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MARCONI INSTRUMENTATION

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MARCONI INSTRUMENTS LIMITED

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Radar

MANY READERS will doubtless recall how in the early days of the last war they first heard the word 'radiolocation' used to describe a newly developed technique for locating the position of an approaching aircraft by means of 'radio'. Soon to be renamed 'radar', it quickly became a most powerful tool in the hands of the military authorities. In the early days exploitation was essentially defensive in character, in the main taking the form of the development of a method of actually identifying the nature of the approaching aircraft (I.F.F.—Identification, Friend or Foe). On the premise, that in war attack is the best form of defence, it was not long, however, before attention was directed to using radar for navigational purposes in which systems were developed to enable attacking aircraft to locate precisely their chosen target.

On the conclusion of hostilities, engineers were able to turn their thoughts to the peaceful uses of radar and realised that, as a navigational aid, it could do much to improve the safety of both air and sea travel, particularly in inclement weather conditions. Thus, over the last 15 years or so, one has witnessed a rapid expansion of activities in this field. Techniques have, in fact, so advanced today that on the marine side, small and economical-to-operate radar sets are available for even the smallest type of craft. For the most spectacular progress, however, one must look to the air. Here the tremendous increase in the volume and speed of traffic has meant rigorous control of flying and has demanded the development of every possible safety device in an effort to avoid an accident. For economic reasons too, operators of expensive jet airliners can ill afford to reduce their payload in order to carry the extra fuel needed for waiting "permission to land". They demand quick landing and turn-round facilities. Radar has, in fact, provided the answers to all these problems, the many different types now in existence being but proof of what has been achieved with its aid.

Although, in general, the applications of radar are beneficial to man, the erring motorist, no doubt, has somewhat different views of P.E.T.A. This Portable Electronic Traffic Analyser can provide an instant indication of the speed of any road vehicle. It operates in the X-band on a c.w. power of only 8 mW using the doppler effect of frequency change reflected from a moving object. Speeds can be recorded to an accuracy of better than $\pm$ 2 miles per hour anywhere in the range 5 to 80 miles per hour.

In the field of radio astronomy too, radar is playing its part. For instance, in the last few weeks, during the close approach of Venus, echoes have been obtained from the planet with equipment set up at Jodrell Bank. With the information thus obtained, scientists have been able to make a new determination of the value of the Solar Parallax and hence the Sun's distance. In a similar way, from work carried out in the U.S.S.R. fresh light has been shed on the enigma of the planet's revolution upon its own axis.

With such an expanding field of activity, it is not surprising to find that engineers are continuously searching for improved radar systems to give a speedier and more comprehensive presentation of the information obtained. This, coupled with the need for miniaturization of airborne equipment, has naturally led to increased complexity. As a by-product this has created a demand for greater accuracy in the field of measurement.

'PETA' in use for traffic analysis. The operator is recording the speeds of vehicles in turn as they pass through the radar beam. 'PETA' is produced by Marconi's Wireless Telegraph Co. Ltd., the parent company of Marconi Instruments Ltd.

As the need arose for specialized instruments for the radar and navigational fields, Marconi Instruments as manufacturers of telecommunications test equipment directed attention to this subject. Although, for obvious reasons, all past achievements cannot be recorded, there are many instances where instruments have been introduced into the catalogue with radar directly in mind. A particular equipment, falling into this category, is the Radar Test Set type TF 890A/1, which was designed to permit the alignment of complete radar systems for optimum performance. On the other hand, there is also the general purpose instrument, which by virtue of the frequency range and type of modulation has obviously radar applications. One such instrument is described in this issue of our bulletin. It is a series of narrow frequency X-band signal generators giving the high discrimination tuning and stability nowadays demanded of such apparatus.

Frequently, too, the development of instruments for use with particular systems is undertaken. When it is thought that there are possibilities of applications, even if minor modifications are required, these are also catalogued. The Spectrum Analyser type TF 1387, also described in this issue, is a case in point. The instrument as outlined is primarily for use with S-band radars but due to its simple mechanical construction, modification for operating in other frequency bands can be contemplated. Work is also proceeding on an instrument operating in the L-band for use with a Secondary Surveillance Radar system to be used for Air Traffic Control. When operated in conjunction with a modified U.H.F. Signal Generator type TF 1060, namely the TF 1060/2, it will be capable of simulating the ground station to test the over-all performance of airborne transponders.

In the preceding remarks emphasis has been placed upon instruments specifically oriented to the radar field. One must not forget, however, that the bulk of our equipments are designed to be as versatile as possible and that many of the instruments in our standard range as listed in the 1961 catalogue could well be used in this specific field. Whether it be a pulse generator, signal generator, wavemeter or power meter, an instrument is probably available which will fulfil your particular requirements.

P.M.R.

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MARCONI INSTRUMENTS

S-Band Spectrum Analyser . . . TYPE TF 1387

by P. M. RATCLIFFE
A.M.I.E.E.

S-Band Spectrum Analyser Type TF 1387 is for use with radar transmitter/receivers working in the frequency band from 2,750 to 3,200 Mc/s, and can display visually several parameters of the complete system. Although its main purpose—as the name implies—is that of examining the frequency spectrum of the transmitter pulse, it can also be used for tuning the receiver local oscillator to the correct frequency. In another condition, when performing as a sweep generator, the response curves of receiver i.f. amplifiers, or the characteristics of a.f.c. discriminators can be displayed.

ALTHOUGH this instrument is called a spectrum analyser, this in reality describes only one of the several functions which the instrument will perform. Generally, a spectrum analyser is considered to be a general-purpose laboratory tool, and every endeavour is made to ensure that it will operate over the widest possible frequency range with the maximum sensitivity. It is in fact a narrow band superheterodyne receiver with a display unit to give a plot of amplitude against frequency for any applied signal within the working range.

Where such a device is to be used for daily checks, or even continuous monitoring, on one particular fixed frequency installation, these features of wide band working and high gain are wasted. A more useful design can be produced by confining the frequency cover and sensitivity to that really required, and utilizing many of the existing circuit elements, with the possible addition of a few others to form a more comprehensive test set which is quick and simple to use.

This version of the instrument has been designed specifically to present a visual display of the essential r.f. and i.f. parameters of pulse modulated S-Band transmitter-receiver systems. The operating frequency can be anywhere in the range from 2,750 to 3,200 Mc/s, and the receiver i.f. must be centred on 30 Mc/s. Due to these restricted requirements in frequency range the input circuits are simplified, and in working directly from the transmitter, high sensitivity is not needed. Because of this it will be shown that it has been possible to produce an instrument with wider applications than are normally available in a spectrum analyser.

R.F. Measurements

When used for performing r.f. tests, the frequency spectrum produced by the transmitter r.f. pulse is displayed on the cathode ray oscilloscope in the usual manner. Being a double superheterodyne system, in which the second local oscillator is swept in frequency, the first local oscillator is available to be locked, if necessary, to the centre frequency of the transmitter. This has the advantage that a stable display is ensured even though the transmitter may vary slightly in frequency. By selecting the correct i.f. for the instrument, namely 15 Mc/s, which is half that of the receiver i.f. of 30 Mc/s, the receiver local oscillator can be precisely tuned so that it is separated from the transmitter centre frequency by the correct amount. This is achieved by tuning the receiver local oscillator to superimpose the c.w. spike derived from that local oscillator upon the centre of the transmitter spectrum. Thus two displays will be obtained, one the upper, and one the lower sideband of the instrument local oscillator. To ensure that the i.f. of the test set is correctly centred on 15 Mc/s, a crystal oscillator can be switched into operation to feed into the i.f. amplifier of the instrument. If the system is operating correctly another c.w. spike will be observed also centred upon the existing display

It is also possible, by means of an external wavemeter such as the Frequency Meter type TF 1026/4, to determine the exact value of the transmitter and receiver local oscillator frequency by measuring the instrument local oscillator and adding or subtracting the i.f. of 15 Mc/s as required.

I.F. Measurements

With the addition of a few circuit elements to those already required for performing the r.f. measurements described above, the instrument will convert into a sweep generator at the receiver i.f. This swept signal at a precise known level can be coupled into the i.f. amplifier under test, and the detected output fed back to give a display on the cathode ray tube. The same crystal oscillator as was used to check that the instrument i.f. was correct can again be used to indicate the centre frequency of the amplifier under test, but now operating on the second harmonic. Likewise, the receiver a.f.c. discriminator can also be correctly tuned, but in this case the presence of the crystal marker on the display will indicate misalignment, as the discriminator output will be zero for an input at the i.f.

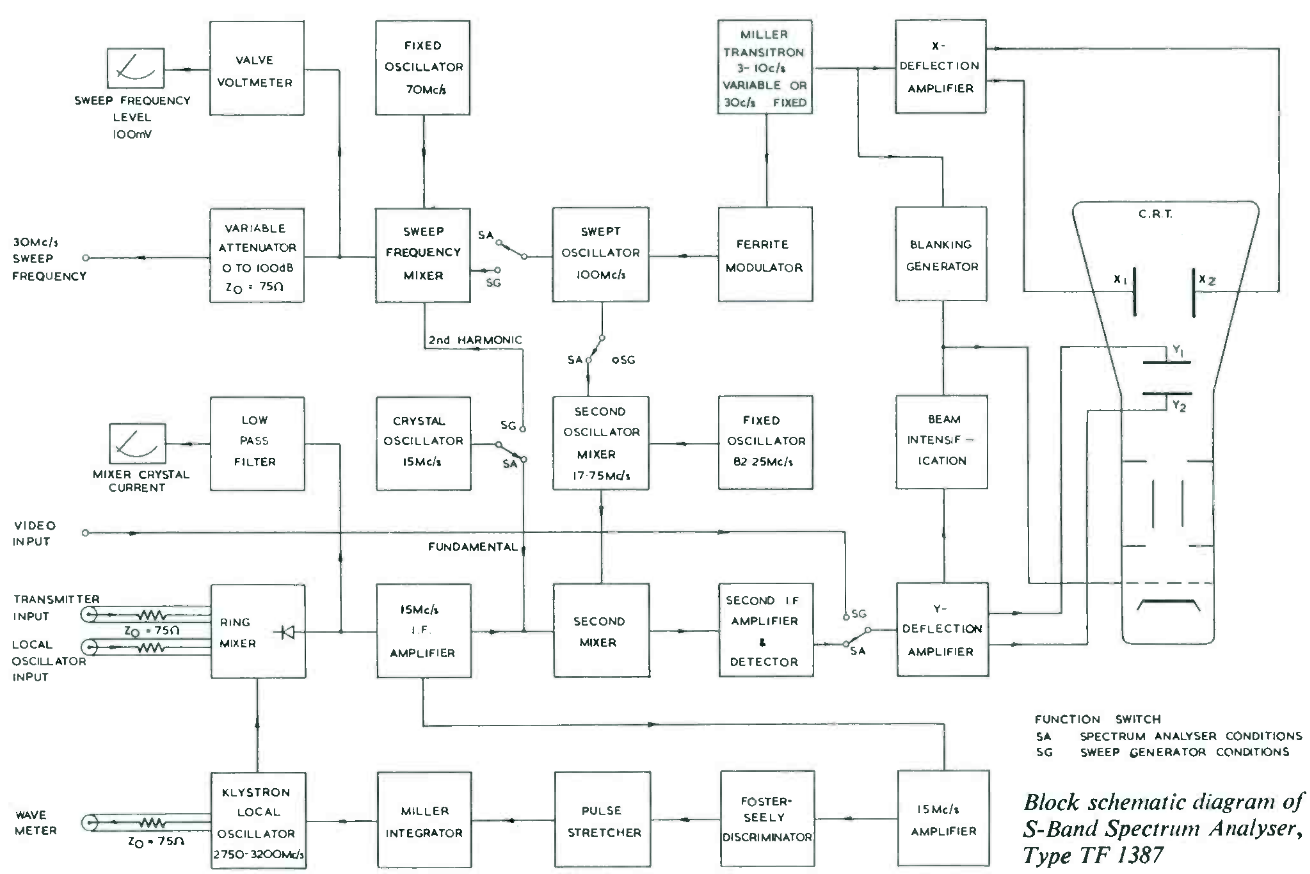
Spectrum Analyser Circuit

The basic circuit elements are shown in the block diagram. A transmitter sample is coupled into the ring mixer via a length of lossy cable where it is mixed with the c.w. signal from the klystron local oscillator working on its fundamental frequency. When the klystron is correctly tuned, the resultant output from the mixer crystal will consist of a 15-Mc/s pulse plus a d.c. component. These two signals are separated by a filter, the d.c. component being fed to a meter to indicate that the klystron is operating satisfactorily at the correct level for optimum mixing. The 15-Mc/s signal is amplified in the i.f. amplifier, which has a bandwidth suitable for transmitting the pulses without distortion. However, in a spectrum analyser it is essential for the overall bandwidth to be such that it is very narrow compared with the bandwidth of the pulse. This is necessary so that the power accepted and amplified at a given time is due to one discrete frequency only, thus providing good resolution. By employing a double superheterodyne system this is possible, so the signal is then mixed with a second local oscillator, and the output amplified in a second i.f. amplifier which has a bandwidth of only 5 kc/s, which with the other parameters of the signal gives a resolution of 5 kc/s. This second local oscillator is frequency modulated with a dispersion greater than the spectrum of the pulse to be examined, and due to the narrow bandwidth of the following i.f. amplifier will produce a discrete number of narrow spikes which together will indicate the spectrum of the pulse. After detection and amplification in the direct coupled Y-amplifier, which incorporates a variable gain control, it is displayed on the cathode ray tube.

