



◆ PRECISION INSTRUMENTS FOR TEST AND MEASUREMENT ◆



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## WARNING



OBSERVE ALL SAFETY RULES  
WHEN WORKING WITH HIGH VOLTAGES OR LINE VOLTAGES.

**Dangerous voltages may be present inside this instrument. Do not open the case  
Refer servicing to qualified personnel**

### **HIGH VOLTAGES MAY BE PRESENT AT THE TERMINALS OF THIS INSTRUMENT**

WHENEVER HAZARDOUS VOLTAGES (> 45 V) ARE USED, TAKE ALL MEASURES TO  
AVOID ACCIDENTAL CONTACT WITH ANY LIVE COMPONENTS.

USE MAXIMUM INSULATION AND MINIMIZE THE USE OF BARE  
CONDUCTORS WHEN USING THIS INSTRUMENT.

**Use extreme caution when working with bare conductors or bus bars.**

WHEN WORKING WITH HIGH VOLTAGES, POST WARNING SIGNS AND  
KEEP UNREQUIRED PERSONNEL SAFELY AWAY.



## CAUTION



DO NOT APPLY ANY VOLTAGES OR CURRENTS TO THE TERMINALS OF THIS  
INSTRUMENT IN EXCESS OF THE MAXIMUM LIMITS INDICATED ON  
THE FRONT PANEL OR THE OPERATING GUIDE LABEL.

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# Chapter 1

## INTRODUCTION

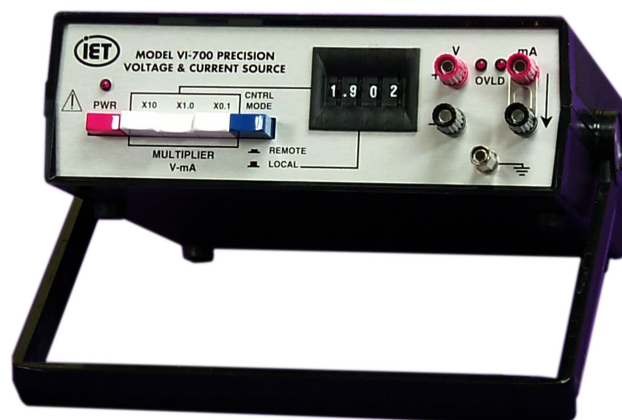
The IET Model **VI-700** (Figure 1.1) is a versatile precision dialable or remotely programmable voltage and current source. Its three ranges provide up to 20 V full scale (200 V with the HV option), and down to 100  $\mu$ V resolution; and 20 mA full scale down to 0.1 mA resolution. Both voltage and current outputs are available simultaneously. The output is set by a range selector and thumbwheel switches in the **LOCAL** mode, or by a digital input at the rear panel. The **REMOTE** mode control can be a BCD parallel or IEEE-488 interface.

The optional **HV** output extends the range of the output voltage to 200 V at 10 mA. It provides an output at the rear panel 10 times higher-than that at the front panel. The optional **HI** feature extends the output current to 200 mA.

The optional, **HP** output extends the output load current capacity to 200 mA for all the voltage ranges. This makes the VI-700 suitable for many precision low to moderate power applications.

The VI-700 offers many full performance features. It fulfills a variety of laboratory needs. Its wide output range (up to 200 V), very low output impedance (5 m $\Omega$ , typical), low noise and ripple, and 200 mA load current capability suit the VI-700 to a variety of applications, such as simulation, calibration, A/D and D/A converter evaluations, and product development.

Front panel overload indicator lamps warn of exceeding of voltage load or current compliance limits. This feature assures the user that the output is within specifications without having to make any measurement or computations. The standard model may still be used within the overload condition and will function for approximately 50-100% overload with only a slight degradation of specifications.



**Figure 1.1: VI-700 Manual or Programmable Voltage and Current Source**

## Chapter 2

# SPECIFICATIONS

For convenience to the user, the pertinent specifications are given in an **OPERATING GUIDE**, shown in Figure 2. 1, affixed to the case of the instrument.

### 2.1 Voltage - Standard

**Output Ranges:**

200 mV, 2 V, 20 V, (200 V with HV Option).

**Resolution:**

100  $\mu$ V, 1 mV, 10 mV,  
(100 mV with HV Option).

**Accuracy:**

$\pm(75 \text{ ppm} + 50 \mu\text{V})$ , 200 mV range;  
 $\pm(75 \text{ ppm} + 0.25 \text{ mV})$ , 2 V range;  
 $\pm(75 \text{ ppm} + 2.5 \text{ mV})$ , 20 V range;  
at 23°C, no load, after warmup.

**Output Current:**

70 mA (200 mA with HP Option), maximum load, with LED overload indicator, for conformance with accuracy specifications; 50-100% current overload output is available with slightly reduced accuracy.

**Output Impedance:**

5 m $\Omega$  typical, 40 m $\Omega$  for 20 V range.

**Noise and Ripple:**

50  $\mu$ V<sub>rms</sub> on 200 mV and 2 V ranges, 100  $\mu$ V<sub>rms</sub> on 20 V range; exclusive of random transients.

**Temperature Coefficient:**

10 ppm/°C typical, 15 ppm/°C maximum.

