FLUKE ®

Calibration

5790A
AC Measurement Standard

Operators Manual

LIMITED WARRANTY AND LIMITATION OF LIABILITY

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).

THIS WARRANTY IS BUYER'S SOLE AND EXCLUSIVE REMEDY AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. FLUKE SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES OR LOSSES, INCLUDING LOSS OF DATA, ARISING FROM ANY CAUSE OR THEORY.

Since some countries or states do not allow limitation of the term of an implied warranty, or exclusion or limitation of incidental or consequential damages, the limitations and exclusions of this warranty may not apply to every buyer. If any provision of this Warranty is held invalid or unenforceable by a court or other decision-maker of competent jurisdiction, such holding will not affect the validity or enforceability of any other provision.

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11/99

To register your product online, visit register.fluke.com

Declaration of the Manufacturer or Importer

We hereby certify that the Fluke Model 5790A is in compliance with BMPT Vfg 243/1991 and is RFI suppressed. The marketing and sale of the equipment was reported to the Central Office for Telecommunication Permits (ZZF). The right to retest this equipment or verify compliance with the regulation was given to the ZZF.

Bescheinigung des Herstellers/Importeurs

Hiermit wird bescheinigt, daB Fluke Modell 5790A in Übereinstimmung mit den Bestimmungen der BMPTAmtsblVfg 243/1991 funk-entstört ist. Dem Zentralamt fur Zulassungen im Femmeldewesen wurde das Inverkehrbringen dieses Gerätes angezeigt und die Berechtigung zur Überprüfung der Serie auf die Einhaltung der Bestimmungen eingeräumt.

Fluke Corporation

INTERFERENCE INFORMATION

This equipment generates and uses radio frequency energy and if not installed and used in strict accordance with the manufacturer's instructions, may cause interference to radio and television reception. It has been type tested and found to comply with the limits for a Class B digital device in accordance with the specifications of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference in a residential installation.

Operation is subject to the following two conditions:

• This device may not cause harmful interference.

• This device must accept any interference received, including interference that may cause undesired operation.

There is no guarantee the interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

• Reorient the receiving antenna

• Relocate the equipment with respect to the receiver

• Move the equipment away from the receiver

• Plug the equipment into a different outlet so that the computer and receive are on different

branch circuits

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet prepared by the Federal Communications Commission helpful: How to Identify and Resolve Radio-TV Interference Problems. This booklet is available from the U.S. Government Printing Office, Washington, DC 20402. Stock No. 004-000-00345-4.

SAFETY TERMS IN THIS MANUAL

This instrument has been designed and tested in accordance with IEC publication 1010-1 (1992-1), Safety Requirements for Electrical Measuring, Control and Laboratory Equipment, and ANSI/ISA-S82.01-1994, and CAN/CSA-C22.2 No. 1010.1-92. This User Manual contains information, warning, and cautions that must be followed to ensure safe operation and to maintain the instrument in a safe condition. Use of this equipment in a manner not specified herein may impair the protection provided by the equipment.

This instrument is designed for IEC 1010-1 Installation Category II use. It is not designed for connection to circuits rated over 4800 VA.

WARNING statements identify conditions or practices that could result in personal injury or loss of life.

CAUTION statements identify conditions or practices that could result in damage to equipment.

SYMBOLS MARKED ON EQUIPMENT

WARNING   Risk of electric shock. Refer to the manual (see the Index for references).

GROUND   Ground terminal to chassis (earth).

Attention   Refer to the manual (see the Index for references). This symbol indicates that information about usage of a feature is contained in the manual.

AC POWER SOURCE

The instrument is intended to operate from an ac power source that will not apply more than 264V ac rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is required for safe operation.

USE THE PROPER FUSE

To avoid fire hazard, for fuse replacement use only the specified unit: 100 or 120 V operation, 2 ampere/250 volt time delay; 200 or 240 V operation, 1 ampere/250 volt time delay.

GROUNDING THE INSTRUMENT

The instrument utilizes controlled overvoltage techniques that require the instrument to be grounded whenever normal mode or common mode ac voltages or transient voltages may occur. The enclosure must be grounded through the grounding conductor of the power cord, or through the rear panel ground binding post.

USE THE PROPER POWER CORD

Use only the power cord and connector appropriate for the voltage and plug configuration in your country.

Use only a power cord that is in good condition.

Refer power cord and connector changes to qualified service personnel.

DO NOT OPERATE IN EXPLOSIVE ATMOSPHERES

To avoid explosion, do not operate the instrument in an atmosphere of explosive gas.

DO NOT REMOVE COVER DURING OPERATION

To avoid personal injury or death, do not remove the instrument cover without first removing the power source connected to the rear panel. Do not operate the instrument without the cover properly installed. Normal calibration is accomplished with the cover closed. Access procedures and the warnings for such procedures are contained both in this manual and in the Service Manual. Service procedures are for qualified service personnel only.

DO NOT ATTEMPT TO OPERATE IF PROTECTION MAY BE IMPAIRED

If the instrument appears damaged or operates abnormally, protection may be impaired. Do not attempt to operate the instrument under these conditions. Refer all questions of proper instrument operation to qualified service personnel.

Table of Contents

List of Tables

List of Figures

Chapter 1
Introduction and Specifications

1-1. Introduction

The 5790A AC Measurement Standard is a systems instrument that measures ac voltage with the uncertainty of a thermal transfer standard. You control the 5790A's operation from the front panel or remotely over the serial or IEEE-488 interface.

You can operate the 5790A in measurement mode or transfer mode. In measurement mode, the 5790A operates as a digital ac voltmeter with up to 8 digits of resolution. Measurement mode uses an internal dc reference. In transfer mode, you apply an external dc or ac reference source. The 5790A automatically performs switching and calculations, and displays the resulting ac-dc or ac-ac difference on the vacuum fluorescent Control Display.

The 5790A covers a voltage range of 700 µV to 1000 V (70 mV minimum in transfer mode), and a frequency range of 10 Hz to 1 MHz. A wideband voltage option extends frequency range to 30 MHz. The 5790A is also compatible with Fluke A40 current shunts, which permit you to make ac-dc or ac-ac current transfer measurements up to 20 A. Refer to the Specifications for details.

A variety of input connections allows you to use the one that best suits your application. There are four sets of input terminals on the 5790A, two 50Ω Type "N" connectors and two sets of five-way binding posts. One 50Ω Type "N" and one set of binding posts is dedicated to the ac measurement and transfer modes. AC or DC voltages can be applied to either input connection, allowing you to perform automated ac-dc transfer measurements. The second Type "N" input connection supports the optional wideband mode, and the SHUNT binding posts are for Fluke A40 Series current shunts.

1-2. Inside the 5790A

Two patented internal standards contribute the most to the 5790A's ability to measure rms ac voltage with such low uncertainty. These two standards are a stable and precisely variable dc source similar to the one in the Fluke 5700A Calibrator and a high-performance thermal rms sensor similar to the one in the Fluke 792A AC/DC Transfer Standard.

Reference amplifiers establish the accuracy and stability of the internal dc source. A patented 26-bit digital-to-analog converter (dac) provides the 5790A with the ability to precisely vary its internal dc source. This is a pulse-width modulated dac with linearity typically better than 0.2 ppm of full scale.

On the ac side, the Fluke rms sensor is similar in principle to a thermal voltage converter (thermocouple), but has faster settling time, low dc reversal error, higher signal-to-noise ratio, and excellent frequency performance.

1-3. Measurement and Transfer Modes

With the 5790A you can measure an ac or dc voltage just as you would with a voltmeter (measurement mode), or you can connect an external dc standard for comparison to an applied ac voltage as you would do with an ac-dc transfer standard (transfer mode). When in measurement mode, among many other things the 5790A automatically does the following:

1. Compares the heating effect of the incoming signal to that of the 5790A internal dc source, through the Fluke rms sensor. This results in direct detection of true rms value.

2. Adjusts its internal dc source for a null at the output of the rms sensor, in the process eliminating many sources of error.

3. Applies correction factors saved at time of calibration.

4. Presents the results of the ac-dc transfer on the Measurement Display, showing rms amplitude and frequency of the signal being applied, accurate to within the uncertainty of the internal dc standard combined with the transfer uncertainty. (See the Specifications.)

Pressing a softkey (a key whose function is defined on the Control Display) sets an incoming signal as a reference, activating transfer mode. In transfer mode, the 5790A automatically does the following:

1. Displays the reference source, the formula it is using to compute ac-dc or ac-ac difference, and the results of the formula.

2. Provides you with a softkey to easily correct for dc reversal error. You apply both polarities of dc and the 5790A computes the average of the absolute values of the applied dc.

3. Continuously shows the results of comparisons of the heating effect of the incoming signal to that of the stored reference.

4. Applies correction factors saved at time of calibration as necessary.

5. Presents the results of the transfer on the Control Display, accurate to within the uncertainty of the transfer device. (See the Specifications.)

6. Always displays the measured amplitude and frequency of the input signal on the Measurement Display, no matter what other processes are taking place.

1-4.   An Overview of the Features

See Section 3 for detailed descriptions of front panel connectors, controls, and displays. Features of the 5790A include the following:

- Two main input choices: 50Ω Type "N" coaxial or five-way binding posts

- A dedicated SHUNT input terminal that provides current transfer capability.

- WIDEBAND 50Ω Type "N" coaxial connector for measuring signals up to 30 MHz. (Requires Option 5790A-03 Wideband Module.)

- Closed-case periodic calibration in which no physical adjustments are necessary.

- The ability to print or upload calibration reports. For reporting purposes, the 5790A maintains in nonvolatile memory a database of the calibration shifts from the previous calibration as well as from the most recent calibration. Calibration reports provide a way to develop a performance history of each 5790A.

- Real-time clock for date and time stamping reports, recording the time and date of calibration, and calculating specifications.

- Standard IEEE-488 (GPIB) interface, complying with ANSI/IEEE Standards 488.1-1987 and 488.2-1987.

- EIA Standard RS-232-C serial data interface for printing, displaying, or transferring internally stored calibration constants, and for remote control of the 5790A.

- Extensive internal software-controlled self testing and diagnostics of analog and digital functions.

1-5. Instruction Manuals

This Operators Manual contains operating instructions for the 5790A. The 5790A Manual Set provides complete information for the Operators and service or maintenance personnel. The set includes the following manuals:

- 5790A Operators Manual, pn 893284
- 5790A Remote Programming Reference Guide, pn 893375
- 5790A Service Manual, pn 893292

1-6. 5790A Operators Manual

This 5790A Operators Manual provides complete information for installing the 5790A and operating it from the front panel and from the remote interface. The manual also provides a glossary of terms related to ac-dc transfers as well as other information for the Operators and programmer, such as specifications, operating parameter setup procedures, and remote programming examples.

1-7. 5790A Remote Programming Reference Guide

The 5790A Remote Programming Reference Guide contains a summary of remote commands for the 5790A. It also contains information needed to determine system status using the status byte and registers.

1-8. 5790A Service Manual

The 5790A Service Manual is a maintenance guide for the 5790A. The following topics are included in the 5790A Service Manual:

Theory of operation

- Performance testing
- Maintenance
- Calibration
- Troubleshooting
- Parts lists
- Schematics

1-9. Wideband Module (Option 5790A-03)

To measure ac voltage in the 1 to 30 MHz range, the 5790A requires the 5790A-03 Wideband Module. Instructions for operating the 5790A in wideband mode are provided in Section 4, and specifications for wideband operation are provided at the end of this section.

The WIDEBAND input presents a 50Ω load to the source. Signals accepted are from 700 μV to 7 V over a frequency range of 10 Hz to 30 MHz. Only the lower eight 5790A voltage ranges are used by the WIDEBAND input.

Use the WIDEBAND input to measure the frequency flatness of 50Ω signal sources such as the 5700A WIDEBAND output. You can use the delta display to show the error of the source in ppm as you sweep the source through the WIDEBAND input frequency range.

1-10. Current Shunt Adapters

Accessory 5790A-7001 allows you to connect Fluke A40 or A40A Current Shunts the 5790A SHUNT input for making current transfers up to 20 A. Accessory 792A-7004 allows you to connect Fluke A40 Current Shunts to the INPUT 1 Type "N" connector for making current transfers up to 5 A.

1-11. Warranty and Service Information

Each 5790A is warranted for a period of 1 year on delivery to the original purchaser. The warranty is printed on the reverse side of the title page of this manual.

Factory authorized service for the 5790A is available at selected Technical Service Centers. For warranty or after-warranty service, contact the nearest Technical Service Center for instructions. A complete list of Technical Service Centers is provided in Appendix D.

To reship the 5790A, use its original shipping carton. If the original carton is not available, use a container that provides adequate protection during shipment. Protect the 5790A with at least three inches of shock-absorbing material on all sides of the container. Do not use loose fill to pad the shipping container. Loose fill allows the instrument to settle to one corner of the shipping container, which could result in damage during shipment.

1-12. Specifications

Specifications are valid after allowing a warm-up period of 30 minutes, or twice the time the 5790A has been turned off, whichever is less. For example, if the 5790A has been turned off for 5 minutes, the warm-up period is 10 minutes. To simplify evaluation of how the 5790A covers you workload, use the Absolute Uncertainty Specification. Those include stability, temperature coefficient, linearity, and traceability to external standards.

Note

When you use the 5790A within ±5 °C of the temperature of the last calibration, you do not need to add anything to the Absolute Uncertainty Specifications to determine the ratios between 5790A uncertainties and the uncertainties of a unit under test. The initial calibration at Fluke is done at 23 °C. (You can verify the temperature of the last calibration at any time by pressing the [SPEC] key.)

Use the Relative Uncertainty Specifications if you use a different procedure to calibrate the 5790A than is specified in the 5790A Service Manual. To calculate absolute uncertainty specifications under such conditions, combine the absolute uncertainty associated with your external equipment and calibration procedures with the Relative Uncertainty Specifications. Secondary Performance and Operating Characteristics are provided for special calibration requirements such as stability or operation at temperature extremes.

Absolute Uncertainty Specifications

± 5 °C of Calibration Temperature

Voltage Range	Frequency Range	AC/DC Transfer Mode ± ppm 2 Years	Absolute Uncertainty		
			Measurement Mode ± (ppm of Reading + µV)		
			90 Days	1 Year	2 Years
2.2 mV	10 Hz - 20 Hz		1700 + 1.3	1700 + 1.3	1700 + 1.3
	20 Hz- 40 Hz		740 + 1.3	740 + 1.3	740 + 1.3
	40 Hz - 20 kHz		420 + 1.3	420 + 1.3	420 + 1.3
	20 kHz - 50 kHz		810 + 2.0	810 + 2.0	820 + 2.0
	50 kHz - 100 kHz		1200 + 2.5	1200 + 2.5	1200 + 2.5
	100 kHz - 300 kHz		2300 + 4.0	2300 + 4.0	2300 + 4.0
	300 kHz - 500 kHz		2400 + 6.0	2400 + 8.0	2600 + 8.0
	500 kHz - 1 MHz		3200 + 6.0	3500 + 8.0	5000 + 8.0
7 mV	10 Hz - 20 Hz		850 + 1.3	850 + 1.3	850 + 1.3
	20 Hz - 40 Hz		370 + 1.3	370 + 1.3	370 + 1.3
	40 Hz - 20 kHz		210 + 1.3	210 + 1.3	210 + 1.3
	20 kHz - 50 kHz		400 + 2.0	400 + 2.0	410 + 2.0
	50 kHz - 100 kHz		600 + 2.5	600 + 2.5	610 + 2.5
	100 kHz - 300 kHz		1200 + 4.0	1200 + 4.0	1200 + 4.0
	300 kHz - 500 kHz		1300 + 6.0	1300 + 8.0	1400 + 8.0
	500 kHz - 1 MHz		2000 + 6.0	2300 + 8.0	3600 + 8.0
22 mV	10 Hz - 20 Hz		290 + 1.3	290 + 1.3	290 + 1.3
	20 Hz - 40 Hz		180 + 1.3	190 + 1.3	190 + 1.3
	40 Hz - 20 kHz		110 + 1.3	110 + 1.3	110 + 1.3
	20 kHz - 50 kHz		210 + 2.0	210 + 2.0	210 + 2.0
	50 kHz - 100 kHz		310 + 2.5	310 + 2.5	310 + 2.5
	100 kHz - 300 kHz		810 + 4.0	810 + 4.0	820 + 4.0
	300 kHz - 500 kHz		860 + 6.0	890 + 8.0	1000 + 8.0
	500 kHz - 1 MHz		1400 + 6.0	1700 + 8.0	2600 + 8.0
70 mV	10 Hz - 20 Hz[1]		240 + 1.5	240 + 1.5	240 + 1.5
	20 Hz - 40 Hz		120 + 1.5	120 + 1.5	130 + 1.5
	40 Hz - 20 kHz		64 + 1.5	65 + 1.5	69 + 1.5
	20 kHz - 50 kHz		120 + 2.0	130 + 2.0	130 + 2.0
	50 kHz - 100 kHz		260 + 2.5	260 + 2.5	260 + 2.5
	100 kHz - 300 kHz		510 + 4.0	510 + 4.0	530 + 4.0
	300 kHz - 500 kHz		660 + 6.0	670 + 8.0	680 + 8.0
	500 kHz - 1 MHz		1100 + 6.0	1100 + 8.0	1300 + 8.0
220 mV	10 Hz - 20 Hz[1]	210	210 + 1.5	210 + 1.5	210 + 1.5
	20 Hz - 40 Hz	82	84 + 1.5	85 + 1.5	87 + 1.5
	40 Hz - 20 kHz	34	37 + 1.5	38 + 1.5	43 + 1.5
	20 kHz - 50 kHz	67	69 + 2.0	69 + 2.0	73 + 2.0
	50 kHz - 100 kHz		160 + 2.5	160 + 2.5	160 + 2.5
	100 kHz - 300 kHz		240 + 4.0	250 + 4.0	280 + 4.0
	300 kHz - 500 kHz		360 + 6.0	380 + 8.0	400 + 8.0
	500 kHz - 1 MHz		940 + 6.0	1000 + 8.0	1200 + 8.0
700 mV	10 Hz - 20 Hz[1]	210	210 + 1.5	210 + 1.5	210 + 1.5
	20 Hz - 40 Hz	73	75 + 1.5	76 + 1.5	78 + 1.5
	40 Hz - 20 kHz	27	31 + 1.5	33 + 1.5	38 + 1.5
	20 kHz - 50 kHz	47	50 + 2.0	51 + 2.0	56 + 2.0
	50 kHz - 100 kHz		79 + 2.5	79 + 2.5	84 + 2.5
	100 kHz - 300 kHz		160 + 4.0	180 + 4.0	210 + 4.0
	300 kHz - 500 kHz		300 + 6.0	300 + 8.0	340 + 8.0
	500 kHz - 1 MHz		900 + 6.0	960 + 8.0	1200 + 8.0

[1]For 9.5 to 10 Hz, the specifications is ± (1000 ppm of reading + 1.5 µV)

Absolute Uncertainty Specifications (cont.)

± 5 °C of Calibration Temperature

Voltage Range	Frequency Range	AC/DC Transfer Mode ± ppm 2 Years	Absolute Uncertainty		
			Measurement Mode ± (ppm of Reading)		
			90 Days	1 Year	2 Years
2.2 V	10 Hz - 20 Hz[2]	200	200	200	200
	20 Hz - 40 Hz	63	65	66	69
	40 Hz - 20 kHz	18	22	24	29
	20 kHz - 50 kHz	43	45	46	52
	50 kHz - 100 kHz		70	71	76
	100 kHz - 300 kHz		150	160	200
	300 kHz - 500 kHz		250	260	310
	500 kHz - 1 MHz		840	900	1200
7 V	10 Hz - 20 Hz[2]	200	200	200	200
	20 Hz - 40 Hz	63	66	67	70
	40 Hz - 20 kHz	18	22	24	29
	20 kHz - 50 kHz	44	46	48	53
	50 kHz - 100 kHz		80	81	88
	100 kHz - 300 kHz		180	190	220
	300 kHz - 500 kHz		380	400	470
	500 kHz - 1 MHz		1100	1200	1500
22 V	10 Hz - 20 Hz[2]	200	200	200	200
	20 Hz - 40 Hz	63	66	67	70
	40 Hz - 20 kHz	21	25	27	31
	20 kHz - 50 kHz	44	46	48	53
	50 kHz - 100 kHz		80	81	85
	100 kHz - 300 kHz		180	190	220
	300 kHz - 500 kHz		380	400	470
	500 kHz - 1 MHz		1100	1200	1500
70 V	10 Hz - 20 Hz[2]	200	200	200	200
	20 Hz - 40 Hz	63	67	68	72
	40 Hz - 20 kHz	25	30	32	39
	20 kHz - 50 kHz	55	56	57	63
	50 kHz - 100 kHz		91	94	110
	100 kHz - 300 kHz		190	200	220
	300 kHz - 500 kHz		400	410	510
	500 kHz - 1 MHz		1100	1200	1500
220 V	10 Hz - 20 Hz	200	200	200	200
	20 Hz - 40 Hz	63	67	68	72
	40 Hz - 20 kHz	23	29	31	38
	20 kHz - 50 kHz	63	67	69	77
	50 kHz - 100 kHz		96	98	110
	100 kHz - 300 kHz		210	210	260
	300 kHz - 500 kHz		440	500	700
700 V	10 Hz - 20 Hz	200	200	200	200
	20 Hz - 40 Hz	92	96	99	110
	40 Hz - 20 kHz	36	39	41	47
	20 kHz - 50 kHz		120	130	150
	50 kHz - 100 kHz		400	500	850
1000 V	10 Hz - 20 Hz	200	200	200	200
	20 Hz - 40 Hz	92	96	99	110
	40 Hz - 20 kHz	33	37	38	44
	20 kHz - 50 kHz		120	130	150
	50 kHz - 100 kHz		400	500	850

[2]For 9.5 to 10 Hz, the specifications is ± (1000 ppm of reading)

Relative Uncertainty Specifications

± 5 °C of Calibration Temperature

Voltage Range	Frequency Range	AC/DC Transfer Mode ± ppm 2 Years	Relative Uncertainty		
			Measurement Mode ± (ppm of Reading + µV)		
			90 Days	1 Year	2 Years
2.2 mV	10 Hz - 20 Hz		100 + 1.3	110 + 1.3	110 + 1.3
	20 Hz - 40 Hz		54 + 1.3	64 + 1.3	68 + 1.3
	40 Hz - 20 kHz		44 + 1.3	57 + 1.3	61 + 1.3
	20 kHz - 50 kHz		57 + 2.0	67 + 2.0	110 + 2.0
	50 kHz - 100 kHz		79 + 2.5	86 + 2.5	120 + 2.5
	100 kHz - 300 kHz		190 + 4.0	230 + 4.0	390 + 4.0
	300 kHz - 500 kHz		590 + 6.0	720 + 8.0	1200 + 8.0
	500 kHz - 1 MHz		2200 + 6.0	2600 + 8.0	4400 + 8.0
7 mV	10 Hz - 20 Hz		80 + 1.3	83 + 1.3	86 + 1.3
	20 Hz - 40 Hz		33 + 1.3	39 + 1.3	45 + 1.3
	40 Hz - 20 kHz		29 + 1.3	36 + 1.3	42 + 1.3
	20 kHz - 50 kHz		40 + 2.0	4 + 2.0	63 + 2.0
	50 kHz - 100 kHz		53 + 2.5	57 + 2.5	72 + 2.5
	100 kHz - 300 kHz		110 + 4.0	130 + 4.0	210 + 4.0
	300 kHz - 500 kHz		370 + 6.0	450 + 8.0	740 + 8.0
	500 kHz - 1 MHz		1600 + 6.0	2000 + 8.0	3400 + 8.0
22 mV	10 Hz - 20 Hz		69 + 1.3	72 + 1.3	75 + 1.3
	20 Hz - 40 Hz		34 + 1.3	40 + 1.3	46 + 1.3
	40 Hz - 20 kHz		30 + 1.3	36 + 1.3	43 + 1.3
	20 kHz - 50 kHz		40 + 2.0	45 + 2.0	64 + 2.0
	50 kHz - 100 kHz		53 + 2.5	57 + 2.5	73 + 2.5
	100 kHz - 300 kHz		97 + 4.0	110 + 4.0	160 + 4.0
	300 kHz - 500 kHz		310 + 6.0	380 + 8.0	610 + 8.0
	500 kHz - 1 MHz		1200 + 6.0	1500 + 8.0	2500 + 8.0
70 mV	10 Hz - 20 Hz		60 + 1.5	61 + 1.5	62 + 1.5
	20 Hz - 40 Hz		27 + 1.5	30 + 1.5	37 + 1.5
	40 Hz - 20 kHz		22 + 1.5	25 + 1.5	34 + 1.5
	20 kHz - 50 kHz		34 + 2.0	36 + 2.0	44 + 2.0
	50 kHz - 100 kHz		53 + 2.5	54 + 2.5	62 + 2.5
	100 kHz - 300 kHz		110 + 4.0	120 + 4.0	170 + 4.0
	300 kHz - 500 kHz		270 + 6.0	290 + 8.0	320 + 8.0
	500 kHz - 1 MHz		910 + 6.0	970 + 8.0	1200 + 8.0
220 mV	10 Hz - 20 Hz	55	60 + 1.5	61 + 1.5	62 + 1.5
	20 Hz - 40 Hz	20	27 + 1.5	29 + 1.5	35 + 1.5
	40 Hz - 20 kHz	17	22 + 1.5	24 + 1.5	31 + 1.5
	20 kHz - 50 kHz	17	22 + 2.0	24 + 2.0	33 + 2.0
	50 kHz - 100 kHz		51 + 2.5	52 + 2.5	59 + 2.5
	100 kHz - 300 kHz		100 + 4.0	120 + 4.0	170 + 4.0
	300 kHz - 500 kHz		260 + 6.0	290 + 8.0	310 + 8.0
	500 kHz - 1 MHz		890 + 6.0	950 + 8.0	1200 + 8.0
700 mV	10 Hz - 20 Hz	55	60 + 1.5	61 + 1.5	62 + 1.5
	20 Hz - 40 Hz	20	27 + 1.5	29 + 1.5	34 + 1.5
	40 Hz - 20 kHz	15	22 + 1.5	24 + 1.5	31 + 1.5
	20 kHz - 50 kHz	15	22 + 2.0	24 + 2.0	33 + 2.0
	50 kHz - 100 kHz		51 + 2.5	52 + 2.5	59 + 2.5
	100 kHz - 300 kHz		100 + 4.0	120 + 4.0	170 + 4.0
	300 kHz - 500 kHz		260 + 6.0	270 + 8.0	310 + 8.0
	500 kHz - 1 MHz		890 + 6.0	950 + 8.0	1200 + 8.0

Relative Uncertainty Specifications

± 5 °C of Calibration Temperature (cont)

Voltage Range	Frequency Range	AC/DC Transfer Mode ± ppm 2 Years	Relative Uncertainty		
			Measurement Mode ± (ppm of Reading + µV)		
			90 Days	1 Year	2 Years
2.2 V	10 Hz - 20 Hz	55	60	61	62
	20 Hz - 40 Hz	19	26	28	34
	40 Hz - 20 kHz	15	20	22	27
	20 kHz - 50 kHz	15	21	23	33
	50 kHz - 100 kHz		49	50	57
	100 kHz - 300 kHz		92	110	160
	300 kHz - 500 kHz		220	230	280
	500 kHz - 1 MHz		830	890	1200
7 V	10 Hz - 20 Hz	55	60	61	62
	20 Hz - 40 Hz	19	27	29	36
	40 Hz - 20 kHz	15	20	22	27
	20 kHz - 50 kHz	18	23	26	35
	50 kHz - 100 kHz		62	64	73
	100 kHz - 300 kHz		140	150	180
	300 kHz - 500 kHz		360	380	450
	500 kHz - 1 MHz		1100	1200	1500
22 V	10 Hz - 20 Hz	55	60	61	62
	20 Hz - 40 Hz	19	28	30	37
	40 Hz - 20 kHz	15	20	22	27
	20 kHz - 50 kHz	18	23	26	35
	50 kHz - 100 kHz		62	64	69
	100 kHz - 300 kHz		140	150	180
	300 kHz - 500 kHz		360	380	450
	500 kHz - 1 MHz		1100	1200	1500
70 V	10 Hz - 20 Hz	55	60	62	63
	20 Hz - 40 Hz	19	29	31	39
	40 Hz - 20 kHz	15	23	25	34
	20 kHz - 50 kHz	22	25	27	39
	50 kHz - 100 kHz		64	68	85
	100 kHz - 300 kHz		140	150	180
	300 kHz - 500 kHz		370	390	490
	500 kHz - 1 MHz		1100	1200	1500
220 V	10 Hz - 20 Hz	55	61	62	64
	20 Hz - 40 Hz	19	30	32	40
	40 Hz - 20 kHz	15	23	25	34
	20 kHz - 50 kHz	24	30	34	49
	50 kHz - 100 kHz		66	69	83
	100 kHz - 300 kHz		160	170	220
	300 kHz - 500 kHz		410	480	680
700 V	10 Hz - 20 Hz	55	62	63	65
	20 Hz - 40 Hz	19	31	33	41
	40 Hz - 20 kHz	19	24	25	31
	20 kHz - 50 kHz		100	110	140
	50 kHz - 100 kHz		390	500	850
1000 V	10 Hz - 20 Hz	55	62	63	65
	20 Hz - 40 Hz	19	31	33	41
	40 Hz - 20 kHz	19	24	25	31
	20 kHz - 50 kHz		100	110	140
	50 kHz - 100 kHz		390	500	850

Secondary Performance and Operating Characteristics

Voltage Range	Frequency Range	24 Hour AC Stability ± 1 °C Slow Filter Peak-Peak ± μV	Temperature Coefficient [1]		Input Resistance [2]
			10 °C to 40 °C	0 °C to 10 °C 40 °C to 50 °C	
			ppm / °C		
2.2 mV	10 Hz - 20 Hz	0.4	50	50	>10 MΩ
	20 Hz - 40 Hz	0.4	50	50	
	40 Hz - 20 kHz	0.4	50	50	
	20 kHz - 50 kHz	0.4	50	50	
	50 kHz - 100 kHz	0.8	75	75	
	100 kHz - 300 kHz	1.5	100	100	
	300 kHz - 500 kHz	3.0	150	150	
	500 kHz - 1 MHz	4.5	200	200	
7 mV	10 Hz - 20 Hz	0.4	15	15	>10 MΩ
	20 Hz - 40 Hz	0.4	15	15	
	40 Hz - 20 kHz	0.4	15	15	
	20 kHz - 50 kHz	0.4	15	15	
	50 kHz - 100 kHz	0.8	25	25	
	100 kHz - 300 kHz	1.5	60	60	
	300 kHz - 500 kHz	3.0	80	80	
	500 kHz - 1 MHz	4.5	125	125	
22 mV	10 Hz - 20 Hz	0.4	5	5	>10 MΩ
	20 Hz - 40 Hz	0.4	5	5	
	40 Hz - 20 kHz	0.4	5	5	
	20 kHz - 50 kHz	0.4	5	5	
	50 kHz - 100 kHz	0.8	8	8	
	100 kHz - 300 kHz	1.5	10	10	
	300 kHz - 500 kHz	3.0	40	40	
	500 kHz - 1 MHz	4.5	100	100	
	± (ppm of Reading)				
70 mV	10 Hz - 20 Hz	18	5	5	>10 MΩ
	20 Hz - 40 Hz	18	5	5	
	40 Hz - 20 kHz	18	5	5	
	20 kHz - 50 kHz	18	5	5	
	50 kHz - 100 kHz	24	8	8	
	100 kHz - 300 kHz	24	10	10	
	300 kHz - 500 kHz	48	30	30	
	500 kHz - 1 MHz	150	75	75	
220 mV	10 Hz - 20 Hz	12	1.5	3.0	>10 MΩ
	20 Hz - 40 Hz	8	1.5	3.0	
	40 Hz - 20 kHz	8	1.5	3.0	
	20 kHz - 50 kHz	8	2.0	3.0	
	50 kHz - 100 kHz	18	5.0	8.0	
	100 kHz - 300 kHz	24	10.0	10.0	
	300 kHz - 500 kHz	36	20.0	20.0	
	500 kHz - 1 MHz	120	50.0	50.0	

Secondary Performance and Operating Characteristics (cont)

Voltage Range	Frequency Range	24 Hour AC Stability ± 1 °C Slow Filter ± (ppm of Reading)	Temperature Coefficient [1]		Input Resistance [2]
			10 °C to 40 °C	0 °C to 10 °C 40 °C to 50 °C	
			ppm / °C		
700 mV	10 Hz - 20 Hz	8	1.5	3.0	>10 MΩ
	20 Hz - 40 Hz	6	1.5	3.0	
	40 Hz - 20 kHz	6	1.5	3.0	
	20 kHz - 50 kHz	6	2.0	3.0	
	50 kHz - 100 kHz	12	5.0	8.0	
	100 kHz - 300 kHz	18	10.0	10.0	
	300 kHz - 500 kHz	36	20.0	20.0	
	500 kHz - 1 MHz	96	50.0	50.0	
2.2 V	10 Hz - 20 Hz	8	1.5	3.0	>10 MΩ
	20 Hz - 40 Hz	5	1.5	3.0	
	40 Hz - 20 kHz	5	1.5	3.0	
	20 kHz - 50 kHz	5	2.0	3.0	
	50 kHz - 100 kHz	10	5.0	8.0	
	100 kHz - 300 kHz	18	10.0	10.0	
	300 kHz - 500 kHz	30	20.0	20.0	
	500 kHz - 1 MHz	90	50.0	50.0	
7 V	10 Hz - 20 Hz	8	1.5	3.0	50 kΩ
	20 Hz - 40 Hz	5	1.5	3.0	
	40 Hz - 20 kHz	5	1.5	3.0	
	20 kHz - 50 kHz	5	2.0	3.0	
	50 kHz - 100 kHz	10	5.0	8.0	
	100 kHz - 300 kHz	18	15.0	15.0	
	300 kHz - 500 kHz	30	30.0	30.0	
	500 kHz - 1 MHz	90	65.0	65.0	
22 V	10 Hz - 20 Hz	8	1.5	3.0	50 kΩ
	20 Hz - 40 Hz	5	1.5	3.0	
	40 Hz - 20 kHz	5	1.5	3.0	
	20 kHz - 50 kHz	5	2.0	3.0	
	50 kHz - 100 kHz	10	5.0	8.0	
	100 kHz - 300 kHz	18	15.0	15.0	
	300 kHz - 500 kHz	30	30.0	30.0	
	500 kHz - 1 MHz	90	65.0	65.0	
70 V	10 Hz - 20 Hz	8	1.5	3.0	50 kΩ
	20 Hz - 40 Hz	5	1.5	3.0	
	40 Hz - 20 kHz	5	1.5	3.0	
	20 kHz - 50 kHz	5	2.0	3.0	
	50 kHz - 100 kHz	18	5.0	8.0	
	100 kHz - 300 kHz	36	15.0	15.0	
	300 kHz - 500 kHz	48	40.0	40.0	
	500 kHz - 1 MHz	120	75.0	75.0	

Secondary Performance and Operating Characteristics (cont)

Voltage Range	Frequency Range	24 Hour AC Stability ± 1 °C Slow Filter ± (ppm of Reading)	Temperature Coefficient [1]		Input Resistance [2]
			10 °C to 40 °C	0 °C to 10 °C 40 °C to 50 °C	
			PPM / °C		
220 V	10 Hz - 20 Hz	8	1.5	3.0	50 kΩ
	20 Hz - 40 Hz	5	1.5	3.0	
	40 Hz - 20 kHz	5	1.5	3.0	
	20 kHz - 50 kHz	5	2.0	3.0	
	50 kHz - 100 kHz	18	5.0	8.0	
	100 kHz - 300 kHz	36	15.0	15.0	
	300 kHz - 500 kHz	48	40.0	40.0	
700 V	10 Hz - 20 Hz	8	1.5	4.0	500 kΩ
	20 Hz - 40 Hz	5	1.5	4.0	
	40 Hz – 20 kHz	5	1.5	4.0	
	20 kHz – 50 kHz	18	5.0	7.0	
	50 kHz - 100 kHz	36	15.0	15.0	
1000 V	10 Hz - 20 Hz	8	1.5	4.0	500 kΩ
	20 Hz - 40 Hz	5	1.5	4.0	
	40 Hz - 20 kHz	5	1.5	4.0	
	20 kHz - 50 kHz	18	5.0	7.0	
	50 kHz - 100 kHz	36	15.0	15.0	

[1]   Add to uncertainty when more than 5 °C from calibration temperature.

[2]   Input capacitance approximately 100 pF.

Resolution and Range Limits

Voltage Range	Autorange Limits [1]		Resolution	
	Upper	Lower	Filter Fast	Filter Med/Slow
2.2 mV	2.2 mV	600 µV	0.1 µV	0.1 µV
7 mV	7 mV	1.9 mV	0.1 µV	0.1 µV
22 mV	22 mV	6 mV	0.1 µV	0.1 µV
70 mV	70 mV	19 mV	0.1 µV	0.1 µV
220 mV	220 mV	60 mV	0.1 µV	0.1 µV
700 mV	700 mV	190 mV	1.0 µV	0.1 µV
2.2 V	2.2 V	600 mV	1.0 µV	0.1 µV
7 V	7 V	1.9 V	10 µV	1.0 µV
22 V	22 V	6 V	10 µV	1.0 µV
70 V	70 V	19 V	100 µV	10 µV
220 V	220 V	60 V	100 µV	10 µV
700 V	700 V	190 V	1.0 mV	100 µV
1000 V	1050 V	600 V	1.0 mV	100 µV

[1]   In locked ranges, readings may be made approximately 1 % beyond the autorange limits.

More Secondary Performance and Operating Characteristics

Maximum Non-destructive Input .... 1200 V rms

Guard Isolation... 10 V peak

Volt-Hertz Product.. 1×10^8

Frequency Accuracy (from 0 °C to 50 °C)

    10 Hz - 120 Hz.. 100 ppm + 10 digits

    Above 120 Hz .... 100 ppm + 2 digits

Frequency Resolution .... 1.00 Hz to 119.99 Hz

                                                             0.1200 kHz to 1.1999 kHz

                                                             1.200 kHz to 11.999 kHz

                                                              12.00 kHz to 119.99 kHz

                                                              0.1200 MHz to 1.0000 MHz

                                                              1.000 MHz to 1.1999 MHz (Wideband only)

                                                              1.200 MHz to 11.999 MHz (Wideband only)

                                                              12.00 MHz to 30.0 Mhz (Wideband only

Reading Rate

    <40 Hz .... 2 seconds per reading

    40 Hz .... 2 seconds decreasing linearly to 1 second at 200 Hz

    >200 Hz .... 1 second per reading

Maximum Settling Time to Full Specifications (in range lock)

    Filter Off .... 1 sample

        dc .... 6 seconds

        <200 Hz .... 8 seconds

        >200 Hz .... 4 seconds

    Filter Fast .... 4 averaged samples

        dc .... 10 seconds

        <200 Hz .... 16 seconds

        >200 Hz .... 8 seconds

    Filter Medium .... 16 averaged samples

        dc .... 22 seconds

        <200 Hz .... 32 seconds

        >200 Hz .... 16 seconds

    Filter Slow .... 32 averaged samples

        dc .... 40 seconds

        <200 Hz .... 64 seconds

        >200 Hz .... 32 seconds

Filter Buffer Restart Limits:

    Fine: Fast: 10 counts

        Medium/Slow

            <220 mV .... 10 counts

            >220 mV .... 100 counts

    Medium: Fast: 100 counts

        Medium/Slow

            <220 mV .... 100 counts

            >220 mV .... 1000 counts

    Course: Fast: 1000 counts

        Medium/Slow

            <220 mV .... 1000 counts

            >220 mV .... 10000 counts

Input Waveform... Specified for sinewave with THD less than 1%

Wideband Uncertainty Specifications (Option -03)

Voltage [1] Range	Frequency Range	Flatness [2] 1 year ± 3 °C ± (% of Reading + μV)	Flatness [3] Temperature Coefficient ppm / °C	Absolute Uncertainty 0 °C to 50 °C [4] ± (% of Reading + μV)			Resolution
				90 Days	1 Year	2 Years	
2.2 mV	10 Hz - 30 Hz	0.10 + 0	75	0.5 + 1.2	0.6 + 1.5	0.8 + 2	0.1 μV
	30 Hz - 120 Hz	0.05 + 0	75	0.5 + 1.2	0.6 + 1.5	0.8 + 2	
	120 Hz - 1.2 kHz	0.05 + 0	75	0.5 + 1.2	0.6 + 1.5	0.8 + 2	
	1.2 kHz - 120 kHz	0.05 + 0	75	0.5 + 1.2	0.6 + 1.5	0.8 + 2	
	120 kHz - 500 kHz	0.07 + 1	75	0.5 + 1.2	0.6 + 1.5	0.8 + 2	
	500 kHz - 1.2 MHz	0.07 + 1	75				
	1.2 MHz - 2 MHz	0.07 + 1	100				
	2 MHz - 10 MHz	0.17 + 1	200				
	10 MHz - 20 MHz	0.30 + 1	200				
	20 MHz - 30 MHz	0.70 + 2	400				
7 mV	10 Hz - 30 Hz	0.10 + 0	75	0.4 + 5	0.5 + 7	0.7 + 8	0.1 μV
	30 Hz - 120 Hz	0.05 + 0	75	0.4 + 5	0.5 + 7	0.7 + 8	
	120 Hz - 1.2 kHz	0.05 + 0	75	0.4 + 5	0.5 + 7	0.7 + 8	
	1.2 kHz - 120 kHz	0.05 + 0	75	0.4 + 5	0.5 + 7	0.7 + 8	
	120 kHz - 500 kHz	0.07 + 1	75	0.4 + 5	0.5 + 7	0.7 + 8	
	500 kHz - 1.2 MHz	0.07 + 1	75				
	1.2 MHz - 2 MHz	0.07 + 1	100				
	2 MHz - 10 MHz	0.1 + 1	200				
	10 MHz - 20 MHz	0.17 + 1	200				
	20 MHz - 30 MHz	0.37 + 1	300				
22 mV	10 Hz - 30 Hz	0.10	75	0.4 + 10	0.5 + 13	0.7 + 16	0.1 μV
	30 Hz - 120 Hz	0.05	75	0.4 + 10	0.5 + 13	0.7 + 16	
	120 Hz - 1.2 kHz	0.05	75	0.4 + 10	0.5 + 13	0.7 + 16	
	1.2 kHz - 120 kHz	0.05	75	0.4 + 10	0.5 + 13	0.7 + 16	
	120 kHz - 500 kHz	0.07	75	0.4 + 10	0.5 + 13	0.7 + 16	
	500 kHz - 1.2 MHz	0.07	75				
	1.2 MHz - 2 MHz	0.07	75				
	2 MHz - 10 MHz	0.1	100				
	10 MHz - 20 MHz	0.17	100				
	20 MHz - 30 MHz	0.37	200				
70 mV	10 Hz - 30 Hz	0.10	40	0.4 + 20	0.5 + 30	0.6 + 40	1.0 μV
	30 Hz – 120 Hz	0.05	40	0.4 + 20	0.5 + 30	0.6 + 40	
	120 Hz - 1.2 kHz	0.05	40	0.4 + 20	0.5 + 30	0.6 + 40	
	1.2 kHz - 120 kHz	0.05	40	0.4 + 20	0.5 + 30	0.6 + 40	
	120 kHz - 500 kHz	0.05	40	0.4 + 20	0.5 + 30	0.6 + 40	
	500 kHz - 1.2 MHz	0.05	40				
	1.2 MHz - 2 MHz	0.05	75				
	2 MHz - 10 MHz	0.1	100				
	10 MHz - 20 MHz	0.15	100				
	20 MHz - 30 MHz	0.35	200				
220 mV	10 Hz - 30 Hz	0.10	40	0.3 + 60	0.4 + 80	0.5 + 100	1.0 μV
	30 Hz - 120 Hz	0.04	40	0.3 + 60	0.4 + 80	0.5 + 100	
	120 Hz - 1.2 kHz	0.04	40	0.3 + 60	0.4 + 80	0.5 + 100	
	1.2 kHz - 120 kHz	0.04	40	0.3 + 60	0.4 + 80	0.5 + 100	
	120 kHz - 500 kHz	0.04	40	0.3 + 60	0.4 + 80	0.5 + 100	
	500 kHz - 1.2 MHz	0.05	40				
	1.2 MHz - 2 MHz	0.05	75				
	2 MHz - 10 MHz	0.1	100				
	10 MHz - 20 MHz	0.15	100				
	20 MHz - 30 MHz	0.35	200				

Wideband Uncertainty Specifications (Option -03) (cont)

Voltage [1] Range	Frequency Range	Flatness [2] 1 year ± 3 °C ± (% of Reading + μV)	Flatness [3] Temperature Coefficient ppm / °C	Absolute Uncertainty 0 °C to 50 °C [4] ± (% of Reading + μV)			Resolution
				90 Days	1 Year	2 Years	
700 mV	10 Hz - 30 Hz	0.10	40	0.3 + 200	0.4 + 300	0.5 + 400	10.0 μV
	30 Hz - 120 Hz	0.03	40	0.3 + 200	0.4 + 300	0.5 + 400	
	120 Hz - 1.2 kHz	0.03	40	0.3 + 200	0.4 + 300	0.5 + 400	
	1.2 kHz - 120 kHz	0.03	40	0.3 + 200	0.4 + 300	0.5 + 400	
	120 kHz - 500 kHz	0.03	40	0.3 + 200	0.4 + 300	0.5 + 400	
	500 kHz - 1.2 MHz	0.05	40				
	1.2 MHz - 2 MHz	0.05	75				
	2 MHz - 10 MHz	0.1	100				
	10 MHz - 20 MHz	0.15	100				
	20 MHz - 30 MHz	0.35	200				
2.2 V	10 Hz - 30 Hz	0.10	40	0.3 + 300	0.35 + 400	0.4 + 500	10.0 μV
	30 Hz - 120 Hz	0.03	40	0.3 + 300	0.35 + 400	0.4 + 500	
	120 Hz - 1.2 kHz	0.03	40	0.3 + 300	0.35 + 400	0.4 + 500	
	1.2 kHz - 120 kHz	0.03	40	0.3 + 300	0.35 + 400	0.4 + 500	
	120 kHz - 500 kHz	0.03	40	0.3 + 300	0.35 + 400	0.4 + 500	
	500 kHz - 1.2 MHz	0.05	40				
	1.2 MHz - 2 MHz	0.05	75				
	2 MHz - 10 MHz	0.1	100				
	10 MHz - 20 MHz	0.15	100				
	20 MHz - 30 MHz	0.35	200				
7 V	10 Hz - 30 Hz	0.10	40	0.3 + 500	0.35 + 800	0.4 + 1000	100.0 μV
	30 Hz - 120 Hz	0.03	40	0.3 + 500	0.35 + 800	0.4 + 1000	
	120 Hz - 1.2 kHz	0.03	40	0.3 + 500	0.35 + 800	0.4 + 1000	
	1.2 kHz - 120 kHz	0.03	40	0.3 + 500	0.35 + 800	0.4 + 1000	
	120 kHz - 500 kHz	0.03	40	0.3 + 500	0.35 + 800	0.4 + 1000	
	500 kHz - 1.2 MHz	0.05	40				
	1.2 MHz - 2 MHz	0.05	75				
	2 MHz - 10 MHz	0.1	100				
	10 MHz - 20 MHz	0.15	100				
	20 MHz - 30 MHz	0.35	200				

[1] Range limits same as INPUT 1 or INPUT 2.

[2] Relative to 1 kHz, for 2-year specification multiply by 1.5.

[3] Add to flatness specifications when more than 3 °C from calibration temperature.

[4] At input connector.

Wideband Characteristics

Maximum Non-Destructive Input.........................200 V rms

Guard Isolation..0.5 V peak

Input Impedance

    1 kHz...50Ω (± 0.5 %)

    30 MHz ....50Ω (± 5 %)

Wideband VSWR with 50 Ω Source

    1 kHz...50 Ω (± 0.5 %)

    30 MHz ....50 Ω (± 5 %)

Shunt Input Characteristics

- The shunt input was designed to allow ac/dc current transfers using the Fluke A40 Series current shunts.

- 5790A-7001 A40/A40A Current Shunt Adapter and Cable required.

Shunt Model Current Range

A40 .... 2.5 mA - 5A

A40A .... 5A - 20A

Input Resistance .... 91 $\Omega \pm 1$ %

Operating Input Voltage .... 250 mV to 500 mV

Maximum Non-Destructive Input .... 50V rms

General Specifications

Warm-up Time .... 30 minutes

Relative Humidity

    Operating .... 45 % to 50 °C 75 % to 45 °C 95 % to 30 °C

    Storage .... <95 % non-condensing

Altitude

    Operating .... 3,050 meters (10,000 feet)

    Non-Operating .... 12,200 meters (40,000 feet)

Temperature

    Operating .... 0 °C to 50 °C

    Calibration .... 15 °C to 35 °C

    Storage .... 40 °C to 70 °C

EMI/RFI

    Complies with .... FCC Part 15 Subpart B, Class B; VDE 0871, Class B; ESD: EIA PN-1361.

Surge .... ANSI C62.41-1980, Category A

Reliability .... MIL-T-2880D, paragraph 3.13.3

Size

    Height .... 17.8 cm (7 in) standard rackmount + 1.5 cm (0.6 in)

    Width .... 43.2 cm (17 in)

    Depth .... 63 cm (24.8 in)

Maximum Power Requirements

    5790A .... 95 VA

    With Wideband Option .... 120 VA

Weight

    5790A .... 24 kg (53 lb)

    With Wideband .... 24.5 kg (54 lb)

Line Power .... 47 Hz to 63 Hz; $\pm$ 10 % of selectable line voltages: 100 V, 110 V, 115 V, 120 V, 200 V, 220 V, 230 V, 240 V

Safety .... Complies with UL1244 and IEC 348-1976 and IEC 1010 and CSA C22.2 No. 231 and ANSI/ISA S82

Remote Interfaces RS-232, IEEE-488

43 cm (17.0 in)

17.8 cm (7.0 in)

63 cm (24.8 in)

6.35 cm (2.5 in)

FOR CABLE
ACCESS
(REAR)

add1f.eps

Figure 1-1. Dimensions

Chapter 2
Installation

⚠️⚠️**Warning**

To avoid electric shock and to conform to IEC Safety Class I, use the 5790A only with sources up to 1000 V dc or rms ac that are protected from short circuit with current-limiting to 200 mA or less.

2-1. Introduction

This section provides instructions for installing the 5790A and connecting it to line power. Because this section explains fusing and operating environment requirements, you should read this section before operating the instrument. Instructions for connecting cables to other standards and to a UUT (Unit Under Test) during operation are in Section 4.

2-2. Unpacking and Inspection

The 5790A is shipped in a container that is specially designed to prevent damage during shipping. Inspect the 5790A carefully for damage, and immediately report any damage to the shipper. Instructions for inspection and claims are included in the shipping container.

When you unpack the 5790A, check for all the standard equipment listed in Table 2-1. Also check for accessories if any were ordered. If performance tests are required for your acceptance procedures, refer to Section 3 of the 5790A Service Manual for instructions.

Line power cords available from Fluke are listed in Table 2-2 and illustrated in Figure 2-1.

