HEWLETT hp PACKARD

CRYSTAL DETECTOR

models 423A & 8470A

OPERATING NOTE 5 MARCH 1969

16-6-001 - C2

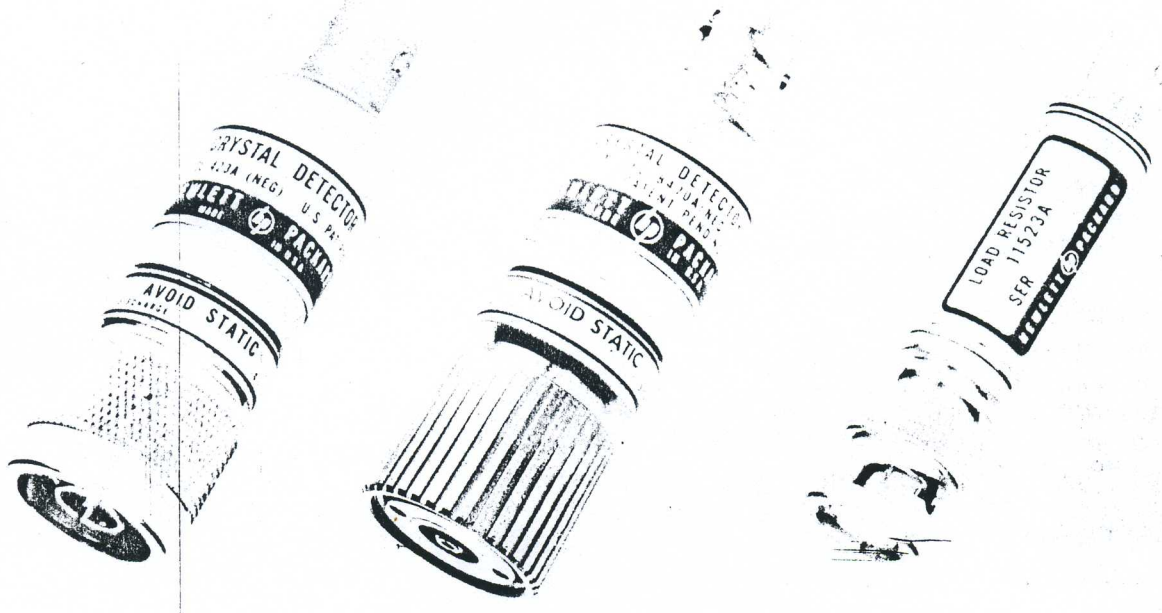

Figure 1. Models 423A and 8470A Crystal Detectors and Model 11523A Load Resistor

1. INTRODUCTION.

2. The 423A and 8470A Crystal Detectors are 50-ohm (nominal) devices designed for measurement use in coaxial systems. They measure relative power up to 100 mW, and have a BNC output jack to connect the detected output to a meter, such as the 415E. Frequency range of the 423A is 10 MHz to 12.4 GHz. The 8470A has additional range up to 18 GHz.

3. Output polarity of the Detectors is negative unless the Option 03 version is purchased. Specifications and Options are listed in Table 1.

4. The optional Load Resistor, Model 11523A, is mounted in a separate housing to permit easy conversion from optimum square law to maximum output. Each load is identified by the serial number of the Detector to which it is matched. If you have more than one Model 11523A, always be sure that the proper one is in use for the Detector you are using.

5. PRECAUTIONS.

6. ELECTRICAL SHOCK.

7. DISCHARGE OF STORED ELECTRICAL ENERGY CAN EASILY DAMAGE THE CRYSTAL DETECTOR. A 100-pF capacitor, the equivalent of four feet of coaxial cable, charged to 14 volts stores 0.1 erg of energy which is the maximum safe pulse rating of the detector. Be certain that a cable is connected to associated equipment and discharged before connecting it to crystal detector.

8. HANDLING DETECTOR ELEMENT.

9. DO NOT HANDLE DETECTOR ELEMENT USED IN CRYSTAL DETECTOR NEEDLESSLY. Static electricity which builds up on a person, especially on a cold, dry day, must never be allowed to discharge through the Crystal Detector. Avoid exposed leads to or from the Crystal Detector, since these are often touched accidentally. Refer to Paragraph 24 for proper precautions.

01613-9

00423-90011

Printed in U.S.A.

1501 Page Mill Road, Palo Alto, California, U.S.A., Cable: "HEWPACK" Tel: (415) 326-7000

Europe: 54 Route Des Acacias, Geneva, Switzerland, Cable: "HEWPACKSA" Tel. (022) 42.81.50

Table 1. Specifications

Frequency Range:

423A: 10 MHz to 12.4 GHz.

8470A: 10 MHz to 18 GHz (Below 1 GHz, RF may leak through the video output connector. It can be eliminated, if objectionable, with suitable low pass filter.)

