VOL. 8 NO. 1 MARCH, 1961

MARCONI INSTRUMENTATION

A Technical Information Bulletin
Issued Quarterly by
Marconi Instruments Limited, St. Albans, England

IN THIS ISSUE

ELECTRONIC INSTRUMENTS FOR TELECOMMUNICATIONS AND INDUSTRY

VOL. 8 NO. 1

MARCH, 1961

MARCONI INSTRUMENTATION

issued with

the compliments of

MARCONI INSTRUMENTS LIMITED

ST. ALBANS

ENGLAND

EDITORS:

A. G. WRAY, M.A., A.M.Brit.I.R.E.

and

J. R. HAYWARD, A.M.Brit.I.R.E.

The New Look

THIS, THE FIRST ISSUE OF a new volume marks another important event in the history of *Instrumentation*, for at this juncture we record a change in both editorship and format.

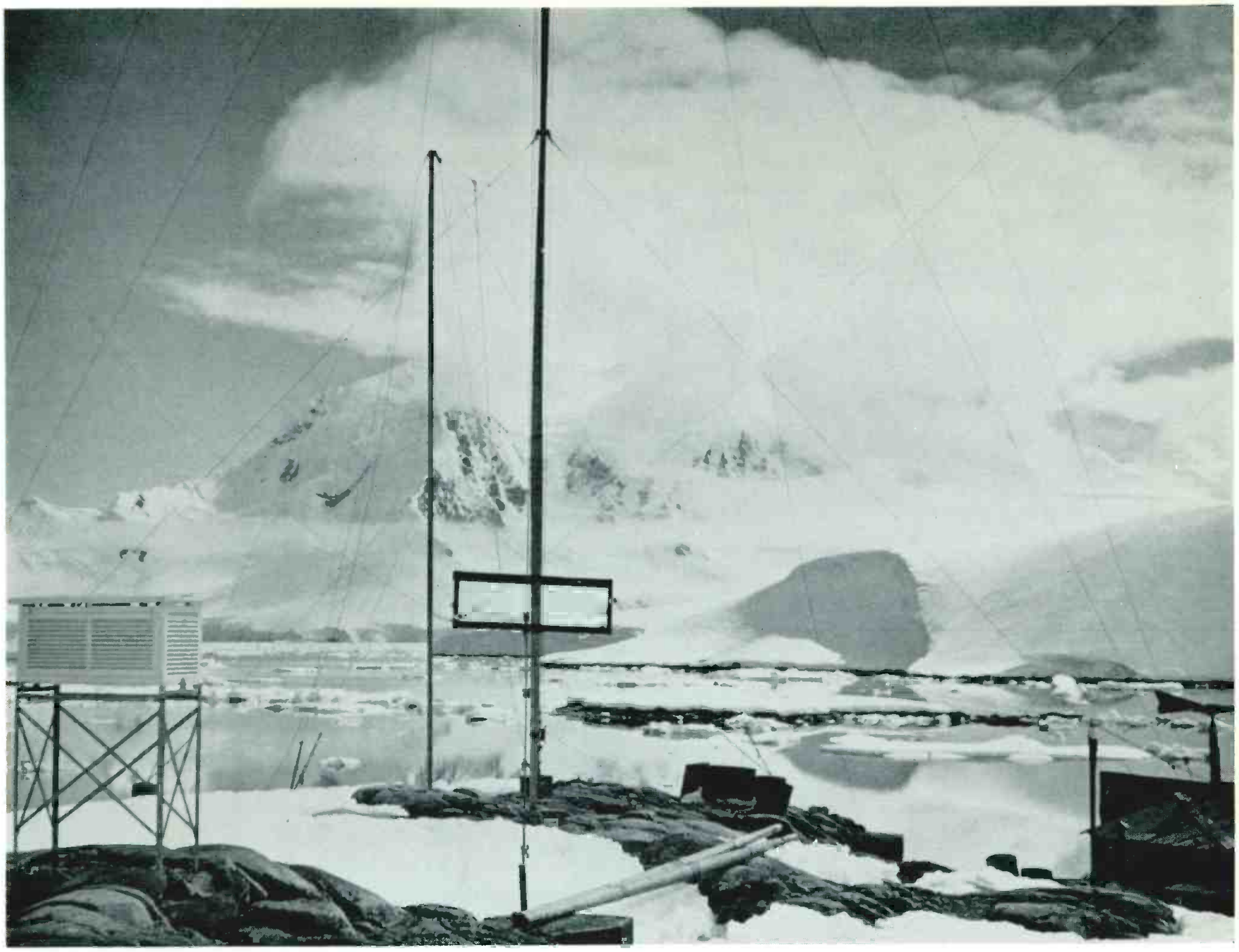
When *Instrumentation* was first published in the Spring of 1947 the readership was under 1,000; for our last issue the print order was something in excess of 30,000, such has been the growth over the years. When it is remembered that this increase has been due solely to receiving requests 'to be placed upon the mailing list' we are led to believe that the bulletin is serving a useful purpose in the dissemination of technical information about the Company's products. Constancy of format has been the aim; the concept, as always, a bulletin written by engineers for engineers.

