VXI bus

Agilent 75000 Series B

Agilent E1332A
4-Channel Counter/Totalizer Module

Service Manual

Enclosed is the Service Manual for the Agilent E1332A 4-Channel Counter/Totalizer Module. Insert this manual, along with any other VXIbus manuals that you have, into the binder that came with your Agilent Technologies mainframe.

Agilent Technologies

Manual Part Number: E1332-90013
Printed in Malaysia E0706

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Agilent E1332A 4-Channel Counter/Totalizer Service Manual
Edition 4 Rev 2

Printing History

The Printing History shown below lists all Editions and Updates of this manual and the printing date(s). The first printing of the manual is Edition 1. The Edition number increments by 1 whenever the manual is revised. Updates, which are issued between Editions, contain replacement pages to correct the current Edition of the manual. Updates are numbered sequentially starting with Update 1. When a new Edition is created, it contains all the Update information for the previous Edition. Each new Edition or Update also includes a revised copy of this printing history page. Many product updates or revisions do not require manual changes and, conversely, manual corrections may be done without accompanying product changes. Therefore, do not expect a one-to-one correspondence between product updates and manual updates.

Edition 1 . . . . May 1991

Edition 2 . . . . March 1992

Edition 3 . . . . May 1996

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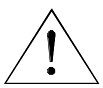
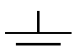
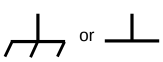
Safety Symbols

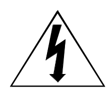

Instruction manual symbol affixed to product. Indicates that the user must refer to the manual for specific WARNING or CAUTION information to avoid personal injury or damage to the product.


Indicates the field wiring terminal that must be connected to earth ground before operating the equipment—protects against electrical shock in case of fault.


Frame or chassis ground terminal—typically connects to the equipment's metal frame.


Alternating current (AC).

Direct current (DC).


Indicates hazardous voltages.

WARNING Calls attention to a procedure, practice, or condition that could cause bodily injury or death.

CAUTION Calls attention to a procedure, practice, or condition that could possibly cause damage to equipment or permanent loss of data.

WARNINGS

The following general safety precautions must be observed during all phases of operation, service, and repair of this product. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the product. Agilent Technologies assumes no liability for the customer's failure to comply with these requirements.

Ground the equipment: For Safety Class 1 equipment (equipment having a protective earth terminal), an uninterruptible safety earth ground must be provided from the mains power source to the product input wiring terminals or supplied power cable.

DO NOT operate the product in an explosive atmosphere or in the presence of flammable gases or fumes.

For continued protection against fire, replace the line fuse(s) only with fuse(s) of the same voltage and current rating and type.
DO NOT use repaired fuses or short-circuited fuse holders.

Keep away from live circuits: Operating personnel must not remove equipment covers or shields. Procedures involving the removal of covers or shields are for use by service-trained personnel only. Under certain conditions, dangerous voltages may exist even with the equipment switched off. To avoid dangerous electrical shock, DO NOT perform procedures involving cover or shield removal unless you are qualified to do so.

DO NOT operate damaged equipment: Whenever it is possible that the safety protection features built into this product have been impaired, either through physical damage, excessive moisture, or any other reason, REMOVE POWER and do not use the product until safe operation can be verified by service-trained personnel. If necessary, return the product to an Agilent Technologies Sales and Service Office for service and repair to ensure that safety features are maintained.

DO NOT service or adjust alone: Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

DO NOT substitute parts or modify equipment: Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the product. Return the product to an Agilent Technologies Sales and Service Office for service and repair to ensure that safety features are maintained.

Agilent Technologies	**DECLARATION OF CONFORMITY** According to ISO/IEC Guide 22 and CEN/CENELEC EN 45014	CE

Manufacturer's Name: Agilent Technologies, Incorporated
Manufacturer's Address: 815 – 14th St. SW
Loveland, Colorado 80537
USA

Declares, that the product

Product Name: 2/4 Channel Counter/Totalizer
Model Number: E1332A
Product Options: *This declaration covers all options of the above product(s).*

Conforms with the following European Directives:

The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC (including 93/68/EEC) and carries the CE Marking accordingly.

Conforms with the following product standards:

EMC	**Standard**	**Limit**
	IEC 61326-1:1997+A1:1998 / EN 61326-1:1997+A1:1998	
	CISPR 11:1990 / EN 55011:1991	*Group 1 Class A*
	IEC 61000-4-2:1995+A1:1998 / EN 61000-4-2:1995	*4kV CD, 8kV AD*
	IEC 61000-4-3:1995 / EN 61000-4-3:1995	*3 V/m, 80-1000 MHz*
	IEC 61000-4-4:1995 / EN 61000-4-4:1995	*0.5kV signal lines, 1kV power lines*
	IEC 61000-4-5:1995 / EN 61000-4-5:1995	*0.5 kV line-line, 1 kV line-ground*
	IEC 61000-4-6:1996 / EN 61000-4-6:1996	*3V, 0.15-80 MHz I cycle, 100%*
	IEC 61000-4-11:1994 / EN 61000-4-11:1994	*Dips: 30% 10ms; 60% 100ms*
		Interrupt > 95%@5000ms
	Canada: ICES-001:1998	
	Australia/New Zealand: AS/NZS 2064.1	

The product was tested in a typical configuration with Agilent Technologies test systems.

Safety
IEC 61010-1:1990+A1:1992+A2:1995 / EN 61010-1:1993+A2:1995
Canada: CSA C22.2 No. 1010.1:1992
UL 3111-1: 1994

1 June 2001
Date

Ray Corson
Product Regulations Program Manager

For further information, please contact your local Agilent Technologies sales office, agent or distributor.
Authorized EU-representative: Agilent Technologies Deutschland GmbH, Herrenberger Straѣe 130, D 71034 Böblingen, Germany

Notes

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Notes

What's in this Manual

Manual Overview

This manual shows how to service the Agilent E1332A 4-Channel Counter/Totalizer. Consult the *Agilent E1332A User's Manual* for additional information on installing, configuring, and operating the counter. Consult the appropriate mainframe user's manual for information on configuring and operating the mainframe.

Manual Content

Chap	Title	Content
1	General Information	Provides a basic description, and lists available options and accessories. Also lists the test equipment required for service.
2	Installation	Procedures for installation, initial inspection, and shipping.
3	Operating Instructions	Procedures to operate the counter, perform scheduled preventive maintenance, and perform the operator's check.
4	Verification Tests	Functional verification, operation verification, and performance verification tests.
5	Adjustments	Procedures for adjusting the counter to within its rated specifications.
6	Replaceable Parts	Lists part numbers for user-replaceable parts in the counter. Provides information on ordering spare parts and module/assembly exchange.
7	Service	Procedures to aid in fault isolation and repair of the counter.
Appx . A	Calculating Counter Accuracy	Shows how counter accuracy, measurement uncertainty, and test accuracy ratios (TARs) are calculated.

Contents

Agilent E1332A Counter/Totalizer Service Manual

General Information

Introduction

This manual contains information required to test, adjust, troubleshoot, and repair the Agilent E1332A B-Size VXI Counter/Totalizer. See the *Agilent E1332A User's Manual* for additional information. Figure 1-1 shows the Agilent E1332A counter.

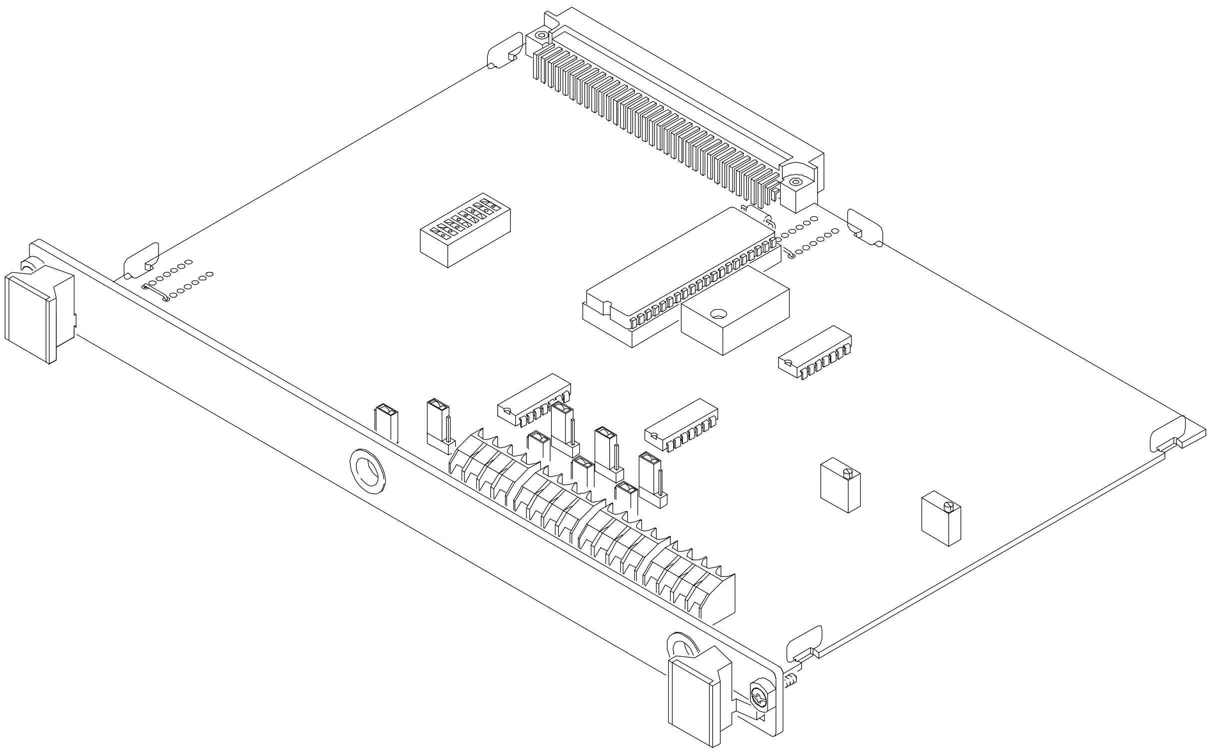

Figure 1-1. Agilent E1332A Counter/Totalizer

Safety Considerations

This product is a Safety Class I instrument that is provided with a protective earth terminal when installed in the mainframe. The mainframe, counter, and all related documentation should be reviewed for familiarization with safety markings and instructions before operation or service.

Refer to the WARNINGS on page 4 of this manual for a summary of safety information. Safety information for preventive maintenance, testing, adjusting, and service follows and is also found throughout this manual.

WARNINGS and CAUTIONS

This section contains WARNINGS which must be followed for your protection and CAUTIONS which must be followed to avoid damage to the equipment when performing instrument maintenance or repair.

WARNING

SERVICE-TRAINED PERSONNEL ONLY. The information in this manual is for service-trained personnel who are familiar with electronic circuitry and are aware of the hazards involved. To avoid personal injury or damage to the instrument, do not perform procedures in this manual or do any servicing unless you are qualified to do so.

CHECK MAINFRAME POWER SETTINGS. Before applying power, verify that the mainframe setting matches the line voltage and that the correct fuse is installed. An uninterruptible safety earth ground must be provided from the main power source to the mainframe input wiring terminals, power cord, or supplied power cord set.

GROUNDING REQUIREMENTS. Interruption of the protective (grounding) conductor (inside or outside the mainframe) or disconnecting the protective earth terminal will cause a potential shock hazard that could result in personal injury. (Grounding one conductor of a two-conductor outlet is not sufficient protection.)

COMMON GROUND. Verify that a common ground exists between the unit under test and the counter (via the mainframe) prior to energizing either unit.

IMPAIRED PROTECTION. Whenever it is likely that instrument protection has been impaired, the mainframe must be made inoperative and be secured against any unintended operation.

REMOVE POWER IF POSSIBLE. Some procedures in this manual may be performed with power supplied to the mainframe while protective covers are removed. Energy available at many points may, if contacted, result in personal injury. (If maintenance can be performed without power applied, the power should be removed.)

USING AUTOTRANSFORMERS. If the mainframe is to be energized via an autotransformer (for voltage reduction) make sure the common terminal is connected to neutral (that is, the grounded side of the main's supply).

WARNING **CAPACITOR VOLTAGES. Capacitors inside the mainframe may remain charged even when the mainframe has been disconnected from its source of supply.**

USE PROPER FUSES. For continued protection against fire hazard, replace the line fuses only with fuses of the same current rating and type (such as normal blow, time delay, etc.). Do not use repaired fuses or short-circuited fuseholders.

CAUTION **Static electricity is a major cause of component failure. To prevent damage to the electrical components in the counter, observe anti-static techniques whenever working on the counter.**

Counter Description

The Agilent E1332A counter is an "instrument" in the slots of a VXIbus mainframe. As such, it is assigned an error queue, input and output buffers, status registers, and is allocated a portion of mainframe memory for reading storage.

NOTE Instruments are based on the logical addresses of the plug-in modules. Refer to the configuration guide provided with your system for information on setting the addresses to create an instrument.

Counter Specifications

Counter specifications are listed in Appendix A of the *Agilent E1332A User's Manual*. These specifications are the performance standards or limits against which the instrument may be tested.

Counter Serial Numbers

Counters covered by this manual are identified by a serial number prefix listed on the title page. Agilent Technologies uses a two-part serial number in the form XXXXAYYYYY, where XXXX is the serial prefix, A is the country of origin (A=USA), and YYYYY is the serial suffix. The serial number prefix identifies a series of identical instruments. The serial number suffix is assigned sequentially to each instrument.

Counter Options

There are no electrical or mechanical options available for the Agilent E1332A counter. However, you can order Option 1BN which provides a MIL-STD-45662A Calibration Certificate, or Option 1BP which provides the Calibration Certificate and measurement data. Contact your nearest Agilent Technologies Sales and Service Office for information on Options 1BN and 1BP.

Recommended Test Equipment

Table 1-1 lists the test equipment recommended for testing, adjusting, and servicing the counter. Essential requirements for each piece of test equipment are described in the Requirements column.

Table 1-1. Recommended Test Equipment

Instrument	Requirements	Recommended Model	Use*
Controller, GPIB	GPIB compatibility as defined by IEEE Standard 488-1978 and the identical ANSI Standard MC1.1: SH1, AH1, T2, TE0, L2, LE0, SR0, RL0, PP0, DC0, DT0, and C1, 2, 3, 4, 5	HP Series 300 or IBM compatible PC with BASIC	A,O,F, P,T
Mainframe	Compatible with counter	Agilent E1300B, E1301B, E1302A, or E1401B/T, E1421A (requires E1405A)	A,O,F, P,T
Function Generator	Frequency Range 10 Hz to 4 MHz Voltage Range 50 mV to 5 V (p-p) Functions: sine, square, triangle wave	Agilent 3325A/B (requires 50 ohm termination)	A,O,F, P,T
DC Standard	Voltage Range -2.84 V to +28.2 V	Datron 4708 with Option 10	F,T
Universal Counter	Frequency Range 10 MHz	Agilent 5334B	A
Oscilloscope	General Purpose	Agilent 54111D	A,T
Digital Multimeter	General Purpose Voltage and Resistance	Agilent 3458A	T

* M = Preventive Maintenance, F = Functional Verification, O = Operation Verification Tests, P = Performance Verification Tests, A = Adjustments, T = Troubleshooting

Chapter 2
Installation

Introduction

This chapter provides information for installing the Agilent E1332A counter, including:

- initial inspection
- preparation for use
- environment
- storage and shipping

Initial Inspection

Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, keep the container until the shipment contents have been checked and the instrument has been checked mechanically and electrically. See Chapter 4 for procedures to check electrical performance.

WARNING **To avoid possible hazardous electrical shock, do not perform electrical tests if there are signs of shipping damage to any portion of the outer enclosure (covers, panels, etc.).**

If the contents are incomplete, if there is mechanical damage or defect, or if the instrument does not pass the electrical performance tests, notify your nearest Agilent Technologies Sales and Service Office. If the shipping container is damaged or the cushioning material shows signs of stress, notify the carrier as well as Agilent Technologies, and keep the shipping materials for the carrier's inspection.

Preparation for Use

See Chapter 2 of the *Agilent E1332A User's Manual* to prepare the Agilent E1332A counter for use. See the appropriate mainframe user's manual to prepare your mainframe. If your mainframe is not manufactured by Agilent Technologies, consult the manufacturer for a list of available manuals.

