



# HP 75000 SERIES B and C

## Eight-Channel Current Source Signal Conditioning Plug-on HP E1505

---

### User's Manual

The HP E1505 manual also applies to HP E1413Bs as HP E1413 Option 15.

Enclosed is the User's Manual for the HP E1505 Signal Conditioning Plug-on. Insert this manual in your HP E1413/E1313 manual behind the "Signal Conditioning Plug-ons" divider.



Copyright © Hewlett-Packard Company, 1993, 1994, 1996



E1505-90002



# HP E1505 Current Source Signal Conditioning Plug-on

---

## Introduction

The HP E1505 is a Signal Conditioning Plug-on that provides eight current sources programmable to one of two current levels. Each current source can be programmed to provide either 30 $\mu$ A, or 488 $\mu$ A. Also provided is input over-voltage detection on each channel.

## About this Manual

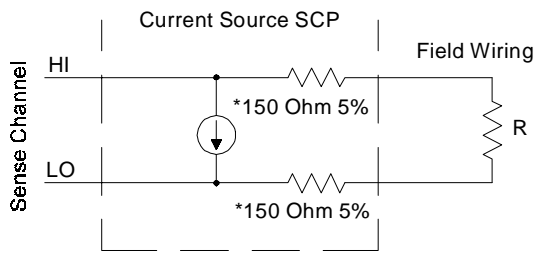
This manual shows you how to control the Signal Conditioning Plug-on (SCP) using SCPI commands as well as Register-Based commands, and explains the capabilities of this SCP. Finally, it covers specifications for this SCP. Installation for this Plug-on is common to several others and is covered in Chapter 1 your HP E1413/E1313 manual. The contents of this manual are:

- Field Wiring ..... 3
- Connecting To The Terminal Module ..... 5
- Programming With SCPI Commands ..... 7
- Programming With Register Commands ..... 9
- Specifications ..... 10

## Field Wiring

The E1505 SCP is used to supply excitation current to resistance and resistance-temperature measurements. Figure 1 shows the general method of connection for both 4-wire and 2-wire connections.

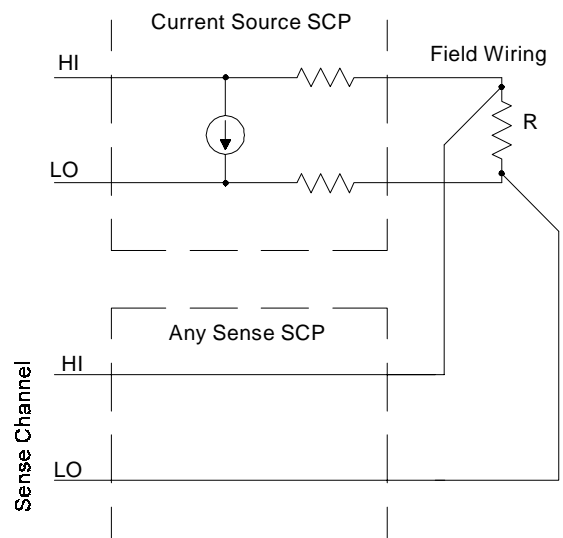
**Two-Wire Measurement**  
(not recommended\*\*)



\* Because of the 150 Ohm resistor in series with each of the current source outputs, Two-Wire resistance and temperature measurements will have a 300 Ohm offset.

\*\* The current source HI terminal is the negative voltage node.  
The current source LO terminal is the positive voltage node.

**Four-Wire Measurement**



**Figure 1 Wiring for Resistance and Temperature**

# Connecting To The Terminal Module

This section shows how to make connections to the Terminal Module.

The SCP connections for the Terminal Modules are shown on the stick-on labels that came with the SCP. Use the appropriate label for the type of Terminal Module you have. The connections and appropriate stickers are as follows:

- For HP E1413C and above Terminal Modules, use stickers for HP E1505 SCPs. The connections are shown in Figure 2.
- For HP E1313 Terminal Modules, use stickers for HP E1505 SCPs. The connections are shown in Figures 3 and 4.
- For HP E1413B and below Terminal Modules, use stickers for HP E1413 Option 15 SCPs. The connections are shown in Figure 5.