The retirement from the Company of our editor, Mr. Newhouse, coinciding as it does with the completion of Volume 7 has, however, created a natural break in this continuity. Accordingly, on the appointment of Mr. Hayward to be his successor, the opportunity has now been taken to look at the publication as a whole to see whether the original concept could not be better achieved by making something of a break with tradition. As a direct result of this study we have decided to introduce a number of changes, beginning with this, our first issue of Volume 8.

From our readers' viewpoint perhaps the most noticeable change is the alteration of page size. For some time past we have felt that the space available to us on a page of $8\frac{1}{2}$ in. $\times$ $5\frac{1}{2}$ in. was insufficient to do full justice to the reproduction of functional diagrams, photographs etc. It appeared, therefore, that certain advantages were to be gained by making the page larger. What then should the size of the new page be? In choosing 11 in. $\times$ $8\frac{1}{2}$ in. we were prompted by the fact that all our existing published literature, catalogues, handbooks, sales information etc. are already printed in this size. It would therefore, seem obvious that by standardizing on the one size we should then make it possible for our customers to keep all their Marconi technical information together in a single file or binder.

With the introduction of the larger page, we have also taken the opportunity to introduce a semi-stiff cover. It is hoped that this will give a greater rigidity to the bulletin when placed in the bookshelf or filing cabinet. The contents of each issue are now printed on the front of the cover; this should make for ready identification and will ease the task of searching through a number of issues for an article of particular interest. As it is impracticable to reproduce a halftone illustration upon a cover of this type, the photograph normally associated with the cover is appearing on the second page of the editorial. It will continue to depict a scene of interest which has some bearing upon the contents of the issue in question.

The main technical content of the bulletin is unaltered. We shall continue to publish articles, written by our design engineers, on new products recently introduced into the catalogue. These, as in the past, will not only give background information on the design itself but will also enable the designer to put forward his thoughts on the ways in which his instrument could be applied in the field. So often, however, theory and practice do not tally—the way in which the designer forsees his equipment being used is not always the way in which a particular customer actually uses it! From time to time a novel application even comes to light. Usually interest in this direction is not confined to the individual or individuals in question; others would stand to gain



The kind of country in which the bridge described on page 11 will be used. The F.I.D.S. ionospheric station at Base A, Port Lochroy, Wiencke Island, off the west coast of Graham Land *(F.I.D.S. photograph)*

by hearing about it. Accordingly we are asking our field engineers, who obtain this sort of information first-hand, to write up their experiences. We intend to publish such contributions as a regular feature and it is hoped that they will be found to be a welcome addition to the technical content of the bulletin. The first article in this connection, written by Mr. Ellam of our U.S. Office, is included in this issue.

Our growing circulation has led to a corresponding increase in our overseas readership. To help them be sure they do not miss anything of interest we are introducing a service in which summaries of all major articles appear in a number of languages. The way these translations are to be presented can be seen from an inspection of the first edition on pages 23 and 24.