Table 2-1. Standard Equipment

Item	Model or Part Number
AC Measurement Standard	5790A
Line Power Cord	See Table 2-2 and Figure 2
Type "N" Extender (protects connector)	875443
5790A Operator Manual	893284
5790A Remote Programming Reference Guide	893375
5790A Service Manual	893292
Report of Calibration	N/A

Table 2-2. Line Power Cord Types Available from Fluke

Type	Voltage/Current	Fluke Option Number
North America	120V/15A	LC-1
North America	240V/15A	LC-2
Universal Euro	220V/16A	LC-3
United Kingdom	240V/13A	LC-4
Switzerland	220V/10A	LC-5
Australia	340V/10A	LC-6
South Africa	240V/5A	LC-7
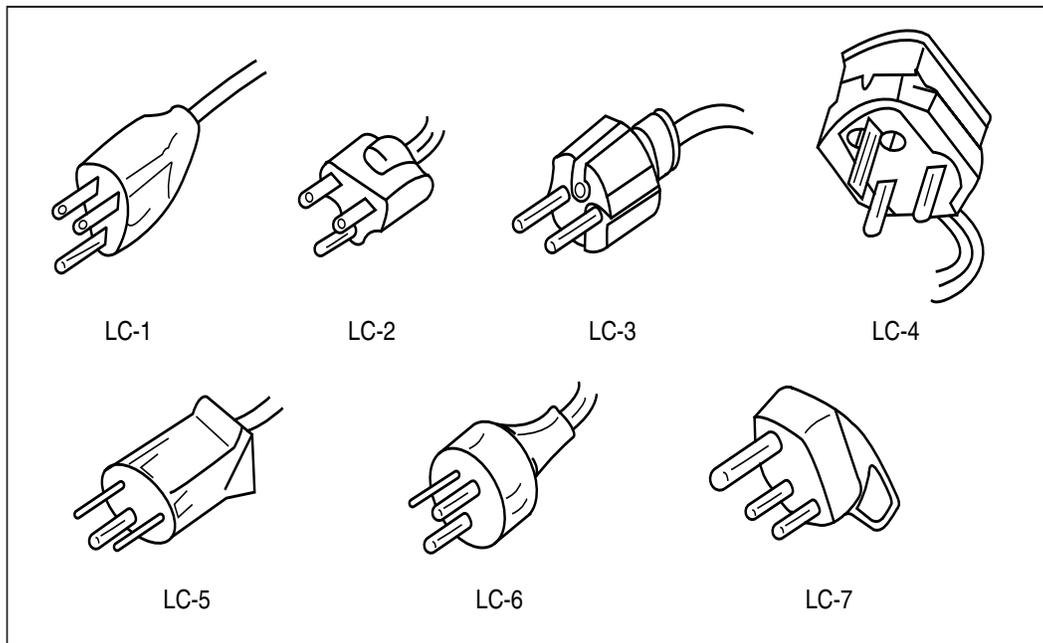
add2f.eps

Figure 2-1. Line Power Cord Types Available from Fluke

2-3. Environmental and Input Requirements

You must operate the 5790A in an ambient temperature within +/-5 °C of the temperature of the last calibration for full accuracy. At any time during operation, press the [SPEC] key to display the temperature of calibration, the absolute uncertainty for the present input, and the number of days since the last calibration. To operate the 5790A outside the specified temperature range, refer to the Specifications in Section 1 for information about temperature constants.

Inputs are protected from overloads on all ranges, but sources connected to the 5790A must be current-limited to 200 mA or less, be below 1000 V dc or rms ac, and be free of high-energy transients. Refer to Section 2 of the Service Manual for more information about protection circuitry.

2-4. Cooling Considerations

⚠ Caution

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

A hidden but important feature of the 5790A is its internal cooling system. Baffles direct cooling air from the fans throughout the chassis to internally dissipate heat during operation. The accuracy and dependability of all internal parts of the 5790A are enhanced by maintaining the coolest possible internal temperature. By observing the following rules, you can lengthen the life of the 5790A and enhance its performance:

- The area around the air filter must be at least 3 inches from nearby walls or rack enclosures.

- The exhaust perforations on the sides of the 5790A must be clear of obstructions.

- The air entering the instrument must be room temperature. Make sure that exhaust from another instrument is not directed into the fan inlet.

- Clean the air filter every 30 days or more frequently if the 5790A is operated in a dusty environment. (Instructions for cleaning the air filter are in Chapter 8.)

2-5. Placement and Rack Mounting

You can place the 5790A on top of a workbench or mount it in a standard 19-inch wide, 24-inch (61-cm) deep equipment rack. For bench-top use, the 5790A is equipped with non-slipping, non-marring feet. To mount the 5790A in an equipment rack, order the accessory Y-5737 Rack Mount Kit. The rack mount kit comes with rack ears, 24-inch slides, fasteners, and an instruction sheet.

2-6. Accessing the Fuse

⚠ Caution

To prevent instrument damage, verify that the correct fuse is installed in accordance with the line voltage setting.

The line power fuse is accessible on the rear panel. The fuse rating label to the right of the fuse holder (labeled F1) shows the correct replacement fuse rating for each line voltage setting. To access the fuse, refer to Figure 2-2 and proceed as follows:

1. Disconnect line power.

2. Insert the blade of a standard screwdriver in the slot of the fuse holder labeled F1.

3. Turn the screwdriver counterclockwise until the cap and fuse pop free.
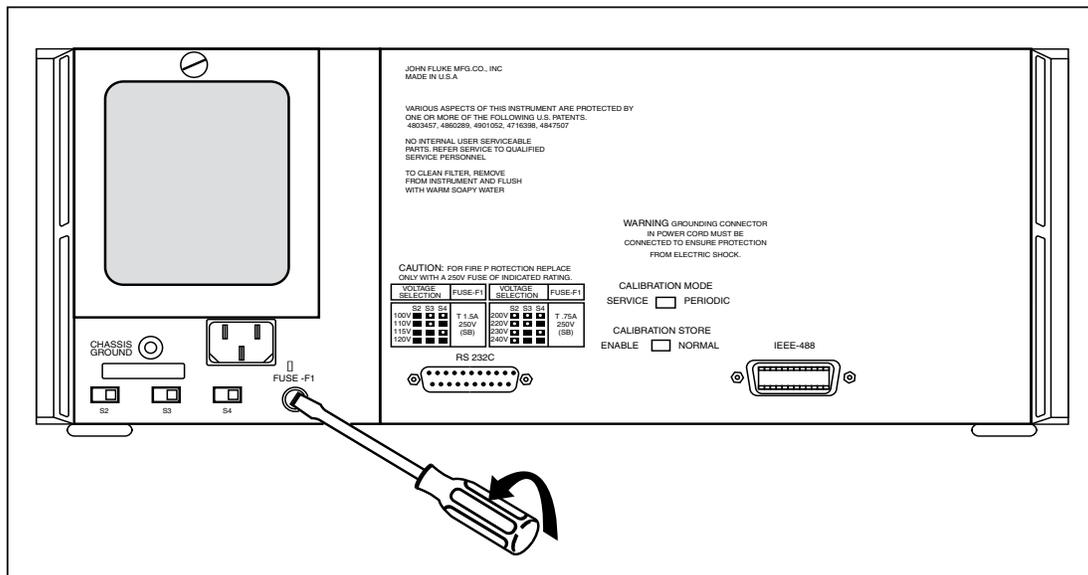
add3f.eps

Figure 2-2. Accessing the Fuse

2-7. Selecting Line Voltage

The 5790A arrives from the factory configured for the line voltage normally appropriate for the country of purchase, or as specified by you at the time of your order. The 5790A also comes with the line power plug appropriate for the country of purchase. If you need a different type, refer to Table 2-2 and Figure 2-1 for a list and illustrations of the line power plug types available from Fluke.

Check the line power label on the rear panel of the 5790A to verify that the line voltage matches local line power. Figure 2-3 shows the location of the line power label.

You can set the 5790A to operate from eight different nominal line voltages. Each voltage setting has a voltage tolerance of +/-10 % and a frequency range of 47 to 63 Hz. The line voltage switches are located on the lower left side of the rear panel.

To change the line voltage setting, set the line voltage selection switches to the appropriate positions as shown in Figure 2-3.

2-8. Connecting to Line Power

⚠⚠Warning

To avoid shock hazard, connect the factory supplied three-conductor line power cord to a properly grounded power outlet. do not use a two-conductor adapter or extension cord; this will break the protective ground connection.

If a two-conductor power cord must be used, a protective grounding wire must be connected between the ground terminal and earth ground before connecting the power cord or operating the instrument.

After you verify that the line voltage selection switches are correctly set, verify that the correct fuse for that line voltage is installed. Connect the 5790A to a properly grounded three-prong outlet.
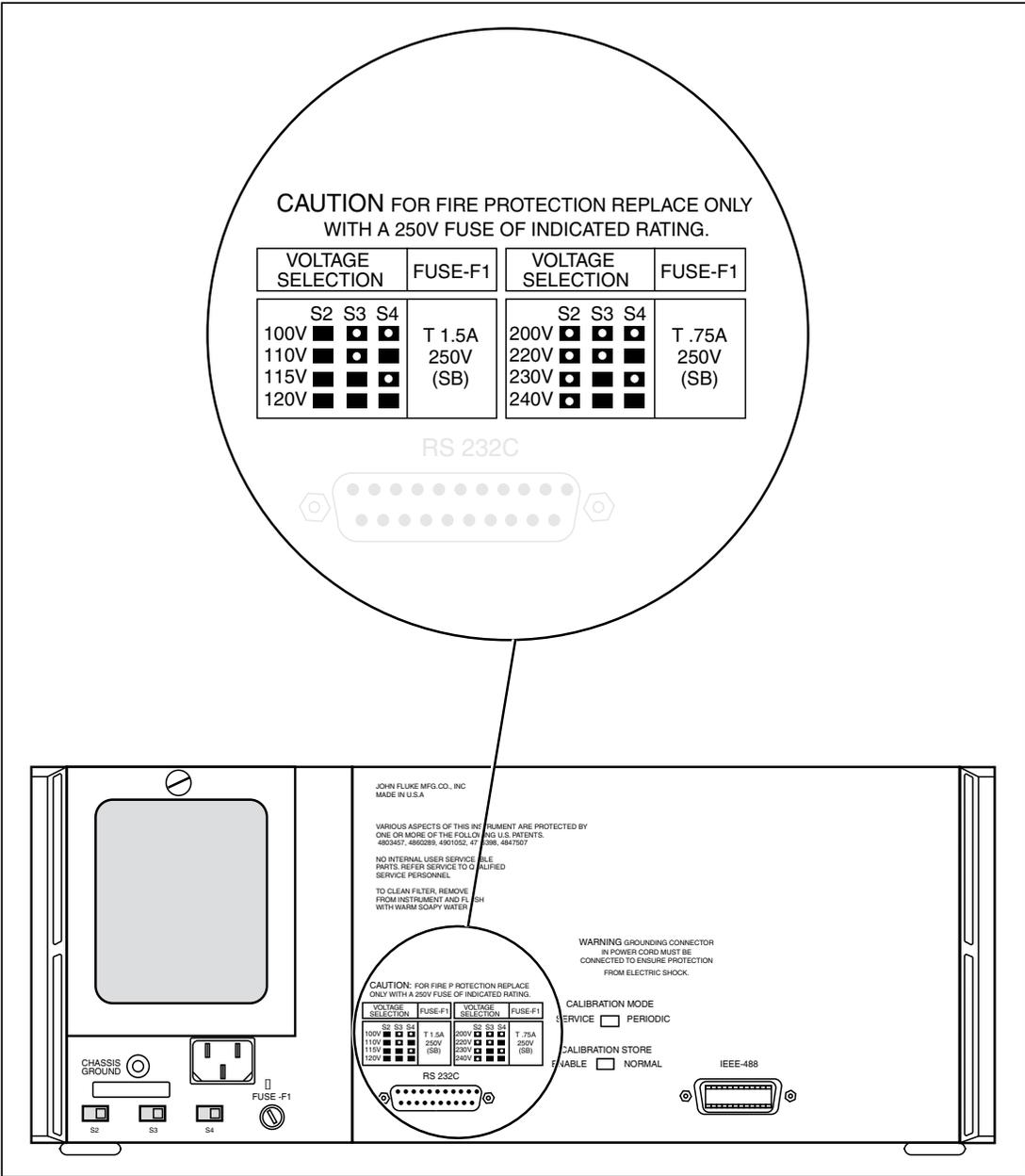
Figure 2-3. Line Power Label and Switch Location

Chapter 3
Features

3-1. Introduction

Please read the following summary of features before operating the 5790A. Separate illustrations and tables describe the functions and locations of the controls, displays, binding posts, and connectors.

3-2. Front Panel Features

Figure 3-1 shows the 5790A front panel features. Table 3-1 describes thesefeatures.

3-3. Rear Panel Features

Figure 3-2 shows the 5790A rear panel features. Table 3-2 describes these features.
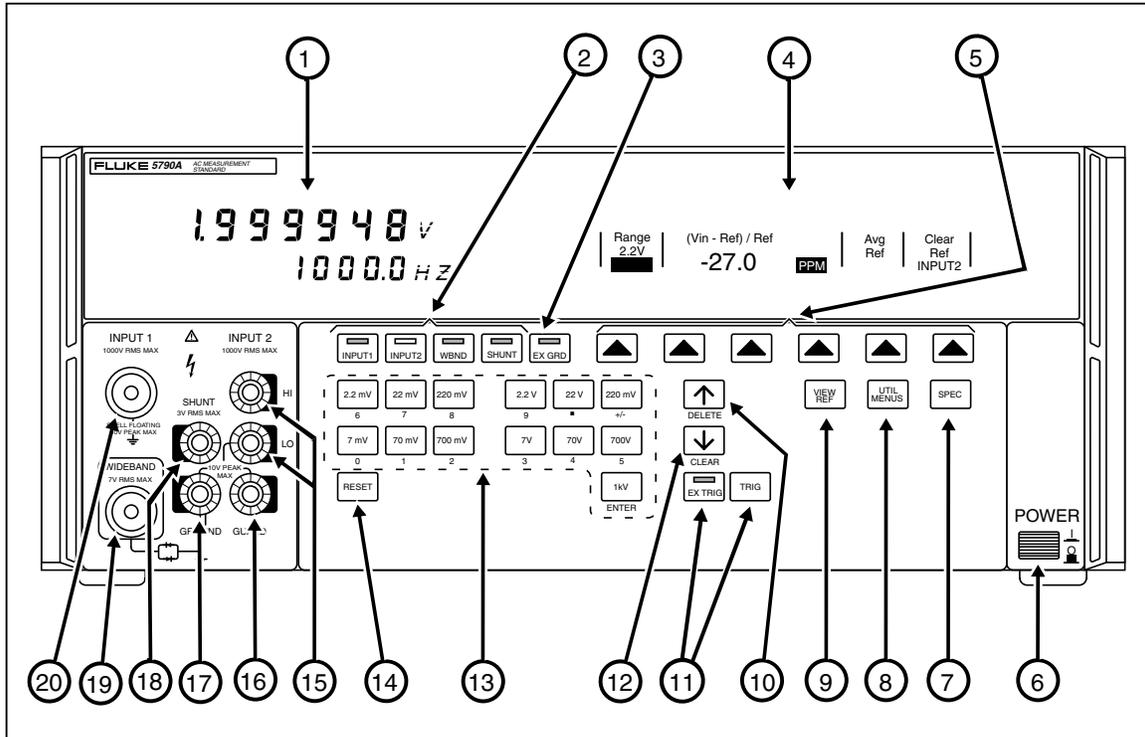
add5f.eps

Figure 3-1. Accessing the Fuse

Table 3-1. Front Panel Features

Ref No.	Name	Function
1	Measurement Display	A two-line vacuum-fluorescent display that shows the measured input voltage and frequency. The top line shows the magnitude of the measured voltage. The bottom line shows frequency of the signal at the active input if over 9 Hz, or goes blank if the input is dc (or below 9 Hz). Following the digits on both lines of the Output Display are unit annunciators for mV, V, Hz, kHz, and MHz. Annunciators below the amplitude line on the Output Display indicate the following active conditions: ADDR: Lit when the 5790A is addressed over the IEEE-488 interface. U: (Unsettled.) This annunciator lights for a second or two when the input level or location changes until the measurement settles to within specification. Display resolution is reduced until a settled condition is reached. If the digital filter is enabled, the unsettled annunciator stays lit until the moving-average window is full. (See "Using the Measurement Control Menu" in Section 4.)
2	Input Connector Selection Keys	INPUT 1 Key: Selects the INPUT 1 50\Q Type "N" connector as the active input. INPUT 2 Key: Selects the INPUT 2 binding posts as the active input. WBND Key: Selects the WIDEBAND 50\Q Type "N" connector as the active input, but only if the Option 5790A-03 Wideband Module is installed. This key generates a beep if no Wideband Module is installed. SHUNT Key: Selects the SHUNT to INPUT 2 LO binding posts as the active input. These binding posts are only for connection through the accessory 5790A-7001 adapter cable to a Fluke Model A40 or A40A shunt.
3	EX GRD (External Guard) Key	Opens and closes an internal connection between the GUARD and the INPUT 1 shell and INPUT 2 LO binding post. The 5790A powers up with the internal GUARD connection closed and the EX GRD indicator off. Pressing the EX GRD key opens the internal GUARD connection and lights the EX GRD indicator. (Also see GUARD binding post.)
4	Control Display	A multipurpose dot-matrix vacuum-fluorescent display that shows data entries, ac-dc errors during transfers, softkey labels, and other prompts and messages. Softkey labels identify the function of the key directly below them. Several softkey labels together are called a menu. The changing menus provide access to many different functions through the six softkeys.
5	Softkeys	The functions of the six unlabeled softkeys are called out when active on the Control Display directly above each key. The functions change during operation so that many different functions are accessible through these keys. A group of softkey labels is called a menu.
6	POWER Switch	Turns the power on and off. The switch is a push-push type; the first push turns the power on and locks the switch in, and the second push turns the power off and releases the switch.
7	SPEC Key	Displays the absolute uncertainty of the active measurement, based on the voltage and frequency being measured, and the calibration interval selected. Press SPEC again to clear the display.

Table 3-2. Front Panel Features (cont.)

Ref No.	Name	Function
8	UTIL MENUS Key	Calls up the top-level Utility Menu, which provides MENUS Key softkeys for calibration, self tests and diagnostics, instrument setup, instrument configuration message, and measurement control. See the Section 4 and the softkey menu tree for more information about the Utilities Menus.
9	VIEW REF Key	Displays the amplitude, frequency, and input connector of the stored eference, if in transfer mode. If the 5790A is in measurement mode (no reference is set) this key generates a beep. Press the key again to return to normal operation.
10	^/DELETE Key	Selects the next higher range and locks the range, except during a numeric entry operation. During a numeric entry operation, as in 5790A calibration, this key erases characters one at a time from a partial data entry.
11	TRIGGER Keys	.EX TRIG Key: Turns off continuous trigger mode. When you press EX TRIG, the keycap LED lights, and the 5790A stops taking continuous measurements at the active input. When the EX TRIG keycap indicator is off, the 5790A automatically takes measurements one after the other.TRIG Key: When the EX TRIG keycap indicator is lit, the TRIG key triggers a single measurement at the active input. In continuous trigger mode, this key aborts the current measurement cycle and triggers a new measurement.
12	v/CLEAR Key	Selects the next lower range and locks the range, except during a numeric entry operation. During a numeric entry operation, as in 5790A calibration,this key clears the entry from the display.
13	Range Keys/Numeric Keypads	These keys either select a specific range and lock Numeric the range (turning off autoranging if active), or Keypad function as a numeric keypad when data entry is required. Autorange or range lock is selected through a softkey on the Control Display. (The keys listed under number 12 above also function as part of the numeric keypad in data entry.)
14	RESET Key	Aborts the current operating state of the 5790A and returns the 5790A to the power-up state. [RESET] works in all cases except when operating under remote control
15	INPUT 2 Binding Post	A pair of five-way binding posts for connection to an Binding external dc source (1000V max), or to an ac source Posts (1000V rms max)
16	GUARD Binding Posts	The GUARD binding post provides an external Binding Post connection point for the internal guard or a floating shield around sensitive measurement circuitry. Refer to "Connecting the Guard and Ground Binding Posts" in Section 4 for proper use of the GUARD. The maximum allowable potential between the GUARD binding post and chassis ground is 10V pk.
17	GROUND Binding Post	A binding post that is internally grounded to the Binding Post chassis. The chassis is normally connected to earth ground through the three-conductor line cord.
18	SHUNT Binding Post	Connection point for a Fluke Model A40 or A40A Binding Post Current Shunt adapter. The shunt adapter connects etween the SHUNT binding post and INPUT 2 LO. (Do not connect the shunt adapter between SHUNT and GROUND.)
19	WIDEBAND 50\Ω Type "N" Connector	A 50\Ω Type "N" connector for inputs in Wideband mode (10 Hz to 30 MHz, 7V rms max). You can only use this connector if the Option 5790A-03 Wideband Module is installed.
20	INPUT 1 Type "N" Connector	A Type "N" connector for dc (1000V max) or ac (to 1 MHz, 1000V max) inputs. For manual transfer applications that use the 5790A with external dc and ac sources, use the INPUT 2 binding posts for the dc source.
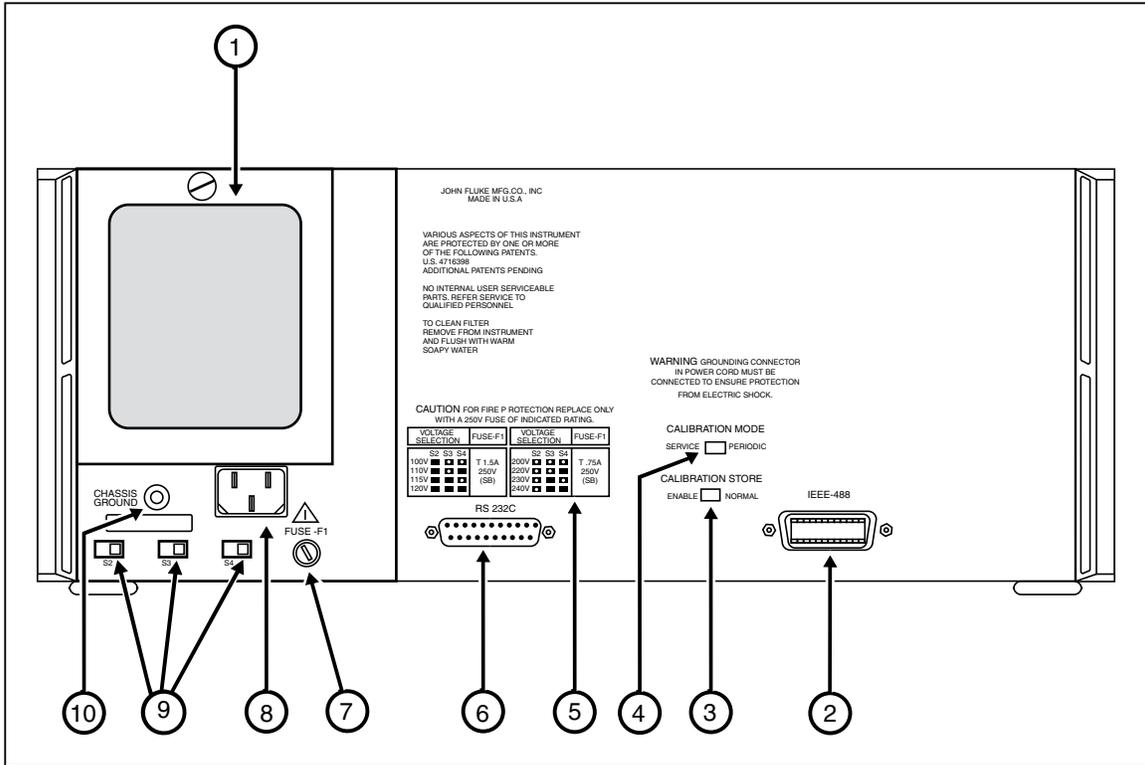
add6f.eps

Figure 3-2. Accessing the Air Filter

Table 3-2. Rear Panel Features

Ref No.	Name	Function
1	Fan Filter	The filter covers the air intake to keep dust and debris out of chassis air baffles. Fans inside the 5790A provide a constant cooling air flow throughout the chassis.
2	IEEE-488 Connector	A standard interface connector for operating the 5790A in remote control as a Talker/Listener on the IEEE-488 Bus. Refer to Section 5 for bus connection and remote programming instructions
3	CALIBRATION STORE Switch	A slide switch that write enables and disables the nonvolatile memory that stores calibration constants and dates Switching to ENABLE write enables the memory, and switching to NORMAL protects data in memory from being overwritten. The switch must be in the ENABLE position to set the date. The switch is recessed to allow the metrologist to cover it with a calibration sticker to guarantee instrument integrity.

Table 3-2. Rear Panel Features (cont.)

Ref No.	Name	Function
4	CALIBRATION MODE Switch	A slide switch that selects SERVICE or PERIODIC calibration. Periodic calibration is what you perform at the end of each calibration cycle and is all that is required to keep a normally-functioning 5790A operating in specification. Service calibration is a more complete calibration that should be done only after repair or replacement of an analog module. Service calibration is the procedure done at the factory when the 5790A is built
.5	Line Voltage	Shows the various settings of the line voltage Switch and switches, and the correct replacement fuse ratings Fuse Rating for fuse F1 for operating voltages of 110 (90-132) Label and 220 (180-264) V ac. Refer to "Accessing the Fuse" in Section 2 for the fuse replacement procedure.
6	RS-232-C Connector	A male (DTE) serial port connector for transmitting internal calibration constant data to a printer, monitor, or host computer, and for remote control of the 5790A. Section 7 describes proper cabling, how to set up the serial interface, and how to transmit data from the 5790A. Section 5 describes how to use the serial interface for remote control.
7	F1 Fuseholder	The line power fuse. Refer to "Accessing the Fuse"in Section 2 for fuse rating information and the fuse replacement procedure.
8	AC PWR INPUT Connector	A grounded male three-prong connector that accepts the line power cord.
9	Line Voltage Selection Switches	Select the operating line voltage. Refer to "Selecting Line Voltage" in Section 2 for instructions on how to select operating line voltage
10	CHASSIS GROUND Binding Post	A binding post that is internally grounded to the chassis. If the 5790A is the location of the ground reference point in a system, this binding post can be used for connecting other instruments to earth ground. (The chassis is normally connected to earth ground through the three-conductor line cord.) Also see GROUND Binding Post in Table 3-1.

Chapter 4
Front Panel Operation

4-1. Introduction

This section presents instructions for operating the 5790A from the front panel. Controls, displays, and terminals are identified and described in detail in Section 3. The first part of this section is general and applies to all modes of operation.

Operating instructions are presented separately for measurement mode and transfer mode. Refer to the instructions for measurement mode if you want to measure ac voltage as you would with an ac voltmeter. Refer to the instructions for transfer mode if you want to apply external standards to the 5790A and use it as a transfer standard.

Different uncertainty specifications apply to measurement mode and transfer mode, as listed in Section 1. Use the specifications to help determine which mode of operation is best for your application.

In measurement mode, the 5790A uses its internal dc reference and software control to automatically make a transfer and show the measured rms voltage of a signal at the input. In transfer mode, the uncertainty contributed by the 5790A is smaller because the instrument is simply comparing inputs and presenting the difference between the two. The 5790A is exceptionally accurate in detecting the difference in levels between rms ac and dc voltages applied to its inputs.

4-2. Turning on the 5790A

⚠⚠Warning

To avoid electric shock, make sure the 5790A is safely grounded as described in section 2.

Note

Before turning the 5790A on, make sure that the line voltage selection switches are set properly for your line voltage. Refer to Figure 2-3 or the line voltage switch label and verify the line voltage setting now if you have not already done so.

When you turn on the 5790A, it undergoes thorough self testing, and the Control Display shows the name of the test in progress. If a self test fails, a prompt on the Control Display identifies the failed test and prevents further operation of the instrument. For information about self diagnostics, refer to Section 3 of the 5790A Service Manual. The following internal systems are verified at power up:

- ROM Checksum
- RAM Checksum
- Control Display
- Measurement Display
- Guard Crossing DUART
- Rear-Panel DUART
- IEEE-488.2 Interface
- Internal Calendar and Clock
- Watchdog Timer

4-3. Power-Up State

After passing power-up self tests and any time you press [RESET], the 5790A goes into the power-up state. The only power-up setting that is nonvolatile (saved when the power is turned off) is the Initial Input setting. When you turn on the power or press [RESET]

(with no stimulus attached), the 5790A autoranges down to the lowest range and the displays appear as shown below:
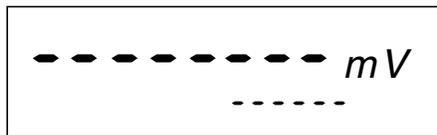
add7f.eps
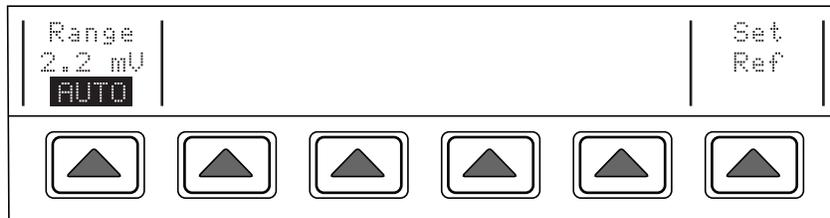
add08a.eps

At any time during front panel operation, you can return the 5790A to the power-up state by pressing [RESET]. Table 4-1 summarizes the power-up state settings. Most instrument parameters that you can set are always saved in memory until you clear nonvolatile memory with an EEPROM format operation. Table 4-2 summarizes the nonvolatile setup parameters and their factory defaults.

4-4. Warmup Requirements

When you turn on a cold 5790A, warm it up for 30 minutes to allow the environmentally controlled components inside to stabilize. You can use the 5790A right away, but a 30-minute warmup period is required to ensure that the 5790A meets or exceeds the specifications listed in Section 1.

If you turn off the 5790A after it has warmed up, allow it to warm up again for at least twice the length of time it was turned off (up to a maximum of 30 minutes of warm-up). For example, if the 5790A is turned off for 10 minutes, allow it to warm up again for at least 20 minutes.

Table 4-1. Power-Up State Defaults and Volatility

Operating State	Factory Default (Setting after Eeprom Format)	Volatile? (Reset at Power Up)
Range	1 kV	Yes
Auto/Lock Range	AUTO	Yes
EX TRIG	OFF (autotrigger)	Yes
EX GRD	OFF (internal)	Yes
Digital Filter Mode	OFF	Yes
Digital Filter Restart Threshold	MEDIUM	Yes
Initial Input	INPUT 2	No
Hi Res	OFF	Yes
Reference	None	Yes
Reference Delta Units	PPM	Yes

Table 4-2. Nonvolatile Setup Parameter Factory Defaults

Setup Parameter	Factory Default (Value after Eeprom Format)
Cal Interval	1 YEAR
Remote Port	GPIB
IEEE-488 Bus (GPIB) Address	6
EOF Characters	FF, NUL
Baud Rate	9600 baud
Data Bits	8
Stop Bits	1
Parity	None
Stall Protocol	XON/ XOFF
Serial Port Remote Interface Mode	Terminal
EOL Characters (RS-232)	CRLF
User Report String (*PUD in remote)	5790A
Real Time Clock Date	Not changed
Real Time Clock Time	Not changed
Date Format	M/D/Y

4-5. *Calibrating DC Zeros*

DC zeros is a quick, automatic process that removes dc offset errors on all ranges and optimizes internal settling parameters to improve measurement speed. Specifications require that you execute dc zeros at least as often as every 30 days. To execute zeros calibration, proceed as follows from the power-up state:

Note

The position of the rear panel CALIBRATION switches does not matter for dc zeros calibration.

1. Press the [UTIL MENUS] key followed by the "Cal" and "Zero Cal" softkeys. The Control Display shows the progress of zero calibration with the name of each part of the procedure. The numbers at the right side (e.g., "8/19") give an indicator of the percentage of completion. In a short time, zeros calibration is finished. The display changes to:
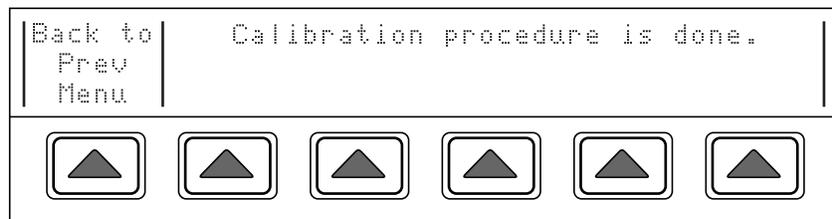
add0b.eps

2. To resume normal operation, press the "Back to Prev Menu," "Done With Cal," and "DONE With Utils" softkeys (they are all the same key).

4-6. Connecting Sources to the 5790A

⚠Caution

To avoid dielectric breakdown, use only cables and connectors that have voltage ratings higher than the voltages you will be applying.

Connect the source to be measured to the INPUT 1 50Ω Type "N" connector or the INPUT 2 binding posts. INPUT 1 is recommended for input frequencies above 300 kHz.

Cable recommendations are different depending on the INPUT connector used and the input amplitude and frequency. Table 4-3 gives test lead and INPUT connector recommendations for different applications.

4-7. Test Leads and Connectors

Make sure cables and connectors are rated for the voltage that will be used. Either coaxial or twisted-pair shielded test leads with low-thermal emf connectors are the best choice. Use short leads to minimize test lead loading. Verify that test lead loading will not effect your measurement by checking the input impedance information in Table 4-4. Refer to the heading "Loading" further on in this section for more information.

4-8. Coaxial Inputs

⚠⚠Warning

The type "N" connector shells are connected to circuit low and can float to hazardous voltages if the input is connected incorrectly.

Use coaxial cable and 50Ω Type "N" connectors when attaching cables to INPUT 1 and the WIDEBAND coaxial input connectors. Coaxial cable and connectors minimize the possibility that radiated electromagnetic energy will disrupt sensitive measurements. Use the shortest possible length of coaxial cable. Be aware that if you do add a length of cable, you calibrate the source to the end of the cable.

4-9. Dual Banana Inputs

You can connect test leads to the 5790A INPUT 2, GUARD, and GROUND binding posts using banana plugs, spade lugs, or stripped insulated wire. Make all screw-on connections tight. To avoid errors induced by thermal voltages (thermal emfs), use connectors and conductors made of copper or materials that generate small thermal emfs when joined to copper. Avoid using nickel-plated connectors. Optimum results can be obtained by using Fluke Model 5440A-7002 Low Thermal EMF Test Leads, which are constructed of well-insulated copper wire and tellurium copper connectors.

Table 4-3. Input Test Lead Summary

Input Connector	Input Frequency			
	dc to 100 kHz	100 to 300 kHz	300 kHz to 1 MHz	1 to 30 MHz
INPUT 1 TYPE "N"	Coax any Length	Coax Up to 3 ft	Coax Up to 1 f.	N/A
INPUT 2 BINDING POSTS.	Twisted-pair or coax any length	Twisted-pair or coax up to 3 Ft.	Twisted-pair or coax up to 1 Ft	N/A
WIDEBAND TYPE "N	RG-58/U, 3 Ft.			

Table 4-4. Input Impedance Summary

Input Range	Inputs 1 and 2	Wideband Input
1000V	500 kΩ	N/A
700V	500 kΩ	N/A
220V	50 kΩ	N/A
70V	50 kΩ	N/A
22V	50 kΩ	N/A
7V	50 kΩ	50 Ω
2.2V	>10 MΩ	50 Ω
700 mV	>10 MΩ	50 Ω
220 mV	>10 MΩ	50 Ω
70 mV	>10 MΩ	50 Ω
22 mV	>10 MΩ	50 Ω
7 mV	>10 MΩ	50 Ω
2.2 mV	>10 MΩ	50 Ω

4-10. Connecting the Guard and Ground Binding Posts

Note

The following information applies to INPUT 1, INPUT 2, and the SHUNT input only. It does not apply to the WIDEBAND input. The Wideband option is designed so that once you connect a coaxial cable, no other connections are required.

Ground currents can occur if instruments are not connected properly, resulting in annoying and often subtle measurement errors. In any system of measurement instruments, the basic rule is that all instruments should be grounded at only one point. If an instrument in the system has a grounded input or output, select it as the common earth ground point for all the grounds in the system.

Otherwise, use the ac voltage source used in the system (if there is one) as the common ground point for all the instruments.

For more information about grounding and guarding, refer to Grounding and Shielding Techniques in Instrumentation, by Ralph Morrison, \C1977, John Wiley & Sons.

4-11. Guard Theory

The GUARD is an electrical shield around the sensitive analog circuitry, insulated from chassis ground and the rest of the 5790A. The GUARD provides a low-impedance path for common-mode noise and ground currents. The guard reduces the chance of ground currents in the signal leads caused by plugging interconnected instruments into ac outlets at different ground potentials.

4-12. Guard Connection

The GUARD is internally connected to the INPUT 1 connector shell or the INPUT 2 LO binding post in this configuration. The GUARD binding post is disconnected from the internal guard. This is the normal power-up state of the 5790A, and is selected by pressing [EX GRD] so that the keycap indicator is off.

For the 5790A it is recommended that most measurements be made in the external guard configuration. To prevent errors due to common mode signals, especially at higher frequencies where the guard becomes less effective, the following steps are recommended. Refer to Figure 4-1 for the recommended test lead connections to test a measuring instrument, and Figure 4-2 for the recommended test lead connections to test a source. These illustrations show recommended ways to connect to a source, and to connect to a source and other measuring device. The hints listed below are identified on the Figure by number.

1. Use short signal connections to reduce the impedance in the signal return path and to reduce the current due to capacitive loading.

2. Use relatively low capacitance coaxial cable for connections to reduce the return currents due to capacitive loading.

3. If attenuation is used, attenuate near the source.

4. Select 5790A [EX GRD]. Connect the GUARD of the 5790A to the GUARD of the source and UUT. This will help prevent ground signals from being capactivety coupled to the Lo at the higher frequencies.

PLANE OF
REFERENCE

5790A
EXT GRD

UUT DMM   EXT GRD

GUARD

Use HEAVY BRAID

SOURCE
INT GRD

LOCATION OF EXTERNAL
ATTENUATOR (IF USED)
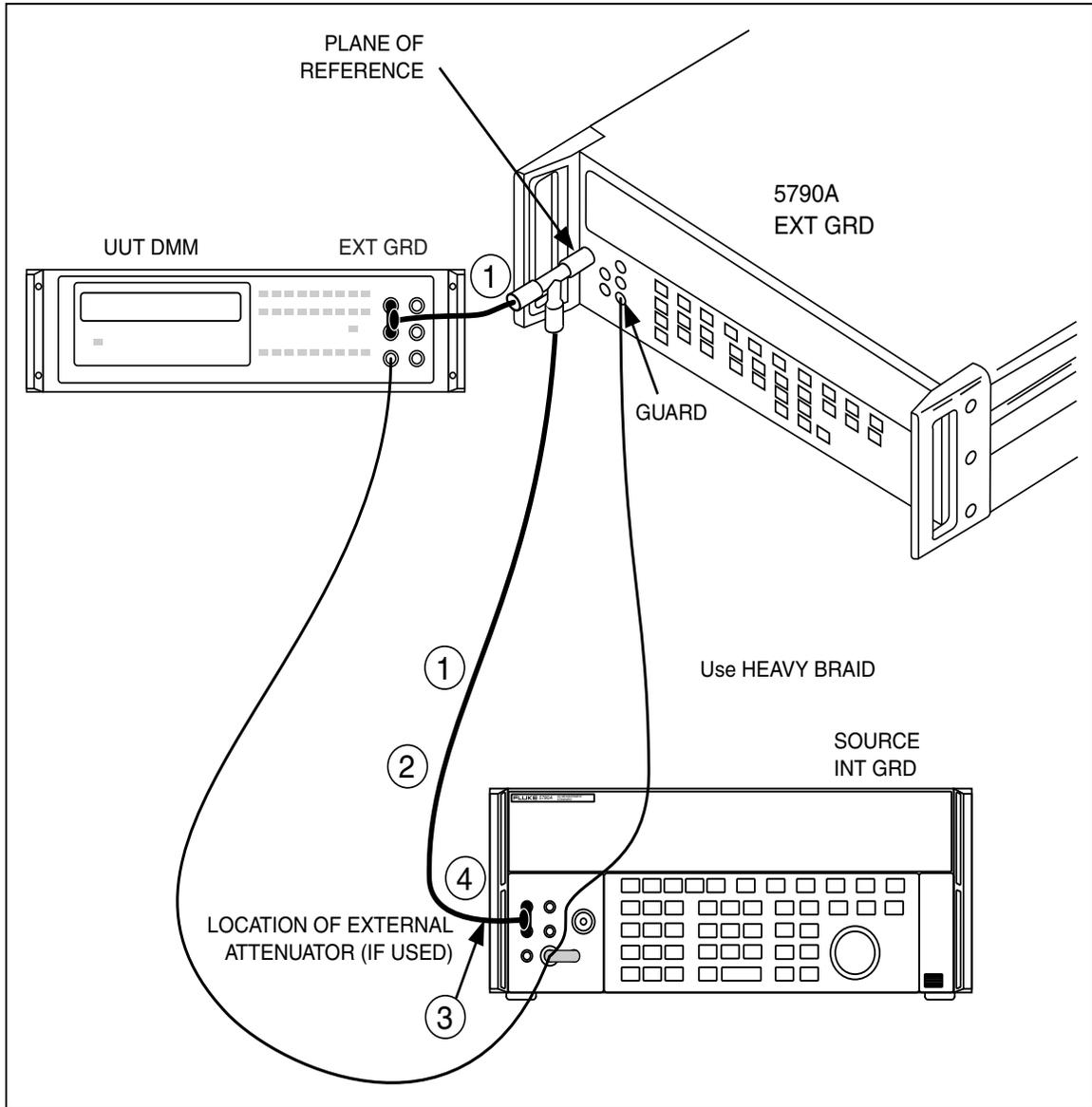
add9f.eps

Figure 4-1. Recommended Test Lead Connections to Test a Voltmeter

add10f.eps
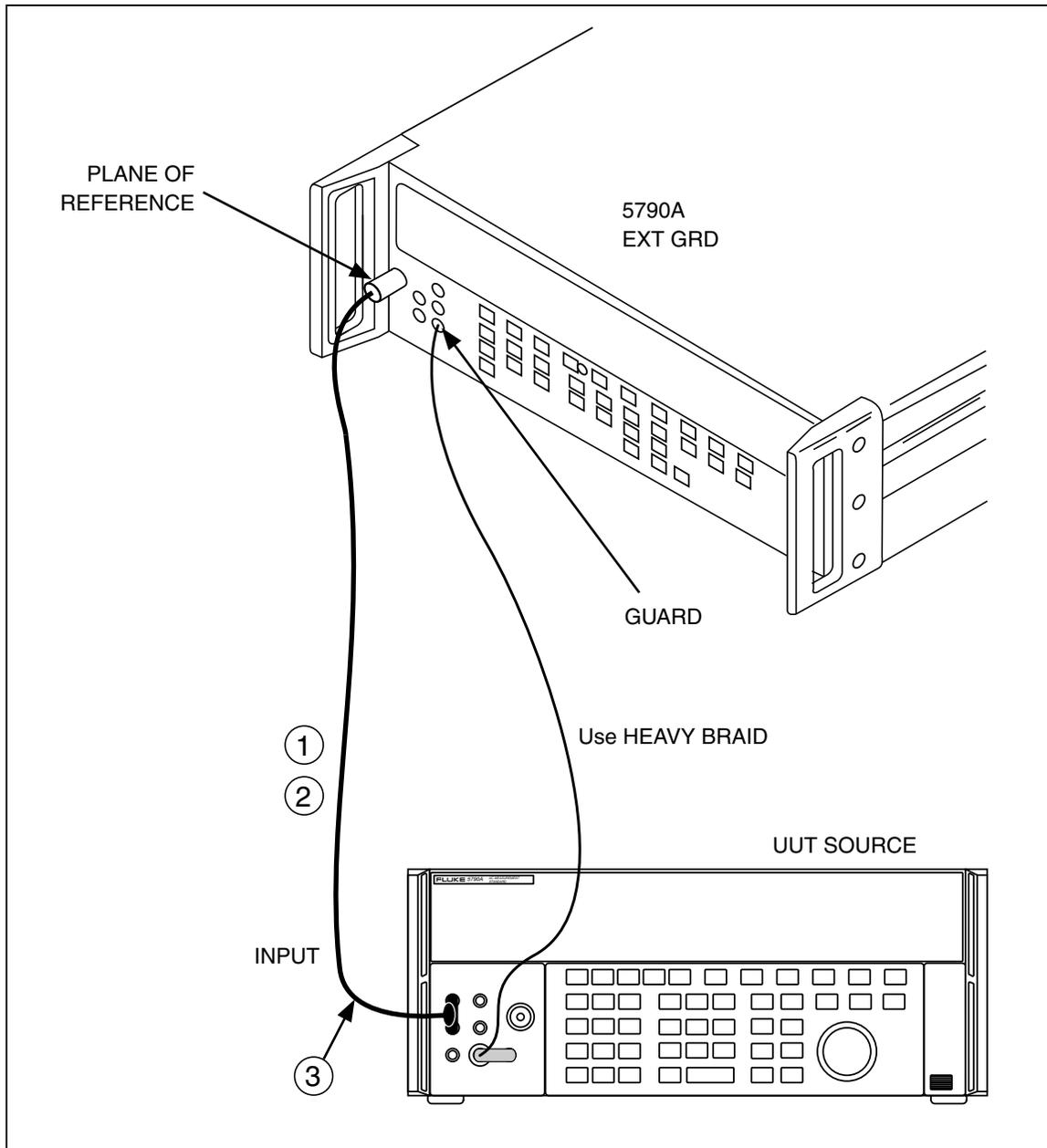
Figure 4-2. Recommended Test Lead Connections to Test a Source

4-13. *External Guard Connection*

For some conditions, such as low-frequency common mode interference, better results may be obtained by using the external guard configuration. Select external guard by pressing [EX GRD] so that the keycap indicator is lit. This disconnects the LO from GUARD and connects the internal guard to the GUARD binding post. A connection from the GUARD binding post can then be made to the common earth ground point for the system.

Note

Whenever EXT GUARD is activated (the green indicator on the EX GRD key is on), you must refresh the guard status after the instrument changes from the 220V range to any higher range. To refresh, push the EX GRD key two times (once to turn the indicator off, and once to turn the indicator on). If using the remote interface, send the commands EXTGUARD OFF, and followed by EXTGUARD ON.

4-14. Operating Instructions for all Modes

Whether your application involves measurement mode or transfer mode, you may select certain measurement parameters. Among them is the Digital Filter Mode and Restart threshold, accessible through the Meas Control menu. This and other measurement parameters are described next.

4-15. Interpreting the Measurement Display

The Measurement Display shows the measured input voltage and frequency on two lines. Features and functions of the Measurement Display are summarized in Table 3-1 in Section 3. Table 4-5 shows the amplitude resolution displayed for each range. Note how the setting of the digital filter, described under the next heading, affects resolution. Table 4-6 shows the frequency display resolution.

Table 4-5. Measurement Display Amplitude Resolution

Input Range	Input 1 and 2 Filter off or fast filter medium or slow and hi res off or hi res on		Wideband Input Filter off or fast filter medium or slow and hi res off or hi res on	
1000V	1000.000	1000.0000	N/A	N/A
700V	700.000	700.0000	N/A	N/A
220V	220.0000	220.00000	N/A	N/A
70V	70.0000	70.00000	N/A	N/A
22V	22.00000	22.000000	N/A	N/A
7V	7.00000	7.000000	7.0000	7.00000
2.2V	2.200000	2.2000000	2.20000	2.200000
700 mV	700.000	700.0000	700.00	700.000
220 mV	220.0000	Same	220.000	220.0000
70 mV	70.0000	Same	70.000	70.0000
22 mV	20.0000	Same	20.0000	Same
7 mV	7.0000	Same	7.0000	Same
2.2 mV	2.200	Same	2.2000	Same

Table 4-6. Measurement Display Frequency Resolution

Frequency Range	Decimal Places Shown
9.00 to 119.99 Hz	2
0.1200 to 1.1999 kHz	4
1.200 to 11.999 kHz	3
12.00 to 119.99 kHz	4
0.1200 to 1.1999 MHz	4
1.200 to 11.999 MHz	3
12.00 to 30.00 MHz	2

The upper display shows the magnitude of the applied signal in volts (V) or millivolts (mV). The lower display shows the frequency of the applied signal in Hz, kHz, or MHz. When the input frequency is below 9 Hz, the frequency portion of the display is blank. When the 5790A has not taken a measurement since power up, or an action such as an input or range change has invalidated a measurement in progress, the display shows dashes instead of numerals:
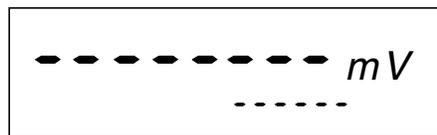
add7f.eps

An overload is indicated by flashing display filled with the letter H:
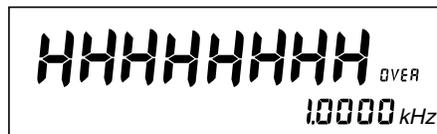
add11f.eps

An under-range input generates a flashing display filled with the letter L:

add12f.eps

Measurements should not be taken as valid until the "U" (for unsettled) indicator goes out. The unsettled indicator stays lit until the digital filter moving average window is full, or until a measurement is complete if the digital filter is turned off.

4-16. *Using the Measurement Control Menu*

To access the Measurement Control Menu, press [UTIL MENUS] followed by the "Meas Control" softkey. The menu appears as follows:

```
│ Done │Digital│Filter│Initial│ Hi Res │        │
│ With │ Mode  │Restart│ Input │        │        │
│ Setup│  OFF  │MEDIUM │INPUT2 │  OFF   │        │
```
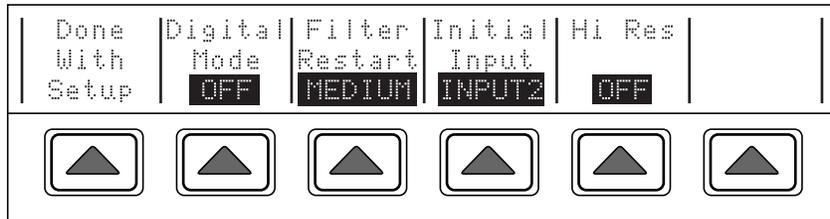
add08c.eps

4-17. Digital Filter Mode Softkey

You can use the digital filter to obtain optimum results in measurement environments with various levels of noise. When enabled, a software digital filter makes the displayed measurement become a window average of the 4, 16, or 32 most recent measurements. These correspond to the FAST, MEDIUM, and SLOW rates that you select with the "Mode" softkey. The "U" unsettled indicator stays lit until the window is full, although full resolution is shown with the first settled reading.

The digital filter affects the value shown on the Measurement Display as well as the value used for references and delta computations on the Control Display when the 5790A is in transfer mode.

Note

When you select a Digital Filter Mode of SLOW or MEDIUM, the displays show an extra digit of resolution in some main input and WIDEBAND input ranges. See Table 4-5 for details.

4-18. Digital Filter Restart Softkey

Use the "Digital Filter Restart" softkey to set the filter's restart floor. The restart floor allows you to set the threshold of restarting the filter (as a way of rejecting inconsistent readings). Readings over the threshold flush the filter and start a new running average. Until the filter completely fills without being restarted, the "U" annunciator stays lit. The restart settings are COARSE, MEDIUM, and FINE, corresponding to 1000, 100, and 10 counts, respectively. For sources that are unstable or noisy, you may have to use the COARSE restart threshold in order to get settled readings.

Note

The extra digit of resolution obtained in the SLOW and MEDIUM Digital Filter Mode settings does not apply to the number of counts selected by the "Restart" softkey.