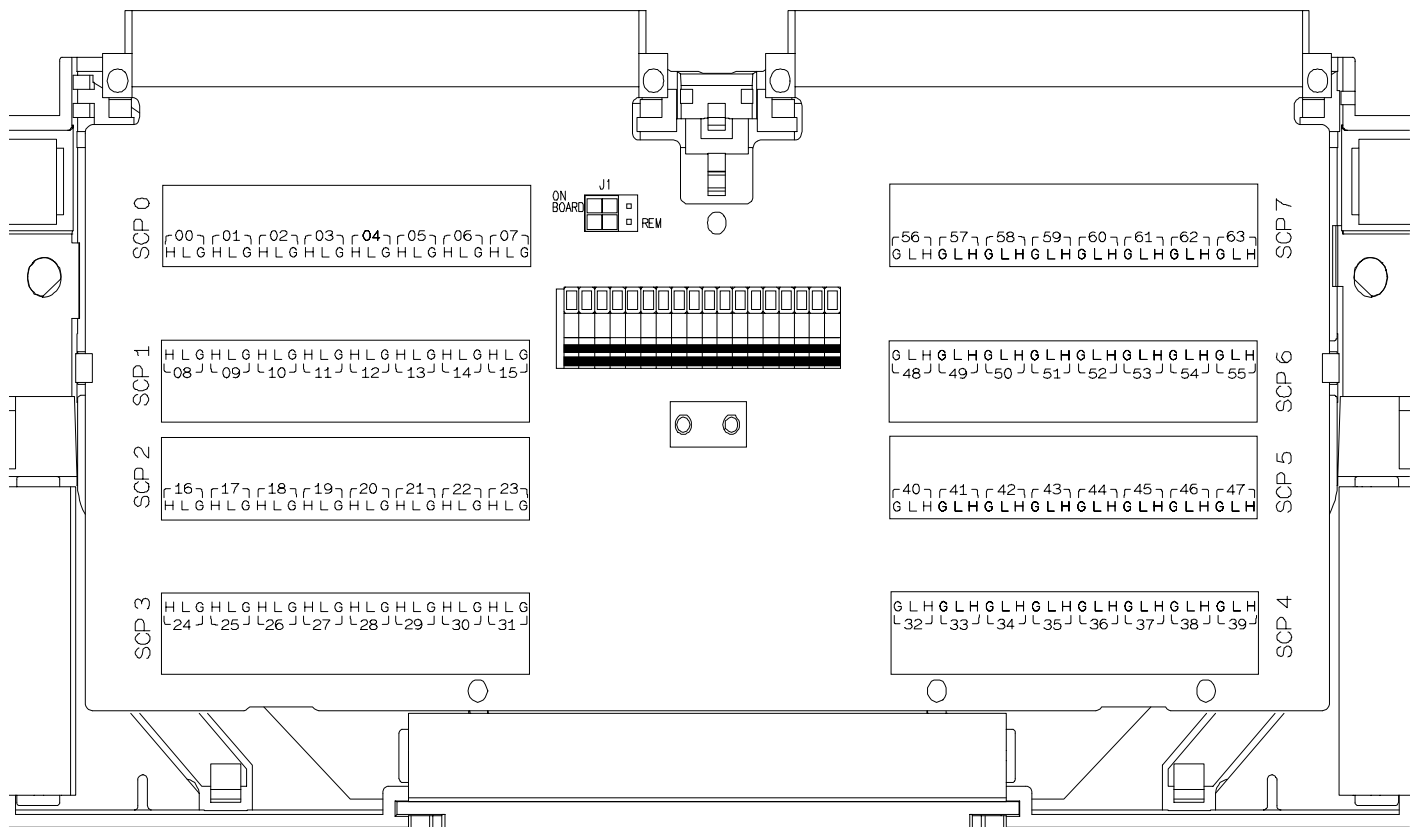
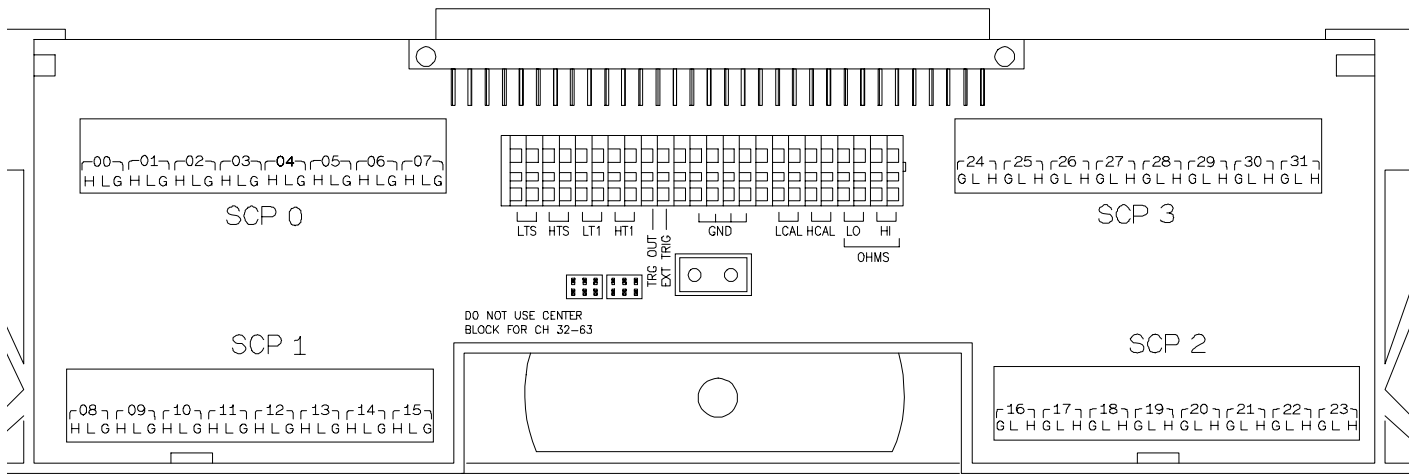
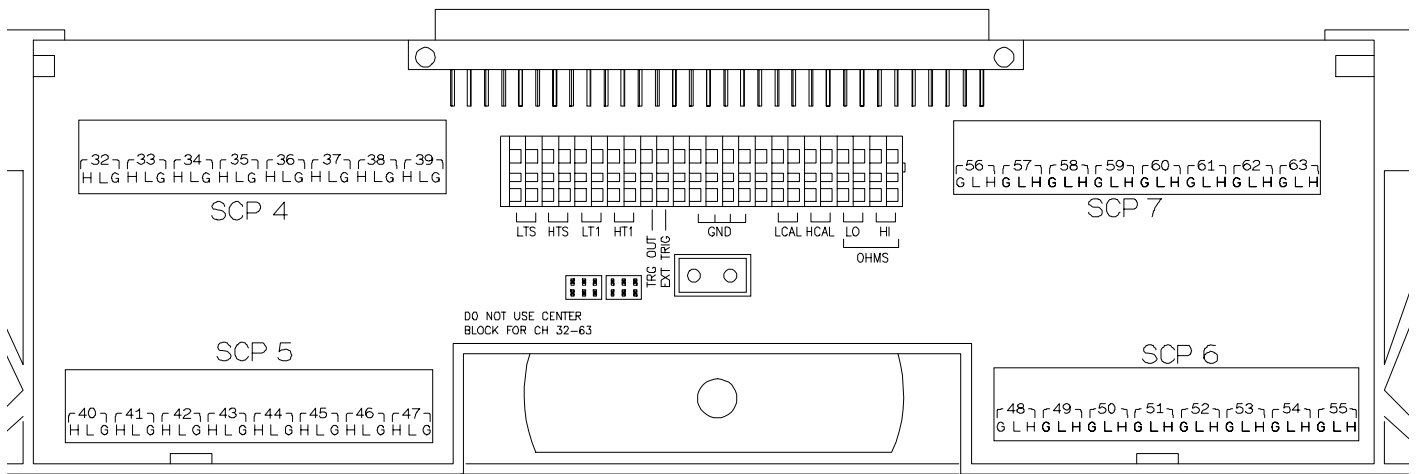


