



Agilent Technologies

537A Coaxial Frequency Meter

Operating Note

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Country	Phone Number	Fax Number
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Malaysia	1-800-828-848	1-800-801664
Philippines	(632) 8426802 1-800-16510170 (PLDT Subscriber Only)	(632) 8426809 1-800-16510288 (PLDT Subscriber Only)
Thailand	(088) 226-008 (outside Bangkok) (662) 661-3999 (within Bangkok)	(66) 1-661-3714
Hong Kong	800-930-871	(852) 2506 9233
Taiwan	0800-047-866	(886) 2 25456723
People's Republic of China	800-810-0189 (preferred) 10800-650-0021	10800-650-0121
India	1-600-11-2929	000-800-650-1101

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Review this product and related documentation to familiarize yourself with safety markings and instructions before you operate the instrument. This product has been designed and tested in accordance with international standards.

WARNING

The **WARNING** notice denotes a hazard. It calls attention to a procedure, practice, or the like, that, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a **WARNING** notice until the indicated conditions are fully understood and met.

CAUTION

The **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a **CAUTION** notice until the indicated conditions are fully understood and met.

Instrument Markings



When you see this symbol on your instrument, you should refer to the instrument's instruction manual for important information.



This symbol indicates hazardous voltages.



The laser radiation symbol is marked on products that have a laser output.



This symbol indicates that the instrument requires alternating current (ac) input.



The CE mark is a registered trademark of the European Community. If it is accompanied by a year, it indicates the year the design was proven.



The CSA mark is a registered trademark of the Canadian Standards Association.

1SM1-A

This text indicates that the instrument is an Industrial Scientific and Medical Group 1 Class A product (CISPER 11, Clause 4).



This symbol indicates that the power line switch is ON.



This symbol indicates that the power line switch is OFF or in STANDBY position.

Safety Earth Ground



This is a Safety Class I product (provided with a protective earthing terminal). An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set. Whenever it is likely that the protection has been impaired, the product must be made inoperative and secured against any unintended operation.

Before Applying Power

Verify that the product is configured to match the available main power source as described in the input power configuration instructions in this manual. If this product is to be powered by autotransformer, make sure the common terminal is connected to the neutral (grounded) side of the ac power supply.

Overview

Description

The Agilent 537A coaxial frequency meter is used for measuring frequency in the 0.96 to 12.4 GHz range. Accuracy is obtained from the spiral scale. The meter contains a coaxial line coupled to a quarter-wavelength coaxial resonant cavity loaded with capacitance at the bottom of the band. At resonance, power is absorbed by the cavity, producing a dip in the coaxial line power. The frequency at which this dip occurs is read directly from the dial in gigahertz.

Tuning is accomplished by moving a piston. A precision lead screw, which is spring-loaded to prevent backlash, is used to position the piston in the cavity. Due to the design of the cavity, its electrical length is extended at lower frequencies, and there are no spurious modes.

Specifications

The instrument specifications are provided in [Table 1 on page 1](#).

Table 1 *Specifications*

Characteristic	Value
Frequency range	3.7 to 12.4 GHz
Reflection coefficient off-resonance	0.33 (2.0 SWR, 9.5 dB return lost)
Calibration increments	10 MHz
Dimensions	
Height	5-3/4 in (146 mm)
Diameter ¹	3-1/2 in (89 mm)
Weight	3-1/2 lb (1.6 kg)
Dip at resonance	1 dB (minimum)
Dial accuracy ²	±0.1%

1. Width (including connector): 4-5/8in (118 mm).

2. Overall Accuracy: ±0.17% which includes allowance of ±0.02% for 0 to 100% relative humidity, ±0.0016 per °C from 13 to 33°C and 0.03% backlash.

Measurement

A detector and indicator are required to indicate the dip in coaxial line power at resonance. It is recommended that 10 dB of attenuation be placed between the signal source and the frequency meter. If insufficient power is available to use a 10 dB attenuator, an attenuator offering less attenuation may be used, to a minimum of 3 dB. The attenuator prevents a shift in the frequency of the signal source due to line impedance changes at resonance.

