

5730A

Multifunction Calibrator

Service Manual

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Each Fluke product is warranted to be free from defects in material and workmanship under normal use and service. The warranty period is one year and begins on the date of shipment. Parts, product repairs, and services are warranted for 90 days. This warranty extends only to the original buyer or end-user customer of a Fluke authorized reseller, and does not apply to fuses, disposable batteries, or to any product which, in Fluke's opinion, has been misused, altered, neglected, contaminated, or damaged by accident or abnormal conditions of operation or handling. Fluke warrants that software will operate substantially in accordance with its functional specifications for 90 days and that it has been properly recorded on non-defective media. Fluke does not warrant that software will be error free or operate without interruption.

Fluke authorized resellers shall extend this warranty on new and unused products to end-user customers only but have no authority to extend a greater or different warranty on behalf of Fluke. Warranty support is available only if product is purchased through a Fluke authorized sales outlet or Buyer has paid the applicable international price. Fluke reserves the right to invoice Buyer for importation costs of repair/replacement parts when product purchased in one country is submitted for repair in another country.

Fluke's warranty obligation is limited, at Fluke's option, to refund of the purchase price, free of charge repair, or replacement of a defective product which is returned to a Fluke authorized service center within the warranty period.

To obtain warranty service, contact your nearest Fluke authorized service center to obtain return authorization information, then send the product to that service center, with a description of the difficulty, postage and insurance prepaid (FOB Destination). Fluke assumes no risk for damage in transit. Following warranty repair, the product will be returned to Buyer, transportation prepaid (FOB Destination). If Fluke determines that failure was caused by neglect, misuse, contamination, alteration, accident, or abnormal condition of operation or handling, including overvoltage failures caused by use outside the product's specified rating, or normal wear and tear of mechanical components, Fluke will provide an estimate of repair costs and obtain authorization before commencing the work. Following repair, the product will be returned to the Buyer transportation prepaid and the Buyer will be billed for the repair and return transportation charges (FOB Shipping Point).

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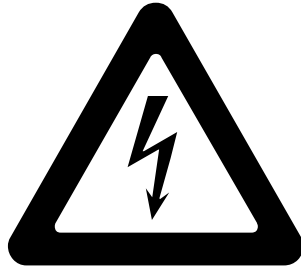
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OPERATOR SAFETY SUMMARY

WARNING



HIGH VOLTAGE

is used in the operation of this equipment

LETHAL VOLTAGE

may be present on the terminals, observe all safety precautions!

To prevent electrical shock hazard, the operator should not electrically contact the output HI or sense HI terminals or circuits connected to these terminals. During operation, lethal voltages of up to 1100 V ac or dc may be present on these terminals.

When the nature of the operation permits, keep one hand away from equipment to reduce the hazard of current flowing through vital organs of the body.

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Introduction

The Fluke Calibration 5730A Calibrator (the “Product” or the “Calibrator”) can calibrate a wide variety of electrical measurement instruments. The Product maintains a high accuracy over a wide ambient temperature range. The Product can calibrate precision multimeters that measure ac or dc voltage, ac or dc current, and resistance. The Calibrator also is available with a Wideband AC Voltage option which extends this workload to include RF voltmeters.

This manual contains specifications, theory of operation, calibration procedures, and verification procedures, list of replaceable parts, and repair instructions. The repairs in this manual are detailed to the modular level. For any repairs other than module replacement, send the Product back to Fluke Calibration for service. The Product is a fully-programmable precision source of:

- DC voltage to 1100 V
- AC voltage to 1100 V, with output available from 10 Hz to 1.2 MHz
- AC and DC current to 2.2 A, with output available from 10 Hz to 10 kHz
- Resistance in values from 1 Ω to 100 M Ω , plus a short
- Optional wideband ac voltage from 300 μ V to 3.5 V into 50 Ω (-57 dBm to +24 dBm), 10 Hz to 30 MHz (5730A/03) or 50 MHz (5730A/05)

Features of the Product include:

- Internal environmentally-controlled references that let the Calibrator maintain full performance over a wide ambient temperature range.
- Automatic meter error calculation obtained through the use of a simple output adjust knob.
- Keys that multiply and divide the output value by 10. This simplifies work on meters with calibration points at decade multiples of a fraction of full-scale.
- Programmable entry limits used to restrict the levels that can be entered into the Calibrator. This prevents access to levels that may be harmful to equipment or personnel.
- Continuous display of Calibrator specifications at the selected operation point, calibration interval, and specification confidence level.

- An auxiliary current binding post to calibrate meters with separate current inputs without the need to move cables.
- Real-time clock and calendar for date stamping reports and reminders issued to perform the dc zeros calibration procedure within the required interval.
- Offset and scaling modes that simplify linearity tests of multimeters.
- Variable phase reference signal output and phase-lock input.
- Interface for the Fluke Calibration 5725A Amplifier.
- Interface for the Fluke Calibration 52120A Amplifier.
- Standard IEEE-488 (GPIB) interface, that complies with ANSI/IEEE Standards 488.1-1987 and 488.2-1987.
- EIA/TIA-574 Standard RS-232 serial data interface for remote control of the Calibrator.
- Universal Serial Bus (USB) 2.0 high-speed interface device port for remote control of the Calibrator.
- Integrated 10/100/1000BASE-T Ethernet port for network connection remote control of the Calibrator.
- Extensive internal self-testing and diagnostics of analog and digital functions.
- USB Host port to save calibration reports to a flash drive.
- Visual Connection Management output terminals that illuminate to help show correct cable connection configurations.
- Soft Power - automatic selection of line voltage/frequency.
- LCD Color VGA display with touch panel overlay.
- A traceable calibration procedure for all modes and ranges that requires only 10 V, 1 Ω , and 10 k Ω external standards, with only occasional independent verification.
- Automated calibration check that provides added confidence between calibration cycles. The data can be used to document and characterize Calibrator performance between calibration cycles.

How to Contact Fluke Calibration

Fluke Corporation operates worldwide. For local contact information, go to our website: www.flukecal.com.

To register your product, view, print, or download the latest manual or manual supplement, go to our website.

+1-425-446-5500

info@flukecal.com.

Safety Information

General Safety Information is in the printed Safety Information document that shipped with the Product. More specific safety information is listed where applicable.

A **Warning** identifies conditions and procedures that are dangerous to the user. A **Caution** identifies conditions and procedures that can cause damage to the Product or the equipment under test.

Specifications

Complete specifications are at www.flukecal.com.

The Product is verified and calibrated at the factory prior to shipment to ensure it meets the accuracy standards necessary for all certified calibration laboratories. By calibrating to the specifications in this chapter, the high-performance level can be maintained throughout the life of the Calibrator.

Specifications are valid after a warm-up period of twice the time the Calibrator has been turned off, up to a maximum of 30 minutes. For example, if the Calibrator has been turned off for five minutes, the warm-up period is 10 minutes.

Specification Confidence Levels

The Product performance level is ensured by regular calibration to the primary performance specifications. These specifications are provided at both the 99 % and 95 % confidence levels. Calibration at the 99 % confidence level is guaranteed by calibration at Fluke Calibration and Fluke Calibration Service Centers. For information on selecting the confidence level, refer to Chapter 4 of the Operators Manual.

The tables in this chapter provide specifications at both the 95 % and 99 % confidence levels for the Calibrators. Included with these tables are operating specifications for use of the Calibrator with the 30 MHz Wideband AC Module (Option 5730A/03), the 50 MHz Wideband AC Module (5730A/05), and the 5725A and 52120A Amplifiers.

Use of Absolute and Relative Specifications

To evaluate the Product coverage of the calibration workload, use the Absolute Accuracy specifications. Absolute accuracy includes stability, temperature coefficient, linearity, line and load regulation, and the traceability to external standards. It is not necessary to add anything to absolute accuracy to determine the ratios between the Calibrator specifications and the tolerance requirements of the calibration workload.

Relative accuracy specifications are provided for enhanced accuracy applications. These specifications apply when range constants are adjusted (see “Range Adjustment” in Chapter 7 of the Operators Manual). To calculate absolute accuracy, combine the uncertainties of the external standards and techniques with relative accuracy.

The accuracy specifications can be used to determine the component of instrumental uncertainty for a particular measurement condition at time of use. When the Calibrator is correctly calibrated, the specifications may be applied to subsequent uncertainty analyses as a Type B evaluation of measurement uncertainty. This is estimated as a normal distribution with a coverage factor of $K=2.58$. Instrumental measurement uncertainty is one of many contributors that must be considered in a thorough uncertainty analysis.

Use of Secondary Performance Specifications

Secondary performance specifications and operating characteristics are included in the absolute specifications. They are provided for special calibration requirements such as stability or linearity tests.

Theory of Operation

Calibrator Overview

Figures 1 and 2 comprise the block diagram of the Calibrator. These figures are in the *Analog Section Overview* and the *Digital Section Overview*.

The Calibrator is configured internally as an automated calibration system with process controls and consistent procedures. Internal microprocessors control all functions and monitor performance, using a switching matrix to route signals between modules. Complete automatic internal diagnostics, both analog and digital, confirm operational integrity.

Digital Section Overview

The unguarded Digital Section contains the CPU assembly (A20), Digital Motherboard (A4), Front Panel assembly (A2), and the unguarded portion of the Rear Panel assembly (A21). Figure 1 is a block diagram of the digital section of the Calibrator.

The CPU assembly uses a soft-core microprocessor contained within an FPGA (Field-Programmable Gate Array), running the μ CLinux operating system. It controls local and remote interfaces, as well as serial communications over a fiber-optic link to the crossing portion of the Regulator/Guard Crossing assembly (A17). The guard crossing controls the guarded analog circuitry. This board also includes an MSP430 microcontroller that does the keyboard scanning and soft-power control functions.

The Front Panel assembly provides user control of the Calibrator and includes subassemblies. The 33-key Keypad assembly (A2) contains the knob encoder, beeper, and USB port. It attaches to the color display, backlight, touch panel, and terminal ring LEDs. The assembly connects to the Digital Motherboard (A4) via an Airmax connector.

The Rear Panel assembly includes digital interfaces for the following:

- IEEE-488 bus connection
- RS-232-C DTE serial port
- 5725A auxiliary amplifier
- 52120A auxiliary amplifier

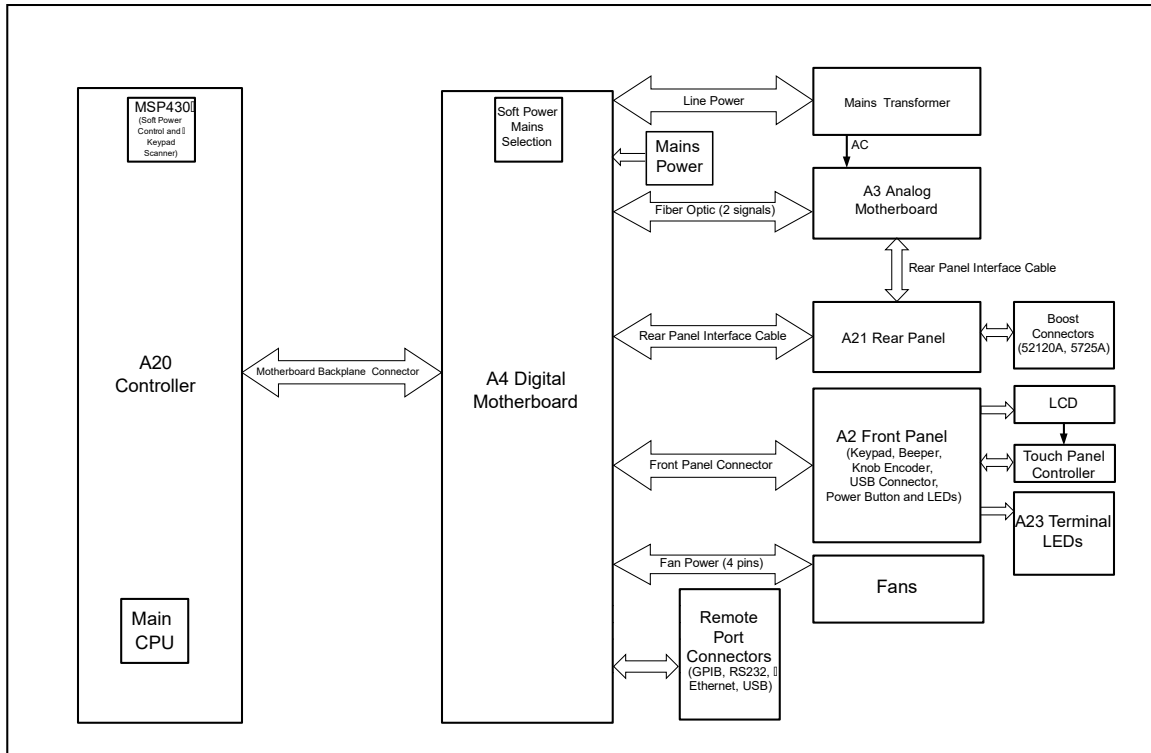


Figure 1. Digital Section Block Diagram

hyv001.emf

Analog Section Overview

The guarded analog section contains these assemblies:

- Wideband Oscillator (A5) (Option 5730A/03 or 5730A/05)
- Current/Hi-Res (A7)
- Switch Matrix (A8)
- Ohms Cal (A9)
- Ohms (A10)
- DAC (A11)
- Oscillator Control (A12)
- Oscillator Output (A13)
- High Voltage Control (A14)
- High Voltage/High Current (A15)

- Power Amplifier (A16)
- Regulator/Guard Crossing (A17)
- Filter/PA Supply (A18)

These analog assemblies interface to the Analog Motherboard assembly (A3).

The guarded digital bus generated by the guard crossing portion of the Regulator/Guard Crossing assembly controls all analog assemblies except the Filter/PA Supply. The Guard Crossing interfaces with the unguarded CPU assembly via a fiber-optic link. The Transformer assembly, along with the filter portion of the Filter/PA Supply assembly and the regulator portion of the Regulator/Guard Crossing assembly, create the system power supply for all the analog assemblies. The Power Amplifier Supply portion of the Filter/PA Supply assembly provides the high voltage power supplies required by the Power Amplifier assembly. The amplitudes of these high voltage supplies are controlled by circuitry contained on the Power Amplifier assembly.

Functional Description Presented by Output Function

The Functional Description section explains the Calibrator operation from the perspective of each output function. It describes which assemblies come into play, and how they interact. It does not provide a detailed circuit description.

DC Voltage Functional Description

The DAC assembly (A11) provides a stable dc voltage and is the basic building block of the Calibrator. DC voltages are generated in these ranges:

- 220 mV
- 2.2 V
- 11 V
- 22 V
- 220 V
- 1100 V

The 11 V and 22 V ranges are generated by the DAC assembly, with its output, DAC OUT HI and DAC SENSE HI routed to the Switch Matrix assembly, where relays connect it to INT OUT HI and INT SENSE HI. Lines INT OUT HI and INT SENSE HI connect to the Calibrator binding posts by relays on the Analog Motherboard assembly (A3).

The 2.2 V range is created on the Switch Matrix assembly by resistively dividing by five the 11 V range from the DAC assembly. Relays on the Switch Matrix and Analog Motherboard route the 2.2 V range output to the Calibrator binding posts.

The 220 mV range is an extension of the 2.2 V range. The Switch Matrix assembly resistively divides by ten the 2.2 V range to create the 220 mV range. Relays on the Switch Matrix and Analog Motherboard route the 220 mV range output to the front panel binding posts.

The 220 V range is generated by the DAC and Power Amplifier assemblies. The Power Amplifier amplifies the 11 V range of the DAC assembly by a gain of -20 to create the 220 V range. The output of the Power Amplifier is routed to the High Voltage Control assembly (A14), where a relay connects it to PA OUT DC. Line PA OUT DC is routed to the binding posts via relays on the Switch Matrix and Analog Motherboard. Figure 3 are block diagrams for the analog section of the Calibrator.

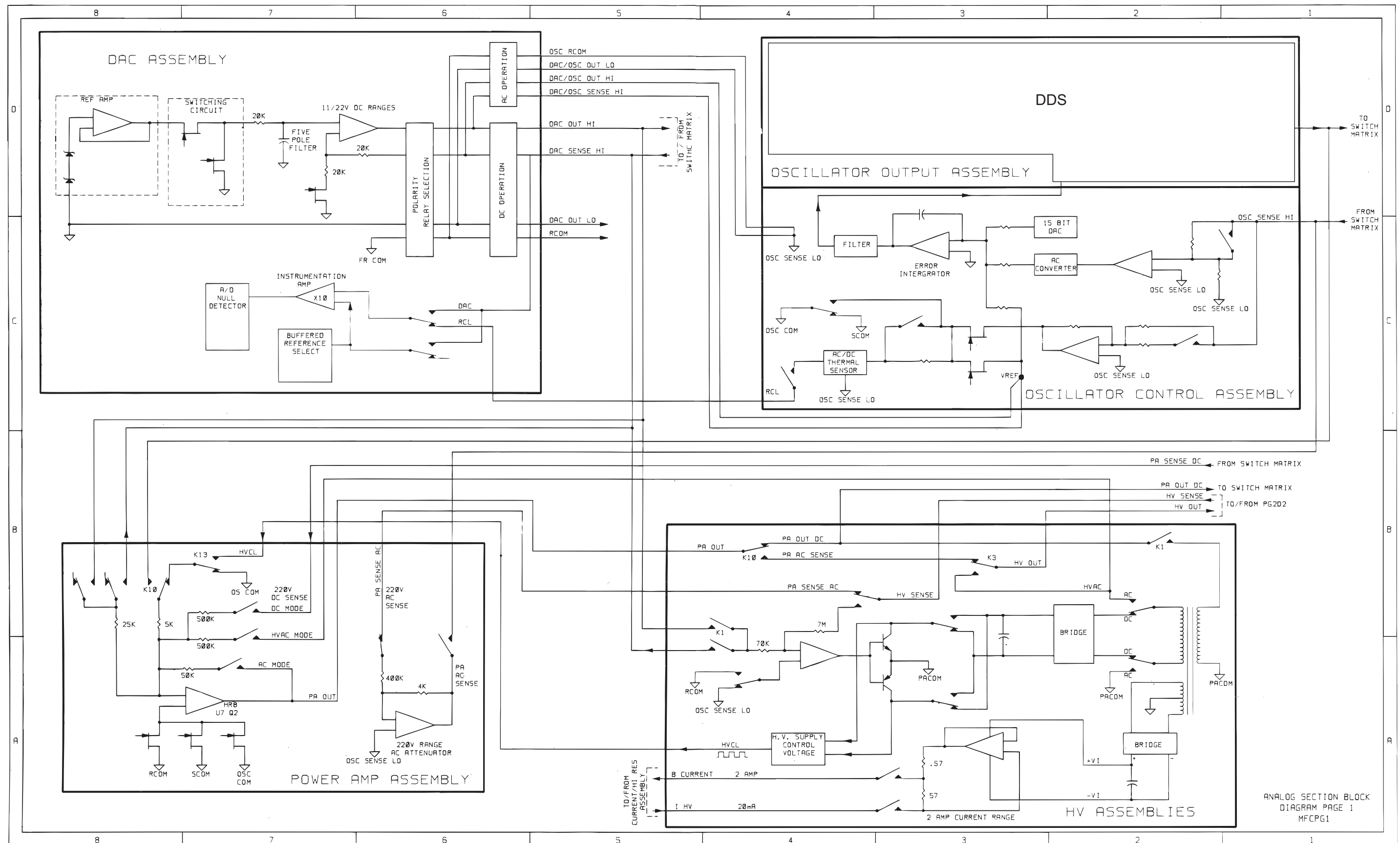


Figure 2. Analog Section Block Diagram, Part 1

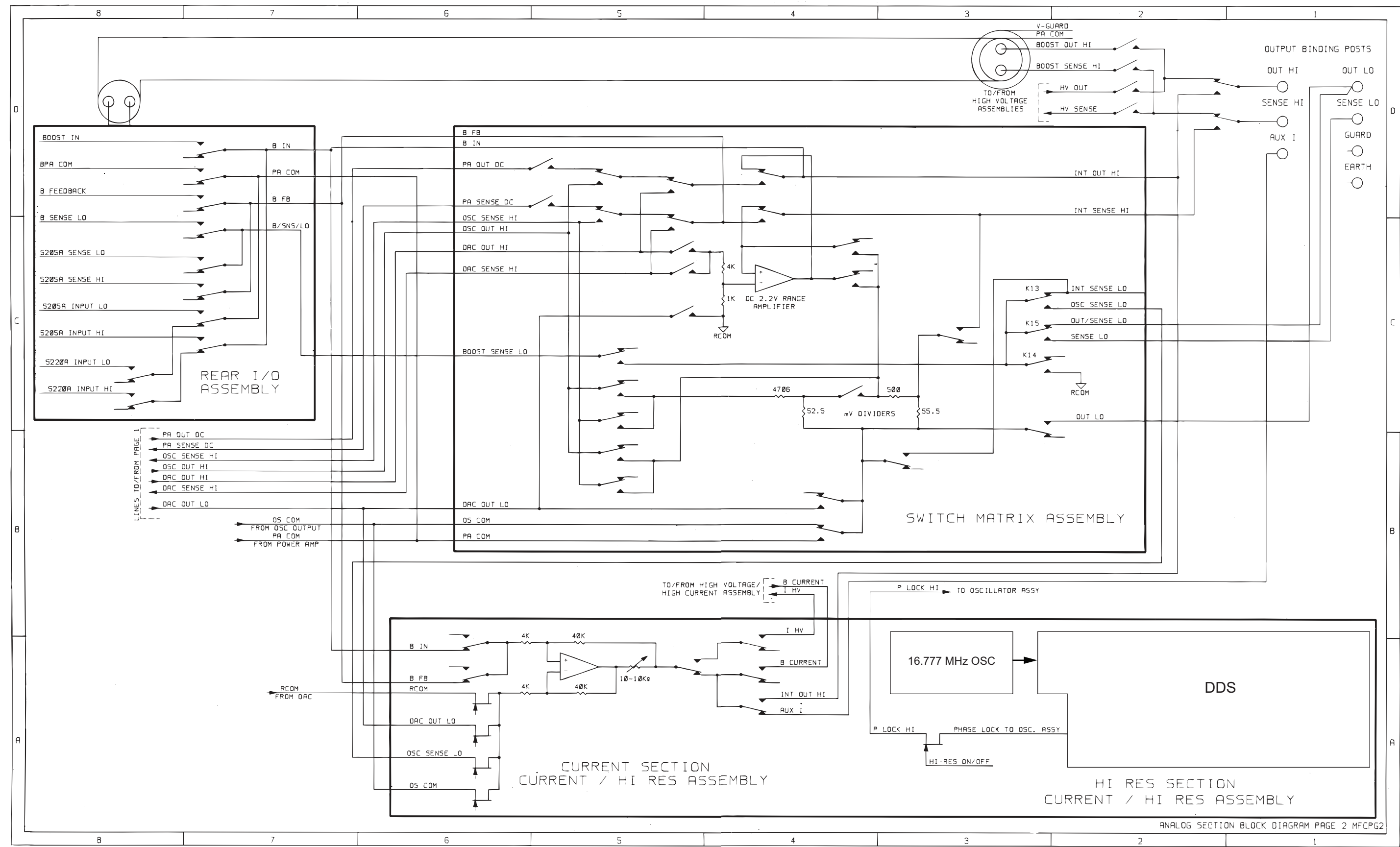


Figure 3. Analog Section Block Diagram, Part 2

The 1100 V range is generated by the High Voltage/High Current assembly (A15) operating in conjunction with the Power Amplifier assembly and the High Voltage Control assembly. The 11 V range of the DAC assembly is routed to the High Voltage/High Current assembly which amplifies by a gain of -100 to create the 1100 V range. Basically the high voltage output is obtained by rectifying and filtering a high voltage ac signal generated by the High Voltage Control assembly operating in conjunction with the Power Amplifier assembly.

AC Voltage Functional Description

The Oscillator Output assembly (A13) is the ac signal source for the Calibrator. The Oscillator Control assembly (A12) controls the amplitude of this ac signal by comparing it with the accurate dc voltage from the DAC assembly and making amplitude corrections via the OSC CONT line. The frequency of oscillation is phase locked to either the high resolution oscillator on the Current/Hi-Res (A7) assembly or an external signal connected to the PHASE LOCK IN connector on the rear panel. AC voltages are generated in these ranges:

- 2.2 mV
- 22 mV
- 220 mV
- 2.2 V
- 11 V
- 22 V
- 220 V
- 1100 V

The 2.2 V and 22 V ranges are generated by the Oscillator Output assembly and routed to the Calibrator binding posts with relays on the Switch Matrix (A8) and Analog Motherboard assemblies.

The 220 mV range is generated on the Switch Matrix assembly, which resistively divides by ten the 2.2 V range of the Oscillator Output assembly. Relays on the Switch Matrix and Analog Motherboard route the 220 mV range to the Calibrator binding posts.

The 2.2 mV and 22 mV ranges are generated on the Switch Matrix assembly. In this mode, the Switch Matrix resistively divides the 2.2 V range or the 22 V range by 1000 to create the 2.2 mV and 22 mV ranges respectively. Relays on the Switch Matrix and Analog Motherboard route these ranges to the Calibrator binding posts.

The 220 V range is generated on the Power Amplifier assembly. In this mode, the Power Amplifier is set for a nominal gain of -10 to amplify the 22 V range from the Oscillator Output to the 220 V range. The 220 V ac range from the Power Amplifier is routed to the Calibrator binding posts by relays on the High Voltage Control assembly and the Analog Mother board.

The 1100 V range is generated by the High Voltage Control assembly operating in conjunction with the Power Amplifier assembly. In this mode, the 22 V range from the Oscillator Output is amplified by the Power Amplifier and High Voltage Control assemblies, which create an amplifier with a nominal gain of -100. Relays on the High Voltage Control and Analog Motherboard assemblies route the 1100 V ac range to the Calibrator binding posts.

30 MHz Wideband AC-V Functional Description (Option 5730A/03 shipped before October 2015)

The 30 MHz Wideband AC Voltage module (Option 5730A/03) consists of the Wideband Oscillator assembly (A6) and the Wideband Output assembly (A5). The wideband frequency ranges are:

- 10 Hz to 1.1999 MHz
- 1.2 MHz to 30 MHz

During operation between 10 Hz and 1.1 MHz, output from the Oscillator Output assembly is routed to the Wideband Output assembly where it is amplified and attenuated to achieve the specified amplitude range. The output is connected to the Calibrator front panel WIDEBAND connector. Operation between 1.2 MHz and 30 MHz works the same way, except the input to the Wideband Output assembly is the ac signal from the Wideband Oscillator assembly.

30/50 MHz Wideband ACV Functional Description (Option 5730A/03 shipped after October 2015 and Option 5730A/05)

Note

In October 2015, the wideband options were redesigned to output 30 MHz and 50 MHz. To see if the 5730A has a newer version wideband option installed, select the Wideband function and output 20 MHz. Calibrators with the older /03 options show "20 MHz". Calibrators with newer options show "20.00 MHz". In addition, the new option is a single board installed in the A5 slot (no A6 needed). See Figure 27.

Operation of the 30/50 MHz Wideband ACV module (Option 5730A/05 and newer 5730A/03) is similar to that of the 30 MHz version described above, except that all circuitry is contained on one board. This board is connected to the front panel WIDEBAND connector.

DC Current Functional Description

DC current is generated in these ranges:

- 220 μ A
- 2.2 mA
- 22 mA
- 220 mA
- 2.2 A

All current ranges except 2.2 A are generated by the current portion of the Current/Hi-Res assembly. These currents are created by connecting the output of the DAC assembly, set to the 22 V range, to the input of the Current assembly. The Current assembly uses this dc voltage to create the output current. The current output can be connected to the AUX CURRENT OUTPUT binding post by relays on the Current assembly, to the OUTPUT HI binding post by relays on the Current, Switch Matrix, and Analog Motherboard assemblies, or to the 5725A via the B-CUR line by relays on the Analog Motherboard assembly and Rear Panel assembly.