The recommended operating environment for the Agilent E1332A counter is 0^{o}C to $+55^{o}$C with humidity <65% relative (0^{o}C to $+40^{o}$C). The instrument should be stored in a clean, dry environment. For storage and shipment, the temperature range is -40^{o}C to $+75^{o}$C, with humidity <65% relative (0^{o}C to $+40^{o}$C).

Shipping the Counter

If you need to return the Agilent E1332A counter to Agilent Technologies, first remove any adapters or connectors before packaging the instrument for shipment. When you return the instrument to Agilent Technologies, attach a tag to the instrument identifying the owner and indicating service or repair required. In any correspondence, refer to the instrument by model number and full serial number.

When shipping the instrument, we recommend using containers and materials identical to those used in factory packaging, which are available through Agilent Technologies Sales and Service Offices. Mark the shipping container "FRAGILE" to assure careful handling.

If you use other (commercially available) shipping materials, wrap the instrument in heavy paper or plastic. Use a strong shipping container.
A double-wall carton of 2.4 MPa (350 psi) test material is adequate.

Use enough shock-absorbing material (75 to 100 mm layer; 3 to 4 inches) around all sides of the instrument to provide a firm cushion and prevent movement in the container. Protect the front panel with cardboard. Seal the shipping container securely and mark the container "FRAGILE" to assure careful handling.

Chapter 3
Operating Instructions

Introduction

This chapter lists operating information for the Agilent E1332A counter, including:

- Counter operation
- Preventive maintenance
- Operator’s check (self-test)

Counter Operation

See the *Agilent E1332A User’s Manual* for counter operation, including:

- Getting started
- Configuring the counter
- Using the counter
- Understanding the counter
- Counter command reference
- Counter specifications
- Counter error messages
- Register-based programming

Preventive Maintenance

Preventive maintenance for the Agilent E1332A counter consists of periodically cleaning the counter and then running the Operator’s Check (***TST?** command). For best results, you should clean the counter once a year, or more often if the counter is used in a very dusty or very humid area. See Table 3-1 for recommended cleaning equipment and supplies.

Table 3-1. Recommended Cleaning Equipment

Description	Recommended Use
Soft-bristle brush	Remove dust from printed circuit board
Mild soap solution	Clean faceplate panel
Lint-free cloth	Clean faceplate panel

WARNINGS and CAUTIONS

WARNING **To eliminate possible electrical shock, disconnect AC power from the mainframe and disconnect all inputs to the multimeter before removing the counter from the mainframe.**

CAUTION **The counter printed circuit assembly (PCA) contains static-sensitive devices that can be damaged when handling. Use static control devices (wrist straps, static mats, etc.) when handling the instrument. See Chapter 7, "Service," for electrostatic discharge (ESD) precautions.**

CAUTION **Do not use a vacuum cleaner to remove dust from the counter PCA, as these assemblies have static-sensitive devices that can be damaged by a vacuum cleaner.**

Cleaning Procedure

Use the following procedure to clean the counter. See Figure 3-1 for contact and cable locations.

1. Disconnect any user wiring connected to the counter input terminals.
2. Using a soft-bristle brush, remove dust from the PCA surfaces.
3. Clean all contacts as indicated in Figure 3-1.
4. Clean the Agilent E1332A counter faceplate panel using a lint-free cloth.
5. Reconnect user wiring to the counter input terminals.

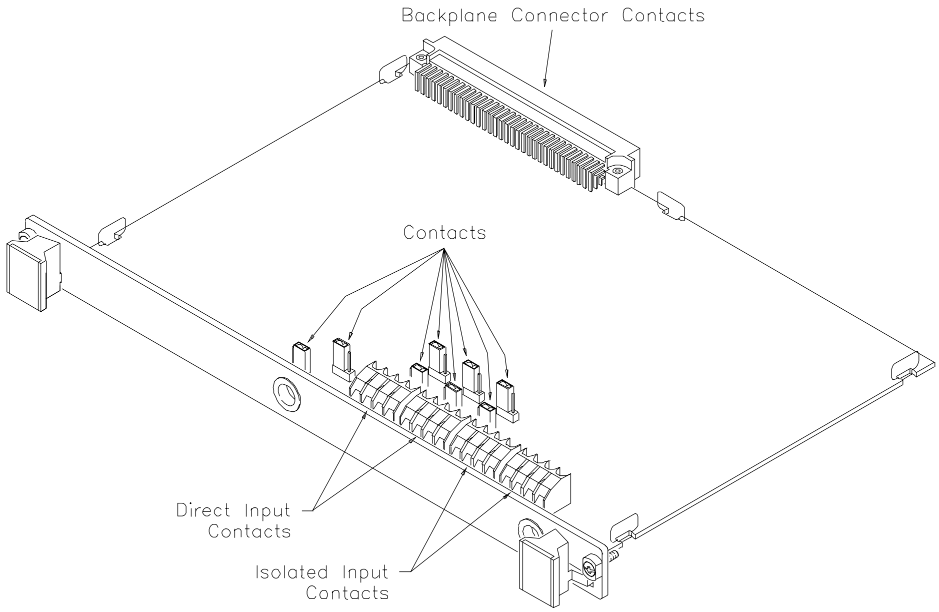

Figure 3-1. Cleaning the Agilent E1332A Counter

Operator’s Check

The Operator’s Check for the Agilent E1332A counter consists of sending the self-test (***TST?**) command and checking the response. The operator’s check can be used at any time to verify that the counter is connected properly and is responding to the self-test command.

As required, see the mainframe user’s manual for information on address selection. See the *Agilent E1332A User’s Manual* for information on counter SCPI commands.

Self-Test Procedure

1. Verify that the counter is properly installed in the mainframe and that the mainframe has passed its power-on test.
2. Execute the counter functional test using the ***TST?** command (see example following).
3. A "0" returned means no self-test failure, while any other number returned means a failure was detected. See Chapter 7, "Service," for troubleshooting information.

NOTE All pull-up jumpers must be in the "NO PULL-UP" position, or the counter will fail its self-test.

Example: Counter Self-Test

An example follows which uses an HP 9000 Series 300 computer with BASIC and a counter address of 70906.

```
10   OUTPUT 70906;"*TST?"          !Send the self-test command
20   ENTER 70906;A                 !Enter self-test result
30   PRINT A
40    END
```

Chapter 4
Verification Tests

Introduction

The three levels of test procedures described in this chapter are used to verify that the Agilent E1332A Counter:

- is fully functional (Functional Verification)
- meets selected testable specifications (Operation Verification)
- meets all testable specifications (Performance Verification)

WARNING **Do not perform any of the following verification tests unless you are a qualified, service-trained technician and have read the WARNINGS and CAUTIONS in Chapter 1.**

Test Conditions and Procedures

See Table 1-1 for test equipment requirements. If you are using an Agilent 3325 Function Generator (or another source that requires a 50 ohm load), you should connect a 50-ohm feed-through termination at the output of the source. Otherwise, the actual voltage output seen by the counter will be approximately twice as high as expected.

For best accuracy, the ambient temperature of the test area should be between 18^{o}C and 28^{o}C and stable to within $\pm 1^{o}$C. You should complete the Performance Verification tests at least once a year. For heavy use or severe operating environments, perform the tests more often.

The verification tests assume that the person performing the tests understands how to operate the mainframe, the counter, and specified test equipment. The test procedures do not specify equipment settings for test equipment, except in general terms. It is assumed a qualified, service-trained technician will select and connect the cables, adapters, and probes required for the test.

Performance Test Record

The results of each Performance Verification test may be recorded in Table 4-1, "Agilent E1332A Performance Test Record." You may make a photocopy of this form, if desired.

The value in the "Measurement Uncertainty" column of Table 4-1 is derived from the specifications for the source used for the test, and represents the expected accuracy of the source. The value in the "Test Accuracy Ratio (TAR)" column of Table 4-1 is the ratio of counter accuracy to measurement uncertainty, rounded to the nearest integer.

Verification Test Examples

Each verification test procedure includes an example program that performs the test. All example programs assume a counter address of 70906, and are written for an HP 9000 Series 200/300 computer running BASIC.

As required, see the mainframe user's manual for information on address selection and cabling guidelines. See the *Agilent E1332A User's Manual* for information on counter Standard Commands for Programmable Instruments (SCPI commands).

Functional Verification Test

The procedures in this section are used to quickly verify that the counter is operating correctly. These tests are not required before performing Operation Verification or Performance Verification.

The recommended Functional Verification sequence includes the Self-test, the Isolated Inputs test, the Non-isolated Inputs test, and the Up/Down Counting test. Other tests included in this section are optional, and are intended primarily for troubleshooting.

Self-test

The purpose of this test is to verify communication with the mainframe, the external controller, and/or the external terminal by performing a self-test. The self-test also checks the counter's trigger level circuitry and performs an internal check of the frequency, period, and totalize functions.

Test Procedure

1. Verify that the counter is correctly installed in the mainframe. No external signals should be connected to the inputs of the counter.

2. On the mainframe, connect a power cable and set the power to ON. Verify that the mainframe performs a proper power-up sequence. See the mainframe user's manual for additional information.

3. Execute the counter self-test using the ***TST?** command.

4. Allow approximately 10 seconds for the test to complete.
   - If a 0 is returned, then no failure was encountered.
   - If any number other than 0 is returned, then a failure was detected. See Chapter 7 for troubleshooting information.

NOTE All pull-up jumpers must be in the "NO PULL-UP" position, or the counter will fail its self-test.

Example: Self-Test

```
10  OUTPUT 70906;"*TST?"        !Send the self-test command
20  ENTER 70906;A               !Read the result
30  PRINT A
40  END
```

Isolated Input Test

This test verifies the operation of all four isolated inputs. Each channel will totalize a 1 Hz signal and a 4 MHz signal.

Equipment Setup

1. Connect the equipment as shown in Figure 4-1.

2. Set the Function Generator controls as follows:
   - Function .... Squarewave
   - Frequency .... 1 Hz
   - DC Offset .... 2.5 V
   - Output .... 5 V p-p

NOTE These settings produce a square wave with lower edge at 0 V and upper edge at +5 V.

---

3. Set up the Agilent E1332A as follows:
   - Reset counter .... ***RST**
   - Isolated inputs .... **INP:ISOL ON**

4. Configure the Agilent E1332A for totalizing on all four channels:
   - Channel 1 to totalize **CONF1:TOT**
   - Repeat for channels 2, 3, and 4

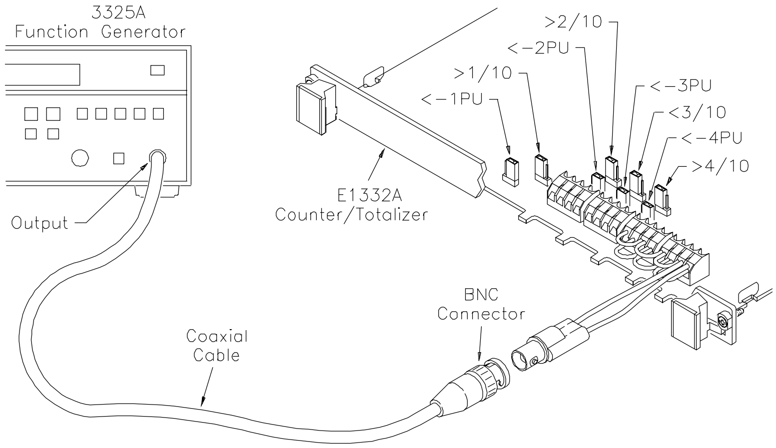

Figure 4-1. Isolated Inputs Test Setup

Test Procedure

1. Begin totalizing:
   - Channel 1 .... **INIT1**
   - Repeat for channels 2, 3, and 4
2. Execute the following commands in a continuous loop:
   - Channel 1 .... **FETC1?**
   - Channel 2 .... **FETC2?**
   - Channel 3 .... **FETC3?**
   - Channel 4 .... **FETC4?**
3. Verify that all channels are totalizing properly.
4. Set input frequency to 4 MHz. Verify that all channels are totalizing properly.

Example: Isolated Inputs Test

```
10  ON KBD GOTO 180
20  DISP "Press any key to exit."
30  OUTPUT 70906;"*RST"                          !Reset counter
40  OUTPUT 70906;"INP:ISOL ON"                   !Select isolated inputs
50  FOR Channel=1 to 4
60    OUTPUT 70906;"CONF"&VAL$(Channel)&":TOT"   !Select Totalize function
70    OUTPUT 70906;"INIT"&VAL$(Channel)          !Initiate measurement
```

(Continued on next page.)

```
80   NEXT Channel
90   !
100 Startloop:   !
110   FOR Channel=1 to 4
120      OUTPUT 70906;"FETC"&VAL$(Channel)&"?"   !Fetch the reading
130      ENTER 70906;Reading(Channel)             !Transfer result to computer
140      PRINT TABXY(1,8+Channel);"Channel";Channel;"reading = ";Reading(channel)
150   NEXT Channel
160   GOTO Startloop
170   !
180   CLEAR SCREEN
190   END
```

Non-isolated Input Test

This test verifies the operation of all four non-isolated inputs. Each channel will totalize a 1 Hz signal and a 4 MHz signal.

Equipment Setup

1. Connect the equipment as shown in Figure 4-2.
2. Set the Function Generator controls as follows:
   - Function .... Sinewave
   - Frequency .... 1 Hz
   - DC Offset .... 0 V
   - Output .... 25 mV rms

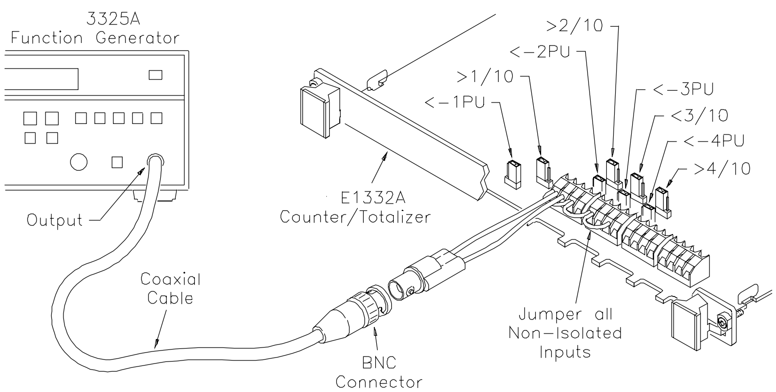

Figure 4-2. Non-Isolated Inputs Test Setup

3. Set up the Agilent E1332A as follows:
   - Reset the counter .... ***RST**

4. Configure the Agilent E1332A to totalize on all four channels:
   - Channel 1 to totalize **CONF1:TOT**
   - Repeat for channels 2, 3, and 4

Test Procedure

1. Begin totalizing:
   - Channel 1 .... **INIT1**
   - Repeat for channels 2, 3, and 4

2. Execute the following commands in a continuous loop:
   - Channel 1 .... **FETC1?**
   - Channel 2 .... **FETC2?**
   - Channel 3 .... **FETC3?**
   - Channel 4 .... **FETC4?**

3. Verify that all channels are totalizing properly.

4. Change input to a 4 MHz, 50 mV rms sinewave. Verify that all channels are totalizing properly.

Example: Non-Isolated Inputs Test

```
10     ON KBD GOTO 170
20     DISP "Press any key to exit."
30     OUTPUT 70906;"*RST"                    !Reset counter
40     FOR Channel=1 to 4
50         OUTPUT 70906;"CONF"&VAL$(Channel)&":TOT"
                                              !Select Totalize function
60         OUTPUT 70906;"INIT"&VAL$(Channel)!Initiate measurement
70     NEXT Channel
80     !
90   Startloop:   !
100  FOR Channel=1 to 4
110      OUTPUT 70906;"FETC"&VAL$(Channel)&"?"   !Fetch the reading
120      ENTER 70906;Reading(Channel)          !Transfer result to computer
130      PRINT TABXY(1,8+Channel);"Channel";Channel;"reading = 
";Reading(channel)
140    NEXT Channel
150    GOTO Startloop
160    !
170    CLEAR SCREEN
180    END
```

Up/Down Count Test

This test verifies the up/down counting function on channel pairs 1/2 and 3/4. After the measurement is initiated:

- the count will increment when only channel 1 (or only channel 3) is connected to the source
- the count will not change when both channels of a channel pair are connected
- the count will decrement when only channel 2 (or only channel 4) is connected to the source

Equipment Setup

1. Connect the equipment as shown in Figure 4-3 (begin with only channel 1 connected to the source).

2. Set the Function Generator controls as follows:
   - Function .... Squarewave
   - Frequency .... 1 MHz
   - DC Offset .... 0 V
   - Output .... 100 mV rms

3. Set up the counter as follows:
   - Reset the counter .... ***RST**
   - Channel pair 1/2 .... **CONF1:UDC**
   - Channel pair 3/4 .... **CONF3:UDC**

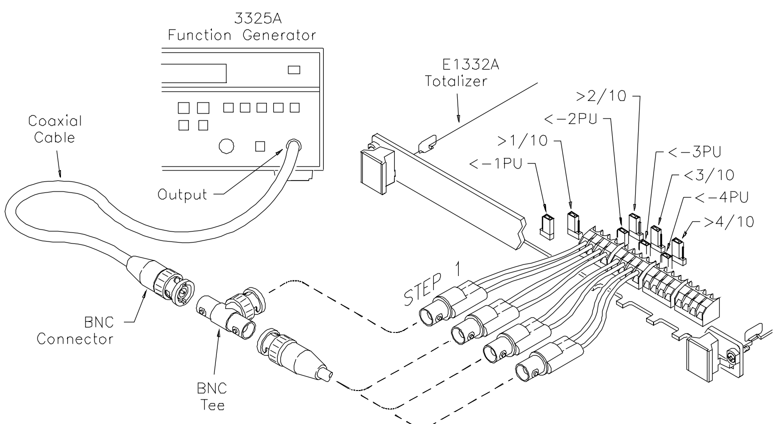

Figure 4-3. Up/Down Counting Test Setup

Test Procedure

1. Initiate measurements:
   - Channel pair 1/2 .... **INIT1**
   - Channel pair 3/4 .... **INIT3**

2. Execute the following commands in a continuous loop:
   - Channel pair 1/2 .... **FETC1?**
   - Channel pair 3/4 .... **FETC3?**

3. For channel pair 1/2, verify that the count increments when only channel 1 is connected to the source, decrements when only channel 2 is connected, and does not change when channels 1 and 2 are both connected.