For example, suppose the instrument is in the 22V range and the digital filter settings are Mode = SLOW and Restart = FINE. The display now shows the window average of the most recent 32 readings with an extra digit of resolution. If after 20 readings the running average is 10.000032 and the 21st reading is 10.000042, the reading does not restart the filter because the extra digit of resolution does not apply to the 10-count threshold. If, however, the 21st reading is 10.000132, it would trigger the 10-count threshold and restart the filter. The "U" annunciator stays lit until the filter is full.

Note

If you change the input voltage slightly with the filter active, you will not get correct readings until the filter has been completely flushed. With the RESTART threshold set to coarse and a small input change, the "U" annunciator may not light. You can manually restart the filter by pressing [TRIG].

4-19. Hi Res Softkey

The "Hi Res" softkey in the Measurement Control menu increases Measurement Display resolution exactly like setting the Digital Filter to SLOW or MEDIUM. Refer to Table 4-5 for the effect of this softkey.

4-20. Selecting Auto or Locked Range

When set to autorange, the 5790A ranges up or down and usually selects the best range in which to measure a voltage. However, for measurements near full-scale, you may need to lock the range to keep the 5790A in the desired range. Autorange is selected at power-up and after a RESET. The setting of AUTO or LOCKED range is indicated under the range value on the left side of the Control Display as shown below:
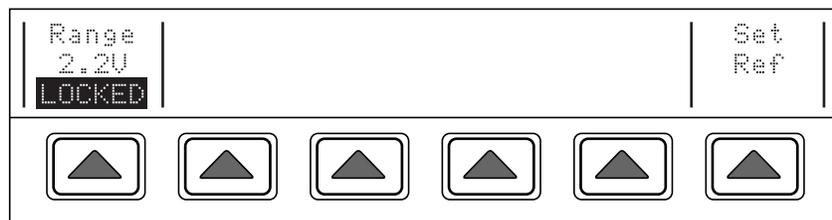
add08d.eps

To lock the 5790A range press the "Range" softkey and note that the label changes to "LOCKED." You can also lock a range by simply pressing one of the range select keys. All further measurements are taken in the locked range until the range is reset to AUTO. Locking a range and applying excessive voltage for that range does not damage the instrument if voltage and current limits are observed (1000 V dc or rms, and 200 mA max).

The 5790A input impedance is dependent on the range selected. For low voltage ranges, 2.2V and below, the 5790A has a high input impedance minimizing errors associated with sources with higher impedances (such as the 5700A millivolt ranges which are 50 ohms). For the 5790A higher voltage ranges, input impedances as low as 50 kΩ are obtained. A temporary introduction of a 50 kΩ load (which will occur during 5790A auto-range) may affect a source instrument. If the output voltage of a source instrument is affected more than 10 %, resulting from 5790A auto-ranging, the 5790A will follow the source voltage fluctuations. Because of the continual voltage fluctuations between the range changes, a condition may arise where the instruments are not able to settle to a stable state.

The 5205A and 5215A instruments provide an internal slew rate trip mechanism that is affected by load fluctuations that occur during voltage transitions. The 5205A and 5215A instruments expect their loads to be stable during voltage transitions. If the load voltage is not stable, a slew rate trip condition may occur. If the slew rate monitor is triggered, the 5205A and 5215A will momentarily source a low voltage and will try to apply the desired voltage again. As a result, a cyclic pattern occurs and the 5790A auto-ranging

tracks the source instrument and appears to oscillate between ranges. The 5790A should be range locked to the desired range and then the voltage applied from either 5205A or 5215A. This will prevent a cyclic auto-range condition between the 5790A, 5205A, and 5215A instruments. When a 5205A is used as the boost amplifier for the 5700A, a slew rate trip condition is avoided because the 5700A forces a controlled ramp to the final voltage. Auto-ranging will then work as expected on the 5790A.

4-21. *Selecting Continuous or External (Single) Trigger*

When the 5790A is in continuous trigger mode, the instrument is continuously taking measurements. This is the initial setting at each power-up. As soon as one measurement is completed, the 5790A begins a new measurement at the active input. Select continuous trigger mode by pressing [EX TRIG] so that the keycap indicator is off.

In the external trigger mode, the 5790A only takes a measurement when you press [TRIG]. When you press [TRIG], the 5790A begins a new measurement, even if a partially completed measurement is under way. Select external trigger mode by pressing [EX TRIG] so that its keycap indicator is lit.

When the Digital Filter is active and the 5790A is in external trigger mode, pressing [TRIG] begins a series of measurements. When the filter is full, the "U" annunciator goes out and the 5790A stops sampling the input until you press [TRIG] again or change to autotrigger mode.

4-22. Instructions for Measurement Mode

In measurement mode, the 5790A measures a voltage applied to the selected input. To take a measurement, simply select an input by pressing one of the input keys so that the associated keycap indicator lights. Depending on trigger mode, the instrument takes single readings when you press [TRIG] or it takes continuous readings. Refer to "Operating Instructions for All Modes" for other settable operating parameters and information about overrange and underrange displays.

Two examples of measurement mode applications are determining the error of an ac source and determining the error of an ac voltmeter. No external calibrators or standards are required during measurement mode operations unless you are calibrating a voltmeter. you are taking a measurement the displays appears as follows (assuming HI RES is ON or Digital Filter is MEDIUM or SLOW):

$$+1.7035730 \text{ } v$$

1.003 kHz

add13f.eps

| Range 2.2V AUTO | | | | | Set Ref |
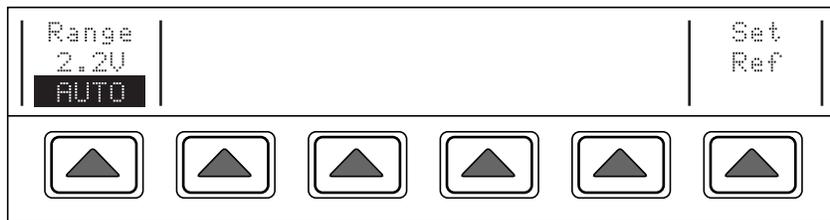
add08fe.eps

To determine the error of an ac source, check the specifications for proper test uncertainty ratios and simply measure the source. To determine the error of an ac voltmeter using measurement mode, apply an ac source to the 5790A input and the ac voltmeter input in parallel. Refer to Figure 4-1 for test lead connection guidelines. If you press the "Set Ref" softkey, the 5790A enters Transfer Mode. The displays appear as follows:

$+1.7035730$ V
1.003 kHz

add13f.eps

| Range
2.2V
AUTO | (Vin - Ref) / Ref

-5.2 PPM | Avg
Ref | Clear
Ref
INPUT2 |
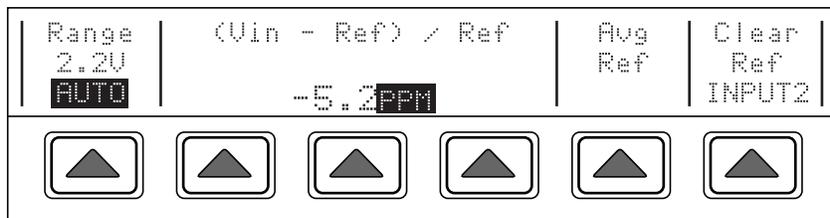
add08f.eps

4-23. Instructions for Transfer Mode

You activate transfer mode when you press the "Set Ref" softkey, thereby establishing (storing) a reference. Transfer mode ends when you press the "Clear Ref" softkey. In transfer mode, the 5790A compares a signal at its input to the stored reference.

One example of a transfer mode application is determining the error of an ac source referenced to an external dc standard such as a Fluke 5700A Calibrator. In transfer mode, you can use an external source to establish a reference, and the uncertainty of the measurement is governed by 5790A ac-dc difference specifications in addition to the uncertainty of the dc source.

A "transfer" is the process of comparing an unknown ac voltage to a known voltage. Accuracy of the transfer depends on the accuracy of the external source combined with the transfer uncertainty as defined in the 5790A specifications.

Before putting these procedures into practice, read the information at the end of this section under "Techniques for Reducing Transfer Error." Observing the hints provided there will help ensure accurate transfers. Refer to Figures 4-1 and 4-2 for test lead connection guidelines. (In these figures, a multifunction calibrator is used as the ac and dc reference.)

4-24. Measuring Frequency Flatness with the Wideband Option

The Option 5790A-03 Wideband AC Voltage module option allows the 5790A to measure the frequency flatness of a 50Ω source signal generator such as the 5700A Wideband output. The 5790A Wideband option measures signals from 700 uV to 7V over a frequency range of 10 Hz to 30 MHz. The input impedance is 50Ω on all ranges.

To measure frequency flatness of a source using the WIDEBAND input, proceed as follows (requires the 5790A-03 Option):

1. Connect the 50Ω source to the WIDEBAND input.

2. Press the [WBND] key and set the range as desired.

3. Set the source to a voltage under 7V, 1 kHz.

4. Press the "Set Ref" softkey to store a reference.

5. Vary the source from 10 Hz to 30 MHz while recording the amplitude error relative to the stored 1 kHz reference. The error can be displayed in ppm, percent, voltage, or ratio as the input frequency is swept through its range.

Note

You can use the same technique to check frequency flatness with the main input.

4-25. *Using the Shunt Input for Relative Current*

To measure relative (not absolute) current, you have two choices: Accessory 5790A-7001 allows you to connect Fluke A40 or A40A Current Shunts to the 5790A SHUNT input for making current transfers up to 20A. Accessory 792A-7004 allows you to connect Fluke A40 Current Shunt to the INPUT 1 Type "N" connector for making current transfers up to 5A. Instruction sheets are supplied with each type of current shunt adapter.

The 5790A Shunt Input is internally terminated with a 90 resistor that allows for direct connection to current shunts. Connection to A40 and A40A Current Shunts requires the 5790A-7001 accessory which consists of an adapter and cable. The cable is approximately 36 inches long and has a male banana plug on one end and a UHF(M) connector on the other. This cable connects between the 5790A Shunt Input and either the A40A Current Shunt or the adapter (see Figure 4-3). The adapter has a UHF(F) connector on one end and one-inch spaced female banana plugs on the other. This one-inch spacing allows for connection to the A40 Current Shunt.
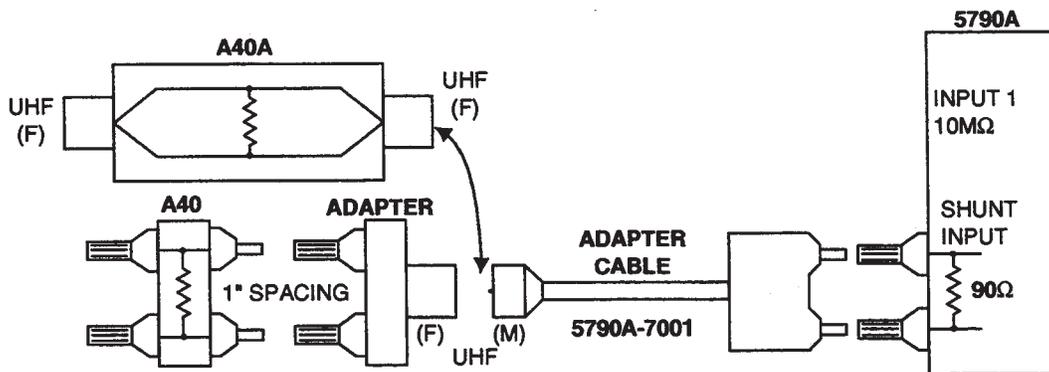
f4-3s.bmp

Figure 4-3. Measuring Relative Current Using 5790A-7001

The 792A-7004 Adapter can also be used with the 5790A. This adapter has two functions. First, it consists of a type N connector on one end and one-inch spaced banana plugs on the other end which enables direct connection between the A40 and the 5790A Input. Second, it has an internal 90Ω resistor to "simulate" the thermal transfer standard. In this application, the 792A-7004 Adapter is connected to Input 1 of the 5790A. Figure 4-4 shows how the 792A-7004 Adapter can be used with Input 1 of the 5790A for AC/DC current transfers. (The A40A Current Shunts have UHF type connectors. Therefore, an A45-4004 Output Cable is also required.)
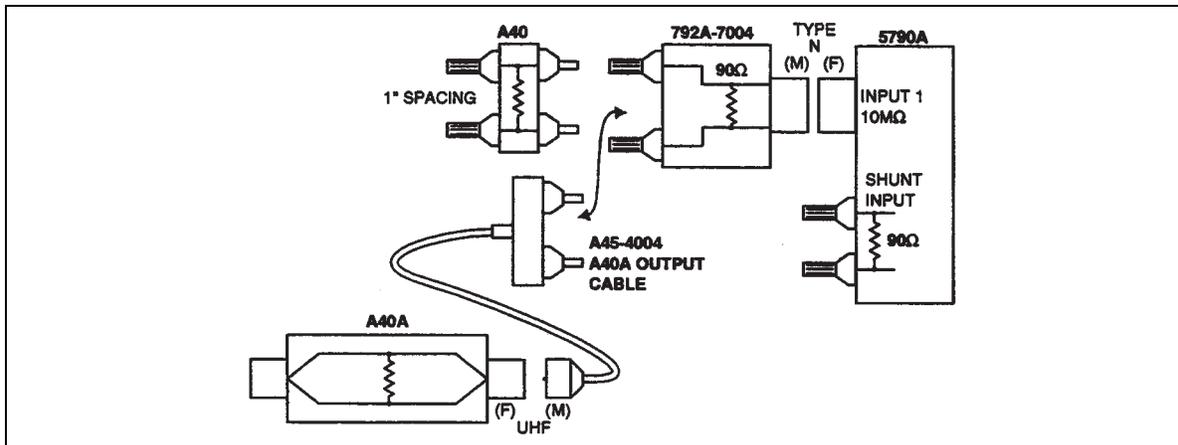
f4-4s.bmp

Figure 4-4. Measuring Relative Current Using 792A-7004

In some applications the previous uncertainty may not meet your specific requirements. Better uncertainties can be obtained by characterizing the A40 Current Shunt (with the 792A-7004 Adapter) for AC/DC current difference. This characterization can be done by NIST or at our Fluke Standards Laboratory. At the Fluke Lab this characterization is performed at specific currents and frequencies with present uncertainties as low a 100 ppm. Since the 792A-7004 Adapter is shunting part of the current, it must be sent in and characterized with the A40 or A40A Current Shunts. When using the 5790A Shunt Input, where the resistor is internal in the 5790A, the 5790A must be characterized with the A40 or A40A Current Shunts. Since this would tie up the entire 5790A Measurement Standard for shunt characterization, it is recommended that for AC/DC current calibration where better than standard uncertainties are needed, the 5790A with the 792A-7004 Adapter should be used.

Note

Current measurements are specified for transfer mode only. Use the ac/dc difference specification for the voltage being read from the current shunt. You supply a dc current reference to make a current transfer.

To use the SHUNT input, proceed as follows:

1. Connect the 5790A-7001 adapter to the SHUNT and INPUT 2 LO binding posts.

2. Connect a Model A40 or A40A Current Shunt to the adapter cable.

3. Connect the current shunt to the ac current source under test.

4. Press the [SHUNT] key so that its keycap indicator lights.

5. Select continuous trigger (EX TRIG keycap indicator off.)

6. The displays show relative readings up to 700 mV.

7. Apply the reference dc current to the current shunt and store the reference as described under "Instructions for Transfer Mode".

8. Reverse the polarity of the reference current and press the softkey to average the reference as described under "Instructions for Transfer Mode".

9. Apply the ac current under test. Transfer results are continuously updated on the Control Display.

To use the INPUT 1 and the 792A-7004 the adapter, proceed as follows:

1. Connect the 792A-7004 adapter to the INPUT 1 Type "N" connector.

2. Connect a Model A40 (not A40A) Current Shunt to the adapter.

3. Connect the current shunt to the ac current source under test.

4. Press the [INPUT1] key so that its keycap indicator lights.

5. Select continuous trigger (EX TRIG keycap indicator off.)

6. The displays show readings up to 700 mV.

7. Apply the reference dc current to the current shunt and store the reference as described under "Instructions for Transfer Mode".

8. Reverse the polarity of the reference current and press the softkey to average the reference as described under "Instructions for Transfer Mode".

9. Apply the ac current under test. Transfer results are continuously updated on the Control Display.

4-26. Choosing Delta Units

During transfers, the Control Display shows the difference between an applied input and the stored reference, or average of references. The difference can be displayed in units of V (or mV), ppm, percent, or ratio. Once a reference has been established you cycle though each choice by pressing any of the three softkeys showing on the Control Display. The Control Display cycles through PPM, PCT, VOLTS, and RATIO, and displays the equation used in each case.

4-27. Establishing a Reference

As an example, apply an external dc reference to INPUT 2. For highest resolution and most stable measurement display, set the Digital Filter to SLOW. (Press [UTIL MENUS] and "Meas Control" to access the Digital Filter controls.) If the wait for a settled reading ("U" annunciator off) is too long, adjust the digital filter speed and/or restart threshold. The displays appear as follows for a typical dc calibrator set to +2 V dc:

$$+1.9999996\text{v}$$

add16f.eps

```
Range                           Set
2.2V                            Ref
AUTO
```
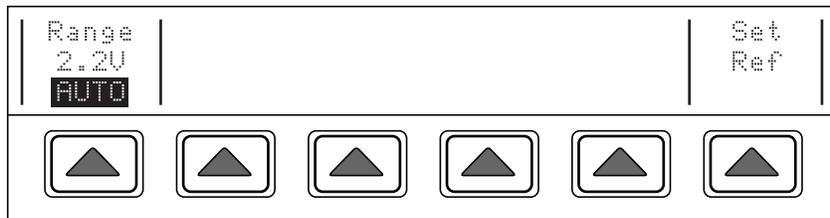
add08g.eps

Press the "Set Ref" softkey to establish the present input level as a reference. The Displays appear as follows:

$$+1.9999996\text{v}$$

add16f.eps

```
┌──────────────────────────────────────────────────────────────────┐
│  Range  │      Vin - Avg      │  Avg   │ Clear │
│  2.2V   │                     │  Ref   │  Ref  │
│  AUTO   │  0.9999645 RATIO    │ INPUT2 │       │
├─────────┬──────────┬──────────┬──────────┬──────────┬─────────────┤
│   ▲     │    ▲     │    ▲     │    ▲     │    ▲     │     ▲       │
└─────────┴──────────┴──────────┴──────────┴──────────┴─────────────┘
```

<div align="right">add08h.eps</div>

Reverse the polarity of the dc input and press the "Avg Ref" softkey to correct for dc reversal error. The 5790A averages a new measurement taken from INPUT 2 with the previously stored reference. The displays now appear as follows:

```
   ┌──────────────────────────┐
   │  -1.9999986 v            │
   └──────────────────────────┘
```

<div align="right">add17f.eps</div>

```
┌──────────────────────────────────────────────────────────────────┐
│  Range  │  (Vin - Avg) / Avg  │  Avg   │ Clear │
│  2.2V   │                     │  Ref   │  Ref  │
│  AUTO   │     -5.0 PPM        │ INPUT2 │       │
├─────────┬──────────┬──────────┬──────────┬──────────┬─────────────┤
│   ▲     │    ▲     │    ▲     │    ▲     │    ▲     │     ▲       │
└─────────┴──────────┴──────────┴──────────┴──────────┴─────────────┘
```

<div align="right">add08i.eps</div>

```
┌──────────────────────────────────────────────────────────────────┐
│  Range  │  (Vin - Avg) / Avg  │  Avg   │ Clear │
│  2.2V   │                     │  Ref   │  Ref  │
│  AUTO   │    -35.5 PPM        │ INPUT2 │       │
├─────────┬──────────┬──────────┬──────────┬──────────┬─────────────┤
│   ▲     │    ▲     │    ▲     │    ▲     │    ▲     │     ▲       │
└─────────┴──────────┴──────────┴──────────┴──────────┴─────────────┘
```

<div align="right">add08j.eps</div>

```
┌──────────────────────────────────────────────────────────────────┐
│  Range  │  (Vin - Avg) / Avg  │  Avg   │ Clear │
│  2.2V   │                     │  Ref   │  Ref  │
│  AUTO   │    -0.00 PCT        │ INPUT2 │ INPUT2│
├─────────┬──────────┬──────────┬──────────┬──────────┬─────────────┤
│   ▲     │    ▲     │    ▲     │    ▲     │    ▲     │     ▲       │
└─────────┴──────────┴──────────┴──────────┴──────────┴─────────────┘
```

<div align="right">add08k.eps</div>

```
┌──────────────────────────────────────────────────────────┐
│  Range   │     Vin - Avg        │  Avg   │ Clear │
│  2.2V    │                      │  Ref   │  Ref  │
│  [AUTO]  │    -0.000071  [V]    │ INPUT2 │       │
├──────────────────────────────────────────────────────────┤
│  [▲]   [▲]   [▲]   [▲]   [▲]   [▲]   │
└──────────────────────────────────────────────────────────┘
```
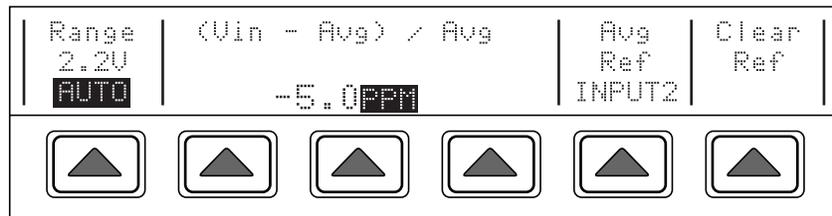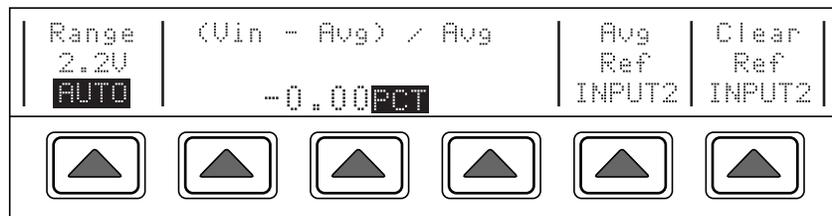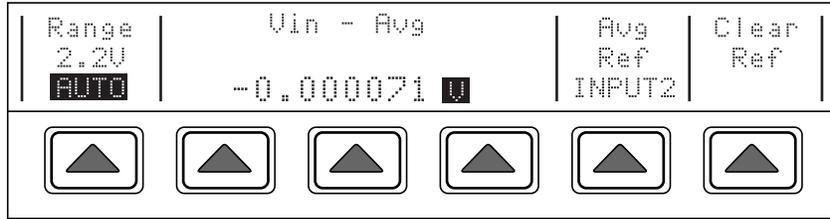
add08l.eps

Apply the unknown ac signal. You can use either of the two following methods to determine the error of an ac source:

1. Simply observe the delta display. For this method, accuracy of the transfer relies on the linearity of the transfer standard.

2. Adjust the ac source for a null with respect to the reference. Read off the error by observing the shift in ac source controls. This method relies on the linearity of the ac voltage source.

As you press the softkey under PPM you can cycle through the delta units choices. Note that the formula used to compute the ac-dc or ac-ac difference changes depending on delta units:


```
┌────────────────────────────────┐
│   1.9999925 v                  │
│          10.000 kHz            │
└────────────────────────────────┘
```

add18f.eps


```
┌──────────────────────────────────────────────────────────┐
│  Range   │     Vin / Avg        │  Avg   │ Clear │
│  2.2V    │                      │  Ref   │  Ref  │
│  [AUTO]  │   0.999964 [RATIO]   │ INPUT2 │       │
├──────────────────────────────────────────────────────────┤
│  [▲]   [▲]   [▲]   [▲]   [▲]   [▲]   │
└──────────────────────────────────────────────────────────┘
```

add08m.eps

4-28. Using the Top-Level Menu Keys

Three front panel keys, [VIEW REF], [UTIL MENUS], and [SPEC], provide quick access to additional operation information at any time except during calibration, self testing, or diagnostics. These keys display information about the reference value, call up an instrument setup menu, and display information about the uncertainty of the present measurement.

4-29. [VIEW REF] Key

If a reference is set, press [VIEW REF] to display the measured value of the active reference. For example, the Control Display could appear as follows:

```
| Range  |              Reference                |
| 2.2V   |   +1.9992370 V, 0.00 Hz @ INPUT2      |
| AUTO   |            2.2V range                  |
```

```
 ┌──────┐ ┌──────┐ ┌──────┐ ┌──────┐ ┌──────┐ ┌──────┐
 │  ▲   │ │  ▲   │ │  ▲   │ │  ▲   │ │  ▲   │ │  ▲   │
 └──────┘ └──────┘ └──────┘ └──────┘ └──────┘ └──────┘
```
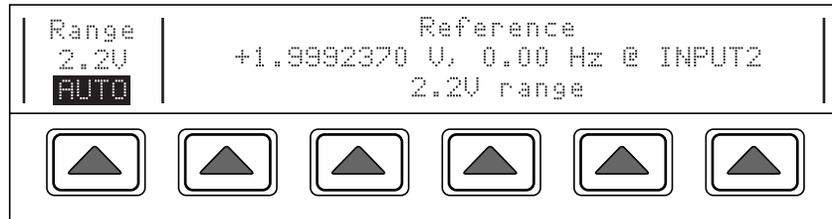
add08n.eps

If you previously pressed the "Avg Ref" softkey, you will see both input values that were used to compute the averaged reference as follows:

```
| Range  |                Reference                |
| 2.2V   |   +1.9992370 V, 0.00 Hz @ INPUT2        |
| AUTO   |   -1.9990762 V, 0.00 Hz @ INPUT2        |
```

```
 ┌──────┐ ┌──────┐ ┌──────┐ ┌──────┐ ┌──────┐ ┌──────┐
 │  ▲   │ │  ▲   │ │  ▲   │ │  ▲   │ │  ▲   │ │  ▲   │
 └──────┘ └──────┘ └──────┘ └──────┘ └──────┘ └──────┘
```
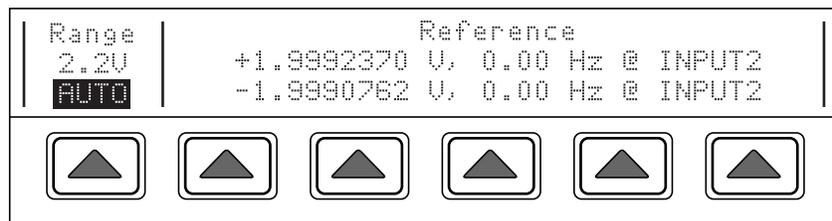
add08o.eps

Press [VIEW REF] again to return to normal operation. If no reference is set, [VIEW REF] generates a beep.

4-30. [UTIL MENUS] Key

Press [UTIL MENUS] to call up the top-level utilities menu, which provides softkeys for calibration, diagnostics, instrument configuration, and measurement control. Most parameters are saved in memory until they are changed, including power-off periods. Refer to Tables 4-1 and 4-2 for a summary.

When you press [UTIL MENUS], the Control Display changes to:

```
| Done  |  Cal  |  Diag |Config | Setup |  Meas  |
| With  |       |       |       |       |Control |
| Utils |       |       |       |       |        |
```

```
 ┌──────┐ ┌──────┐ ┌──────┐ ┌──────┐ ┌──────┐ ┌──────┐
 │  ▲   │ │  ▲   │ │  ▲   │ │  ▲   │ │  ▲   │ │  ▲   │
 └──────┘ └──────┘ └──────┘ └──────┘ └──────┘ └──────┘
```
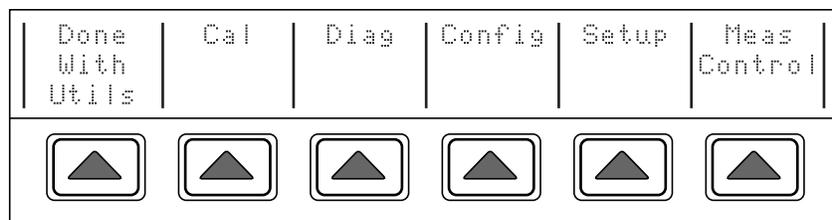
add08p.eps

This is the top-level utilities menu. The list below describes submenus accessed through each softkey and tells you where to find further information in the manuals.

- Cal: Opens the calibration menu. Softkeys in this menu execute dc zeros calibration, as previously described, and control the semiautomated calibration procedure. A softkey in this menu displays calibration date information and another opens a calibration report menu for printing data through the RS-232-C interface. Refer to Section 3 of the 5790A Service Manual for full details on calibration. DC zeros calibration is described earlier in this section.

- Diag: Opens the diagnostics menu. This menu contains softkeys to execute the power-up tests, diagnostics, and interactive tests for verifying the displays and keys. Refer to Section 5 of the 5790A Service Manual for instructions for using these softkeys.

- Config: Opens a menu that contains two softkeys: one that displays a list of installed hardware modules and software version numbers, and another that displays the contents of the user report string. This section describes how to use these softkeys.

- Setup: This menu contains softkeys to open submenus that let you change the calibration interval, set up the remote port, set the clock, Another menu lets you format the EEPROM (Electrically-Erasable Programmable Read-Only Memory), which is nonvolatile memory. Formatting the EEPROM is necessary only when you want to replace some or all of the information in memory with default values. The next part of this section describes the instrument setup menu and its submenus.

- Meas Control: Opens the measurement control menu. This menu contains softkeys for controlling the Digital Filter (a software window-averaging filter) and selecting INPUT 1 or INPUT 2 as the initial input. Section 4-16 describes how to use these softkeys.

4-31. *Checking Instrument Configuration*

The "Config" softkey in the utilities menu shows the serial number of the 5790A as programmed at the factory and presents two softkeys: one that displays a list of installed optional hardware modules and software revision letters, and another that displays the contents of the user report string.

The user report string an area of nonvolatile memory that contains whatever was stored last via the remote command RPTSTR. If this memory has not been changed, it contains the factory default string "5790A". In remote, you can read the contents of this memory using the query RPTSTR?. (See Sections 5 and 6 for more information about all the remote commands.)

Proceed as follows to view the instrument configuration information:

1. Press [UTIL MENUS] followed by the "Config" softkey. The Control Display changes to:
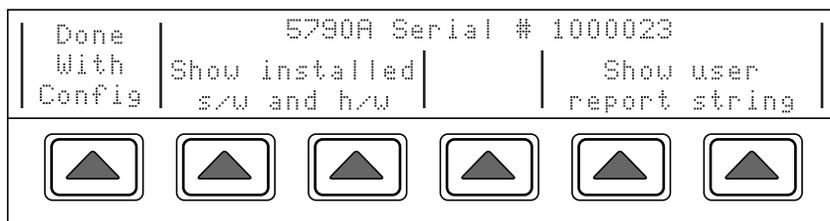
add08q.eps

2. Press the "Show user report string" softkey. The contents of the report string register appear on the Control Display. The string "5790A" is stored until you use the RPTSTR remote command to change it.
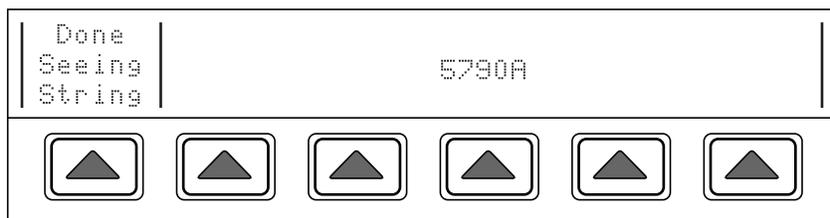
add08r.eps

3. Press "DONE Seeing String" followed by "Show Installed s/w and h/w." Software revisions are shown first. The "Main" software revision refers to software in ROM (Read-Only Memory) on the A20 CPU assembly. The "Inguard" software revision refers to software in ROM on the A17 Guard Crossing/Regulator assembly.

```
| Done   |INSTALLED SOFTWARE REVISIONS| Go to  |
| With   |Main:    1.1                |  H/W   |
| Config |Inguard: 1.0               | Config |
```
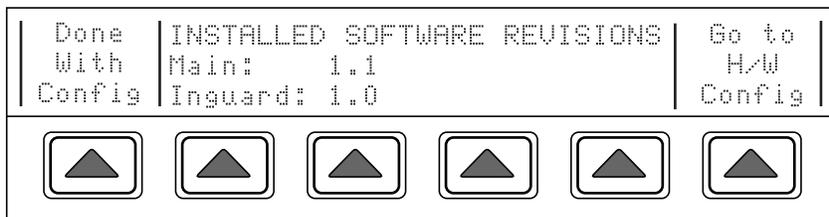
add08s.eps

4. Press the "Go to H/W config" softkey. This displays the options installed in your 5790A.

```
| Done   |        INSTALLED OPTIONS:          |
| With   |        Wideband AC Option          |
| Config |                                    |
```
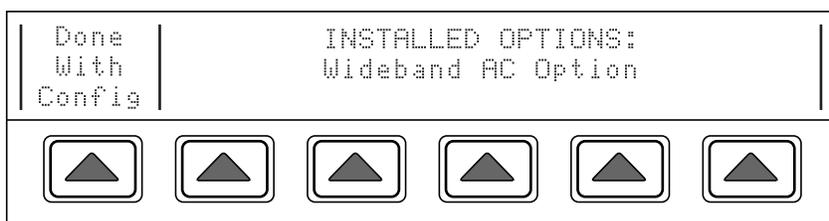
add08t.eps

5. To resume operation, press the "DONE with Config" softkey three times.

4-32. Setup Menu

The softkeys in the setup menu (accessed by pressing "Setup" softkey in the utilities menu) are shown below.

```
| Done   |Format |  Cal   |  Set   |Remote |        |
|Setting |EEPROM |Interval|Internal| Port  |        |
|  Up    |1 YEAR | Clock  | Setup  |       |        |
```
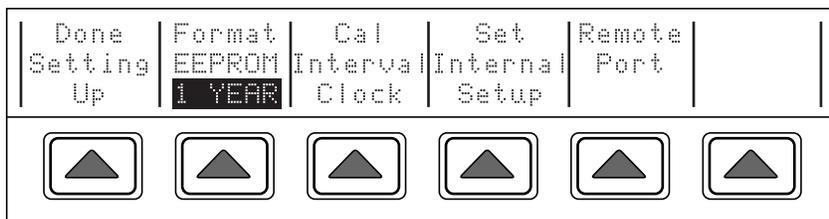
add08u.eps

The list below describes submenus accessed by each softkey and tells you where you can find further information in the manuals.

- Format EEPROM: Opens a menu that lets you restore all or part of the data in the EEPROM to factory defaults. The use of this menu is described right after this list.

- Cal Interval: Sets the calibration cycle length to 90 DAY, 1 YEAR, or 2 YEAR. Press the "Cal Interval" softkey as many times as necessary until your selection appears. The cal interval setting defines which internally stored specification table the [SPEC] key refers to and calibration reports use. Section 3 of the 5790A Service Manual describes how to calibrate the 5790A.

- Set Internal Clock: Accesses softkeys that allow you to check and set the date and time for the clock/calendar. This section describes how to set the time and date under the heading "Setting the Internal Clock/Calendar."

- Remote Port Setup: Opens setup menus for the IEEE-488 instrument control port and the RS-232-C serial interface port. Section 5 describes how to set up the IEEE-488 interface. Section 7 describes how to set up the serial interface. Either interface can be used as the remote control port.

4-33. Format Eeprom Menu

⚠ Caution

Use the format EEPROM with extreme care. This menu presents softkeys that permanently erase calibration constants. This should only be required after repair of the instrument. Pressing "ALL" or "CAL" invalidates the state of calibration of the 5790A. For this reason, the CALIBRATION STORE switch must be in the ENABLE position and the CALIBRATION MODE switch must be in the SERVICE position for these operations.

Pressing "Format EEPROM" in the instrument setup menu opens the following menu:

add08v.eps

The EEPROM is the nonvolatile memory device. (Its contents remain unchanged when the power is turned off.) It contains calibration constants and dates, setup parameters, and the user report string. Softkeys in this menu let you replace all or part of the contents with factory defaults. In the case of calibration constants, factory defaults are the starting defaults used for all 5790As. They are not the calibration constants obtained when the 5790A was originally calibrated by the factory before shipment. The function of each softkey is described below:

- ALL: Replaces the entire contents of the EEPROM with factory defaults. This would be used by service personnel after replacing the EEPROM, for example. It is not required in normal use. This softkey requires the rear panel CALIBRATION STORE switch to be in the ENABLE position and the CALIBRATION MODE switch SERVICE position.

- CAL: Replaces all calibration constants with factory defaults but leaves all the setup parameters unchanged. This is also not required in normal use. This softkey requires the rear panel CALIBRATION STORE switch to be in the ENABLE position and the CALIBRATION MODE switch SERVICE position.

- SETUP: Replaces the setup parameters with factory defaults but leaves the state of calibration intact.

To format a portion or all of the EEPROM, press the corresponding softkey. Formatting the EEPROM is a two-step process where you are asked to confirm your intentions before proceeding. The Control Display appears as follows:

```
|           |Do you really want to format        |      |
|           |            SETUP                   |      |
|    NO     |     portions of the EEPROM         | YES  |
```
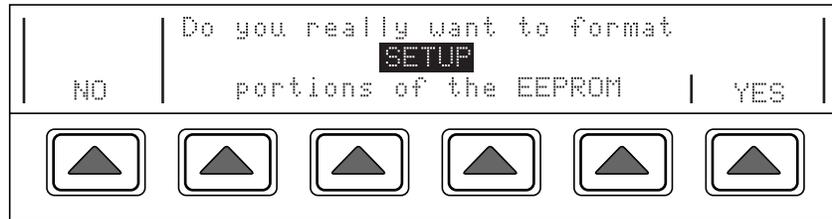

add08w.eps

If you press the NO softkey, the Control Display reverts to the format EEPROM menu. If you press the YES softkey, nonvolatile memory is restored to defaults as previously described.

4-34.   Setting the Internal Clock

An internal clock provides the date (corrected for leap years) and time to the 5790A CPU (Central Processing Unit). Check the clock setting and set it if necessary.

Note

A long-life lithium battery keeps the clock running during power-off periods. If the battery in your 5790A should ever need replacement, refer to the Service Manual. The battery is a button type that is soldered to the CPU Assembly (A20). Any procedure that involves removing the cover is to be performed only by qualified service personnel.

To set or change the time and date of the internal clock, proceed as follows:

1. If you want to set the date or both date and time, set the rear panel CALIBRATION STORE switch to ENABLE. (See Figure 3-2 for the switch location.) The position of the CALIBRATION switch does not matter for setting time only.

2. Press [UTIL MENUS] followed by the "Setup" and "Set Internal Clock" softkeys. The display changes to:

```
| DONE   |        Date = 3/5/91      |Adjust| Date  |
|Setting |        Time = 16:22:06    | the  |Format |
| Clock  |Use arrow keys to adjust->| DAY  | M/D/Y |
```
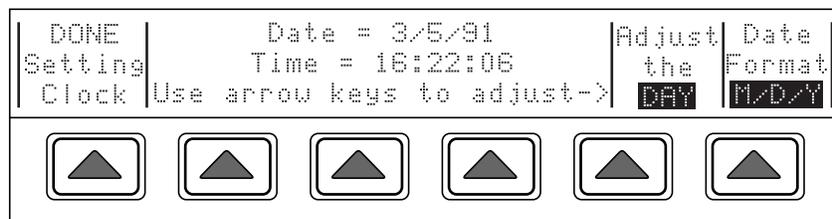

add08x.eps

3. You have three choices for the date display format. The active format is identified under "Date Format" at the right side of the Control Display. Press the "Date Format" softkey to change the date display format to one of the following choices:

    •   M/D/Y, for example, 3/5/91 for March 5, 1991 (leading zeros are not shown but they are required when you enter a new date).

    •   D.M.Y., for example, 5.3.91 for March 5, 1991 (leading zeros are not shown but they are required when you enter a new date).

    •   YMD, for example, 910305 for March 5, 1991 (leading zeros are kept as place holders). This format is typical for computer program use.

4. The choices available under the "Adjust the" softkey are DAY, MONTH, YEAR, HOUR, MINUTE, and SECOND. The softkeys autorepeat if you hold them down. Press the [^] key to increment, or the [v] key to decrement the selected parameter.

Note

Time is shown in 24-hour format and includes leading zeros. The format is hh:mm:ss where hh = hours, mm = minutes, and ss = seconds.

5. Return the rear panel CALIBRATION STORE switch to NORMAL.

6. To clear the clock setting display, press the "DONE Setting Clock" softkey followed by "DONE With Utils."

4-35. [SPEC] Key

At any time during front panel operation, you can display the uncertainty specification of the present output of the 5790A by pressing [SPEC]. To return to normal operation, press the [SPEC] key again. An example of the specification display follows:
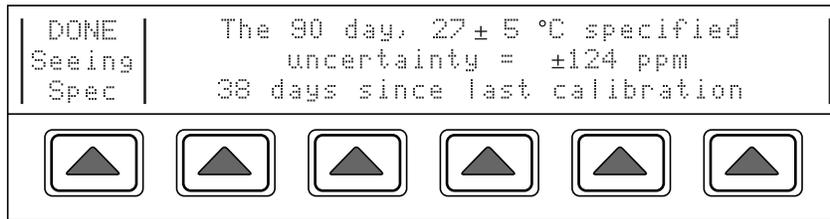
add08y.eps

Note

For INPUT 1 OR 2, the specification displayed is the measurement mode absolute uncertainty specification. For WIDEBAND, the specification displayed is the total uncertainty including flatness. For the SHUNT input, no specification is displayed. The days since calibration relates to the calibration procedure for the active input (Periodic or WIDEBAND).

4-36. Techniques for Reducing Transfer Errors

In making ac-dc transfers for the purpose of determining absolute ac voltage, errors can come from dc reversal, loading (both cable induced and instrument input), thermal emfs, changes in mechanical contact, spurious ground currents in the signal leads, and EMI.

Knowing more about these errors can help reduce the amount of time you spend experimenting and debugging to get the best possible results. Once you are confident that error sources are minimized, a good practice is to take three measurements. That way, if one measurement is faulty, it stands out.

4-37. DC Reversal

In measurement mode, the 5790A cancels potential dc reversal errors by chopping its internal dc reference into a low-frequency square wave. In transfer mode, it is up to you to correct for dc reversal to meet specifications. Apply one polarity of dc to the transfer standard INPUT and press the "Ref" softkey, then reverse the input polarity and press the "Ref Avg" softkey. In this way you establish a reference that consists of the average of both polarities of the dc input.

4-38. Loading

The 5790A input impedance may affect ac voltage source output levels. Refer to Table 4-4 for the input impedance on each range. Sources with resistive dividers on the output are especially sensitive to loading errors. Cables present an additional capacitive load to the source.

Check the specifications and instruction manual for each type of ac voltage source before connecting the source to the 5790A. Avoid exceeding the drive capability of the ac voltage source, no matter what the transfer application is. When in doubt, use an oscilloscope or spectrum analyzer to make sure the ac source is not loaded to the point that it is producing a distorted signal.

Before you calibrate an ac voltage source, there is another source of loading error to consider. What will the ac voltage source be used for after calibration? Many meters have highly capacitive inputs and present a much heavier load than the transfer standard. One way to compensate for meter loading is to simulate a meter load during calibration with the 5790A. To simulate a meter load, connect a load equivalent in capacitance and resistance to the meter input across the 5790A input.

4-39. Mechanical Contact

Connection contact resistance variation is a potential error source on the ranges above 2.2V. By using high quality cables and connectors, you can minimize this source of error. Use stainless steel coaxial connectors if possible. They are machined with more precise threads, which make better electrical contact. The Type "N" connectors on the 5790A are all stainless steel.

To achieve the highest quality measurements, do not disturb the instrumentation setup during the course of a transfer. Try not to move, jostle, or vibrate the 5790A, the source, or any of the input signal wiring from the time you apply the first input voltage until you take the last reading of the transfer.

Note

Most importantly, always repeat the measurements until you are satisfied that the results are repeatable relative to the specification being measured.

4-40. Thermal EMFs

Avoid thermal emf errors in the cabling between a dc voltage source and the INPUT 2 binding posts. They contribute to the uncertainty of the dc voltage output as seen by the 5790A. To reduce thermal emf errors, use low thermal emf cables and connectors and avoid touching any connection during a transfer. All it takes to change the emf error and adversely affect a transfer is to briefly touch a connector or binding post. It typically takes five minutes to thermally stabilize a connection after it has been touched.

4-41. EMI

The 5790A inputs, especially the WIDEBAND input, are broadband inputs. This means you should avoid applying RF signals inadvertently picked up by cables.

To minimize cable pickup, use short coaxial leads when possible, especially at test voltages below 2 V. Shielded cables and connectors can minimize the contribution of EMI to transfer uncertainty. A common-mode choke at the input terminals is an effective EMI suppressor when using low-level inputs. Do not use a common-mode choke for the ranges above 2.2 V.

Soldering irons, fluorescent lights, anything with a motor, and all similar things can radiate EMI. Turn off soldering irons, and keep the 5790A setup away from fluorescent lights.

5-1. Introduction

The 5790A AC Measurement Standard operates in local mode from the front panel controls or under remote control of an instrument controller, computer, or terminal. Remote control can be interactive, with the user controlling each step from a terminal, or under the control of a computer program running the 5790A in an automated system. This section tells you how to connect, configure, and operate the 5790A in remote mode. Section 6 is a command reference that describes all alphabetized commands in detail.

You can control the 5790A using a computer or terminal connected to the RS-232 serial port, or an IEEE-488 instrument controller connected to the IEEE-488 interface connector. When you control the 5790A through the serial port, you can set the 5790A to respond to queries in a conversational style for interactive control purposes, or to respond to queries in an abbreviated style for interpretation by a computer program. The following information tells how to set up for remote control, first for IEEE-488 (GPIB) controller use, then for remote control through the RS-232-C serial interface.

5-2. Using the IEEE-488 Interface for Remote Control

The 5790A is fully programmable for use on the IEEE Standard 488.1 interface bus (IEEE-488 bus). The interface is also designed in compliance with supplemental standard IEEE-488.2. Devices connected to the bus in a system are designated as talkers, listeners, talker/listeners, or controllers. Under the remote control of an instrument controller such as the Fluke 1722A, the 5790A operates exclusively as a talker/listener on the IEEE-488 bus.

This manual assumes you know the basics of the IEEE-488 interface bus. For an introduction to the bus, request Fluke Application Bulletin AB-36, <italic>IEEE Standard 488-1978 Digital Interface for Programmable Instrumentation.

5-3. IEEE-488 Bus Restrictions

The following restrictions apply to all IEEE-488 systems:

1. A maximum of 15 devices can be connected in a single IEEE-488 bus system.

2. The maximum length of IEEE-488 cable used in one IEEE-488 system is the lesser of either 20 meters or 2 meters times the number of devices in the system.

5-4. IEEE-488 Bus Setup Procedure

Setting up the 5790A on the IEEE-488 bus requires only a choice of address and connection to a controller. To set up the 5790A for remote operation,proceed as follows:

Press [UTIL MENUS] followed by the "Setup" softkey. The instrument setup menu appears:

add37f.eps

Press the "Remote Port Setup" softkey. The remote port setup menu appears:

```
┌─────────┬─────────┬─────────┬─────────┬─────────┬─────────┐
│  Done   │         │   Set   │  GPIB   │ Remote  │ RS-232  │
│ Setting │         │   EOF   │  Port   │  Port   │  Port   │
│  Port   │         │         │  GPIB   │  GPIB   │  Setup  │
└─────────┴─────────┴─────────┴─────────┴─────────┴─────────┘
```
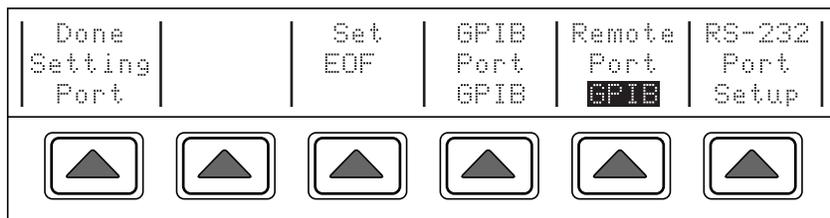
add38f.eps

Press the "Set EOF" softkey. If you want to change the EOF characters from the default, enter the ASCII decimal codes now as instructed on the display:

```
┌─────────┬───────────────────────────────────────────────┐
│  Done   │ EOF = 012,000 [ FF (^L), NUL (^@) ]            │
│  With   │ To change, key in ASCII decimal code           │
│  EOF    │         then Enter New EOF =                    │
└─────────┴───────────────────────────────────────────────┘
```

add39f.eps

Press the "DONE With EOF" softkey followed by the "GPIB Port Setup" softkey. To change the bus address from its factory default of 6, (the range is 0 to 30) use the up or down arrow key as instructed on the display:

```
┌─────────┬───────────────────────────────────────────────┐
│  Done   │          GPIB )(IEE-488) Port                  │
│  Port   │            Address = 6                         │
│ Setting │       down  |  up   |                          │
└─────────┴───────────────────────────────────────────────┘
```
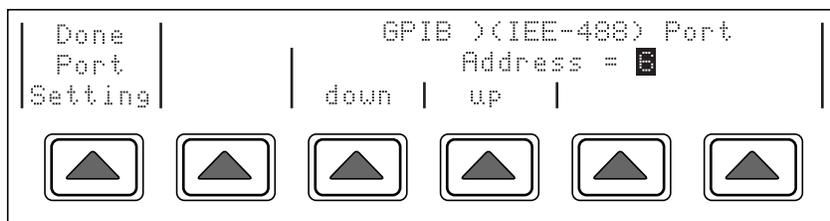
add40f.eps

Attach the IEEE-488 cable to the rear panel IEEE-488 connector. It is recommended that you use Fluke shielded cables Y8021, Y8022, or Y8023, in lengths of 1, 2, or 4 meters, respectively, for this purpose.

5-5. Using the Rs-232 Interface for Remote Control

Use these instructions to set up the 5790A's serial interface for remote control using a terminal or computer with a serial interface.