The 2.2 A range is an extension of the 22 mA range. The 22 mA range output from the Current assembly is amplified by a gain of 100 by the High Voltage/High Current assembly operating in conjunction with the Power Amp assembly and the High Voltage Control assembly. The 2.2 A current range is routed back to the Current assembly where it is connected to either the AUX CURRENT OUTPUT binding post, the OUTPUT HI binding post, or the 5725A in the same manner as the lower current ranges.

AC Current Functional Description

AC current is created in the same manner as dc current, except the input to the Current assembly is the ac voltage from the Oscillator Output assembly set to the 22 V range. The switching between ac and dc is carried out on the Switch Matrix, Oscillator Control, Oscillator Output, and DAC assemblies. AC current is not range lockable and the minimum output on the 200 μ A range is 9 μ A.

Ohms Functional Description

Two assemblies function as one to supply the fixed values of resistance:

- Ohms Main assembly (A10)
- Ohms Cal assembly (A9)

All of the resistance values except the 1 Ω , 1.9 Ω , and short are physically located on the Ohms Main assembly. The 1 Ω , 1.9 Ω , and short are physically located on the Ohms Cal assembly. The resistance is selected by relays on these Ohms assemblies and is connected to the Calibrator binding posts by relays on the Analog Motherboard. The Ohms Cal assembly also contains the appropriate circuitry to enable the Calibrator to perform resistance calibration. Once calibrated, the Calibrator output display shows the true value of the resistance selected, not the nominal (for example 10.00031 k Ω , not 10 k Ω).

Four ohms measurement modes are available. For the two-wire configuration, measurement with or without lead-drop compensation sensed at the binding posts of the UUT (using the SENSE binding posts and another set of leads), or at the ends of its test leads is available for 19 k Ω and below. Four-wire configuration is available for all but the 100 M Ω value.

Product Calibration

The Product uses internal check standards and measurement systems. As a result, it can be completely calibrated in place to full specifications with a small number of convenient, portable, environmentally-tolerant standards available from Fluke Calibration. The calibration verification procedure provides traceability for the ac and dc voltage, resistance, and ac and dc current functions.

When manufactured, each Product is calibrated and thoroughly verified with process metrology and calibration standards traceable to the International System of units (SI) through well-recognized national metrology institutes. Fluke Calibration includes a certificate of calibration that is accredited to ISO 17025.

The calibration verification procedure is recommended every 2 years or as required by established policies. This procedure ensures internal processes are in control, and establishes parallel external traceability paths for internal functions such as ac transfers that are never adjusted or corrected.

The Artifact Calibration Process

Calibration requires only three external standards or artifacts: 10 V, 1 Ω , and 10 k Ω . Environmentally-controlled internal check standards provide the primary reference points. A stored table of calibration constants defines additional reference points for controlling the output. Traceable calibration and adjustment to the specified level of performance is accomplished in a semi-automated process that revises this table.

When finished with artifact calibration, but before the new constants are saved, the Product presents the proposed adjustments as +/- ppm of range and percentage change in specification for each range and function. A list of changes can be sent to the computer through the serial port, USB device port, Ethernet port, or the IEEE-488 port using the remote command: CAL_RPT? CHECK. Also on completion of calibration, the Calibrator shows the largest proposed change.

Calibration can be completed as far as deriving and printing the proposed adjustments without entering the calibration protection passcode. To save the changes in non-volatile memory to adjust future outputs from the Calibrator, the passcode must be entered from the front panel or with a remote command. The passcode entry menu is shown on the display when necessary.

Establish Traceability

Traceability to national standards is established as follows:

- Except for the internal ac/dc transfer standard, the internal check standards are directly calibrated by traceable external standards every time the Calibrator is calibrated.
- The internal ac/dc transfer standard is never adjusted, so its traceability is not disturbed by calibration. Infrequent verification is done in the traditional way, by comparing selected ac voltage outputs with an external dc voltage standard through an external ac/dc transfer standard. Fluke Calibration recommends this to be done every two years or as determined by the policy of your organization.
- Infrequent independent verification is also done on stable parameters, such as frequency flatness, determined more by circuit geometry and dielectric constants than time.

Calibration Reports

The Product stores two sets of calibration constants: the set currently in use and the old set from the previous calibration. This gives the Calibrator the ability at any time to produce a calibration report of the differences between the present settings and the settings that were in effect before the last calibration. The report shows shifts in various output values from before to after the most recent calibration for each range and function in +/- ppm of range and in percentage of specification limit. The report can be saved to a USB drive or retrieve it from a host computer through either the RS-232, USB device port, Ethernet port, or IEEE-488 interface.

Range Adjustment

After calibration, further fine adjustments can be made to each range. Range adjustments are optional and they are not necessary to meet total uncertainty specifications. However, range adjustments can help to align the Calibrator closer to in-house standards.

Before range calibration is done, first do the Artifact Calibration as described later in this chapter. This is to calibrate the ranges that will not be adjusted. It also performs an initial adjustment for each range, and supplies flatness corrections for ac functions.

DC Zeros

DC Zeros is a quick, automatic process that corrects offset errors that increase with time on several output ranges. If a 5725A Amplifier is attached, it also zeros the 11 A dc range. This process takes approximately 2 ½ minutes (plus an additional 30 seconds for the 5725A).

To execute dc zeros, from the normal operation screen:

1. Touch **Setup Menu** to show the Setup Menu. For more information, see the Operators Manual.
2. Touch the **Calibration** menu.
3. Touch **Run DC Zero** to start the dc zeros routine. The status of the dc zero calibration is shown as the Calibrator progresses through a series of steps. When completed, the Calibrator shows "Calibration complete".

Note

If the Calibrator is not warmed up, the display prompts to continue or cancel the DC Zeros function.

4. Touch **Close** to proceed with Calibrator use.

DC Zeros Reminder

Specifications require that dc zeros be run at least every 30 days. If 30 days passes and dc zeros is not done, the display prompts to run the process.

To override the message and run dc zeros at a more convenient time, touch **Cancel**. To run dc zero at this time, touch **OK**.

Note

If this message shows after powering on the Product, let the Product warm up before running dc zeros. Otherwise an error message indicates that the Product is not warmed up. To ensure the best performance, complete the warmup.

Calibration Procedures

Warning

To prevent possible electrical shock, fire, or personal injury:

- Do not put the Product where access to the mains power cord is blocked.
- Do not use an extension cord or adapter plug.
- Do not connect to live output terminals. The Product can supply voltages that can cause death. Standby mode is not sufficient to prevent electrical shock.
- Use only cables with correct voltage ratings.
- Do not touch exposed metal on banana plugs, they can have voltages that could cause death.
- Do not touch voltages > 30 V ac rms, 42 V ac peak, or 60 V dc.

Use this section to calibrate the Product to external standards, adjust the range if necessary, and do a calibration check.

To maintain traceability, you must:

- Complete calibration of the Product to external standards before the start of any calibration cycle.
- Complete a Performance verification every 2 years.

Calibration Check and range calibration are optional procedures that are provided to enhance the accuracy if needed for special requirements. See *Calibration Check*.

Table 1 lists each external uncertainty limit of the standards and the Product specifications that must be adjusted accordingly if that limit is exceeded.

Table 1. Standards for Calibration

Fluke Standard	Traceable Quantity	Nominal Value	Uncertainty Limit	Specifications susceptible to Uncertainty Limit
732B	Voltage	10 V	1.5 ppm	dc volts, ac volts, dc current, ac current
742A-1	Resistance	1 Ω	10 ppm	1 Ω, 1.9 Ω
742A-10k	Resistance	10 kΩ	2 ppm	ac current, dc current 10 Ω to 100 MΩ
Additional Equipment Required for Main Output Calibration				
Equipment		Description		Application
Low Thermal Leads (2 sets)		5730A-7003 (spade lugs)		Artifact Calibration
Single Conductor Test Leads (2)				When using two-conductor low-thermal leads, use this separate cable to connect the guards.
Reference Divider		Fluke 752A		Optional Range Calibration
Long scale DMM		Fluke 8508A		Optional Range Calibration
Equipment Required for Wideband AC Module (Option 5730A/03 and 5730A/05) Calibration				
AC Measurement Standard		Fluke 5790A/B with Wideband Option		Wideband
Wideband Cable (supplied with 5730A/03 and 5730A/05)		Fluke Cable		Wideband
50 Ω Termination (supplied with 5730A/03 and 5730A/05)		Fluke Termination		Wideband
Adapter (supplied with 5730A/03 and 5730A/05)		Pomona 1269 BNC(F) to dual banana plug		Wideband
Adapter (supplied with 5730A/03 and 5730A/05)		Kings KN-99-46 N(F) to BNC(M)		Wideband

Calibration Security Passcode

The integrity of Product calibration is protected by a security passcode that must be entered before new calibration constants can be saved to non-volatile memory. This passcode replaces the hardware calibration switches found on older calibrators such as the Fluke 5720A. As with the 5720A, the passcode also protects the ability to set the date for the internal real-time clock.

If the passcode has not been entered, the Product is secured. Once the passcode is entered, the Product is unsecured. The Product secures itself when it is reset or when the setup menus are closed. The Product can be unsecured at any time over the remote interface with the CAL_SECURE command or by entering the passcode. The front panel prompts for the passcode to unsecure the Product before it can accept new values to be eventually stored.

The passcode contains 1 to 8 decimal digits. The Product is shipped with the passcode set to "5730". To change the passcode, touch **Setup Menu>Calibration>Change Calibration Passcode**. The Product prompts for the current passcode and then the new passcode. The passcode can also be changed over the remote interface with the CAL_PASSWD command.

If the passcode for a particular Product is lost, contact Fluke Customer Support. See *How to Contact Fluke Calibration*.

Artifact Calibration

The Product must be calibrated to external standards at the beginning of the calibration cycle. The length of the cycle (24 hours, 90 days, 180 days, or one year) is selected in a Setup Menu described in Chapter 4 of the Operators Manual.

To calibrate the Product, apply these portable standards to the output binding posts:

- 10 V dc voltage standard
- 1 Ω resistance standard
- 10 k Ω resistance standard

These standards are recommended:

- Model 732A or 732B DC Reference Standard
- Model 742A-1 1 Ω Resistance Standard
- Model 742A-10k 10 Ω Resistance Standard

Use 5730A-7003 (spade lugs) Low Thermal Leads for all connections:

Both the Product and the recommended external standards have the ability to internally control (or compensate for) ambient temperature variations. Therefore, it is unnecessary to keep the Product in tightly-controlled temperatures during calibration. During the calibration procedure, the Product prompts for the ambient temperature, and includes this information in specification readouts and output shift reports.

Note

5440A-7002 and 5440A-7003 Low Thermal Lead sets include a third cable specifically designed for completing Artifact Calibration. The 5730A-7002 and 5730A-7003 Low Thermal Lead sets do not include the third cable for connection between reference standards.

When to Adjust Product Specifications

As long as the external standards have the uncertainties listed in Table 1, it is not necessary to adjust the Product absolute specifications. However, if uncertainty of the in-house standard exceeds the value in the table, some of the absolute specifications of the Product must be adjusted by the algebraic difference between the standard uncertainty and the uncertainty limit listed in the Table 1. For example, if the dc voltage standard has an uncertainty of 2.5 ppm, then the absolute specifications listed in the Electrical Specification tables above for dc volts, ac volts, dc current and ac current must all be increased by 1 ppm.

Main Output Calibration Procedure

Before this procedure is started, make sure the Product is powered on and has completed the appropriate warm-up period.

To calibrate the main output functions:

1. Touch **Setup Menu>Calibration**. The calibration menu is shown.
2. If necessary, touch **Temperature** and enter the correct temperature (in degrees Celsius) to update the ambient temperature. This is the air temperature in the local vicinity of the Product, which can be seen from laboratory environmental monitoring devices or from a temperature probe located closer to the exterior of the Product. Consider the ambient temperature of the Product if it is located in a rack which can have increased temperatures.
3. Touch **Run Artifact Cal** to begin the procedure. The Product prompts to refer to the manual for the correct connections.
4. Connect the 732B to the Product as shown in Figure 4.

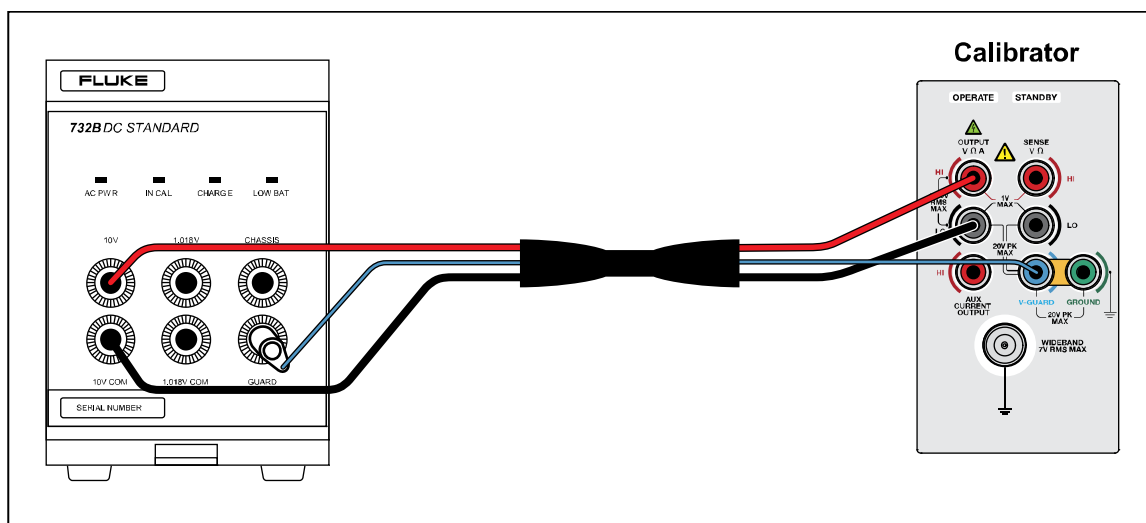


Figure 4. 732B External Calibration Connections

hhp027.emf

5. Enter the value of the 732B 10 V output. Get the value from the report of calibration for the 732B, and preferably, from control charts that use linear regression to predict the value of the 732B at the time of use. If the entered value is not between 9 V and 11 V, an error message is shown. Restart the process from this point with a calibrated 732B.
6. Push **ENTER** to start the calibration procedure. As the Product self-calibrates, it indicates what is happening on the display. When the 6.5 V and 13 V references have been characterized, the display prompts to accept or reject the changes that are about to be made to the calibration constants.
7. To reject the changes, touch **Cancel**. Otherwise, touch **Continue** to accept and save the changes, and to continue with calibration.
8. Reverse the HI and LO connections at the 732B terminals, and push **Continue** on the Product to continue the calibration process.
9. After this part of the calibration procedure is complete, the Product shows the reference shifts and prompts to continue. Touch **Continue**. The Product prompts to refer to the manual for the correct connections and enter the first calibration value.
10. Connect the Product to the 10 k Ω standard as shown in Figure 5 and enter the value of the standard using processes similar to those described for dc voltage. If the standard is not between 9 k Ω and 11 k Ω , an error message is shown. Start over from this point with a different 10 k Ω standard. Push **ENTER** on the Product again to continue.
11. When the internal 10 k Ω reference has been characterized, accept or reject the changes that are about to be made to the calibration constant. To reject the changes, touch **Cancel**. Otherwise, touch **Continue** to accept and save the changes. This lets the calibration process continue.

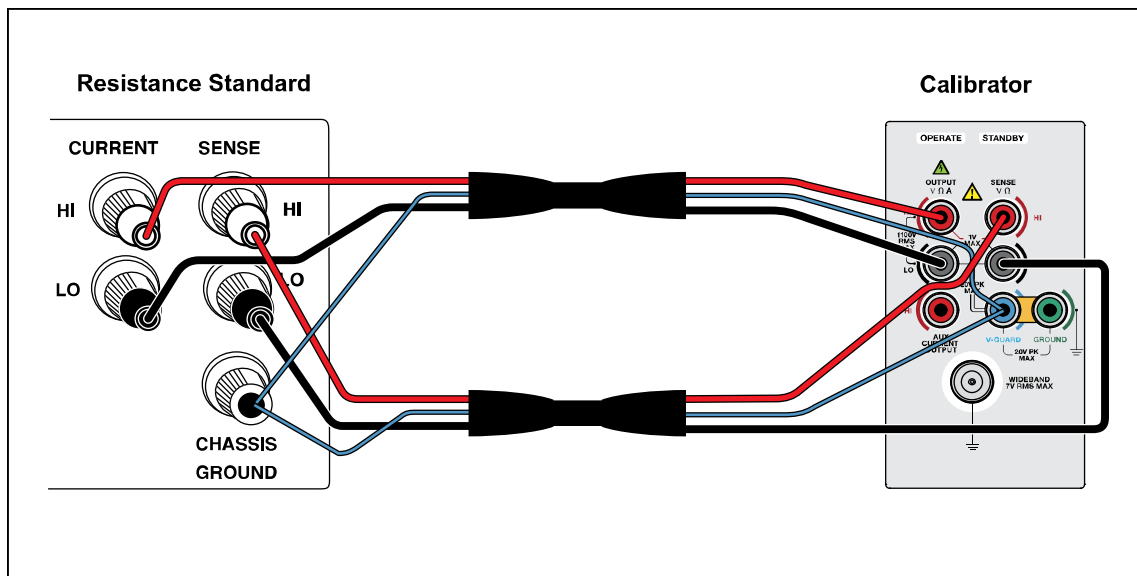
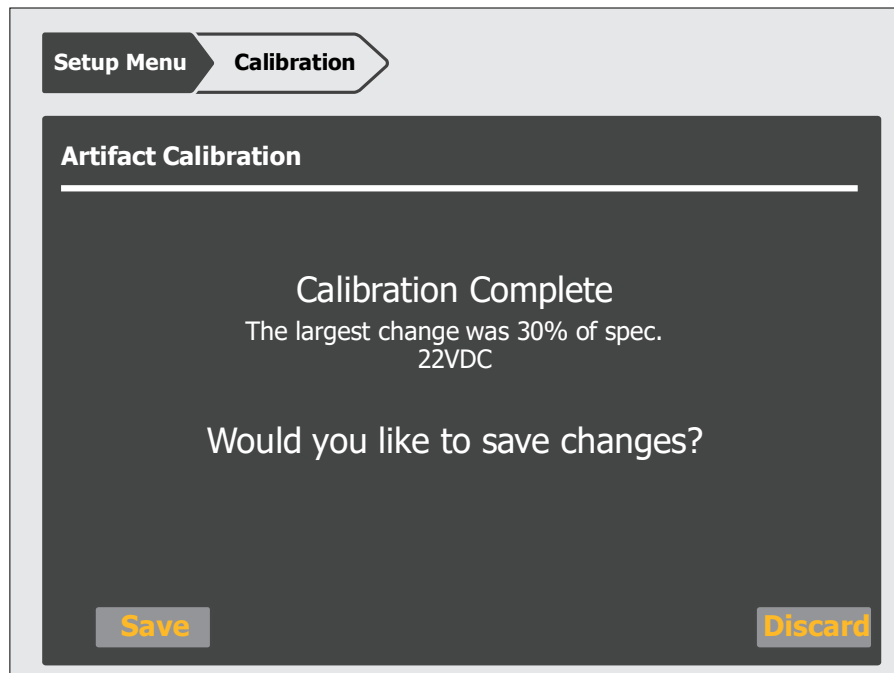


Figure 5. 742A-1 and 742A-10 k External Calibration Connections

hhp028.emf

12. Disconnect the 10 k Ω standard, and connect the Product to the 1 Ω standard. Enter the value of the 1 Ω standard using the processes described for the other standards. If the standard is not between 0.9 Ω and 1.1 Ω , an error message appears, and the user can start over from this point with another standard.
13. Push **Continue** to proceed with calibration.
14. When the internal 1 Ω reference has been characterized, accept or reject the changes that are about to be made to the calibration constant. To reject the changes, touch **Cancel**. Otherwise, touch **Continue** to accept and save the changes, and to continue with calibration.

Once the internal steps are complete, a screen similar to this is shown:



hhp215.emf

15. Touch **Save** to store the results and adjust the Product. If the security passcode has not already been entered, the Product prompts to do so before the results are saved. Touch **Discard** to remove the results from the calibration.

Range Adjustment

Once artifact calibration is complete, it may be necessary to make further adjustments to the range. To make a range adjustment, adjust a range constant, which is an additional gain multiplier. Although range calibration is not needed to meet absolute specifications, they are useful for tuning the Product so that its values are closer to in-house standards.

Use an in-house laboratory standard to adjust the range constants. The subsequent procedure for adjusting the range constants is designed for laboratory standard values that are between 45 % and 95 % of the range's full-scale value.

Once the range constant is adjusted, the new constant remains active until the next calibration, at which time all range constant multipliers are restored to 1. All range adjustments can be erased by selecting **Restore Factory Defaults** from the Calibration Menu.

Before the subsequent procedure is started, make sure the equipment necessary including in-house laboratory standards where necessary, are on hand.

The subsequent example procedure adjusts the 220 V dc range constant with the listed equipment:

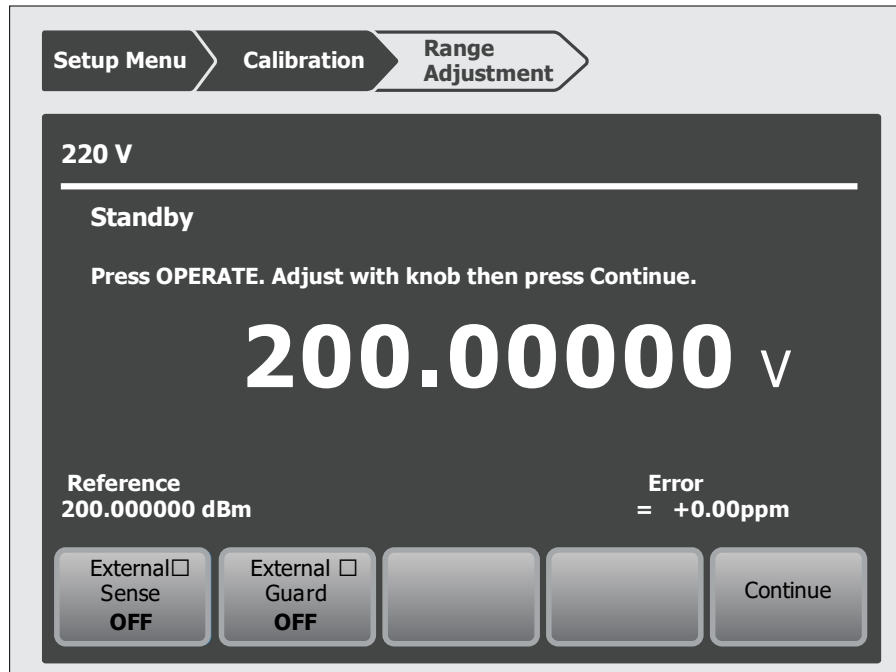
- 732B DC reference standard
- 752A Reference Divider
- 8508A
- Low Thermal Test Leads: 5730A-7003 (spade lugs)

Note

5440A-7002 and 5440A-7003 Low Thermal Lead sets include a third cable specifically designed calibrating a Fluke 5440 series instrument and is not specifically needed here. The 5730A-7002 and 5730A-7003 Low Thermal Lead sets do not include the third cable for connection between reference standards.

Proceed as follows to adjust the 220 V dc range constant (the procedure is similar for all ranges). Complete the calibration to external standards before the range adjustment procedure.

1. Touch **Setup Menu>Calibration>Range Adjustment >DCV** to show the Range Adjustment menu.
2. Touch **220 V** and enter the nominal value.
3. Connect the 732B, 8508A, and 752B in a 10:1 configuration, as shown in Figure 6.
4. Multiply the 732B value by 10, and enter this new value. The Product output will be nulled to this new value.
5. Push **ENTER** to show this display and confirm the values:



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6. Push **OPERATE** to activate the Product output.
7. Turn the output adjustment knob on the Product until a null is achieved on the null detector, and then touch **Continue**.
8. Touch **Save** to store the results and adjust the Product. If the security passcode has not already been entered, the Product prompts to do so before the results are saved. Touch **Discard** to remove the results from the calibration.

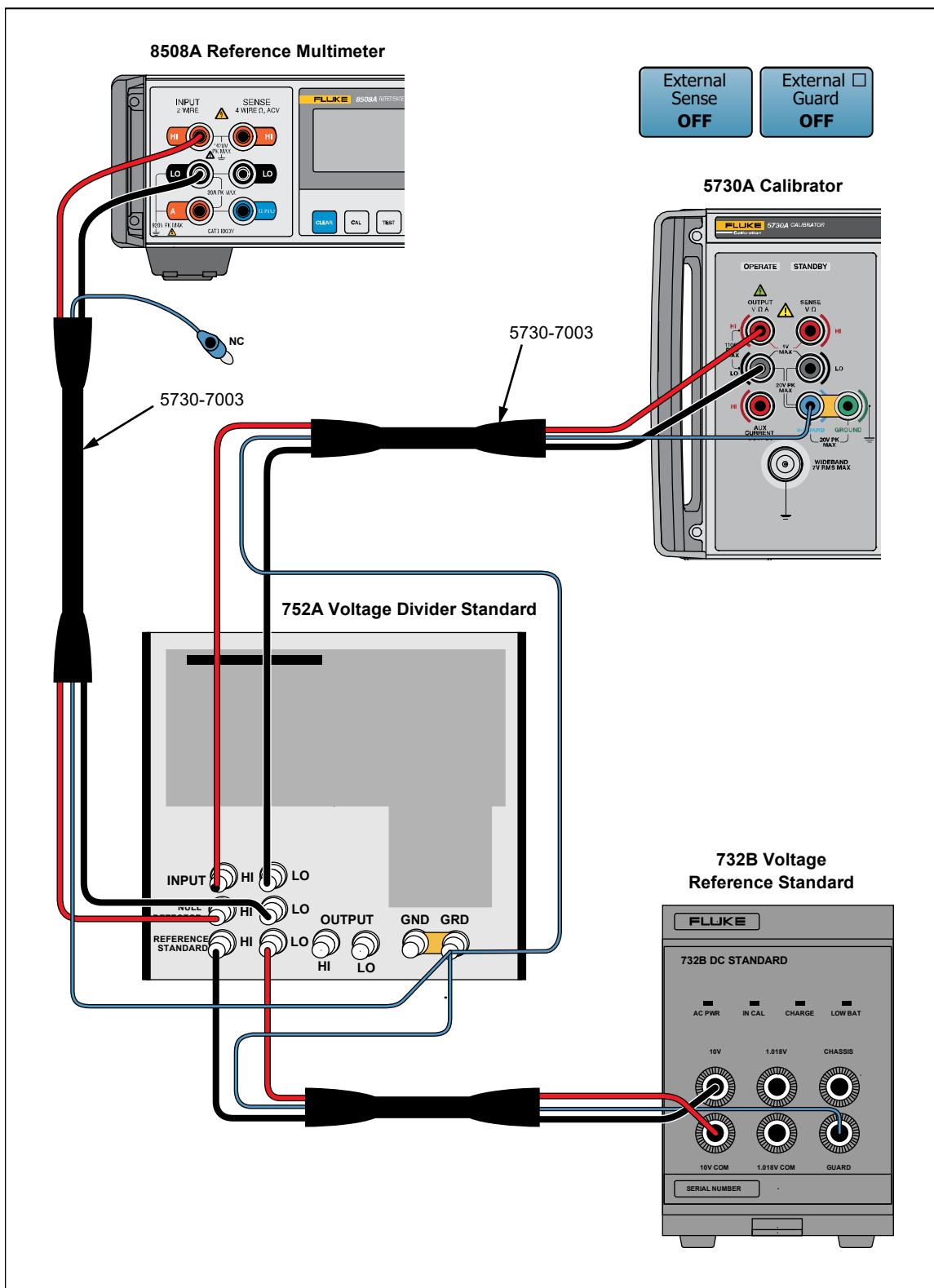


Figure 6. 220 V DC Range Calibration Connections

hhp302.emf

Calibrate the Wideband AC Module Options 5730A/03 and 5730A/05

The Wideband AC Module Options 5730A/03 and 5730A/05 can be installed in the Product. The module needs to be calibrated for both gain and flatness. The gain should be calibrated when the 5730A main output functions undergo their routine calibration.