### 2.2 HP - High Power Option - 200 mA Load Current Capacity

**Output Current:** 200 mA, maximum load, with LED overload indicator, on all ranges.

Since significant current may be drawn from this unit, it is advisable to leave the **mA** terminals open. The current **OVLD** LED will remain on if the **mA** terminals are open, and this indicator may be disregarded. The **OVLD** indicator will be off and will behave normally under normal operation.

### 2.3 HV - High Voltage Option - 200 V Output

**Output Voltage:**

0 to 200 V.

**Resolution:**

1 mV, 10 mV, 100 mV.

**Output Current:**

10 mA (may be increased).

**Accuracy:**

$\pm(0.01\% + 0.5 \text{ LSD})$ ; applies to >20 V.

### 2.4 Current -Standard

**Output Ranges:**

200  $\mu$ A, 2 mA, 20 mA.

**Resolution:**

0.1  $\mu$ A, 1  $\mu$ A, 10  $\mu$ A.

**Accuracy:**

$\pm(75 \text{ ppm} + .05 \mu\text{A})$ ; 200  $\mu$ A;  
 $\pm(75 \text{ ppm} + 0.25 \mu\text{A})$ , 2 mA;  
 $\pm(75 \text{ ppm} + 2.5 \mu\text{A})$ , 20 mA;  
at 23°C, no load, after warmup.

**Compliance:**

0-20 V; with LED overload indicator.



# VI-700 OPERATING GUIDE

CONSULT INSTRUCTION MANUAL FOR PROPER INSTRUMENT OPERATION

VOLTAGE	
OUTPUT RANGES	200 mV, 2 V, 20 V
RESOLUTION	100 $\mu$ V, 1 mV, 10 mV
ACCURACY	$\pm$ (75 ppm + 50 $\mu$ V); 200 mV range; $\pm$ (75 ppm + 0.25 mV), 2 V range; $\pm$ (75 ppm + 2.5 mV), 20 V range; at 23°C, no load, after warmup.
OUTPUT CURRENT	70 mA, maximum load; with LED overload indicator
OUTPUT IMPEDANCE	5 m $\Omega$ typical, 40 m $\Omega$ for 20 V range
NOISE and RIPPLE	50 $\mu$ Vrms on 200 mV and 2 V ranges, 100 $\mu$ Vrms on 20 V range (exclusive of random transients)
TEMPCO	$\pm$ 10ppm/°C typical, $\pm$ 15ppm/°C max.

Traceable to SI

**POWER** 105-125 V, 50-60 Hz; 5 W.

**FUSE** 0.25 A

CURRENT	
OUTPUT RANGES	200 $\mu$ A, 2 mA, 20 mA
RESOLUTION	0.1 $\mu$ A, 1 $\mu$ A, 10 $\mu$ A
ACCURACY	$\pm$ (75 ppm + .05 $\mu$ A); 200 $\mu$ A; $\pm$ (75 ppm + 0.25 $\mu$ A), 2 mA; $\pm$ (75 ppm + 2.5 $\mu$ A), 20 mA; at 23°C, no load, after warmup.
COMPLIANCE	0-20 V; with LED overload indicator

## OPERATION

1. **CNTRL MODE** button has no effect for non programmable units.
2. Make the most secure connection to the V terminals if significant current is drawn.
3. Current **OVLD** LED indicator is on if **mA** terminals are open. **This is of no concern** or leads may be shorted together.
4. The ground terminal is connected to earth ground and may be connected to either **VOLTAGE** terminal.

**MODEL: VI-700 SN: J1-0540317**



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VILBL/p2/VI-700Rev J3/90-100%12-04

Figure 2.1: Typical OPERATING GUIDE Affixed to Unit

## 2.5 HI - High Current Option - 200 mA Output

**Output Current:** 200 mA.  
**Resolution:** 0.1 mA.  
**Accuracy:**  $\pm$ (0.01%+0.75 LSD)

### Compliance:

0- 18 V; with LED overload indicator.

## 2.6 REMOTE Features:

Front panel switch selects **REMOTE** (digital interface) or **LOCAL** (front panel thumbwheel switch) operation. All front panel controls except **POWER** are programmable.

### IEEE-488.2 Interface Option:

IEEE-488.2-1987; SCPI 1994.0;  
"\*IDN" for S/N, Model & REV;  
"CAL:DATE?" for last calibration date.

### RS232 Interface Option:

RS232.SCPI 1994.0;  
"\*IDN" for S/N, Model & REV;  
"CAL:DATE?" for last calibration date;  
25 pin male interface conforming to EIA-STD-RS-530.

## 2.7 General

### Digital Input:

3-1/2 digit parallel BCD or IEEE-488 interface; a front panel pushbutton selects **REMOTE** or front panel thumbwheel operation.

### Operating Temperature Range:

-20°C to +40°C.  
-20°C to +28°C, for HP -High Power Option.

### Power Requirement:

105-125 V or 210-250 V; 50-60 Hz; 5 W.

### Recommended Calibration Interval:

12 months.

### Dimensions:

7.1 cm W x 22.9 cm D x 12.6 cm H  
(8.5"x9.0"x2.8")

with IEEE-488 option:

22 cm W x 24 cm D x 12 cm H  
(8.5"x9.25"x4.44")

### Weight:

1.6 kg (3.5 lb) with no options;  
4.1 kg (9 lb) with HV and IEEE options.

# Chapter 3

## OPERATION

### 3.1 Initial Inspection and Setup

This instrument was carefully inspected before shipment. It should be in proper electrical and mechanical order upon receipt.