So then *Instrumentation* is being given a 'New Look'. The changes we have just outlined have been introduced with the conviction that their implementation will enable us to give a better service to our many readers in the future. We hope that *Instrumentation* in its new form will be found acceptable and that it may continue to forge that link between Company and customer which plays so important a part in the conduct of our affairs in the present age.

A.G.W.

FOR REFERENCE

As Volume 8 commences with this issue we have inserted in each copy an alphabetical and numerical index of the articles and instruments which appeared in Volume 7. If readers have missed any of the issues of this volume we shall be pleased to supply back numbers from Volume 7 Number 4, December 1959, but we are sorry that copies of *Instrumentation* previous to this are, generally speaking, out of print.

A neat binder to contain copies of the old size ($8\frac{1}{2} \times 5\frac{1}{2}$ ins) 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.

621. 396. 615. 1

MARCONI INSTRUMENTS NEW DESIGN

Wide Range R-C Oscillator . . . TYPE TF 1370

by L. M. SARGENT

This general-purpose generator of sinewaves and squarewaves has a frequency range extending from 10 c/s to 10 Mc/s, and makes use of a simple resistance-capacitance oscillator. Sinewaves from 1 mV to 3 volts via a 75-, 100- or 600-ohm attenuator (unbalanced) are available up to 10 Mc/s, and squarewaves up to 100 kc/s. Below this frequency, sinewaves and squarewaves are also available at levels up to 30 volts into a 2,000-ohm load. Three accessories provide a balanced output, a pure 1-kc/s tone, and an output of very low impedance and level.*

**Patent applied for*

THE COVER PHOTOGRAPH of our last issue shows an interesting new signal source being subjected to tests by our latest counting and recording apparatus. This source was in fact the new Wide-Range R–C Oscillator TF 1370—the subject of this article.

The TF 1370 performs similar functions to the Video Oscillator TF 885A/1, the emphasis on various aspects of performance having been shifted in the light of present-day requirements.

DESIGN ALTERNATIVES

The name 'video oscillator' was introduced with the advent of television to describe suitable sources for tests on the vision modulation apparatus. Strictly speaking, the video frequency range extends right down to d.c., but since the very low frequencies require a completely different design approach from the very high, video oscillators in practice extend only down to a few tens of cycles or kilocycles, dependent on the methods adopted. The high frequency requirement these days tends to extend the range towards 20 Mc/s, when, for instance, checks on harmonic content in colour TV are being carried out.

L–C Oscillator

The vast improvements in TV technique have led the video oscillator of the highest class into becoming a specialized device producing signals with very low distortion, with highly stabilized amplitude and fine adjustment of level. Such necessities have led its designers to retain the inductance-capacitance oscillator, with its relatively restricted frequency cover in any one range, and either to limit the lowest frequency to some tens of kilocycles, or else to switch over to a resistance-capacitance oscillator for the purpose of covering the audio band. In the two cases, either the versatility or the cost is sacrificed for the high level of performance.

Beat Frequency Oscillator

For tests of a more general nature, the well-tried beat-frequency system continues to hold its own in some circles by virtue of the very wide range cover, and the ease with which frequency-sweep arrangements can be provided. Although able easily to extend down to, say, 50 c/s, this system exhibits in its disfavour a frequency stability which worsens rapidly as the frequency falls, the distortion tending to suffer similarly. The unfortunate result, from the point of view of the supplier of test apparatus intended to have a wide appeal, is that the audio range, which is only of incidental use to those concerned with video equipment, is of inadequate quality to appeal to the engineer concerned with the higher grade audio tests.

R–C Oscillator

It is not surprising, therefore, to find high-quality test instruments which combine a resistance-capacitance oscillator, performing very satisfactorily up to some 100 kc/s, with inductance-capacitance arrangements operating up to the region of 10 Mc/s. Nor is it surprising to find the demand in the medium class being met, as an example, by the combination of two types of R–C oscillator, embodying the Wien bridge and the phase-shift network, and changing over as before in the 100 kc/s region. It is, therefore, obvious that complexity, size and weight would be improved with the introduction of an instrument using only one R–C oscillator to cover the entire range, and hence having appeal for the majority of audio and video testing. A rearrangement of the Wien bridge technique has achieved this in the oscillator TF 1370.