Since frequency flatness is determined by stable parameters (for example, circuit geometry and dielectric constants), the flatness of the Wideband AC Module has excellent long-term stability. Consequently, a two-year calibration cycle is adequate for flatness calibration and can be scheduled to coincide with the Product shipment to a standards laboratory for periodic verification.

The subsequent procedure describes the process for wideband gain calibration adjustment.

Note

To do this procedure, a Type “N” female to double banana plug adapter is necessary. This adapter comes with the Product. This adapter is not necessary for the 50 MHz wideband (5730A/05).

The 5730A/03 Wideband AC Module can be calibrated with the 5790A, 5790B/3, the 5790B/5, or the 5790B/AF options. The 5730A/05 can only be calibrated with the 5790B/5 or the 5790B/AF.

Before this procedure is started, make sure the Product is powered on and has completed an appropriate warm-up period. To calibrate the wideband gain:

1. Touch **Setup Menu>Calibration** to show the Calibration menu.
2. Connect the wideband output cable between the WIDEBAND connector and the SENSE binding post.

The center conductor of the 50 Ω feedthrough should go to SENSE HI as shown in Figure 7. The GND tab on the adapter should be on the LO side.

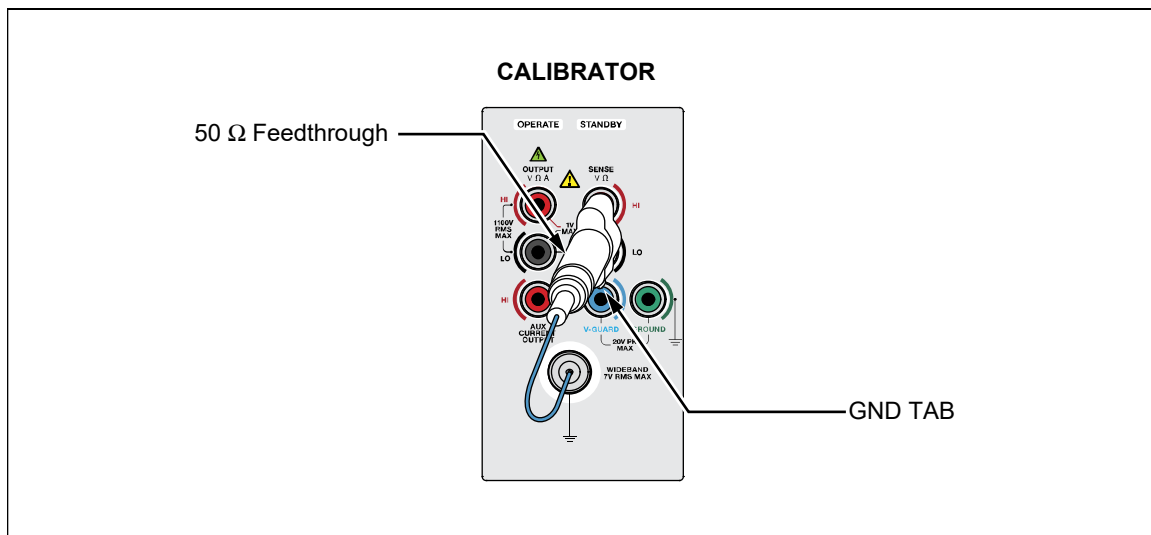


Figure 7. Wideband Module Calibration Connection

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3. Touch **Run Wb Gain Cal** to begin calibration. The Product prompts to refer to the manual for the correct connections.

As the wideband calibration proceeds, messages are shown on the display that identify all processes as they are encountered. When positive gains calibration is complete, a message is shown to refer to the manual for negative gains connections.

4. Reverse the dual-banana connector so that the center connector is connected to LO.
5. Push **ENTER**. The display shows progress through the procedure in the same fashion as for artifact calibration. At the end of the procedure, the Product gives the option to save or discard the results.
6. Touch **Save** to store the results and adjust the Product. If the security passcode has not already been entered, the Product prompts to do so before the results are saved. Touch **Discard** to remove the results from the calibration.

Wideband Flatness Calibration Adjustment Procedure

Do the calibration procedure and the full calibration verification of the Product every 2 years.

For flatness calibration adjustment:

1. Touch **Setup Menu>Calibration**. If the ambient temperature has changed from the displayed value, update it.
2. Touch **Run Wb Flatness Cal**.
3. Connect the equipment as shown in Figure 8. Note that the wideband cable is connected to the 5790A/B directly, the termination is not used.
4. Touch **Continue**.
5. Push **OPERATE**. Wideband flatness calibration starts with a 3 V output at 1 kHz.
6. Push the **SET REF** softkey on the 5790A/B when the 5790A/B settles to a reading. This is the 3 V reference value from which all other frequencies will be compared.
7. Touch **Continue** and the frequency changes to the next value.
8. At this point and all subsequent points for this range, adjust the Product output adjustment knob to bring the 5790A/B error display to 0 and then touch **Continue** on the Product. Repeat this step for each frequency through 30 MHz.
9. The Product wideband output changes to 1 V at 1 kHz. When it has, push the **CLEAR REF WBND** softkey on the 5790A/B.
10. Repeat steps 6 to 9 for the 1 V, 300 mV, 100 mV, 30 mV, and 10 mV ranges.
11. Touch **Save** to store the results and adjust the Product. If the security passcode has not already been entered, the Product prompts to do so before the results are saved. Touch **Discard** to remove the results from the calibration.

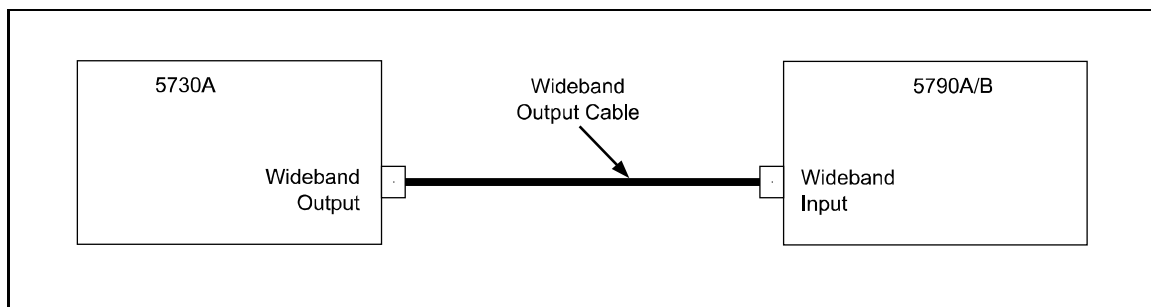


Figure 8. Wideband Flatness Calibration Connections

hhp313.emf

Calibration Check

Calibration check is similar to the artifact calibration, with the primary difference being that no changes are made to the stored constants, and the internal check standards are used as the reference points. A calibration check produces a report similar to the normal artifact calibration report, and shows any proposed changes.

This procedure can be done from an external computer, and can be set to run automatically, with no assistance (there is no need to enter the security passcode, since no constants are changed).

Use calibration check at any time to confirm the integrity of the Product without connecting external standards. The calibration check is also useful to collect a performance history.

Before this procedure is started, make sure the Product is powered on and has completed the appropriate warm-up period.

To check the calibration:

1. Touch the **Setup Menu>Calibration** to show the Calibration menu.
2. Touch **Run Calibration Check** to begin the procedure.

As the calibration check proceeds, the display shows the current process of the calibration check. When the check is complete, the largest shift that is detected is shown on the display. The Product shows when calibration is complete.

3. Touch **Continue** to return to the Calibration menu. To save the calibration report, see *Save Calibration Reports*.

Develop a Performance History

A Fluke Calibration specification is a set of performance limits that all products must meet. To maintain consistent quality, the calibrators are specified with enough margin to include temperature, line, and load extremes, plus additional margin for production. This means that a typical Product in a typical environment operates well within specification limits. For some exacting applications, it can be helpful to know just how accurately a particular Product operates. The proper way to do this is to accumulate a performance history by calibrating regularly and recording results on a control chart.

Calibrating regularly and recording the results on a control chart is tedious and requires a large array of equipment. The Product calibration check feature is an alternative with some distinct advantages:

- Calibrated check standards are already programmed into the unit. External standards are not necessary.
- The process is consistent and automatic and it does not require operator assistance.

Each calibration check produces a new set of data points for accumulating a historical record. When this process is externally automated, significant history can be accumulated much faster than with a manual calibration.

Save Calibration Reports

Use the Product Calibration Report menu to create Calibration Reports and export the reports to a USB flash drive. The subsequent sections describe the reports.

To save a calibration report:

1. Connect a flash drive to the USB port on the front of the Product.
2. Go to **Setup Menu>Calibration>Generate Report**.
3. Select one of the these reports:
 - Save Calibration Shifts
 - Save Check Shifts
 - Save Raw Data

Once an item is selected, the report is saved to the USB flash drive. The report is in comma separated value (CSV) format.

4. Open or print the file from the PC.

Calibration Shift Results

The Calibration Shift report shows all adjustments made to stored zero-offset and gain constants, as a result of any drift detected at the most recent calibration. This report is available and valid at any time.

The report contains this information:

- Heading that shows the date and time the report was saved, the user report string, and the installed version of the Product software.
- Modules present (installed or attached) including any attached amplifiers
- Most recent calibration dates and temperatures
- Values of externally-calibrated internal references including the resistance reference, which is the average of the actual-to-nominal ratios of the 100 Ω , 190 Ω , 1 k Ω , 1.9 k Ω , 10 k Ω , 19 k Ω , 100 k Ω , and 190 k Ω resistors.
- DC voltage output shifts for each range
- AC voltage output shifts for each range. A gain shift for all frequencies is shown along with shifts at selected frequencies for each range.
- Current output shifts for each range (ac and dc)
- Resistance shifts for each value
- 5725A Amplifier output shifts (if attached)
- Wideband AC Module (Options 5730A/03 and 5730A/05) output shifts (if installed)

The shifts of references and outputs are given both as absolute shifts in V, A, ohms, and also (for non-zero magnitudes) as shifts relative to the previous value, in parts per million (ppm) or percent (%).

The specified accuracy for the output is also shown and the ratio of the shift to that accuracy in percent.

The Calibration Shift report file name is CSyymmdd.CSV, where yymmdd is the date today.

Calibration Check Shift Results

The Calibration Check report presents changes in the magnitude of self-correction generated by calibration check. Calibration check uses internal standards rather than external standards as the basis for comparison and does not make permanent changes to calibration constants. This report is available only after a calibration check has been done and until power has been reset to the Product.

The report contains this information:

- Heading that shows the date and time the report was saved and user report string
- Modules present (installed or attached)
- Most recent calibration dates and temperatures
- Values of externally-calibrated internal references
- DC voltage output shifts for each range
- AC voltage output shifts for each range
- AC and dc current output shifts for each range
- Resistance shifts for each value
- 5725A Boost Amplifier output shifts (if attached).

The calibration report file name is CKyymmdd.CSV, where yymmdd is the date today.

Raw Data Results

This report gives the values for the internally stored correction factors (calibration constants), and is useful primarily for Fluke Calibration service centers.

Full Verification

Verification is the process of evaluating the data taken during the process of calibration and evaluating whether the data is within the published specifications for the Product. An independent external verification is recommended every 2 years, before and after normal periodic adjustment or repair of the Product. Verification establishes and maintains parallel external traceability paths for the internal functions that are not adjusted or corrected during artifact calibration. An example is the internal ac/dc transfer standard. Verification also serves as a check that internal calibration processes are in control.

Notes

All performance limits specified in the test records apply to 90-day specifications for the Product at a 99 % level of confidence. If limits to other specifications are desired, the test records must be modified. A description of how to determine a guardband test limits is included in this section.

Equivalent equipment and methods, either manual or automated, may be substituted for the verification tests as long as the same points are tested, and equipment and standards used are at least as accurate as those specified. If standards are less accurate than specified, appropriate tolerance limit and/or accuracy reductions must be made to achieve equivalent results.

Required Equipment for All Tests

An abbreviated summary of required equipment for all the verification tests is given in Table 2. Individual lists of required equipment are included at the beginning of each test.

Warmup Procedure for All Verification Tests

Before verification:

1. Verify that the Product has warmed up for at least 30 minutes.

Note

If the Product has been powered off in an environment outside of operating environment specifications, particularly with humidity above 70 %, allow a minimum of 2 hours warm-up. Extended storage at high temperatures and humidity may require up to 4 days of power-on stabilization.

2. If a regularly scheduled full verification as recommended by Fluke Calibration is being done, calibrate the Product as described in the *Calibration Procedure* section before you continue with verification.
3. Ensure that each piece of external test equipment has satisfied its specified warm-up requirements.
4. Ensure that the Product is in standby (STANDBY annunciator lit).

Table 2. List of Required Equipment for Main Output

Equipment	Description	Application
AC Measurement Standard	Fluke 5790B	ACV, ACI
Resistance Standards	Fluke 742A Series	Cal, Ohms, DCI
Reference Divider	Fluke 752A	DCV
Null Detector	Fluke 8508A	DCV
DC Reference Standard	Fluke 732B	DCV
Frequency Counter	Tektronix FCA3000	Frequency
Shunts	Fluke A40B Series	ACI
Resistance Standard	Guildline 9230 0.1 Ω and 0.01 Ω	DCI
Digital Multimeter	Fluke 8508A	Ohms, DCI, ACV, and DCV
Low Thermal Cables	5730A-7003	Various
Equipment Required for Wideband AC Module (Options 5730A/03 and 5730A/05) Verification		
AC Measurement Standard	Fluke 5790B with Wideband Option	Wideband
Wideband Cable (supplied with 5730A/03 and 5730A/05)	Fluke Cable	Wideband
50 Ω Termination (supplied with 5730A/03 and 5730A/05)	Fluke Termination	Wideband
Adapter (supplied with 5730A/03 and 5730A/05)	Pomona 1269 BNC(F) to dual banana plug	Wideband
Adapter (supplied with 5730A/03 and 5730A/05)	Kings KN-99-46 N(F) to BNC(M)	Wideband

Determine Specification Limits for other Calibration Intervals

The verification procedures in this document test to the 90-day 99 % confidence specification limits. For other calibration intervals, it is necessary to calculate limits based upon the specification that was selected. The subsequent examples show how the 90 day specification limits were calculated. These examples illustrate how to calculate the specifications limits for other intervals or levels of confidence.

The next example shows how to calculate a specification limit for a particular test point from the combined specification which is listed as a percentage (or parts per million) of reading plus a floor error in microvolts, millivolts, microamps or nanoamps. The component of the specification in parts per million is referred to as a range specification. The floor specification has the same base units of measurement as the output value (volts, amps). It is not appropriate to add a range specification and floor specification together directly, because they are not in the same units of measurement. In order to add the two quantities, it is necessary to convert one quantity so that they are both in the same units of measurement.

The 90 day 99 % confidence specification for the Product at 2 mA, 1 kHz is 117 ppm + 40 nA. Convert the range specification to the same units as the floor specification by multiplying the range specification by the output value:

$$(2 \text{ mA} \times 117 \text{ ppm} = [(2 \times 10^{-3}) \text{ A} \times (117 \times 10^{-6})] = 2.34 \times 10^{-7} \text{ A} = 234 \text{ nA}$$

Making the combined absolute specification $234 \text{ nA} + 40 \text{ nA} = 274 \text{ nA}$

The specification limits at 2 mA would be 1.999726 to 2.000274 mA

To test to the 1 year specification of 120 ppm + 40 nA, the specification limit would be $240 \text{ nA} + 40 \text{ nA} = 280 \text{ nA}$.

Applying Guardbands to Specification Limits

The expanded uncertainty of measurement must be determined by each laboratory that calibrates the Product. Even if the procedures for performance verification in this manual are followed completely, there are different sources of uncertainty due to traceability, environment, electrical cabling, electro-magnetic interference, uncertainty of the reference standards used, and operator influences that are unique to each calibration laboratory. These must be accounted for their individual situations, so it is not possible for Fluke Calibration to estimate uncertainty for all user calibrations.

Those doing the calibration of the Product can verify to 99 % confidence limits, 95 % confidence limits, 24 hour, 90 day or 1 year specifications. While the calibration procedure included in this manual is applicable to testing every test point, the uncertainty from the calibration process as compared to the specification limit varies and can require further consideration of measurement decision risk.

Some quality systems require adherence to particular rules for measurement decision risk when making claims of compliance with a specification. Examples of decision rules are:

1. The ratio of the specification tested to the expanded uncertainty of measurement (often referred to as the Test Uncertainty Ratio) must be greater than 4:1.
2. The probability of a false accept risk must be less than 2 %.

3. The Product cannot be determined as meeting specifications unless the measurement at the test point is less than the value of the specification minus the expanded uncertainty.

To comply with these decision rules, it can be necessary to establish a guardband for each test point. A guardband creates a zone that is less than the specification limits, and if the measured value obtained from the calibration is not in the guardband area, the level of measurement decision risk is sufficient. The inner edge of the guardband is the test limit for the calibration shown in Figure 9.

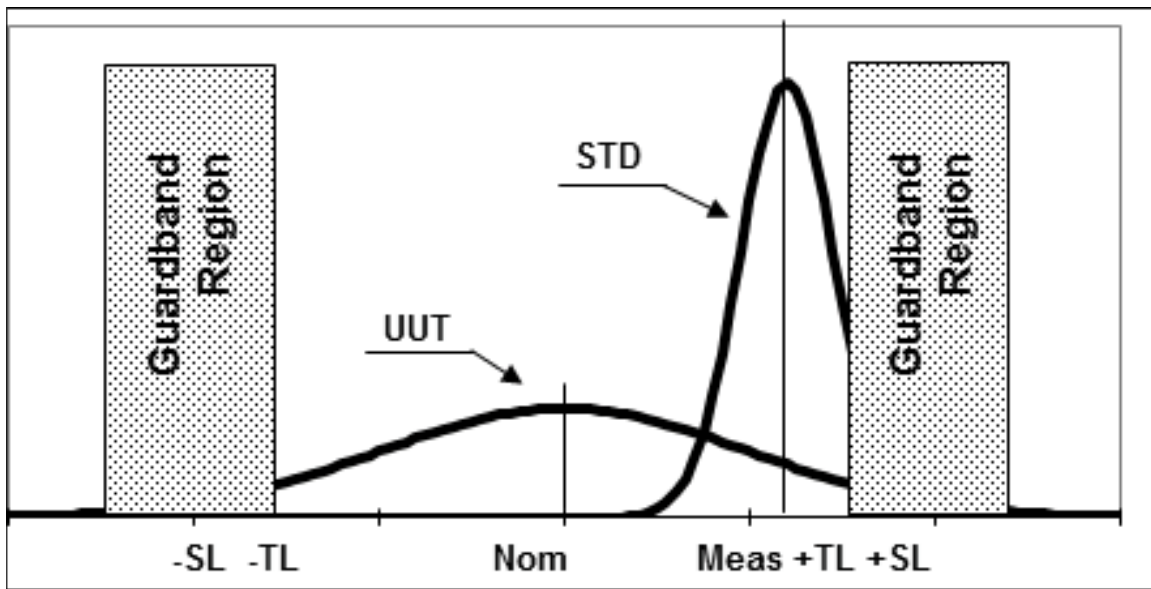


Figure 9. Test Limits Established by Guardbanding

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There are many ways to develop test limits from decision rules. Two of these rules are shown as examples to develop test limits through guardbanding.

ILAC G8 (ISO 14253-1) Decision Rule

This guardband strategy addresses example 5 shown above. The test limit is determined by the subtracting the uncertainty of measurement from the specification.

Test Limit = Specification Limit – Expanded Uncertainty of Measurement

The specification limits can be obtained from the performance verification procedure or can be computed using information from *Determining Specification Limits for other Calibration Intervals* as guidance.

Once the calibration laboratory has determined the expanded uncertainty for a measurement, the test limits for this method may be computed as follows:

Using the example test point in the previous section, for the 90 day 99 % confidence specification for 2 mA at 1 kHz, the specification limits are ± 274 nA. If for example, the expanded uncertainty of measurement at this test point was 55 nA, the test limit would be:

Test Limit = 274 nA – 55 nA = 219 nA

This creates upper and lower test limits of 1.999781 mA to 2.000219 mA. If the

measured value obtained in the calibration were between these limits, by this decision rule the Product would be in tolerance or indicated as Pass.

If the measured value obtained was between 219 nA (the test limit) and 274 nA (the specification limit) this is known as an indeterminate measurement by ISO 14253-1. Some organizations elect to call this a conditional pass as it is more likely that the measurement indicates an in tolerance condition than not.

If the measured value is >274 nA, but <329 nA (the sum of the specification limit plus the uncertainty) ISO 14243-1 indicates that this is an indeterminate measurement as well. Some organizations choose to call this a conditional fail because there is still a possibility that the measurement is in tolerance. Most organizations consider this an out of tolerance result because although the value may exist anywhere with the interval of the measured value plus and minus the uncertainty, the best estimate of the value is the measured value.

RDS Method

Another guardbanding method that is the root difference of squares method. The test limit for this method is defined as:

$$\text{Test Limit} = \sqrt{(\text{Specification limit})^2 - (\text{Expanded Uncertainty of Measurement})^2}$$

This method makes a less aggressive guardband while still providing sufficient confidence in the measurement result for most quality standards. The determination of pass and conditional pass is generally used for this method in the same manner as the ILAC G8 method. The RDS method is used widely at Fluke Calibration and many other companies as a reasonable approach to ensuring confidence that the verified Product meets its published specifications.

This is not an all-inclusive list of guardbanding strategies. The method selected must meet the quality system requirements of the owner of the Product being calibrated. The best uncertainty attainable at some test points can be relatively large as compared to the specification. Fluke Calibration recommends that when making conformity assessment decisions of in or out of tolerance to published specifications during performance verification, the uncertainties of measurement should be evaluated and appropriate guardbanding rules should be applied to have sufficient confidence in the calibration results.

Resistance Verification Test

The subsequent tests check every resistance value from 0 Ω to 100 M Ω . For 0 Ω , 1 Ω , and 1.9 Ω an 8508A measures the resistance directly. For 10 Ω to 100 M Ω the 8508A is used in a transfer method where the Digital Multimeter (DMM) first measures a resistance standard and then measures the Product. The Product resistance value is then calculated. Use Tables 4 and 5 for the test record. Table 4 lists the required equipment.

Table 3. Required Test Equipment

Equipment	Model
Fluke Standard Resistors	742A-10, 742A-100, 742A-1k, 742A-10k, 742A-100k, 742A-1M, 742A-10M and a 100 M Ω Standard
Fluke DMM	Fluke 8508A
Low Thermal Cables	5730A-7003
Special Shielded Cable	See "Verify 100 M Ω " for details

Verify 0 Ω , 1 Ω , and 1.9 Ω

1. Connect the DMM to the Product as shown in Figure 10 using the 5730A-7003 cables.
2. Set the 8508A to Resistance, True Ohms, 2 Ω range, 6 digits, normal current, internal guard, 4 wire, and "Slow".
3. Set the Product to output 0 Ω , 4-wire sense on, and then push **OPERATE**.
4. Wait for the reading to settle and record the reading in the Table 4 DMM Measured Value column.
5. Set the Product to 1 Ω .
6. Wait for the reading to settle and then record the reading in the Table 4 DMM Measured Value column.
7. Set the Product to 1.9 Ω .
8. Wait for the reading to settle and then record the reading in the Table 4 DMM Measured Value column.
9. Push **STANDBY** to put the Product in standby.
10. Enter the value shown on the Product display for 1 Ω and 1.9 Ω into Table 4.
11. Enter the difference in the measured resistance and the resistance shown into the Table 4, Measured Minus Displayed Resistance column.
12. Verify the difference is within the test limits given.

Table 4. 0 Ω , 1 Ω , 1.9 Ω Verification

5730A Output	5730A Displayed Value	DMM Measured Value	Measured Minus Displayed Resistance	Limits
0 Ω	N/A		For 0 Ω use the measured value	$\pm 50 \mu\Omega$
1 Ω				$\pm 95 \mu\Omega$
1.9 Ω				$\pm 180.5 \mu\Omega$

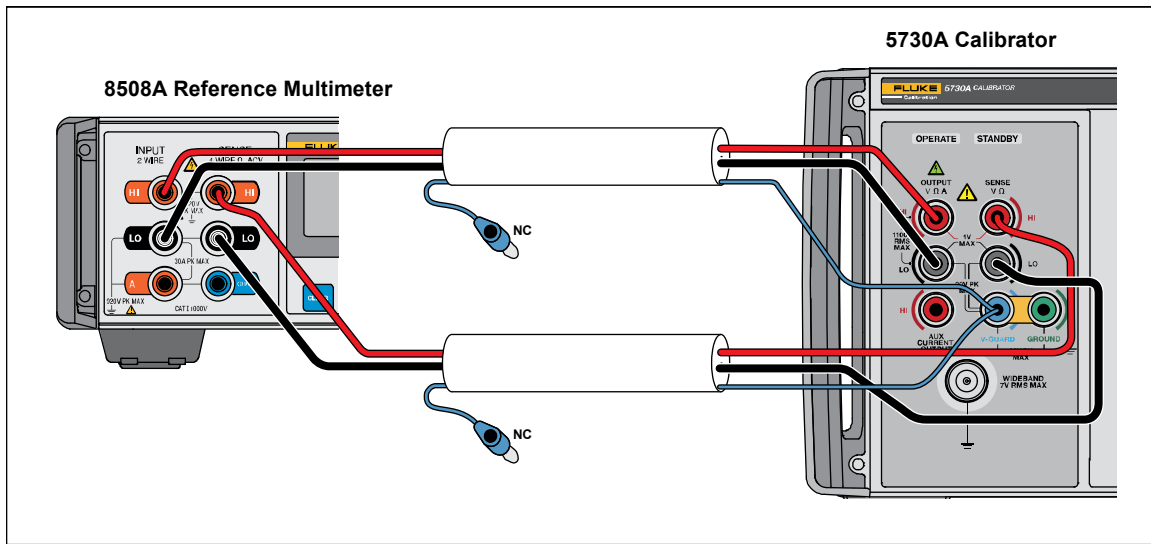


Figure 10. 0 Ω , 1 Ω , 1.9 Ω Resistance Verification

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Verify 10 Ω through 19 M Ω

1. Set the 8508A to Resistance, 7 digits, and 4-wire sense on.
2. Connect a 4-wire short (8508A-7000K) to the 8508A input terminals.
3. Zero the meter on all ranges with the **ZERO FUNC** button.
4. Connect the DMM to the first or next resistance standard (742A) given in Table 5 using the 5730A-7003 cables as shown in Figure 11.
5. Enter the resistance value of the 742A Standard in Table 5 under the 742A STD Ohms Value. This value will be used with two measurements of the Product.
6. Set the 8508A to the range and 2W or 4W Ω as given in Table 5. For the 10 Ω and 19 Ω test, have the 8508A in the True-Ohms mode but for all resistance tests above that use the normal mode. For all measurements set the 8508A to 7 digits, Normal Current, Filter On, "Slow", and Internal Guard.
7. Wait for the reading to settle and then record it in Table 5 under 742A STD Ohm DMM Reading. This reading will be used with two measurements of the Product.
8. Connect the DMM to the Product as shown in Figure 10.