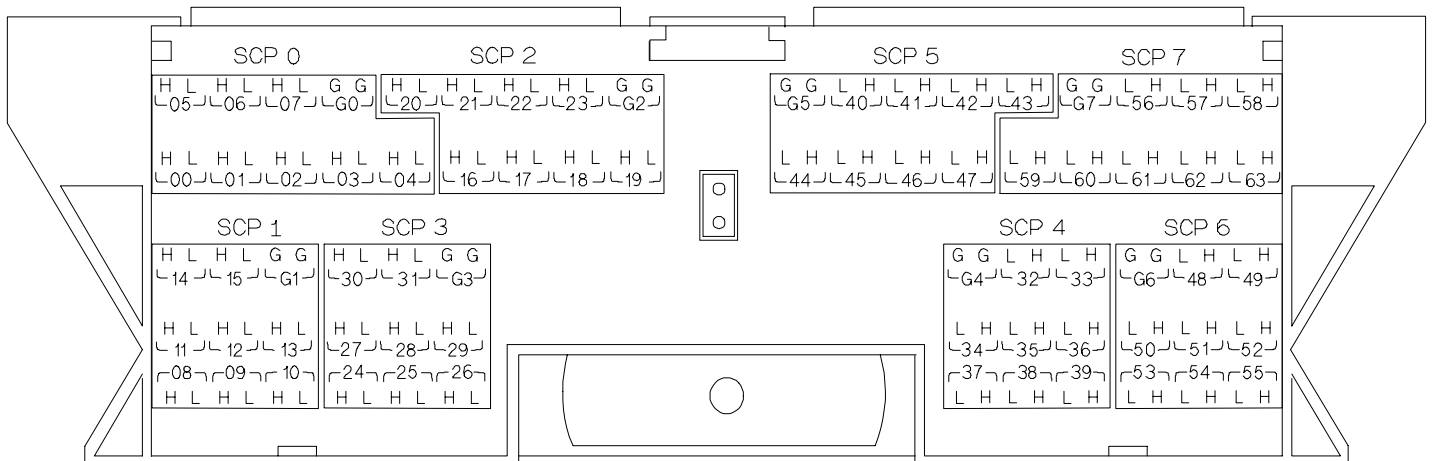
Figure 2 HP E1505 C-Size Terminal Module Connections