5-6. Serial Remote Control Setup Procedure

Press [UTIL MENUS] followed by the "Setup" softkey. The Instrument Setup Menu appears:

```
| Done    | Format | Cal      | Set      | Remote  |         |
| Setting | EEPROM | Interval | Internal | Port    |         |
| Port    |        | 1 YEAR   | Clock    | Setup   |         |
```

add41f.eps

Press the "Remote Port Setup" softkey. Press the "Remote Port" softkey so that "SERIAL" appears as shown below:

```
| Done    |        | Set    | GPIB   | Remote | RS-232 |
| Setting |        | EOF    | Port   | Port   | Port   |
| Port    |        |        | Setup  | RS-232 | Setup  |
```
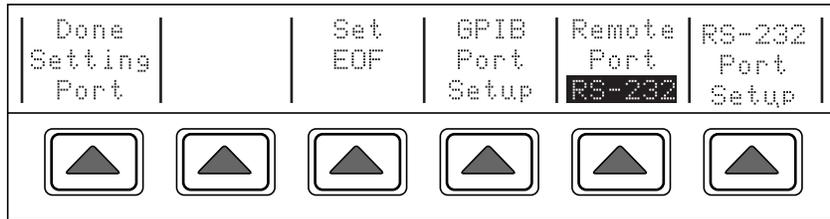
add42f.eps

Press the "RS-232 Port Setup" softkey. The RS-232 port setup menu appears:

```
| Done    |      | RS-232 Port |        | Next |
| Setting | 9600 | 8data | 1stop | Parity | Menu |
| Port    | baud | bits  | bit   | NONE   |      |
```
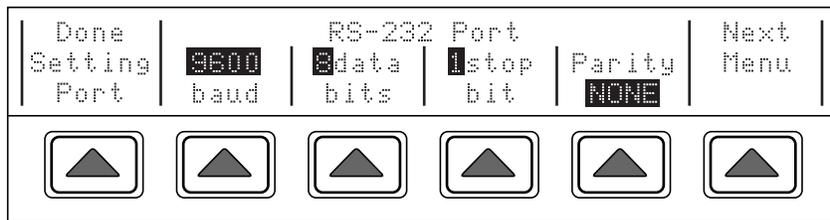
add43f.eps

Press the softkeys to select the desired baud rate, number of data bits, number of stop bits, and parity checking method. Press the "NEXT Menu" softkey. The second RS-232 parameter menu appears:

```
| Done    |       | RS-232 Port  |        | FIRST |
| Setting | Stall | Remote I/F   | EOL    | Menu  |
| Port    | XON   | TERMINAL     | CRLF   |       |
```
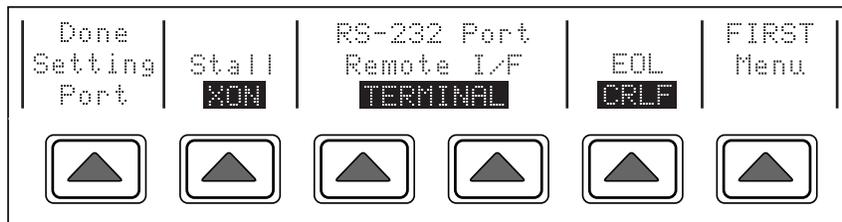
add44f.eps

Press the softkeys to select the desired stall method, terminal/computer responses, and EOL characters. Choose TERMINAL mode for interactive remote control. Responses from the 5790A are longer and are intended for a human operator using a terminal. Choose COMPUTER mode to get compact responses intended for use by a computer program. It is these OMPUTER mode responses that are listed in the remote command information and reference guide.

Use a null-modem serial interface cable such as Fluke accessory Y1702 to interconnect your computer or terminal and the RS-232-C connector on the 5790A.

5-7.   Exceptions for Serial Remote Control

When you use the RS-232-C port to remotely control the 5790A, either interactively with a terminal or under computer control, operation is the same as when you use an IEEE-488 controller connected to the IEEE-488 port for control, with the following exceptions:

1. Control/C performs the same function as DCL (Device Clear) or SDC (Selected Device Clear).

2. The EOL (End of Line) input terminator is Carriage Return (Control/M) or Line Feed (Control/L). All output lines are terminated by the terminator programmed in a setup menu, or set using the remote command SP_SET. This setting applies to all lines, including those with the *PUD command (see number 4).

3. Control/R echoes to the port a Carriage Return, a Line Feed, and any uncompleted remote command entered. This allows you to see a copy of whatever has been typed in since the last command.

4. For the *PUD (Protected User Data) and RPTSTR commands, which store characters for later recall, the serial remote interface does not store the characters listed below. These characters are processed as described above, so they cannot be a part of the *PUD command, except if "C\" notation is used within strings. The *PUD command terminates with Line Feed or Carriage Return, the same as all other serial remote commands.

    - ^C (Control/C)
    - ^J (Line Feed)
    - ^M (Carriage Return)
    - ^R
    - ^S (XOFF)
    - ^Q (XON)
    - ^B (Backup)
    - ^P (Serial Poll)
    - ^D (Cmd List)
    - ESC

5. The status registers still behave as described in this section, but there is no SRQ (Service Request) bus line to assert. For the equivalent of SRQ, refer to the remote commands SRQSTR and SRQSTR?

6. There are seven special commands available only for serial remote control: REMOTE, LOCKOUT, LOCAL, SPLSTR, SPLSTR?, SRQSTR, and SRQSTR?. These are described with the other commands in Section 6.

5-8.   Changing between Remote and Local Operation

In addition to local mode (front panel operation) and remote, the 5790A can be placed in a local lockout condition at any time by command of the controller. Combined, the local, remote, and lockout conditions yield four possible operating states described as follows.

5-9.   Local State

The 5790A responds to local and remote commands. This is normal front panel operation. All remote commands are allowed to execute.

5-10. Local with Lockout State

Local with lockout is identical to local, except the 5790A will go into the remote with lockout state instead of the remote state when it receives a remote command. The local

with lockout state is entered by executing the Fluke 1722A LOCKOUT statement when using the 1722A as an IEEE-488 controller, or by sending the LOCKOUT command described in Section 6 when you use the 1722A serial port to control the 5790A.

5-11. Remote State

When the Remote Enable (REN) line is asserted and the controller addresses the 5790A as a listener, it enters the remote state. These conditions are met, for example, when a 1722A executes the BASIC statement (which sets the active input to INPUT 1):

```
10 REMOTE \ PRINT @6 'INPUT INPUT1'
```

In the remote state, the Measurement Display continues to display the results of measurements as in local operation. The Control Display changes to:
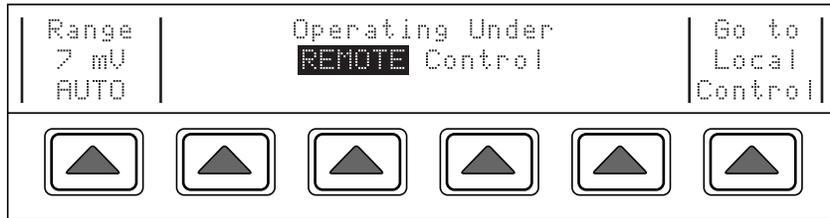
add45f.eps

Front panel operation is restricted to use of the power switch and the "GO TO LOCAL CONTROL" softkey. Pressing this softkey or sending the GTL (Go To Local) interface message returns the 5790A to the local state. (One way to send the GTL interface message is to execute the 1722A LOCAL statement.)

Note

The left most softkey does not toggle between AUTO and LOCKED in remote state although AUTO/LOCKED is indicated. This key is available only when the AUTO/LOCKED indication is in inverse video. (For example: See Section 4-20.)

5-12. Remote with Lockout State

The remote with lockout state can be entered from remote or local with lockout, but not directly from local. Remote with lockout is similar to the remote state, but restricted: the "GO TO LOCAL CONTROL" softkey label does not appear on the Control Display as shown below:

add46f.eps

To return the 5790A to the local with lockout state, the GPIB controller sends GTL. (When you are using the 1722A as an IEEE-488 controller, you can do this manually by executing a WBYTE statement.) To return the 5790A to the local state, the GPIB controller unasserts the REN control line. (In the 1722A, the "LOCAL" BASIC statement does this.)

Table 5-1 summarizes the possible Remote/Local state transitions.

Table 5-1. Operating State Transitions

From	To	Use	1722A Gpib Command	Serial Command
Local	Remote	MLA + REN	REMOTE	REMOTE
Local	Local With Lockout	LLO + REN	LOCKOUT	LOCKOUT
Remote	Local	GTL, or "GO TO LOCAL CONTROL" softkey	LOCAL	LOCAL
Local With Lockout	Remote/Lockout	MLA + REN	REMOTE, or any 5790A command	REMOTE
	Remote/Lockout	LLO + REN	LOCKOUT	LOCKOUT
Remote/Lockout	Local	REN not	LOCAL	LOCAL

5-13. Command Syntax Information

The following syntax rules apply to all the remote commands. (A command consists of a word by itself or a word followed by one or more parameters.) The rules for parameter syntax are provided first (including proper usage of units and multipliers), followed by the rules for extra spaces, followed by the rules for terminator usage. A description of how the 5790A processes incoming characters provides the basis for answering other possible questions about syntax. Information about syntax of response messages is also given.

5-14. Parameter Syntax Rules

Many of the remote commands require parameters. Improper use of parameters causes command errors to occur. When a command error occurs, bit CME (5) in the Event Status Register (ESR) goes to 1 (if enabled in ESE register), and the error is logged in the error queue. Table 5-2 lists the vocabulary of units accepted in command parameters and used in responses.

General rules for parameter usage are:

1. When a command has more than one parameter, the parameters must be separated by commas. For example: "CLOCK 133700,071791").

2. Numeric parameters may have up 15 significant digits and their exponents can be in the range +/-1.0E+/-20.

3. Including too many or too few parameters causes a command error.

4. Null parameters cause a command error (e.g., the adjacent commas in "CLOCK 133700, , 071791").

5. Expressions, for example "(4+2*13)", are not allowed as parameters.

6. Binary Block Data can be in one of two forms. The first form accepts data bytes after the #0 until the ASCII Line Feed character is received with an EOI signal. In the second form, the non-zero digit specifies the number of characters that will follow in the <digits> field. These characters must be 0 through 9 (ASCII 48 through 57 decimal). The value of the number in the <<digits> field defines the number of user data bytes that will follow in the <<user data> field.

```
#0 <<user data> <<ASCII Line Feed with EOI>
or
#<<non-zero digit> <<digits> <<user data>
or
"string"
```

Note

You can substitute a plain string when Binary Block Data is specified. For example "hello world."

5-15. Extra Space or Tab Characters

In the command descriptions in Section 6 and the remote program examples at the end of this section, commands and their parameters are shown separated by spaces. One space after a command is required. All other spaces are optional. Spaces are inserted for clarity in the manual and may be left in or omitted as desired. You can insert extra spaces or tabs between parameters as desired. Extra spaces within a parameter are generally not allowed, except for between a number and its associated multiplier or unit.

Section 6 contains examples for commands whose parameters or responses are not self-explanatory. Remote program examples for the Fluke 1722A Instrument Controller are provided at the end of this section.

5-16. Terminators

To signify the end of a response sent to the controller, the 5790A sends a "terminator." The 5790A sends the ASCII character Line Feed with the EOI control line held high as the terminator for response messages. The 5790A recognizes the following as terminators when encountered in incoming data:

Table 5-2. Units Accepted in Parameters and Used in Responses

UNITS	MEANING
HZ	Frequency in units of Hz
kHZ	Frequency in units of kHz
MHZ	Frequency in units of MHz
UV	Volts in units of uV
MV	Volts in units of mV
V	Volts in units of V
KV	Volts in units of kV
A	Current in units of A
PCT	Percent
PPM	Parts-per-million
RATIO	(Unitless)

ASCII LF character

Any ASCII character sent with the EOI control line asserted

The terminator used by the Fluke 1722A Instrument Controller for data it sends to instruments on the IEEE-488 bus is programmable, but its default is LF with EOI.

5-17. Incoming Character Processing

The 5790A processes all incoming data as follows (except Binary Block Data as described under Parameter Syntax Rules).

The most significant data bit (DIO8) is ignored.

All data is taken as 7-bit ASCII.

Lower-case or upper-case characters are accepted.

ASCII characters whose decimal equivalent is less than 32 (Space) are discarded, except for characters 10 (LF) and 13 (CR) and in the *PUD command argument. Binary Block Data allows all characters in its argument and terminates in a special way.

5-18. Response Message Syntax

In the command descriptions in Section 6, responses from the 5790A are described wherever appropriate. In order to know what type of data to read in, refer to the first part of the entry under "Response" in the tables. The response is identified as one of the data types in Table 5-3.

5-19. Input Buffer Operation

As the 5790A receives each data byte from the controller, it places the bytes in a portion of memory called the input buffer. The input buffer holds up to 128 data bytes and operates in a first in, first out fashion.

The 5790A treats the EOI IEEE-488 control line as a separate data byte and inserts it into the input buffer if it is encountered as part of a message terminator.

Input buffer operation is transparent to the program running on the controller. If the controller sends commands faster than the 5790A can process them, the input buffer fills to capacity. When the input buffer is full, the 5790A holds off the IEEE-488 bus with the NRFD (Not Ready For Data) handshake line. When the 5790A has processed a data byte from the full input buffer, it then completes the handshake, allowing the controller to send another data byte.

The 5790A clears the input buffer on power-up and on receiving the DCL (Device Clear) or SDC (Selected Device Clear) messages from the controller.

Under RS-232-C serial port remote control using Control/S (XOFF) protocol, the 5790A issues a Control/S (XOFF) when the input buffer becomes 80% full. The 5790A issues a Control/Q (XON) when it has read enough of the input buffer so that it is less than 40% full. When using RTS (Request to Send) protocol, the serial interface asserts and deasserts RTS in response to same conditions as for XON/XOFF protocol

Table 5-3. Response Data Types

Data Type	Description
Integer	Integers for some controllers or computers are decimal numbers in the range -32768 to 32767.
	Responses in this range are labeled Integer.
	Example:
	CMD: *ESE 123; *ESE?
	RESP: 123
Floating	Numbers that may have up to 15 significant figures plus an exponent that may range from +/-E20.
	Example:
	CMD: CAL_CONST? FREQ_G
	RESP: +1.000141377406621E+00
String	Any ASCII characters including quotation mark
	Example:
	CMD: RPTSTR "Hello World"; RPTSTR?
	RESP: "Hello World"
Character Response Data (CRD)	This type of response is always a keyword such as PPM, PCT, and RATIO.
	Example:
	CMD: DUNIT PPM;DUNIT?
	RESP: PPM
Indefinite ASCII (IAD)	Any ASCII characters followed by EOM. (EOM is an IEEE-488 bus message.) Queries with this type of response MUST be the last query in a program message.
	Example:
	CMD: *OPT?
	RESP: WBND
	CMD: *OPT?;*ESE?
	RESP: <none>
	ERR? = 1310,"488.2 Query After Indefinite Response"
	CMDSTR? = "*opt?;*ese?\n"
	CAL reports and lists which contains NEWLINE's
	are typically of this type
Binary Block Data	A special data type defined by the IEEE-488.2 standard. This type is used in *PUD? query. It is defined as follows:
	#(non-zero digit) (digits) (user data)
	The non-zero digit specifies the number of characters that will follow in the <digits> field. Characters allowed in the digits field are 0 through 9 (ASCII 48 through 57 decimal). The value of the number in the <digits> field in decimal defines the number of user data bytes that follow in the <user data> field. The maximum response is 64 characters.
	Example:
	CMD: *PUD "test1"; *PUD?
	RESP: #40005test?

5-20. Using Commands

Communication between the controller and the 5790A consists of interface messages and commands. Interface messages are defined by the IEEE-488.1 standard and control the lowest level of bus communication. Interface messages are handled automatically by the controller. (See "Interface Messages" further on in this section for more information.) Commands are sent to the 5790A literally, for example, with the Fluke 1722A BASIC PRINT statement. The commands are described in Section 6. There are three types of commands:

Common commands: Commands that start with an asterisk. These are defined by the IEEE-488.2 standard.

Device-dependent commands: Commands specific to the 5790A.

Queries: Commands that cause the 5790A to send a response to the controller. (These commands always end with a question mark (?).)

A controller program first needs to initialize the interface and the 5790A.

Refer to following sample program:

```
10 INIT PORT 0 \ REMOTE @6  ! PUT THE 5790A INTO THE REMOTE STATE
20 PRINT @6, "INPUT INPUT2" ! MAKE INPUT2 THE ACTIVE INPUT
30 PRINT @6, "MEAS?"                ! TAKE A MEASUREMENT
40 INPUT @6, V,F,ST               ! GET THE RESULT
```

If you wish to use SRQs, first use the *SRE, *ESE, and ISCE commands to enable the desired event. Refer to "Checking the Instrument Status" further on in this section for more information.

You retrieve instrument parameters with a query (a programming command that ends with a question mark):

```
200 PRINT @6, "DUNIT?"        ! RETRIEVE DELTA UNITS
210 INPUT LINE @6, A$
220 PRINT "Delta Units are: "; A$
230 PRINT @6, "ONTIME?"     ! RETRIEVE ON TIME
240 INPUT LINE @6, A$
250 PRINT "The instrument has been on for "; A$;" minutes"
```

This program generates the following sample output:

```
Delta Units are: PPM
The instrument has been on for 1595 minutes
```

Check for programming errors as in the following sample programs. Check the Error Available (EAV) bit in the serial poll register using a serial poll.

```
300 A = SPL(6)                             ! CHECK FOR ERRORS
310 IF (A AND 8) THEN PRINT "There was an error"
320 PRINT @6, "*CLS"             ! CLEAR ERRORS
```

Retrieve errors and explanations as follows. Since errors are accumulated in a queue, you must read the entire queue to retrieve and clear all the errors.

```
400 PRINT @6, "ERR?"            ! CHECK FOR ERRORS
410 INPUT @6, A, A$                 ! READ IN THE ERROR
420 IF (A = 0) THEN GOTO 500    ! NO MORE ERRORS
430 PRINT "Error# :";A, A$             ! PRINT ERROR# AND EXPLANATION
440 GOTO 400
500 END
```

5-21. Multiple Commands

If the controller on the IEEE-488 bus is a Fluke 1722A, commands are sent one at a time or combined in Fluke BASIC PRINT statements. For example, if the 5790A bus address is 6 and you want take a reading on the input at INPUT 2, you could use the following BASIC program statements:

```
10 INIT PORT 0 \ REMOTE @6
20 PRINT @6,"INPUT INPUT2"
30 PRINT @6,"MEAS?"
```

You can combine two commands in one statement as follows:

```
10 INIT PORT 0 \ REMOTE @6
20 PRINT @6,"INPUT INPUT2 ; MEAS?"
```

In both versions of the program, the PRINT statements transmit all necessary interface messages (ATN and MLA) automatically.

To use the 1722A to control the 5790A via its serial interface ("KB1:" on the 1722A), the equivalent program is:

```
10  SI% = 1% \ SO% = 2%
20  OPEN "KB1:" AS NEW FILE SO%
30  OPEN "KB1:" AS OLD FILE SI%
40  PRINT #SO%, "REMOTE"
50  PRINT #SO%, "INPUT INPUT2 ; MEAS?"
```

5-22. Sequential and Overlapped Commands

Commands executed immediately as they are encountered in the data stream are called sequential commands. Commands that begin execution, but are completed some time later are called overlapped commands, because they can be overlapped by later commands. All the commands described in Section 6 are sequential unless it is stated otherwise in the alphabetical listings.

You can use *OPC, *OPC?, and *WAI to detect completion of overlapped or long-term commands. (See the full descriptions of *OPC, *OPC?, and *WAI in Section 6 and the remote examples in this section for more information about these commands.)

5-23. Commands that require the CALIBRATION STORE or MODE Switch to be Enabled

The following commands do not work unless the rear panel CALIBRATION STORE switch is in the ENABLE position: CLOCK, most calibration commands, and *PUD. FORMAT ALL, FORMAT CAL, and some calibration commands also require that you set the CALIBRATION MODE switch to SERVICE. Attempting to use any of these commands with the CALIBRATION STORE or MODE switch in the NORMAL position logs an error into the error queue. (Or it returns the error message if in serial remote control TERMINAL mode.)

5-24. Long-Term Commands

Some remote commands take a relatively long time to execute. These are called "long-term commands" and they are identified as such in the command descriptions in Section 6. If a command that produces a change in instrument state is received during the execution of a long-term command, for example, CAL_AC, the command is not executed and a device-dependent error occurs. (Bit 3 in the Event Status Register is set to 1 if enabled, and the error code for the error is available to be read from the error queue. See the "ERR?" command for more information.)

5-25. Checking 5790A Status

The programmer has access to status registers, enable registers, and queues in the 5790A to indicate various conditions in the instrument as shown in Figure 5-1. Some registers and queues are defined by the IEEE-488.2 standard. The rest are specific to the 5790A. In addition to the status registers, the Service Request control line, SRQ, and a 16-element buffer called the Error Queue provide status information. Table 5-4 lists the status registers and gives the read/write commands and mask registers associated with each.

Each status register and queue has a summary bit in the Serial Poll Status Byte. Enable registers are used to mask various bits in the status registers and generate summary bits in the Serial Poll Status Byte. The Service Request Enable Register can be used to assert the IEEE-488 Service Request (SRQ) control line on detection of any status condition or conditions the programmer chooses.

5-26. Serial Poll Status Byte (STB)

The most important and frequently used register is the serial poll status byte (STB), which the 5790A sends when it responds to a serial poll. This byte is cleared (set to 0) when the power is turned on. The value of this byte at power-on is determined by the value of the service request enable register (SRE), which is saved in nonvolatile memory. Its bits are defined as follows (bits 1 and 0 are always 0).

If you are using the RS-232-C port as the remote control interface, transmitting the ^P character returns the SPLSTR and the status byte. Also refer to the *STB? command in Section 6 for more information.

5-27. Service Request Line (SRQ)

Service Request (SRQ) is an IEEE-488.1 bus control line that the 5790A asserts to notify the controller that it requires some type of service. Many instruments can be on the bus, but they all share a single SRQ line. To determine which instrument set SRQ, the Controller normally does a serial poll of each instrument. The 5790A asserts SRQ whenever the RQS bit in its Serial Poll Status Byte is 1. This bit informs the controller that the 5790A was the source of the SRQ.

The 5790A clears SRQ and RQS whenever the controller performs a serial poll of the 5790A IEEE-488 interface, sends *CLS, or whenever the MSS bit is cleared. The MSS bit is cleared only when RID, ESB, MAV, EAV, and ISCB are 0, or they are disabled by their associated enable bits in the SRE register being set to 0.

5-28. Service Request Enable Register (SRE)

The Service Request Enable Register (SRE) enables or masks the bits of the Serial Poll Status Byte. The SRE is cleared at power up. Refer to "Serial Poll Status Byte" for the bit functions.

5-29. Programming the STB and SRE

By resetting (to 0) the bits in the SRE, you can mask (disable) associated bits in the serial poll status byte. Bits set to 1 enable the associated bit in the serial poll status byte. The following sample program enables the Error Available (EAV) bit.

```
10   ! THIS PROGRAM SETS EAV IN THE SRE

20   PRINT @6,"*SRE 16"                ! LOAD THE REGISTER

30   PRINT @6, "*SRE?"                 ! ASK FOR THE SRE CONTENTS

40   INPUT @6, A%                      ! RETRIEVE THE REGISTER CONTENTS

50   PRINT "SRE = ";A%

60   RETURN
```

The following program generates an error and checks the Serial Poll StatusByte. Enable the EAV bit with the examples above.

```
10   ! THIS PROGRAM GENERATES AN ERROR AND CHECKS IT

20   PRINT @6, "RANGE 1300V"           ! 1300V IS OUT OF 5790A RANGE

30   A% = SPL(6)                       ! DO A SERIAL POLL

40   IF ((A% AND 80%)=0%)THEN PRINT "EAV and RQS should have been set"

50   PRINT @6, "STB?"                  ! RETRIEVE BYTE

60   INPUT @6, A%

70   IF ((A% AND 16%)=0%) THEN PRINT "EAV should have been set"
```

Figure 5-1. Status Register Overview

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Table 5-4. Status Register Summary

Register	Read Command	Write Command	Enable Register
Serial Poll Status Byte	(STB) *STB? (or SPL) for 1722A)	None	SRE
Service Request Enable Register (SRE)	*SRE?	*SRE	None
Event Status Register (ESR)	*ESR?	*ESE	None
Event Status Enable Register (ESE)	*ESE?	*ESE	None
Instrument Status Register (ISR)	ISR?	None	None
Instrument Status 0-1 Change Register (ISCR1)	ISCE1?	ISCR1	None
Instrument Status 0-1 Change Enable Register (ISCE1)	ISCE1?	ISCE1	None
Instrument Status 1-0 Change Register (ISCR0)	ISCR0?	None	ISCE0
Instrument Status 1-0 Change Enable Register (ISCE0)	ISCE0?	ISCE0	None

5-30. Event Status Register (ESR)

The Event Status Register is a two-byte register in which the higher eight bits are always 0, and the lower eight bits represent various conditions of the 5790A. The ESR is cleared (set to 0) when the power is turned on, and every time it is read.

5-31. Event Status Enable Register (ESE)

A mask register called the Event Status Enable register (ESE) allows the controller to enable or mask (disable) each bit in the ESR. When a bit in the ESE is 1, the corresponding bit in the ESR is enabled. When any enabled bit in the ESR is 1, the ESB bit in the Serial Poll Status Byte also goes to 1. The ESR bit stays 1 until the controller reads the ESR or does a device clear, a selected device clear, or sends the reset or *CLS command to the 5790A. The ESE is cleared (set to 0) when the power is turned on.

5-32. Bit assignments for the ESR and ESE

The bits in the Event Status Register (ESR) and Event Status Enable register (ESE) are assigned as shown in Figure 5-3.

5-33. Programming the ESR and ESE

To read the contents of the ESR, send the remote command, "*ESR?." The ESR is cleared (set to 0) every time it is read. To read the contents of the ESE, send the remote command, "*ESE?." The ESE is not cleared when it is read. When you read either register, the 5790A responds by sending a decimal number that when converted to binary represents bits 0 through 15.

The following sample program retrieves the contents of both registers:

```
10  ! THIS PROGRAM READS THE ESR AND THE ESE REGISTERS
20  PRINT @6, "*ESR?"        ! ASK FOR THE ESR CONTENTS
30  INPUT @6, A%                 ! RETRIEVE THE REGISTER CONTENTS
40  PRINT @6, "*ESE?"        ! ASK FOR THE ESE CONTENTS
50  INPUT @6, B%                 ! RETRIEVE THE REGISTER CONTENTS
60  PRINT "ESR = ";A%        ! DISPLAY THE ESR REGISTER CONTENTS VALUE
70  PRINT "ESE = ";B%        ! DISPLAY THE ESE REGISTER CONTENTS VALUE
80  END
```

7	6	5	4	3	2	1	0
RID	**RQS** **MSS**	**ESB**	**MAV**	**EAV**	**ISCB**	**0**	**0**

RID   Remote idle. Set to 1 when the remote interface is waiting for input.

RQS   Requesting service. The RQS bit is set to 1 whenever bits ESB, MAV, EAV, or ISCB change from 0 to 1 and are enabled (1) in the SRE. When RQS is 1, the 5790A asserts the SRQ control line on the IEEE-488 interface. You can do a serial poll to read this bit to see if the 5790A is the source of an SRQ.

MSS   Master summary status. Set to 1 whenever bits ESB, MAV, EAV, or ISCB are 1 and enabled (1) in the SRE. This bit can be read using the *STB? command in serial remote control in place of doing a serial poll.

ESB   Set to 1 when one or more enabled ESR bits are 1.

MAV   Message available. The MAV bit is set to 1 whenever data is available in the 5790A's IEEE-488 interface output buffer.

EAV   Error available. An error has occurred and an error is available to be read from the error queue by using the ERR? query.

ISCB   One or more enabled ISCR bits are 1.

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Figure 5-2. Status Byte and SRE Bit Definitions

Convert the contents of variables A and B into binary, and you can read the status of the registers. For example if A is "32", its binary equivalent is: 00000000 00100000. Therefore, bit 5 (CME) in the ESR is set (1) and the rest of the bits are reset (0). This means that the 5790A tried to execute an incorrectly formed command.

By setting the bits in the ESE, you can mask (disable) the associated bits in the ESR. For example, to prevent the occurrence of a command error from causing bit 5 (ESB) in the serial poll status byte to go to 1, you can reset (to 0) bit 5 in the ESE register. The following sample program accomplishes this by checking the status of the CME bit, then toggling it if it is 1.

```
10  ! THIS PROGRAM RESETS BIT 5 (CME) IN THE ESE
20  PRINT @6,"*ESE 33"         ! INITIAL ESE IS CME + OPC
30  GOSUB 100                          ! GET AND PRINT INITIAL ESE
40  IF (A% AND 32%) THEN A% = A% - 32% ! CLEAR CME (BIT 5)
50  PRINT @6, "*ESE ";A%     ! LOAD THE ESE WITH THE NEW VALUE
60  GOSUB 100                          ! GET AND PRINT NEW ESE
70  END
100 PRINT @6, "*ESE?"          ! ASK FOR THE ESE CONTENTS
110 INPUT @6, A%                 ! RETRIEVE THE REGISTER CONTENTS
120 PRINT "ESE = ";A%
130 RETURN
```

5-34. Instrument Status Register (ISR)

The Instrument Status Register (ISR) gives the controller access to the state of the 5790A, including some of the information presented to the operator on the Control Display and the display annunciators during local operation.

15	14	13	12	11	10	9	8
0	0	0	0	0	0	0	0

7	6	5	4	3	2	1	0
PON	**0**	**CME**	**EXE**	**DDE**	**QYE**	**0**	**OPC**

PON   Power on. This bit is set to 1 if line power has been turned off and on since the last time the ESR was read.

CME   Command error. The 5790A's IEEE-488 interface encountered an incorrectly formed command. (The command ERR? fetches the earliest error code in the error queue, which contains error codes for the first 15 errors that have occurred.)

EXE   xecution error. An error occurred while the 5790A tried to execute the last command. This could be caused, for example, by a parameter being out of range. (The command ERR? fetches the earliest error in the error queue, which contains error codes for the first 15 errors that have occurred.)

DDE   Device-dependent error. An error related to a device-dependent command has occurred.

QYE   Query error. The 5790A was addressed to talk when no response data was available or appropriate, or when the controller failed to retrieve data on the output queue.

OPC   Operation complete. All commands previous to reception of a *OPC command have been executed, and the interface is ready to accept another message.

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Figure 5-3. Bit Assignments for ESE and ESE

5-35. Instrument Status Change Registers

There are two registers dedicated to monitoring changes in the ISR. These are the ISCR0 (Instrument Status 1-0 Change Register) and the ISCR1 (Instrument Status 0-1 Change Register). Each status change register has an associated mask register. Each ISCR is cleared (set to 0) when the 5790A is turned on, every time it is read, and at each *CLS (Clear Status) command.

5-36. Instrument Status Change Enable Registers

The Instrument Status Change Enable registers (ISCE0 and ISCE1) are mask registers for the ISCR0 and ISCR1 registers. If a bit in the ISCE is enabled (set to 1) and the corresponding bit in the ISCR makes the appropriate transition, the ISCB bit in the Status Byte is set to 1. If all bits in the ISCE are disabled (set to 0), the ISCB bit in the Status Byte never goes to 1. The contents of the ISCE registers are set to 0 at power-up.

5-37. Bit Assignments for the ISR, ISCR, and ISCE

The bits in the Instrument Status, Instrument Status Change, and Instrument Status Change Enable registers

5-38. Programming the ISR, ISCR, and ISCE

To read the contents of the ISR, send the remote command, "ISR?." To read the contents of the ISCR0 or 1, send the remote command, "ISCR0?", or "ISCR01?." To read the contents of the ISCE0 or 1, send the remote command, "ISCE0?", or "ISCE1". The 5790A responds by sending a decimal number that represents bits 0 through 15. Every time you read the ISCR0 or 1, its contents are zeroed. The following sample program reads all five registers:

```
10  ! THIS PROGRAM READS THE ISR, ISCR, AND ISCE REGISTERS
20  ! NOTE THAT THE ICSR? COMMANDS CLEAR THE ISCR CONTENTS
30  PRINT @6, "ISR?"       ! ASK THE ISR CONTENTS
40  INPUT @6,A%              ! RETRIEVE THE REGISTER CONTENTS FROM THE 5790A
50  PRINT @6, "ISCR0?"   ! ASK FOR AND CLEAR THE ISCR0 CONTENTS
60  INPUT @6, B%              ! RETRIEVE THE REGISTER CONTENTS FROM THE 5790A
70  PRINT @6, "ISCE0?"   ! ASK FOR THE ISCE0 CONTENTS
80  INPUT @6, C%              ! RETRIEVE THE REGISTER CONTENTS FROM THE 5790A
50  PRINT @6, "ISCR1?"  ! ASK FOR AND CLEAR THE ISCR1 CONTENTS
60  INPUT @6, D%             ! RETRIEVE THE REGISTER CONTENTS FROM THE 5790A
70  PRINT @6, "ISCE1?"  ! ASK FOR THE ISCE1 CONTENTS
80  INPUT @6, E%             ! RETRIEVE THE REGISTER CONTENTS FROM THE 5790A
90  PRINT "ISR =  ";A% ! DISPLAY THE ISR
100 PRINT "ISCR0 = ";B%  ! DISPLAY THE ISCR0
110 PRINT "ISCE0 = ";C%  ! DISPLAY THE ISCE0
100 PRINT "ISCR1 = ";D%  ! DISPLAY THE ISCR1
110 PRINT "ISCE1 = ";E%  ! DISPLAY THE ISCE1
120 END
```

Convert the returned variables into binary, and you can read the status of the instrument. For example if a register contains "4", its binary equivalent is: 00000000 00000100. Therefore, bit 3 (RNGCHG is set (1) and the rest of the bits are reset (0).

By setting the bits in an ISCE register, you can mask (disable) the associated bits in the ISCR. For example, to cause an SRQ interrupt when the input frequency goes over range, bit 10 (MDCHG) in the ISCE1 register must be 1. (The ISCB bit must also be enabled in the SRE.) The following sample program loads a decimal 1024 into the ISCE, which sets bit 10 and resets the other bits:

```
10  ! THIS PROGRAM LOADS 00000100 00000000 BINARY INTO THE ISCE
20  PRINT @6, "ISCE 1024" ! LOAD DECIMAL 1024 INTO THE ISCE
30  PRINT @6, "ISCE?"        ! READ BACK THE VALUE
40  INPUT @6, A%               ! "
50  PRINT "ISCE = ";A%     ! PRINT IT, IT SHOULD BE 1024
60  END
```

5-39. Output Queue

The output queue is loaded whenever a query is processed, and holds up to 128 characters. The controller reads it with a statement such as the Fluke 1722A BASIC INPUT statement, removing what it reads form the queue. If the queue is empty, the 5790A does not respond to the INPUT statement from the controller. The Message Available (MAV) bit in the Serial Poll Status Byte is 1 if there is something in the output queue and 0 if the output queue is empty.

5-40. Error Queue

When a command error, execution error, or device-dependent error occurs, its error code is placed in the error queue where it can be read by the ERR? command. All error codes are defined in Appendix E of this manual. Another way to decode a error code is to send the command, EXPLAIN?, which returns a description of a error code. Reading the first error with the ERR? Command removes that error from the queue. A response of "0" means the error queue is empty. The Error Available (EAV) bit in the Serial Poll Status

Byte indicates whether the queue is empty. The error queue is cleared when you turn off the power, and when you use the *CLS (Clear Status) common command.

15	14	13	12	11	10	9	8
0	REMOTE	RPTBUSY	0	0	0	0	0

7	6	5	4	3	2	1	0
0	0	MCCHG	MDCHG	INPCHG	RNGCHG	VALID	BUSY

REMOTE   Set to 1 when the 5790A is under remote control.

RPTBUSY   Set to 1 when a calibration report is being printed to the serial port.

MCCHG   Set to 1 when measurement controls have changed. Measurement controls are EXTGUARD, EXTRIG, DFILT, AUTORANGE, HIRES.)

MDCHG   Set to 1 when an operating mode has changed. (Modes are MEASUREMENT, CALIBRATION, DIAGNOSTIC, and CALWAITING.) This bit is always 0 in the ISR. It changes to 1 only in the ISCR0 and ISCR1 registers.

INPCHG   Set to 1 when the input source has changed. This bit is always 0 in the ISR. It changes to 1 only in the ISCR0 and ISCR1 registers.

RNGCHG   Set to 1 when the range has changed. This bit is always 0 in the ISR. It changes to 1 only in the ISCR0 and ISCR1 registers.

VALID   Set to 1 when the present measurement is valid.

BUSY   Set to 1 when the 5790A is a making a measurement, running a calibration or diagnostics procedure, or saving anything to nonvolatile memory.

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Figure 5-4. Bit Assignments for the ISR, ISCEs and ISCRs

The error queue contains up to 16 entries. If many errors occur, only the first 15 errors are kept in the queue. A 16th entry in the queue is always an "error queue overflow" error, and all later errors are discarded until the queue is at least partially read. The first errors are kept, because if many errors occur before the user can acknowledge and read them, the earliest errors are the most likely to point to the problem. The later errors are usually repetitions or consequences of the original problem.

5-41. IEEE-488 Interface Configuration

The 5790A IEEE-488 interface supports the IEEE-488 interface function subsets listed in Table 5-5.

5-42. Bus Communication Overview

Communication between the controller and the 5790A takes place using commands established by IEEE-488 standards and commands specifically related to the 5790A. The commands listed in Section 6 are all the remote commands, both common and device-dependent. Definitions of the different types of messages used on the IEEE-488 bus follow.

Table 5-5. IEEE-488 Interface Function Subsets Supported

Uinterface Function	Description
SH1	Complete source handshake capability
AH1	Complete acceptor handshake capability
T6	Basic talker, serial poll, no talk-only mode, Unaddress if MLA
TE0	No extended talker capability
L4	Basic listener operation, no listen-only mode, Unaddress if MTA
LE0	No extended listener capabilities
SR1	Full service request capability, with bit-maskable SRQ
RL1	Full remote/local capability, including local lockout
PP0	No parallel poll capability
DC1	Device clear capability
DT1	Device trigger capability
C0	No bus control capability

5-43. Device-Dependent Commands

Device-dependent commands are messages used to transfer information directly between the 5790A and the IEEE-488 controller. Some commands cause an action to take place in the 5790A. Others, called queries in the IEEE standards, ask for information, and always generate a response message from the instrument. While message format is governed by IEEE-488 standards, messages themselves can be unique to the 5790A. For example, device-dependent commands are used to set the output mode and amplitude, and to switch from standby to operate.

5-44. Common Commands

IEEE standard 488.2 defines common commands, which are used for functions common to most bus devices. Examples include the command for resetting a device (*RST) and the query for device identification (*IDN?). Common commands and queries can be identified easily because they all begin with an asterisk (*).

5-45. Interface Messages

IEEE standards define interface messages, which manage the interface system. Some of the interface messages have their own control lines, and others are sent over the data lines by first asserting the control line ATN (Attention). An important thing to note about interface messages is that unlike device-dependent and common commands, interface messages are not sent literally (in a direct way). For example, when you send a device-dependent query to the 5790A, the controller automatically sends the interface message MTA (My Talk Address).

5-46. Definition: Queries and Commands

Messages directed to the 5790A fall naturally into two categories: commands and queries. Commands instruct the 5790A to do something or to set a value; no response is expected. Queries generally ask only for information from the 5790A; a response is always expected. Some queries also require the 5790A to take action. For example, the *TST? query has the 5790A do a self test, then send the result to the controller. A query always ends with a question mark. A command never ends with a question mark. (In the alphabetical listing of commands in Section 6, all commands and queries are mixed together and called commands.)

Most query responses are generated instantly on receipt of the query, i.e., queries generate their output when the 5790A executes the query rather than when the controller attempts to read the response. The 5790A simply generates the requested message and places it in an area of memory called the output buffer. When the controller addresses the 5790A as a talker, the contents of the output buffer are transmitted to the controller.

Some messages have both query and command forms (e.g., *PUD and *PUD?). In such cases, the command generally sets the value of a parameter and the query generally returns the most recent value of the parameter. Some messages are queries only (e.g., *IDN?). Some messages are commands only (e.g., *RST).

5-47. Functional Elements of Commands

Table 5-6 lists the functional elements of commands described by the IEEE-488.2 standard that are used by the 5790A. This table is for those who have a copy of the standard and want to use it to pursue additional information. The standard provides full definitions and syntax diagrams for each element.

5-48. Interface Messages

Interface messages manage traffic on the bus. Device addressing and clearing, data handshaking, and commands to place status bytes on the bus are all directed by interface messages. Some of the interface messages occur as state transitions of dedicated control lines. The rest of the interface messages are sent over the data lines with the ATN signal true. (All device-dependent and common commands are sent over the data lines with the ATN signal false.)

IEEE-488 standards define interface messages. Table 5-7 lists the interface messages that the 5790A accepts. Table 5-7 also shows the BASIC statement you execute on the 1722A Controller to generate the interface message. Table 5-8 lists the interface messages that the 5790A sends. The mnemonics listed in the tables are not sent in BASIC PRINT statements as commands are; in this way they are different from device-dependent and common commands.

Interface messages are handled automatically in most cases. For example, handshake messages DAV, DAC, and RFD automatically occur under the direction of an instrument's interface itself as each byte is sent over the bus.

5-49. Remote Program Examples

The following programming examples illustrate ways to handle errors, to take measurements, take a number of successive readings, lock the range, and calibrate the 5790A. These excerpts from programs are written in Fluke BASIC for the Fluke 1722A Instrument Controller.

5-50. Writing an SRQ and Error Handler

It is good practice to include fault (error) handling routines in your applications. The following sample program lines show a method for halting program execution on occurrence of an SRQ (Service Request) on the bus, checking to see if the 5790A is the source of the SRQ, retrieving its fault messages, and acting on the faults. You should modify and extend this code as necessary for your application.

If you want to use SRQs, first use the *SRE, *ESE, and ISCE commands to enable the desired event. Refer to "Checking the Instrument Status" earlier in this section for more information.

```
10   INIT PORT0                       ! IFC the bus
20   CLEAR PORT0                      ! DCL the bus
30   ! INITIALIZE THE 5790A SRQ HANDLER
40   PRINT @6, "*SRE 8"          ! Enable STB.EAV (error available)
50   ON SRQ GOTO 1100        ! Install SRQ handler
60   ! Body of the application goes here
1100  ! Bus SRQ handler
1110  CLEAR PORT0           ! Make sure devices are not confused
1120  IF (SPL(6) AND 64) THEN GOSUB 1200    ! If (STB.RQS) call 5790A SRQ
1130  ! TEST OTHER DEVICES RQS BITS IF DESIRED
1140  RESUME
1200  ! 5790A SRQ handler
1210  IF (SPL(6) AND 8) THEN GOSUB 1300   ! If (STB.EAV) call error handler
1220  ! Test other STB bits if desired here
1299  RETURN
1300  ! 5790A STB.EAV (error) handler
1320  PRINT @6, "ERR?"            !   Read and clear error
1330  INPUT @6, E%, E$            !   Read in error # and explanation
1340  PRINT "Error# :";E, E$        !   Print error # and explanation
1350  IF (E% <> 0) THEN GOTO 1320      !   Until no more errors
1360  STOP                             !   Other commands for your app
1370  END
```

5-51. Taking a Measurement

The following program takes one measurement at a time.

```
10 REM Set Bus Timeout to 20 seconds, Init IEEE Bus
20 TIMEOUT 20 * 1000
30 INIT PORT 0
40 CLEAR @6
100 REM Reset 5790A, INPUT2, EXTERNAL Trigger
110 PRINT @6,"*RST; INPUT INPUT2; EXTRIG ON"
200 PRINT "Hit Carriage Return to take a Reading"
210 INPUTLINE A$
220 REM Trigger and wait for measurement, timeout after 15 seconds
230 PRINT @6, "MEAS? 15"
240 REM Read Magnitude,Frequency,Status
250 INPUT @6, V,F,S
260 IF S <> 0 THEN PRINT "Bad MEAS? Status"
270 PRINT V,F,S
280 GOTO 40
```

5-52. *Efficiently Taking N Successive Readings*

Because MEAS? always restarts the measurement cycle, it is more time efficient to use
*WAI;VAL? for taking successive measurements. The following program asks the user
for the number of measurements to average, then takes that number of measurements
using *WAI;VAL?.

```
10 REM Set Bus Timeout to 20 seconds, Init IEEE Bus
20 TIMEOUT 20 * 1000
30 INIT PORT 0
40 CLEAR @6
100 REM Reset 5790A, INPUT1, INTERNAL Trigger, Full Resolution Responses
110 PRINT @6,"*RST; INPUT INPUT1; EXTRIG OFF; HIRES ON"
120 VS = 0.0
200 PRINT "Enter The Number of Measurements to Average ";
210 INPUT N
219 REM Restart Measurements with TRIG
220 PRINT @6, "TRIG"
230 FOR I=0 TO N
240   PRINT @6,"*WAI;VAL?"
250   INPUT @6,V,F,S
260   IF S <> 0 THEN I = I - 1 \ GOTO 300
270   PRINT V,F
280   VS = VS + V
290 NEXT I
300 PRINT "Average of ";N;" Readings = ";VS/N
```

5-53. *Locking the 5790A Range*

The 5790A Autoranging algorithm cannot not always choose the best range with which
to measure a particular value. In order to use the best range for a given value it is
necessary to use 5790A RANGE command. Given the approximate value to be measured,
the RANGE command selects, sets, and locks the best range in which to measure that
value.

```
10 REM Set bus timeout to 20 seconds, init IEEE bus
20 TIMEOUT 20 * 1000
30 INIT PORT 0
40 CLEAR @4,@6     ! 5790A address = 6, 5700A address = 4
100 REM Set 5700A TO 2V,10 kHz, internal transfers OFF
120 PRINT @4, "*RST; OUT 2V,10KHZ;XFER OFF;OPER"
130 REM Set the 5790A to the best range for measuring 2V magnitudes
140 PRINT @6, "RANGE 2V"
150 REM Wait for 5700A output to settle
160 PRINT @4, "*OPC?"
170 INPUT @4,S
200 REM Take Measurement(s)
(see the measurement taking methods under previous heading)
```

5-54. *Calibrating the 5790A Remotely*

You can calibrate the 5790A remotely instead of using the front panel controls.
Calibration is described in detail in Section 3 of the 5790A Service Manual. The
procedure involves making connections to the 5790A binding posts during the process,
and you need to change the position of the rear panel CALIBRATION switch. The
following sample program shows some techniques you can use to control 5790A
calibration using the remote interface. To make this program complete, you will need to

add statements to control your calibration sources and adjust them as necessary to obtain the required accuracy.

```
10 REM Periodic calibration from remote interface
20 REM Set Bus Timeout to 20 seconds, init IEEE bus
30 TIMEOUT 20 * 1000
40 INIT PORT 0
50 A% = 6          ! IEEE address of 5790A
60 CLEAR @A%
70 PRINT @A%, "*RST"
100 REM Get temperature from operator, and set cal temperature
110 PRINT "Enter ambient temperature: ";
120 INPUT T
130 PRINT @A%, "CAL_TEMP "; T
200 REM Do Full DC Calibration
210 I$ = "INPUT2"
220 PRINT "Connect DC voltage source to "; I$
230 PRINT @A%, "CAL_DC "; I$
240 GOSUB 1000
300 REM Do Full AC Calibration
310 I$ = "INPUT1"
320 PRINT "Connect AC voltage source to "; I$
330 PRINT @A%, "CAL_AC "; I$
340 GOSUB 1000

400 REM Save the calibration constants
410 PRINT "Set CAL STORE switch to ENABLE; press RETURN to continue"
420 INPUTLINE A$
430 PRINT @A%, "CAL_STORE ALL"
440 GOSUB 2000
450 STOP

900 REM Subroutines

1000 REM Do calibration steps until procedure is done
1010 PRINT @A%,"CAL_NEXT?"
1020 INPUT @A%, V,F
1030 IF (F < 0) GOTO 1200

1040 REM Automated procedures put code to program source to new value here
1050 PRINT "Set source to "; V; "V, "; F; "Hz"
1060 PRINT "Once source is stable and measured, enter exact source value:"
1070 PRINT "V = ";
1080 INPUT V

1090 REM Do the calibration step, then check for errors
1100 PRINT @A%, "CAL_NEXT "; V
1110 GOSUB 2000
1150 PRINT @A%, "ERR?"
1160 INPUT @A%, ER%, ER$
1170 IF (ER% = 0) GOTO 1010
1180 PRINT "ERROR: #" ER%; ": "; ER$
1190 GOTO 1120
1200 PRINT "Procedure is complete."
1210 RET
```

```
2000 REM Wait for a 5790A command to complete, polling the ESR
2010 PRINT @A%, "*OPC"
2020 PRINT @A%, "*ESR?"
2030 INPUT @A%, ES%
2040 IF ((ES% AND 1%) = 0) GOTO 2020
2050 RET
```

5-55. The IEEE-488 Connector

The IEEE-488 connector on the rear panel mates with an IEEE-488 standard cable. The pin assignments of the rear-panel IEEE-488 connector are shown in Figure 5-5.

Table 5-6. Functional Elements of Commands

Element	Function
PROGRAM MESSAGE	A sequence of zero or more PROGRAM MESSAGE UNIT elements separated by PROGRAM MESSAGE UNIT SEPARATOR elements
PROGRAM MESSAGE UNIT	A single command, programming data, or query received by the device.
COMMAND MESSAGE UNIT	A single command or programming data received by the device.
QUERY MESSAGE UNIT	A single query sent from the controller to the device.
PROGRAM DATA	Any of the six program data types.
PROGRAM MESSAGE UNIT SEPARATOR	Separates PROGRAM MESSAGE UNIT elements from one another in a PROGRAM MESSAGE.
PROGRAM HEADER SEPARATOR	Separates the header from any associated PROGRAM DATA.
PROGRAM DATA SEPARATOR	Separates sequential PROGRAM DATA elements that are related to the same header
PROGRAM MESSAGE TERMINATOR	Terminates a PROGRAM MESSAGE.
COMMAND PROGRAM HEADER	Specifies a function or operation. Used with any associated PROGRAM DATA elements.
QUERY PROGRAM HEADER	Similar to a COMMAND PROGRAM HEADER except a query indicator (?) shows that a response is expected from the device.
CHARACTER PROGRAM DATA	A data type suitable for sending short mnemonic data, generally used where a numeric data type is not suitable. ("String" in this manual.)
DECIMAL NUMERIC PROGRAM DATA	A data type suitable for sending decimal integers of decimal fractions with or without exponents.

NON-DECIMAL NUMERIC PROGRAM DATA	A data type suitable for sending integer numeric representations in base 16, 8, or 2.
SUFFIX PROGRAM DATA	An optional field following DECIMAL NUMERIC PROGRAM DATA used to indicate associated multipliers and units.
STRING PROGRAM DATA	A data type suitable for sending 7-bit ASCII character strings where the content needs to be "hidden" (by delimiters).
ARBITRARY BLOCK PROGRAM DATA	A data type suitable for sending blocks of arbitrary 8-bit information. Blocks are limited in size to 1024 bytes.
BINARY BLOCK DATA	A special data type as used in the *PUD command. (See the definition under "Syntax Parameter Rules.")