9. Set the Product to output the first resistance used with that standard as given in Table 5. Record the shown value in Table 5 under the Product Displayed Value. Set the Product to 4-wire Sense On for the measurements that have the DMM set to 4 wire and 4-wire Sense Off for the 2 wire measurements.
10. Push **OPERATE**.
11. Wait for the reading to settle and then record it in the Table 5 Product Ohms DMM Readings column.
12. Set the Product to the next resistance in Table 5 that uses the same resistance standard.
13. Record the shown value in Table 5 under Product Displayed Value.
14. Wait for the reading to settle and then record it in Table 5.
15. Calculate the Product values using Equation 1 in Table 5 and record it under the Calculated Value column.
16. Subtract the calculated value from the Product Display Value.
17. Confirm that the differences are within the limits given in the Table 5 Limits column.
18. Repeat the same process for the rest of the resistance measurements in Table 5.

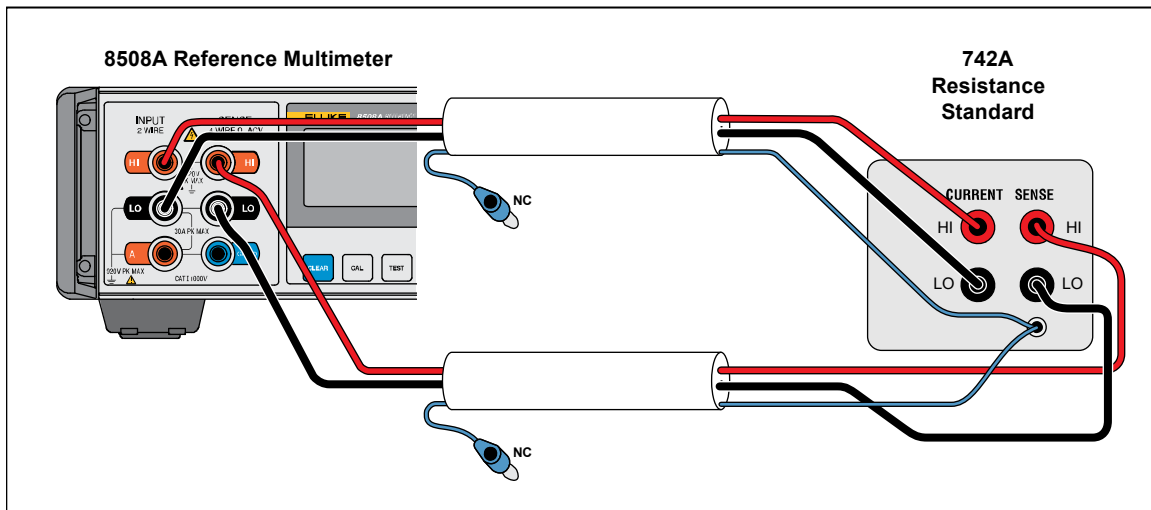


Figure 11. 10 Ω through 19 M Ω Resistance Verification

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Table 5. 10 Ω through 19 MΩ Verification

Product Setting Ohms	DMM Range Ohms	2W/4W Connection	742A STD Used	742A STD Ohms Value (Rstd)	742A STD Ohms DMM Reading	Product Ohms DMM Reading	Calculated Value	Product Displayed Value	Calculated Value Minus Displayed Value	Limits Ω
10	20	4 Wire	10 Ω							±250 μ
19										±475 μ
100	200	4 Wire	100 Ω							±1.1 m
190										±2.09 m
1 K	2 k	4 Wire	1 kΩ							±7.2 m
1.9 K										±13.7 m
10 K	20 k	4 Wire	10 kΩ							±70 m
19 K										±133 m
100 K	200 k	4 Wire	100 kΩ							±800 m
190 K										±1.9
1 M	20 M	2 Wire	1 MΩ							±14
1.9 M										±32.3
10 M	20 M	2 Wire	10 MΩ							±370
19 M										±893
100 M	200 M	2 Wire	100 MΩ							±11 k
Equation 1: $R = R_{std} \frac{\text{Product Ohms DMM Reading}}{\text{742A STD Ohm DMM Reading}}$										

Verify 100 M Ω

1. Verification of 100 M Ω requires a special cable be built that has banana plugs on both ends and is 100 % shielded, including over the banana plugs. Use a twisted pair, shielded cable made with Teflon insulation over the twisted wires. Build or purchase a metal shroud to go over the banana plugs so when they are plugged into the standard, Product, or the DMM, the plugs are covered all the way to the surface. Connect the twisted wires to the two banana plugs and the shield to the shroud.
2. With this special cable, do steps 2 through 11 and 15 through 17 from the *Verify 10 Ω through 19 M Ω* section.
3. For steps 7 and 11, while waiting for the reading to settle, hold very still and have no one moving within 10 feet or so of the test setup. Expect the readings to take several minutes to settle.

DC Voltage Verification Test

This test checks every dc voltage range, first at 0 V including "negative zero" points, then at decade voltages from 100 mV to 1000 V as well as a linearity check on the 22 V range. Use Tables 8 and 9 for the test record. See Table 7 for equipment used.

Table 6. Required Equipment for DC Voltage Tests

Equipment	Model
DC Reference Standard	Fluke 732B
Reference Divider	Fluke 752A
Reference Multimeter	Fluke 8508A
Low Thermal Cables	5730A-7003

DC Zero Test

1. Short one end of a 5730A-7003 cable. This can be done by connecting both spade lugs to a binding post but do not use the binding post on an instrument that is powered, such as the Product, but instead use the 752A or a 742A. Connect the other end to the Fluke 8508A Input HI and LO. Leave the shield connection open.
2. Set the 8508A to dc V, 200 mV range, 7 digits, internal guard, filter IN and "FAST" mode.
3. Wait for the reading to settle and then zero the meter using the **Zero Rng** button.
4. Remove the short from the end of the cable and connect it to the Product OUTPUT HI and LO and the shield to the guard terminal.
5. Connect the Product Guard and Ground together. Make sure the Product is set to internal guard
6. Set the Product to the first zero test on the appropriate range as given in Table 8.

Note

For each new range tested:

1. *Remove the range lock if set.*
2. *Set the Product to a near-full scale voltage on that range.*
3. *Set the range lock.*
4. *Set the zero voltage.*
7. Push **OPERATE** on the Product.
8. Wait for the reading to settle and record it in the Table 8 DMM Reading column.
9. Push **STANDBY** on the Product. Verify that the reading was within the limits given.
10. Repeat steps 6 through 9 for the rest of Table 8.

Table 7. DC Zero Volt Verification

Product Range	Product Setting	DMM Reading	Limits
220 mV	0 mV		$\pm 0.5 \mu\text{V}$
	$-0.010 \mu\text{V}$		$\pm 0.5 \mu\text{V}$
2.2 V	0 V		$\pm 0.8 \mu\text{V}$
	$-1 \mu\text{V}$		$\pm 0.8 \mu\text{V}$
11 V	0 V		$\pm 3 \mu\text{V}$
	$-1 \mu\text{V}$		$\pm 3 \mu\text{V}$
22 V	0 V		$\pm 5 \mu\text{V}$
	$-1 \mu\text{V}$		$\pm 5 \mu\text{V}$
220 V	0 V		$\pm 50 \mu\text{V}$
	$-10 \mu\text{V}$		$\pm 50 \mu\text{V}$

Self-Calibrate a Fluke 752A Divider with a Fluke 8508A as the Null Detector

1. Connect the Product, 752A, and 8508A as shown in Figure 12.
2. Set the 8508A to the 200 mV dc voltage range at 7 digits, filter "ON" and "FAST" and internal guard (external guard not selected). FAST mode updates the reading every 1.5 seconds. This lets the reading track the adjustments but the readings change frequently and it is somewhat noisy. FAST can be turned off so that the readings are updated every 5.3 seconds.
3. Set the 752A MODE switch to CAL and the CALIBRATE switch to 10:1 +.
4. Set the Product to output 0 mV on the 200 mV range and push **OPERATE**.
5. Wait for the reading to settle (this can take several minutes) and then zero the meter using the **Zero Rng** button.
6. Set the Product to output 20 V.
7. Wait for the reading to settle (this can take several minutes) and note the reading. Set the CALIBRATE switch to 10:1 – and note the reading.
8. If the readings in step 7 are not the same, then adjust the BALANCE control until they are the same. (see note 4 below)
9. Set the CALIBRATE switch to 10:1+. Adjust the 10:1 CALIBRATE adjustment until the reading is $0 \pm 0.5 \mu\text{V}$.
10. Set the Product to output 0 mV on the 200 mV range.
11. Set the 752A CALIBRATE switch to 100:1 +.
12. Wait for the reading to settle (this can take several minutes) and then push the **Zero Rng** button to zero the meter.
13. Set the Product to output 20 V.
14. Wait for the reading to settle (this can take several minutes) and note the reading. Set the CALIBRATE switch to 100:1- and note the reading.

15. If the readings in step 14 are not the same then adjust the BALANCE control until they are the same (see note 4 below).
16. Set the CALIBRATE switch to 100:1+. Adjust the 100:1 CALIBRATE adjustment until the reading is $0 \pm 0.5 \mu\text{V}$.
17. Push **STBY** on the Product.
18. Set the CALIBRATE switch to OPERATE and the MODE switch to the necessary position.
19. This completes the self-calibration of the 752A.

Notes

1. *The 10:1 adjustment must be done before the 100:1 adjustment can be done.*
2. *Following the "Self-Calibrate a Fluke 752A Divider with a Fluke 8508A as the Null Detector" procedure above adjusts the 752A to within 0.09 ppm or less of the nominal ratio for 10:1 and 0.18 ppm or less for 100:1.*
3. *Be sure the 752A is well stabilized in a constant temperature environment before calibration starts. The instrument stays calibrated as long as the temperature remains constant.*
4. *It can be difficult to adjust the BALANCE control for a difference of exactly $0 \mu\text{V}$ but it is not necessary to get it to exactly zero to get good results. Instead, adjust the BALANCE for as close to zero as is practical but a difference as large as $1 \mu\text{V}$ is still acceptable. Then adjust the 10:1 or 100:1 CALIBRATION adjustment for a reading that is the same for the switch in the 10:1+ position as the 10:1- position but opposite sign. For example, if the BALANCE difference is $1 \mu\text{V}$, then adjust the appropriate CALIBRATION adjustment until one switch position is say $+0.5 \mu\text{V}$ and the other position is $-0.5 \mu\text{V}$. These two readings do not have to be the same to meet the $\pm 0.5 \mu\text{V}$ requirement given in the procedure. To determine if the adjustment is close enough, use the following equation: Take the reading in the 10:1+ position and add it to the reading in the 10:1- position and then divide the result by two. For example, if the reading in the 10:1+ position is $+0.75 \mu\text{V}$ and in the 10:1- position is $-0.25 \mu\text{V}$ then: $(+0.75 \mu\text{V} + (-0.25 \mu\text{V})) / 2 = +0.25 \mu\text{V}$. This meets the requirement for an adjustment to within $\pm 0.5 \mu\text{V}$.*

5. *Using a DMM does take longer and more care to self-calibrate a 752A then using a Fluke 845 but it can still be done in a reasonable amount of time once the user gets used to the new technique. The user needs to determine which settings of the 8508A work best for them. Settings such as the number of digits, 7 or 8, using FAST or not or using the FILTER or not, can be tried until a combination is found that works best. It may be that some settings are best for the initial adjustments and then a change in the settings for the final adjustment is necessary. For example, it may work best to set up the meter to respond quickly to a change in voltage to get the adjustments close then change to a setting that takes longer per reading but has less scatter for the final readings.*

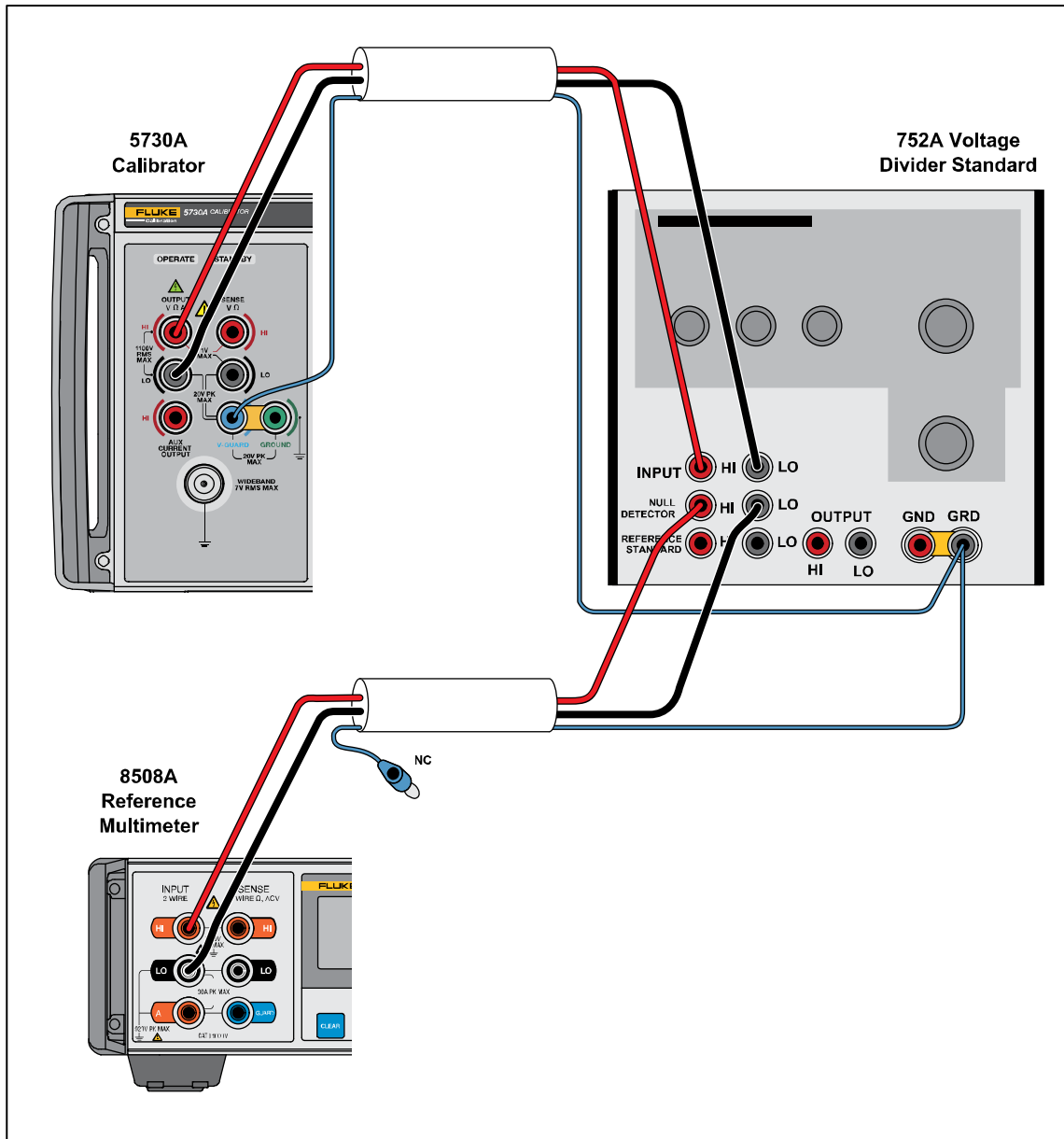


Figure 12. Zero Null Detector Connection

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DC Voltage Test at Decade Values

1. Self-Calibrate the reference divider according to the procedure for using the 8508A as the null detector in the "Self-Calibrate a Fluke 752A Divider with a Fluke 8508A as the Null Detector" section above.
2. Connect the reference divider and the 8508A as shown in Figure 13. The short on the INPUT and REFERENCE STANDARD inputs of the reference divider must be a low thermal EMF connection. A piece of copper wire is recommended for this.
3. Set the reference divider to 0.1 V and the mode switch to OPERATE.
4. Set the 8508A to dc V, 200 mV range, 7 digits, filter IN and "FAST" mode. Be sure the 8508A is on internal guard (external guard not selected).
5. Wait for the reading to settle and then push the **Zero Rng** button to zero the meter.
6. Remove the two shorts from the reference divider and connect the 732B 10 V Reference Standard and the Product as shown in Figure 14.
7. Enter the Reference Standard Voltage (V_{std}) into Table 9.
8. Set the Product to the first test voltage listed in Table 9, the reference divider to the setting given and the reference standard polarity given. To change the polarity of the reference standard, reverse the leads to the HI and LO output.
9. Push **OPERATE**.
10. Wait for the reading to settle, a least 1 minute, and record the reading in Table 9.
11. Calculate the Product measured voltage using the equation shown in Table 9 and ensure it is within the given limits.
12. Repeat steps 8 to 11 for the rest of the voltages given in Table 9. See the note in the *DC Zero Test* section about locking the range.

Table 8. DC Voltage Test at Decade Values Verification

10 V Std Polarity	Divider Setting	Product Range	Product Output	DMM Reading (V _{dmm})	Equation	Calculated Measured Voltage	Limits
POS	0.1	220 mV	100 mV		$\frac{V_{std}}{100} - V_{dmm}$		±1.2 μV
NEG	0.1	220 mV	-100 mV		$\frac{-V_{std}}{100} - V_{dmm}$		±1.2 μV
POS	1	2.2 V	1 V		$\frac{V_{std}}{10} - V_{dmm}$		±4.8 μV
NEG	1	2.2 V	-1 V		$\frac{-V_{std}}{10} - V_{dmm}$		±4.8 μV
POS	10	11 V	10 V		$V_{std} + V_{dmm}$		±33 μV
NEG	10	11 V	-10 V		$-V_{std} + V_{dmm}$		±33 μV
POS	10	22 V	10 V		$V_{std} + V_{dmm}$		±35 μV
NEG	10	22 V	-10 V		$-V_{std} + V_{dmm}$		±35 μV
POS	100	220 V	100 V		$(V_{std} + V_{dmm}) * 10$		±450 μV
NEG	100	220 V	-100 V		$(-V_{std} + V_{dmm}) * 10$		±450 μV
POS	100	1100 V	100 V		$(V_{std} + V_{dmm}) * 10$		±1.1 mV
NEG	100	1100 V	-100 V		$(-V_{std} + V_{dmm}) * 10$		±1.1 mV
POS	1000	1100 V	1000 V		$(V_{std} + V_{dmm}) * 100$		±6.5 mV
NEG	1000	1100 V	-1000 V		$(-V_{std} + V_{dmm}) * 100$		±6.5 mV
V _{std} =							

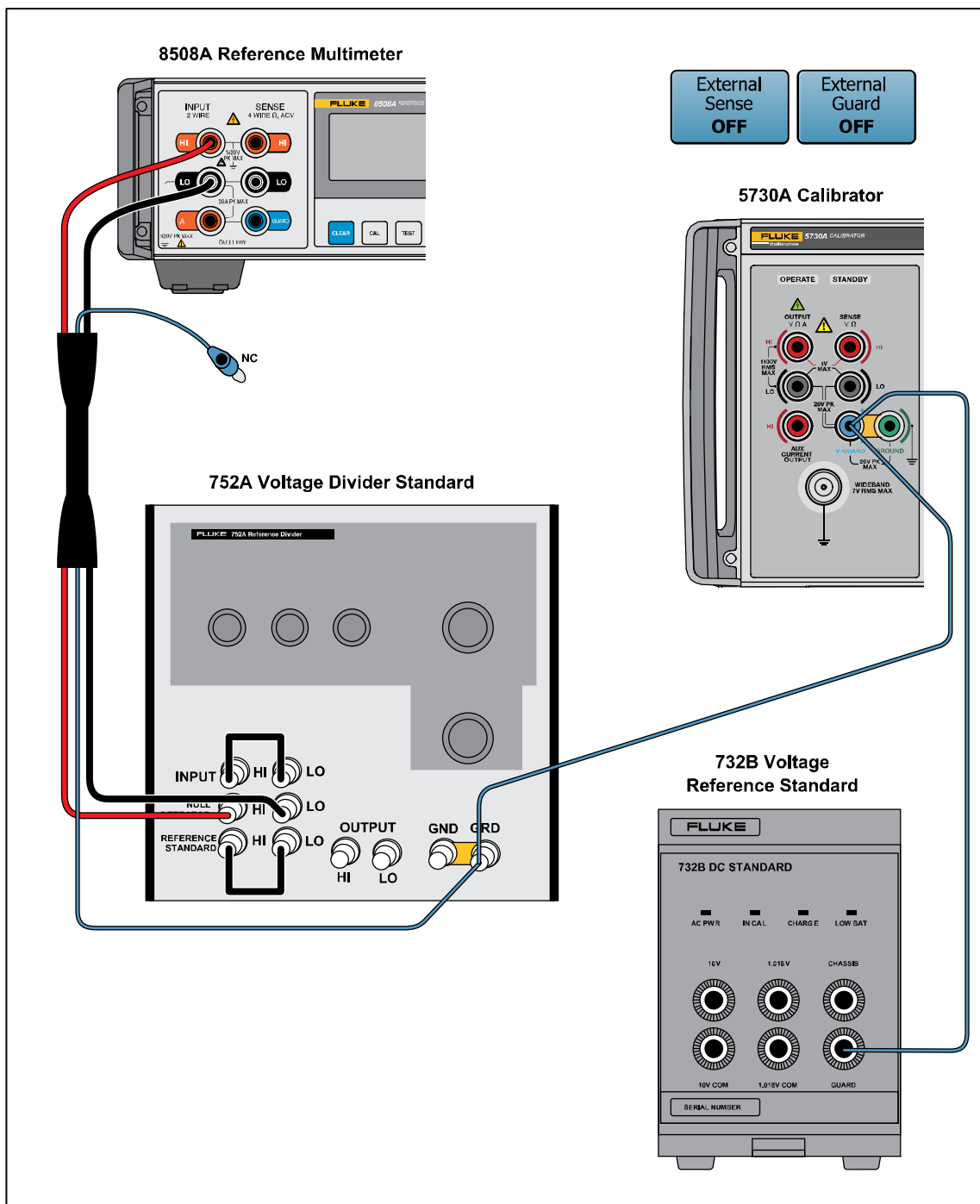


Figure 13. Zero Null Detector Connections

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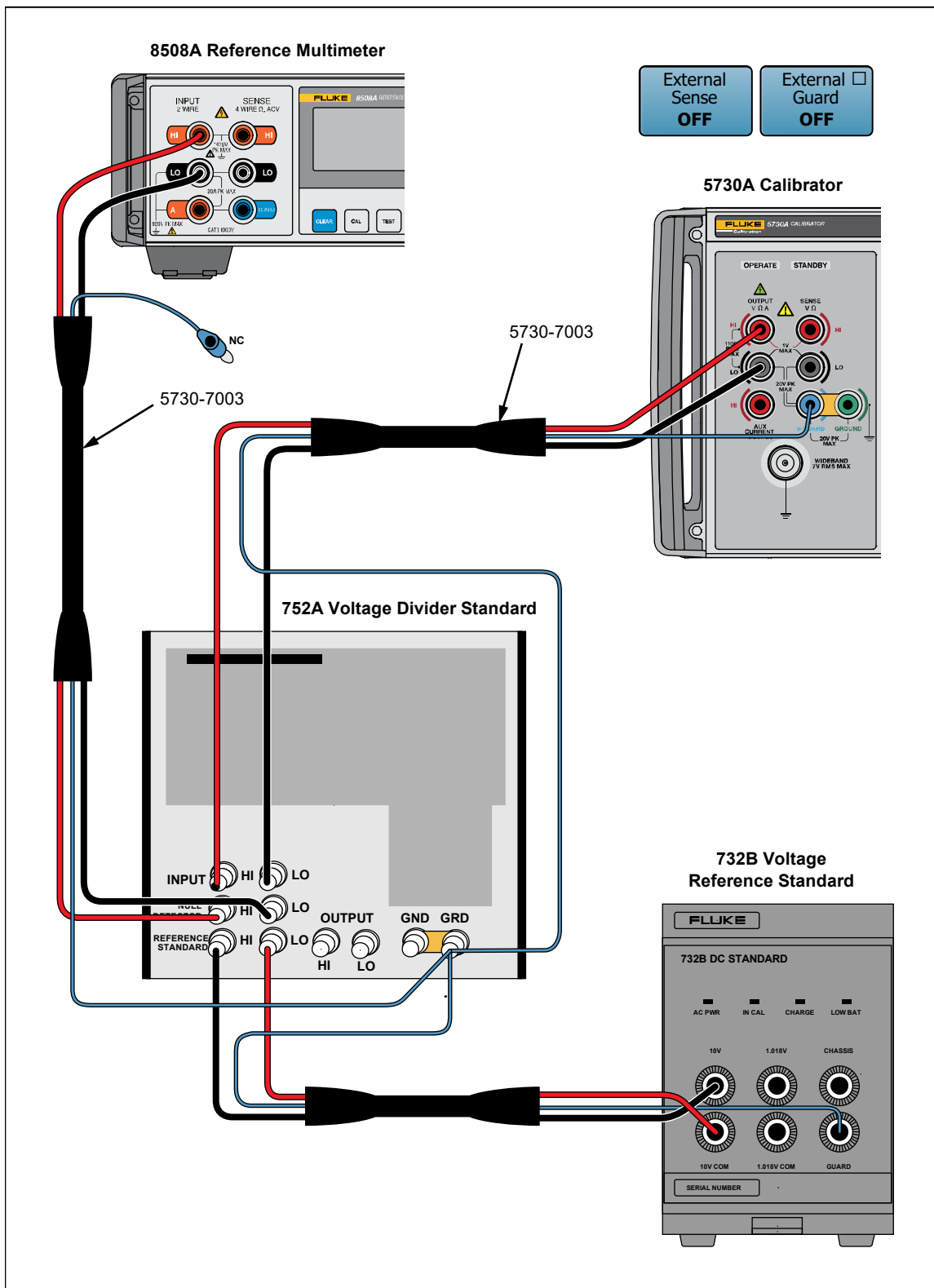


Figure 14. DC Voltage Calibration Connection

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DC Voltage Test at 19 Volts

1. For this test, connect the 10 V standard to the 8508A as shown in Figure 15.
2. Record the value of the 10 V standard in Table 10. Record it as a negative voltage for the -19 V test.
3. Set the 8508A to dc V, 20 V range, 7 digits, filter "IN" and "FAST" mode. Be sure the 8508A is on internal guard (external guard not selected).
4. Wait for the reading to settle and record it in Table 10.
5. Connect the Product to the 8508A as shown in Figure 15.
6. Set the Product to output +19 V dc and push **OPERATE**.
7. Wait for the reading to settle and record it in Table 10. Push **STANDBY**.
8. Connect the 8508A to the 10 V standard but reverse the connection to the HI and LO so the 8508A reads -10 V.
9. Wait for the reading to settle and record it in Table 10.
10. Connect the Product to the 8508A as shown in Figure 15.
11. Set the Product to output -19 V and push **OPERATE**.
12. Wait for the reading to settle and record it in Table 10. Push **STANDBY**.
13. Calculate the measured voltage of the Product for each polarity and verify that it is within limits.