4. Repeat step 3 for channel pair 3/4, substituting channel 3 for channel 1, and channel 4 for channel 2.

Example: Up/Down Counting Test

```
10    ON KBD GOTO 170
20    DISP "Press any key to exit."
30    OUTPUT 70906;"*RST"             !Reset counter
40    OUTPUT 70906;"CONF1:UDC"        !Select Up/Down Count function
50    OUTPUT 70906;"CONF3:UDC"
60    OUTPUT 70906;"INIT1"            !Initiate measurement
70    OUTPUT 70906;"INIT3"
80    !
90  Startloop:   !
100   FOR Channel=1 TO 3 STEP 2
110      OUTPUT 70906;"FETC"&VAL$(Channel)&"?"  !Fetch the reading
120      ENTER 70906;Reading(Channel)  !Transfer result to computer
130      PRINT TABXY(1,8+Channel);"Channel";Channel;"-Channel";
Channel+1;"=";Reading(Channel)
140   NEXT Channel
150   GOTO Startloop
160    !
170   CLEAR SCREEN
180   END
```

Trigger Polarity Test (Optional)

This test verifies positive and negative trigger polarities on all four channels. The pull-up jumpers are used to increment each channel by one count at a time.

Equipment Setup

1. Configure the counter as shown in Figure 4-4. Remove all four pull-up jumpers.

2. Set up the Agilent E1332A as follows:

   – Reset counter .... ***RST**
   – Ch. 1/2 trig level to 2.5V **SENS1:EVEN:LEV 2.5**
   – Ch. 3/4 trig level to 2.5V **SENS3:EVEN:LEV 2.5**
   – Low-pass filter to ON .... **INP:FILT ON**
   – Low-pass filter to 4 Hz .... **INP:FILT:FREQ 4**

3. Configure the Agilent E1332A to totalize on all four channels:

   – Channel 1 to totalize **CONF1:TOT**
   – Repeat for channels 2, 3, and 4

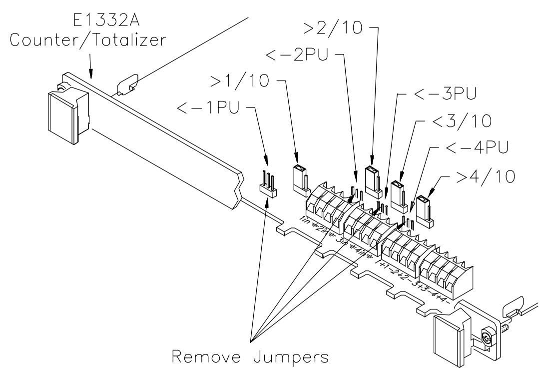

Figure 4-4. Trigger Polarity Test Setup

Test Procedure

1. Begin totalizing:

   – Channel 1 .... **INIT1**
   – Repeat for channels 2, 3, and 4

2. Execute the following commands in a continuous loop:

   – Channel 1 .... **FETC1?**
   – Channel 2 .... **FETC2?**
   – Channel 3 .... **FETC3?**
   – Channel 4 .... **FETC4?**

3. Install (in the left-most pins) and remove pull-up jumper 1PU several times, verifying that the count increments when the jumper is installed, and does not increment when the jumper is removed.

4. Repeat for channel 2 (jumper 2PU), channel 3 (jumper 3PU), and channel 4 (jumper 4PU).

5. Set all four channels to trigger on the negative edge:
   – Channel 1 .... **SENS1:EVEN:SLOP NEG**
   – Repeat for channels 2, 3, and 4

6. Repeat steps 1 through 4. This time, verify that the count increments when the jumper is removed, and does not increment when the jumper is installed.

Example: Trigger Polarity Test

```
10   ON KBD GOTO 320
20   OUTPUT 70906;"*RST"                    !Reset counter
30   OUTPUT 70906;"SENS1:EVEN:LEV 2.5"  !Set trigger levels to 2.5 V
40   OUTPUT 70906;"SENS3:EVEN:LEV 2.5"
50   OUTPUT 70906;"INP:FILT ON"             !Turn input filter ON
60   OUTPUT 70906;"INP:FILT:FREQ 4"         !Set cut-off frequency to 4 Hz
70   FOR I=1 TO 2
80    CLEAR SCREEN
90     IF I=1 THEN
100       PRINT "Polarity:  Positive"
110       PRINT "Count should increment when jumper is INSTALLED on
left-most pins."
120       DISP "Press any key to move on to negative polarity."
130    ELSE
140       PRINT "Polarity:  Negative"
150       PRINT "Count should increment when jumper is REMOVED from
left-most pins."
160      DISP "Press any key to exit."
170    END IF
180    FOR Channel=1 to 4
190       IF I=2 THEN OUTPUT 70906;"SENS"&VAL$(Channel)&
":EVEN:SLOP NEG"                             !Negative trigger slope
200       OUTPUT 70906;"CONF"&VAL$(Channel)&":TOT"
                                             !Select Totalize function
210       OUTPUT 70906;"INIT"&VAL$(Channel)!Initiate measurement
220    NEXT Channel
230    !
240 Startloop:  !
250      FOR Channel=1 TO 4
260         OUTPUT 70906;"FETC"&VAL$(Channel)&"?" !Fetch the reading
270         ENTER 70906;Reading(Channel)      !Transfer result to computer
```

(Continued on next page.)

```
280        PRINT TABXY(1,8+Channel);"Channel";Channel;"count = ";Reading(Channel)
290     NEXT Channel
300     GOTO Startloop
310     !
320  NEXT I
330  CLEAR SCREEN
340  END
```

Gated Totalizing Test (Optional)

This test verifies the gated totalizing function on both channel pairs. The pull-up jumpers for channels 2 and 4 are used as gates for channels 1 and 3, respectively. Positive and negative gate polarities are tested.

Equipment Setup

1. Connect the equipment as shown in Figure 4-5. Remove the pull-up jumpers for channels 2 and 4.

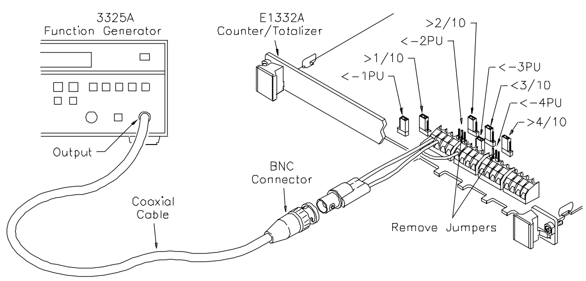

Figure 4-5. Gated Totalizing Test Setup

2. Set the Function Generator controls as follows:
   - Function .... Squarewave
   - Frequency .... 1 KHz
   - DC Offset .... 2.5 V
   - Output .... 5 V p-p

NOTE These settings produce a square wave with lower edge at 0 V and upper edge at +5 V.

---

3. Set up the Agilent E1332A as follows:
   - Reset counter .... ***RST**
   - Ch. 1/2 trig level to 2.5V **SENS1:EVEN:LEV 2.5**
   - Ch. 3/4 trig level to 2.5V **SENS3:EVEN:LEV 2.5**
   - Channel 1 to totalize **CONF1:TOT**
   - Channel 3 to totalize **CONF3:TOT**
   - Channel 2 gate to ON .... **SENS2:TOT:GATE ON**
   - Channel 4 gate to ON .... **SENS4:TOT:GATE ON**

Test Procedure

1. Begin totalizing:
   - Channel pair 1/2 .... **INIT1**
   - Channel pair 3/4 .... **INIT3**
2. Execute the following commands in a continuous loop:
   - Channel pair 1/2 .... **FETC1?**
   - Channel pair 3/4 .... **FETC3?**
3. Install (in the left-most pins) and remove pull-up jumper 2PU several times, verifying that the channel 1 count increments when the jumper is installed, and does not increment when the jumper is removed.
4. Repeat for channel pair 3/4, substituting channel 3 for channel 1, and channel 4 for channel 2.
5. Set the gate polarities to negative:
   - Channel 2 .... **SENS2:TOT:GATE:POL INV**
   - Channel 4 .... **SENS4:TOT:GATE:POL INV**
6. Repeat steps 1 through 4. This time, verify that the count increments when the corresponding jumper is removed, and does not increment when the jumper is installed.

Example: Gated Totalizing Test

```
10  ON KBD GOTO 300
20  OUTPUT 70906;"*RST"                              !Reset counter
30  FOR I=1 TO 3 STEP 2
40    OUTPUT 70906;"SENS"&VAL$(Channel)&":EVEN:LEV 2.5"
                                                     !Set trigger levels to 2.5V
50    OUTPUT 70906;"CONF"&VAL$(Channel)&":TOT"
                                                     !Select Totalize function
60    OUTPUT 70906;"SENS"&VAL$(Channel+1)&":TOT:GATE ON"
                                                     !Set gate to ON
```

(Continued on next page.)

```
70   NEXT Channel
80   FOR I=1 TO 2
90     CLEAR SCREEN
100    IF I=1 THEN
110       PRINT "Channels 2 and 4 gate polarities:  positive"
120       DISP "Press any key to move on to negative polarity."
130    ELSE
140       OUTPUT 70906;"SENS2:TOT:GATE:POL INV"     !Gate polarity to negative
150       OUTPUT 70906;"SENS4:TOT:GATE:POL INV"
160       PRINT "Channels 2 and 4 gate polarities:  negative"
170      DISP "Press any key to exit."
180    END IF
190    OUTPUT 70906;"INIT1"                 !Initiate measurement
200    OUTPUT 70906;"INIT3"
210    !
220 Startloop:  !
230     FOR Channel=1 TO 3 STEP 2
240       OUTPUT 70906;"FETC"&VAL$(Channel)&"?"  !Fetch the reading
250       ENTER 70906;Reading(Channel)      !Transfer result to computer
260       PRINT TABXY(1,8+Channel);"Channel";Channel;"reading = ";Reading(Channel)
270    NEXT Channel
280    GOTO Startloop
290    !
300 NEXT I
310 CLEAR SCREEN
320 END
```

Input Filter Test Procedure (Optional)

This test verifies the operation of the digital low-pass filter on all four channels. Each channel will perform totalizing measurements at cutoff frequencies of 4 Hz, 512 Hz, 8 KHz, 32 KHz, 64 KHz, and 131 KHz to verify pass/rejection points.

Equipment Setup

1. Connect the equipment as shown in Figure 4-6.
2. Set the Function Generator controls as follows:
   - Function .... Squarewave
   - Frequency (pass frequency) .... 4.5 Hz
   - Offset .... 0 V
   - Output .... 50 mV rms

3. Set up the Agilent E1332A as follows:
   - Reset counter .... ***RST**
   - Low-pass filter to ON .... **INP:FILT ON**

4. Configure the Agilent E1332A to totalize on all four channels:
   - Channel 1 to totalize **CONF1:TOT**
   - Repeat for channels 2, 3, and 4.

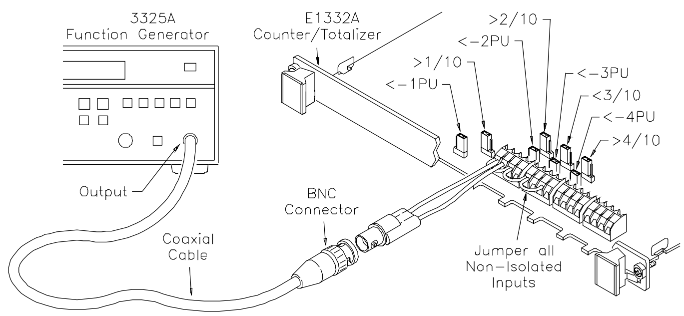

Figure 4-6. Input Filter Test Setup

Test Procedure

1. Set Agilent E1332A filter cut-off frequency:
   - Low-pass filter to 4 Hz .... **INP:FILT:FREQ 4**

2. Begin totalizing:
   - Channel 1 .... **INIT1**
   - Repeat for channels 2, 3, and 4.

3. Execute the following commands in a continuous loop:
   - Channel 1 .... **FETC1?**
   - Channel 2 .... **FETC2?**
   - Channel 3 .... **FETC3?**
   - Channel 4 .... **FETC4?**

4. Verify that all four channels are incrementing.

5. Change input frequency to 6.82 Hz (reject frequency).

6. Verify that all four channels are not incrementing.

7. Repeat steps 1 through 6 using the frequencies in the following table.

E1332A Low Pass Filter Frequency	Function Generator Frequency	
	Pass	Reject
4 Hz 512 Hz 8 KHz 32 KHz 64 KHz 131KHz	4.5 Hz 549 Hz 9 KHz 34.2 KHz 67.5 KHz 125.1 KHz	6.82 KHz 880 KHz 14.3 KHz 55 KHz 102.8 KHz 209 KHz

Example: Input Filter Test

```
10   OPTION BASE 1
20   DIM Fc(6),Fp(6),Fr(6)
30   ON KBD GOTO 330
40   !
50   DATA 4,512,8000,32000,64000,131000
60   DATA 4.5,549,9000,34200,67500,125100
70   DATA 6.82,880,14300,55000,102800,209000
80   READ Fc(*)
90   READ Fp(*)
100  READ Fr(*)
110  !
120  OUTPUT 70906;"*RST"                         !Reset counter
130  OUTPUT 70906;"INP:FILT ON"                  !Turn input filter on
140  FOR I=1 TO 6
150     DISP "Press any key to move on."
160    OUTPUT 70906;"INP:FILT:FREQ ";Fc(I)       !Set cut-off frequency
170    PRINT TABXY(1,1);"Filter cut-off frequency:  ";Fc(I);"Hz"
180    PRINT TABXY(1,3);"Pass frequency:  ";Fp(I);"Hz"
190    PRINT TABXY(1,4);"Reject frequency:  ";Fr(I);"Hz"
200    FOR Channel=1 TO 4
210       OUTPUT 70906;"CONF"&VAL$(Channel)&":TOT"
                                                 !Select Totalize function
220       OUTPUT 70906;"INIT"&VAL$(Channel)      !Initiate measurement
230    NEXT Channel
240    !
250 Startloop:   !
260   FOR Channel=1 TO 4
270     OUTPUT 70906;"FETC"&VAL$                 !Fetch the reading
         (Channel)&"?"
```

(Continued on next page.)

```
280       ENTER 70906;Reading(Channel)  !Transfer result to computer
290       PRINT TABXY(1,8+Channel);"Channel";Channel;"reading = 
";Reading(Channel)
300    NEXT Channel
310    GOTO Startloop
320     !
330 NEXT I
340 CLEAR SCREEN
350 END
```

Trigger Level Test (Optional)

This test verifies trigger level operation for all four channels. Four trigger levels will be tested.