FACILITIES AVAILABLE IN THE TF 1370

Dual-Ratio Tuning Drive

Both sine and squarewaves are generated by the TF 1370, the former over the frequency range 10 c/s–10 Mc/s, the latter over the range 10 c/s–100 kc/s. As shown in the photograph (page 4), the instrument retains the styling which has come to be associated with Marconi Instruments test gear. It is equipped with a frequency dial of 7½ inches diameter, the complete frequency range being covered in six decade bands, giving a total length of scale of about 9 ft. The four lowest ranges share one semi-logarithmic

The Marconi Instruments Wide Range R–C Oscillator, Type TF 1370

scale up to 100 kc/s, whilst separate scales of very similar shape are provided for the two highest decades. When turned through an arc of some 340°, the control knob provides a reduction ratio of about 18:1 with respect to the frequency dial; and when turned further, the knob operates with a ratio of about 3:1 to facilitate rapid traverse of the scale. A frequency change of 1% is easily discernible at the most cramped end of the scale.

Triple Output Impedance

On the right-hand side of the panel is the Output Volts Selector switch, equipped with seven positions, of which the central one is arranged to mute the output signal. One of the remaining two sets of three positions is chosen according to whether sine or square output is required, the three individual positions deciding the method of presentation of the signal. For low impedances and low levels, the signals can be switched via an attenuator with an auxiliary selector providing 75, 100 or 600 ohms output impedance, as desired. The steps are of 10 dB each and provide, with the continuously variable output level control, a total range of 1 mV to 3·16 volts from the source impedance selected. The chosen level is indicated on the 3 in. ×4 in. meter, and may be read in terms of source voltage (i.e. e.m.f. in series with a known resistance), or in decibels with reference to 1 volt peak-to-peak in a 75-ohm load. Sinewave voltages are indicated at r.m.s. levels, and squarewave voltages at peak levels. No panel adjustment of the meter zero position is necessary.

High Outputs

The other two output level positions of the selector switch provide a maximum of either 10 or 30 volts at a further output socket, adjusted by the output level control and monitored by the meter, which now reads the voltage presented direct to the load (if any) at the socket. The minimum load is 2,000 ohms, and the measured source impedance is about 15 ohms for 30 volts, and about 950 ohms for 10 volts. The two output sockets are of the BNC pattern, and a mating plug is provided.

Auxiliary Features

The squarewave signal is limited under all output conditions to 100 kc/s; the sinewave via the attenuator is available up to 10 Mc/s, and via the direct socket it is available up to 100 kc/s. An electrical interlock between the switches for frequency-range and output prevents selection of the limited outputs at too high a frequency and, if an attempt is made, a warning lamp lights as a reminder. Two preset controls on the panel govern respectively the mark/space ratio of the squarewave, and its degree of sag at the lowest frequencies.

A double-pole power supply switch and indicator lamp are provided and the instrument operates from a supply in the ranges 100–150 or 200–250 volts. The supply cord can be stowed in the left-hand pocket when not in use. The front panel is of correct width to screw straight into a 19-inch rack, on removal of the surround and case. An alternative version (TF 1370/1) is fitted with a dust cover and panel protection rails, with power entry at the rear.