Table 9. 19 V DC Verification

Product Range	Product Output	10 V Standard Value (Vstd)	DMM Reading On 10 V Std (Vdmm at 10 V)	DMM Reading on Product (Vdmm at 19 V)	Calculated Product Output	Limits
22 V	+19 V					±62 µV
22 V	-19 V					±62 µV
Product=5730A DMM=8508A $\text{Calculated Product Output} = V_{\text{std}} \frac{V_{\text{dmm at 19 V}}}{V_{\text{dmm at 10 V}}}$						

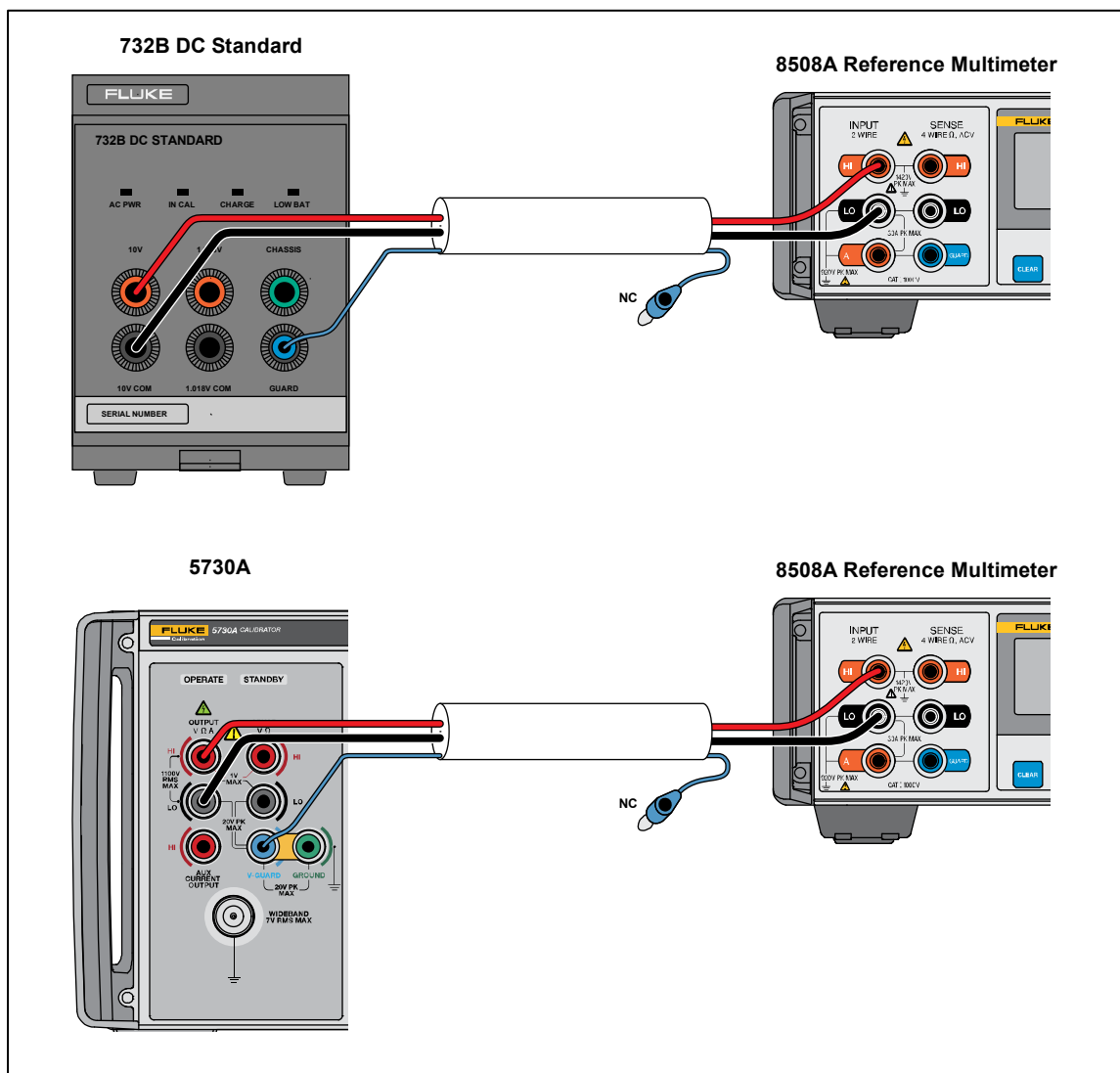


Figure 15. 19 V DC Verification Connections

Direct Current Verification Test

These tests check the Direct Current function by passing the current through a shunt and measuring the voltage drop with a DMM. Use Table 12 for the test record. Table 11 lists the required equipment.

Table 10. Required Equipment for Direct Current Test

Equipment	Model
DC DMM, 7 digits	Fluke 8508A
High-Current Shunt	Guildline 9230A-30 0.1 Ω Guildline 9230A100 0.01 Ω (5725A only)
Resistance Standards	Fluke 742A-1
	Fluke 742A-10
	Fluke 742A-100
	Fluke 742A-1k
	Fluke 742A-10k
Low Thermal EMF Cables	Fluke 5730A-7003

1. Connect the DMM and the Product to the shunt given in Table 12, as shown in Figure 16. When testing a 5725A, connect to the 5725A current output terminals instead of the Product output.
2. Enter the resistance of the shunt into the Table 12 Shunt Value column.
3. Set the DMM to DC Voltage and the range shown in Table 12. Set the DMM to 7 digits, filter ON, "Slow" and internal guard.
4. With the Product in standby wait for the reading to settle and push the **Zero Rng** button to zero the DMM.
5. Set the Product to the current level on the range given in Table 12. The Current Output is set to "NORMAL".
6. If the current in Table 12 is zero on a range above the 220 μ A range first set the Product to a current near full scale on the given range and then lock the range before setting the Product to zero current.
7. Push **OPERATE**.
8. Wait for the reading on the DMM to settle and record the reading in the Table 12 DMM Voltage Reading column.
9. Set the Product to standby.
10. Calculate the current with the equation shown in Table 12 and compare the results to the Limits given. Repeat steps 1 through 9 for all the tests in Table 12.

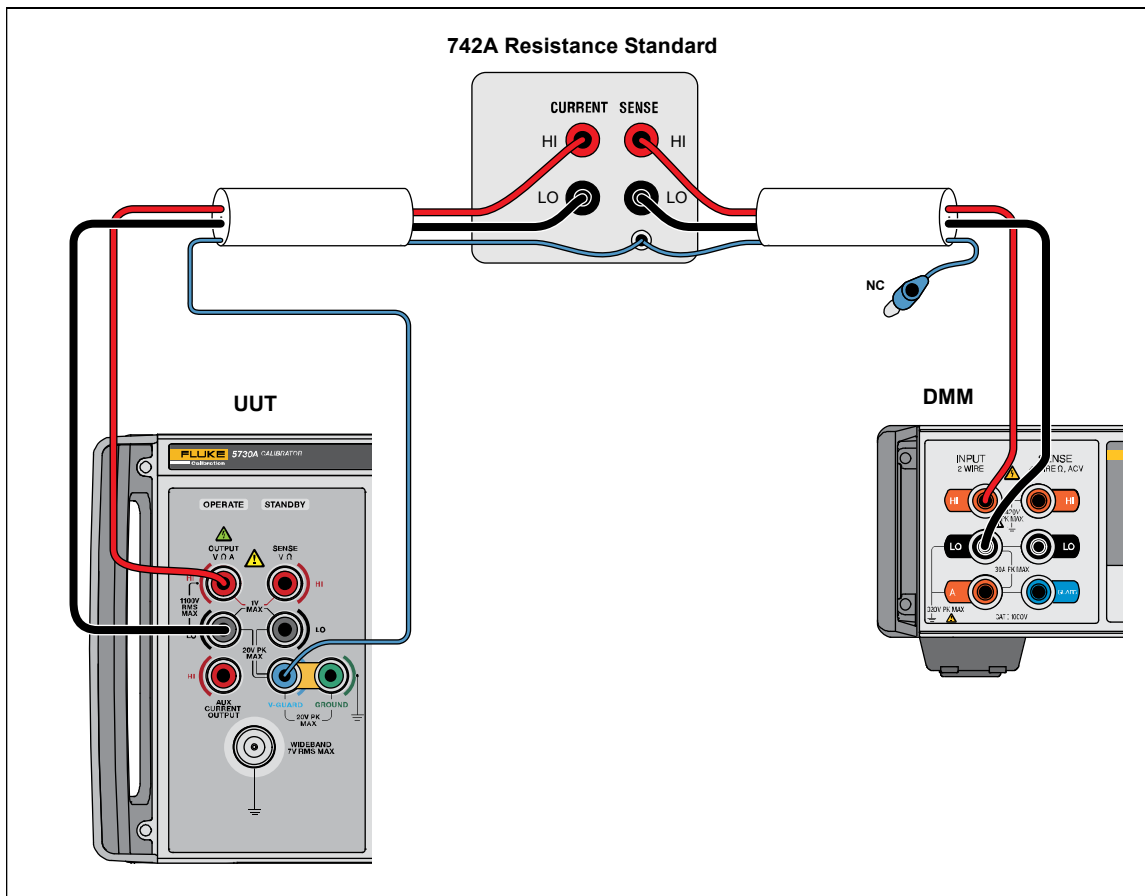


Figure 16. Direct Current Accuracy Test Connections

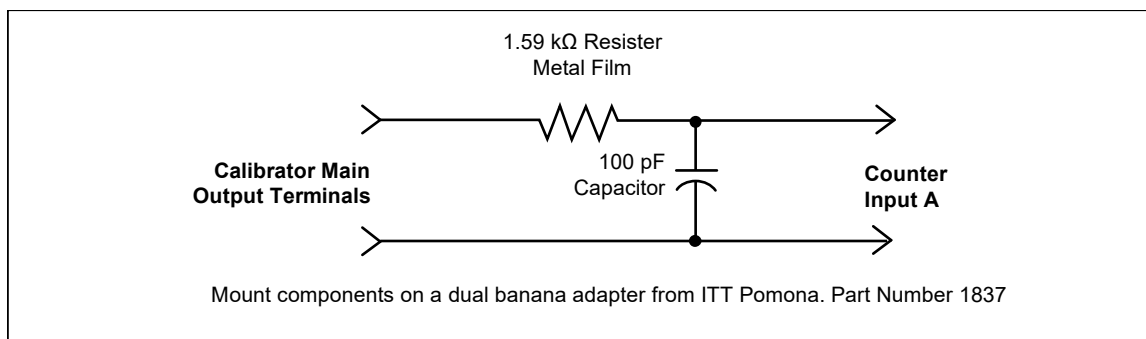
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Table 11. DC Current Accuracy Verification

Product Output	Product Range	DMM Range	Shunt	Shunt Value (Ohms)	DMM Voltage Reading (Volts)	Calculated Current (Amps)	Limits
0 μ A	220 μ A	200 mV	10 k Ω				± 7 nA
10 μ A	220 μ A	200 mV	10 k Ω				± 7.4 nA
-10 μ A	220 μ A	200 mV	10 k Ω				± 7.4 nA
200 μ A	220 μ A	2 V	1 k Ω				± 15.4 nA
-200 μ A	220 μ A	2 V	1 k Ω				± 15.4 nA
0 mA	2.2 mA	200 mV	1 k Ω				± 8 nA
2 mA	2.2 mA	2 V	100 Ω				± 78 nA
-2 mA	2.2 mA	2 V	100 Ω				± 78 nA
0 mA	22 mA	200 mV	100 Ω				± 50 nA
20 mA	22 mA	2 V	10 Ω				$\pm .75$ μ A
-20 mA	22 mA	2 V	10 Ω				$\pm .75$ μ A
0 mA	220 mA	200 mV	10 Ω				± 0.8 μ A
100 mA	220 mA	200 mV	1 Ω				± 5.3 μ A
200 mA	220 mA	2 V	1 Ω				± 11.4 μ A
-200 mA	220 mA	2 V	1 Ω				± 11.4 μ A
0 A	2.2 A	200 mV	1 Ω				± 15 μ A
1 A	2.2 A	200 mV	0.1 Ω				± 85 μ A
2 A	2.2 A	2 V	0.1 Ω				± 235 μ A
-2 A	2.2 A	2 V	0.1 Ω				± 235 μ A
5725A Current Verification							
0 A	11 A	200 mV	10 Ω				± 480 μ A
3 A	11 A	2 V	0.1 Ω				± 1.5 mA
-3 A	11 A	2 V	0.1 Ω				± 1.5 mA
10 A	11 A	200 mV	0.01 Ω				± 3.9 mA
-10 A	11 A	200 mV	0.01 Ω				± 3.9 mA
200 μ A	11 A	2 V	1000 Ω				± 20 nA
-200 μ A	11 A	2 V	1000 Ω				± 20 nA
Current = $\frac{\text{DMM Voltage Reading}}{\text{Shunt Value}}$							

AC Voltage Frequency Accuracy Test

This test requires the use of a frequency counter. Tektronix model FCA3000 or equivalent is recommended. Use Table 13 for the test record. With some counters it may be necessary to use a 1 MHz low pass filter as shown in Figure 17.



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Figure 17. 1 MHz Low Pass Filter

To check the Product frequency accuracy:

1. Connect the frequency counter to the output terminals of the Product.
2. Set the Product to 2 V at the output frequencies listed in Table 13.
3. Record the reading in Table 13 Measured Value. Verify that the counter reads within the limits shown on the test record.
4. Disconnect the counter from the Product.

Table 12. AC Voltage Frequency Accuracy Test Record

Product Function/Range	Nominal Value	Measured Value	Limits
10.000 00 Hz @ 2 V	10.000 000		±0.25 mHz
119.900 00 Hz @ 2 V	119.900 00		±2.99 mHz
120.000 00 Hz @ 2 V	120.000 00		±3 mHz
400.000 0 Hz @ 2 V	400.000 0		±10 mHz
1199.000 0 Hz @ 2 V	1199.000 0		±29.9 mHz
1200.000 0 Hz @ 2 V	1200.000 0		±30 mHz
11990.000 Hz @ 2 V	11990.000		±299.7 mHz
12000.000 Hz @ 2 V	12000.000		±300 mHz
119900.0 Hz @ 2 V	11900.00		±2.997 Hz
120000.0 Hz @ 2 V	120000.00		±3 Hz
1000000.0 Hz @ 2 V	1000000.00		±25 Hz
1199900.0 Hz @ 2 V	1900000.00		±47.5 Hz

AC Voltage Verification Test

The equipment required for this test is listed in Table 13.

Table 13. Equipment Required for AC V Output Level Tests

Equipment	Model
AC Measurement Standard	Fluke 5790A/B
BNC(F) to Dual-Banana Plug Adapter (2 required)	Pomona 1269
Coax Cable - RG-58A/U or RG-58C/U with BNC(M) Connectors, 12 inch Long	

1. Place the 5790B on top of the Product and connect the equipment as shown in Figure 18. Other placements of the equipment are fine as long as they can be connected with the 12 inch cable.

Note

The point of measurement is at the end of the cable and adapter that connects to the 5790B. It is essential that the cable not be longer than 12 inches, it can be shorter.

2. Ensure the guard to ground strap on the Product is connected during the procedure. Also ensure the Product is set to internal Guard (External Guard OFF). Refresh the EX GRD button on the 5790B by pressing it off and on 3 times, and then leave it on. The green LED is lit when in the ON position. Set the range on the 5790B to AUTO and connect the Product guard to the 5790B guard using a short heavy lead.
3. Refer to Table 15 and output .600000 mV @1 kHz and record the reading under Measured Value.
4. Test the remaining amplitudes and frequencies in Table 15.
5. Verify that the measured values are within the limits given in the Table 15.

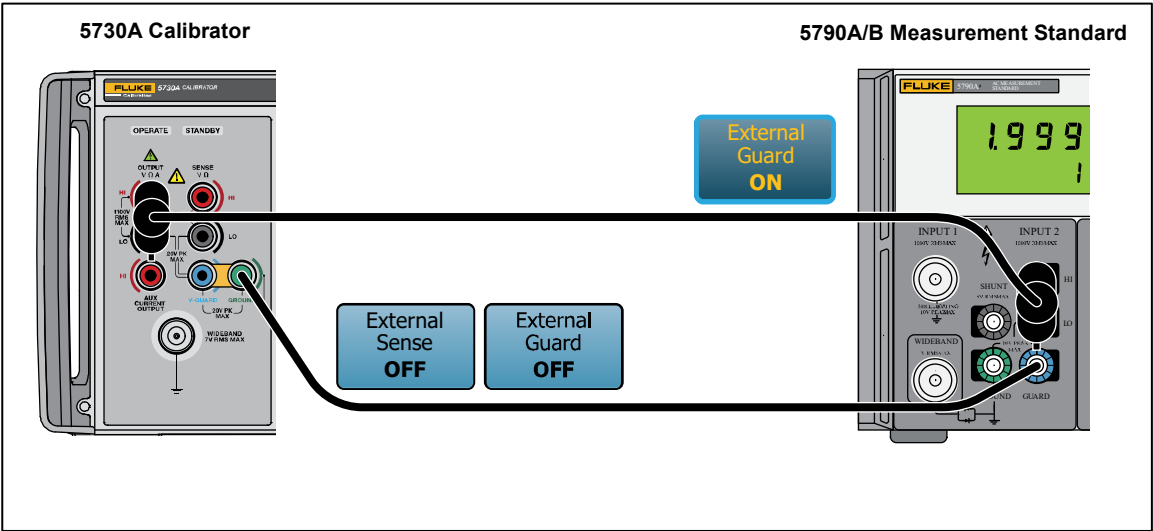


Figure 18. AC Voltage Test Setup

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Table 14. 5790B Adjustment Counts

Product Range	Nominal Value	Measured Value	Limits
2.2 mV	.600 000 mV, 1 kHz		±5.0 µV
2.2 mV	2.000 000 mV, 10 Hz		±5.6 µV
2.2 mV	2.000 000 mV, 20 Hz		±5.2 µV
2.2 mV	2.000 000 mV, 40 Hz		±5.2 µV
2.2 mV	2.000 000 mV, 1 kHz		±5.2 µV
2.2 mV	2.000 000 mV, 20 kHz		±5.2 µV
2.2 mV	2.000 000 mV, 50 kHz		±5.5 µV
2.2 mV	2.000 000 mV, 100 kHz		±7.1 µV
2.2 mV	2.000 000 mV, 300 kHz		±14.4 µV
2.2 mV	2.000 000 mV, 500 kHz		±28 µV
2.2 mV	2.000 000 mV, 1 MHz		±31.2 µV
22 mV	20.00 000 mV, 10 Hz		±10.4 µV
22 mV	20.000 00 mV, 20 Hz		±7.1 µV
22 mV	20.000 00 mV, 40 Hz		±6.8 µV
22 mV	20.000 00 mV, 1 kHz		±6.8 µV
22 mV	20.000 00 mV, 20 kHz		±6.8 µV
22 mV	20.000 00 mV, 50 kHz		±9.6 µV
22 mV	20.000 00 mV, 100 kHz		±16.8 µV
22 mV	20.000 00 mV, 300 kHz		±36.0 µV
22 mV	20.000 00 mV, 500 kHz		±55.0 µV
22 mV	20.000 00 mV, 1 MHz		± 87.0 µV
220 mV	200.000 0 mV, 10 Hz		±69.0 µV
220 mV	200.000 0 mV, 20 Hz		±29.0 µV
220 mV	200.000 0 mV, 40 Hz		±21.2 µV
220 mV	200.000 0 mV, 1 kHz		±21.2 µV
220 mV	200.000 0 mV, 20 kHz		± 21.2 µV
220 mV	200.000 0 mV, 50 kHz		±36.0 µV
220 mV	200.000 0 mV, 100 kHz		±96.0 µV
220 mV	200.000 0 mV, 300 kHz		±165 µV
220 mV	200.000 0 mV, 500 kHz		±330 µV
220 mV	200.000 0 mV, 1 MHz		±640 µV

Table 15. 5790B Adjustment Counts (cont.)

Product Range	Nominal Value	Measured Value	Limits
2.2 V	.500 000 V, 40 Hz		±33 µV
2.2 V	.500 000 V, 1 kHz		±33 µV
2.2 V	.500 000 V, 20 kHz		±33 µV
2.2 V	.500 000 V, 100 kHz		±88.5 µV
2.2 V	.500 000 V, 300 kHz		±285 µV
2.2 V	.500 000 V, 1 MHz		±1.3 mV
2.2 V	1.000 000 V, 40 Hz		±56 µV
2.2 V	1.000 000 V, 1 kHz		±56 µV
2.2 V	1.000 000 V, 20 kHz		±56 µV
2.2 V	1.000 000 V, 100 kHz		±137 µV
2.2 V	1.000 000 V, 300 kHz		±470 µV
2.2 V	1.000 000 V, 1 MHz		±2.2 mV
2.2 V	2.000 000 V, 10 Hz		±590 µV
2.2 V	2.000 000 V, 20 Hz		±220 µV
2.2 V	2.000 000 V, 40 Hz		±102 µV
2.2 V	2.000 000 V, 1 kHz		±102 µV
2.2 V	2.000 000 V, 20 kHz		±102 µV
2.2 V	2.000 000 V, 50 kHz		±166 µV
2.2 V	2.000 000 V, 100 kHz		±234 µV
2.2 V	2.000 000 V, 300 kHz		±840 µV
2.2 V	2.000 000 V, 500 kHz		±2.5 mV
2.2 V	2.000 000 V, 1 MHz		±4.0 mV
22 V	20.000 00 V, 10 Hz		±5.9 mV
22 V	20.000 00 V, 20 Hz		±2.2 mV
22 V	20.000 00 V, 40 Hz		±990 µV
22 V	20.000 00 V, 1 kHz		±990 µV
22 V	20.000 00 V, 20 kHz		±990 µV
22 V	20.000 00 V, 50 kHz		±1.66 mV
22 V	20.000 00 V, 100 kHz		±2.19 mV
22 V	20.000 00 V, 300 kHz		±6.6 mV

Table 15. 5790B Adjustment Counts (cont.)

Product Range	Nominal Value	Measured Value	Limits
22 V	20.000 00 V, 500 kHz		±24.5 mV
22 V	20.000 00 V, 1 MHz		±36 mV
220 V	200.000 0 V, 10 Hz		±59 mV
220 V	200.000 0 V, 20 Hz		±22 mV
220 V	200.000 0 V, 40 Hz		±12.7 mV
220 V	200.000 0 V, 1 kHz		±12.7 mV
220 V	200.000 0 V, 20 kHz		±12.7 mV
220 V	200.000 0 V, 50 kHz		±20.2 mV
220 V	200.000 0 V, 100 kHz		±37 mV
220 V	50 V, 300 kHz		±70 mV
220 V	30 V, 500 kHz		±206 mV
220 V	22 V, 1 MHz		± 298 mV
1000 V	250 V, 15 Hz		±100 mV
1000 V	500 V, 50 Hz		±41.5 mV
1000 V	500 V, 1 kHz		±41.5 mV
1000 V	1000 V, 50 Hz		±79 mV
1000 V	1000 V, 1 kHz		±79 mV
5725A AC Voltage Verification			
1100 V	300 V, 40 Hz		±28 mV
1100 V	300 V, 1 kHz		±28 mV
1100 V	300 V, 20 kHz		±43.5 mV
1100 V	300 V, 50 kHz		±119 mV
1100 V	300 V, 100 kHz		±435 mV
1100 V	600 V, 40 Hz		±52 mV
1100 V	600 V, 1 kHz		±52 mV
1100 V	600 V, 20 kHz		±81 mV
1100 V	600 V, 50 kHz		±227 mV
1100 V	600 V, 100 kHz		±825 mV
1100 V	1000 V, 40 Hz		±84 mV
1100 V	1000 V, 1 kHz		±84 mV
1100 V	1000 V, 20 kHz		±131 mV
1100 V	1000 V, 30 kHz		±371 mV

Alternating Current Verification Test

This test checks the alternating current function by passing the current through a shunt and measuring the voltage drop with an ac voltmeter. Use Table 16 and Table 17 for the test record. Table 16 shows the required equipment.

Table 15. Equipment Required for AC Current Test

Equipment	Model or Description
AC Measurement standard	Fluke 5790 A/B
Current Shunts	Fluke A40B 10 mA Shunt Fluke A40B 20 mA Shunt Fluke A40B 200 mA Shunt Fluke A40B 2 A Shunt Fluke A40B 5 A Shunt (5725A only) Fluke A40B 10 A Shunt (5725A only)
Coaxial Cable, Type N (M) connectors, both ends	Fluke A40B-LEAD/N
1000 Ω Shunt	See 200 μ A Range for description
Coaxial Cable, Type N (M) one end, dual banana plugs other end	Fluke A40B-LEAD/4mm
BNC(F) to Dual-Banana Plug Adapter (2 required) Coax Cable - RG-58A/U or RG-58C/U with BNC(M) Connectors, 12 \pm 1 inch long	Pomona 1269

2 mA to 2 A Ranges

Connect the equipment as shown in Figure 19.

1. Enter the ac resistance of each shunt at each test frequency into the Table 16 A40B AC Resistance column. See the A40B manual for instructions about how to determine the ac resistance.
2. Set the 5790B to Input 1 and the range given in Table 16. Set the 5790B to External Guard.
3. Set the Product to output the current level and frequency as given in Table 16 and then push **OPERATE**.
4. Wait for the 5790B reading to settle and record it in Table 16 under 5790B Reading Volts.
5. Calculate the measured current and record in the Table 16 Calculated Current column. This is found by dividing the 5790B reading in volts by the shunt ac resistance in ohms. See the equation in Table 16. Verify that the results are within the given limits.
6. Repeat steps 2 through 5 for all the test points.
7. Push **STANDBY** when the measurements are complete.

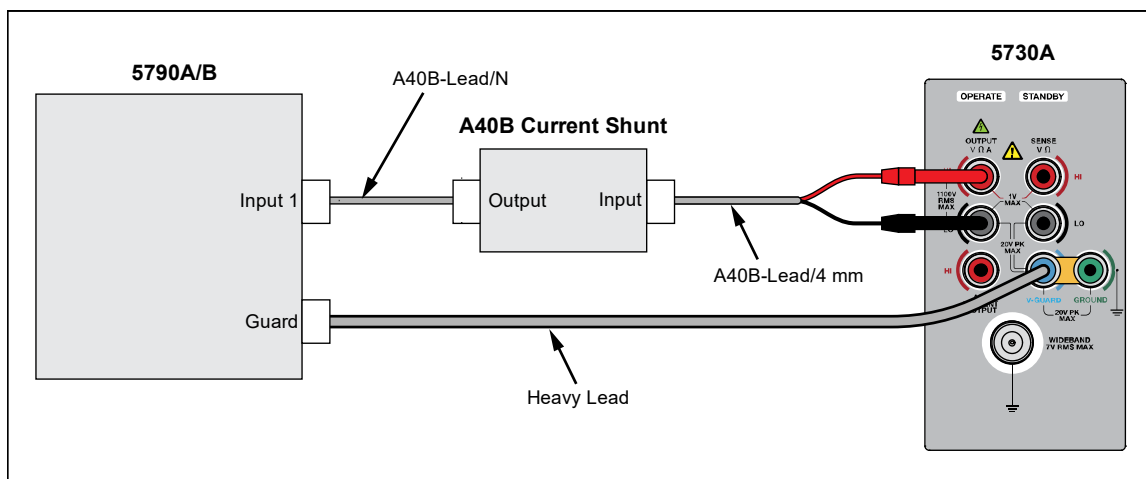


Figure 19. 2 mA to 2 A AC Current Verification Connections

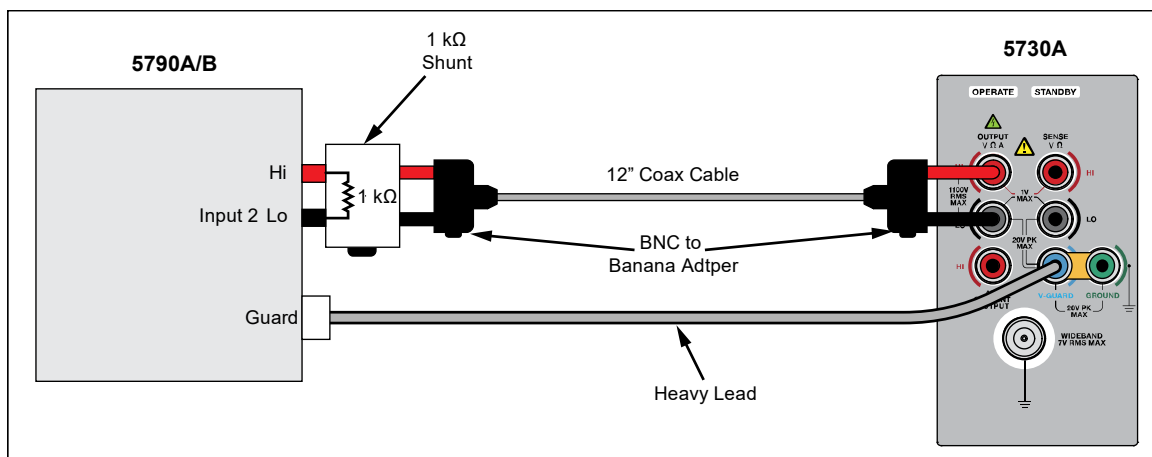
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200 μ A Range

Note

This test requires a 1000 Ω shunt that has been calibrated with the 5790B. It will be used with the levels and frequencies given in Table 17. This shunt can be built from a non-inductive resistor such as a metal film resistor housed in a box with dual banana jacks on one end and banana plugs on the other end (Pomona 2259, 2098 or 2224). The resistor should be of sufficient precision that its variations in resistance with time, temperature, and humidity, plus the uncertainty of the calibration of the shunt with the 5790B, will lead to a satisfactory TUR for the time between calibrations. The box that contains the shunt should mount directly to the 5790B input 2.

