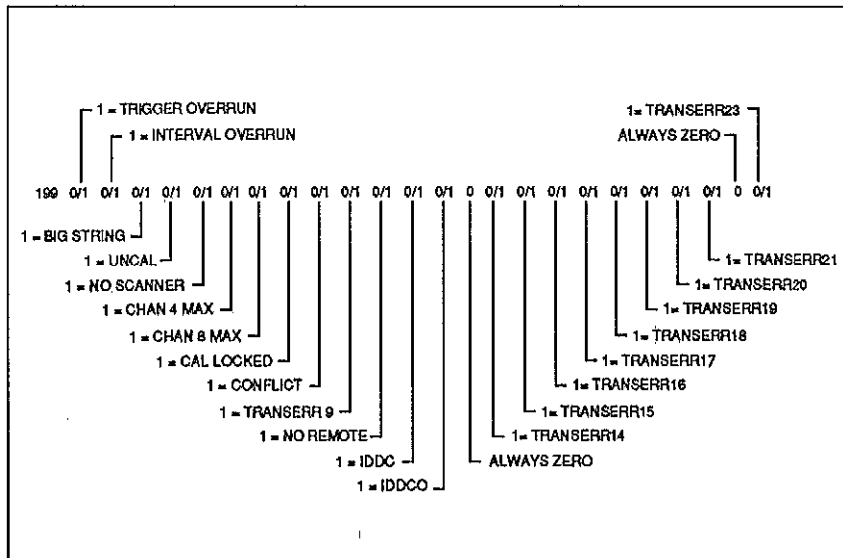
Figure 3. U1 Status Word Format

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## U2-U5 Status Words

| U2 | Returns Translator word list. |
|----|-------------------------------|
| U3 | Returns data store size. |
| U4 | Returns present value programmed with V command in floating point. |
| U5 | Returns INPUT switch status (0= front, 1= rear). |

# SRQ MASK AND
# STATUS BYTE FORMAT

**Figure 4. SRQ and Status Byte Format**

| Bit Position | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
|---|---|---|---|---|---|---|---|---|
| Value | 0 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 | 0/1 |
| Decimal Weighting | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |

1 = RQS
SRQ BY 199
(Status Byte only)
1 = Error
1 = Ready

1 = Reading Overflow
1 = Data Store Full
1 = Data Store Half Full
1 = Reading Done
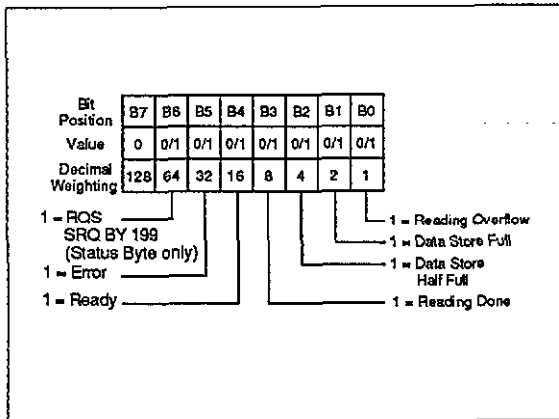
# TRANSLATOR

## Translator Words and Characters

| Translator Word or Character | Description |
|---|---|
| ALIAS | Defines Translator words. |
| ; | Terminates definition string. |
| $ | Wildcard definition character. |
| NEW | Enables Translator. |
| OLD | Disables Translator. |
| SAVE | Saves Translator words as power-up default. |
| LIST | Returns list of Translator words. |
| FORGET | Purges Translator words from memory. |

## Translator Errors

| Display Message | Description |
|---|---|
| TRANSERR 9 | No more Translator memory left. |
| TRANSERR14 | Use of more than one ALIAS in definition. |
| TRANSERR15 | Translator word exceeds 31 characters. |
| TRANSERR16 | Use of X in a Translator word. |
| TRANSERR17 | Defined word already exits. |
| TRANSERR18 | $ character used in definition. |
| TRANSERR19 | ; character sent by itself. |
| TRANSERR20 | LIST used in definition. |
| TRANSERR21 | FORGET used in definition. |
| TRANSERR23 | SAVE used in definition. |

# CONTROLLER PROGRAMS

The following programs have been supplied as a simple aid
to the user and are not intended to suit specific needs. Each
program allows you to send a device-dependent command
string to the instrument and obtain and display an instru-
ment reading string.

# IBM PC OR AT
## (National Instruments GPIB-PC Interface)

The following program sends a command string from an IBM PC or AT computer and displays the instrument reading string on the computer CRT. The computer must be equipped with the National Instruments GPIB-PC IEEE-488 interface and the DOS 2.0 or 3.0 operating system. The GPIB-PC software must be installed and configured as described in the instruction manual.

