HP 75000 SERIES B and C

Eight-Channel Divide by 16 Fixed Attenuator-Low Pass Filter Signal Conditioning Plug-on HP E1513A

User's Manual

Enclosed is the User's Manual for the HP E1513 Signal Conditioning Plug-on. Insert this manual in your HP E1413/E1313 manual behind the "Signal Conditioning Plug-ons" divider.

HEWLETT® PACKARD

E1513-90002

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HP E1513
Eight-Channel Divide by 16 Attenuator Signal Conditioning Plug-on

Introduction

The HP E1513 is a Signal Conditioning Plug-on that provides eight divide by 16 attenuators and fixed low-pass filters with a 3dB cutoff frequency of 7Hz. Also provided is input over-voltage protection.

The HP E1513 allows maximum input voltage of 60VDC between High and Low, or from High or Low to Chassis.

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. The contents of this manual are:

Description

Attenuator

The HP E1513 is a balanced high impedance input attenuator that provides both differential mode and common mode gain of ($\frac{1}{16}$). The input resistance is 1 megohm to chassis from either the high or low input.

The resistor network used for the attenuator, provides accurate gains and moderate common mode rejection. The gains will be within 0.1% of each other and the common mode rejection will be approximately 60 dB. The input will not be a true differential input, in that the gain on the low side cannot be calibrated. Therefore the gain will be specified from high to low

and the low input should be connected to the common mode input voltage. If the high input where grounded and a signal was applied to low, the gain could be in error by 0.1%.

Noise Filter and Output Buffer

The narrow bandwidth of approximately 7 Hz provides about 27.8dB of attenuation for 60Hz signals. The filters are balanced and have two real poles. A pair of buffers drive the signal through another broad band low-pass filter to the A/D multiplexer.

Block Diagram

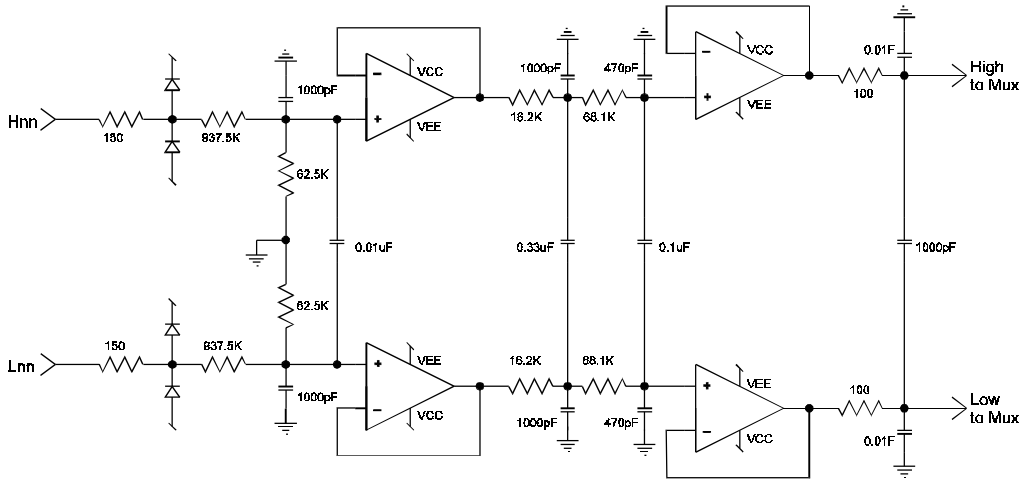

Figure 1 Partial Block Diagram

Installation

Installation for this Plug-on is common to several others and is covered in Chapters 1 and 2 of your HP E1413/E1313A or HP E1415 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 E1513, the part number is : E1513-66501.

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.

