VXI
bus

HP E1532
Eight-Channel Current Output
Signal Conditioning Plug-on

User's Manual

Enclosed is the User's Manual for the HP E1532 Signal Conditioning Plug-on. Insert this manual in your VXI Module's User's Manual behind the "Signal Conditionining Plug-ons" divider.

APPLICABILITY
This SCP is used with the HP E1415 and HP E1419.

HEWLETT®
PACKARD

E1532-90002

HP E1532
Eight-Channel Current Output
Signal Conditioning Plug-on

Introduction

The HP E1532 provides an eight channel non-isolated current source. Each output can source ±10mA with up to ±15 volt compliance. Each HP E1532 output can detect an over-voltage condition.

About this Manual

This manual shows you how to control the Signal Conditioning Plug-on (SCP) using SCPI commands and explains the capabilities of this SCP. The contents of this manual are:

Installation

Installation for this Plug-on is common to several others and is covered in Chapter 1 of your VXI Module User's Manual.

Identifying the Plug-on

You'll find the HP part number on the connector side of the SCP to the left of the serial number bar code. For the HP E1532, the part number is : E1532-63501

Field Wiring

Since this Current Output SCP is NOT ISOLATED, it is extremely important not to introduce ground current loops in the individual channel wiring. To avoid this, make sure you follow the recommended wiring diagram that follows.
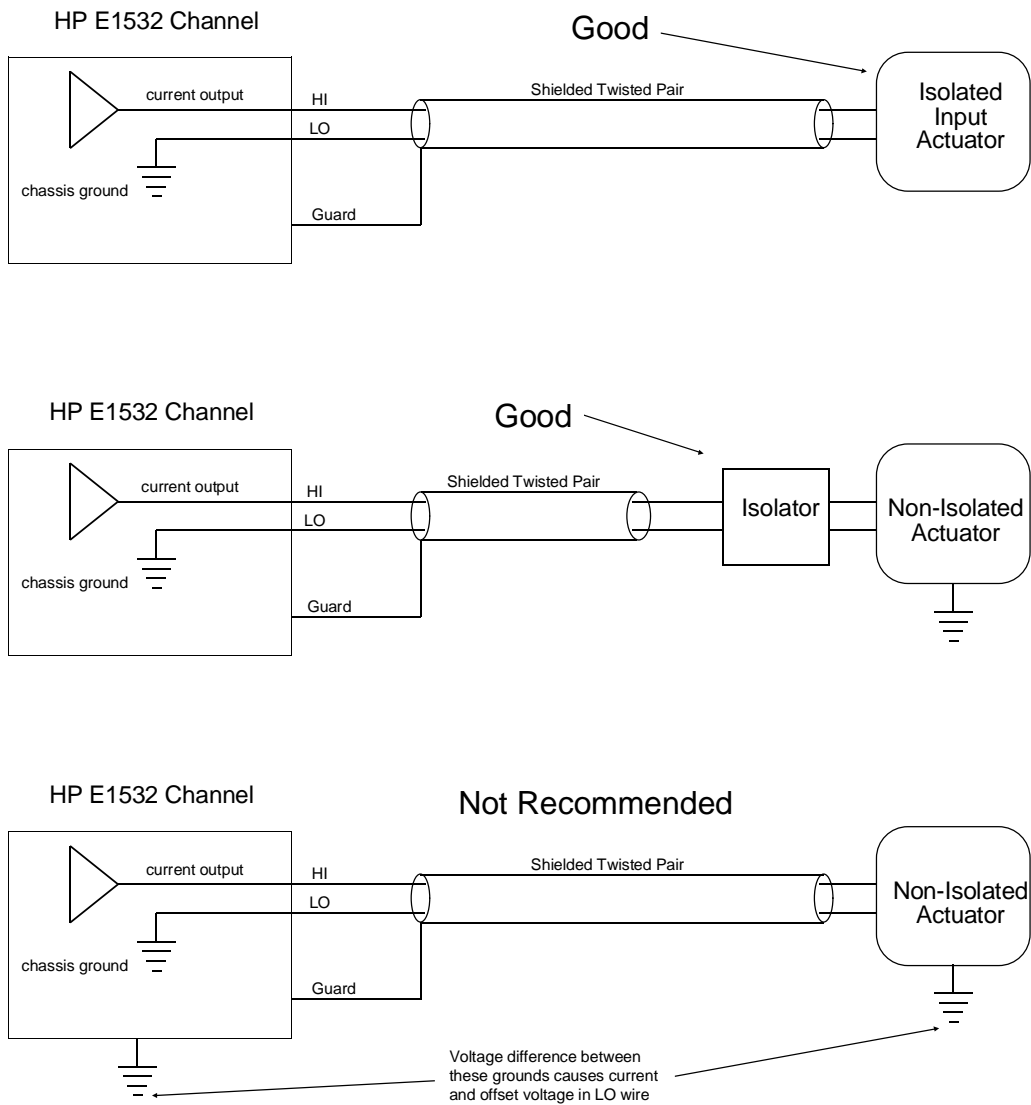
HP E1532 Channel

