



A New 10 MC to 12 KMC Coaxial Crystal Detector Mount

A NEW general-purpose coaxial crystal detector mount has been developed to operate over the entire range from 10 megacycles to 12.5 kilomegacycles. Since this range is essentially

SEE ALSO:
"New Decade
Counters," p. 2
"New Matching
Transformers," p. 4

the complete range practical for coaxial systems, this one mount can be used for all ordinary coaxial-system detector applications. A feature of

the mount is that it has been designed to have reduced sensitivity to variations in crystal characteristics.

The new mount has a rated sensitivity of approximately 0.1 volt per milliwatt and a maximum input power rating of 1 milliwatt. Its frequency characteristic is such that its output is constant within approximately 4 db over the rated frequency range for a constant applied power. Its VSWR does not exceed 3:1. Output

from the mount is provided at a negative polarity.

Either of the physically-identical 1N26A or 1N76 silicon crystals can be used in the mount, but it is supplied with a type 1N76 and this type is available for replacement purposes. To assist in obtaining the wide frequency range that the mount has, the crystals are modified by removing part of the outer shell. Crystals on which this modification has been made are available for replacement purposes, although the modification can also be made by the user.

Crystal detector mounts of this type are generally used in one of two applications: as demodulators for pulse-modulated power where it is desired to view the pulse shape on an oscilloscope, or as simple detectors of r-f power. In simple detector applications, the power can be either modulated or c-w. With modulated power the mount can be combined with a suitable a-c indicator such as a standing-wave indicator or high-gain voltmeter. With c-w power the mount can be used with a d-c microammeter.

As is customary with detector mounts, no video load resistor is included in the mount, since the value of the load resistance usually must be chosen to suit the application. When using detector mounts for viewing pulses on an oscilloscope, the load resistance should be selected commensurate with the required pulse rise time and oscilloscope sensitivity. The mount has an output capacity of approximately 30 micromicrofarads. Typically, therefore, rise times in the order of 0.1 microsecond can be obtained with load resistances of a few hundred ohms in the usual set-up. If the applied r-f level is ap-



Fig. 1. New -hp- Model 420A Crystal Detector Mount operates over 10 mc to 12 kmc range.

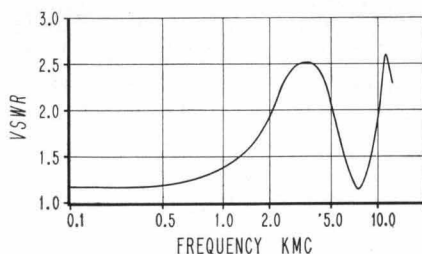


Fig. 2. Typical VSWR characteristic of -hp- 420A Detector Mount.

proximately 1 milliwatt, this arrangement will give sufficient output for operating commonly-used oscilloscopes.

Faster rise-times in the order of a few millimicroseconds can be obtained by operating the mount into still lower impedances. The usual way of doing this is to use a terminated 50-ohm cable. This is done at the expense of output voltage, how-

ever, and it may be necessary to insert additional fast amplification ahead of the oscilloscope.

When crystals are being used as r-f detectors, it is sometimes desirable that the crystals have as accurate a square-law characteristic as possible. Although some improvement in the square-law accuracy of the crystal at levels above about -15 dbm can often be obtained by selecting the value of the load resistance, the resistance of auxiliary equipment such as the microammeter or standing-wave indicator will usually be the determining factor. Loads that optimize the higher-level square-law accuracy of the crystal will usually be in the order of a few kilohms, but will vary with individual crystals.

-N. B. Schrock

SPECIFICATIONS

-hp-

MODEL 420A WIDE BAND

CRYSTAL DETECTOR

FREQUENCY RANGE: 10 mc to 12.5 kmc.

SENSITIVITY: Approx. 0.1 volt/milliwatt.

FREQUENCY RESPONSE: Approximately ± 4 db change in rectified output voltage over entire frequency range for constant input from a 50-ohm source.