An **OPERATING GUIDE**, shown in Figure 2.1, is attached to the bottom of the instrument to provide ready reference to specifications.

### 3.2 Power

#### 3.2.1 AC Line Operation

For a line powered unit, connect the VI-700 to a sounded power outlet. Operation at either 110 or 220 Vac is possible by selecting internal straps. Press the **PWR** switch which is push-on push-release button; the **PWR LED** indicator will light.

### 3.3 Operation Mode: Local or Remote

Operation of the VI-700 Precision Voltage and Current Source is straightforward and is graphically indicated on the front panel.

1. Plug the unit into a sounded ac outlet.
2. Pull out and set the handle for convenient operation.
3. Turn on the **PWR** switch. The **PWR** lamp (as well as the **READY** and **LOCAL** lamps if present with the IEEE-488 option) should come on.

#### 3.3.1 Local Operation

1. Set the **CNTRL MODE** switch to **LOCAL**, i.e. pointing to the thumbwheel switches. The associated **LOCAL** lamp (if present with IEEE-488 option) should come on. For units, without a remote programming option, this switch has no effect.
2. Program the output level manually as described in subsection “Setting of Output Level” below.

#### 3.3.2 Remote Operation, Optional

The VI-700 provides convenient optional remote control operation through a choice of optional IEEE-488 bus control or a parallel BCD signal input.

Optical isolation allows the outputs to be floating and gives the user the option of using the voltage and current outputs in either polarity. They may also be tied to the ground terminal on the front panel.

##### 3.3.2.1 IEEE-488 Control

The VI-700 includes a **REMOTE/LOCAL** switch on the front panel. The **REMOTE** position is a remote *enable*. When in **LOCAL** mode, the VI-700 supplies the output value selected using the front panel thumbwheel switches.

When the switch is in the **REMOTE** position, the VI-700 will supply the remote output value *only if* that option asserts remote control. If the option does

not assert control, the front panel thumbwheel output value is supplied. The **REMOTE** and **LOCAL LEDs** always indicate which interface is controlling the output value.

Setting the front panel **REMOTE/LOCAL** switch to **LOCAL** overrides the **REMOTE** option settings and *always* sets the output to the value selected using the front panel thumbwheels, regardless of the **REMOTE** option's assertion of control.

For IEEE and RS232 units, the **LOCAL** indicator remains on until communication with the unit is initialized. The mode changes to **REMOTE** after controller commands are received.

Set the **MULTIPLIER** on the front panel manually. The **MULTIPLIER** is not under **REMOTE** control.

Set the output level remotely, replacing the front panel thumbwheel setting. See Chapter on IEEE-488 programming.

### 3.3.2.2 BCD Control

Units with a **BCD** option provide a connector on the rear panel for inputting a 3-1/2 digit BCD equivalent of the thumbwheel setting. This digital input is operative whenever the **CNTRL MODE** switch is set to **REMOTE**. The **MULTIPLIER** switches must be manually set.

The digital output pin assignments are given below in Table 3. 1. The digital output connector is a 26 pin header on the rear panel. It may be mated to many popular female connectors such as *3M Company Model 3399*, *GTE Sylvania Inc. Model 6BAXX-26-1XX-Y.X*, *T&B/Ansley Corp. Model 609-2600M* or equivalent. The rear panel connector pin numbering, as the connector is viewed straight on, is also shown in Table 3. 1.

The required input is a 5 V, positive true TTL compatible source.

## 3.4 Setting of Output Level

**IMPORTANT:** The VI-700 must be allowed to warm up for 15 minutes to reach specified accuracy. For maximum stability and minimum drift, allow the unit to warm up for at least one hour.

The front panel controls simultaneously set both the voltage and current output levels. This output may be conveniently and directly read on the front panel. The output in volts and milliamperes is exactly the **MULTIPLIER** setting times the number shown on the thumbwheel switches. For example, a setting of X10 and 1.335 outputs 13.35 V and 13.35 mA; a setting of X0.1 and .025 outputs 2.5 mV and 2.5  $\mu$ A. The range used, i.e. X10, X1, or X0.1, should be the one providing the highest resolution. If 10 mV is required, for example, it should be obtained on the X0.1 range even though it is available on the X1 range. This allows for maximum accuracy even though all settings on an ranges will meet performance specifications.

In the case of a **REMOTE** input being used, it overrides the thumbwheel setting.

## 3.5 Connection to Terminals

Both voltage and current outputs are floating, and in the case of line operated units, may be connected to the earth ground terminal on the front panel.

A voltage of the indicated polarity will be present across the red and black **V** terminals. Be aware that the specified voltage exists **right at the terminals only**. If leads are used to bring this voltage to some remote load, then a voltage drop develops across these leads. Whether this drop is significant or not depends on the amount of current flowing. If, for example, the load is a high input impedance meter or other such device, then the lead potential is safely ignored. If, however, a large amount of current is drawn through the connecting leads, then a significant drop may develop across the leads and various contact resistances. The user should be aware of this and note the following procedures.

Whenever high currents are to be drawn, connections should be made with heavy cables and heavy duty spade terminals or banana plugs securely attached

to the binding posts. If the output voltage is being monitored, then the voltage at the posts *and* at the load should be measured to determine the potential drop between them. These precautions are especially important whenever the X0.1 range is being used, because even very small resistances can result in a significant voltage relative to the least significant digit resolution of that range, i.e. 100  $\mu$ V.