1. Connect the equipment as shown in Figure 20.
2. Enter the Shunt ACI Corrections from the calibration certificate for the 5790B/Shunt combination into the Table 17 5790B Shunt ACI Correction (ppm) column.
3. Set the 5790B to Input 2, External Guard, and the range given in Table 17.
4. Set the Product to output the current level and frequency at the appropriate output terminals as given in Table 17 for the test point being done and then push **OPERATE**.
5. Wait for the 5790B reading to settle and record it in the Table 17 5790B Reading (Volts) column.
6. Calculate the measured current and record in Table 17 under Measured Current (Amps). See equation 2 in Table 17.
7. Verify that the results are within the given limits.
8. Repeat steps 3 through 7 for all tests.
9. Set the Product to STBY when the measurements are complete.



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Figure 20. 200 μ A Range Alternating Current Test Setup

Table 16. AC Current 2 mA to 2 A Verification

Product Applied	Frequency	A40B Shunt	A40B AC Resistance (Ohms)	5790B Range	5790B Reading (Volts)	Calculated Current (Amps)	Limits
2 mA	10 Hz	10 mA		220 mV			610 nA
2 mA	20 Hz	10 mA		220 mV			400 nA
2 mA	40 Hz	10 mA		220 mV			274 nA
2 mA	1 kHz	10 mA		220 mV			274 nA
2 mA	5 kHz	10 mA		220 mV			570 nA
2 mA	10 kHz	10 mA		220 mV			3 μ A
20 mA	10 Hz	20 mA		2.2 V			6.1 μ A
20 mA	20 Hz	20 mA		2.2 V			4 μ A
20 mA	40 Hz	20 mA		2.2 V			2.74 μ A
20 mA	1 kHz	20 mA		2.2 V			2.74 μ A
20 mA	5 kHz	20 mA		2.2 V			5.1 μ A
20 mA	10 kHz	20 mA		2.2 V			28 μ A
200 mA	10 Hz	200 mA		2.2 V			61 μ A
200 mA	20 Hz	200 mA		2.2 V			40 μ A
200 mA	40 Hz	200 mA		2.2 V			26.4 μ A
200 mA	1 kHz	200 mA		2.2 V			26.4 μ A
200 mA	5 kHz	200 mA		2.2 V			48 μ A
200 mA	10 kHz	200 mA		2.2 V			232 μ A
2 A	20 Hz	2 A		2.2 V			600 μ A
2 A	1 kHz	2 A		2.2 V			600 μ A
2 A	5 kHz	2 A		2.2 V			1.02 mA
2 A	10 kHz	2 A		2.2 V			14.2 mA

Table 17. AC Current 2 mA to 2 A Verification (cont.)

5725A							
3 A	40 Hz	3 A		700 mV			1.37 mA
3 A	1 kHz	3 A		700 mV			1.37 mA
3 A	5 kHz	3 A		700 mV			2.93 mA
3 A	10 kHz	3 A		700 mV			10.65 mA
10 A	40 Hz	10 A		2.2 V			4.17 mA
10 A	1 kHz	10 A		2.2 V			4.17 mA
10 A	5 kHz	10 A		2.2 V			8.88 mA
10 A	10 kHz	10 A		2.2 V			33.75 mA
Equation 1: Calculated Current = $\frac{5790A / B \text{ READING (V)}}{A40B \text{ AC RESISTANCE}}$							

Table 17. AC Current 200 µA Accuracy Test Record

Product Applied	Frequency	Output or AUX Current	5790B Range	5790B Shunt ACI Correction (ppm)	5790B Reading (Volts)	Measured Current (Amps)	Limits
20 µA	1 kHz	Output	22 mV				12.34 nA
20 µA	10 kHz	Output	22 mV				102 nA
200 µA	10 Hz	Output	220 mV				76 nA
200 µA	20 Hz	Output	220 mV				48 nA
200 µA	40 Hz	Output	220 mV				33.4 nA
200 µA	1 kHz	Output	220 mV				33.4 nA
200 µA	5 kHz	Output	220 mV				79 nA
200 µA	10 kHz	Output	220 mV				300 nA
20 µA	1 kHz	Aux Output	22 mV				2.0 µA
200 µA	5 kHz	Aux Output	220 mV				2.1 µA
200 µA	10 kHz	Aux Output	220 mV				2.4 µA
<p>Equation 2:</p> $\text{Measured Current} = \frac{5790A / B \text{ READING (V)}}{1000 \text{ Ohms}} \times (1 + (\text{ACI Correction} / 1,000,000))$							

Wideband Frequency Accuracy Test

Use Table 21 for the test record. Proceed as follows to test the Wideband module frequency accuracy:

1. Connect the Frequency Counter, Tektronix Model FCA3000 or equivalent, to the Calibrator wideband output and measure the output frequency at the frequencies listed in Table 21.
2. Verify that the frequency counter indicates frequencies within the 0.01 % limits shown.

Wideband AC Voltage Module Output Verification

The wideband tests are for units with the Option 5730A/03 and 5730A/05 Wideband AC Module only. The verification test for the wideband module works as follows:

- Accuracy at 1 kHz: Output at 1 kHz is tested by comparing the wideband output at the end of the cable and termination supplied with the instrument to the 5790B at INPUT 1 or INPUT 2.
- Output flatness: The output flatness is tested using the 5790B wideband input and using reduced spec limits when the TUR (Test Uncertainty Ratio) is less than 4:1.

Table 19 lists the equipment required for testing and calibrating the Wideband module.

Table 18. Equipment Required for Testing and Calibrating the Wideband Option

Equipment	Model or Description
AC Measurement Standard	Fluke 5790A/B with Wideband Option
Wideband cable	Supplied with 5730A/03 and 5730A/05
50 Ω Termination	Supplied with 5730A/03 and 5730A/05
Adapter	Pomona 1269 BNC(F) to dual banana plug.
Adapter	Kings KN-99-46 N(F) to BNC(M)

Note

The 5730A/03 Wideband AC Module can be verified with the 5790A, the 5790B/3, the 5790B/5, or the 5790B/AF options. The 5730A/05 can only be verified with the 5790B/5 or the 5790B/AF.

Wideband Output Accuracy at 1 kHz Test

This test verifies the Wideband output level at 1 kHz by direct measurement with the 5790A/B at INPUT 2 (alternatively INPUT 1 can be used). Use Table 22 for a test record.

1. Connect the equipment as shown in Figure 21.

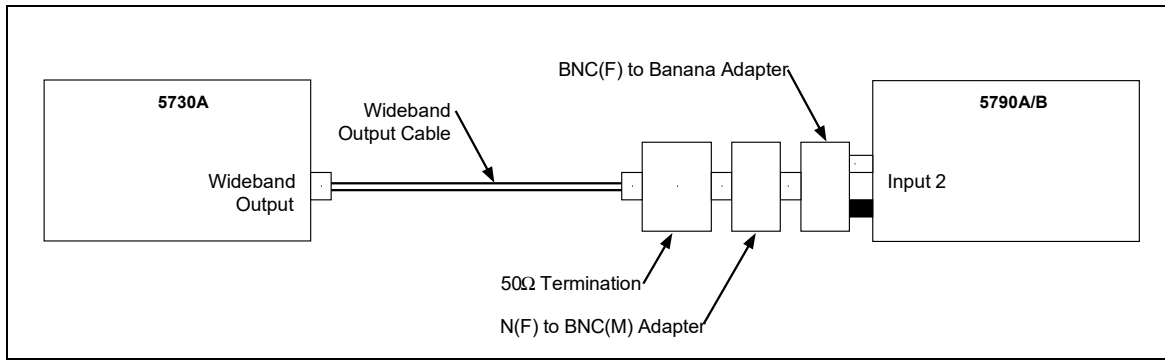


Figure 21. Wideband Accuracy at 1 kHz Test Setup

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2. Set the Product wideband output to 2.1 V at 1 kHz and the 5790A/B to read INPUT 2.
3. Push the 2.2 V RANGE button on the 5790A/B to lock it on the 2.2 V range.
4. On the 5790A/B push UTIL MENUS button and then MEAS CONTROL soft key. Set the digital filter mode to FAST and the restart to MEDIUM. Push the DONE soft key twice to return to the measurement display.
5. Use the Product output adjustment knob to obtain a reading on the 5790A/B measurement display of 2.100000 \pm 20 counts.
6. Read the error on the Product display in ppm. If the error is shown in percent, convert it to ppm by multiplying it by 10,000 and record it in Table 22 for the 2.1 V level for the appropriate verification interval. Verify that it is within specification limits shown.
7. Push the soft key under the RANGE display on the 5790A/B to return to AUTO RANGE.
8. Proceed to the remaining levels shown in Table 22 and repeat steps 5 through 7 with the appropriate output levels set in each step, using the adjustment tolerance in Table 20 in step 5.

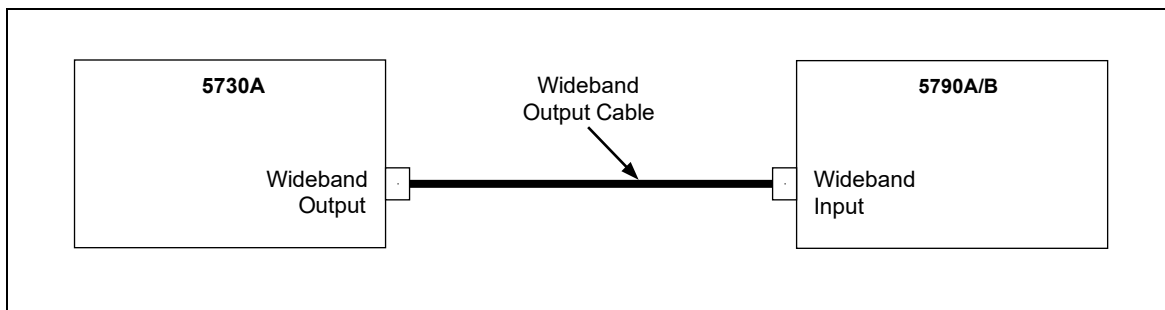
Table 19. Wideband Adjustment Tolerance

5730A Wideband Output	5790B Adjustment Counts \pm ppm
2.10000 V	20
1.00000 V	10
300.000 mV	3
100.000 mV	10
30.0000 mV	3
10.0000 mV	1
3.00000 mV	1
1000.00 μ V	1

Wideband Output Flatness Test

Use Table 23 as a test record. To perform wideband output flatness test, proceed as follows:

1. Connect the equipment as shown in Figure 22. Note that the Calibrator wideband cable is connected to the 5790A/B directly, the termination is not used.



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Figure 22. Wideband Flatness Test Setup

2. Set the wideband output to 3 V at 1 kHz.
3. Push the WBND button on the 5790A/B, when the reading has settled, push the SET REF soft key.
4. Set the Calibrator to frequencies shown in Table 23 for the 3 V output and record the errors on the 5790A/B error display at each frequency in Table 23.
5. Verify that the error readings are within spec limits or reduced spec limits shown on the test record. Reduced spec limits are used when the TUR (Test Uncertainty Ratio) is less than 4:1.
6. Repeat steps 4 and 5 for the remaining output levels shown in Table 23 using the appropriate voltage in step 4.

7. Record the 1 kHz absolute errors at each output level from Table 22 into the appropriate column in Table 24. Record the flatness errors from Table 23 for each output level and frequency into the appropriate column in Table 24. Add the errors and verify that they are within spec for the appropriate time interval.

Table 20. Wideband Frequency Accuracy Test Record

Frequency (Hz)	Frequency Measured	Tolerance Limits
10 Hz		99.99 ms to 100.01 ms
100 Hz		9.999 ms to 10.001 ms
300 Hz		299.97 Hz to 300.03 Hz
500 Hz		499.95 Hz to 500.05 Hz
800 Hz		799.92 Hz to 800.08 Hz
900 Hz		899.91 Hz to 900.09 Hz
1 kHz		999.0 Hz to 1.0001 kHz
1.19 kHz		1.189881 kHz to 1.190119 kHz
2.2 MHz		2.19978 MHz to 2.20022 MHz
3.5 MHz		3.49965 MHz to 3.50035 MHz
3.8 MHz		3.79962 MHz to 3.80038 MHz
10 MHz		9.990 MHz to 10.001 MHz
20 MHz		19.998 MHz to 20.002 MHz
30 MHz		29.997 MHz to 30.003 MHz
40 MHz		39.996 MHz to 40.004 MHz
50 MHz		49.995 MHz to 50.005 MHz

Table 21. Wideband Accuracy at 1 kHz Test Record

Output Level	Measured Error (V)	Test Limit \pm (90-day)
3 V		2.994 V to 3.007 V
2 V		1.996 V to 2.005 V
1.1 V		1.107 V to 1.113 V
1.0 V		0.997 V to 1.003 V
300 mV		299.15 mV to 300.85 mV
100 mV		99.66 mV to 100.34 mV
30 mV		29.90 mV to 30.10 mV
10 mV		9.961 mV to 10.039 mV
3 mV		2985.5 μ V to 3014.5 μ V
1 mV		994.6 μ V to 1005.4 μ V

Table 22. Wideband Flatness Test Record

Output Level	Frequency	Measured Flatness Error (V)	Test Limit (90-day)
3 V	10 Hz		2.991 V to 3.009 V
	30 Hz		2.997 V to 3.003 V
	50 Hz		2.997 V to 3.003 V
	105 Hz		2.997 V to 3.003 V
	500 Hz		2.997 V to 3.003 V
	5 kHz		2.997 V to 3.003 V
	10 kHz		2.997 V to 3.003 V
	12 kHz		2.997 V to 3.003 V
	50 kHz		2.997 V to 3.003 V
	100 kHz		2.997 V to 3.003 V
	120 kHz		2.997 V to 3.003 V
	300 kHz		2.997 V to 3.003 V
	500 kHz		2.997 V to 3.003 V
	1.1999 MHz		2.997 V to 3.003 V
	1.2 MHz		2.997 V to 3.003 V
	2 MHz		2.997 V to 3.003 V
	5 MHz		2.994 V to 3.006 V
	10 MHz		2.994 V to 3.006 V
	15 MHz		2.988 V to 3.012 V
	20 MHz		2.988 V to 3.012 V
	25 MHz		2.970 V to 3.030 V
	30 MHz		2.970 V to 3.030 V
	35 MHz		2.940 V to 3.060 V
	40 MHz		2.940 V to 3.060 V
	45 MHz		2.940 V to 3.060 V
	50 MHz		2.940 V to 3.060 V

Table 23. Wideband Flatness Test Record (cont.)

Output Level	Frequency	Measured Flatness Error (V)	Test Limit (90-day)
2 V	10 Hz		1.994 V to 2.006 V
	30 Hz		1.998 V to 2.002 V
	50 Hz		1.998 V to 2.002 V
	105 Hz		1.998 V to 2.002 V
	500 Hz		1.998 V to 2.002 V
	5 kHz		1.998 V to 2.002 V
	10 kHz		1.998 V to 2.002 V
	12 kHz		1.998 V to 2.002 V
	50 kHz		1.998 V to 2.002 V
	100 kHz		1.998 V to 2.002 V
	120 kHz		1.998 V to 2.002 V
	300 kHz		1.998 V to 2.002 V
	500 kHz		1.998 V to 2.002 V
	1.1999 MHz		1.998 V to 2.002 V
	1.2 MHz		1.998 V to 2.002 V
	2 MHz		1.998 V to 2.002 V
	5 MHz		1.996 V to 2.004 V
	10 MHz		1.996 V to 2.004 V
	15 MHz		1.992 V to 2.008 V
	20 MHz		1.992 V to 2.008 V
	25 MHz		1.980 V to 2.020 V
	30 MHz		1.980 V to 2.020 V
	35 MHz		1.960 V to 2.040 V
	40 MHz		1.960 V to 2.040 V
	45 MHz		1.960 V to 2.040 V
	50 MHz		1.960 V to 2.040 V

Table 23. Wideband Flatness Test Record (cont.)

Output Level	Frequency	Measured Flatness Error (V)	Test Limit (90-day)
1.11 V	10 Hz		1.106670 V to 1.113330 V
	30 Hz		1.108890 V to 1.111110 V
	50 Hz		1.108890 V to 1.111110 V
	105 Hz		1.108890 V to 1.111110 V
	500 Hz		1.108890 V to 1.111110 V
	5 kHz		1.108890 V to 1.111110 V
	10 kHz		1.108890 V to 1.111110 V
	12 kHz		1.108890 V to 1.111110 V
	50 kHz		1.108890 V to 1.111110 V
	100 kHz		1.108890 V to 1.111110 V
	120 kHz		1.108890 V to 1.111110 V
	300 kHz		1.108887 V to 1.111113 V
	500 kHz		1.108887 V to 1.111113 V
	1.1999 MHz		1.108887 V to 1.111113 V
	1.2 MHz		1.107777 V to 1.112223 V
	2 MHz		1.107777 V to 1.112223 V
	5 MHz		1.107777 V to 1.112223 V
	10 MHz		1.107777 V to 1.112223 V
	15 MHz		1.105557 V to 1.114443 V
	20 MHz		1.105557 V to 1.114443 V
	25 MHz		1.098897 V to 1.121103 V
	30 MHz		1.098897 V to 1.121103 V
	35 MHz		1.087797 V to 1.132203 V
	40 MHz		1.087797 V to 1.132203 V
	45 MHz		1.087797 V to 1.132203 V
	50 MHz		1.087797 V to 1.132203 V

Table 23. Wideband Flatness Test Record (cont.)

Output Level	Frequency	Measured Flatness Error (V)	Test Limit (90-day)
1 V	10 Hz		0.997 V to 1.003 V
	30 Hz		0.999 V to 1.001 V
	50 Hz		0.999 V to 1.001 V
	105 Hz		0.999 V to 1.001 V
	500 Hz		0.999 V to 1.001 V
	5 kHz		0.999 V to 1.001 V
	10 kHz		0.999 V to 1.001 V
	12 kHz		0.999 V to 1.001 V
	50 kHz		0.999 V to 1.001 V
	100 kHz		0.999 V to 1.001 V
	120 kHz		0.999 V to 1.001 V
	300 kHz		0.999 V to 1.001 V
	500 kHz		0.999 V to 1.001 V
	1.1999 MHz		0.999 V to 1.001 V
	1.2 MHz		0.999 V to 1.001 V
	2 MHz		0.999 V to 1.001 V
	5 MHz		0.998 V to 1.002 V
	10 MHz		0.998 V to 1.002 V
	15 MHz		0.996 V to 1.004 V
	20 MHz		0.996 V to 1.004 V
	25 MHz		0.990 V to 1.010 V
	30 MHz		0.990 V to 1.010 V
	35 MHz		0.980 V to 1.020 V
	40 MHz		0.980 V to 1.020 V
	45 MHz		0.980 V to 1.020 V
	50 MHz		0.980 V to 1.020 V

Table 23. Wideband Flatness Test Record (cont.)

Output Level	Frequency	Measured Flatness Error (V)	Test Limit (90-day)
300 mV	10 Hz		299.100 mV to 300.900 mV
	30 Hz		299.700 mV to 300.300 mV
	50 Hz		299.700 mV to 300.300 mV
	105 Hz		299.700 mV to 300.300 mV
	500 Hz		299.700 mV to 300.300 mV
	5 kHz		299.700 mV to 300.300 mV
	10 kHz		299.700 mV to 300.300 mV
	12 kHz		299.700 mV to 300.300 mV
	50 kHz		299.700 mV to 300.300 mV
	100 kHz		299.700 mV to 300.300 mV
	120 kHz		299.700 mV to 300.300 mV
	300 kHz		299.697 mV to 300.303 mV
	500 kHz		299.697 mV to 300.303 mV
	1.1999 MHz		299.697 mV to 300.303 mV
	1.2 MHz		299.697 mV to 300.303 mV
	2 MHz		299.697 mV to 300.303 mV
	5 MHz		299.397 mV to 300.603 mV
	10 MHz		299.397 mV to 300.603 mV
	15 MHz		298.797 mV to 301.203 mV
	20 MHz		298.797 mV to 301.203 mV
	25 MHz		296.997 mV to 303.003 mV
	30 MHz		296.997 mV to 303.003 mV
	35 MHz		293.997 mV to 306.003 mV
	40 MHz		293.997 mV to 306.003 mV
	45 MHz		293.997 mV to 306.003 mV
	50 MHz		293.997 mV to 306.003 mV

Table 23. Wideband Flatness Test Record (cont.)

Output Level	Frequency	Measured Flatness Error (V)	Test Limit (90-day)
100 mV	10 Hz		99.700 mV to 100.300 mV
	30 Hz		99.900 mV to 100.100 mV
	50 Hz		99.900 mV to 100.100 mV
	105 Hz		99.900 mV to 100.100 mV
	500 Hz		99.900 mV to 100.100 mV
	5 kHz		99.900 mV to 100.100 mV
	10 kHz		99.900 mV to 100.100 mV
	12 kHz		99.900 mV to 100.100 mV
	50 kHz		99.900 mV to 100.100 mV
	100 kHz		99.900 mV to 100.100 mV
	120 kHz		99.900 mV to 100.100 mV
	300 kHz		99.897 mV to 100.103 mV
	500 kHz		99.897 mV to 100.103 mV
	1.1999 MHz		99.897 mV to 100.103 mV
	1.2 MHz		99.897 mV to 100.103 mV
	2 MHz		99.897 mV to 100.103 mV
	5 MHz		99.797 mV to 100.203 mV
	10 MHz		99.797 mV to 100.203 mV
	15 MHz		99.597 mV to 100.403 mV
	20 MHz		99.597 mV to 100.403 mV
	25 MHz		98.997 mV to 101.003 mV
	30 MHz		98.997 mV to 101.003 mV
	35 MHz		97.997 mV to 102.003 mV
	40 MHz		97.997 mV to 102.003 mV
	45 MHz		97.997 mV to 102.003 mV
	50 MHz		97.997 mV to 102.003 mV

Table 23. Wideband Flatness Test Record (cont.)

Output Level	Frequency	Measured Flatness Error (V)	Test Limit (90-day)
30 mV	10 Hz		29.910 mV to 30.090 mV
	30 Hz		29.970 mV to 30.030 mV
	50 Hz		29.970 mV to 30.030 mV
	105 Hz		29.970 mV to 30.030 mV
	500 Hz		29.970 mV to 30.030 mV
	5 kHz		29.970 mV to 30.030 mV
	10 kHz		29.970 mV to 30.030 mV
	12 kHz		29.970 mV to 30.030 mV
	50 kHz		29.970 mV to 30.030 mV
	100 kHz		29.970 mV to 30.030 mV
	120 kHz		29.970 mV to 30.030 mV
	300 kHz		29.967 mV to 30.033 mV
	500 kHz		29.967 mV to 30.033 mV
	1.1999 MHz		29.967 mV to 30.033 mV
	1.2 MHz		29.967 mV to 30.033 mV
	2 MHz		29.967 mV to 30.033 mV
	5 MHz		29.937 mV to 30.063 mV
	10 MHz		29.937 mV to 30.063 mV
	15 MHz		29.877 mV to 30.123 mV
	20 MHz		29.877 mV to 30.123 mV
	25 MHz		29.697 mV to 30.303 mV
	30 MHz		29.697 mV to 30.303 mV
	35 MHz		29.397 mV to 30.603 mV
	40 MHz		29.397 mV to 30.603 mV
	45 MHz		29.397 mV to 30.603 mV
	50 MHz		29.397 mV to 30.603 mV

Table 23. Wideband Flatness Test Record (cont.)

Output Level	Frequency	Measured Flatness Error (V)	Test Limit (90-day)
10 mV	10 Hz		9.970 mV to 10.030 mV
	30 Hz		9.990 mV to 10.010 mV
	50 Hz		9.990 mV to 10.010 mV
	105 Hz		9.990 mV to 10.010 mV
	500 Hz		9.990 mV to 10.010 mV
	5 kHz		9.990 mV to 10.010 mV
	10 kHz		9.990 mV to 10.010 mV
	12 kHz		9.990 mV to 10.010 mV
	50 kHz		9.990 mV to 10.010 mV
	100 kHz		9.990 mV to 10.010 mV
	120 kHz		9.990 mV to 10.010 mV
	300 kHz		9.987 mV to 10.013 mV
	500 kHz		9.987 mV to 10.013 mV
	1.1999 MHz		9.987 mV to 10.013 mV
	1.2 MHz		9.987 mV to 10.013 mV
	2 MHz		9.987 mV to 10.013 mV
	5 MHz		9.977 mV to 10.023 mV
	10 MHz		9.977 mV to 10.023 mV
	15 MHz		9.957 mV to 10.043 mV
	20 MHz		9.957 mV to 10.043 mV
	25 MHz		9.897 mV to 10.103 mV
	30 MHz		9.897 mV to 10.103 mV
	35 MHz		9.797 mV to 10.203 mV
	40 MHz		9.797 mV to 10.203 mV
	45 MHz		9.797 mV to 10.203 mV
	50 MHz		9.797 mV to 10.203 mV

Table 23. Wideband Flatness Test Record (cont.)

Output Level	Frequency	Measured Flatness Error (V)	Test Limit (90-day)
3 mV	10 Hz		2991 μ V to 3009 μ V
	30 Hz		2997 μ V to 3003 μ V
	50 Hz		2997 μ V to 3003 μ V
	105 Hz		2997 μ V to 3003 μ V
	500 Hz		2997 μ V to 3003 μ V
	5 kHz		2997 μ V to 3003 μ V
	10 kHz		2997 μ V to 3003 μ V
	12 kHz		2997 μ V to 3003 μ V
	50 kHz		2997 μ V to 3003 μ V
	100 kHz		2997 μ V to 3003 μ V
	120 kHz		2997 μ V to 3003 μ V
	300 kHz		2994 μ V to 3006 μ V
	500 kHz		2994 μ V to 3006 μ V
	1.1999 MHz		2994 μ V to 3006 μ V
	1.2 MHz		2994 μ V to 3006 μ V
	2 MHz		2994 μ V to 3006 μ V
	5 MHz		2988 μ V to 3012 μ V
	10 MHz		2988 μ V to 3012 μ V
	15 MHz		2982 μ V to 3018 μ V
	20 MHz		2982 μ V to 3018 μ V
	25 MHz		2952 μ V to 3048 μ V
	30 MHz		2952 μ V to 3048 μ V
	35 MHz		2907 μ V to 3093 μ V
	40 MHz		2907 μ V to 3093 μ V
	45 MHz		2907 μ V to 3093 μ V
	50 MHz		2907 μ V to 3093 μ V

Table 23. Wideband Flatness Test Record (cont.)

Output Level	Frequency	Measured Flatness Error (V)	Test Limit (90-day)
1 mV	10 Hz		997 μ V to 1003 μ V
	30 Hz		999 μ V to 1001 μ V
	50 Hz		999 μ V to 1001 μ V
	105 Hz		999 μ V to 1001 μ V
	500 Hz		999 μ V to 1001 μ V
	5 kHz		999 μ V to 1001 μ V
	10 kHz		999 μ V to 1001 μ V
	12 kHz		999 μ V to 1001 μ V
	50 kHz		999 μ V to 1001 μ V
	100 kHz		999 μ V to 1001 μ V
	120 kHz		999 μ V to 1001 μ V
	300 kHz		995 μ V to 1005 μ V
	500 kHz		995 μ V to 1005 μ V
	1.1999 MHz		995 μ V to 1005 μ V
	1.2 MHz		995 μ V to 1005 μ V
	2 MHz		995 μ V to 1005 μ V
	5 MHz		993 μ V to 1007 μ V
	10 MHz		993 μ V to 1007 μ V
	15 MHz		991 μ V to 1009 μ V
	20 MHz		991 μ V to 1009 μ V
	25 MHz		970 μ V to 1030 μ V
	30 MHz		970 μ V to 1030 μ V
	35 MHz		955 μ V to 1045 μ V
	40 MHz		955 μ V to 1045 μ V
	45 MHz		955 μ V to 1045 μ V
	50 MHz		955 μ V to 1045 μ V

Maintenance

Because this is a high-performance instrument, Fluke Calibration does not recommend that the board be repaired to the component level. It is easy to introduce a subtle long-term stability problem by handling the boards. Access procedures are provided for those who want to replace a faulty module.