APPLICATIONS

The distortion of the sinewave signal remains of the order of 0·3% from 100 c/s up to several hundred kc/s, rising to less than 3% at 10 Mc/s. At 10 c/s it is in the 1% region. The signal is therefore acceptable for a very large number of audio, video and general-purpose checks. The basic attenuator impedance was chosen as 75 ohms, since this is widely used in television transmission interconnecting lines. The impedance of 600 ohms is widely accepted in audio transmission apparatus, and the alternative impedance of 100 ohms caters for direct substitution by TF 1370 for TF 885A/1. The output level of 3·16 volts was chosen so as to accommodate a level well above 1 volt peak-to-peak in a 75-ohm load, thus allowing for overload checks on apparatus complying with this popular operational standard for video gear. A 0 dB mark is provided on the meter for use when operating with respect to this level. Of course, althought not specifically catered for, it is also possible to operate with respect to the audio standard of 1 mW in a 600-ohm load, this level being obtained by setting the voltage indication to read 1·55 volts from the 600-ohm source. Likewise, levels of +10 or +20 dBm for overload tests can be obtained if required, as described in the section concerning the output system. For most checks, it is unnecessary to reset the level whenever the frequency is changed; typically, the internal control maintains the level within a total change of 2% from 100 c/s to 100 kc/s, and there follows a reduction without sudden variations of any kind as the frequency rises to 10 Mc/s, at which point the level has fallen by about 3% with respect to 100 kc/s. As the control element is temperature-sensitive, and as range switching temporarily interrupts the oscillation, there is a brief resultant rise of level and rapid return to normal. No long period of settling down is experienced, the longest time involved being of the order of half a second.

Since the generator is of a general-purpose nature, the quality of the squarewaves provided is limited, for economic reasons. However, it was assumed that the majority of applications lay in the testing of standard television apparatus, high-fidelity audio apparatus and modulation of r.f. signal generators; and hence it was arranged that the squarewave sag or ramp-off should be as low as possible at 10 c/s, and very low indeed at the television frame frequency, whilst the rise-time should be about 0·2 microsecond. The circuit and performance are described in a later section. Turning to the high-level signals, with a maximum of 30 volts sine or square, these were provided to meet the needs of such tests as those on output stages, and of demonstrations and educational exercises, as well as to offer a signal for the modulation of those commercial r.f. signal generators and allied devices requiring signals of the order of 10 to 20 volts: in short, wherever higher voltages at a lower power level are needed. The sinewaves obtainable via both the high-level system and the attenuator have distortion contents which differ very little.

DESIGN DETAILS

The Oscillator

When looked at from the point of view of oscillation at 10 Mc/s, the conventional audio oscillator employing a Wien bridge exhibits a distressing number of shortcomings. The usual two-stage amplifier employed produces a large amount of phase-shift at the output with respect to the input, resulting in a very cramped frequency scale, and what is more serious, instability due to the intended negative feedback having become positive. The resistance values in the bridge itself are liable to cause similarly unacceptable phase-shifts in conjunction with wiring capacitances, resulting in a poor balance at resonance. In the oscillator actually employed, the total range of 10^6:1 in frequency makes it imperative to tune the ranges with variable capacitance and switch them by means of resistance variation. Hence, a total load varying from tens of megohms to hundreds of ohms must be acceptable to the amplifier, with similar values at its input terminal. This requires a very low output impedance and a very high input impedance, cathode-followers being the most appropriate stages to employ.

The amplification must, for reasons of stability, be provided all in one stage. This at once presents a difficulty because the required differential detector arrangement that a Wien bridge demands means that, in this case, the cathode-follower receiving a signal from the output of the two reactive arms must feed into the cathode of the single-stage amplifier, the gain of which will not be as high as expected if a considerable impedance is present in its cathode. This difficulty has to be circumvented by