To produce the frequency modulated signal from the second local oscillator the b.f.o. principle is adopted. A fixed oscillator working at 82·25 Mc/s is mixed with a swept oscillator operating at a frequency centred on 100 Mc/s. This latter oscillator is modulated using a ferrite reactor, where the tuned circuit is wound on a ferrite core, a change of frequency being obtained by a change in the relative permeability of the core. A Miller transitron oscillator provides the signal for modulation in the form of a sawtooth waveform which is variable over the range of 3 to 10 c/s, making it suitable for viewing pulses having a low repetition rate. To obtain a locked display on the c.r.o. the sawtooth waveform is amplified in a paraphase amplifier and also applied to the X plates. Thus the X deflection and sweep frequency are kept synchronized, giving the familiar spectrum display. By differentiating and squaring the sawtooth a suitable flyback blanking waveform is produced, which together with a beam intensification signal derived from the Y-amplifier output, is applied to the control grid of the tube. The tube selected for this application has a 5-inch diameter with a P7 long persistence phosphor and this combined with the beam intensification gives a bright trace even with these low sweep rates.

Receiver Local Oscillator Input

A sample can also be coupled into the instrument from the receiver local oscillator at a separate socket available on the front panel which is also connected to the ring



Block schematic diagram of S-Band Spectrum Analyser, Type TF 1387

The Marconi Instruments S-Band Spectrum Analyser, Type TF 1387

mixer. Provided the klystron has been tuned to give the correct sideband on the transmitter sample, then the input from the receiver local oscillator will also produce a 15-Mc/s output from the mixer, but in this case it will be a c.w. signal. After being amplified and mixed with the second local oscillator it will appear as a spike on the display having a 5-kc/s bandwidth. The receiver can then be tuned to the correct frequency as described previously by moving the spike along the X axis of the display until it is centred upon the transmitter spectrum.

For this setting-up procedure to be successful it is necessary to ensure that the initial tuning of the klystron is exactly 15 Mc/s away from the centre frequency of the transmitter. This is achieved very simply by providing the instrument with a 15-Mc/s crystal oscillator which can be fed into the grid of the second mixer. As this also produces a c.w. signal when switched into operation, it will also give a spike on the display. Therefore, initially the second local oscillator can be adjusted to centre this spike on the cathode ray tube, and the klystron can then be tuned in to the transmitter to superimpose its spectrum on the crystal spike. This means that the klystron is set exactly 15 Mc/s away from the transmitter frequency.

A.F.C. System

When it is desired to monitor the transmitter spectrum continuously it is possible to lock the klystron to the transmitter so that it is maintained exactly 15 Mc/s away, thus giving a stable display even in the presence of frequency drift. An output is taken from the i.f. amplifier, amplified and fed into a Foster Seeley discriminator circuit. If the applied frequency is other than 15 Mc/s, then an output will be produced from the discriminator consisting of positive or negative pulses depending upon the sense in which the frequency has changed. These pulses are then stretched to produce a sawtooth waveform having an amplitude proportional to the i.f. error. A Miller integrator is then used to produce a steady voltage proportional to the mean amplitude of the input waveform. This voltage is directly coupled to the klystron reflector to control its frequency of oscillation in step with the transmitter.

Sweep Generator

To convert this instrument to a sweep generator, it is now only necessary to add another fixed oscillator, operating at 70 Mc/s, and a mixer to be used in conjunction with the 100-Mc/s swept oscillator to produce a sweep output of 30 Mc/s. The maximum output that can be obtained is 100 mV across a 75-ohm load, and this is monitored by a peak reading valve voltmeter. Control of output level is obtained with coarse and fine 75-ohm step attenuators giving a maximum of 100 dB attenuation in 2-dB steps. Interpolation to 1 dB is available by markings on the meter scale. This swept output, set at the required level, is coupled into the amplifier under test and after detection is applied to the Y-amplifier of the instrument. Again it is essential to ensure that the correct frequency is being produced, so the 15-Mc/s crystal oscillator is now applied to the sweep frequency mixer and the second harmonic will produce a marker at the centre frequency of 30 Mc/s.

When examining i.f. amplifiers a plot of the response curve will be displayed upon the cathode ray tube, and if correctly tuned the crystal marker will appear as a slight oscillation on the peak of the response. In testing discriminator circuits the conventional display will be obtained, but in this case if the discriminator is correctly tuned the input from the crystal oscillator will occur at a frequency where the discriminator output is zero. Only if the circuit is mistuned will this marker be visible and correct tuning will move the marker to the centre of the display, gradually decreasing the amplitude.

When operating the instrument as a sweep generator under c.w. conditions, there is no particular requirement to keep the repetition frequency of the X-sweep low as there is when examining pulse spectra. Therefore, when switching to the sweep generator conditions the X-sweep is speeded up to 30 c/s by changing the time constant of the Miller transitron. This has the advantage of increasing the brilliance of the display.

Power Supplies

All power supplies, including the e.h.t. unit, are stabilized against load and mains input variations, and the hum content has been kept to a very low level. The mains input supply is taken through an s.h.f. filter so that none of the transmitter signals can be injected via this path. As a klystron has to be used as a local oscillator for this frequency band, negative h.t. supplies are required for cathode and reflector so the power pack is fairly complex. Therefore, as a servicing facility, the meter which is normally used to monitor the ring mixer crystal current can be switched to each of the d.c. outputs in turn to check for correct operation.

Possible Applications

Although the instrument described here appears to be of a specialized nature for a particular S-band installation, the construction is such that it could have wide applications.

For systems working on other standard radar intermediate frequencies it is only necessary to change the tuning inductors in the i.f. amplifier and the crystal oscillator to half that of the system i.f. and the instrument is then usable. The two fixed oscillators for the second local oscillator and sweep output would merely require retuning. This has in fact been successfully tried in an experimental version for a systems i.f. of 13·5 Mc/s, *i.e.* an instrument i.f. of 6·75 Mc/s.

Both the ring mixer and klystron local oscillator are separate units, either or both of which could possibly be replaced for operation at other r.f. frequencies. As the r.f. inputs to the instrument are low powered, it has been possible to adopt the coaxial form, avoiding any future problems arising concerning various waveguide sizes if the operating r.f. frequency should ever be changed.

Acknowledgments

This instrument was developed in conjunction with the Radar Development Group of Marconi's Wireless Telegraph Co. Ltd., Great Baddow, who were responsible for devising the technique of embodying these various measurements into one instrument.

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20 Mc/s SWEEP GENERATOR, TF 1099

Modification to extend upper limit to 24 Mc/s

The upper frequency limit of the Sweep Generator is specified as 20 Mc/s. It is possible to increase this to about 24 Mc/s (at the expense of output voltage) if the following modifications are carried out:

1. Increase the saw-tooth voltage fed to the modulator valve V2 by changing the value of R9 to between 2·2 MΩ and 2·5 MΩ as required. (Normal value 2·7 MΩ.)
2. Remove R45, R51 and R142 which shunt L12, L14 and L16 respectively. Adjust the iron-dust cores of L12, L13, L14, L15 and L16 for the flattest possible response over the frequency band required.

   It may be possible to obtain some additional improvement in response by careful adjustment of the filters L6–C22–L7 and L9–C33–L10.
3. Reduce the output signal amplitude by means of the preset SET OUTPUT control RV7, which controls the amount of a.g.c. voltage applied to the buffer stage V4. If the voltage is increased a flatter frequency response will result but at the expense of output voltage. If excessive use is made of this means of flattening the frequency characteristic, the zero locking circuit may cease to function at narrow sweep widths.

The only test equipment required to carry out the necessary check on results is a cathode ray oscilloscope whose Y input must be connected to the c.r.o. terminals of the Sweep Generator.

To obtain a detected response of the Sweep Generator output, connect the Output Probe TM 5331 to the SWEEP OUTPUT socket, the 4-pin plug being inserted into the socket marked OUTPUT on the Sweep Generator.

Use sufficient oscilloscope amplification to enable a discrimination of 0·1 dB to be obtained.

The Sweep Generator control labelled L.F. CORRECTION must be adjusted until no sign of 'tilt' is evident at the bottom of the trace

The results obtained should be as follows:

Sweep width:	0–24 Mc/s.
Frequency response:	±0·1 dB.
Output voltage:	2·5 volts approx. peak to peak.

The linearity of the sweep is not quite as good as a normal TF 1099, being a little more cramped at the low frequency end.

621. 396. 615. 142. 2

MARCONI INSTRUMENTS

X-Band Signal Generator . . . *TF 1343A Series*

by R. SMITH

A PARTICULAR requirement for X-band operational equipment is a signal generator with high discrimination tuning, and a high order of frequency and power monitoring accuracy. From these requirements the TF 1343A series of narrow-band generators has been developed, giving a power output of not less than 10 mW; models covering the following frequency bands are available to special order:—

TF 1343A: 8·1 to 8·75 Gc/s
TF 1343A/2: 8·75 to 9·35 Gc/s
TF 1343A/3: 9·35 to 9·95 Gc/s
TF 1343A/4: 9·95 to 10·55 Gc/s

Each is calibrated every 10 Mc/s with an accuracy of $\pm 0{\cdot}05\%$ at 20°C and their power monitor accuracy is ± 1 dB over the temperature range -35°C to $+52$°C.

GENERAL DESCRIPTION

Fig. 1 is a functional diagram showing the basic arrangement of these instruments.

Oscillator Section

A plug-in klystron (CV2346) used in conjunction with a $\frac{3}{4}\lambda$ radial cavity and automatically tracked in the $4\frac{3}{4}$ reflector mode forms the basic oscillator unit. The level of output from the oscillator is adjusted to 10 mW by means of a 20-dB glass vane attenuator situated in the waveguide run between the oscillator output and main arm of a 10-dB directional coupler. The main arm of the directional coupler conveys microwave power to the output flange situated on the front panel of the instrument, whilst the side arm couples power to the r.f. power monitor. The EXT. F.M. socket is coupled to the reflector of the klystron via a time constant of 0·015 sec.

R.F. Power Monitor

Microwave power is applied to a waveguide thermistor mount via the directional coupler. The thermistor mount is situated in one arm of a Wheatstone bridge, and the bridge detector is in the form of a 200-μA microammeter which displays a 'Set 10 mW' mark indicating the power output. The bridge voltage is obtained via two potentiometers labelled COARSE and FINE SET ZERO. Sensitivity and set zero temperature compensating networks are included in the thermistor bridge network.

Power Supply

The power supply provides two -300 volt stabilized lines, one supplying the klystron cathode and the other the klystron reflector electrode. The klystron cathode supply also feeds the r.f. power monitor circuit. The reflector supply is neon stabilized whilst the cathode supply is of the conventional degenerative stabilized type. The instrument will operate from mains supplies in the ranges 200 to 250 volts and 100 to 150 volts.

Mechanical

The aluminium chassis assembly consists of a front panel, two side frames, one horizontal chassis and one vertical chassis. For ease of servicing, resistors, capacitors and valves are mounted on the two side panels.

Mounted on the front panel is the r.f. output meter, full-view frequency dial and all the operating controls and fuses. All preset potentiometers are mounted on the horizontal chassis immediately behind the front panel and are easily accessible from the top of the instrument.

For bench use the instrument is housed in a steel case and when incorporated in a 19-inch rack the case is dispensed with. In its case the instrument is $22\frac{1}{2}$ in. wide, 16 in. high, 15 in. deep and weighs $37\frac{1}{2}$ lb.