If sensing at the load is desired to virtually eliminate this lead drop, consult IET Labs for instructions on implementing this technique.

In the case of the current output, no such problem exists. The current indicated on the front panel is exactly the current flowing through the test load.

### 3.6 Overload Indicators

In order to provide the user with certainty that the output load capability is not being exceeded and that the VI-700 is performing within specifications, two **OVL**D indicator LED lamps are provided. As long as the appropriate indicator is off, its associated output is accurate as specified.

In the case of the current output, note that it is the *voltage or compliance* across the terminals, which cannot be exceeded, 20 volts in particular. An open circuit is therefore an overload condition and will cause that indicator to go on. This condition can be ignored, or, if desired, a short circuit strap may be placed across the current terminals to turn off this lamp.

In the case of the **HP** - High Power Option - where up to 200 mA may be drawn, a shorting link will cause this current to be constantly drawn from the current terminals if the unit is on a high setting. This could cause overheating, and it is advisable to leave the **mA** terminals open. The current **OVL**D LED will remain on if the **mA** terminals are open, and this indicator may be disregarded. The **OVL**D indicator will behave normally under normal operation.

It is important to realize that the **OVL**D indicators are conservatively set. The output in the overload region may be used as long as care is exercised. The voltage output remains precise for 50-100% current

overload with only a slight degradation in accuracy, of the order of one LSD (least significant digit.) The VI-700 can actually be used as a low power programmable power supply.

If both voltage and current connectors are used to supply power simultaneously to outside loads, one or both overload indicators may come on sooner than at the limits indicated above since they are determined by the total output capability of the instrument.

There is a small amount of hysteresis built into the overload indicator circuits in order to prevent them from flickering as the limit threshold is approached. This requires reducing the load substantially below the limit whenever it is necessary to reset or turn off the indicator.

### 3.7 HP - High Power Option - 200 mA Load Current Capacity (Optional)

A unit with this option may be used in the same way as a standard unit. Caution should be exercised since a significant current is available and could overheat the item under load. The current overload indicator will be on; see the Overload Indicators section above.

### 3.8 HV - High Voltage Option - 200 V Output (optional)

**WARNING**  
**OBSERVE ALL SAFETY RULES**  
**WHEN WORKING WITH HIGH VOLTAGES OR LINE**  
**VOLTAGES.**

#### **HIGH VOLTAGE MAY BE PRESENT AT REAR PANEL WITH HV OPTION.**

The rear output voltage is precisely 10 times the voltage set at the front panel. Up to 10 mA may be drawn. Exceeding that current will **not** turn on the **OVL**D indicator. Consult IET Labs if more current is required.

It is up to the user to consider placing a fuse or a current limiting resistor in series with the **X10 200 V OUTPUT** terminals as a safety measure.

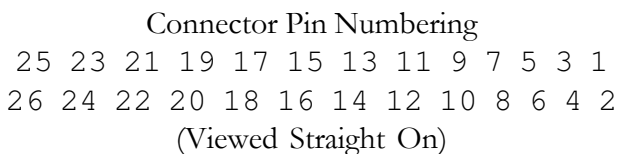
### 3.9 HI - High Current Option - 200 mA Output (optional)

To obtain an X10 higher output current, set the VI-

700 to the X10 Range, and either toggle the 200 mA toggle switch or depress the **200 mA OUTPUT** button switch to **200 mA**. The effective current multiplier becomes X100. The **200 mA** switch must be OFF in order to use the X0.1 and X1 current range.

**Table 3.1 Digital Input Connector Pin Assignments**

PIN NO.	FUNCTION
10	1 bit
12	2 bit
8	4 bit
24	8 bit
5	10 bit
7	20 bit
6	40 bit
20	80 bit
26	100 bit
14	200 bit
16	400 bit
18	800 bit
22	1000 bit
1	No connection
3	Ground
9	No connection
11	No connection
13	No connection
15	No connection
17	No connection
19	No connection
21	No connection
23	No connection
25	No connection
2	No connection
4	No connection



## Chapter 4

# IEEE INTERFACE OPTION

### 4.1 Introduction

The IEEE interface option makes the VI-700 an IEEE-488.2-1987 and SCPI 1994.0 compatible instrument.

The IEEE STD 488.2 covers the electrical and mechanical bus specifications, and state diagrams for each GPIB bus function. It also establishes data formats, common commands for each 488.2 device and controller protocols. The standard is available on-line at <http://www.ieee.org> or by contacting the IEEE at:

IEEE Corporate Office  
3 Park Avenue, 17th Floor  
New York, New York  
10016-5997 U.S.A.  
Tel: +1 212 419 7900

The SCPI standard provides a tree like series of standard commands for programmable instruments so that similar instruments by different manufacturers can be controlled by the same program. SCPI information and a command reference are located in Appendix A.

Other tutorials are available on-line; consult IET for additional information. A software GPIB “keyboard” may be requested from IET to perform elementary commands for training and testing. See Section 5.5.

### 4.2 Capabilities

The IEEE option provides remote control over the output value; it does not control the range.