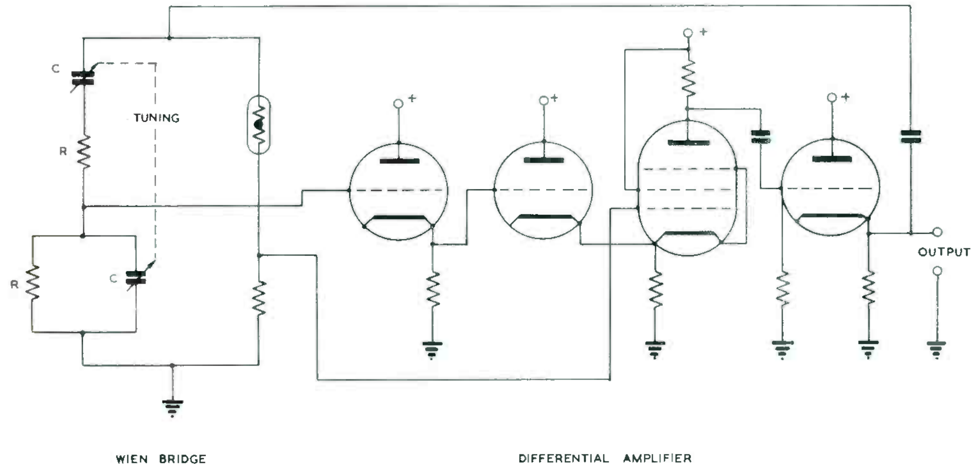


Fig. 1. Wien bridge oscillator modified for operation over a wide frequency range

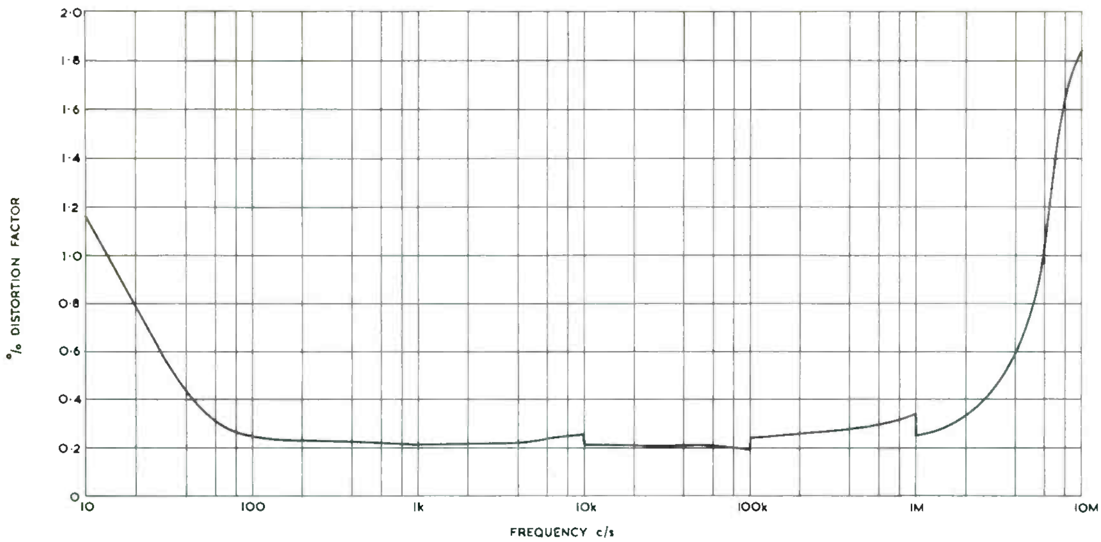


Fig. 2. The distortion factor of the output from the attenuator over the whole frequency range, at a level of 1·5 volts across 75 ohms

employing a special cathode-follower of very low output impedance (see Fig. 1). Unfortunately, this stage has not the high input impedance which the bridge demands at low frequencies, so a further arrangement has to be interposed. The extremely low output impedance for feeding the bridge is achieved, once again, by a special cathode-follower, and this has the added advantage of presenting the minimum capacitance to the amplifying stage, and so maximizing the bandwidth.

It might be thought that the frequency response of the stage must be flat up to at least 10 Mc/s; in point of fact, as long as there is only one effective 'roll-off' (or high-frequency loss of response) in the negative feedback loop for the purpose of ensuring that stability is achieved, the fact that the response commences to fall before the highest frequency is reached has only the effect of modifying the scale-shape of the frequency dial, and of worsening the distortion. Now, the amplifier gain at the highest frequency is fixed by the valve parameters and stray capacitances, and if the anode load were chosen for flat response the distortion would be both poor and constant throughout the frequency range of oscillation. On the other hand, a larger value of load can be chosen, which will give the same gain at 10 Mc/s, but which will increase the gain as the frequency falls, at the expense of causing some phase-shift. The present oscillator employs this principle, and so provides at any frequency the lowest possible distortion. Fig. 2 shows how the distortion of the output signal falls to very low proportions at about 100 kc/s, and then remains fairly constant down to 100 c/s. It then worsens for other reasons, being of the order of 1% at 20 c/s.