**DIRECTIONS**

1. From the front panel, set the primary address of the Model 199 to 26.
2. With the power off, connect the Model 199 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 the declaration file; also modify the address in lines 1 and 2, as described in the GPIB-PC instruction manual.
6. Run the program and type in the desired command string. For example, to place the instrument in the ACV function and autorange, type in F1R0X and press the return key.
7. The instrument reading string will then appear on the computer screen. A typical example is: NACV+0.000000E+0.

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| PROGRAM | COMMENTS |
|---|---|
| 10 CLS | Clear screen |
| 20 NA$=``GPIB0'':CALL IBFIND (NA$,BRD0%) | Find board descriptor. |
| 30 NA$=``DEV1'':CALL IBFIND (NA$,M199%) | Find 199 descriptor. |
| 40 V%=26:CALL IBPAD (M199%,V%) | Set primary address to 26. |
| 50 V%=1:CALL IBSRE (BRD0%,V%) | Set REN true. |
| 60 INPUT``COMMAND STRING'';C$ | Prompt for command string. |
| 65 C$=C$+CHR$(13)+CHR$ (10) | Add <CR> <LF> to command string. |
| 70 CALL IBWRT(M199%,C$) | Send command string to 199. |
| 80 R$=SPACE$(25) | Dimension reading input string. |
| 90 CALL IBRD(M199%,R$) | Get reading string from 199. |
| 100 PRINT R$ | Display reading string on CRT. |
| 110 GOTO 60 | Repeat |

NOTES:

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

```
100 R=VAL(MID$(R$,5,12))
105 PRINT R
```

2. In order for Translator to function properly, a <CR> <LF>—sequence must be added to the end of any Translator execution string sent to the instrument. See line 65 above for an example.

# IBM PC OR AT
## CEC PC-488 Interface

The following program sends a command string from an IBM PC or AT computer and displays the instrument reading string on the computer CRT. The computer must be equipped with the Capitol Equipment Corp. PC-488 IEEE-488 interface. The interface card must be set to a memory address of C400$_H$, as described in the PC-488 Instruction Manual.

**DIRECTIONS**

1. From the front panel, set the primary address of the Model 199 to 26.

2. With the power off, connect the Model 199 to the IEEE-488 interface installed in the IBM computer.

3. Turn on the computer, then boot up BASICA.

4. Type in the program lines shown below, using the return key after each line.

5. Run the program and type in the desired command string at the command string prompt. For example, to place the instrument in the ACV function and autorange, type in F1R0X and press the return key.

6. The instrument reading string will then appear on the computer screen. A typical example is: NACV+0.000000E+0.

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| PROGRAM | COMMENTS |
|---------|----------|
| 10 DEF SEG=&HC400 | Set segment address to C400 hex. |
| 20 INIT=0:SEND=9: ENTER=21 | Define call offsets. |
| 30 MY.ADDRESS%=21: CONTROLLER%=0 | Define interface parameters. |
| 40 ADDRESS%=26 | Set 199 address to 26. |
| 50 CALL INIT(MY.ADDRESS% ,CONTROLLER%) | Initialize PC-488. |
| 60 INPUT''COMMAND STRING'';C$ | Prompt for command string. |
| 65 C$=C$+CHR$(13) | Add <CR> to string. |
| 70 CALL SEND(ADDRESS%, C$,STATUS%) | Send command string to 199. |
| 80 R$=SPACE$(25) | Dimension reading input string. |
| 90 CALL ENTER(R$,LENGTH% ADDRESS%, STATUS%) | Get reading string from 199. |
| 100 PRINT R$ | Display reading string. |
| 110 GOTO 60 | Repeat. |

NOTES:

1. To convert from a string to a numeric variable, modify the program as follows:

```
100 R=VAL(MID$(R$,5,12))
105 PRINT R
```

2. For use with a card memory address other than C400$_H$, modify the DEF SEG statement in line 10 accordingly. For example, with a card memory address of C000$_H$, line 10 should be modified as follows:

```
10 DEF SEG=&HC000
```

3. In order for Translator to function properly, a <CR> sequence should be added to the end of any string sent to the Model 199. See the example is line 65 above.

# HP SERIES 200 and 300

The following program sends a command string to the Model 199 from a Hewlett-Packard Series 200 or 300 computer and displays the instrument reading string on the computer CRT. The computer must be equipped with the HPIB Interface and BASIC 2.0, 3.0, or 4.0.