Decimal Address	SWITCH SETTINGS 5-4-3-2-1	Decimal Address	SWITCH SETTINGS 5-4-3-2-1
0	0-0-0-0-0	16	1-0-0-0-0
1	0-0-0-0-1	17	1-0-0-0-1
2	0-0-0-1-0	18	1-0-0-1-0
3	0-0-0-1-1	19	1-0-0-1-1
4	0-0-1-0-0	20	1-0-1-0-0
5	0-0-1-0-1	21	1-0-1-0-1
6	0-0-1-1-0	22	1-0-1-1-0
7	0-0-1-1-1	23	1-0-1-1-1
8	0-1-0-0-0	24	1-1-0-0-0
9	0-1-0-0-1	25	1-1-0-0-1
10	0-1-0-1-0	26	1-1-0-1-0
11	0-1-0-1-1	27	1-1-0-1-1
12	0-1-1-0-0	28	1-1-1-0-0
13	0-1-1-0-1	29	1-1-1-0-1
14	0-1-1-1-0	30	1-1-1-1-0
15	0-1-1-1-1	31	Reserved, do not use

**Table 4.1 IEEE Bus Address Settings**

### 4.3 Address Switch and Communications Settings

Each GPIB bus device is identified by a five-bit binary address. There are 32 possible primary addresses 0 through 31; addresses 0 and 31 are reserved. The VI-700 **BUS ADDRESS** switch on the rear panel establishes the GPIB address of the unit. Bus address settings are read at power up. Refer to table 4.1.

### 4.4 IEEE Option Operation

The IEEE controller asserts the remote mode upon receipt of a valid command. The **REMOTE LED** will light and impedance settings will be controlled

through the IEEE interface if the **REMOTE/LOCAL** switch is in the **REMOTE** position. Remote control may be dropped by issuing an IEEE GTL command. Dropping remote sets the VI-700 output to the value set on the front thumbwheel switches. See Chapter 3 for information about **REMOTE/LOCAL** functionality.

#### 4.5 GPIB Test Keyboard

To aid the user in operating the VI-700, a GPIB “Keyboard” Controller program - the easiest way to control GPIB devices without writing a program - is available from IET. This GPIB Keyboard program automatically finds your device at start-up and it lets you enter just the data that you want to send to the device. This program works with ICS, Measurement Computing and National Instruments controllers.

To implement, request a download of **ICS\_GPIBkybd\_Install.zip** from IET Labs Tech Support.

Unzip the file and follow instructions to install.

Open the application. You may use the **Find Listeners** button to confirm that the VI-700 unit is recognized. Other instruments may also be recognized at this time.

Enter and set the **Address** to the VI-700 address. Use the window to send a **command string** to the VI-700, where the command string is constructed as described in Chapter 7. A command string might be, for example:

**SOURce:DATA output string**



## Chapter 5

# SERIAL INTERFACE OPTION

### 5.1 Introduction

The SERIAL option adds RS-232C and SCPI 1994.0 capability to the VI-700 series instruments. The SCPI standard provides a tree like series of standard commands for programmable instruments so that similar instruments by different manufacturers can be controlled by the same program. A VI-700 SCPI command reference is included in Appendix A.

Tutorials are available on-line; consult IET for additional information. A software Serial “keyboard” may be requested from IET to perform elementary commands for training and testing. See Section 5.5.

### 5.2 Capabilities

The SERIAL option provides remote control over the output value; it does not control the range.

### 5.3 Signal Interface and Communications Settings

A 25 pin male DTE interface connector conforming with EIA-STD-RS-530 is located on the rear-panel. The default communications parameters are:

Parameter	Default	Range/Choices
Baud	9600	300 - 115,200
Data Bits	8	7 or 8
Stop Bits	1	1 or 2
Parity	None	Odd, Even, None

Connection of a PC to the VI-700 SERIAL option is typically made through a simple null-modem or “LapLink” cable.

IET Pin	RS232	Signal Name	Direction <i>In / Out</i>
1	AA	Chassis	n/a
2	BA	Send Data	⇒
3	BB	Receive Data	⇐
4	CA	Request to Send	⇒
5	CB	Clear to Send	⇐
8	CF	Signal Detected	⇐
20	CD	Data Terminal Rdy	⇒

### 5.4 SERIAL Option Operation

The SERIAL option uses the same command set as the IEEE option. Additional commands exist for configuring the serial interface. Changes to the serial UART take place at power-on or after a reset.

SCPI command strings must be followed by a <CR> to terminate the message. Every command returns a response that includes a message terminator. The program/operator should wait for this message terminator before sending additional commands.

Command characters are not echoed to the interface on power up. Send <CTRL-E> to force the controller to echo commands back to the interface or <CTRL-F> to disable echo.

By default, the controller returns ">" and <LF> as a prompt after executing any command. When echo is turned 'On', the controller returns <CR><LF> and ">" as a prompt after executing any command.

<u>Echo-back</u> <u>Mode</u>	<u>RS232</u> <u>Prompt</u>	<u>Message</u> <u>Terminator</u>
On	CR LF >	CR LF
Off	>LF	LF

## 5.5 Serial Test Keyboard

To aid the user in operating the VI-700, a Serial “Keyboard” Controller program - the easiest way to control serial devices without writing a program - is available from IET. This Serial Keyboard program automatically finds your device at start-up and it lets you enter just the data that you want to send to the device. This program works with ICS, Measurement Computing and National Instruments controllers.