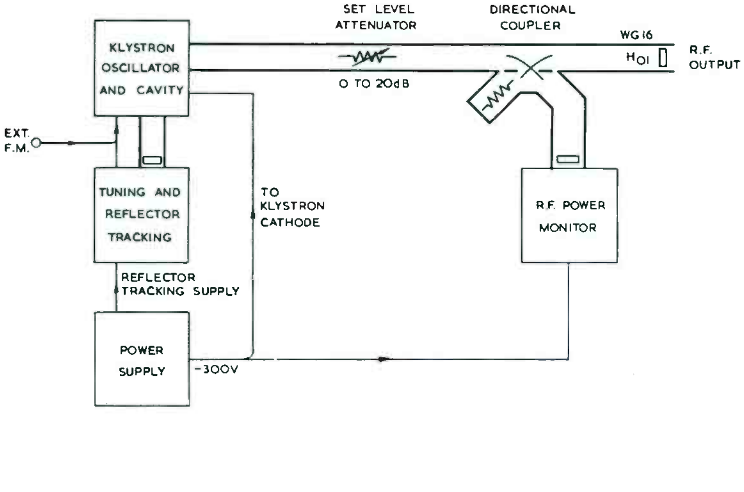


Fig. 1. Functional diagram of X-Band Signal Generator, Type TF 1343A (Series)

The Marconi Instruments X-Band Signal Generator, Type TF 1343A

PERFORMANCE

The frequency dial is calibrated every 10 Mc/s with an accuracy of $\pm 0{\cdot}05\%$ at 20°C. The oscillator has a negative temperature coefficient such that the frequency decreases at a rate not greater than 30 parts in 10^6 per degree centigrade increase in ambient temperature over the working temperature range. The internal power monitor gives a continuous indication of the power output, and the output meter is calibrated to read 10 mW ± 1 dB over the temperature ranges -35°C to $+52$°C. The general design and choice of components have been such that the instrument will operate satisfactorily over the temperature range -35°C to $+52$°C. Stray radiation has been kept to the very low order of not greater than 90 dB below 1 mW (with 10 mW at the r.f. output flange) as detected by a $\frac{1}{4}\lambda$ unipole held 6 in. from any component part of the instrument; this applies when the instrument is not housed in its case.

OPERATION

In operation it is intended that the signal generator shall deliver a c.w. output of 10 mW into a suitably matched load; this output is indicated on the output meter by the 'Set 10 mW' mark. The deflection indicated is peaked to a maximum by the PEAK OUTPUT control, which in effect is a fine control of the klystron reflector voltage. The level of output is adjusted to 10 mW by the set level attenuator, marked SET 10 mW.

For zero-setting the monitor bridge before use, the PRESS SET ZERO switch is depressed to remove the r.f. power into the monitor, and the output meter may then be set to zero by means of the COARSE and FINE SET ZERO controls. Operation of the PRESS CHECK TH_3 switch performs two operations:—

(*a*) to stop the klystron oscillating and

(*b*) to inject into the power monitor bridge circuit a pre-calibrated mains-frequency check voltage.

This serves to check the bead thermistor TH_3 (situated in the thermistor mount) and to make sure that the bridge sensitivity has not changed since the instrument was calibrated. If all is working satisfactorily the meter will indicate 10 mW $\pm 0{\cdot}25$ dB.

DESIGN DETAILS

R.F. Oscillator

In order to obtain a high degree of frequency accuracy and discrimination an oscillator in which the tuning element has a low tuning rate is desirable.

Whilst the coaxial line type of oscillator can be tuned over a fairly wide frequency range, the mechanical travel of the tuning element is comparatively small, i.e. the change in frequency per 0·001 in. movement of the tuning plunger is large. For this reason the $\frac{3}{4}\lambda$ radial cavity used with a plug-in klystron and tuned by a moveable shorting plunger in a section of waveguide 16 was chosen—an arrangement giving a very low tuning rate. Hence small changes in frequency require larger tuning plunger movements, thus making mechanical linkages, drives, etc. a more practical proposition.

The basic oscillator section then consists of a $\frac{3}{4}\lambda$ radial brass cavity into which a plug-in type of reflex klystron (CV.2346) is housed. The cavity is made in two halves, then silver plated and gold flashed to prevent tarnishing—a low temperature (—200°C) shrink fitting technique is employed to join the two halves, thus making a very low-resistance joint, which is desirable. The klystron is completely enclosed in the cavity and the various supply voltages are applied via iron-loaded lossy cables; these two features provide an oscillator section which has an extremely low level of spurious radiation.

The outside of the cavity is painted black, giving better heat radiation and maintaining the glass envelope temperature of the klystron below 200°C at ambient temperatures of up to +52°C.

Introduced into the cavity design is a new method for making contact to the plug-in klystron. The type of contact previously used was a cylindrical arrangement of spring fingers. These proved difficult and expensive to make, requiring special heat treatment and delicate plating operations. The new design of contact is shown in Fig. 2. A silver plated toroidal spring provides the necessary multi-point contact of adjustable diameter. The action of the contact assembly is as follows:

1. With the retaining bush screws slackened off, the klystron is inserted into the cavity; at this point there is no spring tension applied to the klystron.
2. To apply pressure to the klystron the retaining bush screws are alternately tightened; this pushes the compression cone upwards. The taper on the compression cone forces the toroidal spring in two directions: upwards, making contact with the cavity; and radially, gripping the klystron. The spring washer is included to take up mechanical tolerances.

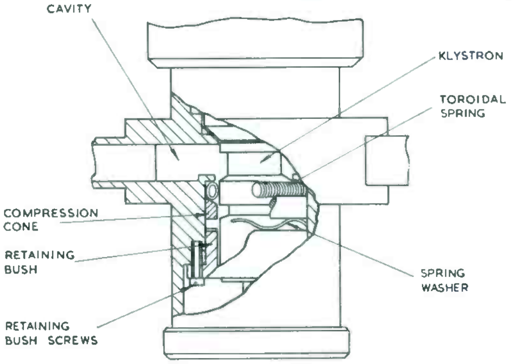


Fig. 2. Cut-away view of cavity showing new design of spring assembly

Tuning Mechanism

The oscillator is tuned over its frequency range by presenting a varying capacitive reactance to the cavity. This is achieved by moving a non-contacting plunger in a section of waveguide attached to the cavity, see Fig. 3. The tuning plunger is linked through a cam and gear-box to the frequency dial on the front panel.

Since movement of the tuning plunger in the waveguide is a non-linear function of frequency, the cam profile had to be made inversely non-linear in order to provide a linear frequency scale on the dial. A close-up of the 4 in. diameter dial is shown in Fig. 4. The open linear scale showing 10-Mc/s calibration marks gives an indication of the high order of discrimination possible.

Because the tuning characteristics in the waveguide section is modified by the individual klystron in use, one cam profile cannot suit all conditions. To overcome this

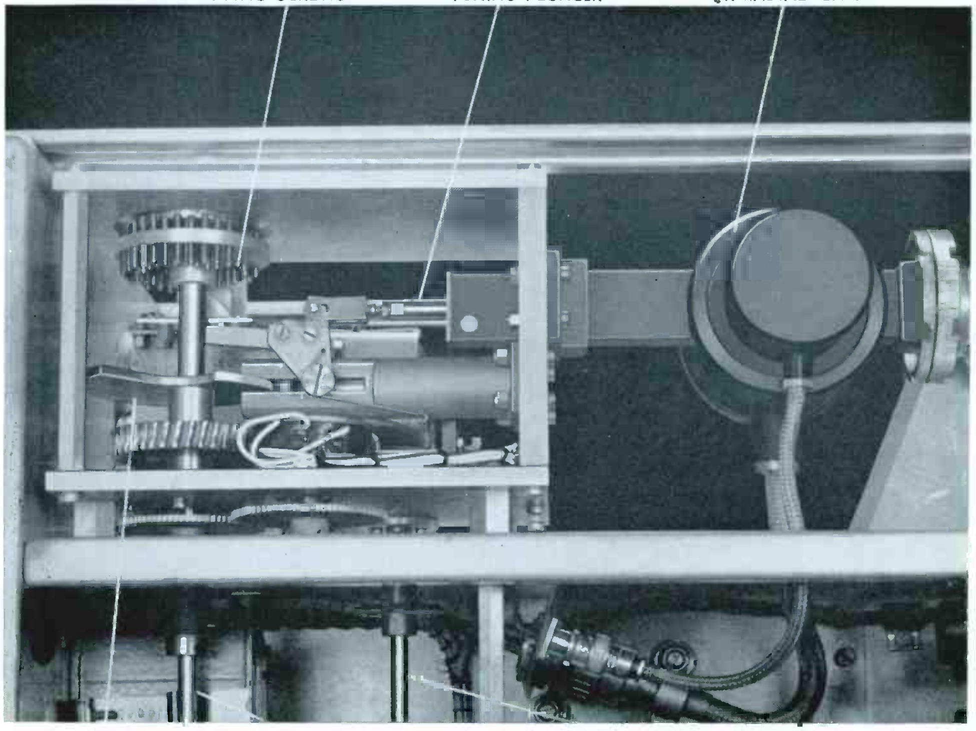


Fig. 3. The oscillator and tuning mechanism of X-Band Signal Generator, Type TF 1343A

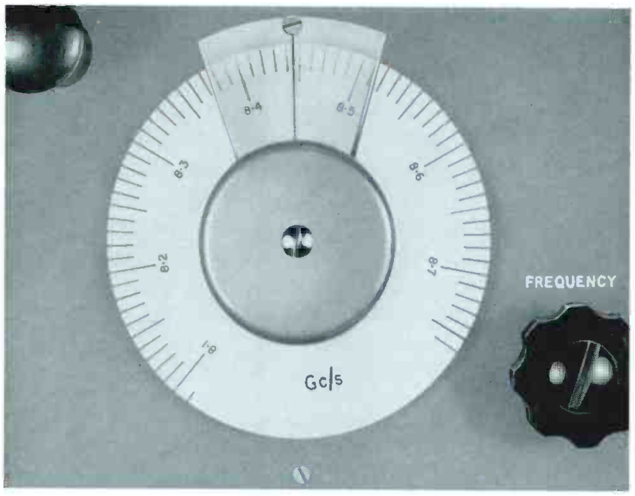


Fig. 4. Close-up of frequency dial

a set of cam adjusting screws are provided, the action of which is to advance or retard the tuning plunger with respect to the cam at any desired point over the frequency range. Thus the actual cam profile, which is an average shape, can be effectively modified to match individual klystrons to the linear dial.

R.F. Power Monitor

Basically the r.f. power monitor consists of a waveguide thermistor mount incorporating a glass encapsulated bead thermistor which is situated in one arm of a Wheatstone bridge. The bead thermistor is used as the microwave power sensitive element, and placed across the thermistor mount parallel to the electric field in the waveguide.

A functional diagram of the power monitor is shown in Fig. 5.

Under the conditions when no microwave power is applied to the thermistor mount the set zero controls are adjusted to balance the bridge to zero. The bead thermistor (TH_3) resistance is then 300 ohms. Application of microwave power causes the bead thermistor to heat up; its resistance consequently decreases and unbalances the bridge. The out-of-balance bridge current is calibrated as a measure of the microwave power applied to the thermistor mount.

For optimum accuracy the bead thermistor (TH_3) must be matched to the waveguide system. This is achieved by adjustment of the two tuning plungers in the thermistor mount so that the reflection coefficient of the thermistor mount is not greater than 0·176, or the voltage standing wave ratio (v.s.w.r.) is not worse than 0·7:1. A typical v.s.w.r. curve over the frequency range is shown in Fig. 6.

Iron-loaded marco resin sections are incorporated in the design of the round tuning plunger, as this was found necessary to reduce leakage radiation past the plunger. Leakage is further reduced by means of a solid block of

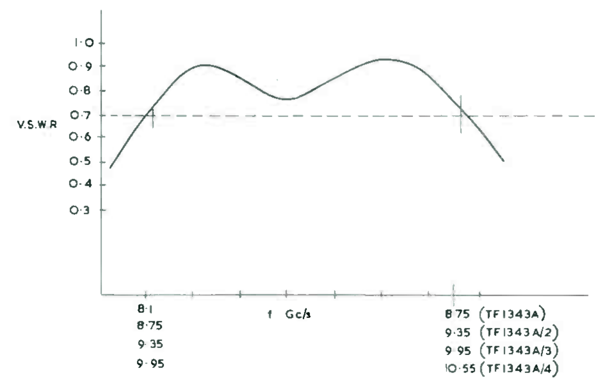


Fig. 6. Typical v.s.w.r. performance of thermistor mount

aluminium placed in the waveguide tube behind the rectangular plunger.