Table 5-7. Interface Messages that the 5790A Accepts

Mnemonic	Name	Function	Related 1722A Command
ATN	Attention	A control line that, when asserted, notifies all instruments on the bus that the next data bytes are an interface message. When ATN is low, the next data bytes are interpreted as device-dependent or common commands addressed to a specific instrument.	(None)
DAC	Data Accepted	Sets the handshake signal line NDAC low.	(None)
DAV	Data Valid	Asserts the handshake signal line DAV.	(None)
DCL	Device Clear	Clears the input/output buffers.	CLEAR
END	End	A message that occurs when the Controller asserts the EOI signal line before sending a byte.	(None)
GTL	Go To Local	Transfers control of the 5790A from one of the remote states to one of the local states. (See Table 5-1.)	LOCAL
LLO	Local Lockout	Transfers remote/local control of the 5790A. (See Table 5-1.)	LOCKOUT
IFC	Interface Clear	A control line that sets the interface to a quiescent state.	INIT
MLA	My Listen Address	Addresses a specific device on the bus as a listener. The controller sends MLA automatically whenever it directs a device-dependent or common command to a specific instrument.	(None)
MTA	My Talk Addresses	Address a specific device on the bus as a talker. The controller sends MTA automatically whenever it directs a device-dependent or common query to a specific instrument.	(None)
REN	Remote Enable	Transfers remote/local control of the 5790A. (See Table 5-1.)	REMOTE
RFD	Ready for Data	Sets the handshake signal line NRFD low.	(None)

SDC	Selected Device Clear	Does the same thing as DCL, but only if the 5790A is currently addressed as a listener.	CLEAR @
SPD	Serial Poll Disable	Cancels the effect of a Serial Poll Enable.	(Part of SPL)
SPE	Serial Poll Enable	After the 5790A receives this message, it sends the Status Byte the next time it is addressed as a listener, no matter what the command is.	(Part of SPL)
UNL	Unlisten	"Unaddresses" a specific device on the bus as a listener. The controller sends UNL automatically after the device has successfully received a device-dependent or common command.	(None)
UNT	Untalk	"Unaddresses" a specific device on the bus as a listener. The controller sends UNT automatically after it receives the response from a device-dependent or common query.	(None)

Table 5-8. Interface Messages that the 5790A Sends

Mnemonic	Name	Function
END	End	A message that occurs when the 5790A asserts the EOI control line. The 5790A asserts EOI while it transmits the ASCII character LF for its termination sequence or terminator.
DAC	Data Accepted	Sets the handshake signal line NDAC low.
DAV	Data Valid	Asserts the handshake signal line DAV.
RFD	Ready for Data	Sets the handshake signal line NRFD low.
SRQ	Service Request	A control line that any device on the bus can assert to indicate that it requires attention. Refer to "Checking 5790A Status" for details.
STB	Status Byte	The Status Byte is what the 5790A sends when it responds to a serial poll (interface message SPE).
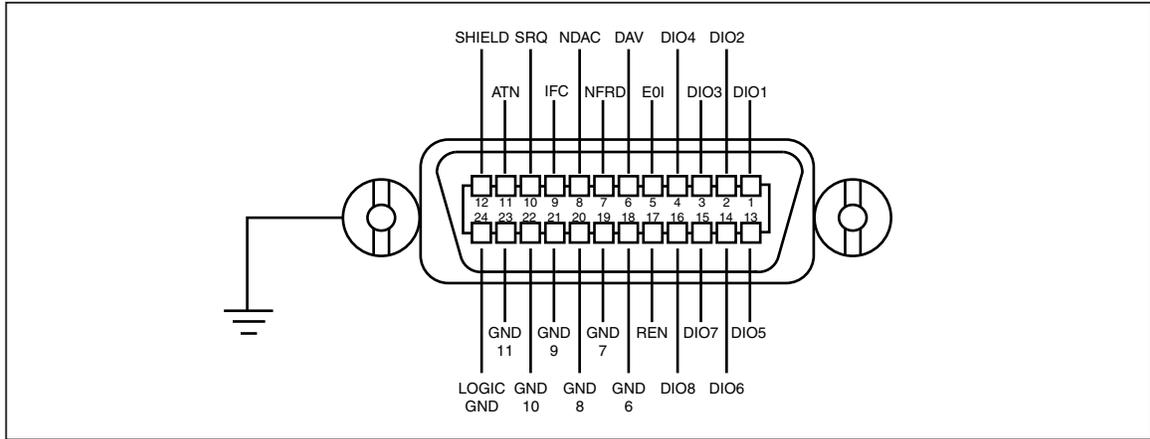
Figure 5-5. IEEE-488 connector pinout (Rear Panel View)

add51f.eps

Chapter 6
Remote Commands

6-1. Introduction

This section documents remote commands for the 5790A AC Measurement Standard. Remote commands duplicate almost all activities that can be initiated from the front panel in local operation.

Table 6-1 summarizes the commands by function. Following the summary table is a complete alphabetical listing of all commands complete with protocol details. First is a list of the IEEE-488.2 Common Commands, followed by a list of the 5790A Device-Dependent Commands.

Separate headings for each command in the listing provide the parameters and responses (if any), and an example for cases in which the parameters are not self-explanatory. Response formats, e.g., CRD (Character Response Data), IAD (Indefinite ASCII), and Binary Block Data, are defined in Table 5-3. Refer to "Using Commands" in Section 5 for meaning of "overlapped," and "long-term" notations in the following command descriptions. (All commands are sequential unless otherwise noted.)

Table 6-1. Command Summary by Function

IEEE-488.2 Common Commands	
*CLS	Clears status. Clears the ESR, the ISCR, and the error queue. Terminates a ending operation complete command (*OPC).
*ESE	Sets event status enable register, described in Status Information section below.
*ESE?	Returns the decimal equivalent of the event status enable register, described in Status Information section below.
*ESR?	Returns the decimal equivalent of the contents of the event status register (ESR) and clears it.
*IDN?	Identification query. Gives an <IAD> that identifies the Model number, instrument serial number, and firmware revision levels
*LRN?	Returns <IAD> which when sent to 5790A restores it to the state in effect when the *LRN? command was executed.
*OPC	Generate the operation complete message in the Event Status Register when all pending device operations have been finished
*OPC?	Reply with a 1 when all pending operations are complete.
*OPT?	Queries which hardware and software options are installed
*PUD	Protected user data command. This command allows the user to store a string of bytes in a nonvolatile location in the 5790A. This command works only when the CAL switch on the 5790A back panel is in the ENABLE position (otherwise an execution error occurs). An execution error also occurs if the argument is over 64 bytes long.
*PUD?	Protected user data query
*RCL	Restores the 5790A setup from a previous setup saved by *SAV.
*RST	Reset. Resets the state of the instrument to the power-up state, except autotriggering is stopped.
*SAV	Saves the current 5790A setup into setup save area for later use by *RCL.

*SRE	Set Service Request Enable register, described in the Status Information section below.
*SRE?	Query Service Request Enable register, described in the Status Information section below.
*STB?	Read status byte. The status byte is described in detail in the instrument status section below
*TRG	Executes the TRIG command
*TST?	Runs some of the 5790A self tests and returns results. The tests included are: ROM checksum test, nonvolatile memory test. Also see DIAG.
*WAI	Wait-to-Continue Command. This command prevents further remote commands from being executed until all previous remote commands have been completely executed.
Instrument Configuration Commands	
CAL_MODE?	Returns the setting of the rear panel CALIBRATION MODE switch.
CAL_SW?	Returns the setting of the rear panel CALIBRATION STORE switch.
CLOCK	Sets the real time clock/calendar
CLOCK?	Queries the value of the real time clock/calendar
DATEFMT	Selects the clock/calendar date format
DATEFMT?	Returns the clock/calendar date format.
EOFSTR	Stores the end of file character sequence for use in cal reports.
EOFSTR?	Returns the end of file character sequence set for cal reports.
EXTGUARD	Sets external guard.
EXTGUARD?	Returns the setting of external guard.
EXTRIG	Selects single trigger mode.
EXTRIG?	Returns the setting of EXTRIG.
FIRSTIN	Stores the power-up configuration for the initial input.
FIRSTIN?	Returns the power-up configuration for the initial input.
FORMAT	Formats the EEPROM device. This command stores default values into the EPROM, overwriting all existing values. Use with extreme care.
SP_SET	Programs serial port nonvolatile settings.
SP_SET?	Returns the serial port nonvolatile settings.
Measurement and Transfer Commands	
DELTA?	Returns the delta (transfer) value from the 5790A.
DFILT	Sets the digital filter parameters for mode and restart.
DFILT?	Returns the digital filter parameters for mode and restart.
DUNIT	Sets the delta unit value.
DUNIT?	Returns the delta unit value.
HIRES	Enables and disables higher resolution amplitude display.

IRES?	Returns the setting of the HIRES command.
INPUT	Selects the active input connector
INPUT?	Returns the active input connector.
MEAS?	Triggers (or in continuous trigger, restart trigger) a new measurement, waits for it to complete, then retrieves the value of the present input measurement (the most recently completed input measurement). This is equivalent to the following sequence of commands: TRIG; *WAI; VAL?
RANGE	Selects the range that best measures the specified value. The range selected is the one within whose limits (as returned by the RANGE? command) the value falls. This command turns off autoranging if it was on.
RANGE?	Returns the present measurement range characteristics.
REF?	Returns the reference value and its associated parameters.
REFAVG	Sets the reference to the average of the present reference value and the present input measurement; this is valid only if the reference has already been set and averaging hasn't been done since it was set.
REFCLR	Clears the reference.
REFSET	Sets the reference to the value of the present input measurement.
TRIG	Triggers a measurement. When the 5790A is in manual trigger mode, it begins a measurement when it receives the *TRG, TRIG, or MEAS? command.
UNCERT?	Returns the present input measurement uncertainty in ppm.
VAL?	Returns the value of the present input measurement (the most recently completed input measurement).
Serial Remote Mode only Commands	
LOCAL	Goes to local state (IEEE-488 GTL function).
LOCKOUT	Goes to lockout state (IEEE-488 LLO function).
REMOTE	Goes to remote state. (IEEE-488 REN and GTL functions).
SPLSTR	Sets the Serial Mode Serial Poll response string.
SPLSTR?	Returns the string used for Serial Mode Serial Poll responses.
SRQSTR	Sets the Serial Mode SRQ response string.
SRQSTR?	Returns the string used for Serial Mode SRQ responses.
Calibration report printing/uploading commands	
CAL_PR	Prints a listing of a calibration report to the serial interface.
CAL_RPT?	Returns a listing of a calibration report through the remote control port.
RPTSTR	Sets the report string.
RPTSTR?	Gets the report string. This is described in the serial print out section of this chapter.
Status Commands	
ETIME?	Elapsed time query. This gives the time in minutes that the instrument has been turned on since it was built or serviced

ISCE0	Sets the Instrument Status One To Zero Change Enable register
ISCE0?	Returns the contents of the Instrument Status Zero To One Change Enable register.
ISCE1	Sets the Instrument Status Zero To One Change Enable register.
ISCE1?	Returns the contents of the Instrument Status One To Zero Change Enable register.
ISCR0?	Returns the contents of the Instrument Status One To Zero Change Register.
ISCR1?	Returns the contents of the Instrument Status Zero To One Change Register.
ISR?	Returns the contents of the Instrument Status Register.
MODE?	Returns the operating mode (MEASUREMENT, CALIBRATION, DIAGNOSTIC, CALWAITING).
MODESTR?	Returns a string that describes what a calibration or diagnostic procedure is doing.
ONTIME?	Returns the time in minutes since the power was turned on.
5790A Calibration, Testing, and Diagnostics Commands	
ABORT	Aborts a measurement, calibration, or diagnostic procedure, or report being printed
CAL_AC	Begins an interactive ac calibration procedure for an ac range.
CAL_AC?	Lists the steps of an interactive calibration procedure or a portion of a procedure as it would run when requested with a CAL_AC command with the same parameters.
CAL_BACKUP	Makes it so that the next CAL_NEXT command redoes the previously finished calibration step.
CAL_CLST?	Lists the symbolic names for all the calibration constants for a specified range.
CAL_CONST?	Returns the value of a particular calibration constant.
CAL_DATE?	Returns the date of the most recent calibration.
CAL_DAYS?	Returns the number of days elapsed in the calibration interval.
CAL_DC	Begins a calibration procedure for a dc range. As in CAL_AC, this merely specifies which step the next CAL_NEXT command does.
CAL_DC?	Lists the steps of an interactive calibration procedure or a portion of a procedure as it would run when requested with a CAL_DC command with the same parameters.
CAL_FPT	Corrects the reference given for an ac calibration step after the fact, and as a result change the resulting calibration constant or constants.
CAL_FPT?	Supplies the first two parameters to be used with a CAL_FPT to correct the next calibration step to be performed.
CAL_FREQ	Executes the frequency calibration procedure. An error is generated if the frequency or amplitude measurement is out of range. If an error occurs, the frequency calibration procedure is not executed.
CAL_I2.	Begins the INPUT 2 vs. INPUT 1 calibration procedure.
CAL_I2?	Lists the steps in the INPUT 2 vs. INPUT 1 calibration procedure.
CAL_INPUT?	Returns the input to which the reference will be applied for the next calibration step.
CAL_INTV	Sets the calibration interval. This is stored in nonvolatile memory and used to calculate the output uncertainty.
CAL_INTV?	Returns the calibration interval.

CAL_NEXT	Initiates the next calibration point.
CAL_NEXT?	Returns the value of the next point to be calibrated when in the middle of calibrating a range.
CAL_OFF	Cancels any interactive calibration underway (that is, one started with the CAL_AC, CAL_I2, and CAL_DC commands).
CAL_SHIFT?	Returns the calibration shift for a single calibration point.
CAL_SKIP	Advances to the next step of an interactive procedure without executing the step (like a CAL_NEXT except the step isn't executed).
CAL_SLST?	Returns the calibration shifts for a group of service calibration points.
CAL_SPEC?	Returns the uncertainty specification for a specified input value, range, and frequency.
CAL_STLST?	Lists the calibration constant groups that have been updated but not saved (and therefore, how many would be written to nonvolatile memory by a CAL_STORE command with the same argument).
CAL_STORE	Stores calibration constants in the specified group list into nonvolatile memory.
CAL_STORE?	Tells how many calibration constant groups have been modified but not saved (this is like CAL_STLST? except only the initial number is given).
CAL_TEMP	Sets the temperature for calibration. This should be done before CAL_DC, CAL_I2, and CAL_AC commands. Once set, the temperature is used for all calibration activities until changed. If not set before a calibration activity is complete, the 5790A uses a default of 23.0 °C.
CAL_TEMP?	Returns the most recent calibration temperature for a specified type of calibration.
CAL_ZERO	Executes internal dc zeros calibration.
CMDSTR?	Returns the command string that caused the last error.
DIAG	Run a self diagnostic routine.
DIAGFLT	Set the 5790A response to errors that occur during execution of diagnostics under remote control. (Nonvolatile.)
DIAGFLT?	Returns the setting of the response to errors that occur during diagnostics executed under remote control.
ERR?	Returns the first error code and description from the 5790A error queue. This error is then taken off the queue.
EXPLAIN?	Explains an error code. (5700A compatibility.)
FAULT?	Returns an error code and takes the error off the error queue. (5700A compatibility.)

6-2. Alphabetical List of IEEE-488.2 Common Commands

*CLS

(Clear status.) Clears the ESR, ISCR0 and ISCR1, the error queue, and the RQS bit in the status byte. This command terminates a pending operation complete (*OPC).

Parameter

None

*ESE

Loads a byte into the Event Status Enable Register, described under "Checking 5790A Status."

Parameter

The decimal equivalent of the 8-bit binary number to load into the register. Each binary digit in the register has a meaning as described in this section under "Checking 5790A Status". You can also send a binary, octal, or hexadecimal number if you precede the number with #b, #o, or #h, respectively. (A number without a preceding designator is taken as decimal.)

Example

```
*ESE 147
```
Sets the register to 10010011 (128+16+2+1), enabling only bits 7 (PON), 4 (EXE), 1 (RQC), and 0 (OPC).

*ESE?

Reads the contents of Event Status Enable register, described under "Checking 5790A Status."

Parameter

None

Example

```
*ESE?
```
Returns "140" if bits 2 (QYE), 3 (DDE), and 7 (PON) are enabled (1) and the rest of the bits are disabled (0). (See "Checking 5790A Status" for details.)

*ESR?

Returns the byte from the Event Status Register and clears the register. The ESR is described under "Checking 5790A Status."

Parameter

None

Response

(Integer) Decimal equivalent of the register byte.

Example

```
*ESR?
```
Returns "140" if bits 2 (QYE), 3 (DDE), and 7 (PON) are set (1) and the rest of the bits are reset (0). (See "Checking 5790A Status" for details.)

*IDN?

Identification query. Returns the instrument model number, serial number, and firmware revision levels for the main and inguard CPUs. (Sequential command.)

Parameter

None

Response

(IAD) A message containing five fields separated by commas, as

follows:

1. Manufacturer (FLUKE)

2. Model number (5790A)

3. Serial number

4. Firmware revision level for the Main CPU

5. Firmware revision level for the Guard Crossing CPU

Example

```
FLUKE,5790A,7649820,1.7,1.2
```

*LRN?

Learns the current setting of the 5790A . The response to this command is a string that when sent back to the 5790A at a later time recreates the operational state. This response uses the *LRN command which is reserved for this purpose and is not documented beyond here.

Parameter

None

Response

An IAD that when later sent to the 5790A recreates the settings present at the time of the *LRN? command. The following operating parameters are saved by this command:

- Input Source
- Auto/Lock Range
- Range (if Locked)
- EX TRIG
- EX GRD
- HIRES setting
- Digital Filter Mode
- Digital Filter Restart
- Reference Delta Units

Example

```
PRINT @4, "*LRN?"
INPUTLINE @4, A$
(Later, to recreate the settings:)
PRINT @4, A$
```

*OPC

Enables setting of bit 0 (OPC for "Operation Complete") in the Event Status Register to 1 when all pending device operations are complete.

> *Note*
>
> *This mechanism (or *OPC? or *WAI) does not wait for a CAL_PR to complete. Also see ISCR.*

> *Note*
>
> *If you use this command for a non-measurement execution to complete, turn off continuous triggering first. If you do not turn off measurements, *OPC (or *OPC? or *WAI) will wait for a measurement to complete. Example: "EXTRIG OFF; CAL_STORE ALL; *OPC".*

Parameter

None

*OPC?

Returns a 1 after all pending operations are complete. This commands causes program execution to pause until all operations are complete. (See also *WAI.)

Parameter

None

Response

(Integer) 1 after all operations are complete.

*OPT?

Query which hardware and software options are installed.

Parameter

None

Response

(IAD) WBND or 0

*PUD

(Protected user data command.) This command allows you to store a string of bytes in nonvolatile memory. This command works only when the CALIBRATION STORE switch is in the ENABLE position. Also see the RPT_STR command, which has a similar function, except the RPT_STR string is printed on calibration shift reports.

Parameter

Binary Block Data

Example

To store the string "CAL LAB NUMBER 1" in the protected user data area.

```
*PUD #0CAL LAB NUMBER 1\<Line Feed with EOI\>
or
*PUD #216CAL LAB NUMBER 1
```

Note
The 2 indicates that there is one digit to follow (in this case, "16"), and the
16 indicates that there are 16 characters including space characters in the
*remainder of the *PUD message (in this case, CAL LAB NUMBER 1).*

This type of data is called Binary Block Data in the IEEE-488.2 Standard. In the 5790A, however, you don't need to use this protocol. The parameter:

```
"CAL LAB NUMBER 1"
```
works exactly the same.

*PUD?

Returns the contents of the *PUD (Protected User Data) memory. (Sequential command.)

Parameter

None

Response

Binary Block Data. The maximum response is 64 characters.

Example

```
*PUD?
```
Returns:

```
"#216CAL LAB NUMBER 1"
```
Assuming that this is stored as in the example for PUD* above.

*RCL

Restores the 5790A operating state to a previous setup saved using the *SAV command. This command together with *SAV gives you up to 16 operating state memories. The following operating parameters are saved by this command:

- Input Source
- Auto/Lock Range
- Range (if Locked)
- EX TRIG
- EX GRD
- HIRES setting
- Digital Filter Mode
- Digital Filter Restart
- Reference Delta Units

Parameter

(Integer) 0 through 15, for the operating state memory number

*RST

Reset. Resets the state of the instrument to the power-up state as described in Section 4, except autotriggering is stopped. The TRIG command is required to start continuous triggering after *RST. This command holds off execution of subsequent commands until it is complete. (See Example.)

Parameter

None

Example

If you send the compound command "*RST;*OPC?", the *OPC? is not waiting for *RST to complete, it is waiting for the next measurement to complete.

*SAV

Save the current 5790A operating state in memory for later use with the *RCL command. This command together with *RCL gives you up to 16 operating state memories. Once an operating state is saved, it is nonvolatile unless an EEPROM format is done.

Parameter

An integer 0 through 15, for one of the 16 operating state memory locations

*SRE

Loads a byte into the Service Request Enable register (SRE), described under

"Checking 5790A Status."

Parameter

The decimal equivalent of the binary number to load into the register. You can also send a binary, octal, or hexadecimal number if you precede the number with #b, #o, or #h, respectively. (A number without a preceding designator is taken as decimal.)

Example

```
*SRE 56
```
Enables bits 3 (EAV), 4 (MAV), and 5 (ESB) in the Service Request Enable register.

*SRE?

Returns the byte from the Service Request Enable register, described under "Checking 5790A Status."

Parameter

None

Response

(Integer) The contents of the Instrument Status Register in decimal.

*STB?

Returns the status byte. The status byte is described under "Status Information."

Parameter

None

Response

(Integer) Decimal equivalent of the status byte.

Example

```
*STB?
```
Returns "72" if bits 3 (EAV) and 6 (MSS) are set (1) and the rest of the bits are reset (0).

*TRG

Triggers a measurement (equivalent to TRIG).

Parameter

None

*TST?

Initiates a series of self-tests, then returns a "0" for pass or a "1" for fail. Included are the ROM checksum test, nonvolatile memory test.

Parameter

None

Response

(Integer) 0 = Pass, 1 = Fail

*WAI

Wait-to-continue command. This command prevents further remote commands from being executed until all previous remote commands have been executed. (See also *OPC.)

Parameter

None

Example

If you had sent a TRIG command, you can cause the 5790A to wait until the measurement has settled before continuing on to the next command by following TRIG with a *WAI command. This is useful because TRIG is an overlapped command, which means the 5790A would normally go on to process other commands before completing the TRIG command.

6-3. Alphabetical List of 5790A Device-Dependent Commands

ABORT

Aborts a measurement, calibration or diagnostic procedure, calibration step in progress, or report being printed. This command holds off execution of subsequent commands until it is complete. (See Example.)

Parameter

None

Example

If you send the compound command "ABORT;*OPC?", the *OPC? is not waiting for ABORT to complete, it is waiting for the next measurement to complete.

CAL_AC

Begins an interactive ac calibration procedure for one range or all ranges. This does not do a calibration step, but sets up the 5790A so the next CAL_NEXT command does the first step and the next CAL_NEXT? command returns the first step.

Parameters

1. INPUT1 or INPUT2 (The input to be used, signifies normal ac   calibration), or WBND for Option -03 Wideband flatness calibration.

2. (Optional) A number that defines the range amplitude (same as for the RANGE command). If this parameter is included, do only the specified range; if not included, do all ranges.

3. (Optional only if parameter 2 is present; prohibited otherwise) number that specifies which step to jump to of the procedure for the specified range.

Example

The sequence of commands for calibrating an entire range is:

```
CAL_TEMP 23.5 (optional)
CAL_AC <input>, <amplitude> input is location, amplitude tells range
CAL_NEXT <amplitude>   this is the first step (frequency is implicit)
CAL_NEXT <amplitude>   this is the last step
```

An error occurs if either the entered amplitude is out of range or the measured input is out of range. The CAL_NEXT? command gives the nominal amplitude and frequency for the next CAL_NEXT command and returns 0,-1 after the last CAL_NEXT command has been done for a range.

CAL_AC?

Lists the steps of an interactive calibration procedure or a portion of a procedure as it would run when requested with a CAL_AC command with the same parameters.

Parameters

1. INPUT1 or INPUT2 (The input to be used, signifies ac calibration), or WBND for Option -03 Wideband calibration

2. (Optional) A number that defines the range amplitude (same as for the RANGE command). If this parameter is included, list only the steps for the specified range; if not included, list steps for all ranges.

3. (Optional only if parameter 2 is present; prohibited otherwise) A number that specifies which step to jump to to begin listing steps for the specified range.

Response

(IAD) A list in the following form:

```
<# of ranges><EOL>
<range 1 max>,<# of steps in range><EOL>
<1st step amplitude in volts>,<1st step frequency in Hz><EOL>
...
```

```
<last step amplitude>,<last step frequency><EOL>
<range 2 max> etc.
```

Example

```
CAL_AC? INPUT1,2.0 (with the CALIBRATION MODE switch in SERVICE)
Gives the response:
1
2.200000e+00,4
2.000000e+00,1.000000e+01
2.000000e+00,1.000000e+02
2.000000e+00,1.000000e+05
2.000000e+00,1.000000e+06
```

CAL_BACKUP

If a calibration step has been done since the last CAL_AC or CAL_DC command, this
command backs the CAL_NEXT pointer one step. (After this command, a CAL_NEXT
command redoes the most recent step.) CAL_BACKUP generates an error if no cal
procedure is underway, or if a CAL_SKIP has occurred since the last step was done.

Parameter

None

CAL_CLST?

Lists the symbolic names and values for a group of calibration constants.

Parameters

1. ACTIVE, STORED, OLD, or DEFAULT.

2. Which constants to list. This parameter may be a single constant (e.g., DI_7V) or a
   group of constants (e.g., AC_7V), or a group of groups (e.g., AC, or ALL). Refer to
   Appendix C for a listing of calibration constants and group names, or use the
   command "CAL_PR CONSTS" to print a list of all calibration constants.

Response

(String) A list of the selected calibration constant names and values. The form is:

```
"<EOL>
<total><EOL>
<name>,<value><EOL>
<name>,<value><EOL>
etc.
```

CAL_CONST?

Returns the value of a particular calibration constant from the active set.

Parameter

The symbolic name of the calibration constant (e.g., DI_7V). Refer to Appendix C for a
listing of calibration constant symbolic names, or use the command "CAL_PR CONSTS"
to print a list of all calibration constants.

Response

(Float) A number signifying the value of the constant.

CAL_DATE?

Returns the date of the most recent calibration.

Parameters

1. ACTIVE, STORED, or OLD (which set the date comes from)

2. One of the following keywords:
   - MAIN (Entire main input calibration)
   - WBND (Wideband calibration)
   - SERVICE (Service calibration)
   - DC (DC calibration)
   - AC (AC calibration)
   - ZC (DC zeros calibration
   - WDC (Wideband 1 kHz calibration)
   - WAC (Wideband Flatness)
   - ALL (All of the above)
   - A group name from Appendix C, e.g., AC_2_2V

Response

(Integer) Date in the format defined by the DATEFMT command (or in the utility menus).

CAL_DAYS?

Returns the number of days elapsed since the most recent calibration.

Parameters

- MAIN (Entire main input calibration)
- WBND (Wideband calibration)
- SERVICE (Service calibration)
- DC (DC calibration)
- AC (AC calibration)
- ZC (DC zeros calibration
- WDC (Wideband 1 kHz calibration)
- WAC (Wideband Flatness)
- ALL (All of the above)
- A group name from Appendix C, e.g., AC_2_2V

Response

(Integer) The number of elapsed days.

CAL_DC

Begins a dc calibration procedure for one range or all ranges. As in CAL_AC, this merely specifies which step the next CAL_NEXT command does.

Parameters

1. INPUT1 or INPUT2 (The input to be used; signifies dc calibration), or WBND for Option -03 Wideband gains calibration

2. (Optional) A number that defines the range amplitude (same as for the RANGE command). If this parameter is included, do only the specified range; if not included, do all ranges.

Example

An example sequence of commands for calibrating a range (in this case, the 220 mV range) is as follows:

```
CAL_TEMP 23.5
CAL_DC INPUT2, 200 mV
CAL_NEXT 200 mV
CAL_NEXT -200 mV
```

An error occurs if either the entered value is out of range or the measured input is out of range.

CAL_DC?

Lists the steps of an interactive calibration procedure or a portion of a procedure as it would run when requested by a CAL_DC command with the same parameters.

Parameters

1. INPUT1 or INPUT2 (The input to be used, signifies ac calibration), or WBND for Option -03 Wideband gains calibration

2. (Optional) A number that defines the range amplitude (same as for the RANGE command). If this parameter is included, list only the steps for the specified range; if not included, list steps for all ranges.

Response

(IAD) A list in the following form:

```
<# of ranges><EOL>
<range 1 max>,<# of steps in range><EOL>
<1st step amplitude in volts>,<1st step frequency in Hz><EOL>
<last step amplitude>,<last step frequency><EOL>
<range 2 max> etc.
```

CAL_FPT

Corrects the reference given for an ac calibration step after the fact, and as a result changes the calibration constant or constants determined in that step.

Parameters

1. A number signifying the range amplitude (as in the RANGE command)

2. The number of the step to correct (obtained using the CAL_FPT? command).

3. The updated reference value divided by what was given as the reference when the calibration step was run. (1.0 means no change, more than 1.0 means the reference is bigger than you said when you did the CAL_NEXT.)

Example

```
CAL_FPT?
(returns) 2.20000,0
CAL_NEXT?
(returns) 2.0E+0,1.00E+6
CAL_NEXT 2.0
CAL_FPT 2.2,0,1.00019
```

CAL_FPT?

Supplies the first two parameters to be used with a CAL_FPT to correct the next calibration step to be performed.

Parameter

None

Response

1. (Float) A number signifying the range amplitude (as in the RANGE command)

2. (Integer) The number of the step to correct (using the CAL_FPT command).

CAL_FREQ

Executes the frequency calibration procedure. An error is generated if the frequency or amplitude measurement is out of range. If an error occurs, the frequency calibration procedure is not executed. This step is part of service calibration. This command requires that you set the CALIBRATION MODE switch to SERVICE and the CALIBRATION STORE switch to ENABLE.

Parameters

1. INPUT1 or INPUT2

2. A number signifying input frequency, including units. If no units are given, HZ are assumed (value must be between 900 Hz and 1.1 kHz inclusive).

CAL_I2

Begins the INPUT 2 vs. INPUT 1 calibration procedure. This proceeds with CAL_NEXT, CAL_NEXT?, and so on like CAL_AC and CAL_DC, except you must use CAL_INPUT? to determine the correct input to apply the calibration voltage. This step is part of service calibration. This command requires that you set the CALIBRATION MODE switch to SERVICE and the CALIBRATION STORE switch to ENABLE.

Parameter

None

CAL_I2?

Lists the values for the INPUT 2 vs. INPUT 1 calibration procedure. It does not list the input to which voltages are applied. Use CAL_INPUT? for that purpose.

Parameter

None

Response

(IAD) A list in the same form as CAL_AC? and CAL_DC?.

CAL_INPUT?

Returns the input to which you will apply a reference for the next step.

Parameter

None

Response

(CRD) INPUT1, INPUT2, WBND, or NONE

CAL_INTV

Sets the calibration interval. This is stored in nonvolatile memory and used to calculate the output uncertainty.

Parameter

The number of days in the calibration interval. Must be 90, 365, or 730.

CAL_INTV?

Returns the calibration interval.

Parameter

None

Response

(Integer) The number of days in the calibration interval (90, 365, 730).

CAL_MODE?

Returns the setting of the rear panel CALIBRATION MODE switch. (CAL_SW? returns the CALIBRATION STORE switch setting).

Parameter

None

Response

(Integer) 0 = PERIODIC, 1 = SERVICE

CAL_NEXT

Initiates the next calibration point. An error occurs if the response from CAL_NEXT? would have been 0,-1 (that is, a series of calibration steps must be begun using a CAL_AC or CAL_DC command). Note that in ac calibration the frequency is implicit (the proper value can be obtained with the CAL_NEXT? command).

Note

This completes the calibration for this step. Make sure the specified reference is connected and stable before executing CAL_NEXT.

All the same errors that occur with calibration from the front panel can also occur here (e.g. if the reference amplitude or frequency is out of tolerance).

Parameter

(Optional. If omitted, the nominal amplitude is used.) A number signifying reference amplitude (must be within a certain percentage of the expected amplitude, obtainable using the CAL_NEXT? command.

CAL_NEXT?

Returns the value of the next point to be calibrated when in the process of calibrating a range. Otherwise, this returns 0.0,-1.0.

Parameter

None

Response

1. (Float) The nominal amplitude of the expected value for the next calibration point. The units are assumed to be volts. For example, if the 5790A has calibrated the positive polarity for a dc range, the CAL_NEXT? query will return the negative of the reference value used for the positive polarity calibration.

2. (Float) The frequency of the next point to be calibrated. The units are assumed to be Hertz.

Example

```
CAL_DC 150 mV
CAL_NEXT?
-1.5E-01,0.0E+00
```

If the 5790A has calibrated the first point of an ac range, the CAL_NEXT? query returns the amplitude and frequency of the next point to be calibrated (the amplitude returned is what would be the default when doing this calibration from the front panel).

```
CAL_AC 150 mV
CAL_NEXT?
1.5E-01,2.0E+01
```

If the 5790A is not in the middle of calibrating a range, the CAL_NEXT? query returns the values 0,0.

CAL_OFF

Cancels any interactive calibration underway (that is, one started with the CAL_AC, CAL_DC, or CAL_I2 commands).

Parameter

None

CAL_PR

Prints a listing of a calibration report to the serial interface. (Overlapped command.)

Parameters

- ABORT (Stops printing a report in progress)
- ACTIVE (The shifts resulting from the last calibration)
- STORED (The shifts resulting from the last stored calibration)
- CONSTS (A list of all calibration constants)

CAL_RPT?

Returns a listing of a calibration report. (The same report as is printed to the serial port when you use the CAL_PR command, but with no page formatting.)

Parameters

- ACTIVE (The shifts resulting from the last calibration)
- STORED (The shifts resulting from the last stored calibration)
- CONSTS (A list of all calibration constants)

Response

(IAD) The report followed by the EOFSTR.

CAL_SHIFT?

Calculates and returns the difference (shift) in the results of updated calibration constants at a specific input, range, and frequency.

Parameters

1. The shift to display from the list:
    - ACTIVE (the shift from STORED to ACTIVE)
    - STORED (the shift from ACTIVE to STORED)
2. Input binding post (WBND, INPUT1, INPUT2, or SHUNT)
3. The value at which to show the shift. This parameter selects the range the same way as in the RANGE command.
4. Frequency at which to show the shift. Use 0.0 for dc.

Response

(Float) The shift in PPM

CAL_SKIP

Advances to the next step of an interactive procedure without executing the step (like a CAL_NEXT except the step isn't executed). This is the same as when you press the "Skip Step" softkey during front panel controlled calibration.

Parameter

None

CAL_SLST?

Calculates and returns the shift (as in CAL_SHIFT) for the given range and input at +DC, -DC, and each service-calibrated frequency point.

Parameters

1. The shift to display from the list:
    - ACTIVE (the shift from STORED to ACTIVE)
    - STORED (the shift from ACTIVE to STORED)
2. Input binding post (WBND, INPUT1, INPUT2, or SHUNT)

3. The value at which to show the shift. This parameter selects the range the same way as in the RANGE command.

Response

(Float) The shift in PPM

CAL_SPEC?

Calculates and returns the absolute uncertainty specification for a specific input, value (and range), and frequency. This is similar to UNCERT?, except CAL_SPEC uses the parameters you send rather than the most recent input.

Parameter

1. Input binding post (WBND, INPUT1, INPUT2, or SHUNT)

2. The value at which to show the specification. This parameter selects the range the same way as in the RANGE command.

3. Frequency at which to show the specification. Use 0.0 for dc.

Response

(Float) The specification in PPM. If there is no specification for the input, 0 is returned.

CAL_STLST?

Lists the calibration constant groups that have been updated but not saved.

Parameters

- DC (DC calibration)
- AC (AC calibration)
- ZC (DC zeros calibration)
- WDC (Wideband 1 kHz calibration)
- WAC (Wideband Flatness)
- ALL (All of the above; use this to list CAL_I2 constants)
- A group name from Appendix C, e.g., AC_2_2V

Response

(String) The list expressed as a string. The form is:

\<number of groups\>,\<1st group\>, etc.

Example

```
CAL_STLST? DC
1,DC_DAC
```

CAL_STORE

Stores all calibration constants in the specified group list into nonvolatile memory. An error occurs if the CALIBRATION STORE switch is not set to ENABLE. (Overlapped command.)

Parameters

- DC (DC calibration)
- AC (AC calibration)

- ZC (DC zeros calibration)
- WDC (Wideband 1 kHz calibration)
- WAC (Wideband Flatness)
- ALL (All of the above; use this to store CAL_I2 constants)
- A group name from Appendix C, e.g., AC_2_2V

CAL_STORE?

Tells how many calibration constant groups have been updated but not saved. (This is like CAL_STLST? except only the initial number is given.)

Parameters

- DC (DC calibration)
- AC (AC calibration)
- ZC (DC zeros calibration)
- WDC (Wideband 1 kHz calibration)
- WAC (Wideband Flatness)
- ALL (All of the above; use this to check CAL_I2 constants)

Response

(Integer) 0 if no calibration constant groups have been updated; otherwise, the number of groups.

CAL_SW?

Returns the setting of the rear panel CALIBRATION STORE switch. (CAL_MODE? returns the CALIBRATION MODE switch setting).

Parameter

None

Response

(Integer) 0 = NORMAL (disabled), 1 = ENABLE

CAL_TEMP

Sets the temperature for calibration. Do this before you run any calibration procedures. Once set, the temperature is used for all calibration activities until changed. If not set before a calibration activity is complete, the 5790A uses a default of 23.0 °C.

Parameter

A number signifying the temperature in oC.

CAL_TEMP?

Returns the most recent calibration temperature for a specified type of calibration, if parameter is supplied. If parameter is not supplied, returns the temperature used for all calibration activities (ie: the value set by CAL_TEMP).

Parameter

Select one of the following options:

- DC (DC calibration)

- AC (AC calibration)
- ZC (DC zeros calibration)
- WDC (Wideband 1 kHz calibration)
- WAC (Wideband Flatness)
- ALL (All of the above)
- A group name from Appendix C, e.g., AC_2_2V

Response

(Integer) The temperature in oC.

CAL_ZERO

Executes dc zeros calibration. An error is generated if the 5790A cannot make a measurement (ie, if the short is not applied to the input as specified in the normal operation section of this SRS). (Overlapped command.)

Parameter

None

CLOCK

Sets the clock/calendar. If the second parameter is present, the rear panel CALIBRATION STORE switch must be in the "ENABLE" position or an execution error results.

Parameters

1. Time in 24-hour format as HHMMSS

2. (Optional) Date in the format controlled by the DATEFMT command

Examples:

```
CLOCK 140700, 021992
```
Sets the clock to 2:07 p.m., February 19, 1992. (Assuming DATEFMT = MDY.)

```
CLOCK 080000, 100392
```
Sets the clock/calendar to 8:00 a.m., March 10, 1992. (Assuming DATEFMT = DMY.)

CLOCK?

Returns the setting of the clock.

Parameter

None

Response

1. (Integer) Time as HHMMSS.

2. (Integer) Date in the format controlled by the DATEFMT command.

Example

```
CLOCK?
```
Returns

```
150000,090191
```

If the clock/calendar is set to 3 p.m., September 1, 1991.

CMDSTR?

Returns the command string (if possible) associated with the last error.

Parameter

None

Response

(String) The erroneous command string

DATEFMT

Sets the format in which dates are entered and returned (and shown on the front panel). This setting is kept in nonvolatile memory.

Parameters

- MDY (for MMDDYY in remote and MM/DD/YY on the display)
- DMY (for DDMMYY in remote and DD.MM.YY on the display)
- YMD (for YYMMDD in remote and YYMMDD on the display)

DATEFMT?

Returns the present date format setting.

Parameter

None

Responses

(CRD)

- MDY (for MMDDYY in remote and MM/DD/YY on the display)
- DMY (for DDMMYY in remote and DD.MM.YY on the display)
- YMD (for YYMMDD in remote and YYMMDD on the display)

DELTA?

Returns the delta (transfer) value from the 5790A . This is the difference between the reference value in memory and the present input. (Also see the DUNIT command.)

Parameters

None

Responses:

1. (Float) the transfer value. The value is 0 if no reference has been set.

2. (String) PPM, PCT, V, RATIO as set by the DUNIT command.

DFILT

Sets the digital filter parameters. The default is OFF.

Parameter

1. OFF, SLOW, MEDIUM, or FAST (the setting for mode)

2. (Optional) FINE, COARSE, or MEDIUM (the setting for restart threshold)

DFILT?

Returns the digital filter parameter settings.

Parameter

None

Response

1. (CRD) OFF, SLOW, MEDIUM, or FAST (the setting for mode)

2. (CRD) FINE, COARSE, or MEDIUM (the setting for restart threshold)

DIAG

Runs a self-diagnostics routine. If any errors are detected, they are logged into the error queue where they can be read by the ERR? query. The response to errors that occur during remote-controlled diagnostics depends by the setting of the DIAGFLT command. Use the ABORT command to abort a diagnostic procedure that is still running (not DIAG ABORT). (Overlapped long-term command.)

Parameter

Selects diagnostic routine to run or action to take if an error was encountered during remote-controlled diagnostics. The choices are:

- ALL (Runs all diagnostics for 5790A)
- CONT (Continues execution of diagnostics after an error)
- ABORT (Terminates execution of diagnostics after an error)

DIAGFLT

Determines the response to errors that occur during remote-controlled diagnostics. In all cases the error encountered is logged into the error queue before the 5790A takes any action as set by this command. The settings of this command are saved in nonvolatile memory. The default is "HALT".

Parameter

- HALT (Halts and waits for DIAG CONT or DIAG ABORT)
- ABORT (Terminates diagnostics, this is the default setting)
- CONT (Diagnostics continues to completion, logging any more errors into the error queue as they are encountered)

DIAGFLT?

Returns the setting of DIAGFLT.

Parameter

None

Response

(CRD) HALT, ABORT, or CONT (see the DIAGFLT command for meanings)

DUNIT

Sets the delta unit value. (Also see the DELTA? command.) The default is PPM. (Nonvolatile.)

Parameter

PPM, PCT, V, or RATIO

DUNIT?

Returns the currently programmed delta units.

Parameters

None

Response

(CRD) PPM, PCT, V, or RATIO

EOFSTR

Sets the End-Of-File character string. The maximum length is two characters. The EOF setting is saved when the power is turned off. (Nonvolatile overlapped command.)

Parameters

The EOF string (two characters maximum)

EOFSTR?

Returns the End-Of-File character string

Parameter

None

Response

(String) The End-Of-File character string

ERR?

Returns the first error code contained in the 5790A error queue, then removes that error code from the queue. Sent following the error code is an explanation of the error code, similar to but not always the same as the string you receive from the EXPLAIN? command. The explanation sent in response to this query can contain variables specific to a particular error event. (To get just the error number use FAULT?)

A zero value is returned when the error queue is empty, so to read the entire contents of the error queue, repeat ERR? until the response is:

```
"0,"No Error"
```

Parameter

None

Response

    1.   (Integer) The error code

    2.   (String) The error message string, formatted for display

ETIME?

Elapsed time query. The response is the total number of minutes that the power switch has been on for the life of the instrument. An application for this command would be to help monitor an interval you set for cleaning the air filter.

Parameters

None

Response

(Integer) Total number of minutes the power has been on

EXPLAIN?

Explains a error code. This command returns a string that explains the error code furnished as the parameter. The error code (same as the parameter) is originally obtained by sending the FAULT? query. (See the ERR? command, which returns both the error code and the explanation string.)

Parameter

The error code (an integer)

Response

The explanation of the error code, with the parameter (if there is one) shown as a percent sign followed by d, f, or s.

EXTGUARD

Sets the GUARD connection to external or internal.

Parameter

ON or non-zero (external guard), or OFF or 0 (internal guard)

EXTGUARD?

Returns the setting of external or internal GUARD connection.

Parameter

None

Response

(Integer) 1 for external guard, 0 for internal guard

EXTRIG

Enables or disables external (single) trigger mode. In external trigger mode, you need to send the TRIG, *TRG, or MEAS? command to start a measurement. The EXTRIG command corresponds with the EXTRIG front panel key.

Parameter

ON or non-zero (external trigger), or OFF or 0 (autotrigger)

EXTRIG?

Returns the internal or external trigger setting.

Parameter

None

Response

(Integer) 1 for external trigger, or 0 for internal trigger

FAULT?

Returns the first error code contained in the 5790A error queue, then removes that error code from the queue. You can use the EXPLAIN? query to get an explanation string for a specified error code. (See the ERR? command, which returns both the error code and the explanation string.)

A zero value is returned when the error queue is empty, so to read the entire contents of the error queue, repeat FAULT? until the response is "0."

Parameter

None

Response

(Integer) The error code

FIRSTIN

Sets the input (INPUT 1 OR INPUT 2) chosen at power-up or reset. The setting is saved in nonvolatile memory.

Parameter

INPUT1 or INPUT2

FIRSTIN?

Returns the setting of FIRSTIN; the input (INPUT 1 OR INPUT 2) chosen at power-up or reset.

Parameter

None

Response

(CRD) INPUT1 or INPUT2

FORMAT

Use with extreme care. Restores the contents of the nonvolatile memory device, or EEPROM (Electrically-Erasable Programmable Read Only Memory) tofactory defaults. The EEPROM holds calibration constants and setup parameters. You lose all calibration

data permanently. The CALIBRATION STORE switch must be set to ENABLE and the CALIBRATION MODE switch must be set to SERVICE to replace ALL or CAL data or an execution error occurs.

Parameter

- ALL (Replaces the whole contents with defaults)
- CAL (Replaces all cal constants with defaults)
- SETUP (Replaces setup parameters with defaults)

HIRES

Enables or disables higher resolution amplitude displays and remote responses as defined in Table 4-5.

Parameter

ON or non-zero, or OFF or 0

HIRES?

Returns the setting of the HIRES command for higher resolution amplitude displays and remote responses as defined in Table 4-5.

Response

(Integer) 1 for on, or 0 for off

INPUT

Selects the active input connector.

Parameter

INPUT1, INPUT2, SHUNT, WBND

INPUT?

Returns the name of the active input connector.

Parameters

None

Response

(CRD) INPUT1, INPUT2, SHUNT, or WBND

ISCE0

Loads two bytes into the Instrument Status 1 to 0 Change Enable register described under "Checking 5790A Status."

Parameter

The decimal equivalent of the binary number to load into the register. You can also send a binary, octal, or hexadecimal number if you precede the number with #b, #o, or #h, respectively. (A number without a preceding designator is taken as decimal.)

Example

```
ISCE0 52
```

Loads 00000000 00110100 into the register, enabling bits 5 (MCCHG), 4

(MDCHG), and 2 (RNGCHG).

ISCE0?

Reads the contents of the Instrument Status 1 to 0 Change Enable register described under "Checking 5790A Status."

Parameter

None

Response

(Integer) The contents of the Instrument Status 1 to 0 Change Enable register in decimal.

Example

```
ISCE0?
```

Returns 52 if bits bits 5 (MCCHG), 4 (MDCHG), and 2 (RNGCHG) are enabled (set to 1) in the Instrument Status 1 to 0 Change Enable register.

ISCE1

Loads two bytes into the Instrument Status 0 to 1 Change Enable register described under "Checking 5790A Status."

Parameter

The decimal equivalent of the binary number to load into the register. You can also send a binary, octal, or hexadecimal number if you precede the number with #b, #o, or #h, respectively. (A number without a preceding designator is taken as decimal.)

Example

```
ISCE1 52
```

Loads 00000000 00110100 into the register, enabling bits 5 (MCCHG), 4 (MDCHG), and 2 (RNGCHG).

ISCE1?

Reads the contents of the Instrument Status 0 to 1 Change Enable register described under "Checking 5790A Status."

Parameter

None

Response

(Integer) The contents of the Instrument Status 0 to 1 Change Enable register in decimal.

Example

```
ISCE1?
```

Returns 52 if bits bits 5 (MCCHG), 4 (MDCHG), and 2 (RNGCHG) are enabled (set to 1) in the Instrument Status 0 to 1 Change Enable register.

ISCR0?

Reads and clears the contents of the Instrument Status 1 to 0 Change Register described under "Checking 5790A Status."

Parameter

None

Response

(Integer) The contents of the Instrument Status 1 to 0 Change Register in decimal.

Example

```
ISCR0?
```
Returns 52 if bits bits 5 (MCCHG), 4 (MDCHG), and 2 (RNGCHG) are enabled (set to 1) in the Instrument Status 1 to 0 Change register.

ISCR1?

Reads and clears the contents of the Instrument Status 0 to 1 Change Register described under "Checking 5790A Status."

Parameter

None

Response

(Integer) The contents of the Instrument Status 0 to 1 Change Register in decimal.

Example

```
ISCR1?
```
Returns 52 if bits bits 5 (MCCHG), 4 (MDCHG), and 2 (RNGCHG) are enabled (set to 1) in the Instrument Status 0 to 1 Change register.

ISR?

Reads the contents of the Instrument Status Register described under "Checking 5790A Status."

Parameter

None

Response

(Integer) The contents of the Instrument Status Register in decimal.

Example

```
ISR?
```
Returns 52 if bits bits 5 (MCCHG), 4 (MDCHG), and 2 (RNGCHG) are enabled (set to 1) in the Instrument Status register.

LOCAL (For serial port remote control only)

Puts the 5790A into the local state. This command duplicates the IEEE-488 GTL (Go To Local) message.

Parameter

None

LOCKOUT (For serial port remote control only)

Puts the 5790A into the local with lockout state. This command duplicates the IEEE-488 LLO (Local Lockout) message.

Parameter

None

MEAS?

Trigger (or in continuous trigger, restart trigger) a new measurement, wait for it to complete, then retrieve the value of the present input measurement (the most recently completed input measurement). If a timeout argument is given and no settled measurement occurs within the timeout period, the command generates an error and presents the closest approximation of the measurement obtained in the timeout period. The MEAS? command is equivalent to the following sequence of commands: TRIG; *WAI; VAL?

Parameter

\<timeout in seconds\> (optional)

Response

1. (Float) The magnitude of the measurement in volts.

2. (Float) The frequency of the measurement in Hertz.

3. (Integer) A code describing the measurement as follows. If more than one conditions is true, the highest number only is returned.

- 0 = Measurement conditions valid, no other condition below is true
- 1 = Frequency underrange
- 2 = Frequency overrange
- 3 = Measurement settled, but digital filter not full
- 4 = Measurement is unsettled ("U" annunciator is lit)
- 5 = Value is underrange ("LLLLLLLL" on display)
- 6 = Value is overrange ("HHHHHHHH" on display)
- 7 = Value is invalid ("--------" on display)

MODE?

Returns the current operating mode. See the response below for modes.

Parameters

None

Response

(CRD) MEASUREMENT, CALIBRATION, DIAGNOSTIC, or CALWAITING

MODESTR?

Returns a string that describes what a calibration or diagnostic procedure is doing.

Parameter

None

Response

(String) The same string that appears on the Control Display in front panel operation. An empty string if no calibration or diagnostic step is underway.

ONTIME?

Returns the time in minutes that the 5790A power has been turned on for the current operating session only.

Parameters

None

Response

(Integer) The number of minutes.

RANGE

Selects the range that best measures the specified value furnished as a parameter, or otherwise controls the range setting as defined by the parameter. The range selected will be the one within whose limits (as returned by the RANGE? command) the value falls. This command turns off autoranging if it was on, unless the parameter is AUTO.

Parameter

The value to be measured (the V (or mV) unit is optional).

or:

- LOCK (To lock the range)
- AUTO (To select autoranging)
- UP (To go to the next highest range)
- DOWN (To go to the next lowest range)

RANGE?

Returns the present measurement range characteristics.

Response

1. (Float) The nominal maximum value for the range (uprange point in autorange).

2. (Float) Minimum value measurable by range (not including low end hysteresis for autoranging).

3. (Float) Resolution of range

4. (Integer) 1 if autoranging, 0 if range locked.

REF?

Returns the reference value and its associated parameters.

Parameter

None

Responses:

1. (Float) The reference value.

2. (Float) The frequency of the reference. (If references at two different frequencies were averaged, the second frequency is returned.)

3. (Integer) The number of readings used to generate the reference value. 0 = reference off, 1 = reference set, 2 = reference averaged.

4. (CRD) The input connector at which the last reference was measured, e.g., INPUT1, or NONE if no reference is set.

REFAVG

Sets the reference to the average of the present stored reference value and the present input measurement. This command generates an error if there is no reference set or if the reference has already been averaged.

Parameter

None

REFCLR

Clears the reference.

Parameter

None

REFSET

Sets the reference to the value of the present input measurement. This generates an error if a reference is already set. (Use REFCLR first in that case.)

Parameter

None

REMOTE (For serial port remote control only)

Puts the 5790A into the remote state. This command duplicates the IEEE-488 REN (Remote Enable) message.

Parameter

None

RPTSTR

Sets the user report string. The user report string can be read on the Control Display in local operation, and appears on calibration reports. Do not use control characters (e.g., CRLF, ^D, etc.) in the string.

Parameter

String of up to 132 characters

RPTSTR?