Equipment Setup

1. Connect the equipment as shown in Figure 4-7.

2. Set up the Agilent E1332A as follows:
   - Reset counter .... ***RST**
   - Low-pass filter to ON .... **INP:FILT ON**
   - Low-pass filter to 4 Hz .... **INP:FILT:FREQ 4**

3. Configure the Agilent E1332A to totalize on all four channels:
   - Channel 1 .... **CONF1:TOT**
   - Repeat for channels 2, 3, and 4

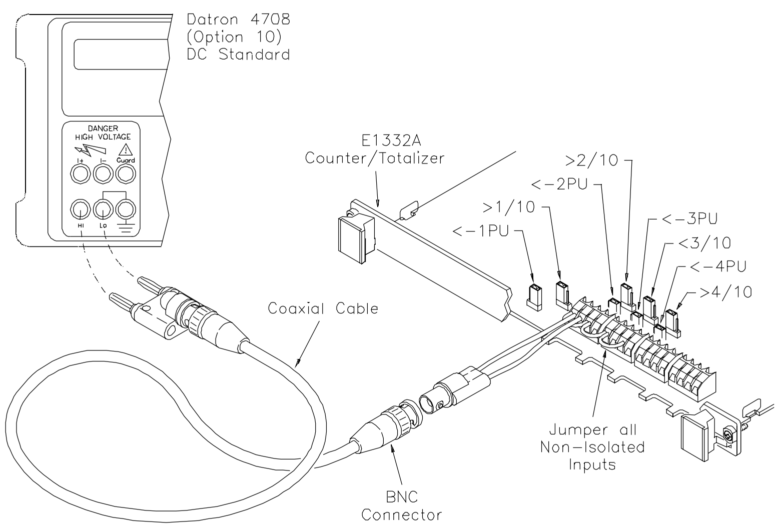

Figure 4-7. Trigger Level Test Setup

Test Procedure

1. Set Agilent E1332A trigger levels:
   - Ch. 1/2 trig lev to -2.56V .... **SENS1:EVEN:LEV -2.56**
   - Ch. 3/4 trig lev to -2.56V..... **SENS3:EVEN:LEV -2.56**

2. Begin totalizing:
   - Channel 1 .... **INIT1**
   - Repeat for channels 2, 3, and 4

3. Execute the following commands in a continuous loop:
   - Read channel 1 .... **FETC1?**
   - Read channel 2 .... **FETC2?**
   - Read channel 3 .... **FETC3?**
   - Read channel 4 .... **FETC4?**

4. Set the DC Supply to -2.84 Vdc.

5. Increase the supply voltage to -2.28 Vdc. Verify that all four channels increment. Incrementing by more than one count is not a problem.

6. Repeat steps 1 through 5 using the values in the following table:

E1332A Trigger Level	Supply voltage below trigger level	Supply voltage above trigger level
-2.56 V 0 V +2.54 V	-2.84 V -0.02 V +2.26 V	-2.28 V +0.02 V +2.82 V

7. Set all four input level jumpers to the /10 position (right-most pins). This must be completed before continuing, because the higher voltages used in the following steps will damage the inputs at their normal level.

CAUTION **This must be completed before continuing, because the higher voltages used in the following steps will damage the inputs at their normal level.**

8. Set trigger levels to +2.54 V. With the input level at /10, this causes the counter to trigger at +25.4 V.
   - Ch. 1/2 trig level **SENS1:EVEN:LEV 2.54**
   - Ch. 3/4 trig level **SENS3:EVEN:LEV 2.54**

9. Repeat steps 2 through 5, using 22.6 Vdc as the low voltage and 28.2 Vdc as the high voltage.

10. Set the supply voltage to 0 V, THEN place the input level jumpers in the normal position (left-most pins). Do not move the input level jumpers while the inputs are connected to >5 V.

Example: Trigger Level Test

```
10   OPTION BASE 1
20   DIM Trig_lev(4),Low(4),High(4)
30   DATA -2.56,0,2.54,2.54
40   DATA -2.84,-.02,2.26,22.6
50   DATA -2.28,.02,2.82,28.2
60   READ Trig_lev(*)
70   READ Low(*)
80   READ High(*)
90   !
100  OUTPUT 70906;"*RST"                    !Reset counter
110  OUTPUT 70906;"INP:FILT ON"             !Turn input filter on
120  OUTPUT 70906;"INP:FILT:FREQ 4"         !Set cut-off frequency to 4 Hz
130  FOR Channel=1 TO 4
140    OUTPUT 70906;"CONF"&VAL$(Channel)&":TOT"    !Select Totalize function
150  NEXT Channel
160  FOR I=1 TO 4
170    IF I=4 THEN
180      CLEAR SCREEN
190      DISP "Move all input level jumpers to right-most pins and press 'Continue'"
200      PAUSE
210      DISP " "
220    END IF
230    OUTPUT 70906;"SENS1:EVEN:LEV ";Trig_lev(I);"V"     !Set trigger levels
240    OUTPUT 70906;"SENS3:EVEN:LEV ";Trig_lev(I);"V"
250    PRINT TABXY(1,1);"Trigger level = ";Trig_lev(I);"V   "
260    PRINT TABXY(1,4);"Procedure:"
270    PRINT TABXY(5,5);"1.  Set supply to ";Low(I);"Volts.   "
280    PRINT TABXY(5,6);"2.  Increase supply to ";High(I);"Volts.    "
290    PRINT TABXY(5,7);"3.  Verify that all channels increment."
300    FOR Channel=1 TO 4
310      OUTPUT 70906;"INIT"&VAL$(Channel)  !Initiate measurement
```

(Continued on next page.)

```
320     NEXT Channel
330     DISP "For next trigger level, press any key."
340     GOSUB Startloop                    !Call measurement subroutine
350  NEXT I
360  CLEAR SCREEN
370  PRINT "Test completed.  Set supply to 0 V, ";
380  PRINT "THEN return input level jumpers to left-most pins."
390  STOP
400  !
410 Startloop:  !
420    ON KBD GOTO 490
430     FOR Channel=1 TO 4
440         OUTPUT 70906;"FETC"&VAL$(Channel)&"?" !Fetch the reading
450         ENTER 70906;Reading(Channel)      !Transfer result to computer
460         PRINT TABXY(10,10+Channel);"Channel";Channel;"total
=";Reading(Channel);"    "
470     NEXT Channel
480     GOTO Startloop
490   RETURN
500   !
510   END
```

Operation Verification

The procedures in this section are used to provide a high confidence that the counter is meeting published specifications. The Operation Verification tests are a subset of the Performance Verification tests and are suitable for checkout after performing repairs.

Operation Verification is performed by completing the following portions of the Performance Verification tests:

Test Name	Test Points
Frequency	4 MHz, 512 msec gate time 100 KHz, 2048 msec gate time 1 KHz, 8192 msec gate time
Period Average	1 KHz, 1024 cycles 100 KHz, 16384 cycles 4 MHz, 65536 cycles
Pulse Width	All
Time Interval	All

Performance Verification

The procedures in this section are used to test the counter’s electrical performance using the specifications in Appendix A of the *Agilent E1332A User’s Manual* as the performance standards. These tests are suitable for incoming inspection, troubleshooting, and preventive maintenance.

Test 4-1: Frequency Test

This test verifies frequency measurement accuracy at 16 different gate (aperture) times. Input level sensitivity is tested indirectly by using input signals with amplitudes equal to the sensitivity limits. Channel 1 and channel 3 are tested.

Equipment Setup

1. Connect the equipment as shown in Figure 4-8.
2. Set the Function Generator controls as follows:
   - Function .... Sinewave
   - Frequency .... 4 MHz
   - DC Offset .... 0 V
   - Output .... 50 mV rms
3. Set up the Agilent E1332A as follows:
   - Reset counter .... ***RST**
   - Bus is trigger source .... **TRIG:SOUR BUS**
   - Channel 1 to frequency **SENS1:FUNC:FREQ**
   - Channel 3 to frequency **SENS3:FUNC:FREQ**

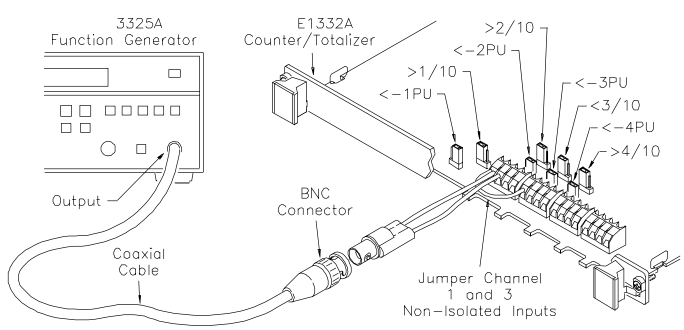

Figure 4-8. Frequency Test Setup

Test Procedure

1. Set the gate time:
   - Ch. 1 gate time to 2 ms .... **SENS1:FREQ:APER .002**
   - Ch. 3 gate time to 2 ms .... **SENS3:FREQ:APER .002**

2. Perform measurement:
   - Initiate measurement on channel 1 .... **INIT1**
   - Initiate measurement on channel 3 .... **INIT3**
   - Trigger measurements .... ***TRG**
   - Return channel 1 measurement results .... **FETC1?**
   - Return channel 3 measurement results .... **FETC3?**

3. Repeat steps 1 and 2 using the values in the following table. Verify that the results are within the limits specified in Table 4-1, "Agilent E1332A Performance Test Record. "

Function Generator		E1332A Gate Time
Frequency	**Voltage**	
4 MHz	50 mV rms	2 msec
4 MHz	50 mV rms	4 msec
4 MHz	50 mV rms	8 msec
4 MHz	50 mV rms	16 msec
4 MHz	50 mV rms	32 msec
4 MHz	50 mV rms	64 msec
4 MHz	50 mV rms	128 msec
4 MHz	50 mV rms	256 msec
4 MHz	50 mV rms	512 msec
1 MHz	25 mV rms	1.024 sec
100 KHz	25 mV rms	2.048 sec
10 KHz	25 mV rms	4.096 sec
1 KHz	25 mV rms	8.192 sec
100 Hz	25 mV rms	16.384 sec
10 Hz	25 mV rms	32.768 sec
1 MHz	25 mV rms	65.536 sec

Example: Frequency Test

```
10   OPTION BASE 1
20   DIM Freq(16),Gate_time(16)
30   DATA 4.E6,4.E6,4.E6,4.E6,4.E6,4.E6,4.E6,4.E6
40   DATA 4.E6,1.E6,1.E5,1.E4,1.E3,100,10,1.E6
50   READ Freq(*)
60   DATA .002,.004,.008,.016,.032,.064,.128,.256,.512
70   DATA 1.024,2.048,4.096,8.192,16.384,32.768,65.536
80   READ Gate_time(*)
90   !
100  OUTPUT 70906;"*RST"                  !Reset counter
110  OUTPUT 70906;"TRIG:SOUR BUS"         !Trigger from bus
120  OUTPUT 70906;"SENS1:FUNC:FREQ"       !Select Frequency
                                           function
```

(Continued on next page.)

```
130  OUTPUT 70906;"SENS3:FUNC:FREQ"
140  FOR I=1 TO 16
150    CLEAR SCREEN
160    IF I=10 THEN
170       DISP "Set source output to 25 mV rms."
180       PAUSE
190       DISP " "
200    END IF
210    PRINT TABXY(1,1);"Gate time:  ";Gate_time(I);" sec"
220    PRINT TABXY(1,2);"Set frequency to ";Freq(I);" Hz"
230    DISP "Press ’Continue’ when ready."
240    PAUSE
250    DISP " "
260    OUTPUT 70906;"SENS1:FREQ:APER ";Gate_time(I)     !Set gate
                                                          times
270    OUTPUT 70906;"SENS3:FREQ:APER ";Gate_time(I)
280    OUTPUT 70906;"INIT1"                         !Initiate measurement
290    OUTPUT 70906;"INIT3"
300    OUTPUT 70906;"*TRG"                          !Trigger measurements
310     FOR Channel=1 TO 3 STEP 2
320       OUTPUT 70906;"FETC"&VAL$(Channel)&"?" !Fetch the reading
330       ENTER 70906;Reading(Channel)              !Transfer result
                                                     to computer
340       PRINT TABXY(1,8+Channel);"Channel";Channel;"frequency
=";Reading(Channel)
350    NEXT Channel
360    DISP "Press ’Continue’ for next test point."
370    PAUSE
380  NEXT I
390  CLEAR SCREEN
400  END
```

Test 4-2: Period Average Test

This test verifies period measurement accuracy at 7 different sampling times (i.e., number of periods averaged). Channel 1 and channel 3 are tested.

Equipment Setup

1. Connect the equipment as shown in Figure 4-9.

2. Set the Function Generator controls as follows:
   - Function .... Squarewave
   - Frequency .... 1 KHz
   - DC Offset .... 0 V
   - Output .... 50 mV rms

3. Set up the Agilent E1332A as follows:
   - Reset counter .... ***RST**
   - Bus is trigger source .... **TRIG:SOUR BUS**
   - Channel 1 to period **SENS1:FUNC:PER**
   - Channel 3 to period **SENS3:FUNC:PER**

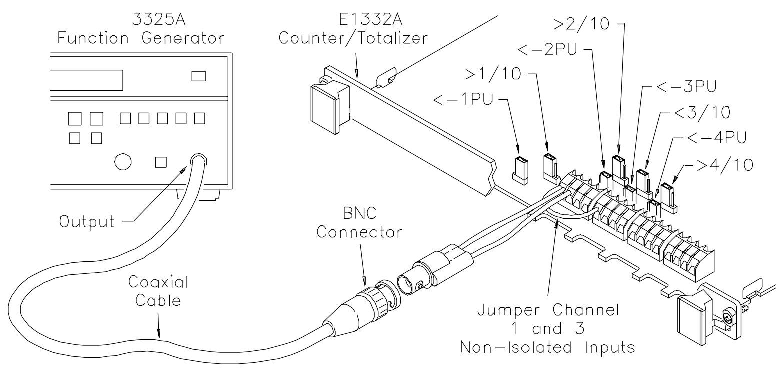

Figure 4-9. Period Average Test Setup

Test Procedure

1. Set the sampling time (number of periods averaged):
   - Ch. 1 to 1024 periods **SENS1:PER:NPER 1024**
   - Ch. 3 to 1024 periods **SENS3:PER:NPER 1024**

2. Perform measurements:
   - Initiate measurement on channel 1 .... **INIT1**
   - Initiate measurement on channel 3 .... **INIT3**
   - Trigger measurements .... ***TRG**
   - Return channel 1 measurement results .... **FETC1?**
   - Return channel 3 measurement results .... **FETC3?**

3. Repeat steps 1 and 2 using the values in the following table. Verify that the results are within the limits specified in Table 4-1, "Agilent E1332A Performance Test Record."

Function Generator		E1332A Periods Averaged
Frequency	Voltage	
1 KHz	50 mV rms	1024
1 KHz	50 mV rms	2048
1 KHz	50 mV rms	4096
10 KHz	50 mV rms	8192
100 KHz	50 mV rms	16384
1 MHz	50 mV rms	32768
4 MHz	50 mV rms	65536

Example: Period Average Test

```
10   OPTION BASE 1
20   DIM Freq(7),Nper(7)
30   DATA 1.E3,1.E3,1.E3,1.E4,1.E5,1.E6,4.E6
40   READ Freq(*)
50   DATA 1024,2048,4096,8192,16384,32768,65536
60   READ Nper(*)
70   !
80   OUTPUT 70906;"*RST"                         !Reset counter
90   OUTPUT 70906;"TRIG:SOUR BUS"                !Trigger from bus
100  OUTPUT 70906;"SENS1:FUNC:PER"               !Select Period function
110  OUTPUT 70906;"SENS3:FUNC:PER"
120  FOR I=1 TO 7
130    CLEAR SCREEN
140    PRINT TABXY(1,1);"Periods averaged:  ";Nper(I)
150    PRINT TABXY(1,2);"Set frequency to ";Freq(I);" Hz"
160    DISP "Press 'Continue' when ready."
170    PAUSE
180    DISP " "
190    OUTPUT 70906;"SENS1:PER:NPER ";Nper(I)  !Set sampling times
200    OUTPUT 70906;"SENS3:PER:NPER ";Nper(I)
210    OUTPUT 70906;"INIT1"                      !Initiate measurements
220    OUTPUT 70906;"INIT3"
230    OUTPUT 70906;"*TRG"                       !Trigger measurements
240    FOR Channel=1 TO 3 STEP 2
250      OUTPUT 70906;"FETC"&VAL$(Channel)&"?" !Fetch the reading
```

(Continued on next page.)

```
260       ENTER 70906;Reading(Channel)      !Transfer result to computer
270       PRINT TABXY(1,8+Channel);"Channel";Channel;"frequency
=";Reading(Channel)
280     NEXT Channel
290     DISP "Press 'Continue' for next test point."
300     PAUSE
310  NEXT I
320  CLEAR SCREEN
330  END
```

Test 4-3: Pulse Width Test

This test verifies pulse width measurement accuracy on channel 2 and channel 4.