In order to maintain the power monitor performance over a wide temperature range, two compensating

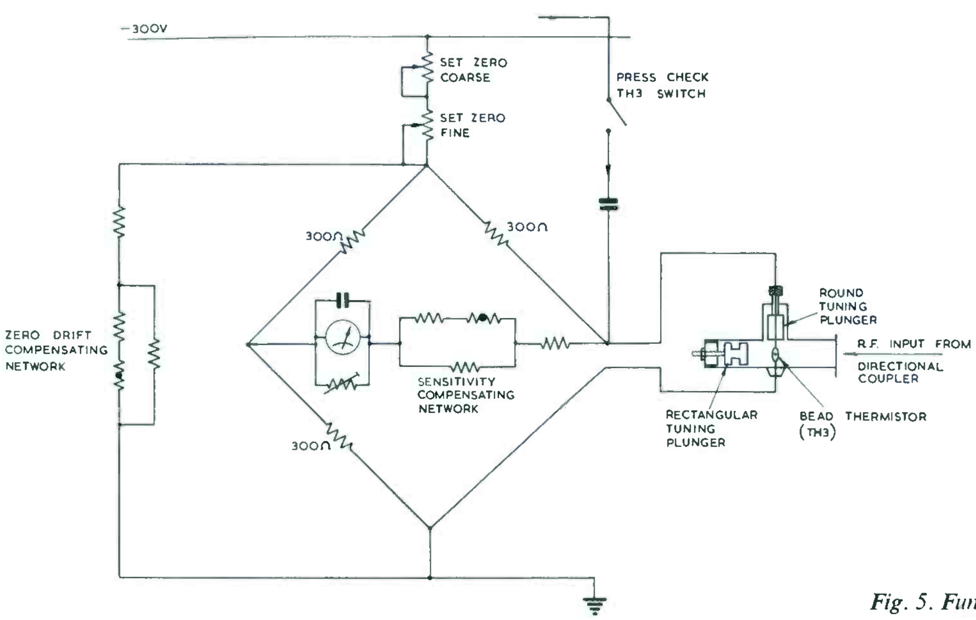


Fig. 5. Functional diagram of power monitor

networks have been incorporated in the bridge circuit. One network shunts the bridge and compensates for zero drift while the other is connected in series with the meter and adjusts the meter arm resistance to counteract bridge sensitivity changes with ambient temperature changes. Fig. 7 shows a typical calibration curve for the power monitor at 20°C; over the temperature range −35°C to +52°C the calibration error does not exceed ±1 dB.

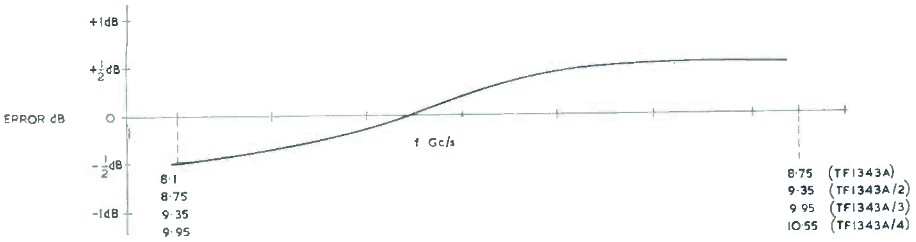


Fig. 7. Typical power monitor accuracy curve

SPECIFICATION

Frequency

RANGE: TF 1343A: 8·1–8·75 Gc/s.
TF 1343A/2: 8·75–9·35 Gc/s.
TF 1343A/3: 9·35–9·95 Gc/s.
TF 1343A/4: 9·95–10·55 Gc/s.

ACCURACY: Calibrated at 20°C to an overall accuracy of 0·05% after warm-up (1 hour minimum). 0·1% within 5 minutes from switching on.

DRIFT: After warm-up, less than 0·005% in a 10-minute period.
During the period from 5 min to 1½ hours after switching on, drift is less than 1·5 Mc/s in any 10-minute period.

FREQUENCY/TEMPERATURE COEFFICIENT: Negative; not greater than 350 kc/s per °C over the working range of −35°C to +52°C.

Output

LEVEL: 10 mW into a matched load.

ACCURACY: ±1 dB at ambient temperatures from −35°C to +52°C.

OUTLET: Waveguide No. 16 flange (I.S.S.C. Round) Z830004.

R.F. LEAKAGE (case removed): Less than 90 dBm, as detected with a λ/4 unipole at 6 inches from any component part.

Modulation

External f.m., applied to klystron reflector via input circuit with a time-constant of 0·015 sec.

DEVIATION SENSITIVITY: 0·2 to 0·7 Mc/s per volt peak.

SPURIOUS F.M.: Not greater than 60 kc/s at mains supply frequency. Not greater than 3 kc/s at other frequencies.

SPURIOUS A.M.: Not greater than 0·75% modulation depth at mains supply frequency. Not greater than 0·1% at other frequencies.

Power supply

100 to 130 volts and 200 to 250 volts, 45 to 66 c/s; 80 watts.

Dimensions (in bench case)

Height	*Width*	*Depth*
16 in	22½ in	15 in
(40·5 cm)	(57 cm)	(38 cm)

Weight

37½ lb (17 kg).

TWO ADDITIONS TO THE VACUUM TUBE VOLTMETER TYPE TF 1300

There are now available an a.c. multiplier for the TF 1300 and a balanced probe version of the Voltmeter.

TM 6067 A.C. Multiplier — this is a C-R voltage divider of 10 to 1 ratio for use from 20 c/s to 50 Mc/s, which plugs on to the ordinary TF 1300 a.c. probe, thus extending the range of the instrument to 1000 volts.

The design of such a divider is particularly complicated at the low-frequency end because of the increasing reactance of the probe d.c. isolating capacitor. Such variations automatically set an upper limit to the resistance elements of the divider which must not exceed 5 MΩ and 630 kΩ for a practical limit of 1% or so variation in voltage division with frequency at l.f.

TF 1300/1 — this is a balanced a.c. probe version of TF 1300, with an upper frequency limit of 200 Mc/s. It is particularly useful for two important applications of valve voltmeters.

One is the measurement of a.c. voltage differences between two circuit points neither of which is earthy. Such applications include measurements on symmetrical push-pull amplifiers, or Colpitts oscillators, or grid/cathode volts in a Hartley circuit as well as many others.

The other important application for which the balanced probe version is superior involves the measurement or assessment of asymmetrical waveforms. The instrument is calibrated in terms of the r.m.s. value of a sine wave but actually measures peak to peak. The asymmetry of a waveform with reference to earth may be found by reversing the a.c. probe so that the 'positive' or 'negative' peaks are alternately measured, the body of the probe and the 'unused' connection to the diode both being earthed to the earthed reference.

Ordinary diode probes measure the positive peak only.

MARCONI INSTRUMENTS NEW DESIGN

614. 898: 621. 387. 4

Gamma Radiation Monitor . . . TYPE TF 1299

by A. A. LUSKOW
B.Sc., Grad.Brit.I.R.E.

In the vicinity of a nuclear reactor the levels of gamma radiation are continuously monitored. This paper describes an instrument designed for this purpose. The monitor, which is fully transistorized except for an electrometer valve, measures dose rates from 0·1 to 100 milliroentgen per hour on a logarithmic scale.

WITH THE ADVENT of the Nuclear Power Station a potential radiation hazard has been produced, and although the reactor radiation shield is designed so that only small quantities of the radiation penetrate it, a careful watch must be maintained at many points in the reactor area for the presence of any escaping radiation. This ensures that operating personnel are not subjected to radiation dose rates beyond a safe limit. This limit (at present 7·5 milliroentgen per hour) has been defined, on the basis of international collaboration, at a level which, if experienced throughout a normal working life, would cause no harm in a human being.

The radiation monitoring instruments used are generally of two types: Personnel and Area. The former determine the exposure received by the individual and the latter measure the general radiation levels in a working area and give alarms when the permissible levels of radiation are exceeded. Generally only the more penetrating gamma radiation and neutrons are monitored in the working area. In fixed area monitors ion chambers are normally used, their main advantage, as health monitors, being that their response to ionizing radiation simulates the human body more closely than any other radiation detectors.

An ion chamber consists of a gas chamber containing concentric electrodes across which a potential of a few hundred volts is maintained. When ionizing radiation enters the chamber the ion pairs produced are swept continuously to their respective electrodes by the polarizing electric field and a steady current flows proportional to the intensity and energy of the incident radiation. The chamber walls are such that unless a thin aluminium window exists, only gamma radiation and neutrons can penetrate. The sensitivity of an ion chamber depends on its volume, pressure and gas filling, so that for low level measurements a large high-pressure chamber is required.

In the Gamma Radiation Monitor TF 1299 the ion chamber current is amplified by a logarithmic amplifier and the output, after further linear amplification, is displayed on an expanded logarithmic scale calibrated in dose rate. A high dose rate alarm, the trip level of which can be set to any point in the range of the instrument, operates the lamp on the monitor. Routine testing of the monitor is carried out by applying internally generated current to the amplifier to simulate the ion chamber outputs at given dose rates.

CIRCUIT DETAILS

The Ionization Chamber

The chamber used in this instrument has a volume of 4·7 litres and the filling consists of argon and nitrogen at a total pressure of 20 atm. This combination of volume, pressure and filling produces a chamber of high sensitivity (10^{-8}A/r/hr) and energy response such that substantially true dose rate measurements are maintained with radiation levels down to energies of 200 keV. The exact value of the polarization voltage is not important so long as a substantial collection efficiency is maintained. It is important

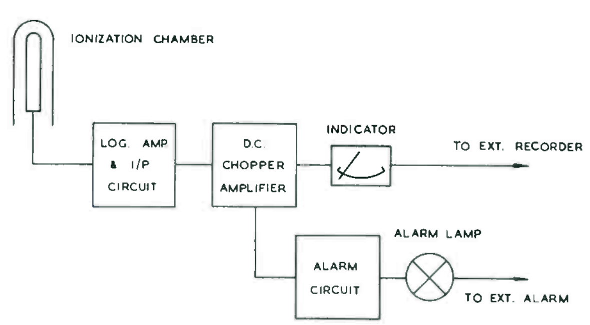
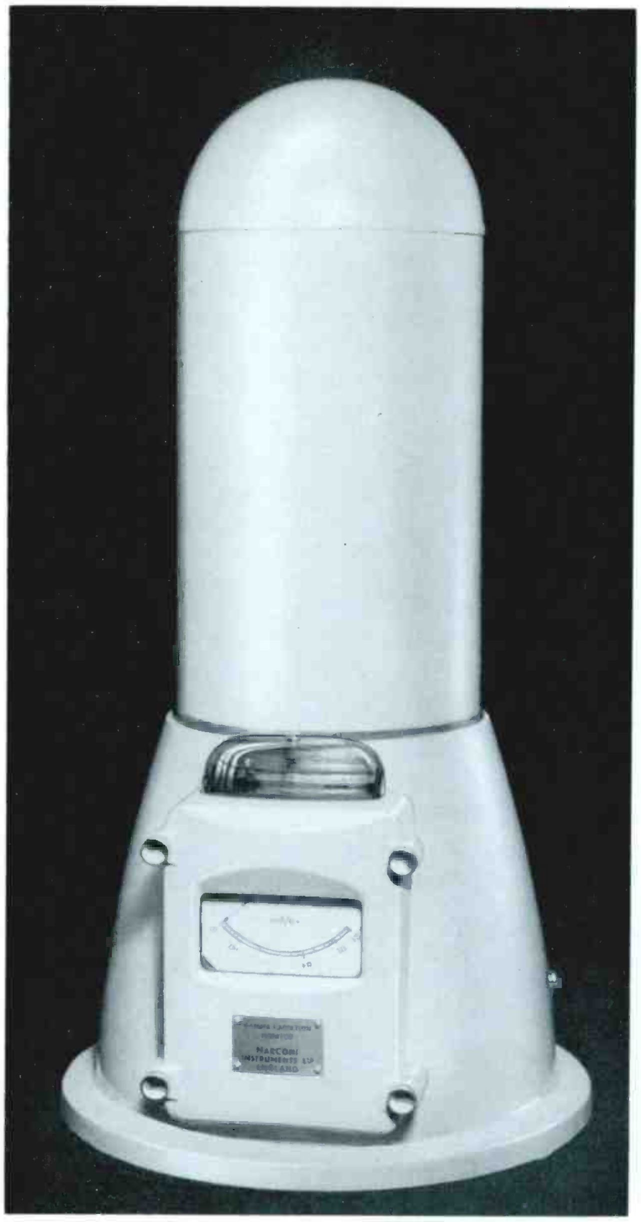


Fig. 1. Gamma Radiation Monitor

however, that the chamber polarization voltage is stabilized against mains voltage variations, as firstly, a change in this voltage would shift the chamber operating point on its saturation characteristic and so change the chamber sensitivity; and, secondly, a more troublesome fault could arise from the transference of voltage transients to the input of the logarithmic amplifier, which would produce violent fluctuations in the meter reading. These errors have been virtually eliminated in this instrument by the stabilizing circuits.