Frequency Response:*

423A: ±0.2 dB/octave 10 MHz to 8 GHz; ±0.5 dB overall.

8470A: ±0.2 dB/octave 10 MHz to 8 GHz; ±0.5 dB to 12.4 GHz; ±1.0 dB overall.

Maximum Power: 100 mW, peak or average.

Sensitivity at 25°C:

High Level: < 0.35 mW produces 100 mV output.
Low Level: > 0.4 mVdc/μW CW.
Output decreases with increasing temperature. Typically 0.015 dB/°C from 0°C to 55°C.

Impedance: 50 ohms.

Reflection Coefficient:

423A and 8470A: 10 MHz to 4.5 GHz, 0.091 (1.2 SWR); 4.5 GHz to 7.0 GHz, 0.15 (1.35 SWR); 7.0 GHz to 12.4 GHz, 0.2 (1.5 SWR).

8470A: 12.4 GHz to 18.0 GHz, 0.26 (1.7 SWR).

Output Impedance: < 15kΩ shunted by 10 pF.

Detector Element: Supplied. (Refer to Table 2 for replacement assemblies.)

Output Polarity: Negative. (Refer to options for positive polarity units.)

Noise: < 200 μV p-p, with CW applied to produce 100 mVdc output.

*As read on a meter calibrated for square-law detectors (such as HP 415E SWR Meter).

Connectors:

423A:

Option 01: Matched pair. Frequency response characteristics (exclusive of basic sensitivity) track within ±0.2 dB per octave from 10 MHz to 8 GHz, ±0.3 dB from 8 to 12.4 GHz.

Option 02: Furnished with matched load resistor (11523A) for optimum square law characteristics at 24°C (75°F),* < ±0.5 dB variation from square law over a range of at least 30 dB up to 50 mV peak output working into an external load > 75k ohms. Sensitivity typically > 0.1 mV/μW when load resistor is used. Overall length 4-1/2 in. (144 mm).

Option 03: Positive polarity output.

8470A:

Option 01: Matched pair. Frequency response characteristics (exclusive of basic sensitivity) track within ±0.2 dB per octave from 10 MHz to 8 GHz, ±0.3 dB from 8 to 12.4 GHz, ±0.6 dB from 12.4 to 18 GHz.

Option 02: Furnished with matched load resistor (11523A) for optimum square law characteristics at 24°C (75°F),* < ±0.5 dB variation from square law over a range of at least 30 dB up to 50 mV peak output working into an external load > 75kΩ. Sensitivity typically > 0.1 mV/μW when load resistor is used. Overall length 4-1/2 in. (144 mm).

Option 03: Positive polarity output.

Option 12: Furnished with stainless steel type N male connector.

Option 13: Furnished with stainless steel type N female connector.

10. GENERAL.

11. The Crystal Detector can be used as a demodulator to obtain a pulse envelope which can then be observed on an oscilloscope. It can also be used as a general purpose detector.

12. When using the Crystal Detector with an oscilloscope and the waveshapes to be observed have rise times of less than 5 μsec, the coaxial cable connecting oscilloscope and detector should be as short as possible and shunted with a resistor. Ideally, this resistor should be 50 ohms to terminate the coaxial cable properly. However, with 50 ohms resistance, possibly the output video pulse may be too small to drive some oscilloscopes. Therefore, the cable should be shunted with the smallest value of resistance that will obtain suitable deflection on the oscilloscope; typically the value will lie between 50 and 2k ohms. The larger the resistance the more degradation of rise time.

13. The power applied to the Detector can be either modulated or continuous wave (CW). If modulated at a 1000-cps rate, the sensitive HP Model 415B/E can be used as the indicator. For CW detection, a dc milliammeter or millivoltmeter such as the HP Model 425A Microvolt-Ammeter can be used as the indicator.

14. PEAK POWER MEASUREMENT.

15. The arrangement of equipment for peak power measurement is shown in Figure 2. The procedure involves calibration of an oscilloscope which in turn is used to calibrate a CW generator. The output of the calibrated CW generator is measured with a power meter; the peak power of a pulse is thereby measured. The procedure is as follows:

a. Connect equipment as shown in Figure 2, step 1.

b. Observe pulse on a dc-coupled oscilloscope. Using a marking pencil, mark on the graticule the base-to-peak amplitude of the pulse envelope.