Overview

The detector-indicator combination can be a thermistor mount and power meter such as the Agilent 478A and 432A, or a crystal detector and SWR meter. If a SWR meter is used as the indicator, the signal source must be modulated at 1000 Hz (sine or square wave modulation). For visual display, an oscilloscope can be used as the indicator. When using an oscilloscope for swept frequency displays, be sure to sweep the oscilloscope at the same rate as the signal source. Resonance will be noted as a dip in the oscilloscope pattern

CAUTION

Do NOT run dial into stops at either end of dial

If frequency measurement is one part of the measurement procedure, be sure to move meter off resonance before proceeding with other measurements.

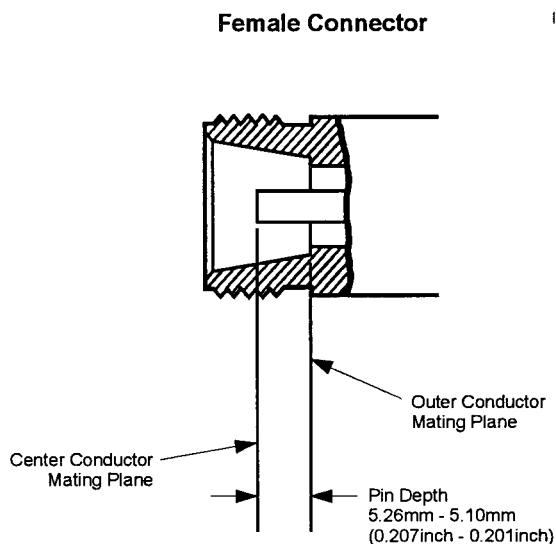


Figure 1 Type-N Connector Dimensions

Connectors The input and output connectors are type-N, female and are compatible with connectors whose dimensions conform to MIL-C-39012.

N-female Pin Depth: 0.207 to 0.201 in (effective 0 to -0.006)

Performance Test

Purpose

The procedures listed in [Table 2](#) and [Figure 3 on page 7](#) check performance for incoming inspection, periodic evaluation, and calibration. The tests are performed without access to the instrument interior. The performance standards are contained in [Table 1 on page 1](#).

Recommended Test Equipment

Test instruments required to make the performance checks are listed in [Table 2](#). Instruments other than those listed may be used provided their performance equals or exceeds the critical specifications given.

Table 2 *Recommended Test Equipment*

Instrument	Critical Specifications	Suggested Agilent Model	Use ¹
Sweep Oscillator	CW and swept-frequency signal in 0.96 to 12.4 GHz range Output: at least +7 dBm	8620C Mainframe (with appropriate RF plugins)	P,T
Directional Coupler	Frequency: 1.7 to 12.4 GHz, Directivity: >26 dB	779D	P,T
Crystal Detector	Frequency: 0.96 to 12.4 GHz, Sensitivity: >0.4 mV/uW		P,T
Oscilloscope	Vert. Sens: <20 mV/dm, Horiz. Sensitivity: <1 V/cm		P,T
Counter	Frequency: 0.96 to 12.4 GHz, Sensitivity: <-7 dBm		P,T

1. P= performance tests, T= troubleshooting.

Maintenance

For dial-stop gear replacement and/or instrument recalibration, refer to [Figure 4 on page 12](#). For any other repair needs, contact your local Agilent Technologies Sales and Service office for instructions and assistance.

Return Loss Specifications

537A reflection coefficient off-resonance: 0.35 (2.0 SWR, 9.5 dB return loss).

Description

As shown in [Figure 2 on page 4](#), two detectors are connected together with a modulator, swept amplitude analyzer, and a dual directional coupler in a reflectometer test setup. The reflectometer is calibrated using a short. The 537A coaxial frequency meter under test is connected and the return measured.