Logarithmic Amplifier

As the current produced by the ionization chamber is very small (10^{-12}A at 0·1mr/hr), the insulation of the logarithmic amplifier stage is important and an airtight box is therefore used to house the circuit.



Gamma Radiation Monitor, Type TF 1299, and right, Fig. 2, control panel and indicating meter

The logarithmic amplifier consists of a single electrometer triode, the grid and cathode of which act as a diode in the retarded field condition. In this state a logarithmic relationship exists between the grid voltage and current. The grid voltage controls the anode current of the valve in the normal way.

A triode has important advantages over the thermionic diode usually employed as a logarithmic element. The triode gives an amplification not available in the diode, and in the diode the logarithmic relationship between diode current and voltage is inherently sensitive to variations in the cathode temperature. In the triode, however, an inherent cancelling effect exists, tending to maintain a constant anode current with changes in filament temperature. A decrease in the filament voltage tends to reduce the anode current since the cathode emission is lowered. As the ionization chamber current remains constant, the grid potential must increase to satisfy the grid-cathode diode relationship and this increase tends to restore the anode current to its original value. This cancelling effect is, however, not perfect and heater voltage stabilization is necessary.

A small priming current is applied to the grid of the electrometer valve to prevent the grid voltage from building up in the absence of radiation. Without this priming current the grid to cathode impedence could rise, producing a long time constant with the inherent chamber and stray capacitance. Consequently considerable delay in indication would arise should a sudden change in radiation level occur. Built-in test current generators simulate the ion chamber outputs at 0·1 and 100 mr/hr. To accommodate any zero drift in the amplifier the instrument is switched to these test positions, '0·1' and '100', and reset if necessary with the ZERO and CALIB controls to produce the correct meter indication — see front panel controls, Fig. 2. To set the Alarm trip level in the monitor the grid of the electrometer valve is connected, in the SCALE test position to an adjustable voltage source ALARM. With this the dose rates in the range of the instrument can be simulated and displayed on the meter. This facility allows any alarm trip level to be set and checked. Under all the test conditions the ionization chamber output is connected to the adjustable voltage source; this ensures that the ionization chamber does not charge up to a potential that

may damage the valve when the selector switch is returned to NORMAL. A further important advantage in connecting the chamber to this voltage, during test, instead of to the cathode of the valve, is that when the grid is switched back to the chamber output it will find a potential that is close to its operating voltage. This improves the recovering time of the indicated reading.

D.C. Chopper Amplifier

The anode current of the electrometer valve must be amplified before it can be displayed on the indicating meter. A transistorized d.c. chopper amplifier is used to achieve low drift in the instrument. The input chopper converts the d.c. input to a proportional a.c. signal, which is then amplified by an inherently drift-free a.c. amplifier. The amplifier output after demodulation drives the indicating meter and is also used directly to operate the high level alarm. The valve anode current necessarily contains a large standing current, which must be backed off so that the meter displays only its variable part; this is achieved by the ZERO control at the amplifier output shown in Fig. 3.

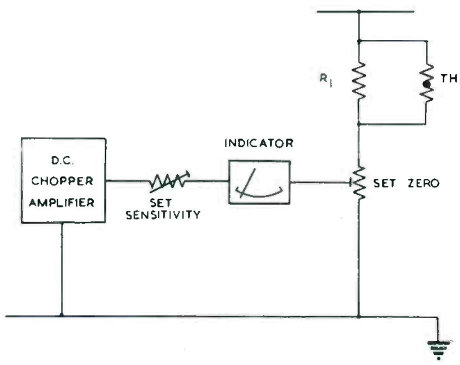


Fig. 3. Output circuit

The chopper transistor is not a perfect switch, because when bottomed (*i.e.* closed) a residual voltage drop exists across it and when cut off (*i.e.* open) a leakage current flows. The variation of these errors with temperature is the main problem in this type of amplifier. If a silicon transistor, with its inherent low leakage current, is used in the inverted mode, at an optimum base drive of about 1 mA, then these errors are minimized.

The indicating meter has a semi-logarithmic movement which together with the logarithmic response of the input stage produces the expanded scale on the meter—see Fig. 2. Thus the first decade, 0·1 to 1 mr/hr, occupies about half the scale. This permits a clear indication of the normal dose rates found in the reactor buildings and their surroundings (about 0·5 mr/hr). The reading remains on scale, however, should the dose rate increase one hundred times, without the necessity of range switching. The meter is calibrated logarithmically, yet a real zero is provided; this corresponds to an input consisting of the priming current plus any leakage currents existing in the input stage. In the calibration of the instrument a known gamma radiation source provides dose rates corresponding to the cardinal points on the indicating meter. With a dose rate of 0·1 mr/hr the backing-off control ZERO of the meter circuit sets the position 0·1 mr/hr and with a dose rate of 100 mr/hr the sensitivity control CALIB sets the 100 mr/hr position. The internal current generators, consisting of high value resistors to which stabilized voltages are applied, are set to provide test currents equivalent to the dose rates 0·1 and 100 mr/hr. This method of calibration compensates for any production spread in the gain and standing current of the electrometer triode. Furthermore, calibration is not dependent on an accurate knowledge of any parameter except the source. The temperature stability of the logarithmic and d.c. chopper amplifier is such that in the 'Normal' operating condition only the demodulator in the chopper amplifier produces appreciable drift This causes an increase in the dose rate indication; however, by producing an equal increase in the backing-off voltage temperature compensation is possible—see Fig. 3. A simple method of compensation is produced by inserting a thermistor, Th_1, into the backing-off network. The negative temperature coefficient of the thermistor is linearized and adjusted to the required value by shunting it with a resistor, R_1, of negligible temperature coefficient.

High Dose Rate Alarm

The alarm is a bistable circuit driven directly from the a.c. amplifier. It has the advantages of low backlash (less than 10% of indication) and of being independent of the temperature errors in the amplifier demodulator. The alarm, with a trip level which can be set at any point in the range of the instrument, will operate a lamp on the monitor when the incident dose rate exceeds the preset level. Facilities for operating a remote alarm are provided.

The Power Unit

This provides the stabilized voltages for the circuits, the chopper transistor base drive and the power for the alarm lamp. A normal series stabilized supply provides the low voltages. The temperature drift in this circuit is minimized by feedback technique and by using components with temperature coefficients which tend to oppose and cancel. The ionization chamber polarization supply is stabilized by a very simple yet novel method using the avalanche breakdown characteristic of a normal semiconductor rectifier as a reference potential. This breakdown mechanism is identical to that in Zener diodes at stabilization voltages greater than about 6 volts. The reverse characteristic of a semiconductor rectifier shows a rapid decrease in dynamic slope resistance when avalanche breakdown occurs, and this effect is used to produce a stabilizing element. The avalanche voltage is generally twice the P.I.V. of a rectifier and of the order of several hundred volts, so that the power rating of most diodes will allow only small currents to be dissipated. This is no disadvantage here, as the current taken by the ion chamber is small.

The avalanche diode can be used in the normal types of d.c. stabilizing circuits; in this instrument, however, a.c. stabilization produces optimum stability with the minimum number of components. An a.c. input will be clipped by the regulator, as shown in Fig. 4, to produce a stabilized a.c. output, which can provide a stabilized d.c. output. The series resistance R_s limits the forward current through the diode. An elaboration of this circuit is shown in Fig. 5; the capacitor C_1 increases the drive to D_1 and so improves the stabilization. As the diode D_1, however, is not a perfect stabilizer, any transients from the mains supply could be transferred via the ion chamber

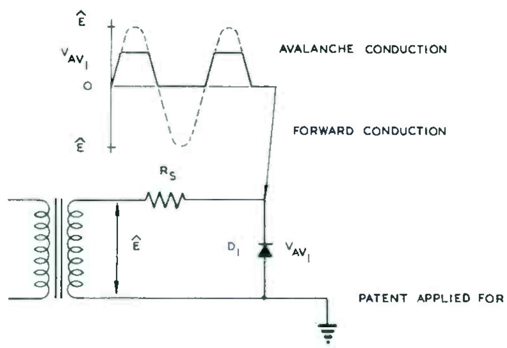


Fig. 4. A.C. regulation with an avalanche diode

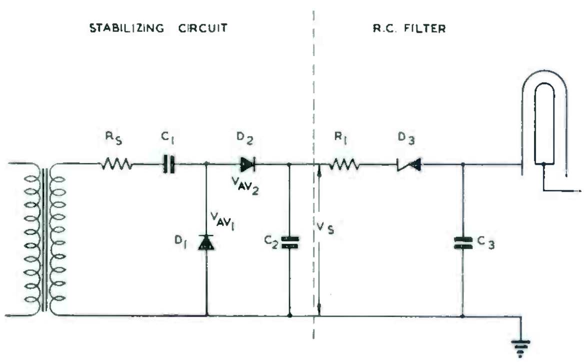


Fig. 5. Chamber polarization supply

inter-electrode capacitance to the grid of the electrometer valve, resulting in large error signals. This effect is considerably reduced if a diode with an avalanche voltage lower than that of D_1 is used for D_2, as a rapid discharge path is then available if C_2 is charged to a higher voltage than normal; furthermore, the output voltage is now defined by an avalanche diode in both half cycles of the mains input. During the positive half cycle D_2 is forward biassed and C_2 will charge up to a voltage defined by D_1. In the negative half cycle D_2 is reverse biassed with a voltage exceeding its avalanche voltage and the voltage on C_2 is defined by D_2. Equilibrium is reached when the charge put into C_2 in the positive half cycle is equal to that removed in the negative half cycle. This simple circuit produces a stabilization which compares favourably with more complex circuits. Mains variation of $\pm 10\%$ produce a change in the polarization voltage of $\pm 0{\cdot}1\%$. The temperature coefficient of these diodes in the avalanche condition appears to produce a $+0{\cdot}1\%$ per °C variation.

To improve the smoothing of the polarization voltage a long time constant filter is used with the stabilized supply. If a simple R-C network were used, then when the instrument is switched on a time delay ($R_1C_3 = 100$ sec) would occur before C_3 is fully charged and an accurate reading of the dose rate can be taken. Now this delay is substantially reduced by using a voltage sensitive resistance in the series elements. The Zener diode D_3 is used as such a resistance. It represents a two-state device, so that when the voltage drop across it exceeds the Zener voltage it represents a low resistance of a few ohms, but as the voltage drop decreases to less than the Zener voltage it becomes a very high resistance. If the capacitor C_3 is considered to be initially discharged, then after switching on, the output voltage from the stabilizer ($V_s \simeq 300$v) will be across R_1 and D_3. If the Zener voltage of D_3 is about 6 volts, then C_3 will charge with a small time constant $R_1C_3 \simeq 10$ sec, as R_1 need only be large enough to limit the current in D_3. As the voltage drop across D_3 reduces to its Zener voltage, a high resistance is produced and the required long time constant of about 100 sec is produced.

The TF 1299 is designed primarily as an industrial instrument and a robust waterproof housing has been provided. Semiconductors are used wherever possible with the aim of a long operating life and maximum reliability.

ABRIDGED SPECIFICATION FOR TF 1299

Range
0·1 to 100 mr/hr.
Displayed on log/log meter scale with 1 mr/hr at approximately mid scale.

Accuracy
Within $\pm 20\%$ for gamma radiation energies down to 0·2 MeV.

Stability
Indication changes by less than $\pm 5\%$ $\pm 0{\cdot}02$ mr/hr of indication for mains variation of $\pm 10\%$, and by about 4% °C change in ambient temperature.

Alarm trip
Trip level adjustable from 0·1 to 100 mr/hr. Backlash less than 10% of indication.

Output
Output for 100 mV recorder and remote alarm provided.