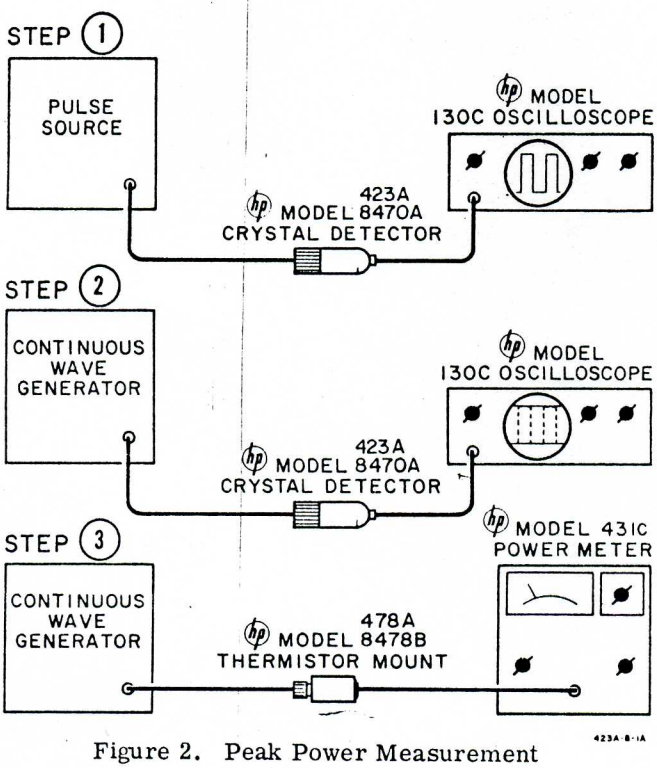

Figure 2. Peak Power Measurement

c. Replace the pulse source with a CW generator (step 2). While observing the oscilloscope trace, adjust amplitude of CW generator output to make crystal output equal to that of pulse generator as indicated by markings on graticule (step b).

d. While performing the next step, leave CW generator at setting obtained in step c. Disconnect Detector from CW generator. Connect output of CW generator to a thermistor and power meter. Measure adjusted level (step c) of CW generator output.

e. The peak power of the pulse envelope observed in step b is equal to the output power of the CW generator.

16. REFLECTOMETER APPLICATION.

17. For information about reflectometer systems and measurements, see HP Application Notes 54 and 61 and Hewlett-Packard Journal Vol. 12, No. 4, copies of which are available upon request.

18. HARMONIC FREQUENCY-COMPARISON MEASUREMENTS.

19. The Detector can be used as a mixer in harmonic-frequency comparison measurements. See HP Application Note 2.

20. REPLACEMENT OF PARTS.

21. Succeeding paragraphs give instructions for repair of the Detector, and the Option 02 Load Resistor, Model 11523A. Additional maintenance information can be obtained from your local Hewlett-Packard field office. Stock numbers for replaceable parts are given in Table 2.

22. The detector element assembly includes a detector element, an Option 02 load resistor for the 11523A, capacitive washer and a capsule spacer. The resistor is to load the diode for square-law operation, the capacitive washer is to match the diode for VSWR, while the capsule spacer is mainly for flatness of sensitivity. All should be replaced as a unit when the diode is replaced.

23. DETECTOR ELEMENT REPLACEMENT.

WARNING

The special detector element (see Figure 3) contained in the Detector can be damaged in handling, removal, or installation if certain precautions are not taken. The handling precautions which follow should be read before performance of any operation with the detector element when it is out of either the housing or the detector element shipping container.

24. DETECTOR ELEMENT HANDLING PRECAUTIONS.

a. Before installing detector into mount, touch exposed metal on mount with your hand to discharge static electricity. Then insert detector into mount.

b. When handing crystal to another person, touch hands first to ensure there is no difference in static electricity potential between you.

c. Ohmmeters should NOT be used to measure forward- and back-resistance since it is rather easy to damage these diodes. (The difficulty arises because of the ohmmeter open-circuit voltages and short-circuit currents. It is easy for these currents or voltages to damage the diode.)

25. REPLACING DETECTOR ELEMENT.

26. Parts mentioned in the following procedure are identified in Figure 3.

a. Remove connector cap from body. To remove connector cap, use a pair of gas pliers with plastic teeth or protect body with heavy paper or tape.

b. Remove old detector element, capsule spacer, and capacitive washer, and discard them.

c. Install the new capacitive washer, capsule spacer, and detector element. Install the washer first, the spacer with its polyiron side against the washer. Finally, install the detector element by inserting the resistive end into the center contact inside the Detector body.

CAUTION

When inserting the detector element, do not force the tip (resistive end) into the center conductor in the body as the fingers of the center conductor might be damaged.