Performance Test

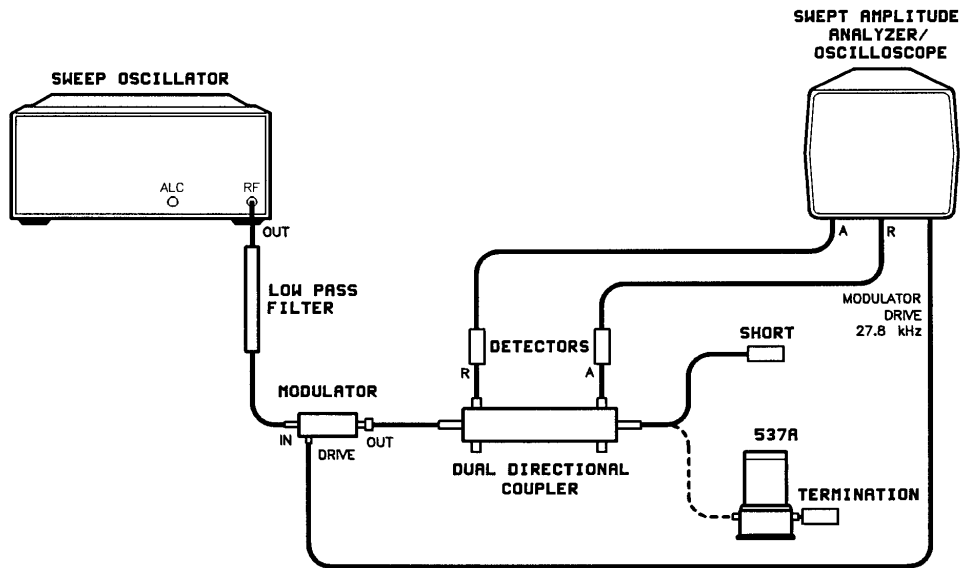


Figure 2 Return Loss Test Setup

Table 3 Equipment

Instrument Type	Suggested Agilent Model	GHz or Connector type
Sweep oscillator	8620C mainframe (with appropriate RF plugins)	-
Dual directional coupler ¹	778D 779D	110 MHz to 2 GHz 1.7 to 12.4 GHz
Detectors (2 required)		-
Modulator		-
Swept amplitude analyzer/oscilloscope		-
Coaxial short		Type-N female Type -N male APC-7
Low-Pass Filter(s)		700 MHz cutoff 1.2 GHz cutoff 2.2 GHz cutoff 4.1 GHz cutoff
Termination(s)		APC-7 Type-N male

1. Two single directional couplers connected as a dual directional coupler can also be used.

Procedure

1. Connect the equipment as shown in [Figure 2](#).
2. Set the analyzer control to 0 dB.
3. Set CHANNEL A OFFSET CAL switch to OFF
4. Press CHANNEL A DISPLAY POSITION push button.
5. Adjust CHANNEL A screwdriver adjustment marked POSITION to place trace on the center graticule. Increase resolution and make fine adjustment.
6. Place short on reflectometer.
7. Press CHANNEL A push buttons marked DISPLAY R and 10 dB/DIV
8. Set the sweep oscillator to sweep the band of interest.
9. Adjust the sweep oscillator output power level to place the trace on the second graticule below the center graticule. (Power input is -20 dBm to the R detector.)
10. Press CHANNEL A push button marked DISPLAY A/R.
11. Turn CHANNEL A OFFSET CAL control to ON and adjust the OFFSET CAL control to place the trace on the center graticule.
12. Increase the dB/DIV resolution by steps to 0.25 dB/DIV if necessary, adjust the OFFSET CAL control to return the trace to the center graticule.
13. Disconnect the short from the reflectometer test port.
14. Connect the 537A under test to the reflectometer test port by disconnecting the short and inserting the properly terminated 537A under test.
15. Use CHANNEL A OFFSET dB thumbwheel to return the trace to the center of the screen, or as close as possible.
16. Read the return loss at the CHANNEL A OFFSET dB window and on the oscilloscope. Return loss is the total indication of both the CHANNEL A OFFSET dB window and the trace on the oscilloscope. Add the trace indication to the window reading if the trace is below the center graticule, subtract if above.

Performance Test

17. Return loss measured should be equal to or greater than the following limits:

Table 4 *Return Loss Limits*

	Lower Limit of Reading		
	Coupler Directivity		
Specification	26 dB	30 dB	40 dB
20.8 dB	27.8 dB	24.6 dB	21.9 dB
9.5 dB	11.0 dB	10.5 dB	9.8 dB

18. If the above limits are not met, test the 537A using a slotted line at the frequency in question.

Overall Accuracy

Specification for the 537A: $\pm 0.17\%$ overall accuracy.

Description

A sweep oscillator, 537A under test, detector, and oscilloscope are connected in series. The sweep oscillator is set to AF to sweep the band in question. The 537A is set to the frequency in question and the notch located on the trace. The sweep oscillator is set to CW and adjusted to the center of the absorption notch of the 537A. The frequency of the sweep oscillator is measured with a counter and compared with the specifications in [Table 1 on page 1](#). The sweep oscillator is set to automatic sweep and the notch depth across the band is checked.