Optional Accessory
Quick-release carrying handle, Type TM 6614.

Dimensions (over projections)

	Height	*Diameter*
	25 in	12 in
	(64 cm)	(30·5 cm)

Weight
44 lb (19·5 kg)

MARCONI INSTRUMENTS

621. 317. 7: 621. 396. 62. 53

Alignment of Modern Communication Receivers

using TF 144H and TF 1104

by J. M. PARKYN

This brief article outlines a technique for using the new Marconi Instruments Standard Signal Generator TF 144H and Television Sweep Generator TF 1104 for the alignment of complex multiple-i.f. communication receivers operating in the m.f./h.f. bands. Particular emphasis is given to the use of the special bandwidth discrimination facilities of the TF 144H.

ALTHOUGH satellite relay stations for microwave links may soon alter the situation, with the present state of the art the recognized system for long-range radio communication is either by use of the h.f. band where ionospheric reflection provides world-wide coverage, or by use of the l.f. band which achieves world-wide coverage by diffraction of the wavefront and consequent curvature of the signal path around the surface of the earth. Since the total bandwidth available for l.f. and h.f. radio communication is less than 30 Mc/s and the required number of channels is enormous, many special systems for making the best use of the smallest possible bandwidth have been devised. As far as the receivers are concerned the requirement can be generalized in the form of extreme frequency stability and very sharp selectivity conforming to a precise response curve. There are many methods of achieving these requirements in a receiver and it is not the purpose of the present brief article to describe the use of Marconi Instruments test gear for one specific receiver but to outline the more common requirements and suggest how receiver alignment and checking can be accomplished.

Marconi Instruments
Standard Signal Generator, Type TF 144H

Narrow final i.f.'s. A common final i.f. is 100 kc/s with a 6-dB bandwidth—often switched—between 100 c/s and 8 kc/s. The TF 144H is well suited to measurements on such circuits since the built-in crystal calibrator offers a check point at 100 kc/s and the unique electrical fine tuning system* provides calibrated increments down to 10 c/s. Regulated d.c oscillator supplies and large good-quality tuned circuit components ensure the high degree of frequency stability essential in order to make full use of the fine discrimination provided.

Measurements of 100-, 300- and 750-c/s bandwidths at 100 kc/s by the TF 144H electrical fine tuning control are indicated on a linear dial calibration where 10 c/s

* *Instrumentation* Vol. 7 No. 8 P. 229

represents approximately $\frac{1}{10}$ in. of circumference. The mechanical simplicity of the device ensures less than about 2 c/s of backlash and the reduction gear on the operating control provides nearly five turns for 1000 c/s cover. The wider bandwidths and 'skirt' figures at the narrower settings, where increments in excess of ± 500 c/s are required, are measured using the precision geared main tuning control; this provides about 300 c/s shift per division of 3·6° of arc, or $\frac{1}{10}$ in. of circumference of the dial. Here again, backlash is only a small part of a division.

Tuneable i.f.'s. Penultimate i.f. circuits are often tuneable over the range 1 to 2 or 2 to 3 Mc/s in a modern receiver with a decade tuning system. Over this tuning range the TF 144H provides crystal check points every 400 kc/s, and the straight-line law of the main tuning system provides accurate 3-kc/s increments between 1 and 2 Mc/s; between 2 and 4 Mc/s the increments are 6 kc/s per division of the geared incremental control. It is also possible to make checks through to the final detector since even at 3 Mc/s a 300-c/s bandwidth is clearly indicated by the electrical fine tuning control.

Wide i.f.'s. First i.f. circuits may be above the maximum signal frequency to permit full tuning cover and to reduce image responses. Such circuits will commonly have quite wide bandwidths and may well include over-coupled tuned circuits. The TF 144H, with a maximum carrier frequency of 72 Mc/s and a precision geared main tuning control, is fully adequate for checking the alignment of such circuits However, the *adjustment* of over-coupled circuits cannot reasonably be undertaken without a sweep frequency generator. The TF 1104, which has a full-screen sweep width adjustable between 500 kc/s and 10 Mc/s, a built-in display tube and a centre frequency range from 250 kc/s up to 220 Mc/s, is a suitable instrument for viewing response curves while undertaking adjustments on over-coupled band-pass circuits. The built-in calibrator system displays crystal controlled markers down to 0·5 Mc/s separation. A feature of the heterodyne markers is that they are generated completely within the sweep generator and are therefore displayed outside the pass-band of the filter under test and permit accurate calibration of the swept frequencies prior to and during the adjustment of the circuits under test. Detector Probe TM 6397 is available for connection between the output of the filter under test and the vertical amplifier of the combined sweep generator and display unit TF 1104.

Overall Response. The excellent frequency stability and purity of the c.w. tone of TF 144H enables the operator to make overall sensitivity and signal-to-noise tests even on the narrowest of h.f. communication channels. The electrical fine tuning control can provide small frequency adjustments considerably beyond the limit of discrimination of the calibrated dial. At 30 Mc/s a bandwidth of 3 kc/s can readily be measured against the calibrated scale, but the control can provide accurate tuning to the centre of a 100-c/s bandwidth. Under such conditions an external electronic frequency counter could be used to extend the calibration should an overall bandwidth measurement be required.

Marconi Instruments Television Sweep Generator, Type TF 1104

As well as frequency discrimination the feature of signal generator performance which becomes particularly apparent when making overall response measurements, especially at high frequencies where the fractional bandwidth is very small, is the ability of the generator to produce an unmodulated carrier output free from spurious frequency and amplitude modulation. In the design of the TF 144H particular emphasis has been placed on this requirement for low hum and noise modulation by the provision of rectifiers to give d.c. heating for the r.f. valves and the use of robust tuned circuit components to reduce mechanical resonance and consequent microphony.

Spurious supply modulation on c.w. typically causes about 10 c/s of frequency deviation at 72 Mc/s and correspondingly less at lower carrier frequencies while spurious a.m. is under 0·1%.

Regulation of both h.t. and l.t. supplies within the TF 144H ensure extreme freedom from supply variation effects. The carrier frequency shift for $\pm 10\%$ mains supply variation is about 350 c/s at 70 Mc/s and about half this at 30 Mc/s, and the amplitude variations are negligible. For ultimate elimination of these effects alternative battery operation is provided.

Automatic level control maintains the carrier level substantially constant with all adjustments of the frequency and attenuator controls thus greatly assisting in the ease of making receiver measurements.

For detailed descriptions and specifications of TF 144H and TF 1104 see:

Parkyn, J. M.—Standard Signal Generator Type TF 144H—Marconi Instrumentation, 7.229.1960.
Parkyn, J. M.—Alignment Oscilloscope Type TF 1104—Marconi Instrumentation, 5,96,1955.

621. 414. 3

MARCONI INSTRUMENTS

Oscilloscope Pre-Amplifier . . . *TYPE TM 6591*

by E. C. CRAWFORD, Graduate I.E.E.

THIS PRE-AMPLIFIER is completely transistorized and battery operated, and has an amplification of $\times 100$ over the frequency range from 3 c/s to 100 kc/s. It was designed for use with the TF 1330 oscilloscope, but it may also be added to the TF 1277 or indeed any other oscilloscope with a basic sensitivity of 50 mV/cm deflection or thereabouts.

To ensure that any signal from 3 mV p-p and above may be seen full size on the oscilloscope screen an accurate attenuator is included in the amplifier giving an alternative $\times 10$ facility. With some pre-amplifiers a gap is left between signals of say 50 mV to 300 mV where the input overloads the pre-amplifier but is not quite big enough for discriminating viewing. No such gap will be found with TM 6591 which has been designed to give continuous coverage with generous overlaps at the cross-over levels of 30 mV and 300 mV p-p, the rated inputs being 70 mV p-p on $\times 100$ and 500 mV p-p on $\times 10$.

High Input Impedance

An input resistance of approximately 10 MΩ has been realized by a combination of two emitter followers together with negative feedback from the emitter of the first amplifier to the collectors of the emitter followers.

Transistors are normally noted for low input resistance due to the 'forward diode' resistance of the base-emitter junction. Suppose this to be as high as 5 kΩ and an input signal to be applied to the base with the transistors arranged as an emitter follower. If the emitter follows to the extent of 0·999 times the base voltage, the effective resistance via the base emitter diode path becomes 1000 times 5 kΩ, or 5 MΩ. Such results can hardly be achieved with one transistor, and it requires the current gain of three successive stages to ensure at least 10 MΩ resistance to the input signal.

The base biasing resistor for the input transistor, which incidentally is a low-leakage silicon type, is also in parallel with the input circuit. In this case, however, it is initially a high-value resistor and the remote or otherwise earthy end is supplied with an a.c. signal almost equivalent to the input. The a.c. current flowing through the resistor, which determines its effect upon the input loading, is proportional to the potential difference across it. If this is only 1 % of the input, the resistor is magnified to 100 times its 'cold' value.

The maximum input to the amplifier will normally be about 150 mV r.m.s. but it is intended that its uses will include the investigation of ripple on power supplies and similar devices which have potentially transistor killer voltages. As a safeguard the input capacitor has a 350-V d.c. (at 70°C) working rating and a 100-kΩ stopper is permanently in series to limit the transistor currents in the event of accidental connection to the mains.

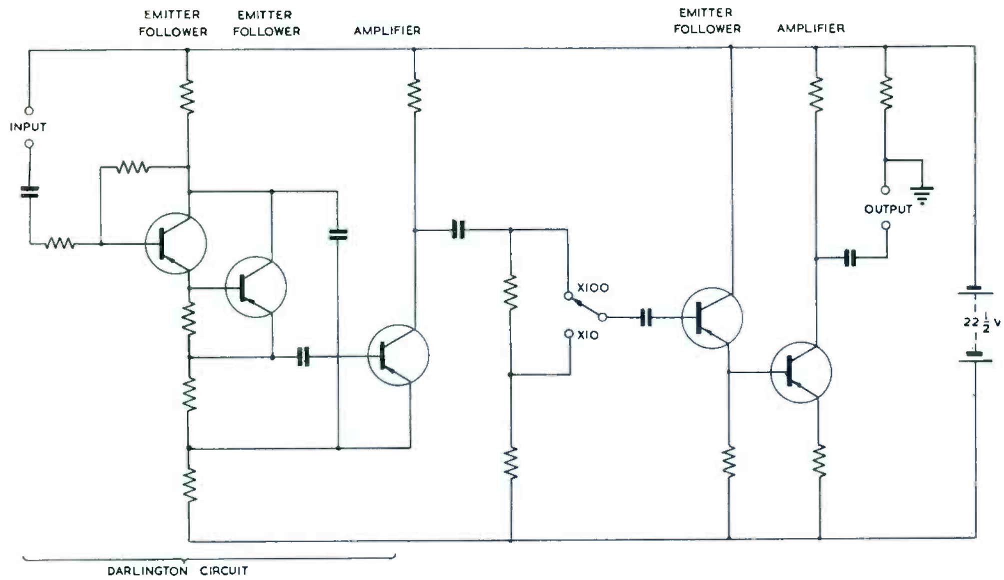
Earth Loop Currents

Despite the isolation of the pre-amplifier by its battery operation and its connection to the oscilloscope by three feet of screened lead, it would still be susceptible to the bugbear of earth loop currents were it not for the inclusion of a resistor specifically intended to reduce the effect.

TM 6591

Consider the oscilloscope, plugged into the mains and earthed via the main earth system. It has a pre-amplifier and is being used to examine a minute signal in another piece of mains earthed apparatus. Quite commonly there will be several millivolts of a.c. at mains frequency between these two 'earthed' objects. This results in a flow of current at mains frequency along the earth conductor linking the pre-amplifier to the test object and, further along the screened cable joining the pre-amplifier to the oscilloscope. The several millivolts of a.c. will be distributed according to the respective resistance of each part of the link. That part which is developed across the conductor linking the pre-amplifier to the test object is subject to the full gain of the system as this is in the input signal loop of the pre-amplifier.

By including a low-value resistor, which is large however compared with the lead resistance, in series with the earth return between the pre-amplifier and the oscilloscope, virtually all the unwanted millivolts of a.c. hum



Functional diagram of Pre-Amplifier, Type TM 6591

are developed across this, and although subject to amplification by the oscilloscope, they are not amplified by the $\times 100$ or $\times 10$ of the pre-amplifier.

This feature is particularly important when the amplifier is being used for hum-chasing.