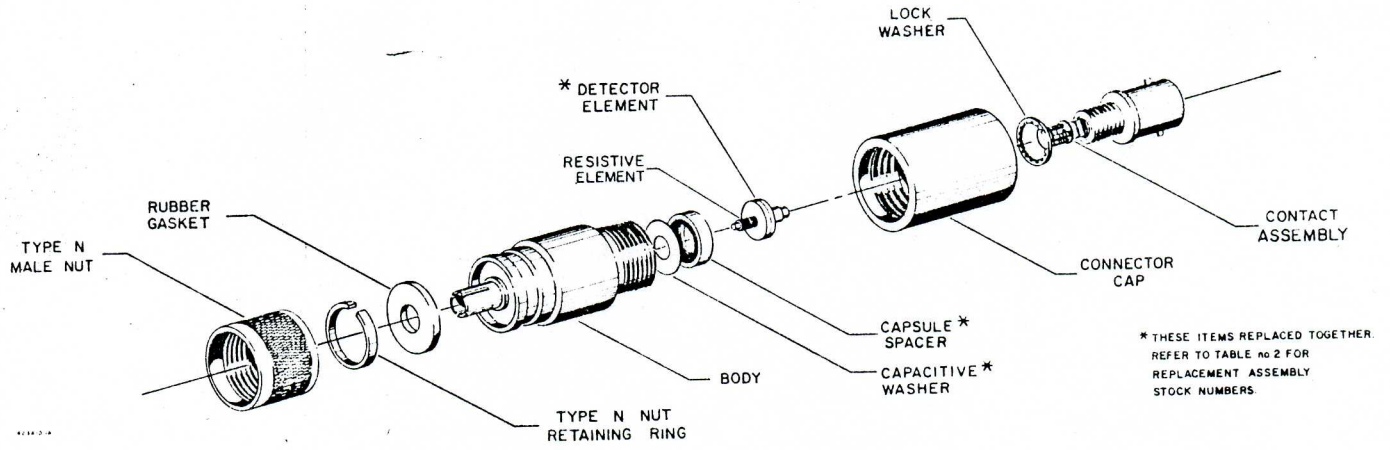

Figure 3. Model 423A Assembly

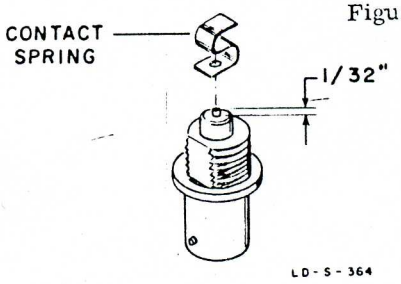

Figure 4. Cutting Center Conductor Lead to Accommodate Contact Spring

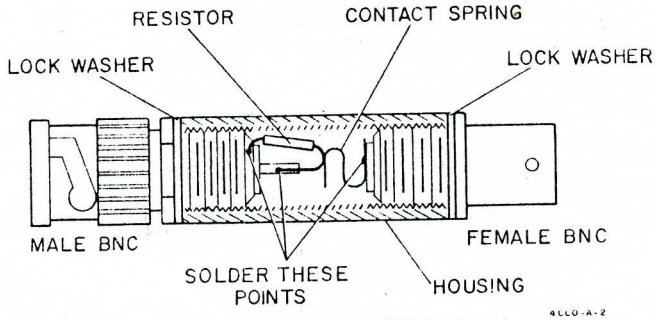

Figure 5. Model 11523A Load Resistor, Cutaway View

d. Replace connector cap and TIGHTEN FIRMLY.

Note

The Option 02 Detector Element Assembly includes a detector element and a resistor. The resistor is for use in the Model 11523A and must be installed to match it to the Detector.

27. REPLACING OUTPUT BNC CONNECTOR.

28. TOOLS REQUIRED.

a. Needle-point soldering iron

b. Wire cutters

d. Flat file, #4

d. Tweezers

29. PROCEDURE. Parts mentioned in the following procedure are identified in Figures 3 and 4.

a. Remove BNC connector and lockwasher.

b. Unsolder contact spring soldered to center conductor lead.

(1) Cut center conductor lead to approximately 1/32 inch (see Figure 4).

(2) With flat file, smooth end of lead; wipe off burr with tweezers or similar metal instrument.

c. Slip contact spring over center conductor lead, and solder.

CAUTION

Use solder sparingly or it will creep back on spring. Solder on spring destroys its usefulness, and solder is difficult to remove from spring.

d. Let spring cool, and then replace lockwasher and connector in connector cap.

30. REPLACEMENT OF 11523A PARTS.

31. Parts mentioned in the following procedure are identified in Figures 4 and 5. Tools required are listed in Paragraph 28.

32. REPLACING MALE BNC CONNECTOR.

a. Remove male BNC connector and lock washer from housing. To remove BNC, use a 3/8-inch open-end wrench and hold the housing either in a vise or with gas pliers. Before putting pliers on, protect the housing of the 11523A with material such as heavy paper.

b. Unsolder resistor.

c. Solder resistor to new BNC.

d. Let resistor cool and then check resistance from male BNC pin through resistor; resistance measured should be ±10% that indicated by the coding.

e. Replace lockwasher and male BNC.