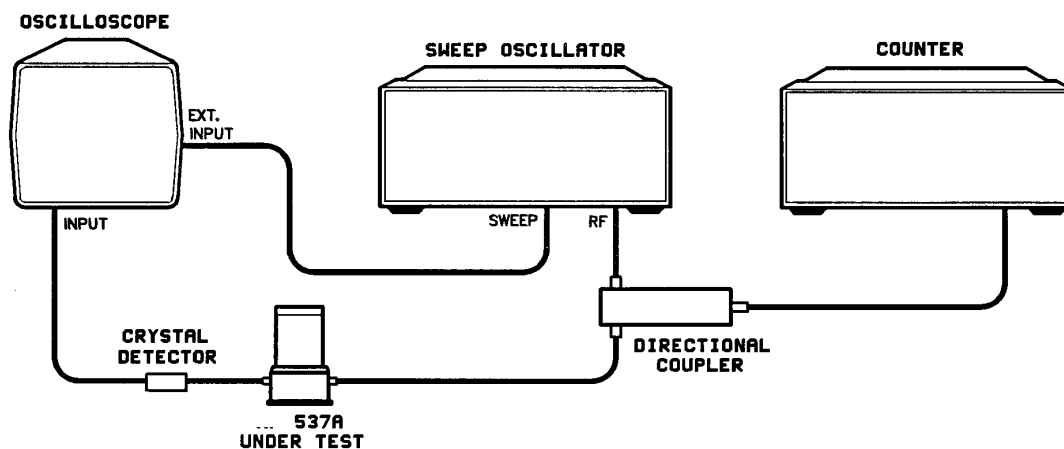


Figure 3 Overall Accuracy Test Setup

Table 5 Test Instruments

Instrument Type	Suggested Agilent Model	Frequency Range (GHz)
Sweep Oscillator	8620C mainframe (with appropriate RF plugins)	0.5 to 2.4
	86222A/B	1.7 to 4.3
	86235A	3.6 to 8.6
	86240C	5.9 to 12.4
	86245A	
Directional Coupler	779D	
Crystal Detector	423A	
Oscilloscope	1740A	
Counter	5342A	

Overall Accuracy

Procedure

1. Connect the equipment as shown in [Figure 3 on page 7](#).
2. Set oscilloscope for a vertical sensitivity of about .02 V/cm (ac) and horizontal sensitivity of about 1 V/cm.
3. Set sweep oscillator for ΔF automatic sweep of about 3.8 GHz + 12 MHz for 537A.
4. Set the 537A to 3.8 GHz.
5. Locate the frequency meter notch and center it on the display by adjusting the sweep limits on the sweep oscillator.
6. Set the sweep oscillator to CW and adjust the frequency to the center of the notch (lowest indication on the oscilloscope).
7. Read the frequency on the counter. Frequency should be within the specifications given in [Table 1 on page 1](#).
8. Repeat above procedure every 200 MHz across the band.
9. Set sweep oscillator to automatic sweep and tune the 537A across frequency range of sweep oscillator. The notch travel across the frequency range should cause at least the notch depth given in Table 1-1.

Stop Gear Replacement Procedure

1. Upon completion of the stop gear replacement it will be necessary to check the frequency calibration of the instrument.
2. The following special tool is required for this procedure. A Waldes No. 3 Truarc pliers with tips bent 45 degrees.
3. For the following procedures refer to [Figure 4 on page 12](#) and [Figure 1 on page 1](#).

Disassembly Procedure

(Numbers in parentheses refer to numbers on drawing in Figure 4. To replace the stop gear, proceed as follows:

1. Remove knob (1).
2. Scribe dial position to give approximate location of dial on dial holder. Do not use pencil as this may be inadvertently erased.
3. Unscrew dial-window retaining nut (3).
4. Remove nut and window
5. Loosen two No. 6 Allen set-screws (9) holding dial. These are located on the inside of dial holder (10).
6. Turn dial holder until cap (7) is approximately flush with top of dial holder (near high frequency stop position).
7. Scribe a line from lead screw on plunger to cap for later alignment.

8. Loosen both No. 6 Allen set screws (9) holding cap in place on lead screw. These are internal and may be found by looking through the two inspection holes in dial holder. These are spaced approximately 90 degrees apart.
9. While holding cap in place, back out both screws sufficiently to allow removal of cap. This should be approximately three full turns of the Allen screw. If spring and cap jump out, replace them with big-diameter end of spring at bottom.