Battery Life

A 22·5-volt deaf-aid battery supplies the 40 milliwatt 'power' for the pre-amplifier. With continuous daily use the battery may be expected to last a month, but of course with more intermittent use the useful hours of life will be more limited by the shelf life of the battery. The gradual fall in battery voltage from 22·5 volts to the recommended minimum of 18 volts or thereabouts has a proportionate effect upon the maximum output voltage and a reduced effect upon the gain due to local emitter negative feedback in the amplifier stages. A change of 10% in gain over the life of the battery is usual. An internal preset control enables the gain to be set at exactly $\times 10$ or $\times 100$, the internal attenuator between $\times 100$ and $\times 10$ having a fixed inaccuracy of about $\pm 2\%$ in the limit.

It would be possible for individual users to arrange for the amplifier to be supplied from the positive h.t. line within the oscilloscope instead of using the battery should the need arise. But it would be necessary to stabilize the pre-amplifier supply with one 22-volt or three 7-volt Zener diodes.

SPECIFICATION

Gain
$\times 100 \pm 5\%$
$\times 10 \pm 5\%$

3-dB Bandwidth
3 c/s to 100 kc/s, with TF 1330. Approximately 10 dB down at 300 kc/s.

Maximum input on $\times 100$
70 mV peak-to-peak.

Maximum input on $\times 10$
500 mV peak-to-peak.

Noise
With 1 MΩ across input, 100 μV r.m.s. approximately.

Input Impedance
10 MΩ, 25 μμF approximately.

Power Supply
22·5-volt battery.

FOR REFERENCE

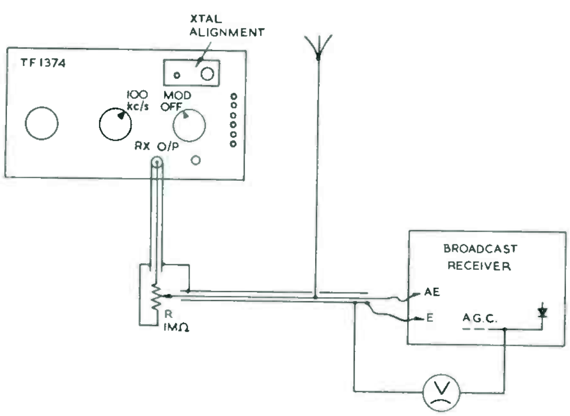
A neat binder to contain copies of the old size ($8\frac{1}{2} \times 5\frac{1}{2}$ in.) of *Instrumentation* is available in order that readers and librarians may keep copies of the bulletin in a convenient form for reference. It will contain twelve copies which can be opened flat and inserted without punching. These binders are available at a cost of 9s. 6d. each post free. To simplify the transaction please send remittances when ordering.

If readers have missed any of the issues of Volume 7 we shall be pleased to supply back numbers from Number 4, December 1959, but we are sorry that copies of *Instrumentation* previous to this are, generally speaking, out of print.

STANDARDIZATION OF CRYSTAL CALIBRATORS TF 1374 & TF 1374/1

by E. ISAACS
Graduate Brit. I.R.E.

THERE have been requests from users recently asking for clarification of the methods employed in setting up the Precision Crystal Calibrator TF 1374 and -/1 to give an accurately known frequency. The method described below has been evolved in direct response to this request.



Tune receiver to Droitwich (200 kc/s), feed in 100 kc/s signal from TF 1374 and adjust level until audio beat occurs as indicated by loudspeaker and/or a.g.c. voltmeter.
Adjust 'Xtal Alignment' controls for very slow or zero beat.

The adjustment of the CRYSTAL ALIGNMENT controls on the TF 1374 requires the provision of a highly stable standard 10-Mc/s signal source or frequency meter. In the factory, this is normally provided by the Marconi Precision Frequency Meter, Type TME2, but should it be required to carry out adjustments in the field, the user is recommended to check the TF 1374 against the standard frequency transmissions of Radio Stations WWV or MSF. While this technique gives results of a high order of accuracy, reception from either of these stations on 10 Mc/s is not always reliable, and usually necessitates the use of a good quality communications receiver and aerial system.

An alternative method has therefore been devised which, in its simplest form, requires the use only of a domestic radio receiver and a multi-range meter. If the meter, set to a low d.c. voltage range, is connected to the a.g.c. line of the receiver, it will act as a carrier level meter, showing a sharp deflection as a station is tuned in.

The receiver is tuned in this manner to the B.B.C. Light Programme on 200 kc/s (Droitwich), and the 100-kc/s output of the TF 1374 is fed into the receiver aerial terminal together with the Droitwich signal. If a frame or ferrite rod aerial is incorporated in the receiver, a coupling loop of a few turns of wire about 6 inches in diameter serves to couple the TF 1374 signal into the receiver.

The level of the TF 1374 signal is then adjusted by a suitable potentiometer (1 MΩ) in the output lead, or movement of the coupling loop, until a beat occurs, as indicated by the a.g.c. level meter or the receiver loudspeaker. The CRYSTAL ALIGNMENT controls on the TF 1374 are then adjusted until zero beat occurs

During this adjustment, care should be taken to ensure that all the frequency dividers in the TF 1374 remain in lock, or spurious results may otherwise be obtained. If it is suspected that one or more of the dividers is out of lock, the following procedure should be adopted:

Plug a pair of headphones into the PHONES jack and, with the SENSITIVITY control fully advanced, turn the centre switch to each divider frequency in turn. No sounds should be heard in the headphones unless the divider in question is out of lock, in which case a mixture of beat notes will be heard. The appropriate trimmer should then be adjusted through the hole in the rear panel to bring the divider back into lock.

For maximum stability, the TF 1374 should be allowed to warm up for at least 30 minutes before this calibration procedure is carried out. The voltmeter may with advantage be replaced by a Valve Voltmeter such as the TF 1041B, or better still by the Suppressed Zero Voltmeter TF 1377; this latter will give a much more sensitive indication as it enables the standing d.c. on the a.g.c. line to be backed off. Receivers successfully employed for this technique include the Bush TR 83C transistor portable receiver, and the Marconi CR 100 communications receiver.

The frequency of the Droitwich transmitter is maintained at 200 kc/s to a nominal accuracy of ± 1 part in 10^7; in practice the accuracy is usually a few parts in 10^9, and it should therefore be possible to set the TF 1374 output to 1 part in 10^6 with ease by this method. The frequency of the Droitwich transmitter is measured daily with reference to N.P.L. Standards, and the results are published each month in *Electronic Technology*.

MEASUREMENT OF FAST PULSE RISE TIMES

by J. F. GOLDING

WHEN USING AN OSCILLOSCOPE to measure pulse rise times which are long compared with the rise time of the oscilloscope Y amplifier, negligible error is introduced by the amplifier. However, it is sometimes desired to use an oscilloscope for measurement of a pulse rise time which is of the same order as that of the Y amplifier; and it is then necessary to apply a correction to the measured time.

The rise time of an amplifier is defined as the time of rise, from 10% to 90%, of the output voltage when a perfect step, *i.e.* one having zero rise time, is applied to the input terminals.

The shape of the output pulse is a function of time, $f_{amp}(t)$, which depends upon the high-frequency response characteristic of the amplifier. Similarly, an input step voltage of finite rise time may follow a different function of time, $f_{pulse}(t)$. The output voltage then follows the product of the two functions; *i.e.* $v_{instant}=f_{amp}(t)\times f_{pulse}(t)$.

Thus the ultimate rise time of the output pulse depends, not only upon the two rise times, but also upon the functions f_{amp} and f_{pulse} In practice, however, the case is simplified by the fact that providing the overshoot is small there is little variation of shape over the portion of the transient between 10% and 90% of the pulse height; and a close approximation to the rise time-relationships is given by the expression:

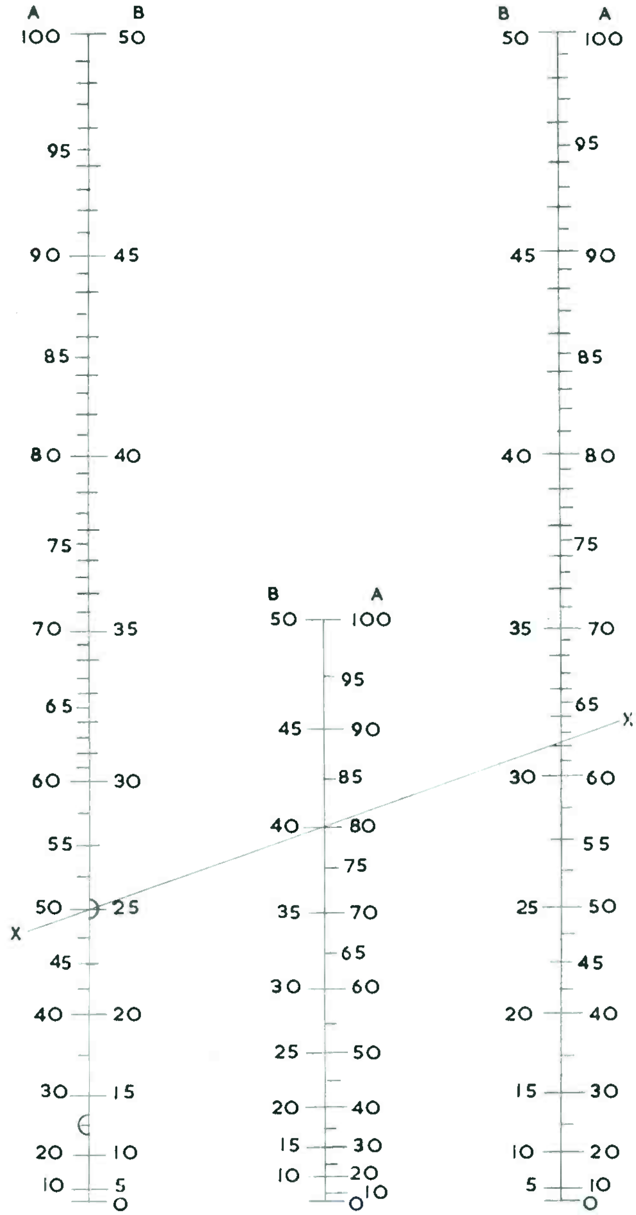
$$t_{display}=\sqrt{t^2_{pulse}+t^2_{amp}}$$

Where $t_{display}$ is the rise time of the output pulse,

t_{pulse} is the rise time of the input pulse,

t_{amp} is the rise time of the amplifier.

The accompanying abac is based upon the above expression and provides a convenient means of converting the rise time measured on an oscilloscope to the true rise time of the input pulse. Two sets of scales (A and B) are provided, A covers the range 0 to 100, B gives better discrimination over the range 0 to 50. No units have been stated; but the measurement would normally be in terms of milli-microseconds.



Oscilloscope Rise Time Scale 1 *Measured Rise Time Scale 2* *Rise Time of Input Pulse Scale 3*

To use the abac, find the point corresponding to the rise time of the oscilloscope in Scale 1 and the point corresponding to the measured rise time on Scale 2. Use a straight-edge to project the line joining these two points on to Scale 3. The point where the line crosses Scale 3 is the rise time of the input pulse. Remember to use the A calibrations or the B calibrations throughout.

As an example, line x–x gives the rise time of a pulse which is measured as 40 mμsec (Scale 1B) on an oscilloscope having a Y-amplifier rise time of 25 mμsec (Scale 2B). The rise time of the input pulse is read from Scale 3B as 31·2 mμsec.

A semicircle adjacent to the appropriate side of Scale 1 has been drawn at the 25-mμsec points. This is the nominal rise time of the Y amplifiers of the Marconi TF 1330 and TF 1331 oscilloscopes. The accuracy of this figure is not given in the published specification, but the rise time does not normally vary outside the limits 23 to 25 mμsec. Use of the nominal figure would, therefore, produce negligible error when the rise time is comparable to or longer than that of the oscilloscope Y amplifier. When the rise of the input pulse is sufficiently fast to require a more precise knowledge of the amplifier rise time, any error introduced by using the nominal figure would be absorbed by the general measurement tolerances of the oscilloscope.

The use of the abac is, of course, not confined to oscilloscope amplifiers. It can be used in conjunction with any amplifier or system carrying fast-rise pulses. If the rise time of the system is known, the deterioration of a pulse can be read directly from the abac by using Scale 1 for the rise time of the system, Scale 3 for the rise time of the input pulse, and Scale 2 to give the output rise time.