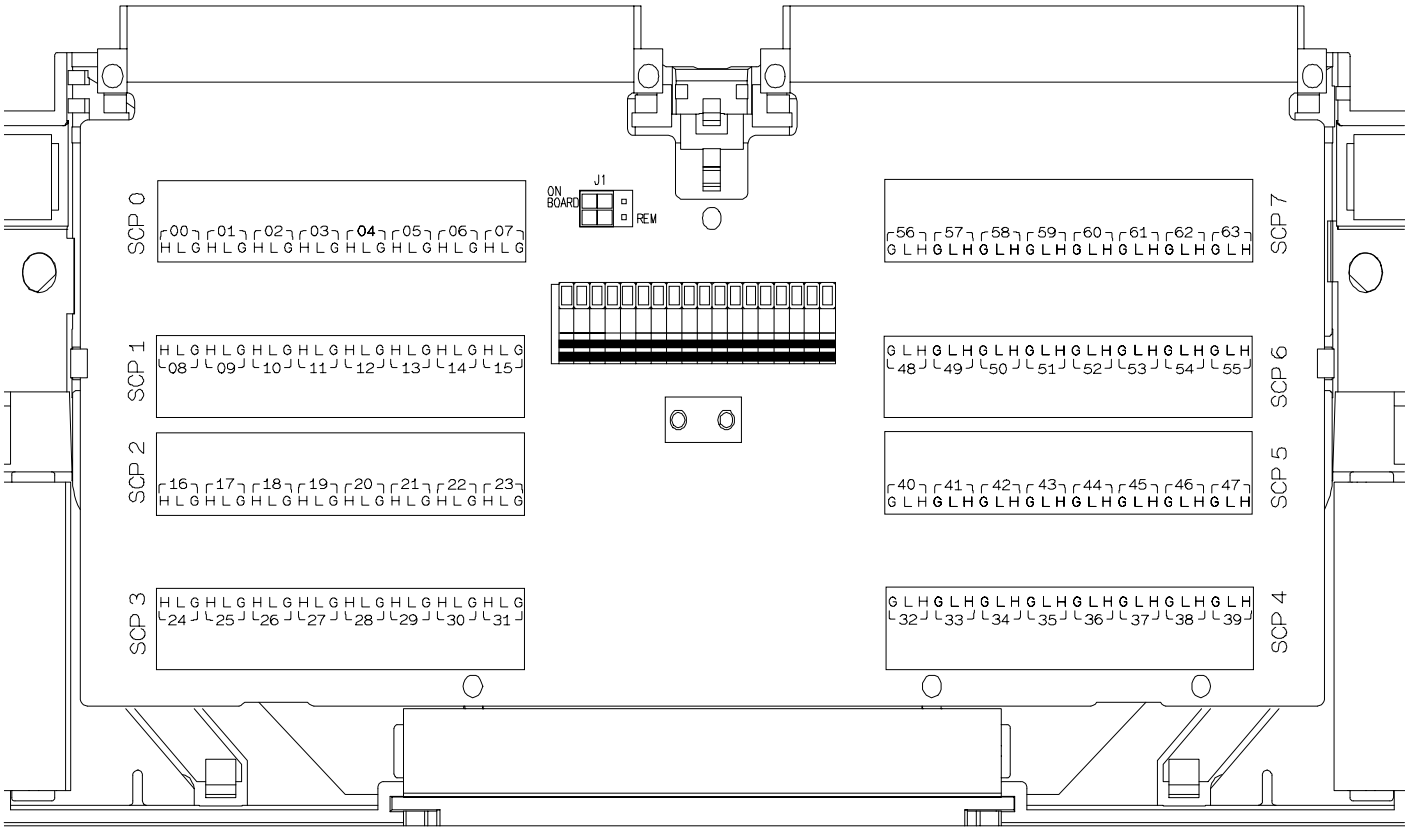

Figure 2 HP E1513 C-Size Terminal Module Connections

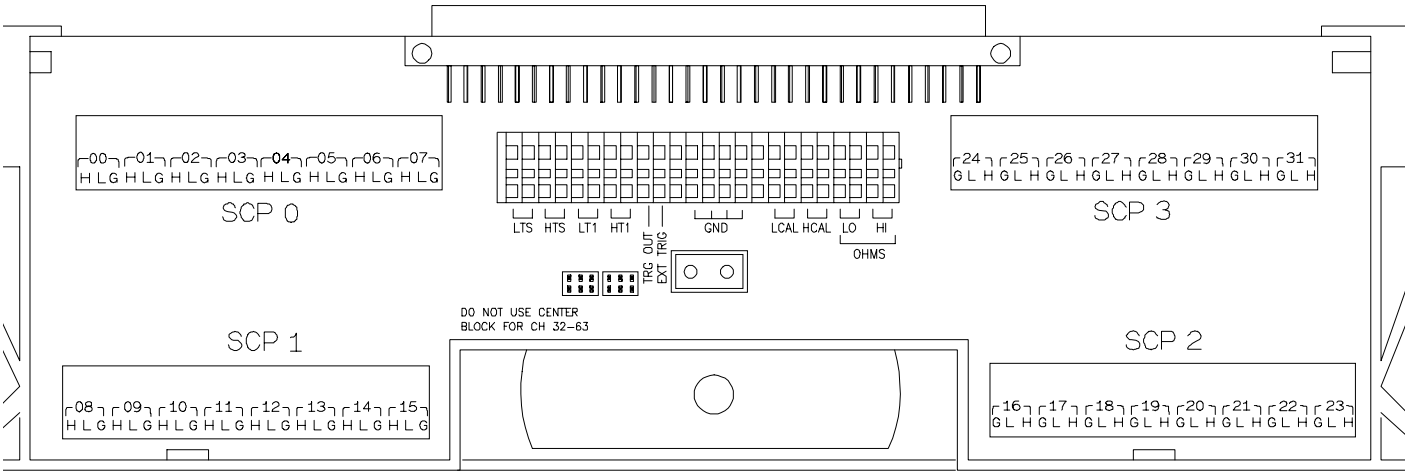

Figure 3 HP E1513 B-size Terminal Module Connections (Ch 00-31)