Equipment Setup

1. Connect the equipment as shown in Figure 4-10.
2. Set the Function Generator controls as follows:
   - Function .... Squarewave
   - Frequency .... 0.5 Hz
   - DC Offset .... 0 V
   - Output .... 50 mVrms
3. Set up the Agilent E1332A as follows:
   - Reset counter .... ***RST**

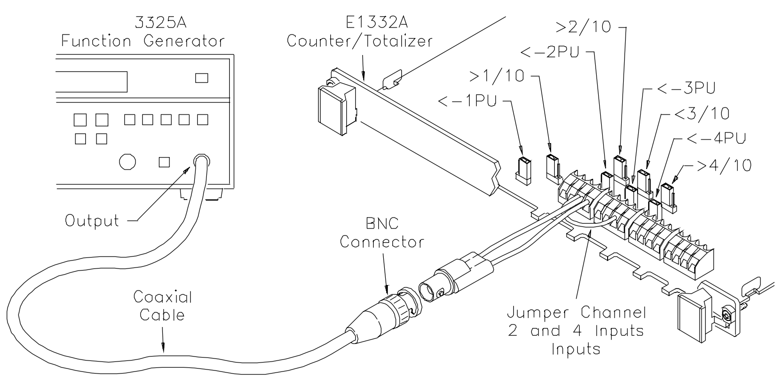

Figure 4-10. Pulse Width Test Setup

Test Procedure

1. Measure positive and negative pulse widths on channels 2 and 4:
   - Channel 2 positive pulse width .... **MEAS2:PWID?**
   - Channel 2 negative pulse width ...... **MEAS2:NWID?**
   - Channel 4 positive pulse width .... **MEAS4:PWID?**
   - Channel 4 negative pulse width ...... **MEAS4:NWID?**

2. Verify that the results are within the limits specified in Table 4-1, "Agilent E1332A Performance Test Record."

Example: Pulse Width Test

```
10    OUTPUT 70906;"*RST"                          !Reset counter
20    CLEAR SCREEN
30    PRINT "Input:  500 Hz, 50 mV rms squarewave"
40    DISP "Press 'Continue' when ready."
50    PAUSE
60    DISP " "
70    FOR Channel=2 TO 4 STEP 2
80      OUTPUT 70906;"MEAS"&VAL$(Channel)&":PWID?"
                                                   !Measure pos. pulse width
90      ENTER 70906;Pwid(Channel)
100     PRINT TABXY(1,6+Channel);"Channel";Channel;"positive pulse
width =";Pwid(Channel)
110     OUTPUT 70906;"MEAS"&VAL$(Channel)&":NWID?"
                                                   !Measure neg. pulse width
120     ENTER 70906;Nwid(Channel)
130     PRINT TABXY(1,7+Channel);"Channel";Channel;"positive pulse
width =";Nwid(Channel)
140  NEXT Channel
150  END
```

Test 4-4: Time Interval Test

The purpose of this test is to verify time interval measurement accuracy. The time intervals between channel 1 rising edge and channel 2 falling edge, and between channel 3 rising edge and channel 4 falling edge, are measured for a 1 MHz signal.

Equipment Setup

1. Connect the equipment as shown in Figure 4-11.

2. Set the Function Generator controls as follows:
   - Function .... Squarewave
   - Frequency .... 1 MHz
   - DC Offset .... 2.5 V
   - Output .... 5 V p-p

NOTE These settings produce a square wave with lower edge at 0 V and upper edge at +5 V.

3. Set up the Agilent E1332A as follows:
   - Reset counter .... ***RST**
   - Ch. 1/2 trig level **SENS1:EVEN:LEV 2.5**
   - Ch. 3/4 trig level **SENS3:EVEN:LEV 2.5**
   - Ch. 2 event slope .... **SENS2:EVEN:SLOP NEG**
   - Ch. 4 event slope .... **SENS4:EVEN:SLOP NEG**

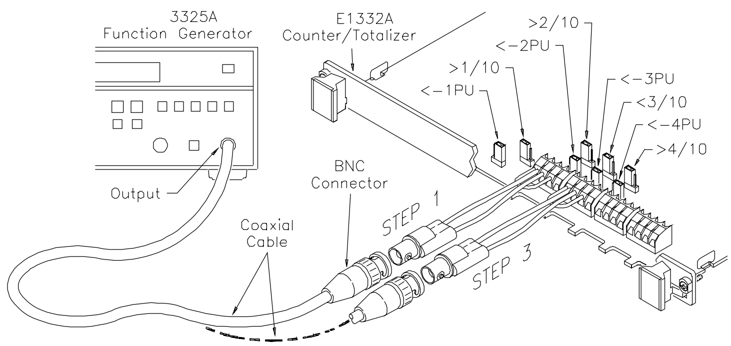

Figure 4-11. Time Interval Test Setup

Test Procedure

1. Measure time interval for channel pairs 1/2 and 3/4:
   - Channel 1/2 time interval .... **MEAS1:TINT?**
   - Channel 3/4 time interval .... **MEAS3:TINT?**

2. Verify that the results are within the limits specified in Table 4-1, "Agilent E1332A Performance Test Record."

Example: Time Interval Test

```
10   OUTPUT 70906;"*RST"                        !Reset counter
20   CLEAR SCREEN
30   PRINT "Input:  1 MHz squarewave, lower edge at 0 V"
40   PRINT "                         upper edge at +5 V"
50   PRINT
60   FOR Channel=1 TO 3 STEP 2
70     PRINT "Connect source to channels";Channel;"and";Channel+1
80     DISP "Press 'Continue' when ready"
90     PAUSE
100    DISP " "
110    OUTPUT 70906;"SENS"&VAL$(Channel)&":EVEN:LEV 2.5"
                                                !Set trigger levels to 2.5V
120    OUTPUT 70906;"SENS"&VAL$(Channel+1)&":EVEN:SLOP NEG"
                                                !Set ch 2,4 to trigger on trailing
                                                edge
130    OUTPUT 70906;"MEAS"&VAL$(Channel)&":TINT?"
                                                !Measure time interval
140    ENTER 70906;Reading(Channel)

150    PRINT TABXY(1,8+Channel);"Channel";Channel;"rising edge to
Channel";Channel+1;"falling edge =";Reading(Channel)
160  NEXT Channel
170  END
```

Performance Test Record

Table 4-1, "Performance Test Record for the Agilent E1332A Counter," is a form you can copy and use to record performance verification test results for the counter. Pages 3 through 5 of Table 4-1 show counter accuracy, measurement uncertainty, and test accuracy ratio (TAR) values. See Appendix A, "Calculating Counter Accuracy," for example calculations of these quantities.

NOTE The accuracy, measurement uncertainty, and TAR values shown in Table 4-1 are valid ONLY for the specific test conditions,test equipment, and assumptions described. If you use different test equipment or change the test conditions, you will need to compute the specific values for your test setup.

Counter Accuracy

Accuracy is defined for Frequency, Period Average, Pulse Width, and Time Interval measurements using the specifications in Appendix A of the *Agilent E1332A User's Manual*. In Table 4-1, the "High Limit" and "Low Limit" columns represent the counter accuracy for the specified test conditions.

Measurement Uncertainty

For the performance verification tests in this manual, measurement uncertainties are calculated assuming an Agilent 3325A/B (locked to a house frequency reference) as a source. Thus, the measurement uncertainty is equal to the accuracy of the house frequency reference.

Test Accuracy Ratio (TAR)

In Table 4-1, the Test Accuracy Ratio (TAR) is calculated from (high limit - expected measurement)/measurement uncertainty. (To meet MIL-STD-45662A requirements, the TAR must be 4:1 or greater.)

If the TAR value is <10:1, the TAR value is listed. If the TAR value is >10:1, the entry is >10:1. If the TAR value is <4:1, a note documents that this measurement does not meet MIL-STD-45662A requirements.

Table 4-1. Performance Test Record for the Agilent E1332A Counter (Page 1 of 5)

Test Facility:

Name_______________________________	Report No._____________________________
Address_____________________________	Date__________________________________
City/State___________________________	Customer______________________________
Phone______________________________	Tested by______________________________
Model______________________________	Ambient temperature____________________°C
Serial No.___________________________	Relative humidity________________________%
Options_____________________________	Line frequency (nominal)___________________Hz
Firmware Rev.________________________	

Special Notes:

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Table 4-1. Performance Test Record for the Agilent E1332A Counter (Page 2 of 5)

Model ______________________	Report No. ____________________	Date __________________

Test Equipment Used: Description	Model No.	Trace No.	Cal Due Date
1. ______________________________	____________	____________	____________
2. ______________________________	____________	____________	____________
3. ______________________________	____________	____________	____________
4. ______________________________	____________	____________	____________
5. ______________________________	____________	____________	____________
6. ______________________________	____________	____________	____________
7. ______________________________	____________	____________	____________
8. ______________________________	____________	____________	____________
9. ______________________________	____________	____________	____________
10. ______________________________	____________	____________	____________
11. ______________________________	____________	____________	____________
12. ______________________________	____________	____________	____________
13 ______________________________	____________	____________	____________
14. ______________________________	____________	____________	____________
15. ______________________________	____________	____________	____________
16. ______________________________	____________	____________	____________
17. ______________________________	____________	____________	____________
18 ______________________________	____________	____________	____________
19. ______________________________	____________	____________	____________
20. ______________________________	____________	____________	____________

Table 4-1. Performance Test Record for the Agilent E1332A Counter/Totalizer (Page 3 of 5)

Model____________________	Report No.________________________	Date____________________

Channel	Test Input	Gate Time	Low Limit	Measured Frequency	High Limit	Measurement Uncertainty*	Test Accuracy Ratio (TAR)**
Frequency Test (Values in Hz) (Gate Time in seconds)							
1	4 MHz	.002	3999474.427	________________	4000525.573	1.2E-4	>10:1
1	4 MHz	.004	3999725.213	________________	4000274.787	1.2E-4	>10:1
1	4 MHz	.008	3999850.607	________________	4000149.393	1.2E-4	>10:1
1	4 MHz	.016	3999913.303	________________	4000086.697	1.2E-4	>10:1
1	4 MHz	.032	3999944.652	________________	4000055.348	1.2E-4	>10:1
1	4 MHz	.064	3999960.326	________________	4000039.674	1.2E-4	>10:1
1	4 MHz	.128	3999968.163	________________	4000031.837	1.2E-4	>10:1
1	4 MHz	.256	3999972.081	________________	4000027.919	1.2E-4	>10:1
1	4 MHz	.512	3999974.041	________________	4000025.959	1.2E-4	>10:1
1	1 MHz	1.024	999993.017	________________	1000006.983	3.0E-5	>10:1
1	100 KHz	2.048	99998.909	________________	100001.091	3.0E-6	>10:1
1	10 KHz	4.096	9999.694	________________	10000.306	3.0E-7	>10:1
1	1 KHz	8.192	999.871	________________	1000.129	3.0E-8	>10:1
1	100 Hz	16.384	99.938	________________	100.062	3.0E-9	>10:1
1	10 Hz	32.768	9.969	________________	10.031	3.0E-10	>10:1
1	1 MHz	65.536	999993.985	________________	1000006.015	3.0E-5	>10:1
3	4 MHz	.002	3999474.427	________________	4000525.573	1.2E-4	>10:1
3	4 MHz	.004	3999725.213	________________	4000274.787	1.2E-4	>10:1
3	4 MHz	.008	3999850.607	________________	4000149.393	1.2E-4	>10:1
3	4 MHz	.016	3999913.303	________________	4000086.697	1.2E-4	>10:1
3	4 MHz	.032	3999944.652	________________	4000055.348	1.2E-4	>10:1
3	4 MHz	.064	3999960.326	________________	4000039.674	1.2E-4	>10:1
3	4 MHz	.128	3999968.163	________________	4000031.837	1.2E-4	>10:1
3	4 MHz	.256	3999972.081	________________	4000027.919	1.2E-4	>10:1
3	4 MHz	.512	3999974.041	________________	4000025.959	1.2E-4	>10:1
3	1 MHz	1.024	999993.017	________________	1000006.983	3.0E-5	>10:1
3	100 KHz	2.048	99998.909	________________	100001.091	3.0E-6	>10:1
3	10 KHz	4.096	9999.694	________________	10000.306	3.0E-7	>10:1
3	1 KHz	8.192	999.871	________________	1000.129	3.0E-8	>10:1
3	100 Hz	16.384	99.938	________________	100.062	3.0E-9	>10:1
3	10 Hz	32.768	9.969	________________	10.031	3.0E-10	>10:1
3	1 MHz	65.536	999993.985	________________	1000006.015	3.0E-5	>10:1

* Measurement Uncertainty of an Agilent 3325B, locked to a house frequency standard with accuracy of ±3.0E-11. (Accuracy must be greater than ±6.0E-7 for all TAR's to be >10:1.)

** TAR = Counter Accuracy/Measurement Uncertainty.

Table 4-1. Performance Test Record for the Agilent E1332A Counter/Totalizer (Page 4 of 5)

Model________________________	Report No.__________________________	Date_______________

Channel	Test Input	Gate Time	Low Limit	Measured Frequency	High Limit	Measurement Uncertainty*	Test Accuracy Ratio (TAR)**
Period Average Test (Values in Seconds)							
1	1 msec	1024	.000999993804	________________	.001000006196	3.0E-14	>10:1
1	1 msec	2048	.000999993902	________________	.001000006098	3.0E-14	>10:1
1	1 msec	4096	.000999993951	________________	.001000006049	3.0E-14	>10:1
1	100 µsec	8192	.000099999376	________________	.000100000624	3.0E-15	>10:1
1	10 µsec	16384	.000009999928	________________	.000010000072	3.0E-16	>10:1
1	1 µsec	32768	.000000999988	________________	.000001000012	3.0E-17	>10:1
1	250 nsec	65536	.000000249995	________________	.000000250005	7.5E-18	>10:1
3	1 msec	1024	.000999993804	________________	.001000006196	3.0E-14	>10:1
3	1 msec	1024	.000999993804	________________	.001000006196	3.0E-14	>10:1
3	1 msec	4096	.000999993951	________________	.001000006049	3.0E-14	>10:1
3	100 µsec	8192	.000099999376	________________	.000100000624	3.0E-15	>10:1
3	10 µsec	16384	.000009999928	________________	.000010000072	3.0E-16	>10:1
3	1 µsec	32768	.000000999988	________________	.000001000012	3.0E-17	>10:1
3	250 nsec	65536	.000000249995	________________	.000000250005	7.5E-18	>10:1

Channel	Test Input	Pulse Polarity	Low Limit	Measured Pulse Width	High Limit	Measurement Uncertainty*	Test Accuracy Ratio (TAR)**
Pulse Width Test (Values in Seconds)							
2	1 msec	POS	.000999794	_____________	.001000206	3.0E-14	>10:1
2	1 msec	NEG	.000999794	_____________	.001000206	3.0E-14	>10:1
4	1 msec	POS	.000999794	_____________	.001000206	3.0E-14	>10:1
4	1 msec	NEG	.000999794	_____________	.001000206	3.0E-14	>10:1

* Measurement Uncertainty of an Agilent 3325B, locked to a house frequency standard with accuracy of ±3.0E-11. (Accuracy must be greater than ±6.0E-7 for all TAR's to be >10:1.)