To implement, request a download of:  
**ICS\_Serkybd\_Install.zip**, from IET Labs Tech Support

Unzip the file and follow instructions to install.

Open the application. Initialize the COM PORT and use the Device Command window to send a **command string** to the VI-700, where the command string is constructed as described in Chapter 7. A command string might be, for example:

**SOURce:DATA output string**

# Chapter 6

## PROGRAMMING

### 6.1 Introduction

VI-700 units equipped with IEEE or SERIAL options implement a consistent SCPI interface. A SCPI command reference is included in Appendix A.

### 6.2 Command String Structure

Output is controlled in the form of a single SCPI command followed by a space and a 4 character ) **Output String**. Each character in the string represents the value of one decade, equivalent to one possible manual thumbwheel switch on the front of the unit.

This **Output String** is constructed as:

- The number is in units as in the thumbwheel switch for the range that is selected, e.g. for the X1.0 range, 1 unit represents 1 mV.
- All 4 characters must be provided; they represent 3-1/2 digits; The most significant character may be 0 or 1 (all odd digits in the most significant position will result in a 1 command; all even digits in the most significant position will result in a 0 command)
- The decade values are straight-reading, from left to right. All preceding and trailing zeros must be included to complete 4 characters; any other characters in those spaces will be ignored.
- A decimal point may not be included.
- Combine with the “SOURce:DATA ” command.

For example:

<u>Value</u>	<u>Command</u>
195 mV	SOURce:DATA 0195 in Range X1.0
100.1 mV	SOURce:DATA 1001 in Range X0.1

### 6.3 Determining the VI-700 Configuration

The IEEE 488.2 specification defines the \*IDN string as containing 4 sections separated by commas; the manufacturer, the model, the serial number and the revision of the instrument.

The Model section of the \*IDN string of the VI-700 has been encoded to provide information about the characteristics of the specific instrument being used. For example, a \*IDN query to a VI-700 might return:

```
IET Labs,VI-700-F-4-100m-0-0,K2-0551324,K2
```

In our example above, the Manufacturer section contains “IET Labs”, the Model section contains “VI-700-F-4-100m-0-0”, the Serial Number section “K2-0551324” and the Revision section “K2”.

#### 6.3.1 Instrument Initialization

Reset the unit to power up defaults using \*RST

Check that the instrument is “in cal” by reading the calibration date and compare it to current date/time using CALibrate:DATE?

# Chapter 7

## CALIBRATION

The VI-700 should be calibrated every twelve months or more frequently if inaccurate outputs are suspected.

### 7.1 Equipment Required

1. Precision digital dc voltmeter, 4-1/2 digit, with 0.2 V, 2 V, and 20 V full scale ranges, accurate to better than 0.01%.
2. Precision digital dc ammeter, 4-1/2 digit, with 0.2 mA, 2 mA, and 20 mA full scale ranges, accurate to better than 0.01%.

### 7.2 Disassembly Procedure

**WARNING**

HIGH VOLTAGES EXIST WITHIN THIS INSTRUMENT.  
REFER SERVICING AND CALIBRATION TO QUALIFIED PERSONNEL.  
OBSERVE ALL APPLICABLE SAFETY PRECAUTIONS.

OBSERVE ALL ESD PRECAUTIONS.

Remove the four screws on the bottom of the unit that are inside the feet. Carefully lift off the top cover.

All calibration steps are performed on the printed circuit board. Refer to Figure 5.1 for the locations of the various test points and trimmer potentiometers. In the instructions to follow, the notation “A” refers to an integrated circuit (IC), and an appended number refers to a particular pin on that IC, e.g. 1-A5/2

refers to pin 2 of IC 5 on the main printed circuit board. The notation “T” refers to a trimmer potentiometer.

### 7.3 Calibration Steps

Turn on the VI-700 and allow it to stabilize for one hour.

#### 7.3.1 Voltage Calibration

1. Attach the digital voltmeter (DVM) leads securely to the voltage output binding posts.
2. Set the VI-700 to 0.000 on the X0.1 range.
3. Adjust trimmer 1-T4 to obtain a voltage as close to zero as possible. 50  $\mu$ V or less is satisfactory.
4. Set the VI-700 to 1.799 on the X10 range.
5. Adjust trimmer 1-T1 to obtain a voltage of 17.990 V.
6. Set the VI-700 to 1.799 on the X1 range.
7. Adjust trimmer 1-T3 to obtain a voltage of 1.7990 V.
8. Set the VI-700 to 1.799 on the X0.1 range.
9. Adjust trimmer 1-T5 to obtain a voltage of 179.90 mV.

#### 7.3.2 HV (X10) Output - Optional

The X10 output is calibrated as follows:

1. Set the front panel output to 19.99 V.
2. Monitor the rear panel output.
3. Locate the potentiometer in the center of the PC board attached to the roof of the unit.
4. Adjust the potentiometer until the X10 output voltage is 199.9 V.