Clean the Exterior

To keep the Product looking new, clean the case, front panel keys, and display with a soft cloth slightly dampened with either water or a non-abrasive mild cleaning solution that is not harmful to plastics.

Caution

Do not use aromatic hydrocarbons or chlorinated solvents for cleaning. They can damage the plastic materials used in the Product.

Fuse Replacement

Access the fuse from the rear panel. The fuse rating label below the fuse holder shows the correct replacement fuse ratings for each operating voltage.

Warning

To prevent possible electrical shock, fire, or personal injury:

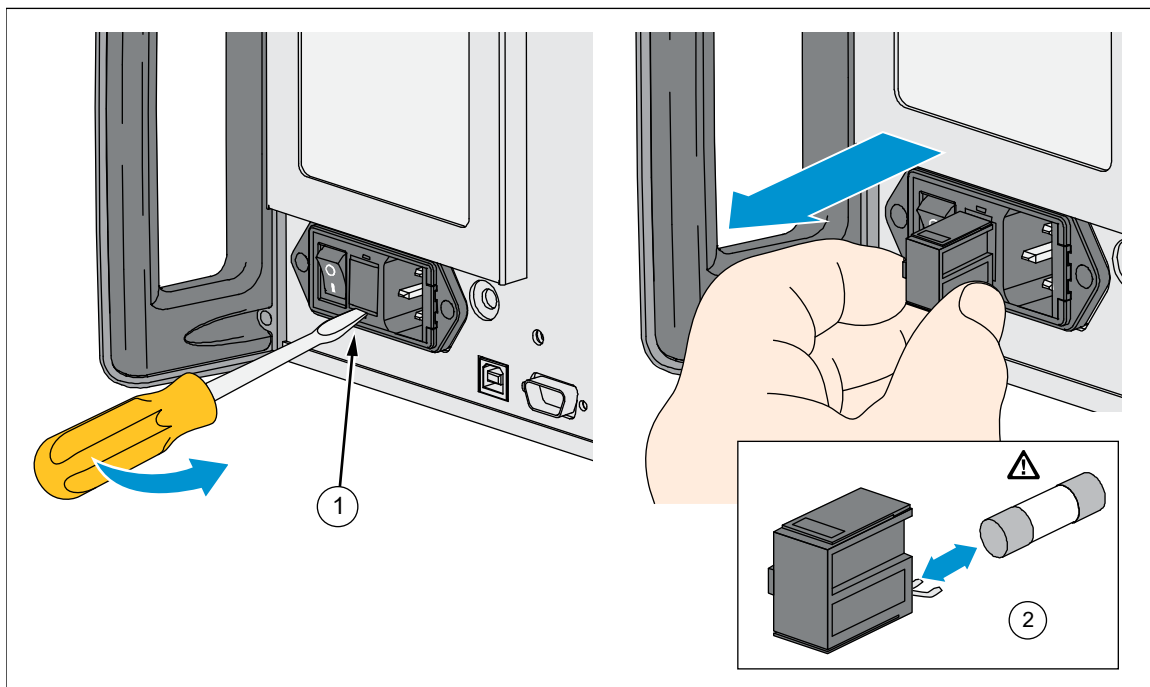
- **Turn the Product off and remove the mains power cord. Stop for two minutes to let the power assemblies discharge before you open the fuse door.**
- **Replace a blown fuse with exact replacement only for continued protection against arc flash.**
- **Use only specified replacement fuses, see Table .**

To access the fuse, refer to Figure :

1. Disconnect the mains power cord.
2. With a standard screwdriver, release the fuse holder door.
3. Pull out the fuse holder.
4. If necessary, replace the fuse.
5. Reinsert the fuse holder.
6. Close the fuse holder door.

Table 23. Replacement Fuses

Line Voltage Setting	Fuse Description	Fluke Part Number
⚠ 100 V to 120 V	T 3 A 250 V	109280
⚠ 220 V to 240 V	T 1.5 A 250 V	109231



hhp003.emf

Figure 23. Access the Fuse

Clean the Air Filter

Caution

Damage caused by overheating can occur if the area around the fan is restricted, the intake air is too warm, or the air filter becomes clogged.

To prevent Product damage, make sure that the filter is completely dry before reinstallation.

The air filter must be removed and cleaned at least every 30 days, or more frequently if the Calibrator is operated in a dusty environment. The air filter is accessible from the rear panel of the Calibrator.

To clean the air filter, refer to Figure 24:

1. Disconnect line power.
2. Unscrew the knurled screw at the top of the air filter and pull the filter retainer downwards (it is hinged at the bottom) to remove the filter.
3. Clean the filter by washing it in soapy water. Rinse and dry it thoroughly.
4. Reinstall the filter and the knurled screw.

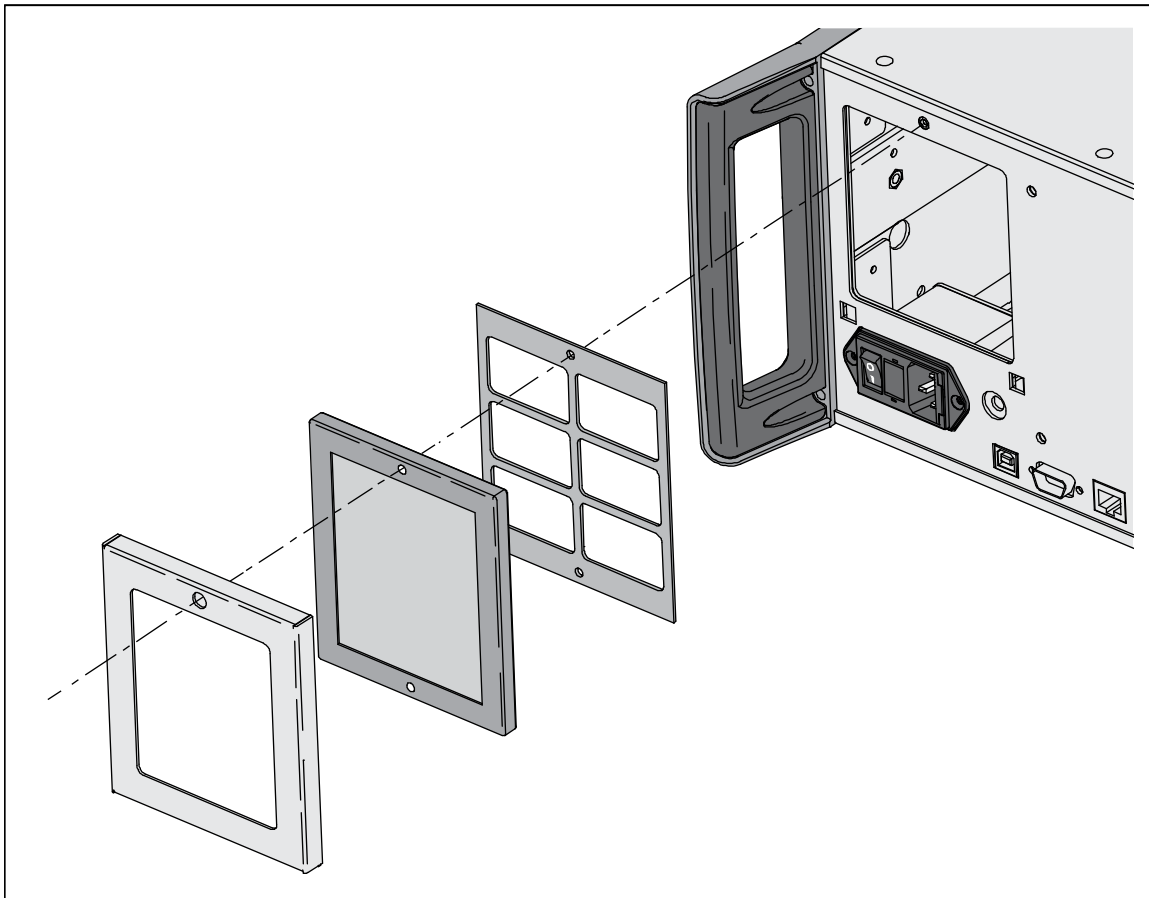


Figure 24. Air Filter Access

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Access Procedures

⚠⚠ Warning

To prevent possible electrical shock, fire, or personal injury, have an approved technician repair the Product.

Top and Bottom Covers

Make sure that power is not connected to the Product. The rear-panel power switch must be off, and the mains power cable must be disconnected. Top and bottom covers are each secured with eight Phillips head screws (four on the front, four on the rear).

Digital Section Cover

Access the Digital Section through the top cover that is secured by six Phillips head screws.

Analog Section Covers

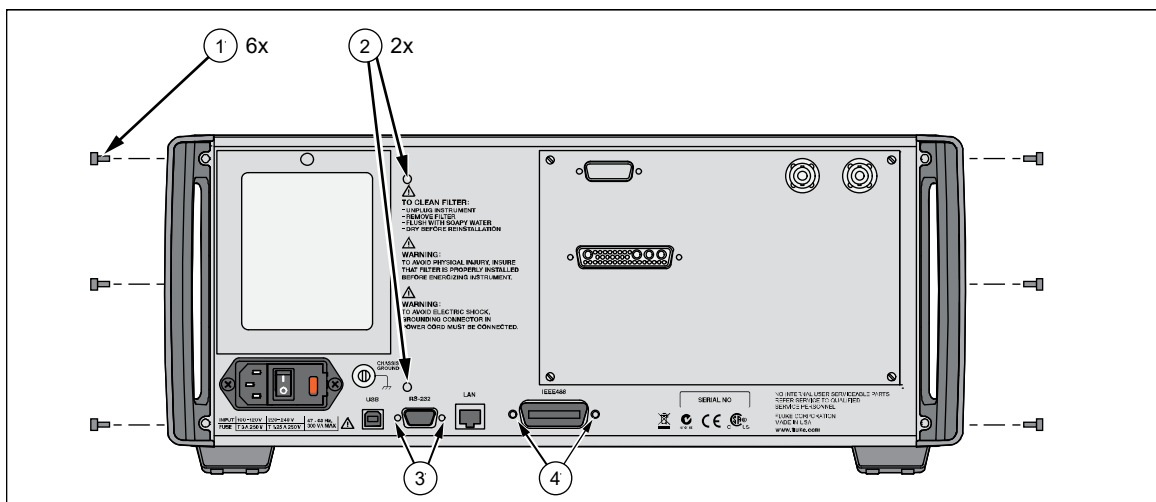
The Analog Section is enclosed with separate covers on the top and bottom. The top cover is secured with seven Phillips head screws. The bottom Analog Section cover is secured with eight Phillips head screws (three short, five longer).

Rear Panel Removal and Installation

To detach the Rear Panel, remove:

- The six hex head screws (three on each rear handle side (①))
- The two Phillips head screws found along the side of the Fan Assembly (②)
- The two hexagonal jack screws next to the RS-232 connector (③)
- The two hexagonal jack screws next to the GPIB connector (④)

Refer to Figure 25 for screw locations.



hyv004.emf

Figure 25. Rear Panel Removal

Rear Panel Assembly Access

1. Carefully pull the rear panel housing from the Rear Panel.
2. Remove the two ribbon cables from the Rear Panel board.
3. Remove the two nuts at TB1 and TB2 on the paddle board.
4. Separate the associated wires from the paddle board. Make sure to note which wire goes to which binding post.
5. Remove the two paddle board mounting screws and separate the paddle board from the Rear Panel assembly.
6. Remove all Phillips head screws from the PC board.
7. Remove the jack screws for each connection on the rear panel housing and then carefully lift the Rear Panel assembly out from the housing.
8. Reverse this procedure to install the Rear Panel assembly.

Front Panel Removal and Installation

Refer to Figure 26 during the following procedure:

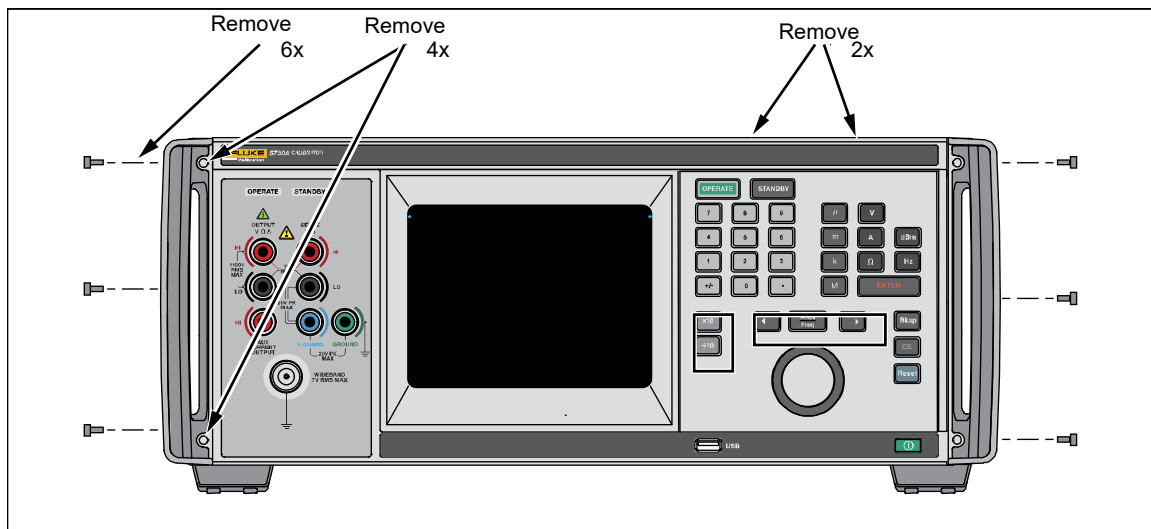


Figure 26. Front Panel Removal

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1. Remove the Calibrator top and bottom covers.
2. Remove the two screws at the top of the Front Panel and the six hex screws on the front handle sides. Grasp both handles and gently pull the Front Panel away from the mainframe. Position the Front Panel on its handles, in front of the instrument.
3. If you need to detach the Front Panel from the Product, all cables must be disconnected. The output cable must be detached in all configurations of the Product. If the Wideband Option is installed, you must also detach the related connector from the Front Panel.

Reverse this procedure to install the Front Panel.

Display Assembly Removal and Installation

Once the Front Panel has been removed, use the following procedure to access the Display assembly.

1. Disconnect the white cable at both ends.
2. Remove the two screws from the small display controller board and put the assembly aside. Make sure to not to damage the two brown flex cables.
3. Remove the ten Philips head screws that hold the display shield in place, and then remove the shield.
4. Disconnect these cables:
 - the white cable assembly
 - the rainbow-colored cable assembly
 - the gray ribbon cable from the keypad board.
5. Remove the sheet metal shield that covers the display.
6. Carefully remove the display assembly.

Reverse this procedure to install the Front Panel Display assembly.

Keyboard Assembly Removal and Installation

The following procedure assumes that the Display Assembly Removal procedure has been completed.

1. Disconnect the white cable at both ends. Remove the two hex screws at the front of each handle and then remove the front handles.
2. Remove the two screws from the small display controller board and put the assembly aside. Make sure not to damage the two brown flex cables.
3. Remove the ten Phillips head screws that hold the display shield in place, and then remove the shield.
4. Disconnect these cables:
 - the white cable assembly
 - the rainbow-colored cable assembly
 - the gray ribbon cable from the keypad board
5. Hold the front panel knob securely and remove the Phillips head screw from the shaft encoder assembly.
6. Remove the shaft encoder wheel.
7. Remove the four Phillips head screws from the keypad assembly and remove it.

Reverse this procedure to install the Keyboard assembly.

Analog Assembly Removal and Installation

The analog assemblies are installed as shown in Figure 27. Note that each module cannot be positioned in any other slot and that the identifying information on the tab for each module faces forward. In most cases, the component side of each module also faces forward. The component side faces to the rear for three modules:

- Current/High Resolution Oscillator (A7)
- Ohms Cal (A9)
- High Voltage Control (A14)

All modules except the High Voltage Control module pull straight up to disengage from the Digital Motherboard. For the High Voltage Control module, two Phillips head captive screws at the outer corners of the High Voltage Transformer must be removed before the module can be removed.

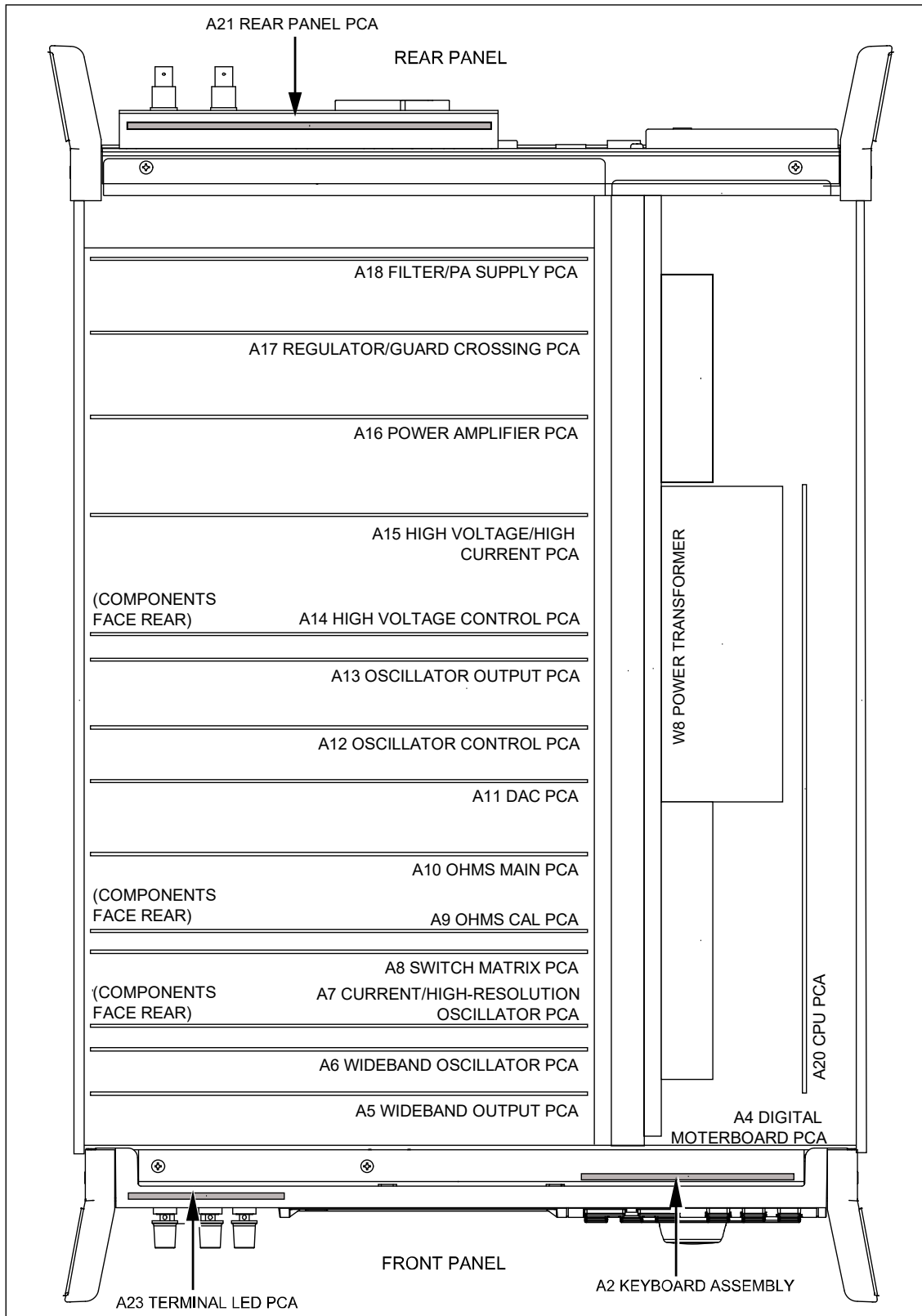


Figure 27. Analog and Digital Assemblies

hyv007.emf

⚠ Caution

Do not touch any circuit area on an analog assembly. Contamination from skin oil can produce high-resistance paths, with resulting leakage currents and possible erroneous readings. Always grasp an analog assembly by its upper corner ears.

Digital Assembly Removal and Installation

To remove the CPU Assembly, pull straight up at the top corners of the assembly. In relation to the chassis side, the CPU Assembly components face toward, and the Digital Power Supply Assembly components face away. See Figure 27.

Power Transformer Removal and Installation

⚠⚠ Warning

To prevent possible electrical shock, fire, or personal injury, turn the Product off and remove the mains power cord. Stop for two minutes to let the power assemblies discharge.

To remove the Power Transformer assembly:

1. Remove the Calibrator Front and Rear Panels.
2. Remove the CPU (A20) assembly, see Figure 27.
3. Detach the five connectors leading from the Power Transformer assembly to the Digital Motherboard. The three connectors at the rear of the assembly may not be accessible without first removing the rear fan. With the digital assembly (A20) removed, the four Phillips head screws securing this fan can be accessed through holes in the chassis side.

Note that no two Power Transformer connectors are the same size and that each connector is keyed. Re-connection only involves matching the appropriate connectors.

4. Working from the bottom of the instrument, remove the Digital Motherboard (A4) assembly, see Figure 27.
5. Remove the eleven screws securing the Power Transformer assembly, as follows:
 - Rear Panel: two screws, which were removed along with the Rear Panel.
 - Front Panel: two screws.
 - Top Edge: four screws.
 - Bottom Edge: three screws.

6. Remove the Power Transformer assembly.

To install the Power Transformer assembly, reverse the preceding steps.

Replacement Parts

Table 24 lists the part numbers of each replacement part or accessory for the Product, see Figure 28.

Table 24. Replacement Parts

Reference Designator	Description	Fluke Stock Number	Qty
A2	FRONT PANEL PCA	4561068	1
A3	ANALOG MOTHERBOARD PCA	761023	1
A4	DIGITAL MOTHERBOARD PCA	4561079	1
A5	WIDEBAND PCA	4696761	1
A7	CURRENT/HIGH RES PCA	764613	1
A8	SWITCH MATRIX PCA	4258451	1
A9	OHMS CAL PCA	775395	1
A10	OHMS MAIN PCA	761114	1
A11	DAC PCA	761122	1
A12	OSCILLATOR CONTROL PCA	761130	1
A13	OSCILLATOR OUTPUT PCA	1607704	1
A14	HIGH VOLTAGE CONTROL PCA	775429	1
A15	HIGH VOLTAGE PCA	761155	1
A16	POWER AMP & DIG CONTROL PCA	761163	1
A17	VOLT.REG./GUARD CROSSING PCA	761171	1
A18	FILTER/PWR.AMP PCA	761189	1
A20	MAIN CPU PCA	4561087	1
A21	REAR OUTPUT PCA	4561093	1
A23	TERMINAL INDICATOR PCA	4561101	1
MP1	TOP COVER	4104376	1
MP2	BOTTOM COVER	4104383	1
MP3	FILTER GUARD	674231	1
MP4	RELAY BRACKET	761015	1
MP5	SHIELD, HIGH VOLTAGE CONTROL	761197	2
MP6	INSULATOR,DIGITAL MOTHERBOARD	761247	1
MP7	SHIELD, DAC REAR	761429	1
MP8	FRONT PANEL SHEET METAL	4104352	1

Reference Designator	Description	Fluke Stock Number	Qty
MP9	LCD MOUNT	4303920	1
MP10	ANALOG TOP COVER	4104390	1
MP11	SHIELD, DAC-ADC AMP	775353	1
MP12	INSULATOR, ANALOG BOTTOM	775361	1
MP13	DIGITAL COVER	4104408	1
MP14	RIVETED CHASSIS ASSY	4104424	1
MP15	SHIELD, HIGH VOLTAGE, REAR	791921	1
MP16	SHIELD, DAC, FRONT, SMALL	797720	1
MP17	SHIELD, DAC, FRONT	797761	1
MP18	RIVETED, VOLTAGE REGULATOR AIR DUCT	802777	1
W1	SHROUD, CPU CABLE	4219584	1
MP19	COVER, ANALOG BOX, BOTTOM	874912	1
MP20	SHIELD, A2 DISPLAY	4219578	1
MP21	REAR OUTPUT HOUSING	4104341	1
MP22	REAR PANEL	4104365	1
MP23	FILTER FRAME	886390	1
MP24	HANDLE, 4U	3468705	4
MP25	FRONT PANEL PLASTIC	4104413	1
MP26	ENCODER MODULE	4221193	1
MP27	DECAL, INPUT	4104451	1
MP28	BINDING POST-RED	886382	3
MP29	BINDING POST-BLACK	886379	2
MP30	BINDING POST-GREEN	886374	1
MP31	BINDING POST-BLUE	886366	1
W2	CONNECTOR,ADAPTER,C0AXIAL,N(F),SMA(F),BULKHEAD MOUNT,BULK	1279066	1
MP50	SPACER, LED	4219591	1
MP32	KEYPAD	4104449	1
MP33	ENCODER WHEEL	764548	1
MP34	DISPLAY ASSEMBLY	4304647	1
MP35	KNOB, ENCODER	4219600	1

Reference Designator	Description	Fluke Stock Number	Qty
MP36	DECAL, USB	4219557	1
MP37	DECAL, MODEL 5730A	4219569	1
F1	△ FUSE,.25X1.25,3A,250V,SLOW	109280	1
F2	△ POWER ENTRY MODULE,6A,250V,FILTER,FUSE,DPST SWITCH,FLANGE MT,.187TABS,SHIELDED	4355075	1
MP38	FILTER,LINE,3A/250V,CHASSIS MOUNT,.250 SPADE TERMINALS,64X34MM	4221500	1
MP39	BINDING POST, STUD, PLATED	102707	1
H1	WASHER,LOCK,INTRNL,STL,.267ID	110817	1
H2	NUT,HEX,BR,1/4-28	110619	1
H3	BINDING HEAD, PLATED	102889	1
W3	TRANSFORMER/MODULE ASSY	4233875	1
H4	GROMMET,SLOT,RUBBER,.438,.062	853291	1
W4	RELAY,ARMATURE,2 FORM C,4.5VDC	783746	3
MP40	BUMPER,HI-TEMP SILICONE,.44 DIA,.188 THK,ADHESIVE	1601870	3
MP41	FAN & CONNECTOR ASSY	761213	2
MP42	FILTER, AIR	813493	1
MP43	SIDE EXTRUSION	4222803	2
MP44	INSERT EXTRUSION	4233853	2
MP45	AIDE,PCB PULL	541730	3
H5	WASHER,FLAT,SS,.119,.187,.010	853296	6
H6	WASHER,FLAT,STL,.160,.281,.010	111005	6
H7	SCREW,8-32,.375,LO CAP,SCKT,STAINLESS STEEL,BLK OXIDE,LOCK	295105	20
H8	SCREW,6-32,.375,PAN,PHILLIPS,STAINLESS STEEL,LOCK	334458	2
H9	CONNECTOR ACCESSORY,D-SUB JACK SCREW,4-40,.250 L,W/FLAT WASHER	1777348	6
H10	CONNECTOR ACCESSORY,MICRO-RIBBON,SCREW LOCK,M3.5,6-32,STEEL,ZINC-BLACK OR -CLEAR	854737	2
H11	WASHER, LOW THERMAL	760892	4
H12	NUT, LOW THERMAL, 6-32	760876	2
H13	NUT, LOW THERMAL, 8-32	850334	14
H14	SCREW,6-32,.250,PAN,PHILLIPS,STEEL,ZINC-CLEAR,LOCK	152140	44