** TAR = Counter Accuracy/Measurement Uncertainty.

Table 4-1. Performance Test Record for the Agilent E1332A Counter/Totalizer (Page 5 of 5)

Model ____________________	Report No. ____________________________	Date __________________

Channel	Test Input	Trigger Polarity	Low imit	Measured Time Interval	High Limit	Measurement Uncertainty*	Test Accuracy Ratio (TAR)**
Time Interval Test (Values in Seconds)							
1	500 nsec	POS					
2	500 nsec	NEG	.0000003000	_____________	.0000007000	1.5E-17	>10:1
3	500 nsec	POS					
4	500 nsec	NEG	.0000003000	_____________	.0000007000	1.5E-17	>10:1

* Measurement Uncertainty of an Agilent 3325B, locked to a house frequency standard with accuracy of ±3.0E-11. (Accuracy must be greater than ±6.0E-7 for all TAR's to be >10:1.)

** TAR = Counter Accuracy/Measurement Uncertainty.

Chapter 5
Adjustments

Introduction

This chapter contains procedures to adjust the Agilent E1332A counter for peak performance. For best performance, the instrument should be adjusted after repair. The following adjustments are available:

- 10 MHz reference oscillator
- Channel pair 1/2 trigger level zero
- Channel pair 3/4 trigger level zero

All adjustments are made manually, so the Agilent E1332A card must be accessible to the technician. Install the counter in an Agilent E1400T mainframe (which has no top or sides) if one is available. Otherwise, install the counter in the lowest slot of the B-size mainframe, and remove any cards above the counter.

WARNING **Do not perform any of the following adjustments unless you are a qualified, service-trained technician, and have read the WARNINGS and CAUTIONS in Chapter 1.**

Adjustment Conditions and Procedures

For best accuracy, the temperature of the area where adjustments are made should be between 18°C and 28°C and stable to within ±1°C. See Table 1-1, "Recommended Test Equipment," for test equipment requirements.

The adjustment procedures assume that the person performing the adjustments understands how to operate the mainframe, counter, and specified test equipment. The adjustment procedures do not specify test equipment settings, except in general terms. It is assumed that a qualified, service-trained technician will select and connect the cables and jumpers required for the adjustments.

Reference Oscillator Adjustment

This procedure adjusts the 10 MHz reference oscillator. For best results, use a universal counter that has an accuracy of at least ±0.1 ppm.

Equipment Setup

1. Connect the equipment as shown in Figure 5-1. If necessary, consult Figure 5-4 for component locations.
2. Set the universal counter to measure frequency.

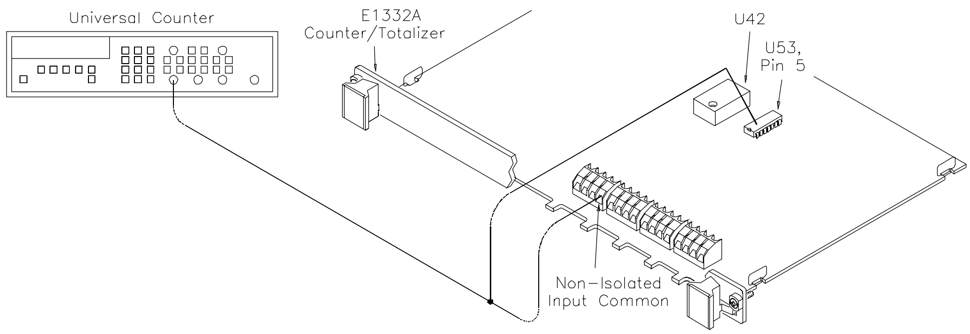

Figure 5-1. Reference Oscillator Adjustment Setup

Adjustment Procedure

1. Adjust U42 until the universal counter reads 10 MHz ± 10 Hz. This will give the reference oscillator an accuracy of ±1 ppm or better.

Trigger Level Zero Adjustment

Channel Pair 1/2

This procedure adjusts the trigger level zero for channel pair 1/2.

Equipment Setup

1. Connect the equipment as shown in Figure 5-2. If necessary, consult Figure 5-4 for component locations.

2. Set the function generator controls as follows:

   – Function .... Triangle wave
   – Frequency .... 10 KHz
   – DC Offset .... 0 V
   – Output .... 1 V p-p

3. Ensure that the counter is in its power-on state by cycling power or executing the ***RST** command.

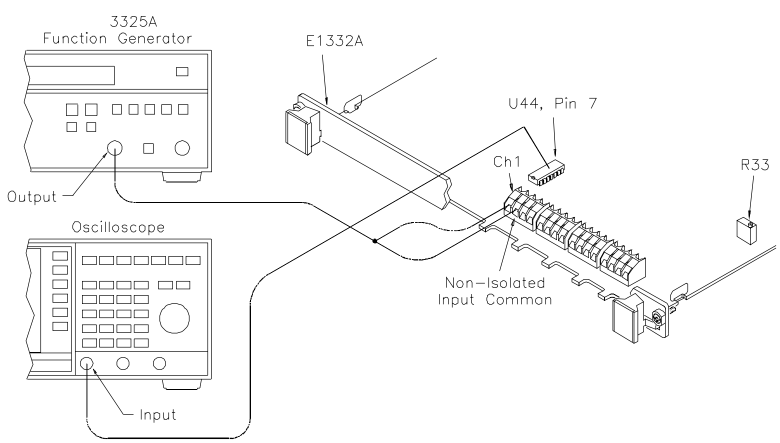

Figure 5-2. Ch. 1/2 Trigger Level Zero Adjustment

Adjustment Procedure

1. The triangle wave input to channel 1 should produce a squarewave output at U44, pin 7 (referenced to the input common). Set the oscilloscope to view one cycle of the squarewave on the display (10 μsec/div for a 10 KHz signal).

2. Adjust R33 until the positive and negative portions of the squarewave are equal in width.

3. Reduce the function generator output to 250 mV p-p. Repeat step 2.
4. Reduce the function generator output to 100 mV p-p. Repeat step 2. The adjustment accuracy increases for lower triangle wave amplitudes.

NOTE Triangle wave amplitudes below 100 mV p-p begin to approach the input level sensitivity limits of the counter, causing the adjustment to become invalid.

Channel Pair 3/4

This procedure adjusts the trigger level zero for channel pair 3/4.

Equipment Setup

1. Connect the equipment as shown in Figure 5-3. If necessary, consult Figure 5-4 for component locations.

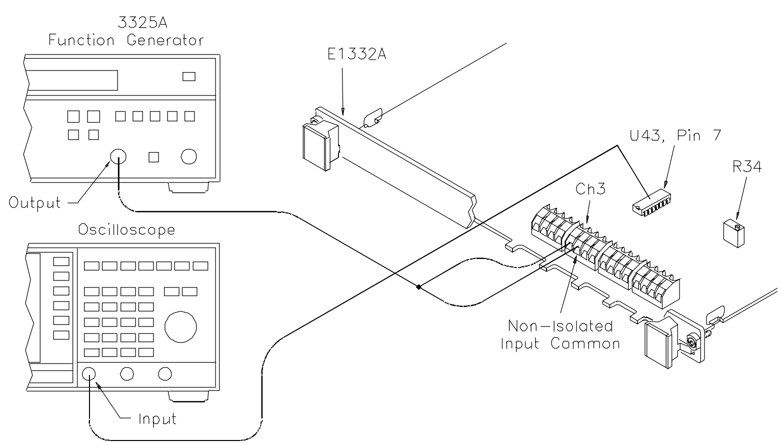

Figure 5-3. Ch. 3/4 Trigger Level Zero Adjustment

2. Set the function generator controls as follows:
   - Function .... Triangle wave
   - Frequency .... 10 KHz
   - DC Offset .... 0 V
   - Output .... 1 V p-p
3. Ensure that the counter is in its power-on state by cycling power or executing the ***RST** command.

Adjustment Procedure

1. The triangle wave input to channel 3 should produce a squarewave output at U43, pin 7 (referenced to the input common). Set the Oscilloscope to view one cycle of the squarewave on the display (10 μsec/div for a 10 KHz signal).
2. Adjust R34 until the positive and negative portions of the squarewave are equal in width.
3. Lower the Function Generator output to 250 mV p-p. Repeat step 2.
4. Lower the Function Generator output to 100 mV p-p. Repeat step 2. The adjustment accuracy increases for lower triangle wave amplitudes.

NOTE Triangle wave amplitudes below 100 mV p-p begin to approach the input level sensitivity limits of the counter, causing the adjustment to become invalid.

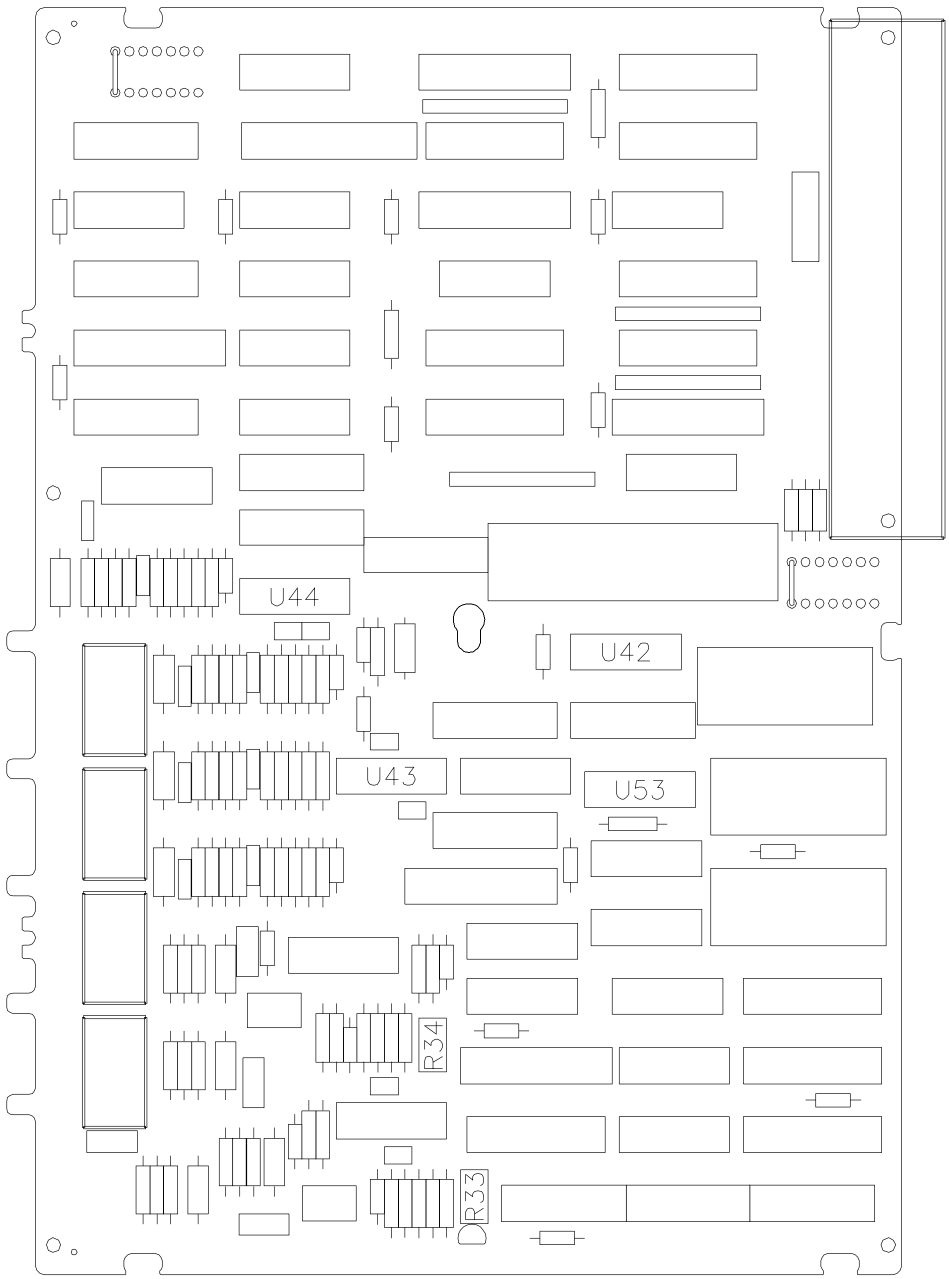

Figure 5-4. Locations of Key Components

Replaceable Parts

Introduction

This chapter contains information for ordering replaceable parts for the Agilent E1332A counter.

Exchange Assemblies

Table 6-1 lists assemblies that may be replaced on an exchange basis (EXCHANGE ASSEMBLIES). Factory-repaired and tested exchange assemblies are available only on a trade-in basis. Defective assemblies must be returned for credit. Assemblies required for spare parts stock must be ordered by the new assembly part number. Contact your nearest Agilent Technologies Sales and Service Office for details.

Ordering Information

To order a part listed in Table 6-1, specify the Agilent Technologies part number, the check digit (CD), and the quantity required. Send the order to your nearest Agilent Technologies Sales and Service Office. (Using the check digit will help ensure accurate processing of your order.)

Replaceable Parts List

Table 6-1 below lists the replaceable parts for the Agilent E1332A counter. See Figure 6-1 later in this chapter for locations of parts listed in Table 6-1.

Table 6-1. Agilent E1332A Replaceable Parts

Reference* Designator	Agilent Part Number	C D	Qty	Description
				EXCHANGE ASSEMBLIES
	E1332-66201	0	1	COUNTER MODULE (NEW)
	E1332-69201	6	1	COUNTER MODULE (EXCHANGE)
A1	E1332-66501	0	1	PRINTED CIRCUIT ASSEMBLY [a]
A1BRK1	0050-2183	1	2	BRACKET-RIGHT ANGLE, MTG;PNL-PCB
	0361-1295	3	2	RIVET-SEMITUBULAR .095 X .406 LNG
A1BRK2	0050-2183	1		BRACKET-RIGHT ANGLE, MTG;PNL-PCB
	0361-1295	3		RIVET-SEMITUBULAR .095 X .406 LNG
A1F1	2110-0712	8	3	FUSE-SUBMINIATURE 4A 125V NTD AX
A1F2	2110-0712	8		FUSE-SUBMINIATURE 4A 125V NTD AX
A1F3	2110-0712	8		FUSE-SUBMINIATURE 4A 125V NTD AX

Reference* Designator	Agilent Part Number	C D	Qty	Description
A1J1	1251-4682	6	8	CONN-POST TYPE .100-PIN-SPCG 3-CONT
A1J2	1251-4682	6		CONN-POST TYPE .100-PIN-SPCG 3-CONT
A1J3	1251-4682	6		CONN-POST TYPE .100-PIN-SPCG 3-CONT
A1J4	1251-4682	6		CONN-POST TYPE .100-PIN-SPCG 3-CONT
A1J5	1251-4682	6		CONN-POST TYPE .100-PIN-SPCG 3-CONT
A1J6	1251-4682	6		CONN-POST TYPE .100-PIN-SPCG 3-CONT
A1J7	1251-4682	6		CONN-POST TYPE .100-PIN-SPCG 3-CONT
A1J8	1251-4682	6		CONN-POST TYPE .100-PIN-SPCG 3-CONT
A1JM15	7175-0057	5	2	RESISTOR-ZERO OHMS TINNED COPPER
A1JM16	7175-0057	5		RESISTOR-ZERO OHMS TINNED COPPER
A1P1	1252-1596	7	1	CONN-POST TYPE 2.54-PIN-SPCG 96-CONT
RVT1	0361-1294	2	2	RIVET-SEMITUBULAR .095/.099 X .328 LNG
RVT2	0361-1294	2		RIVET-SEMITUBULAR .095/.099 X .328 LNG
A1PJM1	1258-0141	8	8	JUMPER-REMOVABLE, 0.025 IN SQ PINS
A1PJM2	1258-0141	8		JUMPER-REMOVABLE, 0.025 IN SQ PINS
A1PJM3	1258-0141	8		JUMPER-REMOVABLE, 0.025 IN SQ PINS
A1PJM4	1258-0141	8		JUMPER-REMOVABLE, 0.025 IN SQ PINS
A1PJM5	1258-0141	8		JUMPER-REMOVABLE, 0.025 IN SQ PINS
A1PJM6	1258-0141	8		JUMPER-REMOVABLE, 0.025 IN SQ PINS
A1PJM7	1258-0141	8		JUMPER-REMOVABLE, 0.025 IN SQ PINS
A1PJM8	1258-0141	8		JUMPER-REMOVABLE, 0.025 IN SQ PINS
A1SW1	3101-3066	3	1	SWITCH-ROCKER 8-POSITION DIP SPMRKD
A1TB1	0360-2390	9	4	TERMINAL BLOCK 4POS. SCREW TYPE
A1TB2	0360-2390	9		TERMINAL BLOCK 4POS. SCREW TYPE
A1TB3	0360-2390	9		TERMINAL BLOCK 4POS. SCREW TYPE
A1TB4	0360-2390	9		TERMINAL BLOCK 4POS. SCREW TYPE
A1XU3	1200-0817	4	1	SOCKET-IC 40-CONT DIP DIP-SLDR
				MECHANICAL PARTS
MP1	E1300-45101†	4	1	HNDL-KIT TOP, Agilent†
MP2	E1300-45102†	5	1	HNDL-KIT BTM, VXI†
LBL1	E1332-84302	7	1	SERIAL LABEL
SCR3	0515-1968	4	2	SCR-MACH,PANHD,M2.5X11 SLOT,NI PLD
SCR4	0515-1968	4		SCR-MACH,PANHD,M2.5X11 SLOT,NI PLD
PNL1	E1332-00202†	9	1	PNL-RR CENTER 4CH†
SCR1	0515-2140	9	2	SCR-THD-RLG M2.5 X0.45 14mm
SCR2	0515-2140	9		SCR-THD-RLG M2.5 X0.45 14mm
SCR5-SCR6	0515-2743	2	2	SCR-FH M2.5 X 8 THREAD ROLLING
SHD1	E1300-80601	3	1	SHIELD SAFETY

* See Table 6-2 for Reference Designator definitions

[a] Repair limited to replacement of parts listed - see Introduction for ordering information

† These parts are not compatible with older version fixed handles and their corresponding front panels. To replace one or more of these older parts, you must order all three new parts (Top and Bottom Handle Kits AND External Panel).