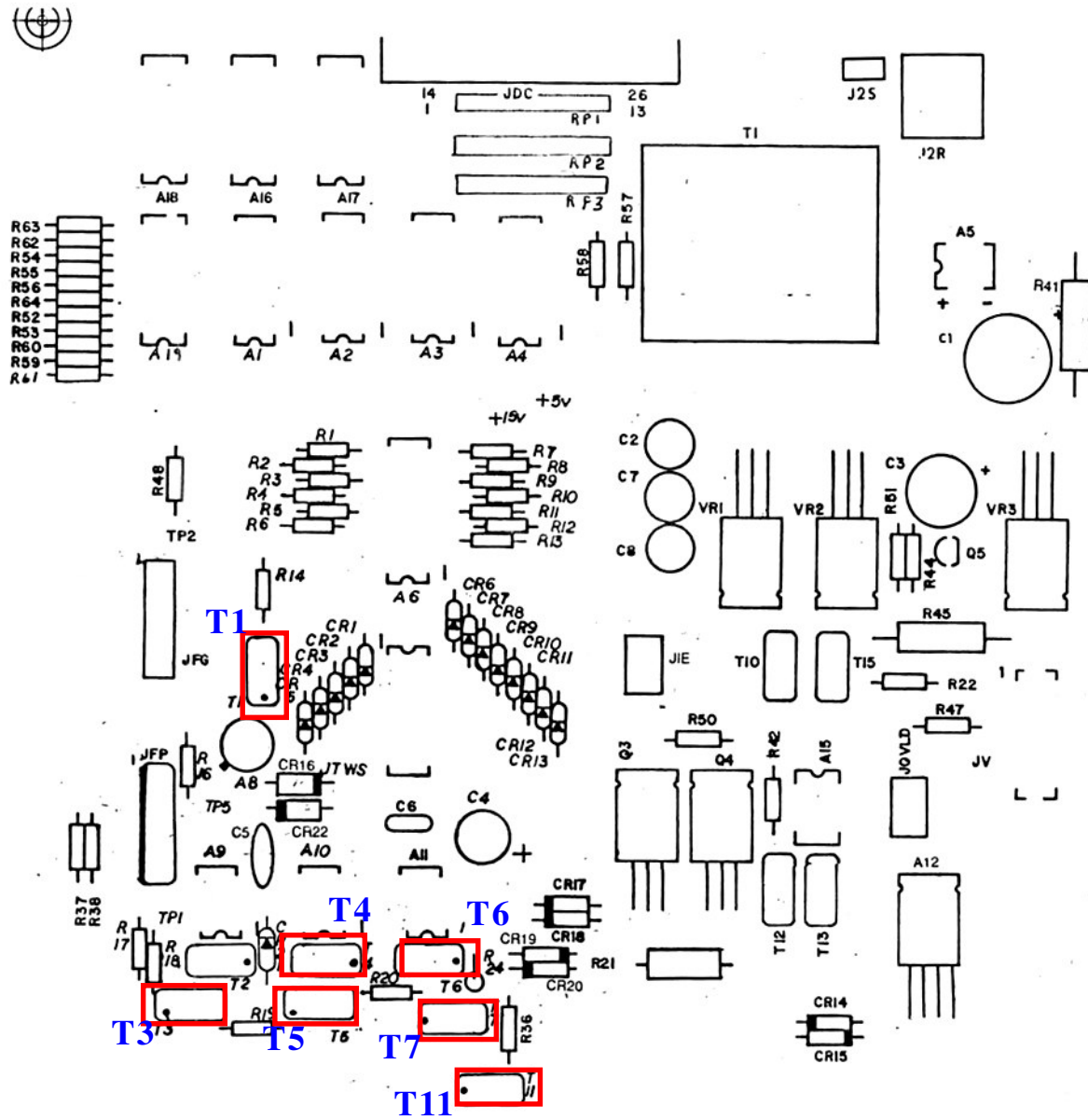


Figure 7.1: Layout for VI-700 Printed Circuit Board

### 7.3.3 Current calibration

The voltage calibration of the above subsection must be performed before this current calibration. The calibration may be performed using an ammeter or a voltmeter with a precision resistor. This latter method may be preferable since an ammeter with the required accuracy is not as common or convenient as a voltmeter. If the voltmeter method is to be employed, connect a stable 1 k $\Omega$  precision resistor, whose value, is known to the required accuracy, securely across the current output binding posts. In the instructions below, follow the items in parentheses for the voltmeter method

1. Attach the digital ammeter (voltmeter) leads securely to the current output binding posts.
2. Set the VI-700 to 0.000 on the X0.1 range.
3. Adjust trimmer 1-T6 to obtain a current (voltage) reading as close to zero as possible. 0.05  $\mu$ A (50  $\mu$ V) or less is satisfactory.
4. Set the VI-700 to 1.799 on the X10 range.
5. Adjust trimmer 1-T11 to obtain a current of 17.990 mA (voltage of 17.990 V).
6. Set the VI-700 to 1.799 on the X0.1 range.
7. Adjust trimmer 1-T7 to obtain a current of 179.90  $\mu$ A (voltage of 179.90 mV).

### 7.3.4 High Current Output Calibration - Optional

1. Attach the digital ammeter leads securely to the current output binding posts.
2. Set the VI-700 to the X10 range.
3. Set the 200 mA pushbutton ON.
4. Set the thumbwheel switch to 1000.
5. Adjust trimmer 1-T16 to obtain a current reading of 100 mA.

### 7.3.5 Current Overload Indicator Setting

This is not a critical adjustment and may be bypassed unless a problem is suspected.

1. Set the front panel to 1.999 on the X10 range.
2. Connect a 1 k $\Omega$  resistor whose value is precisely known to the current output connectors.
3. Adjust trimmer 1-T12 so that the current **OVLD** indicator is just about to come on.