**DIRECTIONS**

1. From the front panel, set the primary address of the Model 199 to 26.
2. With the power off, connect the Model 199 to the HPIB interface installed in the computer.
3. Enter the computer EDIT mode.
4. Enter the lines in the program below, using the ENTER key after each line.
5. Run the program, and type in the desired command string at the command prompt. For example, to place the instrument in ACV and autorange, type in F1R0X and press the ENTER key.
6. The instrument reading string will then appear on the CRT. A typical display is: NACV+0.000000E+0.

| PROGRAM | COMMENTS |
|---------|----------|
| 10 REMOTE 726 | Place 199 in remote. |
| 15 DIM A$[25], B$[25] | |
| 20 INPUT''COMMAND | Prompt for and input |
| STRING'',A$ | command. |
| 30 OUTPUT 726; A$ | Address 199 to listen, |
| | send string. |
| 40 ENTER 726; B$ | Address 199 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 726;B
50 PRINT B
```

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# APPLE II
## APPLE II IEEE-488 Interface

The following program sends a command string to the Model 199 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. From the front panel, set the primary address of the Model 199 to 26.
2. With the power off, connect the Model 199 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 ACV and autorange, type in F1R0X and press the return key.
5. The instrument reading string will then appear on the CRT. A typical display is: NACV+0.00000E+0.

| PROGRAM | COMMENTS |
|---|---|
| 10 Z$=CHR$(26) | Terminator. |
| 20 INPUT''COMMAND STRING ?'';B$ | Prompt for and enter command string. |
| 30 PR#3 | Set output to IEEE-488 bus. |
| 40 IN#3 | Define input from IEEE-488 bus. |
| 50 PRINT ''RA'' | Enable remote. |
| 60 PRINT ''WT:'';Z$;B$ | Address 199 to listen, send string. |
| 70 PRINT ''LF1'' | Line feed on. |
| 80 PRINT ''RDZ'';Z$;: INPUT '' '';A$ | Address 199 to talk, input data. |
| 90 PRINT ''UT'' | Untalk the 199. |
| 100 PR#0 | Define output to CRT. |
| 110 IN#0 | Define input from keyboard. |
| 120 PRINT A$ | Display reading string. |
| 130 GOTO 20 | Repeat. |

NOTES:

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

```
120 A=VAL(MID$(A$,5,12))
125 PRINT A
```

2. The Apple II terminates on commas in the data string. To avoid problems, program the Model 199 for the B0G0 or B0G1 data format to eliminate commas.

# HP MODEL 85

The following program sends a command string to the Model 199 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. From the front panel, set the primary address of the Model 199 to 26.
2. With the power off, connect the Model 199 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 ACV and autorange, type in F1R0X and press the END LINE key.
5. The instrument reading string will then appear on the CRT. A typical display is: NACV+0.000000E+0.

| PROGRAM | COMMENTS |
|---------|----------|
| 10 DIM A$[25],B$[25] | Dimension strings. |
| 20 REMOTE 726 | Place 199 in remote. |
| 30 DISP''COMMAND STRING''; | Prompt for command. |
| 40 INPUT A$ | Input command string. |
| 50 OUTPUT 726; A$ | Address 199 to listen, send string. |
| 60 ENTER 726; B$ | Address 199 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 MODEL 9825A

Use the following program to send a command string to the Model 199 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 199 to 26.
2. With the power off, connect the Model 199 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 ACV and autorange, type in F1R0X and press the CONT key.
5. The instrument reading string will then appear on the computer print out. A typical display is: NACV+0.000000E+0.

| PROGRAM | COMMENTS |
|---|---|
| 0 dim A$[25],B$[25] | Dimension data strings. |
| 1 dev''199'',726 | Define 199 at address 26. |
| 2 rem''199'' | Place 199 in remote. |
| 3 ent''COMMAND STRING'', B$ | Prompt for command string. |
| 4 wrt''199'',B$ | Address 199 to listen, send string. |
| 5 red''199'',A$ | Address 199 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 199 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. From the front panel program feature, set the primary address of the Model 199 to 26.
2. With the power off, connect the Model 199 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 26 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 ACV and autorange, type in F1R0X and press RETURN.
11. The instrument data string will appear on the computer display. A typical display is: NACV+0.000000E+0.

| 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:',$) ACCEPT
      0,PRIADR
   10 FORMAT (I2)
   12 TYPE 15
   15 FORMAT (1X,'TEST SETUP:   Prompt for command
      ',$)                      string.
      CALL GETSTR (5,MSG,72)    Program instrument.
      CALL IBSEOI (MSG,-1,      Address 199 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 199.
      GOTO 12                   Repeat.
      END
```