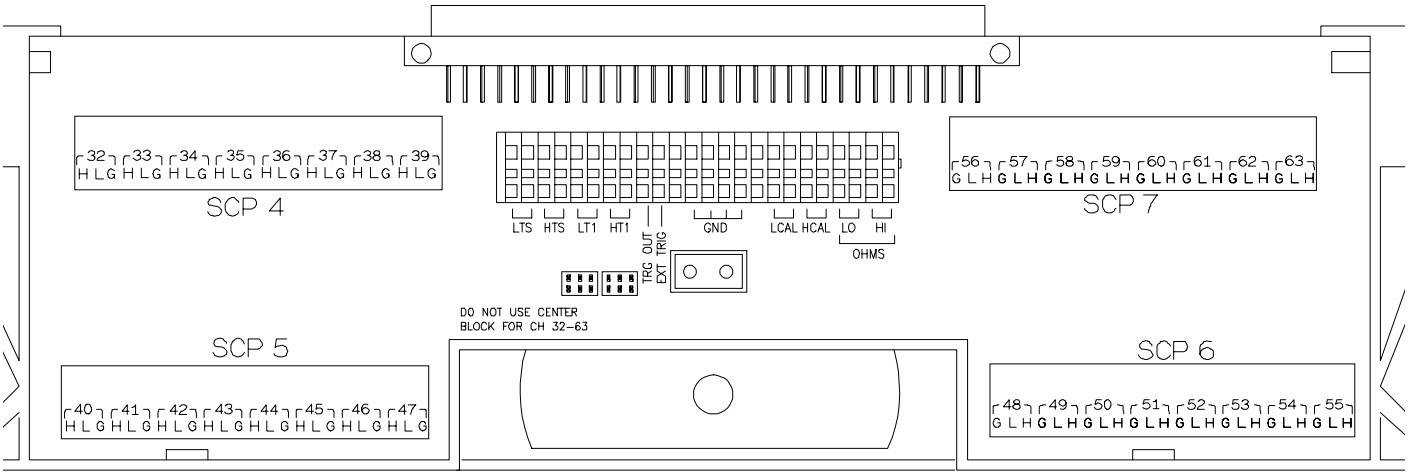

Figure 4 HP E1513 B-size Terminal Module Connections (Ch 32-63)

Recommended Measurement Connections

The following illustration shows the recommended method of wiring to the HP E1513.