current output

HI
LO

chassis ground

Guard

Good

Shielded Twisted Pair

Isolated Input Actuator

HP E1532 Channel

current output

HI
LO

chassis ground

Guard

Good

Shielded Twisted Pair

Isolator

Non-Isolated Actuator

HP E1532 Channel

current output

HI
LO

chassis ground

Guard

Not Recommended

Shielded Twisted Pair

Non-Isolated Actuator

Voltage difference between these grounds causes current and offset voltage in LO wire

Figure 1 Recommended Field Wiring

The following table maps SCP channels to Terminal Module terminal names. Also see the Terminal Module labels supplied with your HP E1532.

SCP's Channel	SCP 0 channels	SCP 1 channels	SCP 2 channels	SCP3 channels	SCP 4 channels	SCP 5 channels	SCP 6 channels	SCP 7 channels
0 HI & LO	0 H & L	8 H & L	16 H & L	24 H & L	32 H & L	40 H & L	48 H & L	56 H & L
1 HI & LO	1 H & L	9 H & L	17 H & L	25 H & L	33 H & L	41 H & L	49 H & L	57 H & L
2 HI & LO	2 H & L	10 H & L	18 H & L	26 H & L	34 H & L	42 H & L	50 H & L	58 H & L
3 HI & LO	3 H & L	11 H & L	19 H & L	27 H & L	35 H & L	43 H & L	51 H & L	59 H & L
4 HI & LO	4 H & L	12 H & L	20 H & L	28 H & L	36 H & L	44 H & L	52 H & L	60 H & L
5 HI & LO	5 H & L	13 H & L	21 H & L	29 H & L	37 H & L	45 H & L	53 H & L	61 H & L
6 HI & LO	6 H & L	14 H & L	22 H & L	30 H & L	38 H & L	46 H & L	54 H & L	62 H & L
7 HI & LO	7 H & L	15 H & L	23 H & L	31 H & L	39 H & L	47 H & L	55 H & L	63 H & L

Programming With SCPI Commands

The only SCPI command shown here is used to query the SCP's identification string. Your VXI Module may or may not support SCPI commands to control the SCP's output amplitude. Check for OUTPut subsystem commands in the SCPI Command Reference of your VXI Module's User's Manual.

Checking the ID of the SCP

To verify the SCP type(s) installed on your VXI module, use the SYSTem:CTYPe? (@<channel>) command.

- The *channel* parameter specifies a single channel in the channel range covered by the SCP. The first channel number for each of the eight SCP positions are; 0,8,16,24,32,40,48, and 56.

The value returned for the HP E1532 SCP is:
HEWLETT-PACKARD,E1532A 8-Channel Current Output SCP,0,0

To determine the type of SCP installed on channels 0 through 7 send

SYST:CTYP? (@100)   *query SCP type @ ch 0*
enter statement here   *enter response string*

Programming with the HP E1415 Algorithm Language

The following example shows the command sequence (platform/language independent) to send values to the SCP output channels. It assumes the SCP is installed in SCP position 0. Use SCP positions 4 - 7 for the HP E1419A

```
                              first algorithm source in string variable
alg_string = "   static float chan_0, chan_1, chan_2, chan_3;  /* define algorithm variable. these*/
                 static float chan_4, chan_5, chan_6, chan_7;  /* will default to zero at first */
                 O100 = chan_0;                                /* algorithm execution */
```

```
                O101 = chan_1;
                O102 = chan_2;
                O103 = chan_3;
                O104 = chan_4;
                O105 = chan_5;
                O106 = chan_6;
                O107 = chan_7; "
```

ALG:DEF 'ALG1','alg_string'   *send SCPI command to define algorithm "ALG1"*

INIT   *start algorithm (using default trig sys setup)*

Algorithm sets starting channel values to zero. The following example shows how your
application program can change channel output values while the algorithm is running

```
ALG:SCALAR 'ALG1','chan_0',-0.010
ALG:SCALAR 'ALG1','chan_1',0.010
ALG:SCALAR 'ALG1','chan_2',0.005
ALG:SCALAR 'ALG1','chan_3',-0.001
ALG:SCALAR 'ALG1','chan_4',0.008
ALG:SCALAR 'ALG1','chan_5',0.010
ALG:SCALAR 'ALG1','chan_6',-0.095
ALG:SCALAR 'ALG1','chan_7',0.000
```