**Figure 3 HP E1505 B-size Terminal Module Connections (Ch 00-31)**



**Figure 4 HP E1505 B-size Terminal Module Connections (Ch 32-63)**



**Figure 5 HP E1413 Option 15 Terminal Module Connections**

# Programming With SCPI Commands

The SCPI commands shown here are covered in Chapters 3 and 5 of your HP E1413/E1313 manual. This section will relate those commands to the parameter values which are specific to this Plug-on.

## Checking the ID of the SCP

To verify the SCP type(s) installed on the HP E1413/E1313 use the SYSTem:CTYPe? (@<channel>) command.

- The *channel* parameter specifies a single channel in the channel range covered by the SCP of interest. 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 SCP in an HP E1413B is:  
HEWLETT-PACKARD,E1413 Opt 15 8-Channel Current Source SCP,0,0

The value returned for the SCP in an HP E1313A/E1413C is:  
HEWLETT-PACKARD,E1505 8-Channel Current Source 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*

## Setting Current Output Level

To set the current output level use the OUTPut:CURRent:AMPLitude <level>,@<ch\_list> command.

- The *level* parameter can set the current output level to either 30 $\mu$ A or 488 $\mu$ A. The default unit for *level* is Amps DC. You may also include a units suffix to specify milliamps (ma), or microamps (ua). The level parameter will also accept MIN (30 $\mu$ A) and MAX (488 $\mu$ A). Use 488 $\mu$ A for resistance measurements under 8000 Ohms and 30 $\mu$ A for resistances of 8000 Ohms and greater.

---

### Notes

1. 30 $\mu$ A is the \*RST and Power-On amplitude for all filter channels.
  2. Whenever you change the current amplitude, you must execute \*CAL? or CAL:SETup then CAL:SETup? to calibrate the newly selected output amplitude.
- 

To set channels 0 through 15 and 20 to measure < 8K Ohm, send

OUTP:CURR:AMPL 488E-6, (@100:115,120)

To set channels 16 through 31 to measure 8K Ohm or greater, send  
OUTP:CURR:AMPL 30ua,(@116:131)

## Querying the Current Level

To query any channel to determine the current level use the  
OUTPut:CURRent:AMPLitude? (@<channel>) command. The  
OUTP:CURR? command returns either +4.88E-4 or +3.0E-5.

- The *channel* parameter must specify a single channel.

To query the current level of channel 2 send

OUTP:CURR:AMPL? (@102)	<i>query channel 2</i>
<i>enter statement here</i>	<i>returns 4.88e-4 or 3.0e-5</i>

## Turning Current Source Channels Off and On

To Disable and re-enable the current source channel use  
OUTPut:CURRent[:STATe] <enable>,(@<ch\_list>) command.

- The *enable* parameter can take the values ON or 1, and OFF or 0.

To disable current source channels 0 through 15 and 20, send

OUTP:CURR:STAT OFF, (@100:115,120)

To enable current source channels 16 through 31, send

OUTP:CURR:STAT ON,(@116:131)

---

### Note

The \*RST and Power-On state for all Current Source SCP channels is OFF.

---

## Querying the Current Source State

To query any channel to determine the current source output state use the  
OUTPut:CURRent[:STATe]? (@<channel>) command. The OUTP:CURR?  
command returns either a 1 for ON or a 0 for OFF.

- The *channel* parameter must specify a single channel.

To query the current state of channel 2 send

OUTP:CURR:STAT? (@102)	<i>query channel 2</i>
<i>enter statement here</i>	<i>returns 1 or 0</i>



# Register Based Programming

The register-based commands shown here are covered in Appendix D of the HP E1413/E1313 manual. You should read that section first to become familiar with accessing registers and executing Register-Based Commands. This section will relate those commands to the parameter values which are specific to this Plug-on.