Reference Designator	Description	Fluke Stock Number	Qty
H15	SCREW,PH,P,LOCK,SS,6-32,,500	320051	18
H16	SCREW,PH,P,LOCK,SS,6-32,,750	376822	12
H17	SCREW,6-32 X 0.25,FLAT HD UNDERCUT,PHILLIPS,HEAT TREATED,MAGNETIC SS,NYLON PATCH	320093	24
H18	WASHER, LOW THERMAL #8	859939	17
W5	CABLE, FRONT/REAR	802835	1
W6	CABLE, BOOST	802744	1
W7	JUMPER LINK,BINDING POST	190728	1
W8	TRANSFORMER,POWER,HIGH VOLTAGE,110/220VAC,50/60HZ,1:0.07:5.2:5.2,5700A-6530,UI75	775288	1
H19	WASHER,FLAT,STL,,149,,375,,031	110270	2
H20	WASHER,FLAT,STL,,191,,289,,010	111047	2
MP46	EJECTOR,PCB CARD EJECTOR,NYLON,ACCEPTS PCB THICKNESS 1/16 IN,UP TO 3/32 IN,WHITE	494724	4
W9	CABLE, LVDS DISPLAY	4312028	1
W10	CABLE, DISPLAY BACKLIGHT	4312037	1
W11	CABLE, TOUCH CONTROLLER	4312043	1
H21	SCREW,4-40,,375,FLAT,PHILLIPS,STAINLESS,PASSIVATE,LOCK (MUST BE ROHS COMPLIANT)	256024	2
MP47	CLEAR STATIC CLING VINYL	4365799	1
H22	NUT,EXT LOCK,STL,6-32	152819	2
H23	SCREW,6-32,1.250,PAN,PHILLIPS,STEEL,ZINC-CLEAR,LOCK	159756	8
W12	INLET HARNESS	4308875	1
W13	INLET WIRE	4308882	1
W14	INLET WIRE	4308894	1
W15	GROUND WIRE	4308907	1
W16	GROUND WIRE	4308918	1
H24	SCREW,4-14,,375,PAN,PHILLIPS,STEEL,ZINC-ROHS CLEAR,THREAD FORM	448456	8
W17	CABLE ACCESSORY ,CABLE ACCESS,TIE,4.00L,,10W,,75 DIA	172080	1

Reference Designator	Description	Fluke Stock Number	Qty
W18	CABLE, WIDEBAND TO FRONT PANEL -5730A	4382328	1
MP48	FOOT	868786	4
MP51	DECAL, NON USB	4376947	1
MP52	DECAL, 5730A/S	4388519	1

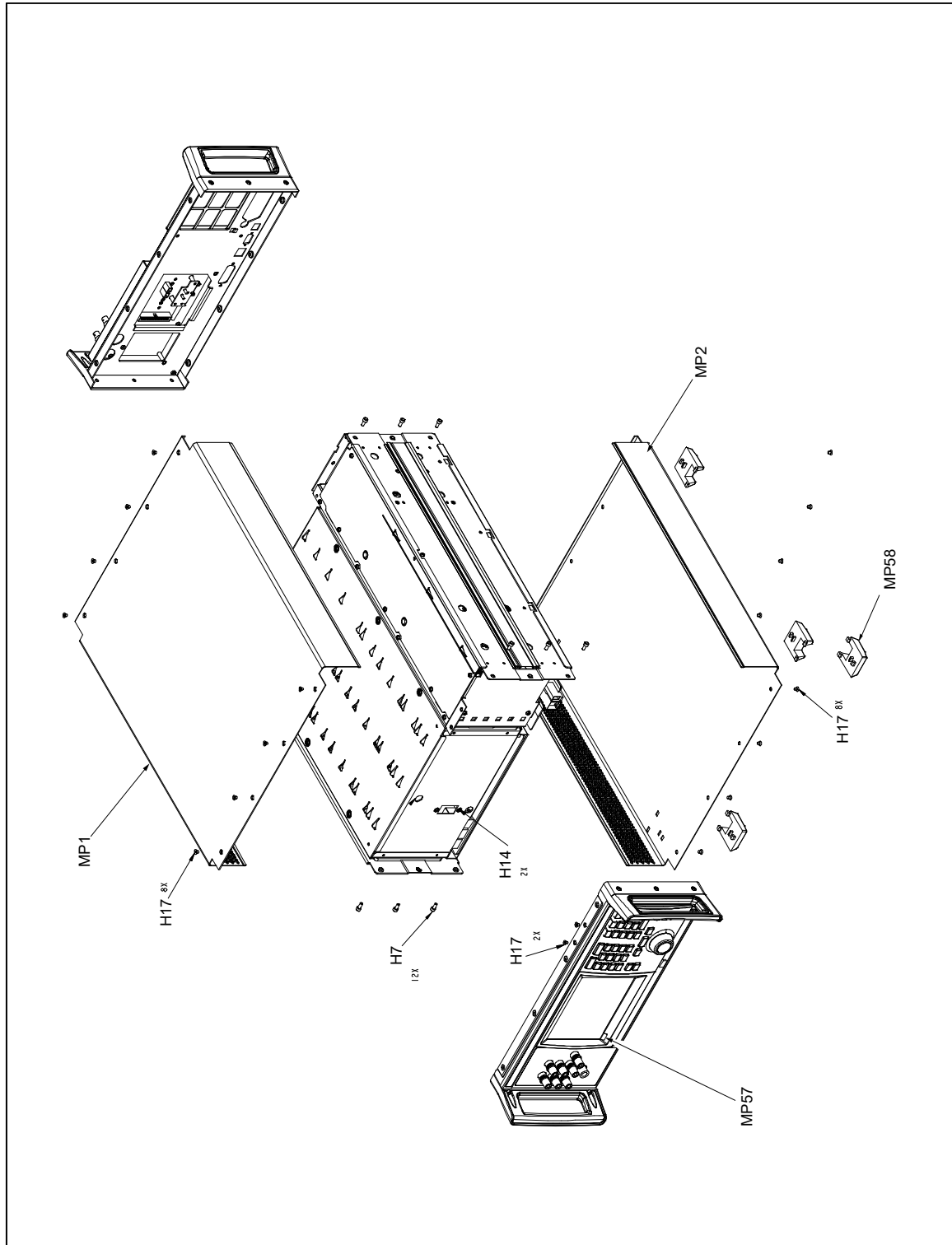


Figure 28. Replacement Parts

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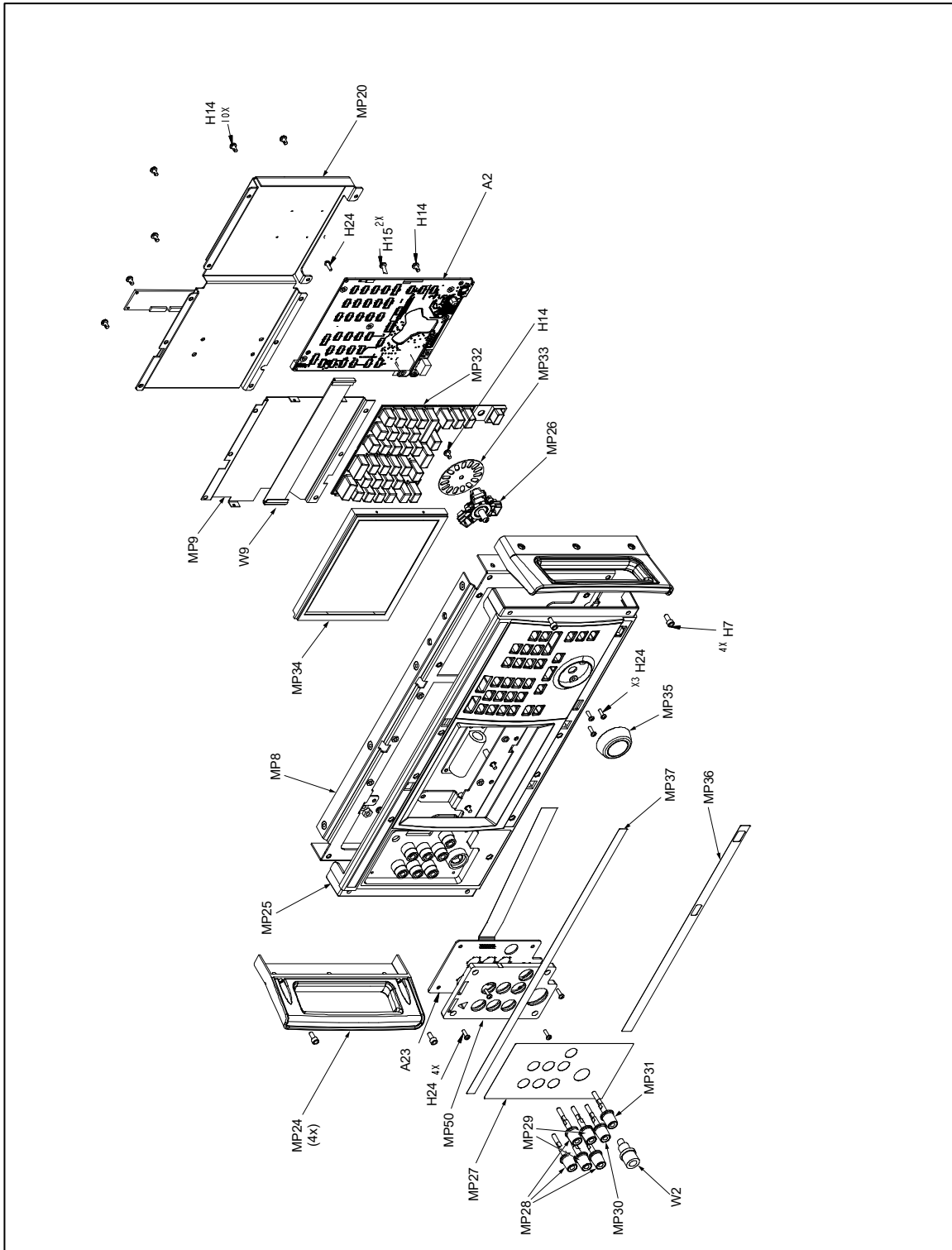
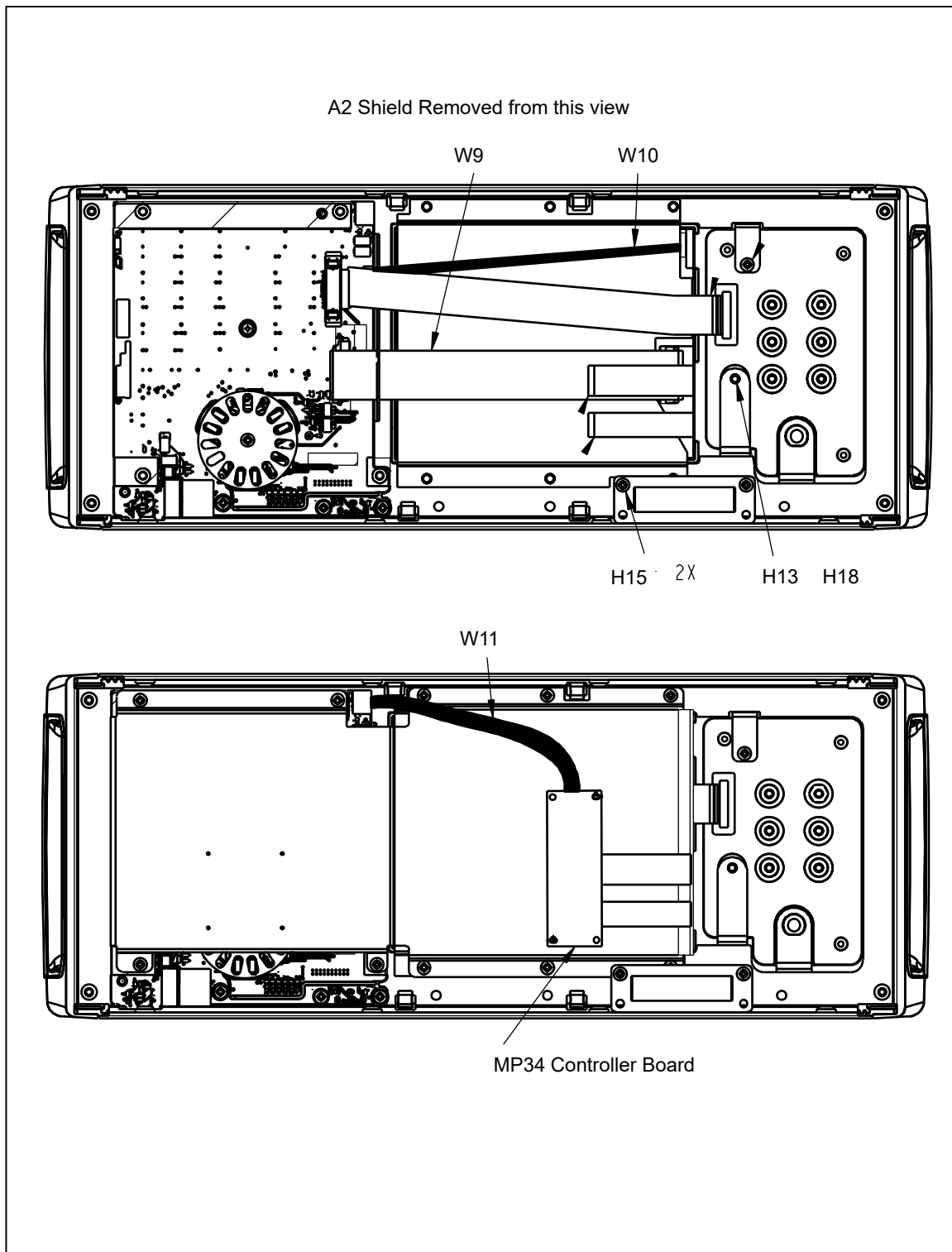


Figure 29. Replacement Parts (cont.)

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hyv311_6.emf

Figure 29. Replacement Parts (cont.)

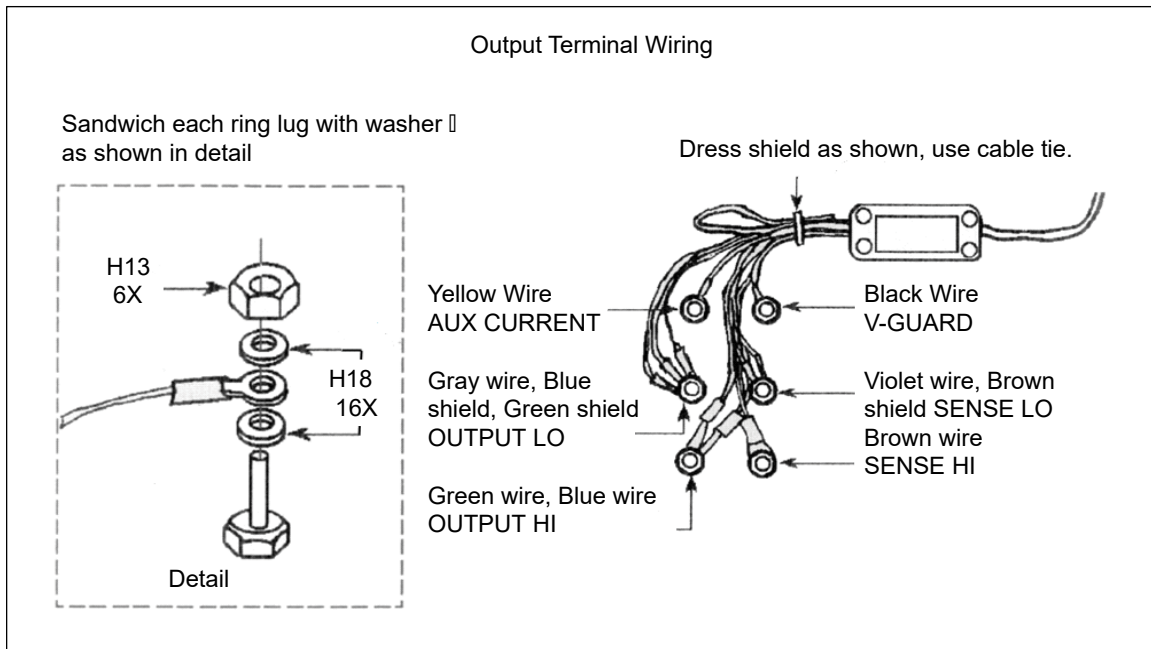


Figure 29. Replacement Parts (cont.)

hyv311_7.emf

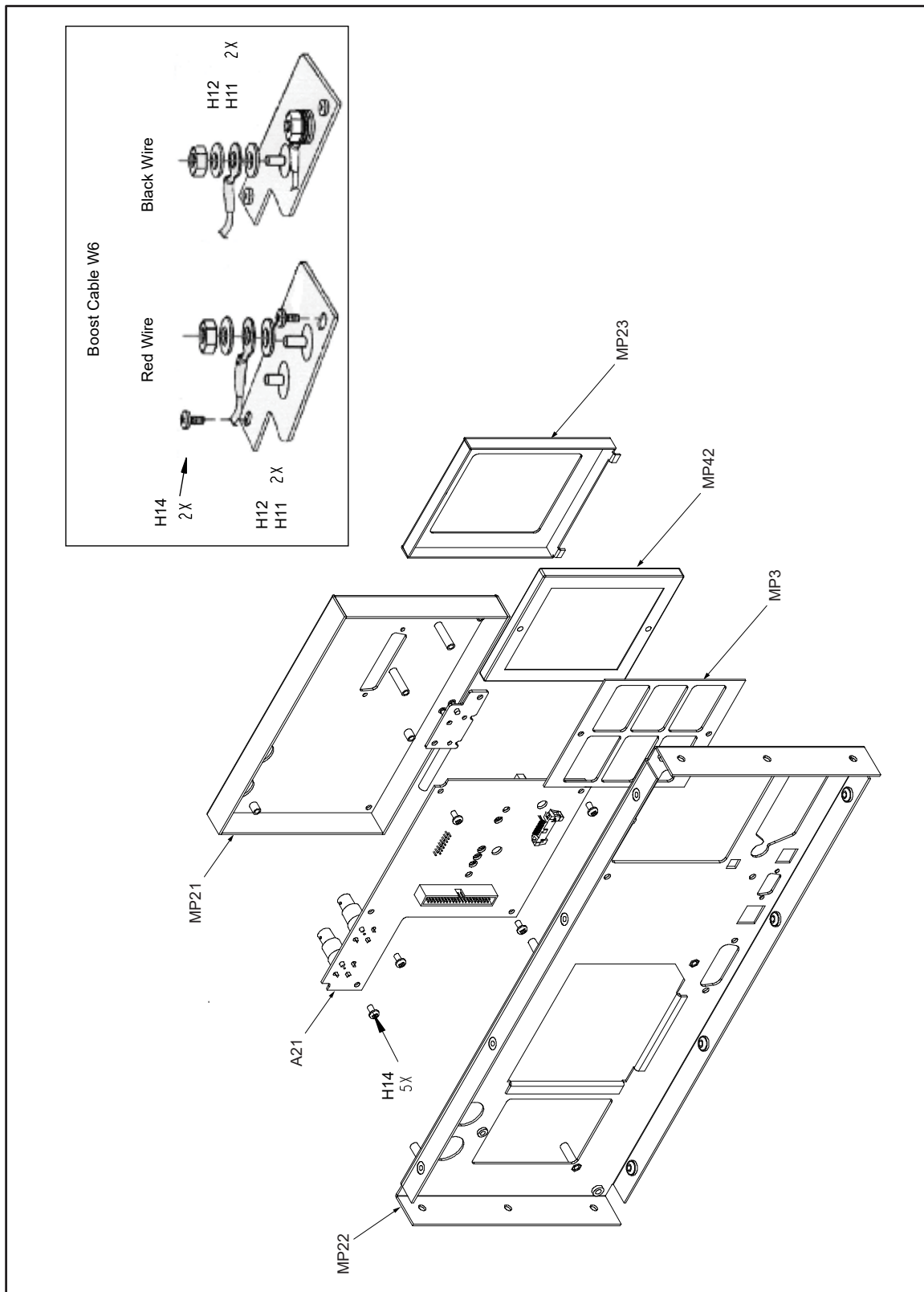
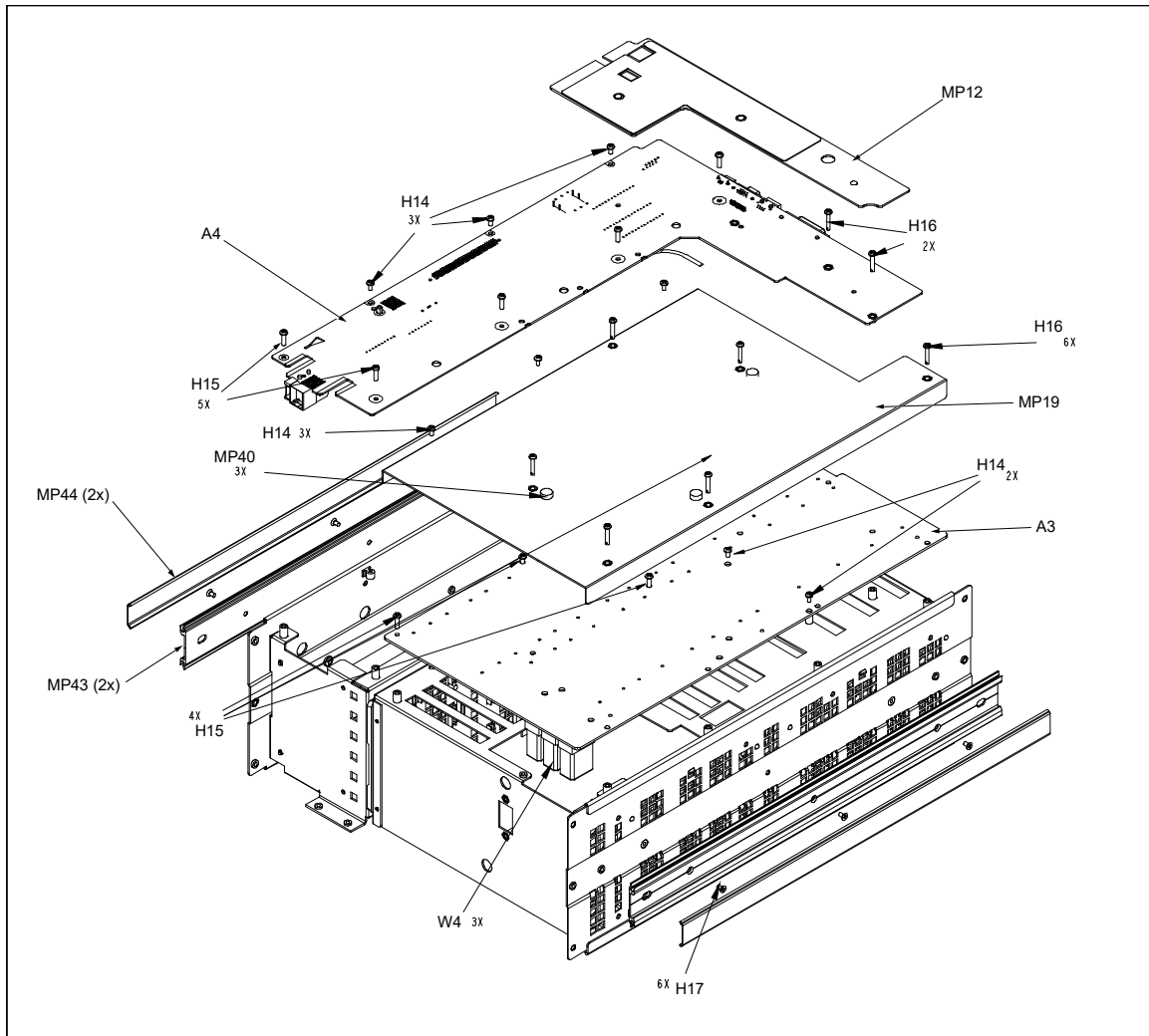


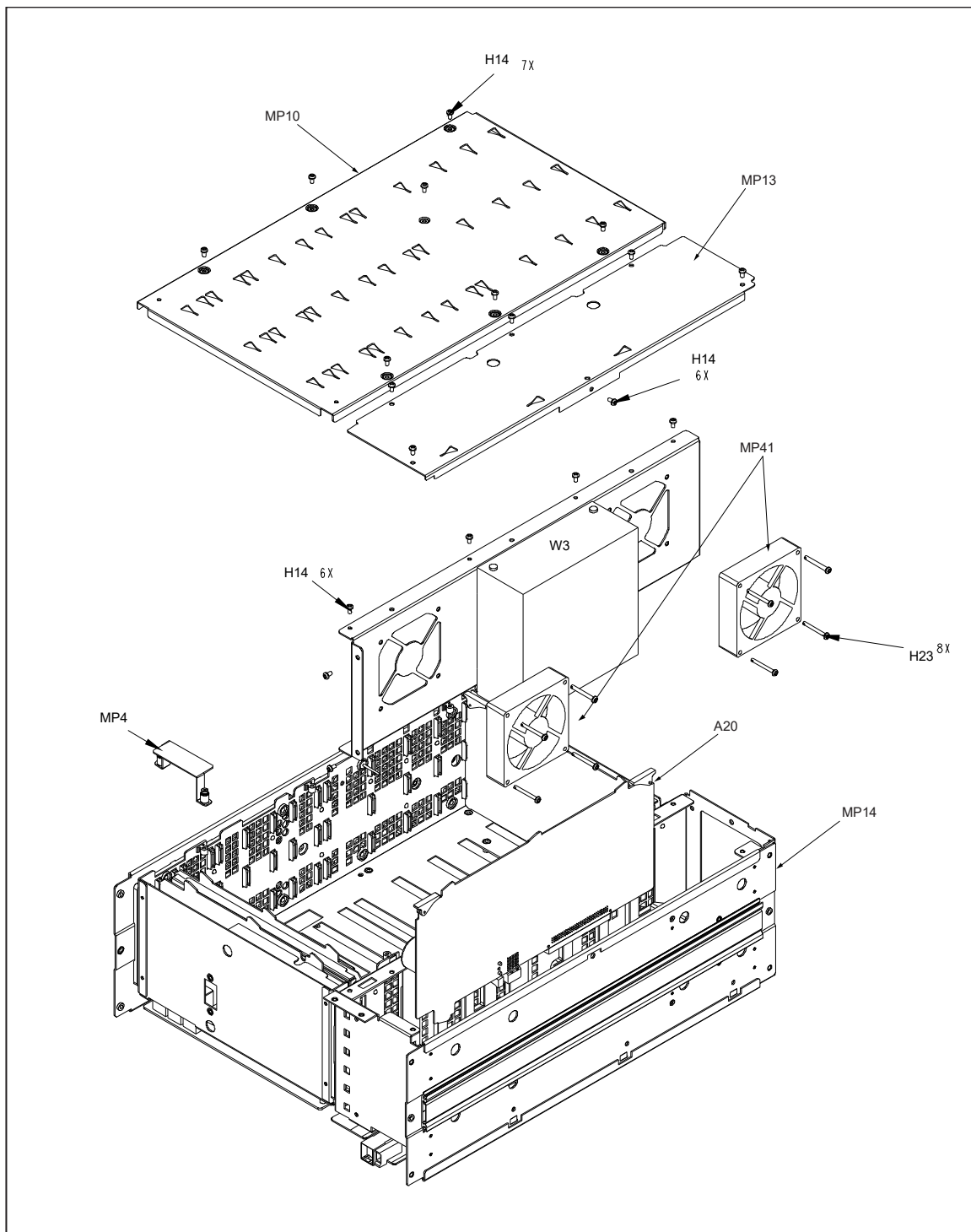
Figure 29. Replacement Parts (cont.)

hhp311_3.emf



hhp311_4.emf

Figure 29. Replacement Parts (cont.)



hhp311_5.emf

Figure 29. Replacement Parts (cont.)