CAUTION

Do not turn or remove plunger.

10. Turn the 537A upside down and remove the Truarc retaining-ring holding dial holder (3). (This requires special Truarc pliers. It may be necessary to adapt some of your own tools to the job of removing the retaining ring.).
11. Lift 537A off dial holder and place base assembly upright again. Examine both sections for pieces of broken stop gear.
12. Inspect bearing and gear rack to make sure that these hasn't been damaged by portions of the broken stop gear. If any of the internal workings other than stop gear have been damaged, it will be necessary to return to the factory for a major rebuilding.

Reassembly Procedure

1. Replace dial holder, taking care not to damage gears when engaging stop gear with gear rack
2. Check rotation of the dial holder. There should be approximately 11-1/4 turns of the dial. If not, disengage and try again with a new gear position.
3. When the stop gear is positioned to give approximately 11-1/4 turns from stop to stop, secure dial holder with the Truarc retaining ring. Make sure ring is seated properly on inside groove of dial holder.
4. Turn dial holder to stop at high-frequency end of dial.
5. Insert spring into dial holder.
6. Replace cap by compressing spring. Note alignment of cap and lead screw. See steps 6 thru 9 of disassembly procedure.
7. Tighten both No. 6 Allen set-screws holding cap to lead screws.
8. Turn from stop to stop. Check for binding or other erratic behavior. It may be necessary to make slight adjustments in cap position so that no binding occurs during rotation.
9. Turn dial holder counterclockwise (toward lower frequency) to expose dial retaining set screws.

Overall Accuracy

10. Place dial on dial holder and check alignment with scribe mark of step 2.

11. Tighten both No. 6 Allen set-screws to hold dial in place.

CAUTION

Do not tighten excessively as knob may not slip into place over the dial/dial holder.

12. Turn dial clockwise near the stop at the high-frequency end and place both cursors (6) into the dial grooves to indicate approximately 12.4 GHz.

13. Carefully replace window making sure that cursors ride in the window grooves.

14. Align window with base. Window keys must be in the window retention grooves.

15. Replace window-retaining nut.

16. Turn from stop to stop. Check for binding or other erratic behavior. It may be necessary to make slight adjustments in screw tightness or dial position so that no binding occurs during dial rotation.

17. When assured of smooth operation, check calibration. Calibration should be reasonably close if care was taken in alignment of the cap lead screw and dial. Replace knob.

Calibration Procedure

Test equipment recommended for testing the 537A are listed in [Table 2 on page 3](#). Test equipment other than that recommended may be substituted if their performance equals or exceeds the minimum required specifications given. [Figure 2 on page 4](#) and [Figure 3 on page 7](#) list procedures for checking instrument specifications. If dial accuracy is not within listed specifications, adjust 537A as detailed in the Calibration Alignment Procedure, as follows.

Calibration Alignment Procedure

If dial accuracy of the 537A is not within specifications. The following procedure can be used for readjustment.

1. Remove knob (1).
2. Remove base (11) retaining screws. With base retaining screws removed, place the 537A in upright position and make electrical hookup for OVERALL ACCURACY TEST.
3. In the original high-frequency end setting, 12.4 GHz is set almost one-half turn (about 150 degrees) counterclockwise from the stop. The dial (5) is held to the dial holder (10) by two set screws (9). Check frequency accuracy at 12.4 GHz, and if not within overall accuracy specification, loosen set screws (9) and slip dial. The set screws are loosened from inside the dial holder; the dial must be rotated about 6 turns before the access holes become visible.
4. The low-frequency end adjustment is made at 3.7 GHz by moving capacitive load with two cap screws. This adjustment should not change the high frequency setting.
5. Check dial accuracy in vicinity of 3.7 to 4.1 and 8.2, 12.0, and 12.4 GHz. Reposition the dial, or capacitive load if a compromise is necessary
6. If accuracy specifications cannot be met, further disassembly is not recommended. The unit should be returned to your local Agilent Technologies Sales and Service office.
7. Replace base and knob.