Returns the user report string. The user report string can be read on the Control Display in local operation, and appears on calibration reports.

Parameter

None

Response

(String) Up to 132 characters

SPLSTR

Sets the serial remote mode Serial Poll response string.

Parameters

The string (up to 40 characters) to print on receipt of a ^P character.

SPLSTR?

Returns the string programmed for serial remote mode Serial Poll responses.

Response

(String) The serial remote mode Serial Poll string.

SP_SET

Sets the serial port settings and saves them in nonvolatile memory.

Parameters

One or more of the following, in any order:

1. Baud rate as 300, 600, 1200, 2400, 4800, 9600, 19200, or 38400

2. TERM or COMP (See note below)

3. XON, RTS, or NOSTALL (Stall method)

4. DBIT7 or DBIT8 (Number of data bits)

5. SBIT1 or SBIT2 (Number of stop bits)

6. PNONE, EVEN, ODD, or IGNORE (Parity)

7. CR, LF, or CRLF (End-Of-Line)

> *Note*
>
> *The "TERM" or "COMP" parameter sets the responses in serial remote control to be appropriate for interactive terminal use or operation under program control. Specifying "TERM" generates remote responses in plain English for a human operator using a terminal. Specifying "COMP" generates remote responses for computer program use. (This command has the same effect as setting Remote I/F to "TERMINAL" or "COMPUTER" in the RS-232-C Port Setup Menu.)*

Defaults:

9600,TERM,XON,DBIT8,SBIT1,PNONE,CRLF

Example

        1200,COMP,XON,DBIT8,SBIT1,EVEN,CRLF

SP_SET?

Returns the serial port settings contained in nonvolatile memory.

Response

1. (Integer) One of these baud rate values: 300, 600, 1200, 2400, 4800, 9600, 19200, or 38400

2. (CRD) TERM or COMP (Response type)

3. (CRD) XON, RTS, or NOSTALL (Stall method)

4. (CRD) DBIT7 or DBIT8 (Data bits)

5. (CRD) SBIT1 or SBIT2 (Stop bits)

6. (CRD) PNONE, EVEN, ODD, or IGNORE (Parity)

7. (CRD) CR, LF, or CRLF (End-Of-Line)

Example

        9600,TERM,XON,DBIT8,SBIT1,PNONE,CRLF

SRQSTR

Sets the serial remote mode SRQ (Service Request) response string (up to 40 characters).

Parameter

The serial remote mode SRQ string.

Example

        SRQSTR "\nSRQ\n"

> *Note*
>
> *"\n" denotes the NEWLINE character (hex 0A).*

SRQSTR?

Returns the string programmed for Serial Mode SRQ responses.

Response

(String) The serial remote mode SRQ string.

TRIG

Triggers a measurement. When the 5790A is in manual trigger mode, a measurement begins when you send the TRIG, *TRG, or MEAS? command. Use the EXTRIG? query to determine the trigger mode setting.

Parameter

None

UNCERT?

Returns the uncertainty in ppm of the instrument for the present measurement value and the present calibration interval setting. This returns 0 if there is no specification for the present measurement.

Parameter

None

Response

1. (Float) The uncertainty in ppm

2. (CRD) PPM

3. (Integer) 90, 365, or 720, depending on the CAL_INTV setting

Example

```
33.1,PPM,365
```

VAL?

Retrieve the value of the most recently completed input measurement.

Parameters

None

Response

The same response as the MEAS? query

Chapter 7
Using the RS-232 Interface

7-1. Introduction

This section describes how to set up the RS-232 interface for remote control using a protocol similar to IEEE-488, and to print or transmit data from the 5790A. Once you set up the interface for remote control, refer to Section 5 for full details of remote operation. This section provides all details on printing or transmitting data.

The standard equipment serial interface is designed in accordance with EIA (Electronic Industries Association) standard EIA-232-D. Through its serial interface, the 5790A can be remotely controlled, and it can transmit its internal calibration constant values and other information to a printer, video-display terminal, or host computer.

7-2. Serial Interface Specifications

The serial interface is configured as DTE (Data Terminal Equipment). A null-modem cable with two female 25-pin subminiature D connectors must be used to connect the 5790A to other DTE (Data Terminal Equipment) such as printers, video-display terminals, or computers. Recommended cables are Fluke accessories Y1702 or Y1703.

The pinout for the 5790A serial interface connector is shown in Figure 7-1. The choices available and the defaults for all programmable interface parameters are shown in Table 7-1.
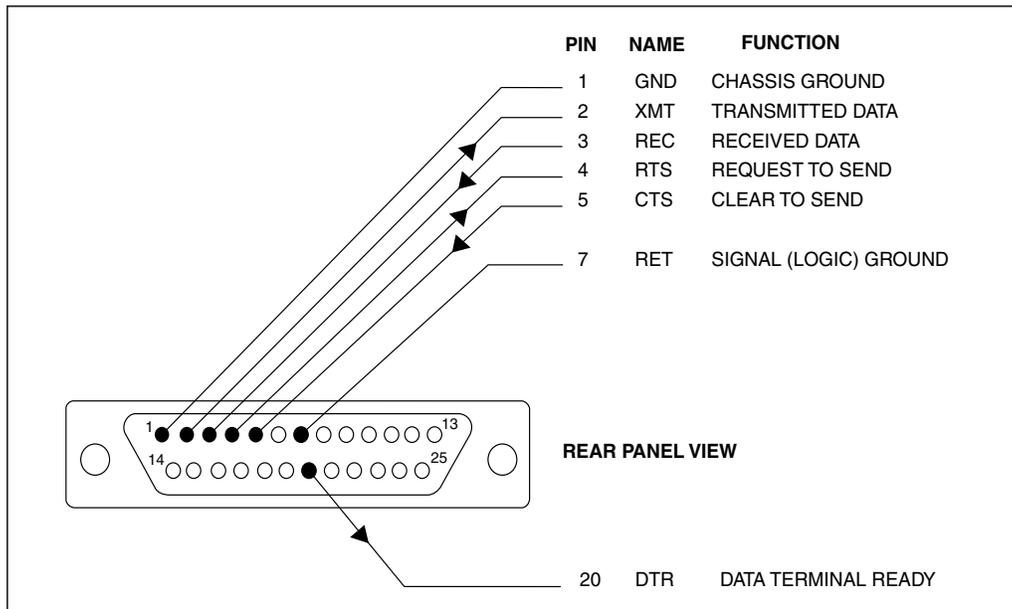
add52f.eps

Figure 7-1. RS-232 Connector Pinout

Table 7-1. Serial Interface Parameter Choices

Parameter	Choices	Default Setting
Data Bits	7 or 8	8
Stop Bits	1 or 2	1
Flow Control	XON/XOFF, RTS, or NOSTAL	XON/XOFF
Parity Checking	ODD, EVEN. NONE, or IGNORE	NONE
Baud Rate	300, 600, 1200, 2400, 4800, 9600, 19200, or 38400	9600
Timeout Period	0 to 30 seconds	0 (No timeout)
EOL (End Of Line)	CR, LF, or CD LF	CR LF
EOL (End of file)	Any two ASCII	"E" and "O"

Note
The DTR line is always asserted.

7-3. Setting Up and Connecting the Serial Interface

Refer to the specifications for your peripheral device, and proceed as follows to set up the serial interface for your application:

1. Connect an RS-232 null-modem cable such as Fluke accessory Y1702 or Y1703 to the rear panel RS-232 connector and to the peripheral device.

2. Press [UTIL MENUS] followed by the sequence of softkeys: "Setup", "Remote Port Setup", "RS-232 Port Setup". The display changes to:
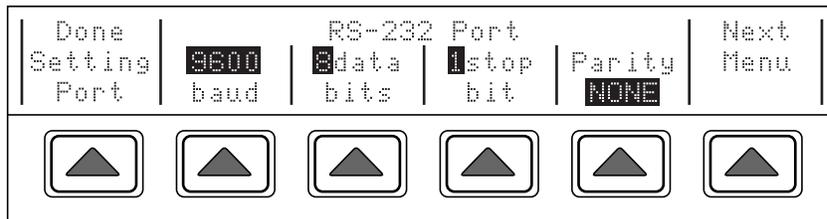
add443f.eps

3. Select the baud rate, number of data bits, number of stop bits, and parity method by pressing the associated softkeys.

4. Press the "Next Menu" softkey. The display changes to:
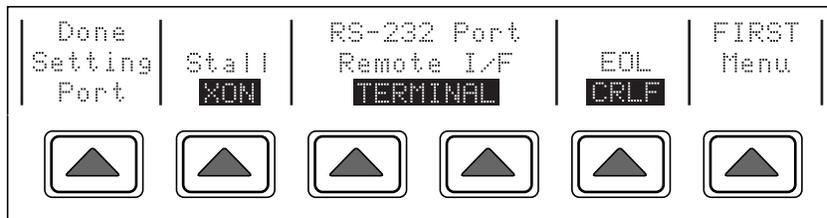
add44f.eps

5. Select the stall method by pressing the "Stall" softkey.

6. This step needs to be done only if you are setting up the interface for remote control of the 5790A. Press one of the softkeys under "Remote I/F" to set the label to "TERMINAL" or "computer".

   "Terminal" sets the remote port to expect a human operator to be using a terminal attached to the RS-232 port to control the 5790A. This setting has the same effect as specifying "TERM" in the SP_SET remote command parameter string.

   "Computer" sets the remote port to expect a computer to be controlling the 5790A over the RS-232-C port. This setting has the same effect as specifying "COMP" in the SP_SET remote command parameter string.

7. Press the "EOL" softkey to select the End of Line character.

8. To designate a character or character string as the EOF (End Of File) character, press the "DONE Setting Port" and "Set EOF" softkeys.

9. Enter the decimal code of the ASCII (American Standard Code for Information Interchange) character or characters to be designated as EOF. (Appendix C contains a table of ASCII codes.) Verify that your selection is correct as shown on the display.

10. To exit the setup menus, press the leftmost softkey four times.

7-4. *Printing Calibration Reports*

Calibration Reports show the shifts at various input levels and frequencies that are the result of the most recent, or the previous calibration. How to print the reports and examples of each type of report are provided next.

Note

The calibration reports are test reports, not calculations of correction factors for you to apply. Do not use the shifts printed on the reports as correction factors. After configuring the serial interface for compatibility with your peripheral device and attaching an RS-232 null-modem cable, proceed as follows from the power-up state to transmit the report:

1. Press [UTIL MENUS], the "Cal" softkey, followed by the "Cal Reports" softkey. The Control Display appears as follows:
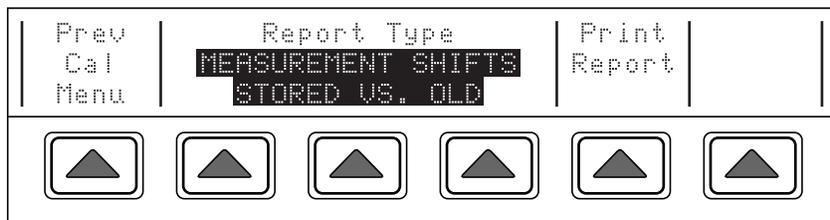
add55f.eps

2. Press one of the middle three softkeys to see the other report choice:

```
| Prev  |    Report Type    | Print  |              |
| Cal   | MEASUREMENT SHIFTS | Report |             |
| Menu  |   STORED VS. OLD   |        |              |
```
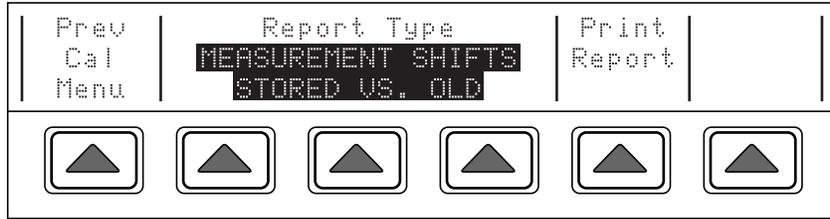

add55f.eps

3. When you print a report, the display appears as follows, allowing your to abort printing at any time:

```
| Prev  |    Report Type    | STOP   |              |
| Cal   |   Calibration     | Report |              |
| Menu  |    Constants      |        |              |
```


add57f.eps

The printout begins if the interface parameters are set up correctly and the cable wiring is correct for the peripheral device. If the input buffer of the peripheral device fills and the device sends the 5790A a stall command, the 5790A stops sending data and starts a timer. If the timeout period expires, printing is aborted. Press any key to clear the abort message.

Line Feed characters are embedded in the data stream so that the output is paginated for a 66-line page.

7-5. Sample Measurement Shifts Report

```
JOHN FLUKE MFG. CO., INC. 5790 CALIBRATION REPORT
Calibration Shifts -- STORED vs. OLD Constants
Printed on 12/17/91 at 11:39:00
Serial Number:      5420001
Report String:      5790A
Software Versions:  Main: 1.2      Inguard: 1.2
----------------------------------------------------------------------
                  CALIBRATION DATES AND TEMPERATURES
CAL TYPE                ACTIVE DATES AND TEMPERATURE      STORED DATE OLD
DATE
Zero                    12/14/91 17:25:47 @ 22.4 degC     12/14/91 9/10/91
Main Periodic :         12/14/91 18:47:46 @ 22.3 degC     12/14/91 9/10/91
Main Service  :         12/14/91 18:47:46 @ 22.3 degC     12/14/91 9/10/91
Wideband      :         12/14/91 17:09:17 @ 22.4 degC     12/14/91 9/10/91

----------------------------------------------------------------------
                        MEASUREMENT SHIFTS
NOTE: A positive shift means it takes a larger voltage to produce the same
reading with the new constants than it did with the old constants. An ***
indicates a point calibrated directly during periodic calibration. The I2 vs
I1 shift pertains to measuring the same voltage at INPUT1 and INPUT2. A
positive shift means the new INPUT2 measurement is smaller for the same
INPUT1 measurement.
                        2.2 mV RANGE
```

```
                           DC Cal: INPUT1  AC Cal: INPUT1
                    FREQUENCY        STORED vs OLD     1 YEAR ABS SPEC  % OF
                  SPEC
        ***              + DC              +0.0 ppm            (No Spec)
        ***              - DC              +0.0 ppm            (No Spec)
                    10.0  Hz              -606.3 ppm          2290.9 ppm    -
26.5 %
                     1.0 kHz              -616.8 ppm          1010.9 ppm    -
61.0 %
                    20.0 kHz              -583.5 ppm          1010.9 ppm    -
57.7 %
        ***         300.0 kHz             -620.4 ppm          4118.2 ppm    -
15.1 %
                    500.0 kHz             -784.4 ppm          6036.4 ppm    -
13.0 %
                    800.0 kHz             -829.2 ppm          7136.4 ppm    -
11.6 %
        ***          1.0 MHz             -1764.7 ppm          7136.4 ppm    -
24.7 %
        I2 vs I1 @ 1.0 MHz               +1.1 ppm
                              7 mV RANGE
                      DC Cal: INPUT1  AC Cal: INPUT1
              FREQUENCY      STORED vs OLD     1 YEAR ABS SPEC  % OF SPEC
***              + DC              +0.0 ppm            (No Spec)
***              - DC              +0.0 ppm            (No Spec)
                10.0  Hz             -42.8 ppm          1035.7 ppm      -4.1 %
                 1.0 kHz             -33.5 ppm            95.7 ppm      -8.5 %
                20.0 kHz             -48.3 ppm           395.7 ppm     -12.2 %
***             300.0 kHz            -70.8 ppm          1771.4 ppm      -4.0 %
                500.0 kHz           -155.0 ppm          2442.9 ppm      -6.3 %
                800.0 kHz           -364.0 ppm          3442.9 ppm     -10.6 %
***              1.0 MHz            -777.5 ppm          3442.9 ppm     -22.6 %
    I2 vs I1 @ 1.0 MHz               1.3 ppm
                             22 mV RANGE
                     DC Cal: INPUT1  AC Cal: INPUT1
             FREQUENCY      STORED vs OLD     1 YEAR ABS SPEC  % OF SPEC
***              + DC              +0.0 ppm            (No Spec)
***              - DC              +0.0 ppm            (No Spec)
                10.0  Hz             +11.9 ppm           349.1 ppm      +3.4 %
                 1.0 kHz             +22.1 ppm           169.1 ppm     +13.1 %
                20.0 kHz              +9.5 ppm           169.1 ppm      +5.6 %
***             300.0 kHz            -48.9 ppm           991.8 ppm      -4.9 %
                500.0 kHz           -111.0 ppm          1253.6 ppm      -8.9 %
***              1.0 MHz            -537.0 ppm          2063.6 ppm     -26.0 %
    I2 vs I1 @ 1.0 MHz              +1.3 ppm
                              0 mV RANGE
                     DC Cal: INPUT1  AC Cal: INPUT1
             FREQUENCY      STORED vs OLD     1 YEAR ABS SPEC  % OF SPEC
***              + DC              +0.0 ppm            (No Spec)
***              - DC              +0.0 ppm            (No Spec)
                10.0  Hz              +2.8 ppm           261.4 ppm      +1.1 %
                 1.0 kHz              +6.5 ppm            86.4 ppm      +7.5 %
                20.0 kHz              -2.6 ppm            86.4 ppm      -3.0 %
***             300.0 kHz            -68.7 ppm           567.1 ppm     -12.1 %
***              1.0 MHz            -388.8 ppm          1214.3 ppm     -32.0 %
```

```
             I2 vs I1 @ 1.0 MHz          +1.4 ppm
                               220 mV RANGE
                        DC Cal: INPUT1  AC Cal: INPUT1
                FREQUENCY      STORED vs OLD    1 YEAR ABS SPEC  % OF SPEC
***                  + DC        +0.0 ppm              (No Spec)
***                  - DC        +0.0 ppm              (No Spec)
                10.0  Hz         +2.8 ppm              216.8 ppm     +1.3 %
                1.0  kHz         +0.2 ppm               44.8 ppm     +0.4 %
                20.0 kHz         -1.5 ppm               44.8 ppm     -3.3 %
               300.0 kHz         -2.9 ppm              268.2 ppm     -1.1 %
***             1.0  MHz        -85.8 ppm             1036.4 ppm     -8.3 %
        I2 vs I1 @ 1.0 MHz          +1.4 ppm
                               700 mV RANGE
                        DC Cal: INPUT1  AC Cal: INPUT1
                FREQUENCY      STORED vs OLD    1 YEAR ABS SPEC  % OF SPEC
***                  + DC        +0.0 ppm              (No Spec)
***                  - DC        +0.0 ppm              (No Spec)
                10.0  Hz         +4.8 ppm              212.1 ppm     +2.3 %
                 .0  kHz         +3.6 ppm               35.1 ppm    +10.2 %
                20.0 kHz         +1.9 ppm               35.1 ppm     +5.4 %
               300.0 kHz        +21.2 ppm              185.7 ppm    +11.4 %
***             1.0  MHz        -37.4 ppm              971.4 ppm     -3.8 %
         2 vs I1 @ 1.0 MHz          +1.4 ppm
                               2.2V RANGE
                        DC Cal: INPUT1  AC Cal: INPUT1
                FREQUENCY      STORED vs OLD    1 YEAR ABS SPEC  % OF SPEC
***                  + DC        +0.0 ppm              (No Spec)
***                  - DC        +0.0 ppm              (No Spec)
                10.0  Hz         +2.2 ppm              200.0 ppm     +1.1 %
                1.0  kHz         +1.2 ppm               24.0 ppm     +5.0 %
                20.0 kHz         +1.6 ppm               24.0 ppm     +6.7 %
               300.0 kHz        +10.3 ppm              160.0 ppm     +6.4 %
***              .0  MHz        +11.6 ppm              900.0 ppm     +1.3 %
        I2 vs I1 @ 1.0 MHz           1.4 ppm
                                7V RANGE
                        DC Cal: INPUT1  AC Cal: INPUT1
                FREQUENCY      STORED vs OLD    1 YEAR ABS SPEC  % OF SPEC
***                  + DC        +0.0 ppm              (No Spec)
***                  - DC        +0.0 ppm              (No Spec)
                10.0  Hz         +2.1 ppm              200.0 ppm     +1.1 %
                1.0  kHz         +1.1 ppm               24.0 ppm     +4.6 %
                20.0 kHz         +2.0 ppm               24.0 ppm     +8.3 %
***            100.0 kHz         +3.8 ppm               81.0 ppm     +4.7 %
               300.0 kHz         -0.4 ppm              190.0 ppm     -0.2 %
               500.0 kHz         +2.1 ppm              400.0 ppm     +0.5 %
               800.0 kHz        +23.6 ppm             1200.0 ppm     +2.0 %
***             1.0  MHz       +119.3 ppm             1200.0 ppm     +9.9 %
        I2 vs I1 @ 1.0 MHz          +0.6 ppm
                                22V RANGE
                        DC Cal: INPUT1  AC Cal: INPUT1
                FREQUENCY      STORED vs OLD    1 YEAR ABS SPEC  % OF SPEC
***                  + DC        +0.0 ppm              (No Spec)
***                  - DC        +0.0 ppm              (No Spec)
                10.0  Hz         +1.1 ppm              200.0 ppm     +0.6 %
                1.0  kHz         +0.1 ppm               27.0 ppm     +0.4 %
```

	FREQUENCY	STORED vs OLD	1 YEAR ABS SPEC	% OF SPEC
	20.0 kHz	+0.4 ppm	27.0 ppm	+1.5 %
***	100.0 kHz	+1.7 ppm	81.0 ppm	+2.1 %
	300.0 kHz	-2.5 ppm	190.0 ppm	-1.3 %
	500.0 kHz	+3.2 ppm	400.0 ppm	+0.8 %
***	1.0 MHz	+70.8 ppm	1200.0 ppm	+5.9 %

```
   I2 vs I1 @ 1.0 MHz        +0.6 ppm
```

```
                        70V RANGE
             DC Cal: INPUT1  AC Cal: INPUT1
```

	FREQUENCY	STORED vs OLD	1 YEAR ABS SPEC	% OF SPEC
***	+ DC	+0.0 ppm	(No Spec)	
***	- DC	+0.0 ppm	(No Spec)	
	10.0 Hz	+2.6 ppm	200.0 ppm	+1.3 %
	1 .0 kHz	+1.6 ppm	32.0 ppm	+5.0 %
	20.0 kHz	+1.8 ppm	32.0 ppm	+5.6 %
***	500.0 kHz	+2.5 ppm	410.0 ppm	+0.6 %
***	1.0 MHz	+24.5 ppm	1200.0 ppm	+2.0 %

```
   I2 vs I1 @ 1.0 MHz        +0.6 ppm
```

```
                        220V RANGE
             DC Cal: INPUT1  AC Cal: INPUT1
```

	FREQUENCY	STORED vs OLD	1 YEAR ABS SPEC	% OF SPEC
***	+ DC	+0.0 ppm	(No Spec)	
***	- DC	+0.0 ppm	(No Spec)	
	10.0 Hz	+1.0 ppm	200.0 ppm	+0.5 %
	1.0 kHz	+0.0 ppm	31.0 ppm	+0.0 %
	20.0 kHz	-0.7 ppm	31.0 ppm	-2.3 %
***	300.0 kHz	+6.1 ppm	210.0 ppm	+2.9 %

```
   I2 vs I1 @ 1.0 MHz        +0.6 ppm
```

```
                        700V RANGE
             DC Cal: INPUT1  AC Cal: INPUT1
```

	FREQUENCY	STORED vs OLD	1 YEAR ABS SPEC	% OF SPEC
***	+ DC	+0.0 ppm	(No Spec)	
***	- DC	+0.0 ppm	(No Spec)	
	10.0 Hz	-4.9 ppm	200.0 ppm	-2.5 %
	1.0 kHz	-5.9 ppm	41.0 ppm	-14.4 %
	20.0 kHz	-7.3 ppm	41.0 ppm	-17.8 %
***	100.0 kHz	-34.1 ppm	500.0 ppm	-6.8 %

```
   I2 vs I1 @ 100 kHz        +10.2 ppm
```

```
                        1 kV RANGE
             DC Cal: INPUT1  AC Cal: INPUT1
```

	FREQUENCY	STORED vs OLD	1 YEAR ABS SPEC	% OF SPEC
***	+ DC	+0.0 ppm	(No Spec)	
***	- DC	+0.0 ppm	(No Spec)	
	10.0 Hz	+2.0 ppm	200.0 ppm	+1.0 %
	1.0 kHz	+0.9 ppm	38.0 ppm	+2.4 %
	20.0 kHz	+0.8 ppm	38.0 ppm	+2.1 %
***	100.0 kHz	-26.8 ppm	500.0 ppm	-5.4 %

```
   I2 vs I1 @ 100 kHz        +10.2 ppm
```

```
                  WIDE BAND 2.2 mV RANGE
```

	FREQUENCY	STORED vs OLD	1 YEAR ABS SPEC	% OF SPEC
***	10.0 Hz	-0.0163 %	0.6682 %	-2.4 %
***	100.0 Hz	-0.0062 %	0.6682 %	-0.9 %
***	1.0 kHz	+0.0000 %	0.6682 %	+0.0 %
***	10.0 kHz	+0.0106 %	0.6682 %	+1.6 %
***	50.0 kHz	-0.0062 %	0.6682 %	-0.9 %
***	200.0 kHz	+0.0127 %	0.6682 %	+1.9 %

	FREQUENCY	STORED vs OLD	1 YEAR ABS SPEC	% OF SPEC
***	500.0 kHz	+0.0164 %	0.6682 %	+2.5 %
***	1.0 MHz	+0.0080 %	0.7836 %	+1.0 %
***	2.0 MHz	-0.0042 %	0.7836 %	-0.5 %
***	4.0 MHz	+0.0050 %	0.8836 %	+0.6 %
***	8.0 MHz	-0.0033 %	0.8836 %	-0.4 %
***	10.0 MHz	+0.0028 %	0.8836 %	+0.3 %
***	15.0 MHz	+0.0274 %	1.0136 %	+2.7 %
***	20.0 MHz	+0.0447 %	1.0136 %	+4.4 %
***	26.0 MHz	+0.0452 %	1.4591 %	+3.1 %
***	30.0 MHz	+0.0777 %	1.4591 %	+5.3 %

WIDE BAND 7 mV RANGE

	FREQUENCY	STORED vs OLD	1 YEAR ABS SPEC	% OF SPEC
***	10.0 Hz	-0.0006 %	0.6000 %	-0.1 %
***	100.0 Hz	-0.0011 %	0.6000 %	-0.2 %
***	1.0 kHz	+0.0000 %	0.6000 %	+0.0 %
***	10.0 kHz	+0.0052 %	0.6000 %	+0.9 %
***	50.0 kHz	+0.0017 %	0.6000 %	+0.3 %
***	200.0 kHz	+0.0005 %	0.6000 %	+0.1 %
***	500.0 kHz	+0.0003 %	0.6000 %	+0.1 %
***	1.0 MHz	+0.0011 %	0.6843 %	+0.2 %
***	2.0 MHz	+0.0027 %	0.6843 %	+0.4 %
***	4.0 MHz	+0.0003 %	0.7043 %	+0.0 %
***	8.0 MHz	+0.0060 %	0.7043 %	+0.9 %
***	10.0 MHz	+0.0116 %	0.7043 %	+1.6 %
***	15.0 MHz	+0.0203 %	0.7843 %	+2.6 %
***	20.0 MHz	+0.0390 %	0.7843 %	+5.0 %
***	26.0 MHz	+0.0462 %	0.9843 %	+4.7 %
***	30.0 MHz	+0.0775 %	0.9843 %	+7.9 %

WIDE BAND 22 mV RANGE

	FREQUENCY	STORED vs OLD	1 YEAR ABS SPEC	% OF SPEC
***	10.0 Hz	-0.0039 %	0.5591 %	-0.7 %
***	100.0 Hz	-0.0013 %	0.5591 %	-0.2 %
***	1.0 kHz	+0.0000 %	0.5591 %	+0.0 %
***	10.0 kHz	-0.0003 %	0.5591 %	-0.1 %
***	50.0 kHz	+0.0005 %	0.5591 %	+0.1 %
***	200.0 kHz	-0.0005 %	0.5591 %	-0.1 %
***	500.0 kHz	-0.0006 %	0.5591 %	-0.1 %
***	1.0 MHz	+0.0027 %	0.6291 %	+0.4 %
***	2.0 MHz	+0.0031 %	0.6291 %	+0.5 %
***	4.0 MHz	+0.0019 %	0.6491 %	+0.3 %
***	8.0 MHz	+0.0090 %	0.6491 %	+1.4 %
***	10.0 MHz	+0.0096 %	0.6491 %	+1.5 %
***	15.0 MHz	+0.0184 %	0.7291 %	+2.5 %
***	20.0 MHz	+0.0321 %	0.7291 %	+4.4 %
***	26.0 MHz	+0.0549 %	0.9291 %	+5.9 %
***	30.0 MHz	+0.0778 %	0.9291 %	+8.4 %

WIDE BAND 70 mV RANGE

	FREQUENCY	STORED vs OLD	1 YEAR ABS SPEC	% OF SPEC
***	10.0 Hz	-0.0030 %	0.5429 %	-0.6 %
***	100.0 Hz	-0.0022 %	0.5429 %	-0.4 %
***	1.0 kHz	+0.0000 %	0.5429 %	+0.0 %
***	10.0 kHz	-0.0004 %	0.5429 %	-0.1 %
***	50.0 kHz	+0.0017 %	0.5429 %	+0.3 %
***	200.0 kHz	+0.0007 %	0.5429 %	+0.1 %
***	500.0 kHz	-0.0003 %	0.5429 %	-0.1 %

```
***        1.0 MHz        +0.0008 %            0.5929 %      +0.1 %
***        2.0 MHz        +0.0017 %            0.5929 %      +0.3 %
***        4.0 MHz        +0.0029 %            0.6129 %      +0.5 %
***        8.0 MHz        +0.0072 %            0.6129 %      +1.2 %
***       10.0 MHz        +0.0113 %            0.6129 %      +1.8 %
***       15.0 MHz        +0.0179 %            0.6929 %      +2.6 %
***       20.0 MHz        +0.0309 %            0.6929 %      +4.5 %
***       26.0 MHz        +0.0560 %            0.8929 %      +6.3 %
***       30.0 MHz        +0.0743 %            0.8929 %      +8.3 %
                      WIDE BAND 220 mV RANGE
          FREQUENCY      STORED vs OLD    1 YEAR ABS SPEC  % OF SPEC
***       10.0   Hz      -0.0006 %            0.4364 %      -0.1 %
***      100.0   Hz      -0.0016 %            0.4364 %      -0.4 %
***        1.0 kHz       +0.0000 %            0.4364 %      +0.0 %
***       10.0 kHz       -0.0002 %            0.4364 %      +0.0 %
***       50.0 kHz       -0.0003 %            0.4364 %      -0.1 %
***      200.0 kHz       -0.0003 %            0.4364 %      -0.1 %
***      500.0 kHz       +0.0001 %            0.4364 %      +0.0 %
***        1.0 MHz       +0.0003 %            0.4764 %      +0.1 %
***        2.0 MHz       -0.0005 %            0.4864 %      -0.1 %
***        4.0 MHz       -0.0007 %            0.5064 %      -0.1 %
***        8.0 MHz       +0.0008 %            0.5064 %      +0.2 %
***       10.0 MHz       +0.0013 %            0.5064 %      +0.3 %
***       15.0 MHz       +0.0028 %            0.5864 %      +0.5 %
***       20.0 MHz       +0.0052 %            0.5864 %      +0.9 %
***       26.0 MHz       +0.0074 %            0.7864 %      +0.9 %
***       30.0 MHz       +0.0110 %            0.7864 %      +1.4 %
                      WIDE BAND 700 mV RANGE
          FREQUENCY      STORED vs OLD    1 YEAR ABS SPEC  % OF SPEC
***       10.0   Hz      -0.0050 %            0.4429 %      -1.1 %
***      100.0   Hz      +0.0010 %            0.4429 %      +0.2 %
***        1.0 kHz       +0.0000 %            0.4429 %      +0.0 %
***       10.0 kHz       +0.0000 %            0.4429 %      +0.0 %
***       50.0 kHz       -0.0003 %            0.4429 %      -0.1 %
***      200.0 kHz       -0.0009 %            0.4429 %      -0.2 %
***      500.0 kHz       -0.0006 %            0.4429 %      -0.1 %
***        1.0 MHz       +0.0012 %            0.4829 %      +0.2 %
***        2.0 MHz       +0.0012 %            0.4929 %      +0.2 %
***        4.0 MHz       +0.0028 %            0.5129 %      +0.5 %
***        8.0 MHz       +0.0046 %            0.5129 %      +0.9 %
***       10.0 MHz       +0.0032 %            0.5129 %      +0.6 %
***       15.0 MHz       +0.0086 %            0.5929 %      +1.5 %
***       20.0 MHz       +0.0087 %            0.5929 %      +1.5 %
***       26.0 MHz       +0.0128 %            0.7929 %      +1.6 %
***       30.0 MHz       +0.0145 %            0.7929 %      +1.8 %
                      WIDE BAND 2.2V RANGE
          FREQUENCY      STORED vs OLD    1 YEAR ABS SPEC  % OF SPEC
***       10.0   Hz      +0.0014 %            0.3682 %      +0.4 %
***      100.0   Hz      +0.0006 %            0.3682 %      +0.2 %
***        1.0 kHz       +0.0000 %            0.3682 %      +0.0 %
***       10.0 kHz       -0.0005 %            0.3682 %      -0.1 %
***       50.0 kHz       -0.0001 %            0.3682 %      +0.0 %
***      200.0 kHz       +0.0003 %            0.3682 %      +0.1 %
***      500.0 kHz       -0.0002 %            0.3682 %      -0.1 %
***        1.0 MHz       -0.0006 %            0.3982 %      -0.2 %
```

```
***          2.0 MHz          -0.0009 %              0.4182 %    -0.2 %
***          4.0 MHz          -0.0008 %              0.4382 %    -0.2 %
***          8.0 MHz          -0.0001 %              0.4382 %    +0.0 %
***         10.0 MHz          +0.0016 %              0.4382 %    +0.4 %
***         15.0 MHz          +0.0024 %              0.5182 %    +0.5 %
***         20.0 MHz          +0.0042 %              0.5182 %    +0.8 %
***         26.0 MHz          +0.0017 %              0.7182 %    +0.2 %
***         30.0 MHz          +0.0072 %              0.7182 %    +1.0 %
                             WIDE BAND 7V RANGE
         FREQUENCY      STORED vs OLD    1 YEAR ABS SPEC  % OF SPEC
***         10.0  Hz          -0.0039 %              0.3614 %    -1.1 %
***        100.0  Hz          -0.0014 %              0.3614 %    -0.4 %
***          1.0 kHz          +0.0000 %              0.3614 %    +0.0 %
***         10.0 kHz          +0.0017 %              0.3614 %    +0.5 %
***         50.0 kHz          -0.0002 %              0.3614 %    -0.1 %
***        200.0 kHz          -0.0005 %              0.3614 %    -0.1 %
***        500.0 kHz          +0.0008 %              0.3614 %    +0.2 %
***          1.0 MHz          +0.0007 %              0.3914 %    +0.2 %
***          2.0 MHz          +0.0015 %              0.4114 %    +0.4 %
***          4.0 MHz          +0.0022 %              0.4314 %    +0.5 %
***          8.0 MHz          +0.0025 %              0.4314 %    +0.6 %
***         10.0 MHz          +0.0045 %              0.4314 %    +1.0 %
***         15.0 MHz          +0.0055 %              0.5114 %    +1.1 %
***         20.0 MHz          +0.0057 %              0.5114 %    +1.1 %
***         26.0 MHz          +0.0081 %              0.7114 %    +1.1 %
***         30.0 MHz          +0.0079 %              0.7114 %    +1.1 %
-------------------------- END OF REPORT ----------------------------
    JOHN FLUKE MFG. CO., INC.                5790 CALIBRATION REPORT
```

7-6. *Sample Calibration Constants Report*

```
JOHN FLUKE MFG. CO., INC.                    5790 CALIBRATION REPORT
Calibration Constant List
Printed on 12/17/91 at 13:11:43
Serial Number:     5420001
Report String:     5790A
Software Versions:  Main: 1.2      Inguard: 1.2
----------------------------------------------------------------------
CALIBRATION DATES AND TEMPERATURES
CAL TYPE          ACTIVE DATE AND TEMPERATURE   STORED DATE OLD DATE
Zero        :  12/14/91 17:25:47 @ 22.4 degC    12/14/91 9/10/91
Main Periodic :  12/14/91 18:47:46 @ 22.3 degC    12/14/91 9/10/91
Main Service  :  12/14/91 18:47:46 @ 22.3 degC    12/14/91 9/10/91
Wideband    :  12/14/91 17:09:17 @ 22.4 degC    12/14/91 9/10/91
----------------------------------------------------------------------
                 CALIBRATION CONSTANT NAMES AND VALUES
CONSTANT      NAME              ACTIVE        STORED        OLD
DAC gain    DAC_G      =   2.999973e+03  2.999973e+03  2.999973e+03
DAC zero(c)  DAC_Z1     =   3.980000e+02  3.980000e+02  3.980000e+02
DAC zero(f)  DAC_Z2     =   1.774600e+04  1.774600e+04  1.774600e+04
DAC ratio   DAC_RATIO  =   1.623699e+04  1.623699e+04  1.623699e+04
A/D x1g     AD_X1_G    =  -7.223189e-06 -7.223189e-06 -7.223189e-06
A/D x1z     AD_X1_Z    =  -2.600000e+01 -2.600000e+01 -2.600000e+01
A/D x100g   AD_X10_G   =   7.186980e-08  7.186980e-08  7.186980e-08
A/D x100z   AD_X10_Z   =   1.141500e+03  1.141500e+03  1.141500e+03
```

```
Null DACg     AD_X10_G     =    7.186980e-08   7.186980e-08   7.186980e-08
Null DACz     AD_X10_Z     =    1.141500e+03   1.141500e+03   1.141500e+03
Sensor(C1)    SENSOR_C1    =    1.007827e+00   1.007827e+00   1.007827e+00
Sensor(C2)    SENSOR_C2    =    2.444168e-03   2.444168e-03   2.444168e-03
LF Linear     LN_C         =    2.346406e-02   2.346406e-02   2.330602e-02
I2vI1<2.2V    INPUT2_LO    =    1.791093e-04   1.791093e-04   1.805283e-04
I2vI1 Mid.    INPUT2_MID   =    1.678519e-04   1.678519e-04   1.684042e-04
I2vI1>220V    INPUT2_HI    =   -5.757886e-05  -5.757886e-05  -4.737085e-05
WBND sns(C1)  SENSOR_C1_WB =    3.313111e-03   3.313111e-03   3.313111e-03
WBND sns(C2)  SENSOR_C2_WB =   -2.712209e-06  -2.712209e-06  -2.712209e-06
                             2.2 mV RANGE
CONSTANT      NAME              ACTIVE         STORED         OLD
True Gain     DI_2_2MV     =    5.004941e+03   5.004941e+03   5.004941e+03
Rough Gain    IA_2_2MV     =    9.750996e-04   9.750996e-04   9.750996e-04
DC Zero       Z_2_2MV      =    3.459755e-05   3.459755e-05   3.459755e-05
DC Turnover   OF_2_2MV     =    3.935235e-06   3.935235e-06   3.935235e-06
Shunt Offset  SHO_2_2MV    =    6.719826e-08   6.719826e-08   6.719826e-08
10.0  Hz      F1_2_2MV     =    1.00053405     1.00053405     0.99992899
1.0 kHz       F2_2_2MV     =    1.00036803     1.00036803     0.99975104
20.0 kHz      F3_2_2MV     =    1.00044122     1.00044122     0.99985744
300.0 kHz     F4_2_2MV     =    1.00179093     1.00179093     1.00116943
500.0 kHz     F5_2_2MV     =    1.00428882     1.00428882     1.00350105
800.0 kHz     F6_2_2MV     =    1.01424763     1.01424763     1.01340664
1.0 MHz       F7_2_2MV     =    1.01795813     1.01795813     1.01616176
                              7 mV RANGE
CONSTANT      NAME              ACTIVE         STORED         OLD
True Gain     DI_7MV       =    1.001031e+03   1.001031e+03   1.001031e+03
Rough Gain    IA_7MV       =    3.070076e-03   3.070076e-03   3.070076e-03
DC Zero       Z_7MV        =    3.514791e-05   3.514791e-05   3.514791e-05
DC Turnover   OF_7MV       =    2.028734e-07   2.028734e-07   2.028734e-07
Shunt Offset  SHO_7MV      =    2.156815e-07   2.156815e-07   2.156815e-07
10.0  Hz      F1_7MV       =    1.00038472     1.00038472     1.00034341
1.0 kHz       F2_7MV       =    1.00023666     1.00023666     1.00020315
20.0 kHz      F3_7MV       =    1.00028379     1.00028379     1.00023549
300.0 kHz     F4_7MV       =    1.00210799     1.00210799     1.00203702
500.0 kHz     F5_7MV       =    1.00482908     1.00482908     1.00467335
800.0 kHz     F6_7MV       =    1.01275040     1.01275040     1.01238173
1.0 MHz       F7_7MV       =    1.01804593     1.01804593     1.01725438
                             22 mV RANGE
CONSTANT      NAME              ACTIVE         STORED         OLD
True Gain     DI_22MV      =    5.000476e+02   5.000476e+02   5.000476e+02
Rough Gain    IA_22MV      =    9.801491e-03   9.801491e-03   9.801491e-03
DC Zero       Z_22MV       =    5.685692e-05   5.685692e-05   5.685692e-05
DC Turnover   OF_22MV      =   -6.344478e-07  -6.344478e-07  -6.344478e-07
Shunt Offset  SHO_22MV     =    8.020670e-07   8.020670e-07   8.020670e-07
10.0  Hz      F1_22MV      =    1.00013851     1.00013851     1.00015195
1.0 kHz       F2_22MV      =    1.00003143     1.00003143     1.00005356
20.0 kHz      F3_22MV      =    1.00006100     1.00006100     1.00007055
300.0 kHz     F4_22MV      =    1.00136073     1.00136073     1.00131176
500.0 kHz     F5_22MV      =    1.00300280     1.00300280     1.00289151
1.0 MHz       F6_22MV      =    1.01165627     1.01165627     1.01111298
                             70 mV RANGE
CONSTANT      NAME              ACTIVE         STORED         OLD
True Gain     DI_70MV      =    1.000016e+02   1.000016e+02   1.000016e+02
Rough Gain    IA_70MV      =    3.122913e-02   3.122913e-02   3.122913e-02
```

```
DC Zero        Z_70MV      =   3.003405e-05   3.003405e-05   3.003405e-05
DC Turnover    OF_70MV     =   3.029944e-06   3.029944e-06   3.029944e-06
Shunt Offset   SHO_70MV    =   2.531815e-06   2.531815e-06   2.531815e-06
10.0  Hz       F1_70MV     =   1.00011296     1.00011296     1.00011731
1.0 kHz        F2_70MV     =   1.00004725     1.00004725     1.00005371
20.0 kHz       F3_70MV     =   1.00005889     1.00005889     1.00005633
300.0 kHz      F4_70MV     =   1.00144648     1.00144648     1.00137772
1.0 MHz        F5_70MV     =   1.01357124     1.01357124     1.01317722
                               220 mV RANGE
CONSTANT       NAME            ACTIVE         STORED         OLD
True Gain      DI_220MV    =   5.006776e+01   5.006776e+01   5.006776e+01
Rough Gain     IA_220MV    =   9.893278e-02   9.893278e-02   9.893278e-02
DC Zero        Z_220MV     =   2.686493e-05   2.686493e-05   2.686493e-05
DC Turnover    OF_220MV    =   3.675321e-06   3.675321e-06   3.675321e-06
Shunt Offset   SHO_220MV   =   2.414825e-06   2.414825e-06   2.414825e-06
10.0  Hz       F1_220MV    =   1.00005189     1.00005189     1.00005623
1.0 kHz        F2_220MV    =   1.00005157     1.00005157     1.00005180
20.0 kHz       F3_220MV    =   1.00005855     1.00005855     1.00005701
300.0 kHz      F4_220MV    =   1.00137050     1.00137050     1.00136757
1.0 MHz        F5_220MV    =   1.01228878     1.01228878     1.01220188
                               700 mV RANGE
CONSTANT       NAME            ACTIVE         STORED         OLD
True Gain      DI_700MV    =   1.001187e+01   1.001187e+01   1.001187e+01
Rough Gain     IA_700MV    =   3.151971e-01   3.151971e-01   3.151971e-01
DC Zero        Z_700MV     =   3.093178e-05   3.093178e-05   3.093178e-05
DC Turnover    OF_700MV    =   1.770888e-06   1.770888e-06   1.770888e-06
Shunt Offset   SHO_700MV   =   2.520451e-05   2.520451e-05   2.520451e-05
10.0  Hz       F1_700MV    =   1.00010458     1.00010458     1.00011098
1.0 kHz        F2_700MV    =   1.00001441     1.00001441     1.00001801
20.0 kHz       F3_700MV    =   1.00001393     1.00001393     1.00001588
300.0 kHz      F4_700MV    =   0.99975799     0.99975799     0.99977920
1.0 MHz        F5_700MV    =   0.99691597     0.99691597     0.99687867
                               2.2V RANGE
CONSTANT       NAME            ACTIVE         STORED         OLD
True Gain      DI_2_2V     =   5.001011e+00   5.001011e+00   5.001011e+00
Rough Gain     IA_2_2V     =   9.985861e-01   9.985861e-01   9.985861e-01
DC Zero        Z_2_2V      =   3.334759e-05   3.334759e-05   3.334759e-05
DC Turnover    OF_2_2V     =  -4.076221e-06  -4.076221e-06  -4.076221e-06
10.0  Hz       F1_2_2V     =   1.00006764     1.00006764     1.00007137
1.0 kHz        F2_2_2V     =   1.00001861     1.00001861     1.00001978
20.0 kHz       F3_2_2V     =   1.00001891     1.00001891     1.00002053
300.0 kHz      F4_2_2V     =   0.99977211     0.99977211     0.99978241
1.0 MHz        F5_2_2V     =   0.99741677     0.99741677     0.99742835
                               7V RANGE
CONSTANT       NAME            ACTIVE         STORED         OLD
True Gain      DI_7V       =   1.001570e+00   1.001570e+00   1.001570e+00
Rough Gain     IA_7V       =   3.150763e+00   3.150763e+00   3.150763e+00
DC Zero        Z_7V        =   2.734087e-04   2.734087e-04   2.734087e-04
DC Turnover    OF_7V       =  -1.004920e-05  -1.004920e-05  -1.004920e-05
10.0  Hz       F1_7V       =   1.00006617     1.00006617     1.00006982
1.0 kHz        F2_7V       =   1.00001714     1.00001714     1.00001824
20.0 kHz       F3_7V       =   0.99999685     0.99999685     0.99999880
100.0 kHz      F4_7V       =   0.99948177     0.99948177     0.99948555


CONSTANT       NAME            ACTIVE         STORED         OLD
```

```
True Gain     DI_7VHF    =   1.000471e+00  1.000471e+00  1.000471e+00
Rough Gain    IA_7VHF    =   3.121418e+00  3.121418e+00  3.121418e+00
DC Zero       Z_7VHF     =   0.000000e+00  0.000000e+00  0.000000e+00
DC Turnover   OF_7VHF    =   2.769412e-03  2.769412e-03  2.769412e-03
100.0 kHz     F1_7VHF    =   1.00034275    1.00034275    1.00034515
300.0 kHz     F2_7VHF    =   1.00197258    1.00197258    1.00197219
500.0 kHz     F3_7VHF    =   1.00494330    1.00494330    1.00494541
800.0 kHz     F4_7VHF    =   1.01118595    1.01118595    1.01120983
1.0 MHz       F5_7VHF    =   1.01749551    1.01749551    1.01761686-
```

```
                              22V RANGE
```

```
CONSTANT      NAME            ACTIVE        STORED        OLD
True Gain     DI_22V     =   5.002928e-01  5.002928e-01  5.002928e-01
Rough Gain    IA_22V     =   9.981963e+00  9.981963e+00  9.981963e+00
DC Zero       Z_22V      =   3.040093e-04  3.040093e-04  3.040093e-04
DC Turnover   OF_22V     =  -6.927607e-05 -6.927607e-05 -6.927607e-05
10.0  Hz      F1_22V     =   1.00006764    1.00006764    1.00007033
1.0 kHz       F2_22V     =   1.00001861    1.00001861    1.00001875
20.0 kHz      F3_22V     =   0.99999843    0.99999843    0.99999879
100.0 kHz     F4_22V     =   0.99948635    0.99948635    0.99948804
```

```
CONSTANT      NAME            ACTIVE        STORED        OLD
True Gain     DI_22VHF   =   5.009064e-01  5.009064e-01  5.009064e-01
Rough Gain    IA_22VHF   =   9.888533e+00  9.888533e+00  9.888533e+00
DC Zero       Z_22VHF    =   0.000000e+00  0.000000e+00  0.000000e+00
DC Turnover   OF_22VHF   =   2.515259e-03  2.515259e-03  2.515259e-03
100.0 kHz     F1_22VHF   =   1.00034703    1.00034703    1.00034965
300.0 kHz     F2_22VHF   =   1.00201623    1.00201623    1.00201375
500.0 kHz     F3_22VHF   =   1.00502193    1.00502193    1.00502520
1.0 MHz       F4_22VHF   =   1.01682573    1.01682573    1.01689773
```

```
                              70V RANGE
```

```
CONSTANT      NAME            ACTIVE        STORED        OLD
True Gain     DI_70V     =   1.001639e-01  1.001639e-01  1.001639e-01
Rough Gain    IA_70V     =   3.150582e+01  3.150582e+01  3.150582e+01
DC Zero       Z_70V      =   2.854542e-03  2.854542e-03  2.854542e-03
DC Turnover   OF_70V     =   1.513116e-05  1.513116e-05  1.513116e-05
10.0  Hz      F1_70V     =   1.00006720    1.00006720    1.00007140
1.0 kHz       F2_70V     =   1.00001817    1.00001817    1.00001981
20.0 kHz      F3_70V     =   1.00002600    1.00002600    1.00002781
500.0 kHz     F4_70V     =   1.00075720    1.00075720    1.00075972
1.0 MHz       F5_70V     =   1.00125437    1.00125437    1.00127889
```

```
                             220V RANGE
```

```
CONSTANT      NAME            ACTIVE        STORED        OLD
True Gain     DI_220V    =   5.003270e-02  5.003270e-02  5.003270e-02
Rough Gain    IA_220V    =   9.981338e+01  9.981338e+01  9.981338e+01
DC Zero       Z_220V     =   3.140710e-03  3.140710e-03  3.140710e-03
DC Turnover   OF_220V    =  -5.501616e-04 -5.501616e-04 -5.501616e-04
10.0  Hz      F1_220V    =   1.00006747    1.00006747    1.00007000
1.0 kHz       F2_220V    =   1.00001844    1.00001844    1.00001842
20.0 kHz      F3_220V    =   1.00002971    1.00002971    1.00002906
```

```
300.0 kHz    F4_220V    =    1.00042444    1.00042444    1.00043054
```

                              700V RANGE

CONSTANT	NAME		ACTIVE	STORED	OLD
True Gain	DI_700V	=	1.001187e-02	1.001187e-02	1.001187e-02
Rough Gain	IA_700V	=	3.151999e+02	3.151999e+02	3.151999e+02
DC Zero	Z_700V	=	2.722724e-02	2.722724e-02	2.722724e-02
DC Turnover	OF_700V	=	-9.239058e-04	-9.239058e-04	-9.239058e-04
10.0 Hz	F1_700V	=	1.00006483	1.00006483	1.00006148
1.0 kHz	F2_700V	=	1.00001580	1.00001580	1.00000990
20.0 kHz	F3_700V	=	1.00004728	1.00004728	1.00003995
100.0 kHz	F4_700V	=	1.00059835	1.00059835	1.00056422