To measure the rise time of an amplifier or system, apply a fast rise pulse to its input, and measure the rise time of the output pulse on an oscilloscope, applying abac corrections where necessary. The rise time of the system can then be obtained from the abac by the method given in the previous paragraph. Providing the overshoot is less than 5% of the pulse height, the bandwidth of the system can be calculated from the expression:

$$F_{-3\,\mathrm{dB}} = 0{\cdot}35/t_{\mathrm{amp}}$$

Where $F_{-3\,\mathrm{dB}}$ is the upper frequency limit at which the response is 3 dB below the mid-frequency response,

t_{amp} is the rise time of the system.

Summaries of Articles appearing in this issue

RESUME D'ARTICLES PUBLIES DANS LE PRESENT NUMERO

ANALYSEUR DE SPECTRE BANDE S, TYPE TF 1387

L'analyseur de spectre (bande S, Type TF 1387) a été conçu pour être employé avec les émetteurs-récepteurs de radar opérant dans la gamme de fréquence de 2750 à 3200 Mc/s et peut présenter visuellement plusieurs paramètres du système complet. Bien que son but principal, comme l'indique son nom, soit d'examiner le spectre de fréquences de l'impulsion de l'émetteur, il peut aussi être employé pour accorder l'oscillateur local du récepteur avec la fréquence exacte. Dans d'autres circonstances, lorsque l'analyseur fonctionne en générateur de balayage, les courbes des réponses des amplificateurs F.I. des récepteurs ou les caractéristiques des discriminateurs du contrôle automatique de fréquence peuvent être tracées.

Page 27

GENERATEURS BANDE X, SERIE DE TYPE TF 1343A

Cette série de générateurs hyperfréquence couvre une gamme totale de 8,1 a 10,55 GHz en bandes consécutives de 600 MHz environ. La fréquence est etalonnée tous les 10 Mc/s avec une précision de 0,05%. Les générateurs fournissent une puissance de sortie de 10 mW mesurée avec une précision de 1 dB entre les températures de −35° a +52°C.

Page 31

MONITEUR DE RAYONNEMENT GAMMA TYPE TF 1299

Dans le voisinage d'un réacteur nucléaire les niveaux du rayonnement gamma sont continuellement mesurés. Cet exposé décrit un appareil conçu à cet usage. Le moniteur qui est complètement équipé de transistors à part un seul tube electromètre mesure les taux de dose de 0,1 a 1000 milli Roentgen/heure sur échelle logarithmique.

Page 36

ALIGNEMENT DES RECEPTEURS DE COMMUNICATIONS MODERNES EMPLOYANT LES TYPES TF 144H ET TF 1104

Cet exposé très court esquisse une technique pour l'emploi de deux nouveaux générateurs de la firme Marconi Instruments: le générateur étalon TF 144H et le générateur de balayage pour télévision TF 1104 qui servent à accorder les récepteurs de communications à fréquences intermédiaires multiples, dans les bandes MF/HF. On y souligne l'emploi de la spéciale discrimination de largeur de bande que possède le TF 144H.

Page 40

PREAMPLIFICATEUR TYPE TM 6591 POUR OSCILLOSCOPE CATHODIQUE

Ce préamplificateur est complètement équipé avec des transistors, est alimenté par piles, et fournit un agrandissement de ×100, dans la gamme de fréquence 3 c/s a 100 kc/s. Bien que le préamplificateur fût conçu pour être employé avec l'oscilloscope TF 1330, il peut aussi être ajouté au TF 1277 ou à tout autre oscilloscope ayant une sensibilité d'environ 50 mV/cm de déflexion.

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ZUSAMMENFASSUNG DER IN DIESER NUMMERER SCHEINENDEN ARTIKEL

S-BAND SPEKTRUMANALYSATOR TYP TF 1387

Der S-Band Spektrumanalysator Typ TF 1387 kann bei Radargeräten mit einer Betriebsfrequenz zwischen 2750 und 3000 MHz benutzt werden und eignet sich für eine Sichtanzeige der verschiedenen Parameter der gesamten Anlage. Obwohl sein Hauptzweck—wie der Name besagt—eine Prüfung des Frequenzspektrums der Senderimpulse ist, kann das Gerät ebenfalls für die Abstimmung des Empfänger-Mischoszillators auf die richtige Frequenz benutzt werden. Bei einer anderen Schaltungsbedingung als Generator mit periodischer Frequenzänderung können die Durchlasskurve des ZF-Verstärkers im Empfänger und die Charakteristik des Diskriminators für die automatische Frequenzregelung auf dem Schirmbild wiedergegeben werden.

Seite 27

X-BAND MESS-SENDER DER TYPENSERIE TF 1343A

Diese Serie von Mikrowellen-Messsendern überstreicht einen gesamten Frequenzbereich von 8,1 bis 10,55 GHz in lückenlosen Teilbereichen von ungefähr 600 MHz Breite. Sie sind in Abständen von 10 MHz mit einer Genauigkeit von 0,05% geeicht und können eine Dauerstrichleistung von 10 mW abgeben, wobei diese mit einer Genauigkeit von 1 dB in dem Temperaturbereich von −35° bis +52°C überwacht werden kann.

Seite 31

GAMMASTRAHLUNGS-UBERWACHUNGSGERAT TYP TF 1299

Die Stärke der Gammastrahlung in der Nähe eines Kernreaktors wird laufend überwacht. In diesem Aufsatz wird ein für diesen Zweck entwickeltes Gerät beschrieben. Das Überwachungsgerät, welches ausser einer Elektrometerröhre nur Transistoren enthält, zeigt Strahlungsstärken von 0,1 bis 100 Milli-Röntgen pro Stunde auf einer logarithmischen Skala an.

Seite 36

DER ABGLEICH MODERNER KOMMERZIELLER EMPFÄNGER MIT HILFE DER GERÄTE TF 144H UND TF 1104

Dieser kurze Aufsatz beschreibt eine Methode zum Abgleich komplizierter kommerzieller Mittelwellen- und Kurzwellen-Empfänger mit mehreren Zwischenfrequenzen unter Benutzung der Messsender TF 144H und Fernseh-Wobbelsender TF 1104 der Marconi Instruments. Die Benutzung der besonderen Bandbreiten-Messeinrichtung des Gerätes TF 144H wird besonders hervorgehoben.

Seite 40

OSZILLOGRAPHEN-VORVERSTÄRKER TYP TM 6591

Dieser vollständig mit Transistoren bestückte und batteriebetriebene Vorverstärker hat einen Verstärkungsfaktor von 100 im Frequenzbereich 3 Hz bis 100 kHz. Er wurde für den Kathodenstrahl-Oszillograph TF 1330 entwickelt, kann aber auch vor den Oszillograph TF 1277 oder jeden anderen mit einer Ablenkempfindlichkeit von ungefähr 50 mV/cm geschaltet werden.

Seite 42

SOMMARIO DEGLI ARTICOLI PUBBLICATI IN QUESTO NUMERO

ANALIZZATORE SPETTRALE PER LA BANDA S TIPO TF 1387

L'analizzatore spettrale per la banda S tipo TF 1387 va adoperato con radar transmittenti-riceventi operanti nella banda di frequenza da 2.750 a 3.200 MHz e permette la presentazione visuale di diversi parametri del sistema completo. Sebbene, come implica il nome, il suo scopo principale sia quello di esaminare lo spettro di frequenze dell'impulso trasmesso, esso può essere anche adoperato per sintonizzare l'oscillatore locale del ricevitore alla frequenze corretta. In un'altra applicazione, in cui lo strumento funziona come un generatore di analisi, le curve di risposta degli amplificatori a media frequenza del ricevitore o le caratteristiche dei discriminatori per il controllo automatico di frequenza possono venir presentate sullo schermo.

Pagina 27

GENERATORI DI SEGNALI PER BANDA X TIPO 1343A (SERIE)

Questa serie di generatori di segnali a micro-onde copre un intervallo da 8,1 a 10,55 GHz in bande consecutive aventi una larghezza di circa 600 MHz. Sono stabilizzati di frequenza ogni 10 MHz con una precisione di 0,05%, e forniscono un'uscita a onda continua di 10 mW controllata con una precisione di 1 dB in un intervallo di temperatura da −35° a +52°C.

Pagina 31

MONITORE DELLA RADIAZIONE GAMMA TIPO TF 1299

Il livello della radiazione gamma nelle vicinanze di un reattore nucleare va continuamente controllato. Uno strumento progettato per questo scopo è descritto in questo articolo. Il monitore che è interamente transistorizzato, tranne un elettrometro a valvola, misura valori dell'intensità della dose da 0,1 a 100 milliroentgen all'ora su di una scala logaritmica.

Pagina 36

L'ALLINEAMENTO DI RICEVITORI MODERNI PER COMUNICAZIONE PER MEZZO DEGLI STRUMENTI TF 144H E TF 1104

Questo breve articolo descrive un metodo per l'allineamento di ricevitori per comunicazione a multipli stadii di media frequenza, operanti nelle bande di media e alta frequenza, per mezzo del Generatore di Segnali Standard TF 144H e del Generatore di Analisi per Televisione TF 1104, ambedue della Marconi Instruments. Un pregio particolare del TF 144H, che viene sottolieato, consiste nei suoi appositi circuiti per discriminazione di banda.

Pagina 40

PREAMPLIFICATORE PER OSCILLOSCOPIO TIPO TM 6591

Questo preamplificatore è interamente transistorizzato ed è previsto per alimentazione a batteria. Ha un'amplificazione di 100 volte in un intervallo di frequenze da 3 Hz a 100 kHz, è stato progettato per essere adoperato con l'oscilloscopio TF 1330, ma può essere usato con l'oscillopio TF 1277, come pure con un qualunque altro oscilloscopio con una sensibilità base di 50 mV per cm di deviazione o una sensibiltà di quest'ordine.

Pagina 42

RESUMENES DE ARTICULOS QUE APARECEN EN ESTE NUMERO

ANALIZADOR ESPECTRAL EN BANDA S TIPO TF 1387

El analizador espectral en banda S tipo TF 1387 es para usarse con transmisores/receptores de radar, funcionando en la gama de frecuencias desde 2.750 a 3.200 Mc/s y puede mostrar visualmente varios parámetros del sistema completo. Aunque su propósito principal, como el nombre lo indica, es de examinar el espectro de frecuencia del transmisor, es también usado para sintonizar el oscilador local del receptor a su frecuencia correcta. En otras condiciones, funcionando como generador de barrido puede mostrar las curvas de respuesta de los amplificadores de frecuencia intermedia del receptor o las características de los discriminadores de c.a.f.

Página 27

GENERADORES DE SEÑALES EN BANDA X TIPO SERIE 1343A

Esta serie de generadores de señales en microondas cubre una gama de frecuencias desde 8,1 hasta 10,55 Gc/s en bandas consecutivas de unos 600 Mc/s. Están calibrados a cada 10 Mc/s con una exactidud de 0,05% y tienen una salida en onda continua de 10 mW medida con una exactidud de 1 dB sobre la gama de temperaturas desde −35° hasta +52°C.

Página 31

MONITOR DE RADIACION GAMMA TIPO TF 1299

Los niveles de radiación gamma en la vecindad de un reactor nuclear son continuamente registrados. El instrumento que se describe en este artículo ha sido diseñado para este propósito.

Con la excepción de una sola válvula, el monitor está completamente transistorizado y mide regímenes de dosificación desde 0,1 a 100 milliroentgen por hora sobre una escala logarítmica.

Página 36

ALINEACION DE RECEPTORES DE COMUNICACIONES MODERNOS CON EL USO DE LOS TF 144H Y TF 1104

Este breve artículo describe un modo de usar los nuevos generadores de señales Marconi TF 144H y generador de barrido para la televisión TF 1104. Con estos se puede sintetizar las frecuencias intermedias de receptores de comunicaciones funcionando en las bandas de frecuencias medias y altas. Particularmente se le da énfasis al uso de las facilidades que tiene el TF 144H para la discriminación de anchura de banda.

Página 40

PREAMPLIFICADOR PARA OSCILOSCOPIO TIPO TM 6591

Este preamplificador está completamente transistorizado y alimentado por pilas y tiene una amplificación de 100 sobre la gama de frecuencias desde 3 c/s hasta 100 kc/s.

Fué proyectado para uso con el osciloscopio TF 1330, pero también se le puede agregar al TF 1277 o cualquier otro osciloscopio que tenga una sensibilidad de unos 50 mV/cm.

Página 42

SIGNAL GENERATORS

NOISE GENERATORS

OSCILLATORS

OSCILLOSCOPES

PULSE GENERATORS

MODULATION METERS

DISTORTION ANALYSERS

SPECTRUM ANALYSERS

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