## Appendix A

### SCPI COMMAND REFERENCE

SCPI is an acronym for “Standard Commands for Programmable Instruments”. For additional information or an on-line copy of this standard, see:

<http://www.scpiconsortium.org>.

The IEEE 488.2 Standard was established in 1987 to standardize message protocols and status reporting and to define a set of common commands for use on the IEEE 488 bus. IEEE 488.2 devices are supposed to receive messages in a more flexible manner than they send. A message sent from GPIB controller to GPIB device is called: PROGRAM MESSAGE. A message sent from device to controller is called: RESPONSE MESSAGE. As part of the protocol standardization the following rules were generated:

- (;) Semicolons separate messages.
- (:) Colons separate command words.
- (,) Commas separate data fields.
- <nl> Line feed and/or EOI as last character terminates a 'program message'.  
Line feed (ASCII 10) and EOI terminates a RESPONSE MESSAGE.
- (\*) Asterisk defines a 488.2 common command.
- (?) Ends a query where a reply is expected.

SCPI builds on the programming syntax of IEEE-488.2 to give the programmer the capability of handling a wide variety of instrument functions in a common manner. This gives all instruments a common "look and feel". SCPI commands are not case-sensitive.

The portion of commands shown in capitals denotes the abbreviated form of the keyword. Either the abbreviated or whole keyword may be used when entering a complete command. There must be a space between the command and a parameter or channel list. Multiple SCPI commands may be concatenated together as a compound command by using semicolons as command separators.

Keywords shown inside braces [ ] are defaults, and are optional when constructing a PROGRAM MESSAGE.

Commands not recognized have no effect on the unit's operation and will set the corresponding bits in the Standard Event Status Register. SCPI commands that end with a question mark '?' are queries. All queries should be followed by reading their response to avoid data loss.

Keyword	Parameter Form	Notes & Short Form Commands
<b>SYSTEM</b>		<b>System Address</b>
:COMMunicate		
:GPIB		<i>IEEE option only</i>
:MODE	SINGLE   DUAL   SECondary	
:SERial		<i>SERIAL option only</i>
:EXTernal	01 or OFFION [0]	
:BAUD	<numeric value> [9600]	
:PARity	EVEN   ODD   [NONE]	
:BITS	7   [8]	
:SBITs	[1]   2	
:NETwork	01 or OFFION [0]	
:ADDRESS	0-15 [4]	
:UPdate	no value-command only	
:RS485	01 or OFFION [0]	
:ERRor?	(0, "No error")	
:VERSion?	(1994.0)	
<b>SOURCE</b>		<b>Port Output</b>
[:DIGital]		
:DATA		
[:VALue]	10 digits representing the possible decade values	PO
<b>CALibrate</b>		<b>Calibrate</b>
:DATE?	mm-dd-yyyy	



## Appendix B

### IEEE-488.2 COMMON COMMANDS

The VI-700 Series is compliant with the complete command set defined in the IEEE-488.2 specification. As an output device, the required input related commands

such as SRQ and TRG are implemented in the controller but have no affect on the operation of the instrument.

<u>COMMAND</u>	<u>NAME</u>	<u>DESCRIPTION</u>																		
*CLS	Clear Status	Clears all event registers summarized in the status byte, except for "Message Available," which is cleared only if *CLS is the first message in the command line.																		
*ESR?	Event Status Register Query	VI-700 returns the <value> of the "Event Status Register" and then clears it. <value> is an integer whose binary equivalent corresponds to the state (1 or 0) of bits in the register. Reading of this register resets the contents to zero.																		
		<table border="1"> <thead> <tr> <th><u>Bit</u></th> <th><u>Description</u></th> </tr> </thead> <tbody> <tr> <td>7</td> <td>Power On</td> </tr> <tr> <td>6</td> <td>User Request</td> </tr> <tr> <td>5</td> <td>Command Error</td> </tr> <tr> <td>4</td> <td>Execution Error</td> </tr> <tr> <td>3</td> <td>Dev. Dep. Error</td> </tr> <tr> <td>2</td> <td>Query Error</td> </tr> <tr> <td>1</td> <td>Request Control</td> </tr> <tr> <td>0</td> <td>Operation Complete</td> </tr> </tbody> </table>	<u>Bit</u>	<u>Description</u>	7	Power On	6	User Request	5	Command Error	4	Execution Error	3	Dev. Dep. Error	2	Query Error	1	Request Control	0	Operation Complete
<u>Bit</u>	<u>Description</u>																			
7	Power On																			
6	User Request																			
5	Command Error																			
4	Execution Error																			
3	Dev. Dep. Error																			
2	Query Error																			
1	Request Control																			
0	Operation Complete																			
*IDN?	Identification Query	Returns its identification code as four fields separated by commas. These fields are: manufacturer, model, serial number and hardware version.																		
*RST face is Byte.	Reset	Restores the VI-700 to power-up state; state of IEEE unchanged, including: instrument address and Status  Allow the REMOTE option 150 ms to complete command.																		
*SAV <value>	Save	Saves current configuration in the Flash. *SAV 0 saves the current setting as the new power on setting.																		
*STB?	Read Status Byte	Returns the value of the "Status Byte" with bit six as the "Master Summary" bit. The value is an integer whose binary equivalent corresponds to the state of bits in the register.																		