MAX. SWR: 3.

OUTPUT POLARITY: Negative.

OUTPUT CAPACITY: Approx. 30 mmf.

INPUT CONNECTOR: UG-21B/U, Type N.

OUTPUT CONNECTOR: Type BNC.

SIZE: $\frac{3}{4}$ " diameter, 3" long.

SHIPPING WEIGHT: Approximately 1 lb.

DETECTOR ELEMENT: 1N76 Crystal, modified (-hp- 444A-25E), \$15.00 f.o.b. Palo Alto

PRICE, WITH CRYSTAL: \$50.00 f.o.b. Palo Alto, California.

Data subject to change without notice

New Plug-In Decade Counters of Refined Design

SOME months ago -hp- began manufacturing a new 120 kc plug-in decade counter. When driven by suitable waveforms, such decades "count" by illuminating individ-

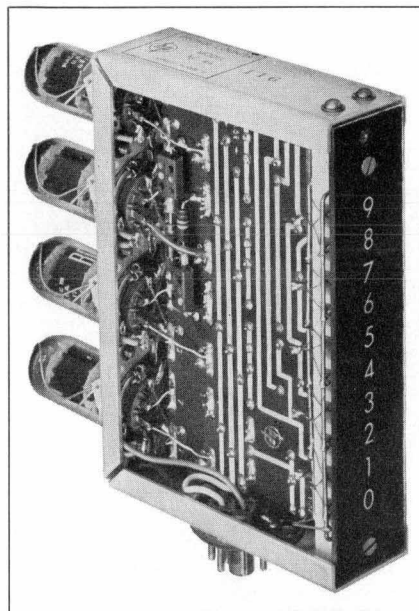


Fig. 1. -hp- 120 kc plug-in decade counter. Design features include etched circuit layout and output staircase.

ually in consecutive order a series of numerals from 0 through 9 which are arranged in a vertical column on a plastic strip. On the tenth applied waveform the circuit returns itself to 0 and generates an output pulse which can be counted by an additional decade counter. Commensurate with their maximum counting speed, any number of decades can be cascaded to enable counts to be made to any number of places. Such decades are used in frequency counters to count and display measured frequencies and time intervals.

The new decades have for some time been supplied in all -hp- counters and can be used for replacement purposes in all of the earlier -hp- counters. They are also interchangeable with other standard decades.

While the electrical design of the new decades is conventional, considerable care has been taken in mechanical execution to increase the reliability and convenience of the units. In addition, the units are de-

signed to provide an output staircase voltage which can be used to operate remote indicators.

Probably the most apparent feature of the new design is the use of etched circuits (Fig. 1) combined with dip-soldering techniques. This combination gives the unusually clean lay-out arrangement and accessibility of components illustrated in Fig. 2.

It may not be immediately apparent, however, that the lay-out design increases the electrical performance and reliability of the circuit. It can be seen in Fig. 2 that a balanced type layout is used for the components of the flip-flop circuits that comprise the decade, i.e., one-half of the mounting board is almost a mirror image of the other half. Such a lay-out has the advantage that stray capacities in the circuit are balanced. The result of the balanced layout is that a 20% or more increase in maximum counting rate is achieved for the units. Although rated at 120 kc,

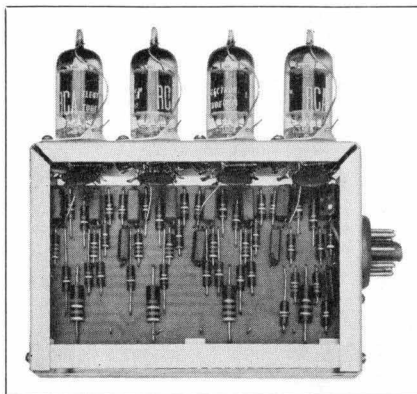


Fig. 2. *Balanced layout of components balances stray capacities, improves speed and driving characteristics.*

all units are tested for a minimum rate of 125 kc and many will operate to 140 kc. Even if they are used only at maximum rates of 100 kc as is done in the *-hp-* counters, it will be seen that a greater margin of reliability is obtained. The balanced arrangement further makes the limitations on the driving pulse less severe.