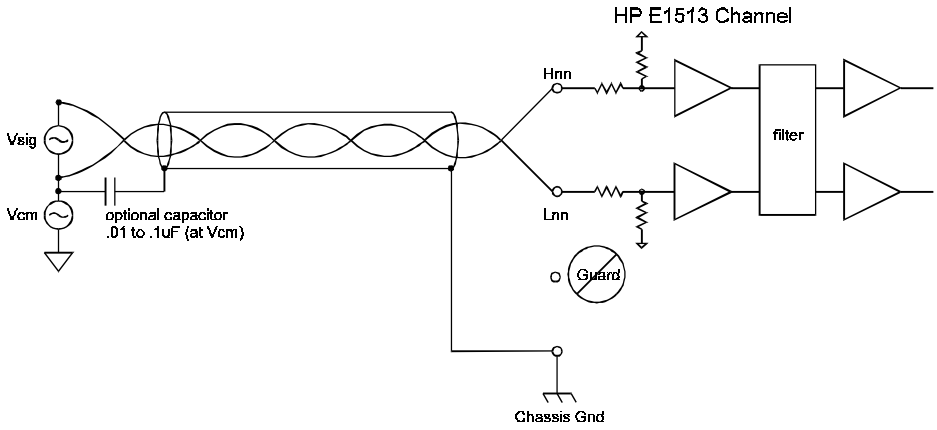

Figure 5 Wiring to the HP E1513 Attenuator

Note All guard connections for a particular SCP tie to a common point, therefore different common mode voltages should not be tied to this shared guard.

Programming With SCPI Commands

The SCPI commands shown here are covered in Chapters 3 and 5 of your HP E1413/E1313 manual and Chapters 3 and 6 of your HP E1415 manual. This section will relate those commands to the parameter values which are specific to this Plug-on.

Range Selection

The [SENSe:]Function:... commands include the range parameter. This parameter selects the A/D range for the measurement. Set this parameter based on the maximum input voltage you expect, divided by 16 (the attenuation factor). While you have to keep in mind the channel gain ($\frac{1}{16}$) when you set the range, the DSP knows the gain and your range selection, and returns the actual input value, not the divided value. Example:

Maximum input value expected for channels 32 through 35 is 48 volts. 48 volts divided by 16 is 3 volts. You can use the 4 volt A/D range.

```
SENS:FUNC:VOLT  4,(@132:135)        meas volts on chs 32-35,
                                    4V range
```

With input voltages of 15, 22, -40, and 55 volts DC, the reading values will be 1.5E+1, 2.2E+1, -4.0E+1, and 5.5E+1 respectively.

Auto-Range

If you wish to use auto-range (range parameter not sent or set to AUTO), you should limit the lowest A/D range used to the 1 volt range. The reason for this can be seen in the noise figures presented in the "DC Measurement Accuracy" specifications on page 10. The signal-to-noise ratio of the 1 and 4 volt ranges is much better than the 0.0625 and 0.25 volt ranges. The lower ranges' increased resolution is offset by increased noise. To keep your module from selecting the 0.0625 and 0.25 volt ranges for HP E1513 channels, send the command DIAG:FLOOR <*range_floor*>,(@<*ch_list*>). Example:

To limit lowest range on HP E1513 channels to the 1 volt range

```
DIAG:FLOOR  1,(@132:140)        all 8 channels in SCP position 4
```

The same noise limitation is true for manual selection of ranges.

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 returned value is:

```
HEWLETT-PACKARD,E1513A 8-Channel Fixed Attenuator-Filter SCP,0,0
```

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

```
SYST:CTYP?   (@100)              query SCP type @ ch 0
execute enter statement here
```

Querying the Filter Cutoff Frequency

While the Low Pass Filter SCP does not provide programmable cutoff frequency the filter frequency can be queried. The response to this query will always be 7. To query any channel for its cutoff frequency use the INPut:FILTer[:LPASs]:FREQuency? (@<*channel*>) command. The

INP:FILT:FREQ? command returns the numeric cutoff value currently set for the channel specified.