                              1 kV RANGE

CONSTANT	NAME		ACTIVE	STORED	OLD
True Gain	DI_1000V	=	5.001028e-03	5.001028e-03	5.001028e-03
Rough Gain	IA_1000V	=	9.982153e+02	9.982153e+02	9.982153e+02
DC Zero	Z_1000V	=	3.054467e-02	3.054467e-02	3.054467e-02
DC Turnover	OF_1000V	=	-6.713175e-03	-6.713175e-03	-6.713175e-03
10.0 Hz	F1_1000V	=	1.00005607	1.00005607	1.00005948
1.0 kHz	F2_1000V	=	1.00000704	1.00000704	1.00000790
20.0 kHz	F3_1000V	=	1.00004015	1.00004015	1.00004093
100.0 kHz	F4_1000V	=	1.00062207	1.00062207	1.00059530

                         WIDE BAND 2.2 mV RANGE

CONSTANT	NAME		ACTIVE	STORED	OLD
True Gain	DI_2_2MV_WB	=	5.012127e+03	5.012127e+03	5.012127e+03
Rough Gain	IA_2_2MV_WB	=	3.074441e-02	3.074441e-02	3.074441e-02
10.0 Hz	F1_2_2MV_WB	=	1.00273520	1.00273520	1.00257203
100.0 Hz	F2_2_2MV_WB	=	1.00011280	1.00011280	1.00005047
1.0 kHz	F3_2_2MV_WB	=	1.00000000	1.00000000	1.00000000
10.0 kHz	F4_2_2MV_WB	=	0.99987956	0.99987956	0.99998532
50.0 kHz	F5_2_2MV_WB	=	0.99941666	0.99941666	0.99935448
200.0 kHz	F6_2_2MV_WB	=	0.99835392	0.99835392	0.99848098
500.0 kHz	F7_2_2MV_WB	=	0.99813744	0.99813744	0.99830079
1.0 MHz	F8_2_2MV_WB	=	0.99854214	0.99854214	0.99862194
2.0 MHz	F9_2_2MV_WB	=	0.99969993	0.99969993	0.99965821
4.0 MHz	F10_2_2MV_WB	=	1.00085605	1.00085605	1.00090657
8.0 MHz	F11_2_2MV_WB	=	0.99907588	0.99907588	0.99904309
10.0 MHz	F12_2_2MV_WB	=	0.99766237	0.99766237	0.99769041
15.0 MHz	F13_2_2MV_WB	=	0.99026719	0.99026719	0.99053854
20.0 MHz	F14_2_2MV_WB	=	0.98423950	0.98423950	0.98467933
26.0 MHz	F15_2_2MV_WB	=	0.98959092	0.98959092	0.99003868
30.0 MHz	F16_2_2MV_WB	=	1.00752385	1.00752385	1.00830696