HIGHER READABILITY

As part of the mechanical design, the readability of the display has been significantly improved. A special reflector is used to give the numerals a more even illumination and this gives faster identification. Further, reverse engraving has been used on the face plate to increase the ease of reading from side angles.

ELECTRICAL DATA

The new decades require an 80-volt negative-going pulse of 1 microsecond maximum rise time for driving purposes, somewhat lower than the driving voltage of previous units because of reduced stray capacities in the new layout. If faster rise time is available, somewhat less amplitude can be used since the driving pulse is applied to a differentiating network of approximately 100 mmf in series with 15,000 ohms. Each decade provides an 80-volt negative-going output step for driving another decade. The oscillogram of the output voltage in Fig. 3 shows the quality of the waveform.

The output staircase is provided for use when it is desired to operate remote indicating meters. The staircase waveform decreases in approximately equal steps from 135 volts at a count of zero to 55 volts at a count of nine. These voltages are the open-circuit voltages which are provided from a high source impedance of 700 kilohms. The staircase output can be operated into any passive load from short circuit to open circuit without affecting the operation of the decade. The high source impedance in combination with inevitable capacities will cause the shape of the steps to deteriorate at higher counting rates, but this is of no consequence since it is the d-c level during the display time that operates the remote indicating meters.

The reset connection on the decade is intended to be connected to ground either directly or through a low impedance. Resetting to zero can be accomplished in simple setups by mechanically opening this connection. Electrical resetting to zero can be accomplished by pulsing a low impedance placed in the reset lead with a positive pulse of 150 volts amplitude with 1 microsecond rise time and a slower decay time of

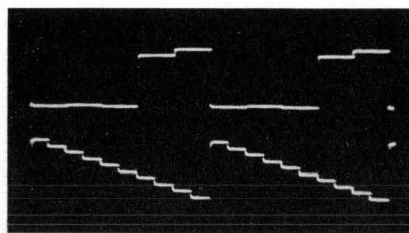


Fig. 3(a). *Oscillogram of output voltages from decade. Upper trace is output waveform, lower is output staircase.*

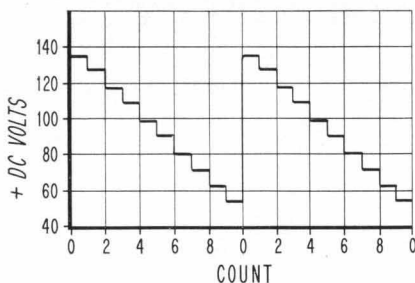


Fig. 3(b). *Explanatory drawing indicating voltage excursion and count relation. Plateaus correspond to counts.*

at least 3 microseconds. Resetting to nine can be accomplished where desired with a negative pulse of similar amplitude and speed.

The decade requires a nominal plate voltage of +300 volts at 15 ma and filament supply of 6.3 vac at 1.2 amperes. All connections to the decades are made by means of a standard octal tube base type plug which serves as the mounting base.

GENERAL

To insure long life and a high degree of freedom from trouble, the resistors in the decades are all 5%-tolerance or better while all but the cathode capacitors are of the silver mica type. Computer type 5963 tubes are used. Production samples of the decades have been subjected to a wide range of tests. Samples have been operated continuously for 60 days at ambient temperatures above 70°C without failure. Other samples have been stored in temperatures of -60°C and, when removed, operated satisfactorily as soon as the tube filaments heated. Samples have also passed the 100-hour salt spray test defined in Specification QQ-M-151A and the shock and vibration tests defined in Specification MIL-T-945.

—Marvin Willrodt

SPECIFICATIONS

-hp-

MODEL AC-4A PLUG-IN DECADE COUNTER

COUNTING RATE: 120 kc maximum.

DOUBLE-PULSE RESOLUTION: 5 microseconds.