Calibration Procedure

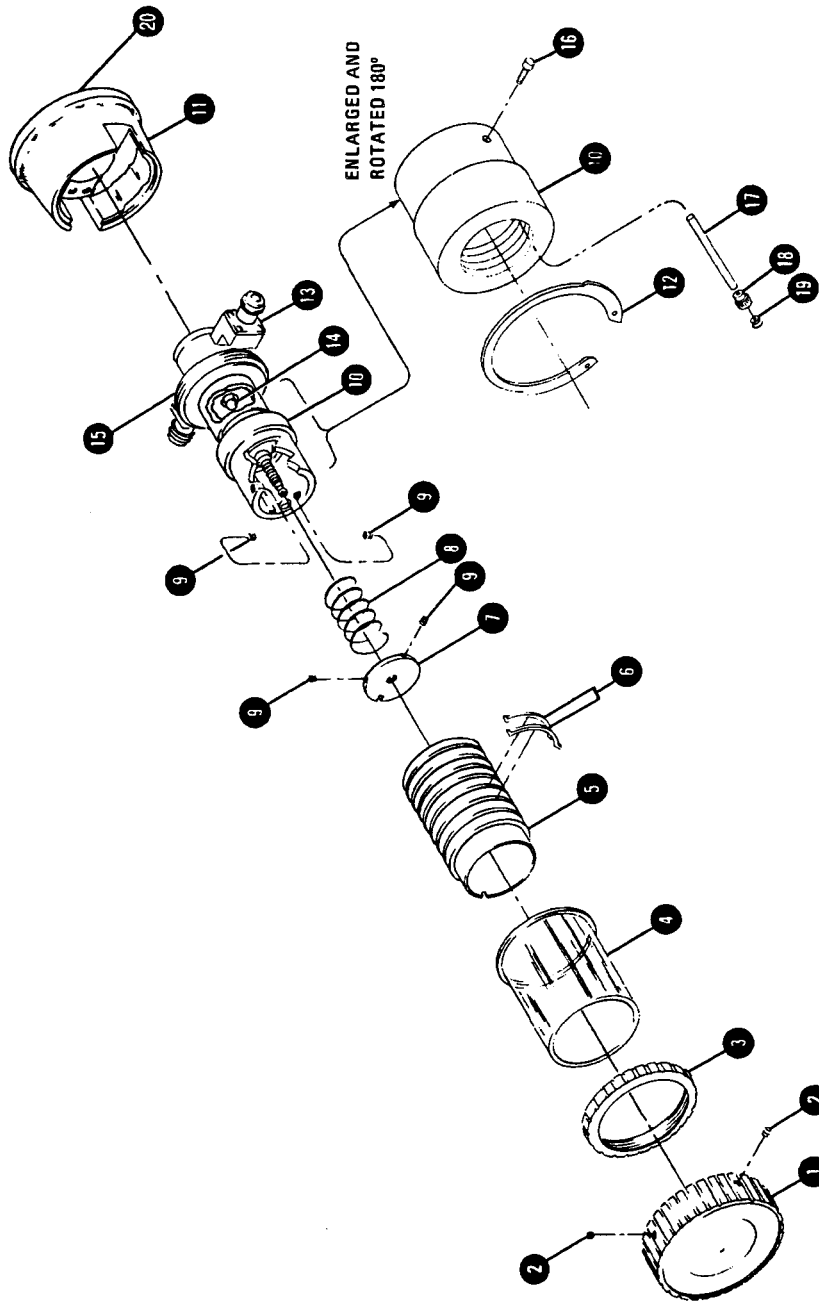


Figure 4 537A Repair and Recalibration.

Replaceable Parts

Table 6 *Replaceable Parts*

Reference Designator ¹	Description	Part Number	Quantity
1	Knob	5040-6950	1
2	Screw, set 8-32 x 3/16	3030-0001	2
3	Nut, dial window retainer	00532-40005	1
4	Window	K532A-18	1
5	Dial	00537-20031	1
6	Cursor	K532A-20	2
7	Cap	R532A-16	1
8	Spring, lead screw	1460-0044	1
9	Screw, set 6-32 x 1/4	3030-0106	2
10	Holder, dial	P532A-4	1
11	Base	00537-20029	1
12	Ring retaining	0510-0069	1
13	Coupling loop assembly	00537-601	
14	Bearing, ball	1410-0005	1
15	Window support	00537-206	
16	Screw, fill Hd 2-56 x 1/4	0520-0012	
17	Shaft stop gear	P532A-5	1
18	Gear stop	P532A-19	1
19	Ring, retaining	0510-0070	1
20	Cork ring	2190-0345	1

1. See Figure 4 for parts location.