Table 6-3. Agilent E1332A Reference Designators

Agilent E1332A REFERENCE DESIGNATORS	
A .... assembly	MP .... misc. mechanical part
CBL .... cable	P .... electrical connector (plug)
F .... fuse	PNL .... panel
J .... electrical connector (jack)	SCR.....................................screw
JM ... electrical connector (header)	SHD .... shield
K ....relay	SW .... switch
LBL .... label	TB...........................terminal block
	XU .... socket, integrated circuit

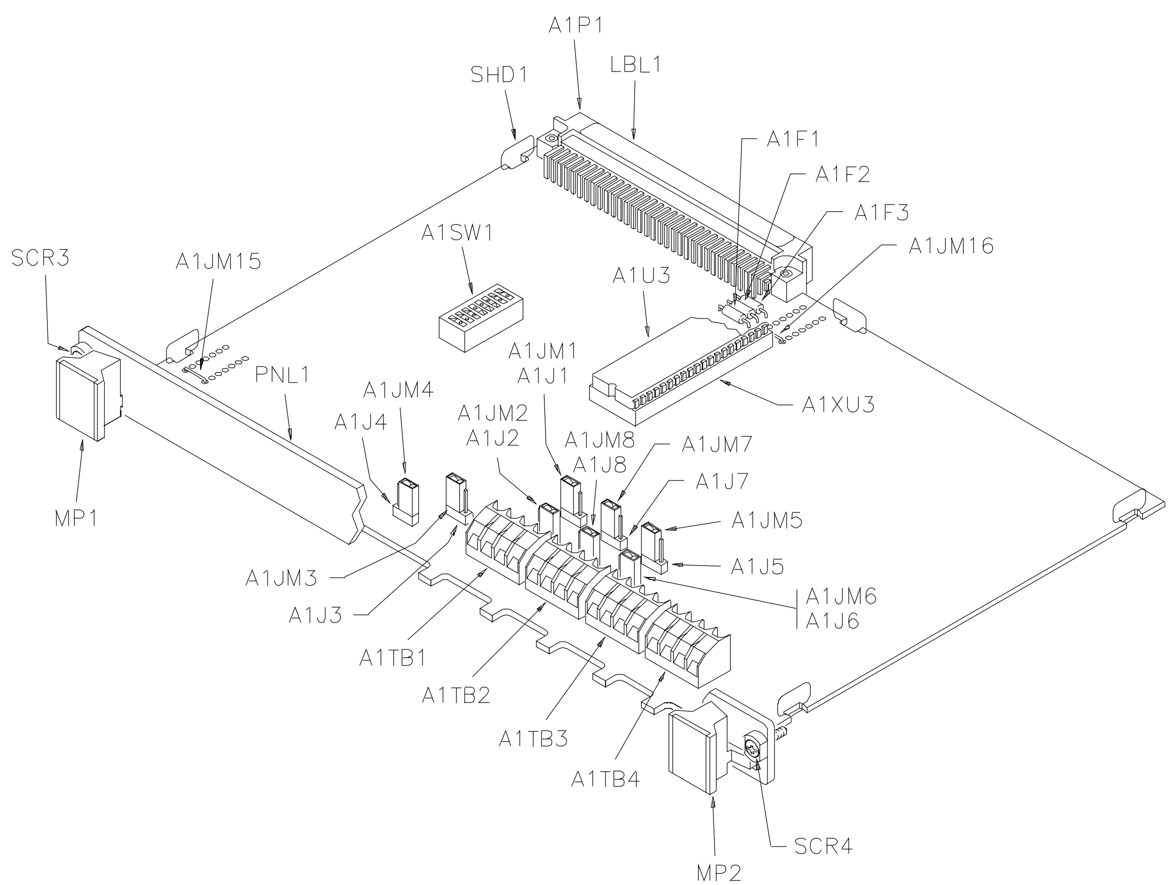

Figure 6-1. Agilent E1332A Replaceable Parts

Chapter 7
Service

Introduction

This chapter contains service information for the Agilent E1332A counter, including troubleshooting guidelines and repair/maintenance guidelines.

WARNING **Do not perform any of the service procedures shown unless you are a qualified, service-trained technician, and have read the WARNINGS and CAUTIONS in Chapter 1.**

Equipment Required

Equipment required for counter troubleshooting and repair is listed in Table 1-1, "Recommended Test Equipment." Any equipment that satisfies the requirements given in the table may be substituted. To avoid damage to the screw head slots, use a T8 Torx driver to remove the front panel handles.

Service Aids

Service aids on printed circuit boards include pin numbers, some reference designations, and assembly part numbers. See Chapter 6, "Replaceable Parts," for descriptions and locations of Agilent E1332A replaceable parts. Service notes, manual updates, and service literature for the Agilent E1332A counter may be available through Agilent Technologies. For information, contact your nearest Agilent Technologies Sales and Service Office.

Troubleshooting Techniques

There are two main steps in troubleshooting an Agilent E1332A counter problem: (1) identifying the problem, and (2) isolating the cause to a user-replaceable component.

Identifying the Problem

Counter problems can be divided into four general categories:

- Self-test errors
- Operator errors
- Catastrophic failures
- Performance out of specification

Self-Test Errors

A non-zero error number is returned when the counter self-test fails. If a self-test error occurs, cycle power and repeat the self-test. If the error repeats, see "Testing the Assembly" to troubleshoot the counter.

Error	Description
1	Improper module power-up
2	Trigger level malfunction (digital circuitry)
3	Frequency measurement error
4	Period measurement error
5	Totalize measurement error
6	Trigger level malfunction (analog circuitry)
7	Improper state after reset

Operator Errors

Apparent failures may result from operator errors. See Appendix B, "Error Messages," in the *Agilent E1332A User's Manual* for information on operator errors.

Catastrophic Failure

If a catastrophic failure occurs, see "Testing the Assembly" to troubleshoot the counter.

Performance Out of Specification

If the counter performance is out of specification limits, use the adjustment procedures in Chapter 5 to correct the problem. If the condition persists, see "Testing the Assembly" to troubleshoot the counter.

Testing the Assembly

You can use the tests and checks in Table 7-3 to isolate the problem to a user-replaceable part on the counter. See Figure 6-1 in Chapter 6 for locations of user-replaceable parts.

NOTE If the problem cannot be traced to a user-replaceable part listed in Table 6-1, return the counter to Agilent Technologies for exchange. See Chapter 6 for procedures.

Table 7-1. Agilent E1332A Tests/Checks

Test/Check	Reference Designator	Check:
Heat Damage	- - - - - - - - - -	Discolored PC boards Damaged insulation Evidence of arcing
Switch/Jumper Settings	JM15, JM16 JM1, JM2,..., JM8 SW1	IRQ Level setting Jumper settings LADDR setting
Counter PCA	F1, F2, F3 TB1, TB2, TB3, TB4 P1	Fuse continuity Input wiring Connector contact

Checking for Heat Damage

Inspect the counter for signs of abnormal internally generated heat such as discolored printed circuit boards or components, damaged insulation, or evidence of arcing. If there is damage, do not operate the counter until you have corrected the problem.

Checking Switches/Jumpers

Verify that the logical address setting is set correctly (factory set at 48). Verify that the interrupt priority jumpers are set correctly (factory set at level 1). See the *Agilent E1332A User's Manual* for information.

Repair/Maintenance Guidelines

This section provides guidelines for repairing and maintaining the Agilent E1332A counter, including:

- ESD precautions
- Soldering printed circuit boards
- Post-repair safety checks

ESD Precautions

Electrostatic discharge (ESD) may damage MOS, CMOS, and other static sensitive devices in the Agilent E1332A counter. This damage can range from slight parameter degradation to catastrophic failure. When handling counter assemblies, follow these guidelines to avoid damaging counter components:

- Always use a static-free work station with a pad of conductive rubber or similar material when handling counter components.

- If a device requires soldering, be sure the assembly is placed on a pad of conductive material. Also, be sure that you, the pad, and the soldering iron tip are grounded to the assembly.

Soldering Printed Circuit Boards

The etched circuit boards in the counter have plated through-holes that allow a solder path to both sides of the insulating material. Soldering can be done from either side of the board with equally good results. When soldering to any circuit board, keep in mind the following guidelines:

- Avoid unnecessary component unsoldering and soldering. Excessive replacement can result in damage to the circuit board and/or adjacent components.

- Do not use a high power soldering iron on etched circuit boards, as excessive heat may lift a conductor or damage the board.

- Use a suction device or wooden toothpick to remove solder from component mounting holes. When using a suction device, be sure the equipment is properly grounded to prevent electrostatic discharge from damaging CMOS devices.

Post-Repair Safety Checks

After making repairs to the Agilent E1332A counter, inspect the counter for any signs of abnormal internally generated heat, such as discolored printed circuit boards or components, damaged insulation, or evidence of arcing. Determine and correct the cause of the condition. Then run the self-test (***TST?** command) to verify that the counter is functional.

Appendix A
Counter Accuracy Calculations

Introduction

This appendix shows how counter accuracy is defined and calculated for the Agilent E1332A 4-Channel Counter/Totalizer. See Table 4-1, "Performance Test Record for the E1332A Counter," for values of counter accuracy.

Counter accuracy is defined as the expected accuracy of the measurement considering ONLY the Agilent E1332A counter. The "Low Limit" entry in Table 4-1 corresponds to the lower (-) value of counter accuracy, while the "High Limit" entry in Table 4-1 corresponds to the upper (+) value of counter accuracy.

For further information on counter accuracy specifications, see Application Note 200, "Fundamentals of Electronic Counters" (Agilent part number 02-5952-7506) and Application Note 200-4, "Understanding Frequency Counter Specifications" (Agilent part number 02-5952-7522).

Calculating Counter Accuracy

For the Agilent E1332A counter, accuracy is defined for Frequency, Period Average, Pulse Width, and Time Interval Measurements by the following equation:

accuracy = ±[resolution + timebase error + trigger noise error]

Resolution is defined as the smallest change in the measurement that can be detected. For frequency measurements, resolution is in Hz. For period average, pulse width, and time interval measurements, resolution is in seconds (see Table A-1).

Table A-1. Agilent E1332A Counter Resolution Equations

Measurement	Resolution	Range/values
Frequency	$\frac{1}{gate\ time}$ (Hz)	.002, .004,...,65.536 sec
Period Average	$\frac{200}{\#\ periods\ avgd}$ (nsec)	2, 4, 8,...,65536 periods
Pulse Width/ Time Interval	200 (nsec)	1 period

Timebase error is defined as the maximum fractional change in the 10 MHz reference timebase frequency due to all error sources, multiplied by the measurement result. That is:

timebase error = ± [initial accuracy + aging rate + temperature drift] x measurement result.

For the Agilent E1332A, the *worst-case* values are:

- initial accuracy = $\pm\ 2\times10^{-6}$
- aging rate = $\pm\ 2\times10^{-6}$/year
- temperature drift = $\pm\ 5\times10^{-6}$, 0^{o}C to 50^{o}C

However, typical maximum temperature drift is about ±2 ppm (see Figure A-1), and calibration is usually performed at 1-year intervals. Thus, a typical timebase error = $\pm(2 \text{ x } 10^{-6} + 2 \text{ x } 10^{-6} + 2 \text{ x } 10^{-6}) = \pm(6 \text{ x } 10^{-6})$ x measurement result.

Trigger Noise Error

Trigger noise error is defined as the additional error caused by counter input noise (200 µV for the Agilent E1332A) and by noise on the input signal. The *input slew rate at trigger point* (in µV/sec) is the rate at which the input voltage is changing when the input is triggered. That is:

$$\textbf{slew rate} = \frac{\Delta V}{\Delta t}$$

For example, for a 50 mV square wave input with a 20 nsec rise time,

$$\textbf{slew rate} = \frac{0.8 \times 50 \times 10^{-3}}{20 \times 10^{-9}} = 2 \text{ x } 10^{6} \text{ V/sec} = 2 \text{ x } 10^{12}\ \mu\text{V/sec}$$

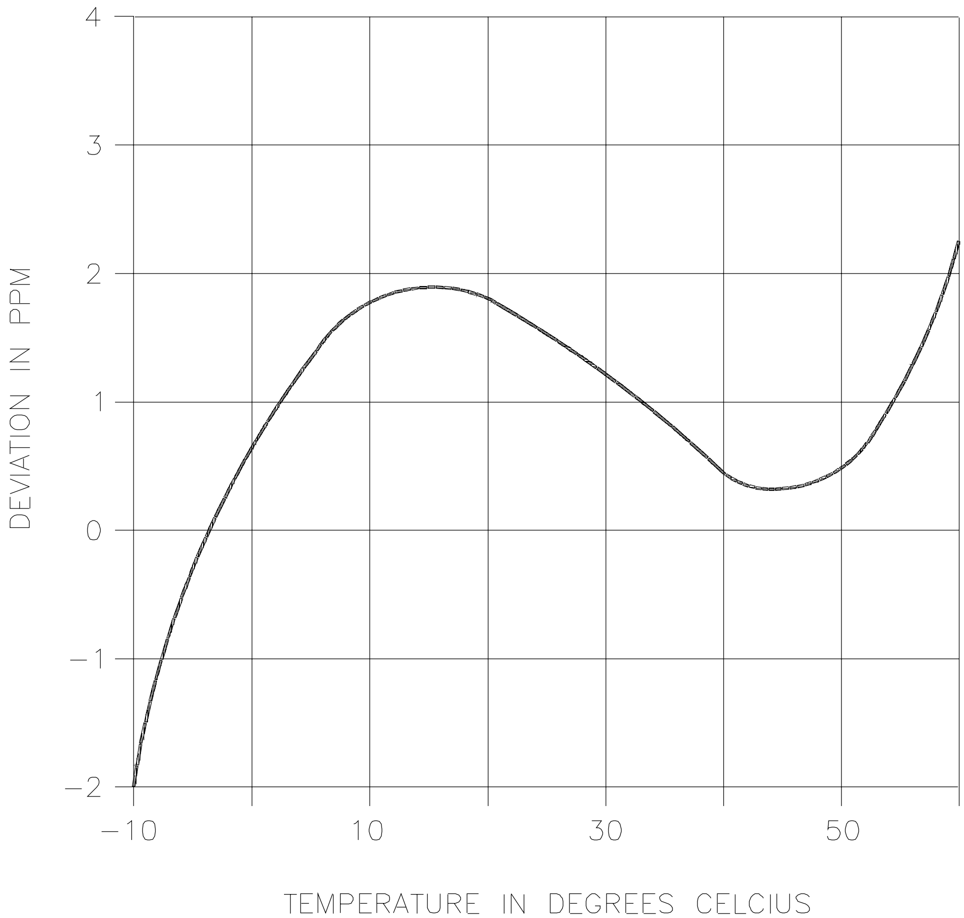

Figure A-1.Typical Temperature Drift

Frequency Measurements Trigger Noise Error

From Appendix A of the *Agilent E1332A User's Manual*, for frequency measurements:

Trigger Noise Error (RMS) = T, where:

$$T = \sqrt{\frac{(200\ \mu V)^2 + (e_n)^2}{\textit{input slew rate at trigger point}}}$$

e_n = rms noise (in µV) on the input signal for a 150 MHz bandwidth.