INPUT VOLTAGE: Approx. 80 v negative pulse 1 μ sec rise time. (Less amplitude required for faster rise time.)

OUTPUT VOLTAGE: 80 volt negative pulse to drive succeeding AC-4A Counter.

RESET: (a) Reset to zero by opening base pin connection. (b) Reset to nine by applying negative pulse.

STAIRCASE OUTPUT VOLTAGE: 135 volts at count of zero, 55 volts at count of nine in 10 steps. Internal resistance, 700K. Operation of counter unaffected by load on staircase output.

POWER SUPPLY: Filament—6.3 v $\pm 10\%$ at 1.2 amp; Plate—300 v $\pm 10\%$ at 15 ma (nominal).

DIMENSIONS: 5 $\frac{5}{8}$ " deep x 1 $\frac{1}{4}$ " wide x 6 $\frac{1}{8}$ " high (overall).

MOUNTING: Standard; requires octal socket.

WEIGHT: 1 lb.; shipping weight approx. 2 lbs.

PRICE: \$45.00 f.o.b. Palo Alto, California. Quantity discount quotations available from the factory.

Data subject to change without notice

Two New Transformers for Measurements on Balanced Systems

SINGLE-ENDED electronic measuring instruments such as electronic voltmeters, distortion meters and wave analyzers can be used quite successfully to make measurements on balanced systems by introducing a high-performance transformer between the balanced system and the single-ended instrument. To enable single-ended *-hp-* instruments to be used in such applications, two new balanced transformers have been designed. One is especially useful in carrier-communications work and operates over a range from 5 kc to 600 kc at a maximum level of +22 dbm. The second is designed for audio work and operates from 20 cps to 45 kc at levels up to +15 dbm.

A schematic diagram of the 5 kc to 600 kc transformer is shown in Fig. 3. The switch shown in the diagram is built into the transformer case as are the resistances in the secondary circuit. The transformer is designed for use with either 135- or 600-ohm systems and can be made to have an input impedance of 135,

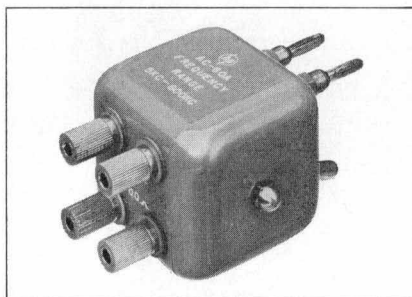


Fig. 1. *-hp- AC-60A Matching Transformer* is designed for carrier work, operates from 5 kc to 600 kc.

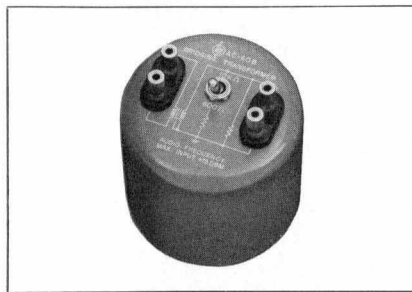


Fig. 2. *-hp- AC-60B Bridging Transformer* is designed for audio applications from 20 cps to 45 kc.

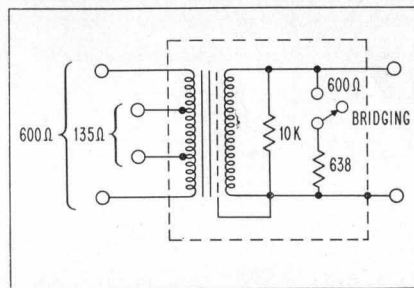


Fig. 3. Schematic diagram of *-hp- AC-60A*.

600, 2250, or 10,000 ohms as desired. It can thus be used either as a terminating or bridging device as required by the application. Typical arrangements are shown in Fig. 4.

The transformer can also be used with the *-hp-* Model 200CD 5 cps to 600 kc 1 watt test oscillator in combination with an *-hp-* 400 series vtvm to form an accurate signal generator for balanced system work. An arrangement for this combination is shown in Fig. 5.