ALG:UPDATE   *must command HP E1415 to update the algorithm variable*

Sensing Output Current

Each channel has a 69 Ohm current sense resistor in series with its output.
The analog input channel associated with each output channel is connected
across this current sense resistor. Reading a channel returns the voltage
developed across its current sense resistor. The value input from these
channels is related to the output current by the formula:

$$Current = \frac{VoltageRead}{69}$$ for example:

```
O100 = current_output   /* program the output current for channel 0    */
readback = I100 / 69     /* current sense channel divided by 69 Ohms */
```

Notes   1. This readback value is only an approximation of the actual output
                       current. The SCP's output current is calibrated to specification each
                       time you execute the *CAL? command. The input channels for this
                       SCP are not calibrated by *CAL?. The programmed current output
                       value will be more accurate than the sense value. The sense value is
                       used only to verify the approximate programmed current.

                    2. An overload reading returned from one of the sense channels does
                       not indicate an overcurrent condition. It indicates that the channel's
                       HI terminal has exceeded the voltage input range of the channel. This
                       can occur when the channel output is programmed to 0 but is not
                       connected to a load. This will occur when the channel is programmed
                       to output current and is not connected to a load.

Over-Voltage Protection

As was mentioned in the first paragraph, the HP E1532 can sense an over-voltage condition on any of its outputs. This is to protect the SCP and the module it is installed on from damaging voltage levels applied to its outputs. If greater than approximately 21 volts is applied to an output channel, the SCP may signal the VXI module to open all of its Calibration/Protection relays. The module will then generate an error message in its error queue (read by SYST:ERR?), and set a status bit in its STAT:QUES:COND register.

Note   The over-voltage protect condition can only be reset by issuing the command *RST, or by cycling power to the module.

*RST *CAL? and *TST? (important!)

During execution of *RST, *CAL?, and *TST?, the outputs of the HP E1532 will be disconnected momentarily from your system. When the operation is completed, outputs will be programmed to output approximately 0mA. The *RST command is typically used at the beginning of all application programs. Make sure the design of your system takes into account this *RST behavior.

SCP Calibration

The HP E1415 calibrates all channels of this SCP when the *CAL? or CALibration:SETup commands are sent. If this SCP is replaced with a different HP E1532, or this SCP is moved to a different SCP location, the calibration must be repeated. By default, the HP E1415 uses the Least Squares Curve Fitting method to determine the gain and offset calibration constants for each HP E1532 channel. This maximizes the overall channel accuracy (see "Voltage Output Accuracy" in specifications section).

Because the Least Squares Curve Fit method does not force the output at a programmed zero to be zero, there can be up to 3.3µA error at this point. By sending then DIAG:CAL:SETUP 1 command before you send the *CAL?, or CAL:SET commands, all HP E1532 and HP E1531 outputs will be calibrated to reduce the error at their programmed zero point. The trade-off is that this can approximately double the error at the HP E1532's $\pm125\,\mu A$ point. The specifications then become $\pm0.06\%$ of expected output $\pm5.7\mu A$ offset. DIAG:CAL:SETUP 1 or *RST before the next *CAL? restores the Least Squares Fit calibration.

Specifications

These specifications for the HP E1532 reflect its performance while installed on your VXI module. These specifications are not to be added to those presented in your VXI module User's Manual.

General Specifications

Maximum voltage applied to any output Hi terminal	Damage level: > ±42 V peak
Current Output Range	at least ±10 mA Full Scale at greater than ±15 Volt compliance (multiple channels can be connected in parallel to provide additional current.)
Current Resolution	16 bits (monotonic to 16 bits) = 316nA
Output Impedance	greater than ±600KΩ
Noise	<2μA rms (20Hz - 250KHz, into 250Ω)
Output Settling Time	350 μsec with 250 Ω load
Temperature Coefficient	(for change in temperature from *CAL after 1 hr. warm up) Accuracy: ±0.004%/°C Offset Error: 0.3μA/°C
Current Output Accuracy	(90 days) 23°C ±1°C (with *CAL? done after 1 hr. warm up, and applied load is <=500 Ω) (±0.06% of expected output)±(3.3μA Offset Error)

Power Required	+5 Volts:	Typical 11mA, Maximum 15mA
	±24 Volts:	With 0mA into 250Ω: Typical 60mA, Max 75mA With outputs at 10mA: Typical 135mA, Max 150mA