However, T is NOT the "trigger noise error" term for frequency measurements accuracy, but is only part of the expression. From Application Note 200-4, for frequency measurements:

trigger noise error (Hz)

= [(1.4 x T)/gate time] x frequency

$$= 1.4 \times \sqrt{\frac{(200\ \mu V)^2 + (e_n)^2}{\textit{input slew rate at trigger point} \times \textit{gate time}}} \times \textit{frequency}$$

Period Measurements Trigger Noise Error

From Appendix A of the *Agilent E1332A User's Manual*, for period, pulse width, and time interval measurements:

Trigger Noise Error (RMS) = T, where T is:

$$T = \sqrt{\frac{(200\ \mu V)^2 + (e_n)^2}{\textit{input slew rate at trigger point}}}$$

However as with frequency measurements, T is NOT the "trigger noise error" term for period measurements, but is only part of the expression. For period average measurements, **trigger noise error** = (1.4 x T)/*nper*, where *nper* = number of periods averaged. Therefore:

trigger noise error (sec) =

$$1.4 \times \sqrt{\frac{(200\ \mu V)^2 + (e_n)^2}{\textit{nper} \times \textit{input slew rate at trigger point}}}$$

For pulse width and time interval measurements, multiple period averaging is not allowed, so **trigger noise error** = (1.4 x T). Therefore:

trigger noise error (sec) =

$$1.4 \times \sqrt{\frac{(200\ \mu V)^2 + (e_n)^2}{\textit{input slew rate at trigger point}}}$$

Counter Accuracy Equations Table

Table A-2 summarizes counter accuracy expressions for frequency, period average, pulse width, and time interval measurements. For any listed measurement, **accuracy** = ± [resolution + timebase error + trigger noise error].

Table A-2. Agilent E1332A Counter Accuracy Equations

Measurement	±resolution	±timebase error*	±trigger noise error**
Frequency	$\frac{1}{gate\ time}$ (Hz) (.002, .004,...,65.536 sec)	$timebase \times frequency$ (Hz)	$\frac{1.4 \times T}{gate\ time} \times frequency$ (Hz)
Period Average	$\frac{200}{\#\ periods\ avgd}$ (nsec) (2, 4, 8,...,65536 periods)	$timebase \times period$ (sec)	$\frac{1.4 \times T}{\#\ periods\ avgd}$ (sec)
Pulse Width	200 (nsec)	$timebase \times pulse\ width$ (sec)	$1.4 \times T$
Time Interval	Same as Pulse Width	$timebase \times interval$ (sec)	Same as Pulse Width

* timebase = [initial accuracy +aging rate + temp drift] = 6.0 x 10^{-6} (typical)

$$** \ T = \sqrt{\frac{(200\ \mu V)^2 + (e_n)^2}{input\ slew\ rate\ at\ trigger\ point}}$$

Accuracy Calculations Examples

Two examples follow to calculate Agilent E1332A counter accuracy. The first example calculates frequency measurement accuracy, while the second example calculates period measurement accuracy.

Example: Calculating Frequency Accuracy

For this example, assume the following values/conditions:

Input frequency: 10 kHz sine wave
Input amplitude: 50 mV rms
Gate time: 4.096 sec
Timebase: 6.0 x 10^{-6}
Source noise (e_n): 1 mV rms
Slew rate: 1000 V/sec
Triggering at signal midpoint

NOTE The source noise of 1 mV is a typical value. You will need to measure the noise of your source for most accurate calculations.

Frequency Measurement Accuracy Equation

For frequency measurements: **accuracy** (Hz) = ±[resolution + timebase error + trigger noise error].

Calculate Resolution

For a gate time of 4096 msec, **resolution** = ± 1/gate time
= ± 1/(4.096) = ±0.244 Hz

Calculate Timebase Error

For frequency measurements, **timebase error** = timebase x frequency
= ± [initial accuracy + aging rate + temp drift] x frequency
= $\pm(6.0 \times 10^{-6}) \times 10^{4}$ Hz = ±0.06 Hz

Calculate Trigger Noise Error

From Table A-2, for frequency measurements:

$$\textbf{trigger noise error (Hz)} = \pm \frac{1.4 \times T}{gate\ time} \times frequency$$

where $T = \sqrt{\frac{(200\ \mu V)^2 + (e_n)^2}{input\ slew\ rate\ at\ trigger\ point}}$

e_n = rms noise (in μV) on the input signal

Thus, for input noise e_n = 1 mV, gate time of 4.096 sec, and slew rate of 1000 V/sec, the trigger noise error is:

trigger noise error (Hz)

$$= \pm\ 1.4 \times \sqrt{\frac{(200\ \mu V)^2 + (1\ mV)^2}{4.096\ sec \times 1000\ V/sec}} \times 10^4\ \text{Hz} = \pm 0.00342\ \text{Hz}$$

Calculate Frequency Measurement Accuracy

Since **accuracy** (frequency measurements) = ± [resolution
+ timebase error + trigger noise error]

accuracy = ± (0.2441 Hz + 0.06 Hz + 0.00342 Hz)
= ± 0.3075 Hz.

Effects of Varying Signal Conditions

Although this example showed resolution as the primary contributor to counter accuracy, timebase errors can also be a major contributor, as shown in Table A-3. For Case 1, the resolution error contributes about 80% of the error. However, for Case 2 the timebase error contributes about 99.9% of the error. For Case 3, triggering is assumed to NOT be at the midpoint of the sine wave, and a slew rate of 1 V/sec is assumed. Note that, for a wide range of conditions, the trigger noise error is not significant.

Table A-3. Effects on Frequency Accuracy of Varying Input Conditions

Case	Freq (Hz)	Gate Time (sec)	Slew Rate (V/sec)	Resolution (Hz)	Timebase Error (Hz)	Trigger Error (Hz)	Counter Acc (Hz)
1	10 kHz	4.096	10^3	0.2441 (80%)	0.06	.00342	0.3075
2	10 MHz	32.768	10^6	0.031	60.0 (99.9%)	4.27×10^{-4}	60.031
3	1 Hz	4.096	1	0.2441 (99.9%)	6×10^{-6}	3.4×10^{-4}	0.2444

NOTE

Although the combinations shown in Table A-3 do not necessarily reflect actual test conditions, the numbers do indicate that a careful analysis of the input signal and triggering points is required to determine the accuracy of your measurements.

Example: Calculating Period Average Accuracy

For this example, assume the following values/conditions:

Input period: 200 µsec (5 kHz square wave)
Number periods averaged: 32
Timebase: 6.0×10^{-6}

Source Noise (e_n): 1 mV rms
Slew rate: 1000 V/sec
Triggering at midpoint of the signal

NOTE

The source noise of 1 mV is a typical value. You will need to measure the noise of your source for most accurate calculations. You can use this example for time interval and pulse width measurements by substituting the appropriate resolution and trigger noise error equations shown in Table A-1.

Period Measurement Accuracy Equation

For period measurements, **accuracy** (sec) = ±[resolution + timebase error + trigger noise error].

Calculate Resolution

For 32 periods to be averaged, **resolution =** ± (200/*nper*) = ± (200/32) = ± 6.250 nsec

Calculate Timebase Error

For period measurements, **timebase error (sec)** = timebase x period = ± [initial accuracy + aging rate + temp drift] x period. For this example, timebase error = ± (6.0 x 10^{-6}) x (200 x 10^{-6}) = ±1.2 nsec

Calculate Trigger Noise Error

From Table A-1, **trigger noise error (sec)** = 1.4 x T/*nper*, where:

$$T = \sqrt{\frac{(200\ \mu V)^2 + (e_n)^2}{\textit{input slew rate at trigger point}}}$$

For a 1 mV rms input noise, 32 periods averaged, and a slew rate of 1000 V/sec:

trigger noise error (sec) =

$$\pm 1.4 \times \sqrt{\frac{(200\ \mu V)^2 + (1000\ \mu V)^2}{32 \times 1000\ ^{V}\!/_{sec}}} = \pm 43.75 \text{ nsec}$$

Calculate Period Average Measurement Accuracy

accuracy (period average measurements)
= ± [resolution + timebase error + trig noise error]
= ± (6.250 nsec + 1.2 nsec + 43.75 nsec) = ± 51.2 nsec

Effects of Varying Signal Conditions

Although this example showed trigger noise error as the primary contributor to counter accuracy, resolution errors and timebase errors can also be major contributors, as shown in Table A-4. For Case 1, the resolution error contributes about 94% of the error. However, for Case 2 the timebase error contributes about 82% of the error. For Case 3, triggering is assumed to NOT be at the midpoint of the sine wave. With a slew rate of 100 V/sec assumed, the trigger noise error contributes about 98.5% of the total error.

Table A-4. Effects on Period Accuracy of Varying Input Conditions

Case	Period (sec)	Periods Avgd	Slew Rate (V/sec)	Resolution (nsec)	Timebase Error (nsec)	Trigger Error (nsec)	Counter Acc (nsec)
1	1×10^{-3}	2	10^6	100.000 (93.7%)	6.000	0.700	106.700
2	2×10^{-3}	128	10^4	1.563	12.000 (81.9%)	1.094	14.65
3	5×10^{-7}	2048	10^2	.0977	.0030	6.836 (98.5%)	6.937

Counter Accuracy Programs

Two programs follow to calculate counter accuracies. After you enter the parameter values, the program computes frequency or period/pulse width/time interval measurement accuracies and prints the results. The programs are designed for HP 9000 Series 200/300 computers using BASIC.

Frequency Measurement Accuracy

To make frequency measurement accuracy calculations, first enter the desired number of accuracy calculations you want to make (up to 100 sets of calculations). Then, for each calculation enter the desired values for:

- Frequency (Hz)
- Gate time (sec)
- Timebase
- Source noise (μV rms)
- Slew rate (μV/sec)

The program calculates frequency measurement accuracy for each set of input values and prints or displays the results. A typical display follows the program listing.

NOTE If you want to make more than 100 calculations, change the DIM statement (line 30) for the number of calculations required. Also, if your printer address is not 701, change line 20, PRINTER IS 701 to your printer address. If you do not have a printer, change line 20 to PRINTER IS 1.

Program Listing

```
10   OPTION BASE 1
20   PRINTER IS 701
30   DIM Freq (100),Gate(100),Timebase(100),Noise(100),
Slewrate(100),Accuracy(100)
40    Calc_no=0
50    INPUT " Select number of calculations (1 to 100)  ",Calc_no
60    FOR I = 1 TO Calc_no
70          CLEAR SCREEN
80          OUTPUT CRT;"Select values for frequency accuracy calculation
number";I
90          INPUT " Frequency (Hz) =  ",Freq(I)
100          INPUT " Gate time (sec) = ",Gate(I)
110          INPUT " Timebase  = ",Timebase(I)
120          INPUT " Source noise (uV rms) = ",Noise(I)
130          INPUT " Slew rate (uV/sec) = ",Slewrate(I)
140       Accuracy(I)=1/Gate(I)+Timebase(I)*Freq(I) +
Freq(I)*(1.4*SQRT(2.0E-4^2+Noise(I)^2)/(Slewrate(I)*Gate(I)))
```

(Continued on next page.)

```
150   NEXT I
160   CLEAR SCREEN
170   PRINT "Frequency Measurement Accuracy (Hz)"
180   PRINT
190   PRINT
200  Format:IMAGE 10A,2X,10A,2X,12A,2X,14A,2X,12A,3X,8A
210   PRINT USING Format;"Frequency";"Gate  Time"; "Timebase";
"Source  Noise";"Slew Rate";"Accuracy"
220   PRINT USING Format;"(Hz)";"(sec)";"(sec)";"(uV rms)";
"(uV/sec)";"(Hz)"
230   PRINT
240   FOR I=1 TO Calc_no
250   Format1:IMAGE D.5DE,3X,2D.3D,3X,D.5DE,3X,D.5DE,
4X,D.5DE,3X,2A,D.5DE
260       PRINT USING Format1;Freq(I);Gate(I);Timebase(I)*Freq(I);
Noise(I);Slewrate(I);CHR$(254);Accuracy(I)
270   NEXT I
280   END
```

Typical display

Frequency Measurement Accuracy (Hz)

Frequency (Hz)	Gate Time (sec)	Timebase (sec)	Source Noise (uV rms)	Slew Rate (uV/sec)	Accuracy (Hz)
1.00000E+04	4.096	6.00000E-6	1.00000E+03	1.00000E+09	±3.07559E-01

Period Measurements Accuracy

To make period/pulse width/time interval accuracy calculations, enter the number of accuracy calculations you want to make (up to 100 sets of calculations). Then, for each calculation enter the desired values for:

- Period/pulse width/time interval (sec)
- Number of periods averaged
- Timebase
- Source noise (μV rms)
- Slew rate (μV/sec)

For pulse width and time interval calculations, enter 1 for the number of periods averaged. The program calculates period, pulse width, or time interval measurement accuracy for each set of input values and displays the results. A typical display follows the program listing.

NOTE If you want to make more than 100 calculations, change the DIM statement (line 30) for the number of calculations required. Also, if your printer address is not 701, change line 20, PRINTER IS 701, to your printer address. If you do not have a printer, change line 20 to PRINTER IS 1.

Program Listing

```
10   OPTION BASE 1
20   PRINTER IS 701
30   DIM Period(100),Nper(100),Timebase(100),Noise(100),
Slewrate(100),Accuracy(100)
40   Calc_no=0
50   INPUT " Select number of calculations  (1 to 100) ",Calc_no
60   FOR I=1 TO Calc_no
70     CLEAR SCREEN
80     OUTPUT CRT;"Select values for period/PW/TI calculation number";I
90     INPUT " Period/pulse width/time interval (sec) = ",Period(I)
100    INPUT " Number periods averaged = ",Nper(I)
110    INPUT " Timebase = ",Timebase(I)
120    INPUT " Source noise (uV rms) = ",Noise(I)
130    INPUT " Slew rate (uV/sec) = ",Slewrate(I)
140    Accuracy(I)=2.E-7/Nper(I)+Timebase(I)*Period(I)+
1.4*SQRT(2.0E-4^2+Noise(I)^2)/(Nper(I)*Slewrate(I))
150  NEXT I
160  CLEAR SCREEN
170  PRINT "Period /Pulse Width/Time Interval Measurement Accuracy
(sec)"
180  PRINT
190  PRINT
200  Format:IMAGE 12A,3X,8A,2X,11A,2X,12A,3X,9A,6X,8A
210  PRINT USING Format;"Period/P.W./";"Periods";"Timebase";
"Source Noise ";"Slew Rate";"Accuracy"
220  PRINT USING Format;"T.I.(sec)";"Averaged";"(sec)";
"(uV rms)";"(uV/sec)";"(sec)"
230  PRINT
240  FOR I=1 TO Calc_no
250 Format1:IMAGE D.5DE,3X,2D.3D,3X,D.5DE,3X,D.5DE,
 3X,D.5DE,3X,2A,D.5DE
260      PRINT USING Format1;Period(I);Nper(I);Timebase(I)*Period(I);
Noise(I);Slewrate(I);CHR$(254);Accuracy(I)
270  NEXT I
280  END
```

Typical Display

Period/Pulse Width/Time Interval Measurement Accuracy (sec)

Period/P.W./ T.I. (sec)	Periods Averaged	Timebase (sec)	Source Noise (uV rms)	Slew Rate (uV/sec)	Accuracy (sec)
2.00000E-04	32	6.00000E-6	1.00000E+03	1.00000E+9	±5.12000E-08

Notes