When Register Programming an SCP most communication is through the Signal Conditioning Bus. For that we'll use the Register Commands:

SCBWRITE <regaddr> <regvalue>  
and  
SCBREAD? <regaddr>

**HP E1505 Register Map**

Read (returned value)	Write( <regvalue>)	SCP Register	<regaddr> Value
<b>SCP ID</b> (A0A0 <sub>16</sub> )		Whole SCP Reg 0	00ppp000000 <sub>2</sub>
<b>SCP Gain Scale</b> (XXX0 <sub>16</sub> )		Whole SCP Reg 1	00ppp000001 <sub>2</sub>
<b>Channel Control</b> (XXX0 <sub>16</sub> =Off&Low, XXX1 <sub>16</sub> =Off&High, XXX2 <sub>16</sub> =On&Low, XXX3 <sub>16</sub> =On&High)		Channel Reg 0	01ppppccc000 <sub>2</sub>
<b>Channel Gain</b> (XXX0 <sub>16</sub> )		Channel Reg 1	01ppppccc001 <sub>2</sub>
	<b>Calibration</b> (Xnnn <sub>16</sub> ) where nnn=Cal Value	Channel Reg 7	01ppppccc111 <sub>2</sub>

XX=don't care

ppp=Plug-on  
ccc=SCP channel

## Checking ID of SCP

To query an SCP for its ID value, write the following value to Parameter Register 1:

$$(SCP\ number) \times 40_{16}$$

Then write the opcode for SCBREAD? (0800<sub>16</sub>) to the Command Register. The ID value will be written to the Query Response Register.

## Controlling Current Source Channels

To set current amplitude and enable or disable an SCP channel, write the following SCP channel address to Parameter Register 1:

$$200_{16} + (SCP\ number) \times 40_{16} + (SCP\ channel\ number) \times 8_{16}$$

Write one of the following control values to Parameter Register 2:

- 0000<sub>16</sub> = current low, output off
- 0001<sub>16</sub> = current high, output off
- 0002<sub>16</sub> = current low, output on
- 0003<sub>16</sub> = current high, output on

Then write the opcode for SCBWRITE (0810<sub>16</sub>) to the Command Register.

## Channel Calibration Register

The channel calibration registers control DACs that adjust the current output of each current source channel. The Register-Based command `CARDCAL?` (1000<sub>16</sub>) controls these registers and the user should not write to them.

## Specifications

The general specifications for the HP E1505 reflect the performance of the Signal Conditioning Plug-on itself. The resistance performance specification reflects the combined performance of the HP E1413/E1313 and the SCP.

### General Specifications

<b>Compliance</b>	L terminal is at ground H terminal $\pm 16$ V with respect to ground	
<b>Output Accuracy</b>	(90 days) 23°C $\pm 1$ °C (with *CAL? done after 1 hr warm up)	
	Current Amplitude $\mu\text{A}$	Output Accuracy
	30.518	$\pm 9$ nA
	488.28	$\pm 60$ nA
<b>Temperature Coefficient</b>	Current Amplitude $\mu\text{A}$	Temperature Coefficient
	30.518	$\pm 0.9$ nA/°C
	488.28	$\pm 6$ nA/°C
<b>Ripple and Noise</b>	(7.5 KOhm resistor to L, 3 sigma)	
	Current Amplitude $\mu\text{A}$	Ripple and Noise
	30.518	$\pm 9$ nA
	488.28	$\pm 15$ nA
<b>Off Leakage Current</b>	(7.5 KOhm resistor to L)	
	0 - 30 °C	Less than $\pm 10$ nA
	30 - 55 °C	$\pm 10$ nA + 1.6 nA/°C

**Resistance Specifications**

(90 days) 23°C ±1°C (with \*CAL? done after 1 hr warm up and CAL:ZERO? within 5 min.).

Range Ohms FS	Current Amplitude μA	(A/D Range VDC)	Maximum Resolution Ω
131.1 K	30.518	4	4
32.77 K	30.518	1	1
8.192 K	30.518	.25	.25
8.192 K	488.28	4	.25
2.048 KΩ	488.28	1	.0625
512	488.28	.25	.015
128	488.28	.0625	.0039

**Resistance Accuracy**

(Four-Wire connection)

Gain:	Current Amplitude	Resistance Accuracy
	30.518 μA	.035% of reading
	488.28 μA	.02% of reading

Offset: Ω	$\frac{\text{offset of input SCP (in Volts)}}{\text{current source value (in Amps)}}$
-----------	---

Noise: Ω	$\frac{\text{noise of input SCP (in Volts)}}{\text{current source value (in Amps)}}$
----------	--

## *Notes*

---