                         WIDE BAND 7 mV RANGE

CONSTANT	NAME		ACTIVE	STORED	OLD
True Gain	DI_7MV_WB	=	1.000048e+03	1.000048e+03	1.000048e+03
Rough Gain	IA_7MV_WB	=	9.750821e-02	9.750821e-02	9.750821e-02
10.0 Hz	F1_7MV_WB	=	1.00264447	1.00264447	1.00263874

```
100.0  Hz   F2_7MV_WB    =   1.00000372   1.00000372   0.99999306
1.0 kHz     F3_7MV_WB    =   1.00000000   1.00000000   1.00000000
10.0 kHz    F4_7MV_WB    =   0.99996737   0.99996737   1.00001902
50.0 kHz    F5_7MV_WB    =   0.99936039   0.99936039   0.99937707
200.0 kHz   F6_7MV_WB    =   0.99854364   0.99854364   0.99854902
500.0 kHz   F7_7MV_WB    =   0.99849656   0.99849656   0.99849935
1.0 MHz     F8_7MV_WB    =   0.99871436   0.99871436   0.99872516
2.0 MHz     F9_7MV_WB    =   0.99972563   0.99972563   0.99975243
4.0 MHz     F10_7MV_WB   =   1.00087555   1.00087555   1.00087863
8.0 MHz     F11_7MV_WB   =   0.99944813   0.99944813   0.99950774
10.0 MHz    F12_7MV_WB   =   0.99826554   0.99826554   0.99838170
15.0 MHz    F13_7MV_WB   =   0.99339562   0.99339562   0.99359748
20.0 MHz    F14_7MV_WB   =   0.98867328   0.98867328   0.98905870
26.0 MHz    F15_7MV_WB   =   0.99219481   0.99219481   0.99265342
30.0 MHz    F16_7MV_WB   =   1.00675863   1.00675863   1.00753915


                      WIDE BAND 22 mV RANGE


CONSTANT     NAME          ACTIVE       STORED       OLD
True Gain    DI_22MV_WB   =   4.994265e+02   4.994265e+02   4.994265e+02
Rough Gain   IA_22MV_WB   =   3.083553e-01   3.083553e-01   3.083553e-01
10.0  Hz     F1_22MV_WB   =   1.00255460   1.00255460   1.00251508
100.0  Hz    F2_22MV_WB   =   0.99993962   0.99993962   0.99992699
1.0 kHz      F3_22MV_WB   =   1.00000000   1.00000000   1.00000000
10.0 kHz     F4_22MV_WB   =   1.00000917   1.00000917   1.00000663
50.0 kHz     F5_22MV_WB   =   0.99939840   0.99939840   0.99940348
200.0 kHz    F6_22MV_WB   =   0.99862014   0.99862014   0.99861548
500.0 kHz    F7_22MV_WB   =   0.99859246   0.99859246   0.99858680
1.0 MHz      F8_22MV_WB   =   0.99872840   0.99872840   0.99875553
2.0 MHz      F9_22MV_WB   =   0.99970820   0.99970820   0.99973927
4.0 MHz      F10_22MV_WB  =   1.00082824   1.00082824   1.00084697
8.0 MHz      F11_22MV_WB  =   0.99950697   0.99950697   0.99959673
10.0 MHz     F12_22MV_WB  =   0.99847229   0.99847229   0.99856820
15.0 MHz     F13_22MV_WB  =   0.99443036   0.99443036   0.99461306
20.0 MHz     F14_22MV_WB  =   0.99000096   0.99000096   0.99031858
26.0 MHz     F15_22MV_WB  =   0.99216542   0.99216542   0.99271013
30.0 MHz     F16_22MV_WB  =   1.00468489   1.00468489   1.00546624


                      WIDE BAND 70 mV RANGE


CONSTANT     NAME          ACTIVE       STORED       OLD
True Gain    DI_70MV_WB   =   9.985574e+01   9.985574e+01   9.985574e+01
Rough Gain   IA_70MV_WB   =   9.752138e-01   9.752138e-01   9.752138e-01
10.0  Hz     F1_70MV_WB   =   1.00241116   1.00241116   1.00238136
100.0  Hz    F2_70MV_WB   =   0.99978452   0.99978452   0.99976215
1.0 kHz      F3_70MV_WB   =   1.00000000   1.00000000   1.00000000
10.0 kHz     4_70MV_WB    =   1.00005267   1.00005267   1.00004911
50.0 kHz     F5_70MV_WB   =   0.99949358   0.99949358   0.99951018
200.0 kHz    F6_70MV_WB   =   0.99879237   0.99879237   0.99879984
500.0 kHz    F7_70MV_WB   =   0.99876142   0.99876142   0.99875857
1.0 MHz      F8_70MV_WB   =   0.99897520   0.99897520   0.99898302
2.0 MHz      F9_70MV_WB   =   0.99994307   0.99994307   0.99996002
4.0 MHz      F10_70MV_WB  =   1.00109232   1.00109232   1.00112161
8.0 MHz      F11_70MV_WB  =   0.99986812   0.99986812   0.99994045
10.0 MHz     F12_70MV_WB  =   0.99889600   0.99889600   0.99900914
```

```
15.0 MHz     F13_70MV_WB  =   0.99526398    0.99526398    0.99544172
20.0 MHz     F14_70MV_WB  =   0.99102871    0.99102871    0.99133449
26.0 MHz     F15_70MV_WB  =   0.99258511    0.99258511    0.99314078
30.0 MHz     F16_70MV_WB  =   1.00412847    1.00412847    1.00487431


                        WIDE BAND 220 mV RANGE


CONSTANT      NAME            ACTIVE        STORED        OLD
True Gain     DI_220MV_WB  =   3.152397e+01  3.152397e+01  3.152397e+01
Rough Gain    IA_220MV_WB  =   3.168023e+00  3.168023e+00  3.168023e+00
10.0  Hz     F1_220MV_WB  =   1.00115213    1.00115213    1.00114587
100.0  Hz    F2_220MV_WB  =   1.00004182    1.00004182    1.00002563
1.0 kHz      F3_220MV_WB  =   1.00000000    1.00000000    1.00000000
10.0 kHz     F4_220MV_WB  =   1.00005603    1.00005603    1.00005402
50.0 kHz     F5_220MV_WB  =   0.99983691    0.99983691    0.99983353
200.0 kHz    F6_220MV_WB  =   0.99969276    0.99969276    0.99968928
500.0 kHz    F7_220MV_WB  =   0.99990836    0.99990836    0.99990906
1.0 MHz      F8_220MV_WB  =   1.00003225    1.00003225    1.00003529
2.0 MHz      F9_220MV_WB  =   1.00057721    1.00057721    1.00057238
4.0 MHz      F10_220MV_WB =   1.00075606    1.00075606    1.00074868
8.0 MHz      F11_220MV_WB =   1.00198563    1.00198563    1.00199341
10.0 MHz     F12_220MV_WB =   1.00236429    1.00236429    1.00237767
15.0 MHz     F13_220MV_WB =   1.00260698    1.00260698    1.00263519
20.0 MHz     F14_220MV_WB =   1.00231442    1.00231442    1.00236612
26.0 MHz     F15_220MV_WB =   1.00256308    1.00256308    1.00263741
30.0 MHz     F16_220MV_WB =   1.00316900    1.00316900    1.00327895


                        WIDE BAND 700 mV RANGE


CONSTANT      NAME            ACTIVE        STORED        OLD
True Gain     DI_700MV_WB  =   9.965484e+00  9.965484e+00  9.965484e+00
Rough Gain    IA_700MV_WB  =   1.002080e+01  1.002080e+01  1.002080e+01
10.0  Hz     F1_700MV_WB  =   1.00130454    1.00130454    1.00125429
100.0  Hz    F2_700MV_WB  =   1.00001989    1.00001989    1.00003018
1.0 kHz      F3_700MV_WB  =   1.00000000    1.00000000    1.00000000
10.0 kHz     F4_700MV_WB  =   1.00006393    1.00006393    1.00006421
50.0 kHz     F5_700MV_WB  =   0.99983600    0.99983600    0.99983304
200.0 kHz    F6_700MV_WB  =   0.99967444    0.99967444    0.99966540
500.0 kHz    F7_700MV_WB  =   0.99989726    0.99989726    0.99989113
1.0 MHz      F8_700MV_WB  =   1.00008766    1.00008766    1.00009993
2.0 MHz      F9_700MV_WB  =   1.00060048    1.00060048    1.00061223
4.0 MHz      F10_700MV_WB =   1.00078373    1.00078373    1.00081142
8.0 MHz      F11_700MV_WB =   1.00200348    1.00200348    1.00204914
10.0 MHz     F12_700MV_WB =   1.00239212    1.00239212    1.00242467
15.0 MHz     F13_700MV_WB =   1.00256060    1.00256060    1.00264721
20.0 MHz     F14_700MV_WB =   1.00210027    1.00210027    1.00218697
26.0 MHz     F15_700MV_WB =   1.00199335    1.00199335    1.00212149
30.0 MHz     F16_700MV_WB =   1.00223679    1.00223679    1.00238195


                        WIDE BAND 2.2V RANGE


CONSTANT      NAME            ACTIVE        STORED        OLD
True Gain     DI_2_2V_WB   =   3.151708e+00  3.151708e+00  3.151708e+00
Rough Gain    IA_2_2V_WB   =   3.168347e+01  3.168347e+01  3.168347e+01
10.0  Hz     F1_2_2V_WB   =   1.00117656    1.00117656    1.00119047
```

```
100.0  Hz    F2_2_2V_WB   =   1.00000940    1.00000940    1.00001548
1.0 kHz      F3_2_2V_WB   =   1.00000000    1.00000000    1.00000000
10.0 kHz     F4_2_2V_WB   =   1.00005365    1.00005365    1.00004840
50.0 kHz     F5_2_2V_WB   =   0.99983408    0.99983408    0.99983299
200.0 kHz    F6_2_2V_WB   =   0.99968690    0.99968690    0.99968960
500.0 kHz    F7_2_2V_WB   =   0.99988522    0.99988522    0.99988314
1.0 MHz      F8_2_2V_WB   =   1.00007714    1.00007714    1.00007108
2.0 MHz      F9_2_2V_WB   =   1.00055758    1.00055758    1.00054898
4.0 MHz      F10_2_2V_WB  =   1.00062819    1.00062819    1.00062025
8.0 MHz      F11_2_2V_WB  =   1.00160559    1.00160559    1.00160447
10.0 MHz     F12_2_2V_WB  =   1.00183014    1.00183014    1.00184647
15.0 MHz     F13_2_2V_WB  =   1.00151007    1.00151007    1.00153429
20.0 MHz     F14_2_2V_WB  =   1.00043838    1.00043838    1.00048052
26.0 MHz     F15_2_2V_WB  =   0.99910883    0.99910883    0.99912552
30.0 MHz     F16_2_2V_WB  =   0.99820942    0.99820942    0.99828133


                         WIDE BAND 7V RANGE


CONSTANT       NAME          ACTIVE        STORED        OLD
True Gain      DI_7V_WB   =   9.964605e-01  9.964605e-01  9.964605e-01
Rough Gain     IA_7V_WB   =   1.001994e+02  1.001994e+02  1.001994e+02
10.0  Hz       F1_7V_WB   =   1.00124664    1.00124664    1.00120786
100.0  Hz      F2_7V_WB   =   1.00002552    1.00002552    1.00001103
1.0 kHz        F3_7V_WB   =   1.00000000    1.00000000    1.00000000
10.0 kHz       F4_7V_WB   =   1.00003975    1.00003975    1.00005718
50.0 kHz       F5_7V_WB   =   0.99980094    0.99980094    0.99979892
200.0 kHz      F6_7V_WB   =   0.99963307    0.99963307    0.99962820
500.0 kHz      F7_7V_WB   =   0.99980487    0.99980487    0.99981296
1.0 MHz        F8_7V_WB   =   1.00010185    1.00010185    1.00010916
2.0 MHz        F9_7V_WB   =   1.00050415    1.00050415    1.00051915
4.0 MHz        F10_7V_WB  =   1.00045312    1.00045312    1.00047551
8.0 MHz        F11_7V_WB  =   1.00089005    1.00089005    1.00091492
10.0 MHz       F12_7V_WB  =   1.00073643    1.00073643    1.00078130
15.0 MHz       F13_7V_WB  =   0.99912199    0.99912199    0.99917680
20.0 MHz       F14_7V_WB  =   0.99669928    0.99669928    0.99675623
26.0 MHz       F15_7V_WB  =   0.99349830    0.99349830    0.99357840
30.0 MHz       F16_7V_WB  =   0.99070133    0.99070133    0.99077963


-------------------------- END OF REPORT ----------------------------
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Chapter 8
Operator Maintenance

8-1. Introduction

This section explains how to perform the routine maintenance and calibration tasks required to keep a normally operating 5790A AC Measurement Standard in service. These tasks include:

- Replacing the fuse

- Cleaning the air filter

- Cleaning the external surfaces

- Calibration

Refer to the 5790A Service Manual for intensive maintenance tasks such as troubleshooting or repair, and all procedures that require opening the cover of the instrument such as moving the active binding post position between the front and rear. The service manual also contains complete verification procedures for checking that traceability to national standards is being maintained by the normal calibration procedure.

8-2. Accessing the Fuse

⚠ Caution

To prevent instrument damage, verify that the correct fuse is installed in accordance with the line voltage setting.

The fuse is accessible on the rear panel. The fuse rating label to the right of the fuse holder shows the correct replacement fuse ratings for each operating voltage. To access the fuse, refer to Figure 8-1 and proceed as follows:

1. Disconnect line power.

2. Insert the blade of a standard screwdriver in the slot of the fuse holder.

3. Turn the screwdriver counterclockwise until the cap and fuse pop free.
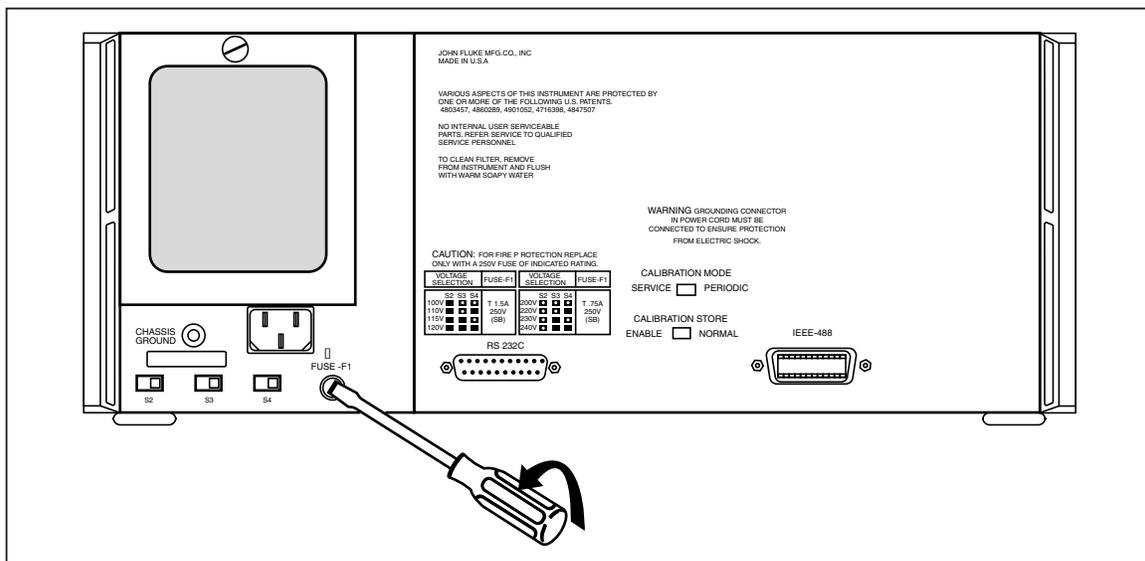
add58f.eps

Figure 8-1. Accessing the Fuse

8-3. Cleaning the Air Filter

⚠ **Caution**

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

The air filter must be removed and cleaned every 30 days or more frequently if the 5790A is operated in a dusty environment. The air filter is accessible from the rear panel.

To clean the air filter, refer to Figure 8-2 and proceed as follows:

1. Remove the filter element.

    a. Unscrew the knurled screw at the top of the air filter (counterclockwise).

    b. Pull the air filter retainer downward; it hinges at the bottom.

    c. Remove the filter element.

2. Clean the filter element.

    a. Wash the filter element in soapy water.

    b. Rinse the filter element in fresh running water.

    c. Shake out the excess water, then allow the filter element to dry thoroughly before reinstalling it.
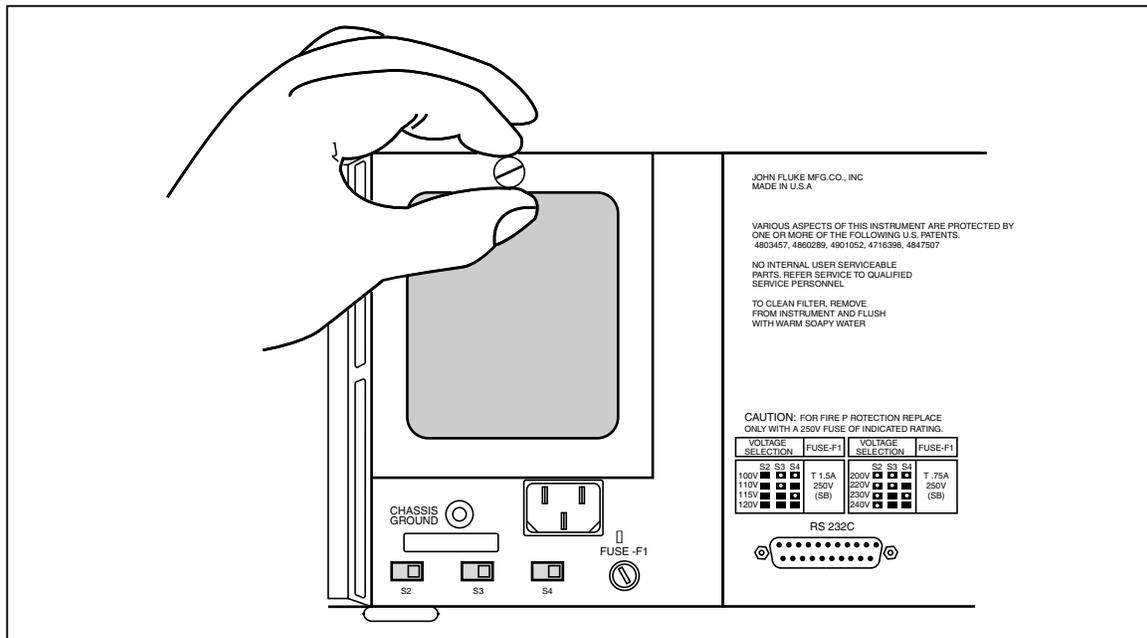
add59f.eps

Figure 8-2. Accessing the Air Filter

8-4. General Cleaning

To keep the 5790A looking like new, clean the case, front panel keys, and lens using a soft cloth slightly dampened with water or a non-abrasive mild cleaning solution that does not harm plastics.

⚠ **Caution**

Do not use aromatic hydrocarbons or chlorinated solvents for cleaning. They can damage the plastic materials used in the 5790A.

8-5. Calibration

When shipped, your 5790A is calibrated at the factory, traceable to the U.S. National Institute of Standards and Technology. To maintain traceability, calibrate the 5790A to traceable external standards using proper procedures, as often as required by your choice of calibration cycle: 90 day, 1 year, or 2 years. Refer to Section 3 of the 5790A Service Manual for the calibration procedure.

Chapter 9
Options and Accessories

Title	Page

9-1. Introduction

This section describes options and accessories available to enhance the capabilities or operating convenience of the 5790A AC Measurement Standard. Section 4 contains instructions for operating the 5790A with the options and accessories described here. To order options or accessories, call or write to a Fluke sales or Technical Service Center.

9-2. Wideband Module (Option 5790A-03)

To measure ac voltage in the 1 to 30 MHz range, the 5790A requires the 5790A-03 Wideband Module. Instructions for operating the 5790A in wideband mode are provided in Section 4, and specifications for wideband operation are provided at the end of Section 1.

The WIDEBAND input presents a 50Ω load to the source. Signals accepted are from 700 uV to 7V (maximum power input 140 mW) over a frequency range of 10 Hz to 30 MHz. Only the lower eight 5790A voltage ranges are used by the WIDEBAND input.

Use the WIDEBAND input to measure the frequency flatness of 50Ω signal sources such as the 5700A WIDEBAND output. You can use the delta display to show the error of the source in ppm as you sweep the source through the WIDEBAND input frequency range.

9-3. Accessories

Table 9-1 summarizes the accessories available for use with the 5790A. Following the table is a brief description of each accessory.

9-4. Fluke A40 and A40A Current Shunt Adapter (5790A-7001)

Accessory 5790A-7001 allows you to connect Fluke A40 or A40A Current Shunts the 5790A SHUNT input for making current transfers up to 20A. Instructions for using the adapter are in Section 4, in addition to the instruction sheet packed with the accessory.

9-5. Fluke A40A Current Shunt Adapter for Input 1 (792A-7004)

Accessory 792A-7004 allows you to connect Fluke A40 Current Shunts to the INPUT 1 Type "N" connector for making current transfers up to 5A. Instructions for using the adapter are in Section 4, in addition to the instruction sheet packed with the accessory.

Table 9-1. Accessories

ModeL	Description
5790A-7001	Adapter/cable for Fluke A40 or A40A Current Shunts
792A-7004	Adapter for Fluke A40 Current Shunt
5440A-7002	Low Thermal EMF Test Leads, 2 ft (61 cm)
A45-4004	Output Cable for A40A Current Shunt
Y5737	24 in. (61 cm) Rack Mount Kit
Y1702	RS-232-C Null-Modem Cable, 6.56 ft (2m)
Y1703	RS-232-C Null-Modem Cable, 13 ft (4m)
Y8021	IEEE-488 Cable, 1m
Y8022	IEEE-488 Cable, 2m
Y8023	IEEE-488 Cable, 3m

9-6.   *Low Thermal EMF Test Leads (5440A-7002)*

Model 5440A-7002 Low Thermal Test Leads are designed to exhibit low thermal emfs. The set includes three cables, each made up of two conductors and a shield lead.

9-7.   *Rack Mount Kit (Y5737)*

The rack mount kit provides all the hardware necessary to mount the 5790A on slides in a 24-inch (61 cm) equipment rack. An instruction sheet is packed with the rack mount kit.

9-8.   *Shielded IEEE-488 Interface Cables (Y8021, Y8022, and Y8023)*

Shielded IEEE-488 cables are available in three lengths (see Table 9-1). The cables attach the 5790A to any other IEEE-488 device. Each cable has double 24-pin connectors at both ends to allow stacking. Metric threaded mounting screws are provided with each connector. Figure 5-2 in Section 5 shows the pinout for the IEEE-488 connector.

9-9.   *RS-232-C Null-Modem Cables (Y1702 and Y1703)*

The Y1702 (6.56 ft, 2m) and Y1703 (32.8 ft, 10m) RS-232-C Null-Modem Cables connect the 5790A to a printer, video-display terminal, computer, or other serial device configured as DTE (Data Terminal Equipment). These cables are wired with the correct signal line inversions and two female 25-pin subminiature D connectors as necessary to connect two DTE units together. Figure 7-1 in Section 7 shows the pinout for the rear-panel serial interface connector.

Section 7 contains instructions for transferring serial data from the 5790A. Sections 5 and 6 contain instructions for using the RS-232 port as the remote control interface.

Appendices

Appendix A
Glossary of AC-DC Transfer Related Terms

absolute uncertainty

    Uncertainty that includes contributions from all sources, i.e., traceability to national standards of the standards used, plus the uncertainty of the measurement process. Absolute uncertainty should be used to compute test uncertainty ratio. Also see "relative uncertainty".

accuracy

    The degree to which the measured value of a quantity agrees with the accepted, consensus, or true value of that quantity. Accuracy is the same as 1 - % uncertainty. For example, an instrument specified to +/-1% uncertainty is 99% accurate. Also see "uncertainty".

artifact calibration

    An instrument calibration technique that uses a calibration system within the instrument to reduce the number of required external standards to a small number of artifact standards. The Fluke 5700A Calibrator uses Artifact Calibration.

artifact standard

    A stable object that produces or embodies a physical quantity for use as a reference standard. An artifact standard may have an assigned traceable value when used for calibration purposes. Fluke 732A DC Voltage Reference Standard and the Fluke 742A Series Standard Resistors are examples. Also see "transfer standard".

ac-dc absolute uncertainty

    Includes all known error sources contributing to the uncertainty of an ac-dc difference correction. This includes NIST (National Institute of Standards and Technology) uncertainties, transfer uncertainty from a primary standard to a working standard, and internal error contributions (both random and temperature related).

ac-dc transfer

    The process of comparing an ac voltage to a known dc voltage, thereby transferring the low uncertainty of the dc voltage to the ac voltage. The 792A can be used to perform two different types of ac-dc transfers:

1. An ac measurement

2. An ac-dc difference measurement

In an ac measurement, the transfer standard is used to determine absolute rms ac voltage level. In an ac-dc difference measurement, the transfer standard is a reference that tests the ac and dc response of another transfer standard. The goal of an ac measurement is to determine the error of the ac source or ac voltmeter under test. The goal of an ac-dc difference measurement is a value called the "ac-dc difference," which is positive when more ac voltage than dc voltage is required to produce the same output in the transfer standard under test.

ac-dc difference

A measurement of an ac-dc transfer device's accuracy. The ac-dc difference is a transfer device's error when it compares a dc voltage to the same ac rms voltage. A positive ac-dc difference indicates that more alternating than direct voltage is required to produce the same reading.

base units

Units in the SI system that are dimensionally independent. All other units are derived from base units. The only base unit in electricity is the ampere.

buffer

1. An area of digital memory for temporary storage of data.

2. An additional amplifier stage to reduce output impedance levels.

burden voltage

The maximum sustainable voltage across the terminals of a load.

calibration

The comparison of a measurement system or device of unknown accuracy to a measurement system or device of known and greater accuracy to detect or correct any variation from required performance of the unverified measurement system or device. Also see "verification" and "traceability".

calibration constant

A coefficient that is applied manually or automatically to adjust the output or reading of an instrument.

calibration curve

A smooth curve drawn through a graph of calibration points.

calibration interval

The interval after which calibration must occur to maintain the performance of an instrument as stated in its specifications.

calibration report

A record of shifts or calibration constant changes that have occurred during calibration.

calibrator

A device that supplies outputs with a known uncertainty for use in testing the accuracy of measurement devices or other sources.

characterization

A calibration process that produces a calibration constant or known error for use in correcting the output or reading of an instrument or standard.

common mode noise

An undesired signal that exists between a device's terminals and ground. Common mode noise is at the same potential on both terminals of a device. Also see "normal mode noise".

compliance voltage

The maximum voltage that a constant-current source can supply.

confidence level

A percentage indicating certainty or assurance that an associated condition is true.

control chart

A chart devised to monitor one or more processes in order to detect the excessive deviation from a desired value of a component or process.

crest factor

The ratio of the peak voltage to the rms voltage of a waveform (with the dc component removed). Also see rms.

dac (digital-to-analog converter)

A device or circuit that converts a digital waveform to an analog voltage.

derived units

Units in the SI system that are derived from base units. Volts, ohms, and watts are derived from amperes and other base and derived units.

distribution function

The expression of a relationship between the values and the corresponding frequencies of a variable.

drift

Gradual change in a value over time.

error

Deviation from correct value. The different types of error defined in this glossary are floor, gain, offset, linearity, random, scale, systematic, transfer, and zero.

flatness

A measure of output level variation for an ac voltage source as frequency is varied. Flatness limits are normally specified as a ratio (%) to nominal output level at a reference frequency.

floor error

A contribution to measurement or source uncertainty that is independent of reading or output setting. In uncertainty specifications, floor error is often combined with fixed range errors and expressed in units such as microvolts or counts of the least significant digit. Also see "error".

full scale

The upper limit of measurement or source value for which a given uncertainty specification applies, including any "overrange". Also see "overrange" and "range".

gain error

Same as scale error. An example of scale or gain error is when the slope of a calibrator's displayed output vs. its true output is not exactly 1. A calibrator with only gain error (no offset or linearity error), will read 0V with 0V on the display, but something other than 10V with 10V on the display.

ground
> The voltage reference point in a circuit. Earth ground is a connection through a ground rod or other conductor to the earth, usually accessible through the ground conductor in an ac power receptacle.

ground loop
> Undesirable current induced when there is more than one chassis ground potential in a system of instruments. Ground loops can be minimized by connecting all instruments in a system to ground at one point.

guard
> A floating shield around sensitive circuitry inside an instrument. The guard provides a low-impedance path to ground for common-mode noise and ground currents, thereby eliminating errors introduced by such interference.

International System of Units
> Same as "SI System of Units"; the accepted system of units. See also "units," "base units," and "derived units."

legal units
> The highest echelon in a system of units, for example the 1990 SI volt.

life-cycle cost
> The consideration of all elements contributing to the cost of an instrument throughout its useful life. This includes initial purchase cost, service and maintenance cost, and the cost of support equipment.

linearity
> The relationship between two quantities when a change in the first quantity is directly proportional to a change in the second quantity.

linearity error
> Linearity error occurs when the true output vs. selected output response curve of a calibrator is not exactly a straight line. You can measure this type of error by plotting the response curve, then measuring how far the curve deviates from the straight line at various points.

MAP (Measurement Assurance Program)
> A program for a measurement process. A MAP provides information to demonstrate that the total uncertainty of the measurements (data), including both random error and systematic components of error relative to national or other designated standards is quantified, and sufficiently small to meet requirements.

maximum transfer time
> Maximum time that an ac-dc transfer can be made to stay within the stated ac-dc absolute uncertainty.

metrology
> The science of, and the field of knowledge concerned with measurement.

minimum V_{in}
> For each range of an ac/ac transfer standard, the minimum input rms voltage for which uncertainty specifications apply. Also see rms.

metrology
> The science of, and the field of knowledge concerned with measurement.

minimum use specifications
> Specifications computed to satisfy the calibration requirements of measurement or source device (UUT). Usually determined by a specified test uncertainty ratio between the absolute uncertainties of the UUT and its required calibration equipment. Also see Test Uncertainty Ratio.

noise
> An undesirable signal that is superimposed on a desired or expected signal. See "normal mode noise" and "common mode noise".

noise floor
> For an ac-dc transfer standard, the transfer uncertainty due to noise factors.

nonvolatile memory
> An electronic memory that retains its contents when power is turned off.

normal mode noise
> An undesired signal that appears between the terminals of a device.

offset error
> Same as zero error. The reading shown on a meter when an input value of zero is applied is its offset or zero error.

parameters
> Independent variables in a measurement process such as temperature,humidity, test lead resistance, etc.

precision
> The degree of agreement among independent measurements of a quantity under specified conditions. The precision of a measurement process is its coherence or repeatability. Note that while precision is necessary for accuracy, it does not imply it.

predictability
> A measure of what is known of the time-behavior of a device. A documented drift rate with understood characteristics (e.g., linear, exponential) can be highly predictable.

primary standard
> A standard defined and maintained by some authority and used to calibrate
>
> all other secondary standards.

process metrology
> Tracking the accuracy drift of calibration and other equipment by applying statistical analysis to correction factors obtained during calibration.

random error
> Any error which varies in an unpredictable manner in absolute value and in sign when measurements of the same value of a quantity are made under effectively identical conditions.

range
> Stated upper limits of measurement or source values for which given uncertainty specifications apply. Also see "overrange" and "scale".

reference standard
> The highest-echelon standard in a laboratory; the standard that is used to maintain working standards that are used in routine calibration and comparison procedures.

relative uncertainty
> Uncertainty specifications that are relative to a reference value, and not traceable to national standards. Also see "absolute uncertainty".

reliability

A measure of the probability of failure of an instrument.

repeatability

See "precision".

resistance

A property of a conductor that determines the amount of current that will flow when a given amount of voltage exists across the conductor. Resistance is measured in ohms. One ohm is the resistance through which one volt of potential will cause one ampere of current to flow.

resolution

The smallest change in quantity that can be detected by a measurementsystem or device. For a given parameter, resolution is the smallest increment that can be measured, generated or displayed.

reversal error

Also called turnover error, the difference in output of an ac-dc transfer standard for the same dc input but with polarity reversed. The output logged for the dc reference should be the average of the two readings.

retrace error

For an ac-dc transfer standard, the degree of agreement of output value readings when input is applied, removed, and reapplied over a specified time period.

rf (radio frequency)

The frequency range of radio waves; from 150 kHz up to the infrared range.

rms (root-mean-square)

The value assigned to an ac voltage or current that results in the same power dissipation in a resistance as a dc current or voltage of the same value.

rms sensor

A device that generates a dc output signal proportional to the rms value of the input signal. RMS sensors operate by measuring the heat generated by a voltage through a known resistance (i.e., power); therefore, they sense true rms voltage. RMS sensors are used to make ac-dc difference measurements.

scale

The absolute span of the reading range of a measurement device including overrange capability.

scale error

See "gain error".

secondary standard

A standard maintained by comparison against a primary standard.

sensitivity

The degree of response of a measuring device to the change in input quantity, or a figure of merit that expresses the ability of a measurement system or device to respond to an input quantity.

settling time

The time it takes for a measurement device's reading to stabilize after a voltage is applied to the input.

shield

A grounded covering device designed to protect a circuit or cable from electromagnetic interference. Also see "guard".

SI System of Units

The accepted International System of Units. See also "units," "base units," and "derived units."

specifications

A precise statement of the performance of a measurement or stimulus device.

square law

Defines the response of a device whose output is proportional to the squareof the applied stimulus. Thermocouple-type transfer devices have a square-lawresponse.

stability

A measure of the freedom from drift relative to a reference value, over time and over changes in other variables such as temperature. Note that stability is not the same as uncertainty.

standard

A device that is used as an exact value for reference and comparison.

standard cell

A primary cell that serves as a standard of voltage. The term "standard cell" often refers to a "Weston normal cell", which is a wet cell with a mercury anode, a cadmium mercury amalgam cathode, and a cadmium sulfate solution as the electrolyte.

systematic error

Any error that remains constant or varies in a predictable manner as successive measurements of the same quantity are made under effectively identical conditions. Note that a known systematic error can be compensated for with a correction, whereas a random error cannot. Also see "random error".

temperature coefficient

A factor used to calculate the change in indication or output of an instrument as a result of changes in temperature. Changes in temperature contribute to instrument uncertainty by an amount determined by the temperature coefficient.

test uncertainty ratio

The numerical ratio of the uncertainty of the measurement system or device being calibrated or verified, and the uncertainty of the measurement system or reference device.

thermal emf

The voltage generated when two dissimilar metals joined together are heated.

traceability

The ability to relate individual measurement results to legally defined national standards through an unbroken chain of comparisons. Traceability requires evidence produced on a continuing basis, such as calibration records, that the measurement process is producing results for which the total measurement uncertainty relative to national standards is quantified.

transfer

See "ac-dc transfer."

transfer error

Error induced by the process of comparing one standard or instrument with another. This does not include the uncertainty of the transfer standard.

transfer stability

        Change in the ac-dc difference correction over time, with stated conditions.

transfer standard

        Any standard used to intercompare one measurement or source device with another. Note that a transfer standard needs only to be stable for the duration of the transfer. It does not need an assigned value.

transport standard

        A transfer standard that is rugged enough to allow shipment by common carrier to another location.

true value

        Also called legal value, the accepted consensus, i.e., the correct value of the quantity being measured.

uncertainty

        The range of values, usually centered on the indicated or requested value, within which the true, accepted, or consensus value is expected to lie with stated probability or confidence. Fluke uses 99.7% (3σ) confidence limits. Uncertainty is a quantification of inaccuracy.

units

        Symbols or names that define the measured quantities. Examples of units are: V, mV, A, kW, and dBm. See also "SI System of Units."

UUT (Unit Under Test)

        An abbreviated name for an instrument that is being tested or calibrated.

verification

        The comparison of a measurement or source device (UUT) with a measurement or source device of known and lesser uncertainty, to report variation from required performance. Verification does not include adjustment or reassignment of values to UUT, and is often done to determine whether adjustment is necessary. Also see "calibration".

volt

        The unit of emf (electromotive force) or electrical potential in the SI system of units. One volt is the difference of electrical potential between two points on a conductor carrying one ampere of current, when the power being dissipated between these two points is equal to one watt.

watt

        The unit of power in the SI system of units. One watt is the power required to do work at the rate of one joule/second. In terms of volts and ohms, one watt is the power dissipated by one ampere flowing through a one-ohm load.

wideband

        In instrumentation, wideband refers to the ability to measure or generate signals in the radio frequency spectrum.

working standard

        A standard that is used in routine calibration and comparison procedures in the laboratory, and is maintained by comparison to reference standards.

zero error

        Same as offset error. The reading shown on a meter when an input value of zero is applied is its zero or offset error.

Appendix B
ASCII and IEEE-488 Bus Codes

Control Characters / Commands / Listen Addresses

ASCII CHAR.	DECIMAL	OCTAL	HEX	BINARY 7654 3210	DEV. NO.	MESSAGE ATN=TRUE	GROUP
NUL	0	000	00	0000 0000			ADDRESSED COMMANDS
SOH	1	001	01	0000 0001		GTL	
STX	2	002	02	0000 0010			
ETX	3	003	03	0000 0011			
EOT	4	004	04	0000 0100		SDC	
ENQ	5	005	05	0000 0101		PPC	
ACK	6	006	06	0000 0110			
BELL	7	007	07	0000 0111			
BS	8	010	08	0000 1000		GET	
HT	9	011	09	0000 1001		TCT	
LF	10	012	0A	0000 1010			
VT	11	013	0B	0000 1011			
FF	12	014	0C	0000 1100			
CR	13	015	0D	0000 1101			
SO	14	016	0E	0000 1110			
SI	15	017	0F	0000 1111			
DLE	16	020	10	0001 0000			UNIVERSAL COMMANDS
DC1	17	021	11	0001 0001		LLO	
DC2	18	022	12	0001 0010			
DC3	19	023	13	0001 0011			
DC4	20	024	14	0001 0100		DCL	
NAK	21	025	15	0001 0101		PPU	
SYN	22	026	16	0001 0110			
ETB	23	027	17	0001 0111			
CAN	24	030	18	0001 1000		SPE	
EM	25	031	19	0001 1001		SPD	
SUB	26	032	1A	0001 1010			
ESC	27	033	1B	0001 1011			
FS	28	034	1C	0001 1100			
GS	29	035	1D	0001 1101			
RS	30	036	1E	0001 1110			
US	31	037	1F	0001 1111			
SPACE	32	040	20	0010 0000	0	MLA	LISTEN ADDRESSES
!	33	041	21	0010 0001	1	MLA	
"	34	042	22	0010 0010	2	MLA	
#	35	043	23	0010 0011	3	MLA	
$	36	044	24	0010 0100	4	MLA	
%	37	045	25	0010 0101	5	MLA	
&	38	046	26	0010 0110	6	MLA	
'	39	047	27	0010 0111	7	MLA	
(	40	050	28	0010 1000	8	MLA	
)	41	051	29	0010 1001	9	MLA	
*	42	052	2A	0010 1010	10	MLA	
÷	43	053	2B	0010 1011	11	MLA	
,	44	054	2C	0010 1100	12	MLA	
-	45	055	2D	0010 1101	13	MLA	
.	46	056	2E	0010 1110	14	MLA	
/	47	057	2F	0010 1111	15	MLA	
0	48	060	30	0011 0000	16	MLA	
1	49	061	31	0011 0001	17	MLA	
2	50	062	32	0011 0010	18	MLA	
3	51	063	33	0011 0011	19	MLA	
4	52	064	34	0011 0100	20	MLA	
5	53	065	35	0011 0101	21	MLA	
6	54	066	36	0011 0110	22	MLA	
7	55	067	37	0011 0111	23	MLA	
8	56	070	38	0011 1000	24	MLA	
9	57	071	39	0011 1001	25	MLA	
:	58	072	3A	0011 1010	26	MLA	
;	59	073	3B	0011 1011	27	MLA	
<	60	074	3C	0011 1100	28	MLA	
=	61	075	3D	0011 1101	29	MLA	
>	62	076	3E	0011 1110	30	MLA	
?	63	077	3F	0011 1111		UNL	

Talk Addresses / Secondary Addresses

ASCII CHAR.	DECIMAL	OCTAL	HEX	BINARY 7654 3210	DEV. NO.	MESSAGE ATN=TRUE	GROUP
@	64	100	40	0100 0000	0	MTA	TALK ADDRESSES
A	65	101	41	0100 0001	1	MTA	
B	66	102	42	0100 0010	2	MTA	
C	67	103	43	0100 0011	3	MTA	
D	68	104	44	0100 0100	4	MTA	
E	69	105	45	0100 0101	5	MTA	
F	70	106	46	0100 0110	6	MTA	
G	71	107	47	0100 0111	7	MTA	
H	72	110	48	0100 1000	8	MTA	
I	73	111	49	0100 1001	9	MTA	
J	74	112	4A	0100 1010	10	MTA	
K	75	113	4B	0100 1011	11	MTA	
L	76	114	4C	0100 1100	12	MTA	
M	77	115	4D	0100 1101	13	MTA	
N	78	116	4E	0100 1110	14	MTA	
O	79	117	4F	0100 1111	15	MTA	
P	80	120	50	0101 0000	16	MTA	
Q	81	121	51	0101 0001	17	MTA	
R	82	122	52	0101 0010	18	MTA	
S	83	123	53	0101 0011	19	MTA	
T	84	124	54	0101 0100	20	MTA	
U	85	125	55	0101 0101	21	MTA	
V	86	126	56	0101 0110	22	MTA	
W	87	127	57	0101 0111	23	MTA	
X	88	130	58	0101 1000	24	MTA	
Y	89	131	59	0101 1001	25	MTA	
Z	90	132	5A	0101 1010	26	MTA	
[	91	133	5B	0101 1011	27	MTA	
\	92	134	5C	0101 1100	28	MTA	
]	93	135	5D	0101 1101	29	MTA	
^	94	136	5E	0101 1110	30	MTA	
_	95	137	5F	0101 1111		UNT	
`	96	140	60	0110 0000	0	MSA	SECONDARY ADDRESSES
a	97	141	61	0110 0001	1	MSA	
b	98	142	62	0110 0010	2	MSA	
c	99	143	63	0110 0011	3	MSA	
d	100	144	64	0110 0100	4	MSA	
e	101	145	65	0110 0101	5	MSA	
f	102	146	66	0110 0110	6	MSA	
g	103	147	67	0110 0111	7	MSA	
h	104	150	68	0110 1000	8	MSA	
i	105	151	69	0110 1001	9	MSA	
j	106	152	6A	0110 1010	10	MSA	
k	107	153	6B	0110 1011	11	MSA	
l	108	154	6C	0110 1100	12	MSA	
m	109	155	6D	0110 1101	13	MSA	
n	110	156	6E	0110 1110	14	MSA	
o	111	157	6F	0110 1111	15	MSA	
p	112	160	70	0111 0000	16	MSA	
q	113	161	71	0111 0001	17	MSA	
r	114	162	72	0111 0010	18	MSA	
s	115	163	73	0111 0011	19	MSA	
t	116	164	74	0111 0100	20	MSA	
u	117	165	75	0111 0101	21	MSA	
v	118	166	76	0111 0110	22	MSA	
w	119	167	77	0111 0111	23	MSA	
x	120	170	78	0111 1000	24	MSA	
y	121	171	79	0111 1001	25	MSA	
z	122	172	7A	0111 1010	26	MSA	
{	123	173	7B	0111 1011	27	MSA	
|	124	174	7C	0111 1100	28	MSA	
}	125	175	7D	0111 1101	29	MSA	
~	126	176	7E	0111 1110	30	MSA	
	127	177	7F	0111 1111			

Appendix C
Calibration Constant Information

The constants in these tables are arranged by group. Each group is stored as a block in nonvolatile memory. The value given for each constant in this list is the default assigned before the instrument is first calibrated. Defaults are reinstated if you perform a format of the EEPROM ALL or CAL areas.

Group ZC_BASIC: Internally Calibrated DAC, Sensor, and A/D Parameters

Name	Default	Function
DAC_Z1	398.0	Reference DAC zero, coarse channel
DAC-Z2	17500.00	Reference DAC zero, fine channel
DAC_RATIO	16500.0	Reference DAC coarse/fine gain ratio
AD_X1_Z	0.0	A/D x1 range zero
AD_X1_G	-7.23E-6	A/D x1 range gain
AD_X10_Z	0.0	A/D x100 range zero
AD_X10_G	7.23E-8	A/D x100 range gain
NULLDAC_Z	0.0	Null DAC zero
NULLDAC_G	6560.0	Null DAC gain
SENSOR_C1	1.0	Main thrmal sensor linearization
SENSOR_C2	0.0	Main thrmal sensor linearization
OF_VSQ	0.0	Main thrmal sensor turnover correction

Group FREQ: Frequency Counter Gain

Name	Default	Function
FREQ_G	1.0	(see title)

Group DC-DAC: Reference DAC Coarse Channel Gain

Name	Default	Function
DAC_G	3017.0	(see title)

Group WDC_SENSOR: Wideband Sensor Linearization

Name	Default	Function
SENSOR_C1_WB	3.162277660e-03	Wideband thermal sensor linearization
SENSOR_C2_WB	0.0	Wideband thermal sensor linearization

Group AC_LINEARITY: Low Frequency Linearization

Name	Default	Function
LN-C	.02	(see title)

Group AC_LINEARITY: Low Frequency Linearization

Name	Default	Function
INPUT2_LO	150.0E-6	(INPUT2 vs INPUT1 flatness, <2.2 V)
INPUT2_MID	350.0E-6	(INPUT2 vs INPUT1 flatness, 2.2-220 V)
INPUT2_HI	-17.0E-6	(INPUT2 vs INPUT1 flatness, >220 V)

Group DC-2_2MV: DC Constants, 2.2 mV Range

Name	Default	Function
DI_2_2MV	5000.0	Basic gain (Ref DAC to input ratio)
OF_2_2MV	0.0	Full scale calibration DC offset

Group ZC-2_2MV: More DC Constants, 2.2 mV Range

Name	Default	Function
Z_2_2MV	0.0	Zero calibrated DC offset
SHO_2_2MV	0.0	Shunt input DC offset
IA_2_2MV	0.001	Rough gain (input to A/D ratio)

Group AC_2_2MV: Flatness Constants, 2.2 mV Range

Name	Default	Function
F1_2_2MV	1.0	(10 Hz)
F2_2_2MV	1.0	(1 kHz)
F3_2_2MV	1.0	(20 kHz)
F4_2_2MV	1.0	(300 kHz)
F5_2_2MV	1.0	(500 kHz)
F6_2_2MV	1.0	(800 kHz)
F7_2_2MV	1.0	(1 MHz)

Group DC_7MV: DC Constants, 7 mV Range

Name	Default	Function
DI_7MV	1000.0	Basic gain (Ref DAC to input ratio)
OF_7MV	0.0	Full scale calibrated DC offset

Group ZC_7MV: DC Constants, 7 mV Range

Name	Default	Function
Z_7MV	0.0	Zero calibrated DC offset
SHO_7MV	0.0	Shunt input DC offset
IA_7MV	0.00316228	Rough gain (input to A/D ratio)

Group AC_7MV: Flatness Constants, 7 mV Range

Name	Default	Function
F1_7MV	1.0	(10 Hz)
F2_7MV	1.0	(1 kHz)
F3_7MV	1.0	(20 kHz)
F4_7MV	1.0	(300 kHz)
F5_7MV	1.0	(500 kHz)
F6_7MV	1.0	(800 kHz)
F7_7MV	1.0	(1 MHz)

Group DC_22MV: DC Constants, 22 mV Range

Name	Default	Function
DI_22MV	500.0	Basic gain (Ref DAC to input ratio)
OF_22MV	0.0	Full scale calibrated DC offset

Group ZC_22MV: More DC Constants, 22 mV Range

Name	Default	Function
Z_22MV	0.0	Zero calibrated DC offset
SHO_22MV	0.0	Shunt input DC offset
IA_22MV	0.01	Rough gain (input to A/D ratio)

Group AC_22MV: Flatness Constants, 22 mV Range

Name	Default	Function
F1_22MV	1.0	(10 Hz)
F2_22MV	1.0	(1 kHz)
F3_22MV	1.0	(20 kHz)
F4_22MV	1.0	(300 kHz)
F5_22MV	1.0	(500 kHz)
F6_22MV	1.0	(1MHz)

Group DC_70MV: DC Constants, 70 mV Range

Name	Default	Function
DI_70MV	100.0	Basic gain (Ref DAC to input ratio)
OF_70MV	0.0	Full scale calibrated DC offset

Group ZC_70MV: More DC Constants, 70 mV Range

Name	Default	Function
Z_70MV	0.0	Zero calibrated DC offset
SHO_70MV	0.0	Shunt input DC offset
IA_70MV	0.0316228	Rough gain (input to A/D ratio)

Group AC_70MV: Flatness Constants, 70 mV Range

Name	Default	Function
F1_70MV	1.0	(10 Hz)
F2_70MV	1.0	(1 kHz)
F3_70MV	1.0	(20 kHz)
F4_70MV	1.0	(300 kHz)
F5_70MV	1.0	(1 MHz)

Group DC_220MV: DC Constants, 220 mV Range

Name	Default	Function
DI_220MV	50.0	Basic gain (Ref DAC to input ratio)
OF_220MV	0.0	Full scale calibrated DC offset

Group ZC_220MV: More DC Constants, 220 mV Range

Name	Default	Function
Z_220MV	0.0	Zero calibrated DC offset
SHO_220MV	0.0	Shunt input DC offset
IA_220MV	0.1	Rough gain (input to A/D ratio)

Group AC_220MV: Flatness Constants, 220 mV Range

Name	Default	Function
F1_220MV	1.0	(10 Hz)
F2_220MV	1.0	(1 kHz)
F3_220MV	1.0	(20 kHz)
F4_220MV	1.0	(300 kHz)
F5_220MV	1.0	(1 kHz)

Group DC_700MV: DC Constants, 700 mV Range

Name	Default	Function
DI_700MV	10.0	Basic gain (Ref DAC to input ratio)
OF_700MV	0.0	Full scale calibrated DC offset

Group ZC_700MV: More DC Constants, 700 mV Range

Name	Default	Function
Z_700MV	0.0	Zero calibrated DC offset
SHO_700MV	0.0	Shunt input DC offset
IA_700MV	0.316228	Rough gain (input to A/D ratio)

Group AC_700MV: Flatness Constants, 700 mV Range

Name	Default	Function
F1_700MV	1.0	(10 Hz)
F2_700MV	1.0	(1 kHz)
F3_700MV	1.0	(20 kHz)
F4_700MV	1.0	(300 kHz)
F5_700MV	1.0	(1 MHz)

Group DC_2_2V: DC Constants, mV Range

Name	Default	Function
DI_2_2V	5.0	Basic gain (Ref DAC to input ratio)
OF_2_2V	0.0	Full scale calibrated DC offset

Group ZC_2_2MV: More DC Constants, mV Range

Name	Default	Function
Z_2_2V	0.0	Zero calibrated DC offset
IA_2_2V	1.0	Rough gain (input to A/D ratio)

Group AC_2_2V: Flatness Constants, mV Range

Name	Default	Function
F1_2_2V	1.0	(10 Hz)
F2_2_2V	1.0	(1 kHz)
F3_2_2V	1.0	(20 kHz)
F4_2_2V	1.0	(300 kHz)
F5_2_2V	1.0	(1 MHz)

Group DC_7 V: DC Constants, 7 V Range

Name	Default	Function
DI_7V	1.0	Basic gain (Ref DAC to input ratio)
OF_7V	0.0	Full scale calibrated DC offset

Group ZC_7 V: More DC Constants, 7 V Range

Name	Default	Function
Z_7V	0.0	Zero calibrated DC offset
IA_7V	3.16228	Rough gain (input to A/D ratio)

Group AC_7 V: Flatness Constants, 7 V Range

Name	Default	Function
F1_7V	1.0	(10 Hz)
F2_7V	1.0	(1 kHz)
F3_7V	1.0	(20 kHz)
F4_7V	1.0	(100 kHz)

Group DC_7VHF: DC Constants, 7 V Range

Name	Default	Function
DI_7VHF	1.0	Basic gain (Ref DAC to input ratio)

Group ZC_7VHF: More DC Constants, High Frequency 7 V Range

Name	Default	Function
IA_7VHF	3.16228	Rough gain (input to A/D ratio)

Group AC_7VHF: Flatness Constants, High Frequency 7 V Range

Name	Default	Function
F1_7VHF	1.0	(100 Hz)
F2_7VHF	1.0	(300 kHz)
F3_7VHF	1.0	(500 kHz)
F4_7VHF	1.0	(800 kHz)
F5_7VHF	1.0	(1 MHz)

Group DC_22 V: DC Constants, 22 V Range

Name	Default	Function
DI_22V	0.5	Basic gain (Ref DAC to input ratio)
OF_22V	0.0	Full scale calibrated DC offset

Group ZC_22 V: More DC Constants, 22 V Range

Name	Default	Function
Z_22V	0.0	Zero calibrated DC offset
IA-22V	10.0	Rough gain (input to A/D ratio)

Group AC_22 V: Flatness Constants, 22 V Range

Name	Default	Function
F1_22V	1.0	(10 Hz)
F2_22V	1.0	(1 kHz)
F3_22V	1.0	(20 kHz)
F4_22V	1.0	(100 kHz)

Group DC_22VHF: DC Constants,High Frequency 22 V Range

Name	Default	Function
DI_22VHF	0.5	Basic gain (Ref DAC to input ratio)

Group ZC_22VHF: More DC Constants, High Frequency 22 V Range

Name	Default	Function
IA_22VHF	10.0	Rough gain (input to A/D ratio)

Group AC_22VHF: Flatness Constants, High Frequency 22 V Range

Name	Default	Function
F1_22VHF	1.0	(100 kHz)
F2_22VHF	1.0	(300 kHz)
F3_22VHF	1.0	(500 kHz)
F4_22VHF	1.0	(1 MHz)

Group DC_70 V: DC Constants, 70 V Range

Name	Default	Function
DI_70V	0.1	Basic gain (Ref DAC to input ratio)
OF_70V	0.0	Full scale calibrated DC offset

Group ZC_70 V: More DC Constants, 70 V Range

Name	Default	Function
Z_70V	0.0	Zero calibrated DC offset
IA-70V	31.6228	Rough gain (input to A/D ratio)

Group AC_70 V: Flatness Constants, 70 V Range

Name	Default	Function
F1_70V	1.0	(10 Hz)
F2_70V	1.0	(1 kHz)
F3_70V	1.0	(20 kHz)
F4_70V	1.0	(500 kHz)
F5_70V	1.0	(1 MHz)

Group DC_220 V: DC Constants, 220 V Range

Name	Default	Function
DI_220V	0.05	Basic gain (Ref DAC to input ratio)
OF_220V	0.0	Full scale calibrated DC offset

Group ZC_220 V: More DC Constants, 220 V Range

Name	Default	Function
Z_220V	0.0	Zero calibrated DC offset
IA-220V	100.0	Rough gain (input to A/D ratio)

Group AC_220 V: Flatness Constants, 220 V Range

Name	Default	Function
F1_220V	1.0	(10 Hz)
F2_220V	1.0	(1 kHz)
F3_220V	1.0	(20 kHz)
F4_220V	1.0	(100 kHz)

Group DC_700 V: DC Constants, 700 V Range

Name	Default	Function
DI_700V	0.01	Basic gain (Ref DAC to input ratio)
OF_700V	0.0	Full scale calibrated DC offset

Group ZC_700 V: More DC Constants, 700 V Range

Name	Default	Function
Z_700V	0.0	Zero calibrated DC offset
IA-700V	316.228	Rough gain (input to A/D ratio)

Group AC_700 V: Flatness Constants, 700 V Range

Name	Default	Function
F1_700V	1.0	(10 Hz)
F2_700V	1.0	(1 kHz)
F3_700V	1.0	(20 kHz)
F4_700V	1.0	(100 kHz)

Group DC_1000 V: DC Constants, 1000 V Range

Name	Default	Function
DI_1000V	0.005	Basic gain (Ref DAC to input ratio)
OF_1000V	0.0	Full scale calibrated DC offset

Group ZC_1000 V: More DC Constants, 1000 V Range

Name	Default	Function
Z_1000V	0.0	Zero calibrated DC offset
IA_1000V	1000.0	Rough gain (input to A/D ratio)

Group AC_1000 V: Flatness Constants, 1000 V Range

Name	Default	Function
F1_1000V	1.0	(10 Hz)
F2_1000V	1.0	(1 kHz)
F3_1000V	1.0	(20 kHz)
F4_1000V	1.0	(100 kHz)

Group WDC_2_2MV: Gain Constants, Wideband 2.2 mV Range

Name	Default	Function
DI_2_2MV_WB	5000.0	Basic gain (Ref DAC to input ratio)
IA_2_2MV_WB	0.0316228	Full scale calibrated DC offset

Group WAC_2_2MV: Flatness Constants, Wideband 2.2 mV Range

Name	Default	Function
F1_2_2MV_WB	1.0	(10 Hz)
F2_2_2MV_WB	1.0	(100 Hz)
F3_2_2MV_WB	1.0	(1 kHz)
F4_2_2MV_WB	1.0	(10 kHz)
F5_2_2MV_WB	1.0	(50 kHz)
F6_2_2MV_WB	1.0	(200 kHz)
F7_2_2MV_WB	1.0	(500 kHz)
F8_2_2MV_WB	1.0	(1 MHz)
F9_2_2MV_WB	1.0	(2 MHz)
F10_2_2MV_WB	B 1.0	(4 MHz)
F11_2_2MV_WB	B 1.0	(8 MHz)
F12_2_2MV_WB	B 1.0	(10 MHz)
F13_2_2MV_WB	B 1.0	(15 MHz)
F14_2_2MV_WB	B 1.0	(20 MHz)
F15_2_2MV_WB	B 1.0	(26 MHz)
F16_2_2MV_WB	B 1.0	(30 MHz)

Group WDC_7MV: Gain Constants, Wideband 7 mV Range

Name	Default	Function
DI_7MV_WB	1000.0	Basic gain (Ref DAC to input ratio)
IA_7MV_WB	0.1	Rough gain (input to A/D ratio)

Group WAC_7MV: Flatness Constants, Wideband 7 mV Range

Name	Default	Function
F1_7MV_WB	1.0	(10 Hz)
F2_7MV_WB	1.0	(100 Hz)
F3_7MV_WB	1.0	(1 kHz)
F4_7MV_WB	1.0	(10 kHz)
F5_7MV_WB	1.0	(50 kHz)
F6_7MV_WB	1.0	(200 kHz)
F7_7MV_WB	1.0	(500 kHz)
F8_7MV_WB	1.0	(1 MHz)
F9_7MV_WB	1.0	(2 MHz)
F10_7MV_WB	1.0	(4 MHz)
F11_7MV_WB	1.0	(8 MHz)
F12_7MV_WB	1.0	(10 MHz)
F13_7MV_WB	1.0	(15 MHz)
F14_7MV_WB	1.0	(20 MHz)
F15_7MV_WB	1.0	(26 MHz)
F16_7MV_WB	1.0	(30 MHz)

Group WDC_22MV: Gain Constants, Wideband 22 mV Range

Name	Default	Function
DI_22MV_WB	500.0	Basic gain (Ref DAC to input ratio)
IA_22MV_WB	0.316228	Rough gain (input to A/D ratio)

Group WAC_22MV: Flatness Constants, Wideband 22 mV Range

Name	Default	Function
F1_22MV_WB	1.0	(10 Hz)
F2_22MV_WB	1.0	(100 Hz)
F3_22MV_WB	1.0	(1 kHz)
F4_22MV_WB	1.0	(10 kHz)
F5_22MV_WB	1.0	(50 kHz)
F6_22MV_WB	1.0	(200 kHz)

Group WAC_22MV: Flatness Constants, Wideband 22 mV Range (cont)

F7_22MV_WB	1.0	(500 kHz)
F8_22MV_WB	1.0	(1 MHz)
F9_22MV_WB	1.0	(2 MHz)
F10_22MV_WB	1.0	(4 MHz)
F11_22MV_WB	1.0	(8 MHz)
F12_22MV_WB	1.0	(10 MHz)
F13_22MV_WB	1.0	(15 MHz)
F14_22MV_WB	1.0	(20 MHz)
F15_22MV_WB	1.0	(26 MHz)
F16_22MV_WB	1.0	(30 MHz)

Group WDC_70MV: Gain Constants, Wideband 70 mV Range

Name	Default	Function
DI_70MV_WB	100.0	Basic gain (Ref DAC to input ratio)
IA_70MV_WB	1.0	Rough gain (input to A/D ratio)

Group WAC_70MV: Flatness Constants, Wideband 70 mV Range

Name	Default	Function
F1_70MV_WB	1.0	(10 Hz)
F2_70MV_WB	1.0	(100 Hz)
F3_70MV_WB	1.0	(1 kHz)
F4_70MV_WB	1.0	(10 kHz)
F5_70MV_WB	1.0	(50 kHz)
F6_70MV_WB	1.0	(200 kHz)
F7_70MV_WB	1.0	(500 kHz)
F8_70MV_WB	1.0	(1 MHz)
F9_70MV_WB	1.0	(2 MHz)
F10_70MV_WB	1.0	(4 MHz)
F11_70MV_WB	1.0	(8 MHz)
F12_70MV_WB	1.0	(10 MHz)
F13_70MV_WB	1.0	(15 MHz)
F14_70MV_WB	1.0	(20 MHz)
F15_70MV_WB	1.0	(26 MHz)
F16_70MV_WB	1.0	(30 MHz)

Group WDC_220MV: Gain Constants, Wideband 220 mV Range

Name	Default	Function
DI_220MV_WB	31.6228	Basic gain (Ref DAC to input ratio)
IA_220MV_WB	3.16228	Rough gain (input to A/D ratio)

Group WAC_220MV: Flatness Constants, Wideband 220 mV Range

Name	Default	Function
F1_220MV_WB	1.0	(10 Hz)
F2_220MV_WB	1.0	(100 Hz)
F3_220MV_WB	1.0	(1 kHz)
F4_220MV_WB	1.0	(10 kHz)
F5_220MV_WB	1.0	(50 kHz)
F6_220MV_WB	1.0	(200 kHz)
F7_220MV_WB	1.0	(500 kHz)
F8_220MV_WB	1.0	(1 MHz)
F9_220MV_WB	1.0	(2 MHz)
F10_220MV_W	B 1.0	(4 MHz)
F11_220MV_W	B 1.0	(8 MHz)
F12_220MV_W	B 1.0	(10 MHz)
F13_220MV_W	B 1.0	(15 MHz)
F14_220MV_W	B 1.0	(20 MHz)
F15_220MV_W	B 1.0	(26 MHz)
F16_220MV_W	B 1.0	(30 MHz)

Group WDC_700MV: Gain Constants, Wideband 700 mV Range

Name	Default	Function
DI_700MV_WB	10.0	Basic gain (Ref DAC to input ratio)
IA_700MV_WB	10.0	Rough gain (input to A/D ratio)

Group WAC_700MV: Flatness Constants, Wideband 700 mV Range

Name	Default	Function
F1_700MV_WB	1.0	(10 Hz)
F2_700MV_WB	1.0	(100 Hz)
F3_700MV_WB	1.0	(1 kHz)
F4_700MV_WB	1.0	(10 kHz)
F5_700MV_WB	1.0	(50 kHz)
F6_700MV_WB	1.0	(200 kHz)

Group WAC_700MV: Flatness Constants, Wideband 700 mV Range (cont)		
F7_700MV_WB	1.0	(500 kHz)
F8_700MV_WB	1.0	(1 MHz)
F9_700MV_WB	1.0	(2 MHz)
F10_700MV_WB	B 1.0	(4 MHz)
F11_700MV_WB	B 1.0	(8 MHz)
F12_700MV_WB	B 1.0	(10 MHz)
F13_700MV_WB	B 1.0	(15 MHz)
F14_700MV_WB	B 1.0	(20 MHz)
F15_700MV_WB	B 1.0	(26 MHz)
F16_700MV_WB	B 1.0	(30 MHz)

Group WDC_2_2 V: Gain Constants, Wideband 2.2 V Range

Name	Default	Function
DI_2_2V_WB	3.16228	Basic gain (Ref DAC to input ratio)
IA_2_2V_WB	31.6228	Rough gain (input to A/D ratio)

Group WAC_2_2V: Flatness Constants, Wideband 2.2 V Range

Name	Default	Function
F1_2_2V_WB	1.0	(10 Hz)
F2_2_2V_WB	1.0	(100 Hz)
F3_2_2V_WB	1.0	(1 kHz)
F4_2_2V_WB	1.0	(10 kHz)
F5_2_2V_WB	1.0	(50 kHz)
F6_2_2V_WB	1.0	(200 kHz)
F7_2_2V_WB	1.0	(500 kHz)
F8_2_2V_WB	1.0	(1 MHz)
F9_2_2V_WB	1.0	(2 MHz)
F10_2_2V_WB	1.0	(4 MHz)
F11_2_2V_WB	1.0	(8 MHz)
F12_2_2V_WB	1.0	(10 MHz)
F13_2_2V_WB	1.0	(15 MHz)
F14_2_2V_WB	1.0	(20 MHz)
F15_2_2V_WB	1.0	(26 MHz)
F16_2_2V_WB	1.0	(30 MHz)

Group WDC_7V: Gain Constants, Wideband 7 V Range

Name	Default	Function
DI_7V_WB	1.0	Basic gain (Ref DAC to input ratio)
IA_7V_WB	100.0	Rough gain (input to A/D ratio)

Group WAC_7V: Flatness Constants, Wideband 7 V Range

Name	Default	Function
F1_7V_WB	1.0	(10 Hz)
F2_7V_WB	1.0	(100 Hz)
F3_7V_WB	1.0	(1 kHz)
F4_7V_WB	1.0	(10 kHz)
F5_7V_WB	1.0	(50 kHz)
F6_7V_WB	1.0	(200 kHz)
F7_7V_WB	1.0	(500 kHz)
F8_7V_WB	1.0	(1 MHz)
F9_7V_WB	1.0	(2 MHz)
F10_7V_WB	1.0	(4 MHz)
F11_7V_WB	1.0	(8 MHz)
F12_7V_WB	1.0	(10 MHz)
F13_7V_WB	1.0	(15 MHz)
F14_7V_WB	1.0	(20 MHz)
F15_7V_WB	1.0	(26 MHz)
F16_7V_WB	1.0	(30 MHz)

Appendix D
5790A Error Codes

Error Codes

0 ERR	•	No errors
1 ERR	•	Error queue is full
100 CAL	•	Invalide procedure number
101 CAL	•	No such step in procedure
102 CAL	•	No Cal/Diag procedure underway
103 CAL	•	Cal/Diag not halted
104 CAL	•	No cal step to which to back up
105 CAL	•	No such position for range under cal
106 CAL	•	No such range for cal procedure
107 CAL	•	External DAC calibration failed
108 CAL	•	Entered reference outside of limits
109 CAL	•	Measured and entered input don't match
110 CAL	•	Frequency doesn't match expected
111 CAL	•	Input is of wrong polarity
112 CAL	•	Input is changing during cal
113 CAL	•	Input tripped protection circuit
114 CAL	•	Constant %s out of limits
115 CAL	•	Flatness constant out of limits
116 CAL	•	Range gain constant out of limits
117 CAL	•	Rough gain constant out of limits
118 CAL	•	Offset constant out of limits
119 CAL	•	Low F constant out of limits
120 CAL	•	%s range Zero out of limits
121 CAL	•	%s range shunt offset out of limits
122 CAL	•	Divide by zero %s IA update
123 CAL	•	Old ^{O}/os IA is WAY OFF! do a DC cal

124 CAL	•	Temperature gain is zero
125 CAL	•	New temperature Zero out of limits
126 CAL	•	CAL switches must be ENABLE and SERVICE
127 CAL	•	INPUT2 Correction factor out of limits
128 CAL	•	Calibration step in progress
199 CAL	•	Cal error occurred; Already reported
200 CNF	•	Need A %s to do that
201 CNF	•	Need Wideband AC option to do that
202 CNF	•	IG Software out of date: Use %s or newer
300 IG	•	A17 guardcrossing: ROM checksum
301 IG	•	A17 guardcrossing: RAM
302 IG	•	A17 Guardcrossing: DUART
303 IG	•	A17 guardcrossing: Watchdog
304 IG	•	Hardware intialization
400 DIAG	•	%s
401 DIAG	•	A16 DAC: %s channel
402 DIAG	•	%s
403 DIAG	•	A15 ND: %s self test
404 DIAG	•	A15 A/D: %s Zero
405 DIAG	•	A15 A/D: Null DAC O/c's
406 DIAG	•	A15 ND: DAC %s
407 DIAG	•	A15 ND: Chopper %s
408 DIAG	•	A10 Transfer: %s Range
409 DIAG	•	A10 Transfer: %s Protection check
410 DIAG	•	A10 Transfer: Overload check
411 DIAG	•	A10 Transfer: Sensor input/output match
412 DIAG	•	A10 Transfer: %s Range Zero
413 DIAG	•	A10 Transfer: %s Input path
414 DIAG	•	A10 Transfer: %s Frequency measurement
415 DIAG	•	A6 Wideband: %s Range
416 DIAG	•	A6 Wideband: Overload check
417 DIAG	•	A6 Wideband: %s Frequency measurement
418 DIAG	•	A3 Motherboard: DV Divider %s
419 DIAG	•	A10 Transfer: Sensor loop settling
420 DIAG	•	A6 Wideband: Sensor loop settling
421 DIAG	•	A16 DAC: DAC settling
422 DIAG	•	A6 Wideband: Dormant protection check
423 DIAG	•	A15 A/D: %s linearity
500 STA	•	Bad Delta Unit
501 STA	•	Invalid range
503 STA	•	Can't get Ref
504 STA	•	Can't set average Ref
505 STA	•	Can't decode learned string
506 STA	•	Learned string checksum bad
507 STA	•	Recalling unsaved instrument state
508 STA	•	Already printing a report
509 STA	•	Eternal guard not available

700 GX	•	ACK queue full
701 GX	•	Both sides of GX want to be master
702 GX	•	Both sides of GX want to be slave
703 GX	•	Couldn't ACK packet from inguard
704 GX	•	Bad packet number from inguard
705 GX	•	Multiple timeouts sending to inguard
706 GX	•	Inguard indefinite ACKWAIT holdoff
707 GX	•	Packet too large for inguard
708 GX	•	Bad ACK packet number from inguard
709 GX	•	Received invalid control byte
710 GX	•	Received invalid acknowledgement
711 GX	•	Link quality indicator below limit
712 GX	•	Inguard CPU Reset
900 NRM	•	A/D measurement failed
901 NRM	•	Protection activated
902 NRM	•	Over voltage for input
1000 NV	•	EEPROM write failed
1001 NV	•	EEPROM read checksum error (%s)
1002 NV	•	Block %s would not format
1003 NV	•	Bad NV selector %d
1004 NV	•	%d Blocks failed post-format check
1100 OPM	•	Guard crossing protocol failed to start
1101 OPM	•	Analog hardware initialization failed
1102 OPM	•	Giving up on initializing hardware
1103 OPM	•	NV Memory check found %d bad block(s)
1104 OPM	•	Analog hardware control inoperative
1300 REM	•	Bad Syntax
1301 REM	•	Unknown command
1302 REM	•	Bad parameter count
1303 REM	•	Bad keyword
1304 REM	•	Bad parameter type
1305 REM	•	Bad parameter unit
1306 REM	•	Bad parameter value
1307 REM	•	488.2 I/O deadlock
1308 REM	•	488.2 Interrupted Query
1309 REM	•	488.2 Unterminated command
1310 REM	•	488.2 Query after indefinite response
1311 REM	•	nvalid from GPIB interface
1312 REM	•	Invalid from serial interace
1313 REM	•	Service Only
1314 REM	•	Parameter tool long
1315 REM	•	Invalid device trigger
1316 REM	•	*DDT recursion
1317 REM	•	Macro calls too deep
1337 REM	•	Already executing a procedure
1338 REM	•	Already writing to NV memory
1339 REM	•	MEAS? timed-out

1360 REM	•	Bad binary number
1361 REM	•	Bad binary block
1362 REM	•	Bad character
1363 REM	•	Bad decimal number
1364 REM	•	Exponent magnitude too large
1365 REM	•	Bad hexadecimal block
1366 REM	•	Bad hexadecimal number
1368 REM	•	Bad octal number
1369 REM	•	Too many characters
1370 REM	•	Bad string
1500 RTC	•	Invalid time
1501 RTC	•	Invalid date
1502 RTC	•	Can't set date, CAL STORE switch NORMAL
1602 SEQ	•	Bad reply size from inguard
1603 SEQ	•	False MSG semaphore from inguard
1604 SEQ	•	Inguard CPU A/D error
1605 SEQ	•	Inguard CPU timer out on main CPU
1606 SEQ	•	Inguard CPU command error
1607 SEQ	•	Timed out waiting for inguard reply
1608 SEQ	•	Sequence name too long
1609 SEQ	•	Element array full
1610 SEQ	•	Name array full
1611 SEQ	•	Already defining a sequence
1612 SEQ	•	Not defining a sequence
1613 SEQ	•	Command failed
1700 SER	•	Bad virtual channel %d
1701 SER	•	%d framing
1702 SER	•	%d input queue overflow
1703 SER	•	%d overrun
1704 SER	•	%d Parity
1705 SER	•	%d UART failed self test
1900 SYS	•	Bad interrupt vect #h%02x
2100 TST	•	A20 main CPU: ROM checksum
2101 TST	•	A20 main CPU: RAM
2102 TST	•	A20 main CPU: Real time clock
2103 TST	•	A01 Keyboard: keyboard
2104 TST	•	A02 Display: Output display
2105 TST	•	A02 Display: Control display
2106 TST	•	A21 Rear panel: IEEE488
2107 TST	•	A21 Rear panel: Rear panel DUART
2108 TST	•	A20 main CPU: Guard crossing DUART
2109 TST	•	A20 main CPU: Watchdog timer
2110 TST	•	A20 main CPU Watchdog
2111 TST	•	A2 Display: Refresh
2201 UT	•	To format, set switches to ENABLE & SERVICE
2202 UT	•	Can't store, CAL STORE switch NORMAL
2203 UT	•	Cant' set string, CAL STORE switch NORMAL

| 2204 UT | • | Domain error %s |
2205 UT	•	Singularity %s
2206 UT	•	Overflow %s
2207 UT	•	Underflow %s
2208 UT	•	Error %s
2209 UT	•	%s
2300 WD	•	Watchdog timed out (tid=%d)
65535 ERR	•	Unknown error

Appendix E
5200A Verification and Calibration

Introduction

The 5790A can be used as the measuring device to measure a 5200A AC Calibrator. To do so, replace the procedures in section 4 of the 5200A manual, with the equivalent procedures contained in this appendix. These new procedures will require additional test accessories (see Table F-1). Use all other verification and calibration procedures of the 5200A manual as written.

Table F-1. Additional Test Accessories

Accessories	Model
Ferrite Toroid Core	Fluke PN 851188
3-Foot Coax Cable with BNC Male Connectors	RG58A/U
Blocking Capacitor Adapter	Two 33 uf 6V Tantalum Capacitors and a 100- k Ω metal film resistor mounted on a Pomona model 1837 plug. (See Figure F-1.)
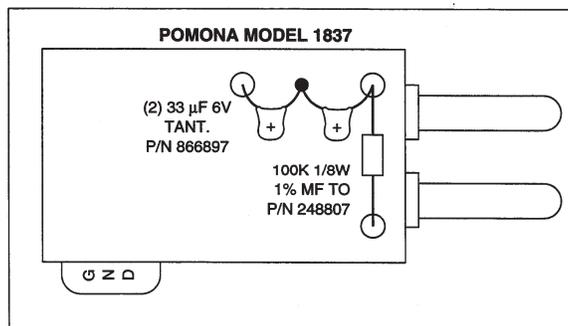
ff1.bmp

Figure F-1. Blocking Capacitor Adapter

Performance Verification Checks

Starting on page 4-5 of the 5200A manual, the following procedures replace the Output Accuracy Test - Voltage Ranges, Output Accuracy Test - Millivolt Ranges and Voltage Error Control Test.

Output Accuracy Test - Voltage Ranges

Use the following procedure to perform the output accuracy test.

1. Connect the equipment as shown in Figure F-2.
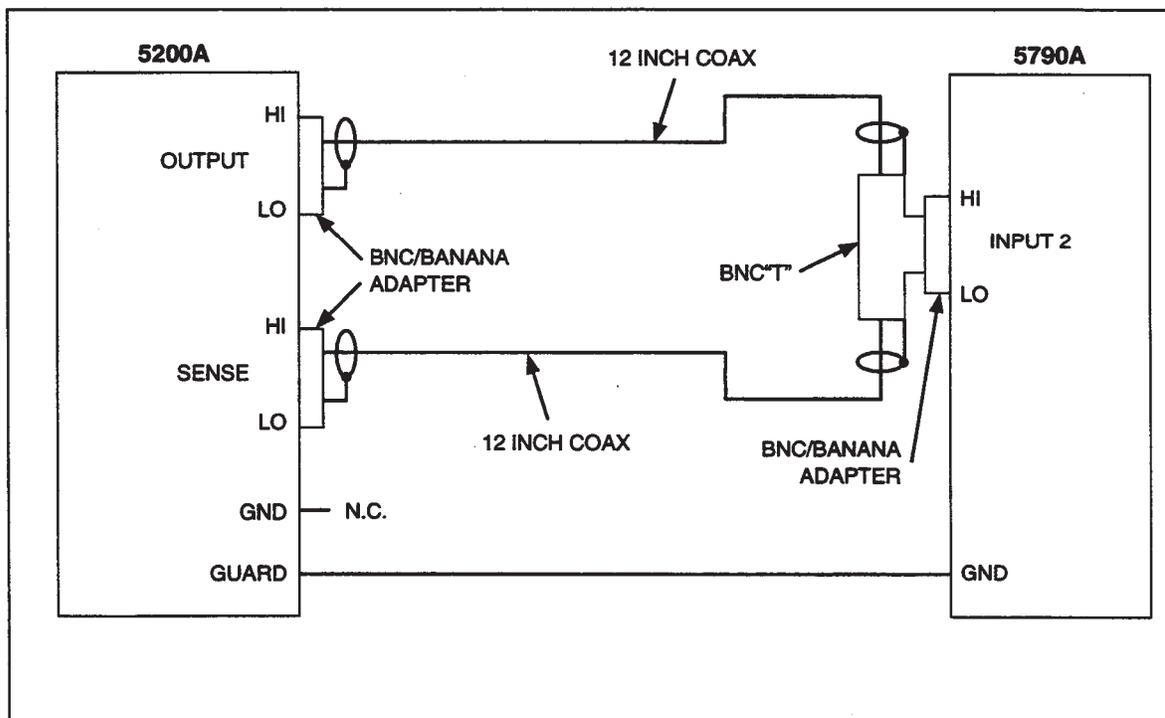
Figure F-2. 1V, 10V, 100V Output Accuracy Equipment Configuration

2.   Ensure the Equipment Set-Up procedure has been performed.

3.   Select the desired output voltage and frequency from the 5200A. Suggested representative voltage and frequency combinations along with accuracy tolerances are listed in Table F-2.

4.   Set the reference voltage of the 5790A to give a direct error read-out as follows:
   a.   Select the desired voltage from the 5200A at 1 kHz.

   b.   Set the MODE switch to OPER.

   c.   Adjust the 5200A voltage if necessary to give the exact desired reading on the 5790A display (±10 counts) and push the SET REF soft key on the 5790A.

   d.   Push the soft key under the error display units to give PCT.

   e.   Reset the 5200A to the desired output voltage.

5.   Perform the measurements at frequencies desired.

6.   Repeat steps 3 through 5 for other desired voltage and frequency combinations.

**Table F-2. Output Voltage Accuracy Test Tolerances**

Freq/Range	Volts/Range			
	1/1	1/10	10/10	100/100
1 kHZ/1 kHz	±0.02 %	±0.04 %*	±0.02 %*	±0.02 %*
20 kHz/100 kHz	±0.02 %	±0.04 %	±0.02 %	±0.02 %
100 kHz/100 kHz	±0.05 %	±0.10 %	±0.05 %	±0.05 %
1 MHz/1 MHz	±0.33 %*	±0.66 %*	±0.33 %	NOT ALLOWED
*These points are adjusted during the calibration procedure.				

Output Accuracy Test-Millivolt Ranges

Use the following procedure to perform the millivolt output accuracy test:

1. Connect the equipment as shown in Figure F-3.
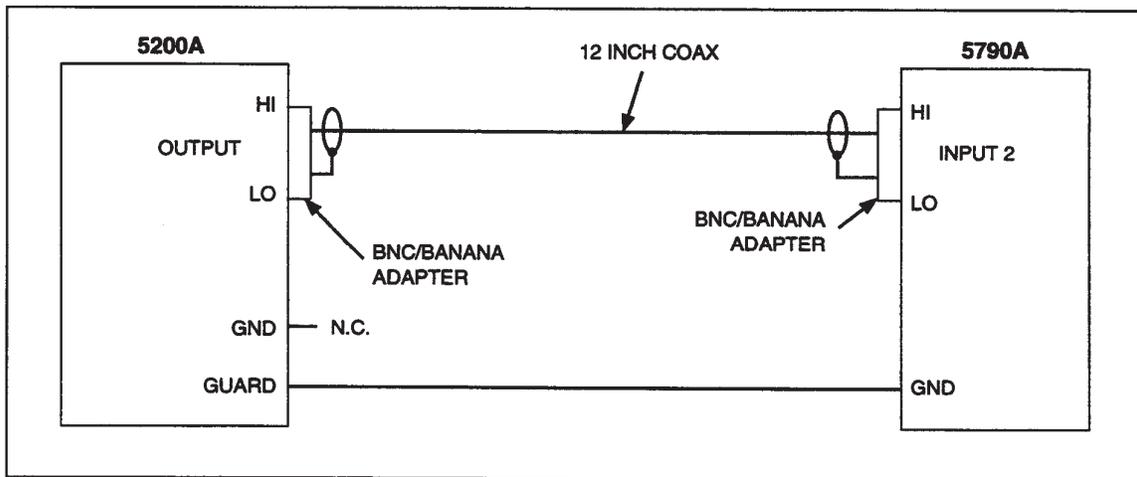
Figure F-3. 100 mV Output Accuracy Equipment Configuration

2. Ensure the Equipment Set-Up procedure has been performed.

3. Set the 5200A output to 100 mV on the 100-mV range at 1 kHz.

Note
Internal sensing is automatic on the 5200A millivolt ranges.

4. Set the reference voltage of the 5790A to give a direct error read-out as follows:

    a. Set the mode switch to OPR.

    b. Adjust the 5200A output voltage if necessary to give the exact reading of 100.0000 mV (±10 counts) and push the SET REF soft key on the 5790A.

    c. Push the soft key under the error display units to give PCT.

    d. Reset the 5200A to 100 mV.

5. Perform the measurements at the frequencies desired. The readings should not be greater than the values listed for the voltage/frequency selected in Table F-3.

Note

With internal sensing on the millivolt ranges, capacitive loading causes an increase in the 5200A output in the 100-kHz to 1-MHz range. This increase in output is due to external capacitance being placed in parallel with internal inductance, resulting in a parallel tuned circuit. The nominal calibration is at the end of the 1-foot cable with 36-pf capacitance load. The 5790A input capacitance is 64 pf, causing a 0.08 % increase in the output at 1 MHz. Subtract this error from the 5790A error reading before applying the test tolerance. Calculate errors at other frequencies by using the equation in Table F-3.

Table F-3. Millivolt Ranges Output Accuracy Tests Tolerances

Output/Range	Voltage/Frequency Ranges			
	10 Hz - 30 Hz **(0.1% + 10 μV)**	**30 Hz - 20 kHz** **(0.02% + 10 μV)**	**20 kHz - 100 kHz** **(0.05% + 20 μV)**	**0.1 MHz - 1.0 MHz** **(0.33% + 30 μV)**
100 mV /100 mV range 10 mV/10 mV range	±0.11 % ±0.2 %	±0.03 % ±0.12 %	±0.07 % ±0.25 %	±0.36 %* ±0.63 %
1 mV /1 mV range	±1.1 %	±1.02 %	±2.05 %	±3.33 %
* Subtract the following capacitance loading error from the measured readings before comparison to the test tolerance: 5790A cap loading error in % = 0.08 $\left(\dfrac{f \text{ MHz}}{1 \text{ MHz}}\right)^2$				

6. Connect the equipment as shown in Figure F-4.

7. Set the 5200A output to 10 mV on the 10-mV range at 1 kHz.

8. Set the reference voltage of the 5790A to give a direct error read-out as follows:

   a. Set the MODE switch to OPR.

   b. Adjust the 5200A output voltage if necessary to give the exact reading of 10.0000 mV (±2 counts) and push the SET REF soft key on the 5790A.

   c. Push the soft key under the error display units to give PCT.

   d. Reset the 5200A to 10 mV.
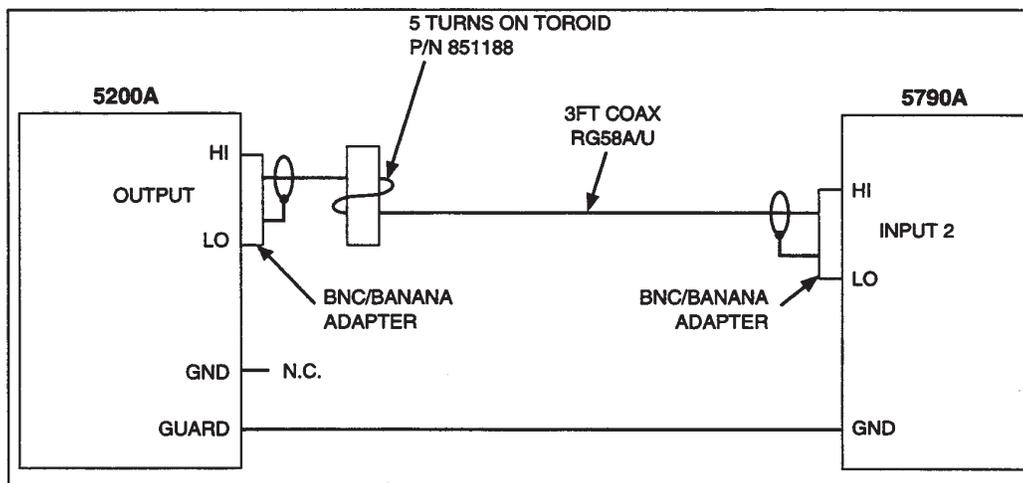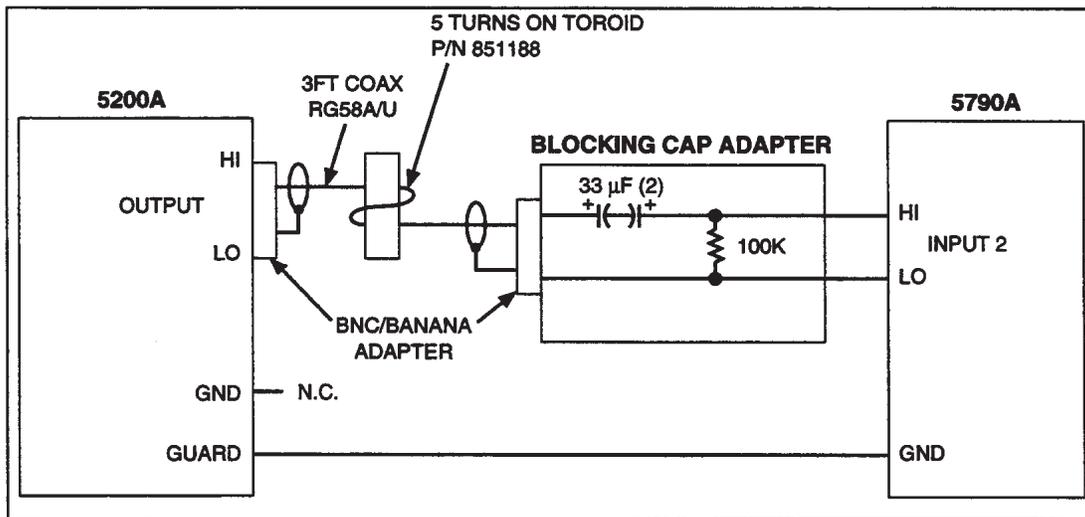

Figure F-4. 10 mV Output Accuracy Equipment Configuration

9. Perform the measurements at the frequencies desired. The readings should not be greater than the values listed for the voltage/frequency selected in Table F-3.

10. Connect the equipment as shown in Figure F-5.

11. Set the 5200A output to 1 mV on the 1-mV range at 1 kHz.

12. Set the reference voltage of the 5790A to give a direct error read-out as follows:

    a. Set the MODE switch to OPR.

    b. Adjust the 5200A output voltage if necessary to give the exact reading of 1.0000 mV (±2 counts) and push the SET REF soft key on the 5790A.

    c. Push the soft key under the error display units to give PCT.

    d. Reset the 5200A to 1 mV.

13. Perform the measurements at the frequencies desired. The readings should not be greater than the value listed for the voltage/frequency selected in Table F-3.

Figure F-5. 1 mV Output Accuracy Equipment Configuration

ff5.bmp

Voltage Error Control Test

Use the following procedure to check the voltage error control:

1. Ensure that the Equipment Set-Up procedure has been performed.

2. Connect the equipment as shown in Figure F-2.

3. Set the 5200A for an output of 10 V on the 10 V-range and at 1 kHz on the 1-kHz range.

4. Set the MODE switch to OPER.

5. Push the SET REF soft key on the 5790A.

6. Set the VERNIER dial to 0.00 and the VOLTAGE ERROR-% switch to X1. The 5790A error display should read 0 ±.01 %.

7. Set the VOLTAGE ERROR-% switch to X1. The 5790A error display should read 0 ± 0.001 %.

8. Check the end point accuracy of the vernier by setting the VERNIER dial to +3.00 and the VOLTAGE ERROR-% switch to X1. The 5790A error display should read between -2.9800 % and -3.0200 %.

9. Set the 5200A VOLTAGE ERROR-% switch to X1. The 5790A error display should read between -0.2980 % and -0.3020 %.

10. Check the other end point accuracy of the vernier by setting the VERNIER dial to -3.00 and the VOLTAGE ERROR-% switch to X1. The 5790A error display should read between +2.9800 % and +3.0200 %.

11. Set the 5200A VOLTAGE ERROR-% switch to X1. The 5790A error display should read between +0.2980 % and +0.3020 %.

12. Return the 5200A VERNIER to 0.00 and the VOLTAGE ERROR-% switch to OFF.

Calibration Procedures

Starting on page 4-17 of the 5200A manual, the following procedures replace the Voltage Amplitude/Linearity Calibration and Millivolt Amplitude Calibration.

Voltage Amplitude and Linearity Calibration

The following procedures deal with voltage amplitude and linearity for the 1V, 10V, and 100V ranges.

1. Install the inner covers and firmly secure for these tests.

2. Make the adjustments through the marked ports in the instrument compartment inner cover as shown in Figure F-6.

3. Perform the tests in sequence ensuring that the Equipment Set-Up procedure has been performed prior to starting the test.

Low Frequency Zero and Gain Calibration.

Use the following procedure to perform the low frequency zero and gain calibration test:

1. Connect the equipment as shown in Figure F-2.

2. Set the 5200A output to 1V on the 10 V range and 1 kHz on the 1-kHz range.

3. Set the mode switch to OPER. The 5790A should read 1.000000 ±0.000050 V.

4. Adjust INT ZERO (R63, AC/DC Converter PCB) until the reading is within tolerance.

5. Set the 5200A output to 10 V on the 10 V range and 1 kHz on the 1-kHz range. The 5790A should read 10.00000 ±0.00050 V.

6. Adjust REF (R48, Reference PCB) until the reading is within tolerance.

7. Repeat steps 1 through 5 until both readings are within tolerance without adjustment.

100V Low Frequency Calibration

Use the following procedure to perform the 100 V low frequency calibration test:

1. Set the 5200A output to 100 V on the 100 V range and 1 kHz on the 1-kHz range.

2. Adjust 100 V (R9, Attenuator PCB) if necessary to give 100.0000 ±0.0050 V.

High Frequency Zero Calibration

Use the following procedure to perform the high frequency zero calibration test:

1. Set the 5200A output to 1 V on the 10 V range and 1 MHz on the 1-MHz range.

2. Adjust HIGH FREQ ZERO (R89, AC/DC Converter PCB) if necessary to give a 5790A reading of 1.000000 ±0.000100 V.

High Frequency Gain Calibration

Use the following procedure to perform the high frequency gain calibration test:

1. Set the 5200A output to 1 V on the 1 V range and 1 MHz on the 1-MHz range.

2. Adjust HIGH FREQ GAIN (R91, AC-DC Converter PCB) if necessary to give a 5790A reading of 1.0000000 ±0.000100 V.

3. Repeat the High Frequency Zero Calibration and High Frequency Gain Calibration until both are within tolerance.

High Frequency 100v Range Calibration

Use the following procedure to perform the high frequency 100 V range calibration test:

1.   Set the 5200A output to 10 V on the 100 V range and 1 MHz on the 1-MHz range.

2. Adjust 100V-HIGH FREQ (C3, Attenuator PCB) if necessary to give a 5790A reading of 9.96700 V ±0.00500 V.

Note

The output at 1 MHz is purposely adjusted 0.33 % low in order to optimize accuracy at lower frequencies.

FRONT
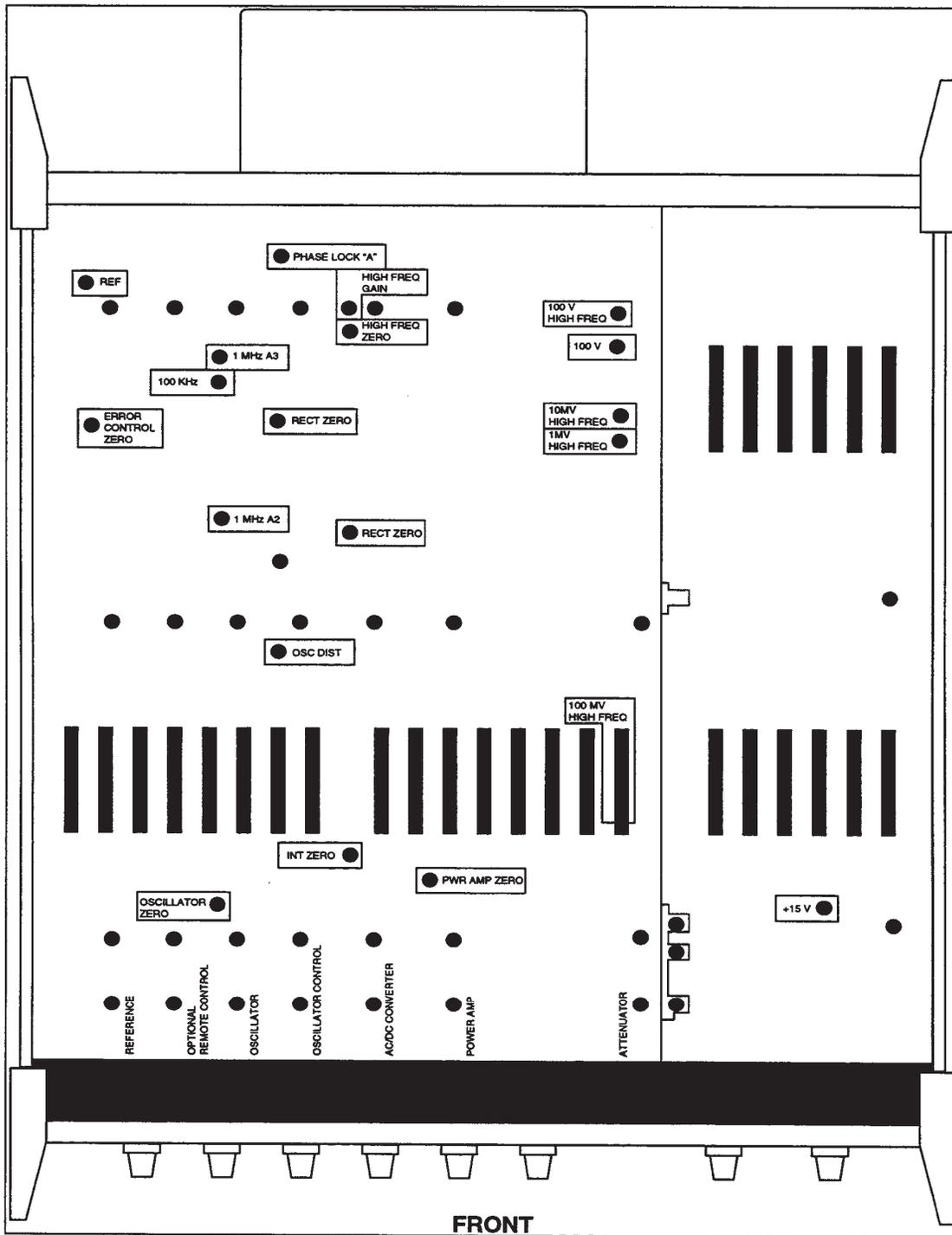
ff6.bmp

Figure F-6. Labeled Adjustment Ports

Millivolt Amplitude Calibration

The following procedures deal with voltage amplitude and linearity for the 1 mV, 10 mV, and 100 mV ranges. Install the inner covers and firmly secure for these tests. Make the adjustments through the marked ports in the instrument compartment inner cover as shown in Figure F-6. Perform the tests in sequence ensuring that the Equipment Set-Up procedure has been performed prior to starting the test.

Use the following procedure to perform the millivolt range output accuracy test:

1. Connect the equipment as shown in Figure F-3.

2. Set the 5200A output to 100 mV on the 100-mV range and 1 MHz on the 1-MHz range.

3. Set the MODE switch to OPER.

Note

Internal Sensing is automatic on the 5200A millivolt ranges.

4. Adjust the 100-mV HIGH FREQ (L1, Attenuator PCB) if necessary to give a 5790A reading of 100.0800 mV ±0.0020 mV.

Note

The output at 1 MHz is purposely adjusted 0.08 % high in order to compensate for the input capacity of the 5790A.

5. Connect the equipment as shown in Figure F-4.

6. Set the 5200A output to 10 mV on the 10-mV range and 1 MHz on the 1-MHz range.

7. Set the MODE switch to OPER.

8. Adjust the 10-mV HIGH FREQ (R12, Attenuator PCB) if necessary to give a reading of 10.0000 ±0.0005 mV.

9. Connect the equipment as shown in Figure F-5.

10. Set the 5200A output to 1 mV on the 1-mV range and 1 MHz on the 1-MHz range.

11. Adjust the 1-mV High Freq (R11, Attenuator PCB) if necessary to give a reading of 1.0000 ±0.0010 mV.

Error Control Calibration

Use the following procedure for the error control calibration:

1. Connect the equipment as shown in Figure F-2. Ensuring that both covers are installed and secured.

2. Set the 5200A output to 10V on the 100-mV range and 1 MHz on the 1-MHz range.

3. Set the MODE switch to OPER.

4. Push the SET REF soft key on the 5790A.

5. Set the VERNIER dial to 0.00 and the VOLTAGE ERROR-% switch to X1.

6. Adjust Error Control Zero (R75, Reference PCB) if necessary to get an error display on the 5790A of 0.0 ±50 ppm.

7. Check the adjustment by rotating the VOLTAGE ERROR-% switch between X1 and OFF positions. The 5790A error display should remain at 0.0 ±50 ppm.

Note

The toroid and blocking capacitor adapter are required during calibration ONLY, due to equipment characteristics. During normal use the 100-mV range is specified at the end of the 12-inch RG-58A/U cable. The 10-mV and 1-mV ranges are specified at the end of the 3-foot RG-58A/U cable. The 1V, 10V, and 100V ranges are specified with 1 foot output and sense RG-58A/U coax and with EXT SENSE.