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

To query the cutoff frequency of channel 6 send

```
INP:FILT:FREQ?  (@106)                    query channel 6
execute enter statement here
```

Querying the Filter State

While the Low Pass Filter SCP does not allow controlling whether the filters are enabled or disabled, this state can be queried. The response to this query will always be 1. To query any channel to determine if it is enabled or disabled use the INPut:FILTer[:LPASs][:STATe]? (@<*channel*>) command. The INP:FILT? command returns a 0 if the channel is OFF or a 1 if the channel is ON.

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

To query the filter state of channel 2 send

```
INP:FILT?  (@102)                         query channel 2
execute enter statement here
```

Querying the Channel Gain

While the Low Pass Filter SCP does not provide amplifiers, the channel gain can be queried. The response to this query will always be 0.0625 (gain = $\frac{1}{16}$). To query any channel to determine its gain setting use the INPut:GAIN? (@<*channel*>) command. The INP:GAIN? command returns the current gain value for the specified channel.

- The channel parameter must specify a single channel.

To query the gain setting of channel 8 send

```
INP:GAIN?  (@108)                         query channel 8
execute enter statement here
```

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 you will use the Register Commands:

SCBWRITE <*regaddr*> <*regvalue*>

and

SCBREAD? <*regaddr*>

HP E1513 Register Map

Read (returned value)	Write(<*regvalue*>)	SCP Register	<*regaddr*> Value
SCP ID (7070_{16})		Whole SCP Reg 0	$00ppp000000_2$

ppp=Plug-on
ccc=SCP channel

In addition you will access bits in the Card Control register to control Open Transducer Detection.

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_{16}) to the Command Register. The ID value will be written to the Query Response Register.

Specifications

These specifications for the HP E1513 reflect the combined performance of the HP E1413/E1313 and the E1513 Signal Conditioning Plug-on. These specifications are not to be added to those presented in the HP E1413/E1313 User's Manual.

General Specifications

Measurement ranges	±1v to ±60VDC Full Scale
Maximum input voltage (Normal mode plus common mode)	Operating: ±60 VDC ±42 V peak
Maximum common mode voltage	Operating: ±60 DCV ±42 V Peak
Normal mode rejection	@ 7Hz -3dB, @ 50Hz > -24@ 60Hz > -27dB
Common mode rejection	0-60Hz -60dB
Input impedance	1Mohm ±1% (each differential input to ground)

Maximum tare cal offset

(Maximum tare offset depends on A/D range and SCP gain)

A/D range ±V F.Scale	16	4	1	0.25	0.0625
Max Offset	49.95	13.13	3.689	1.212	0.606

Measurement accuracy
DC Volts

(90 days) 23°C ±1°C (with *CAL? done after 1 hr warm up and CAL:ZERO? within 5 min.). If autoranging is ON, add ±.02% FS to accuracy specifications.
For E1313, multiply Noise Spec. by 1.4.

A/D Range (±V FS)		Linearity % of reading	Common Mode Error %of Vcm	Offset Error	Noise 3 sigma	Noise* 3 sigma
These ranges are → .0625	(1V)	0.02%	0.1%	100 µV	700 µV	280 µV
not recommended → .25	(4V)	0.02%	0.1%	175 µV	860 µV	430 µV
1	(16V)	0.02%	0.1%	500 µV	1.8 mV	1.4 mV
4	(60V)	0.02%	0.1%	1.95 mV	7.0 mV	5.8 mV

* [SENSe:]FILTer[:LPASs][:STATe] ON (max scan rate - 100 rdgs/sec/channel)

Temperature Coefficients: Gain - .001/°C. Relative to temp at last *CAL?
Offset - (0 - 40°C) 0.14µV/°C, (40 - 55°C) 0.8µV+0.38µV/°C Relative to 23°C.