It is interesting to note that in the terminating arrangement of Fig. 4(a) and the signal generator arrangement of Fig. 5 the dbm calibrations on the *-hp-* 400 series voltmeters can be used to read the power level directly in dbm. This is true regardless of whether a 135- or 600-ohm circuit is used, provided the proper primary taps are used. This occurs because the voltmeter is always connected at a 600-ohm level and because the db

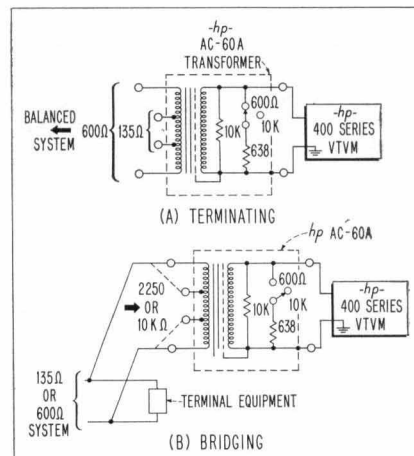


Fig. 4. Connection of transformer for terminating and bridging applications.

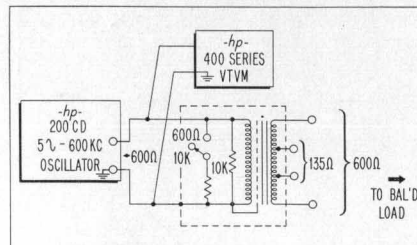


Fig. 5. Connection of 5 kc-600 kc transformer for monitoring signal power.

calibrations on the voltmeter are referred to a 0 db value of 1 milliwatt in 600 ohms. In the bridging arrangement of Fig. 4(b) the dbm calibration of the voltmeter will also be valid if the proper primary taps are used, because the voltmeter sees an impedance of 600 ohms.

The second transformer, the *-hp-* AC-60B, has a circuit similar to the first but differs in that it has no 135-ohm input terminals. Otherwise the AC-60B can be used in the same manner as the AC-60A.

SPECIFICATIONS

-hp-

MODEL AC-60A LINE MATCHING TRANSFORMER

FREQUENCY RANGE: 5 kc to 600 kc.
 IMPEDANCE: Primary, 135-ohms $\pm 10\%$ or 600-ohms $\pm 10\%$ balanced; Secondary, 600-ohms, one side grounded.
 TERMINATING RESISTANCE: 600 ohms or 10,000 ohms.
 INSERTION LOSS: Less than 0.3 db at 100 kc.
 FREQUENCY RESPONSE: Less than ± 0.5 db change at 5 kc and 600 kc from mid-frequency value.
 BALANCE: Better than 40 db, entire frequency range.
 MAXIMUM LEVEL: +22 dbm (10 volts at 600 ohms).
 SIZE: 2" x 2" x 4".
 SHIPPING WEIGHT: Approximately 2 lbs.
 PRICE: \$25.00 f.o.b. Palo Alto, California.

MODEL AC-60B BRIDGING TRANSFORMER

FREQUENCY RANGE: 20 cps to 45 kc.
 IMPEDANCE, PRIMARY: 600 ohms $\pm 10\%$ balanced.
 TERMINATING RESISTANCE: 600 ohms or 10,000 ohms.
 INSERTION LOSS: Less than 1 db at 1 kc.
 FREQUENCY RESPONSE: ± 1 db, 20 cps to 20 kc; ± 2 db to 45 kc.
 DISTORTION: Less than 0.1%, 50 cps to 20 kc; less than 0.5% at 20 cps.
 BALANCE: Better than 60 db.
 MAXIMUM LEVEL: +15 dbm, (4.5 volts at 600 ohms).
 SIZE: 4-5/16" diameter, 4 7/8" high overall.
 SHIPPING WEIGHT: 6 lbs.
 PRICE: \$35.00 f.o.b. Palo Alto, California.
 Data subject to change without notice.