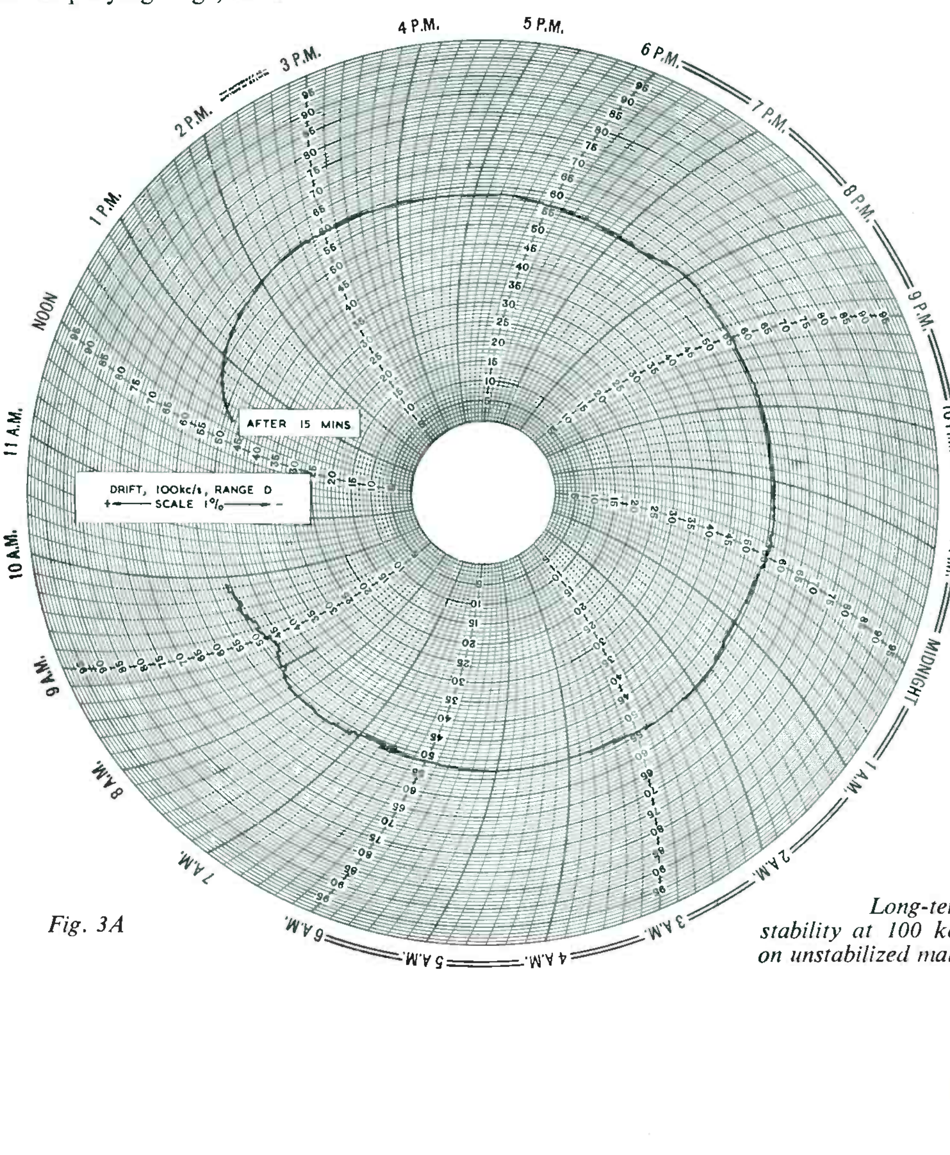


Fig. 3A

Long-term stability at 100 kc/s on unstabilized mains

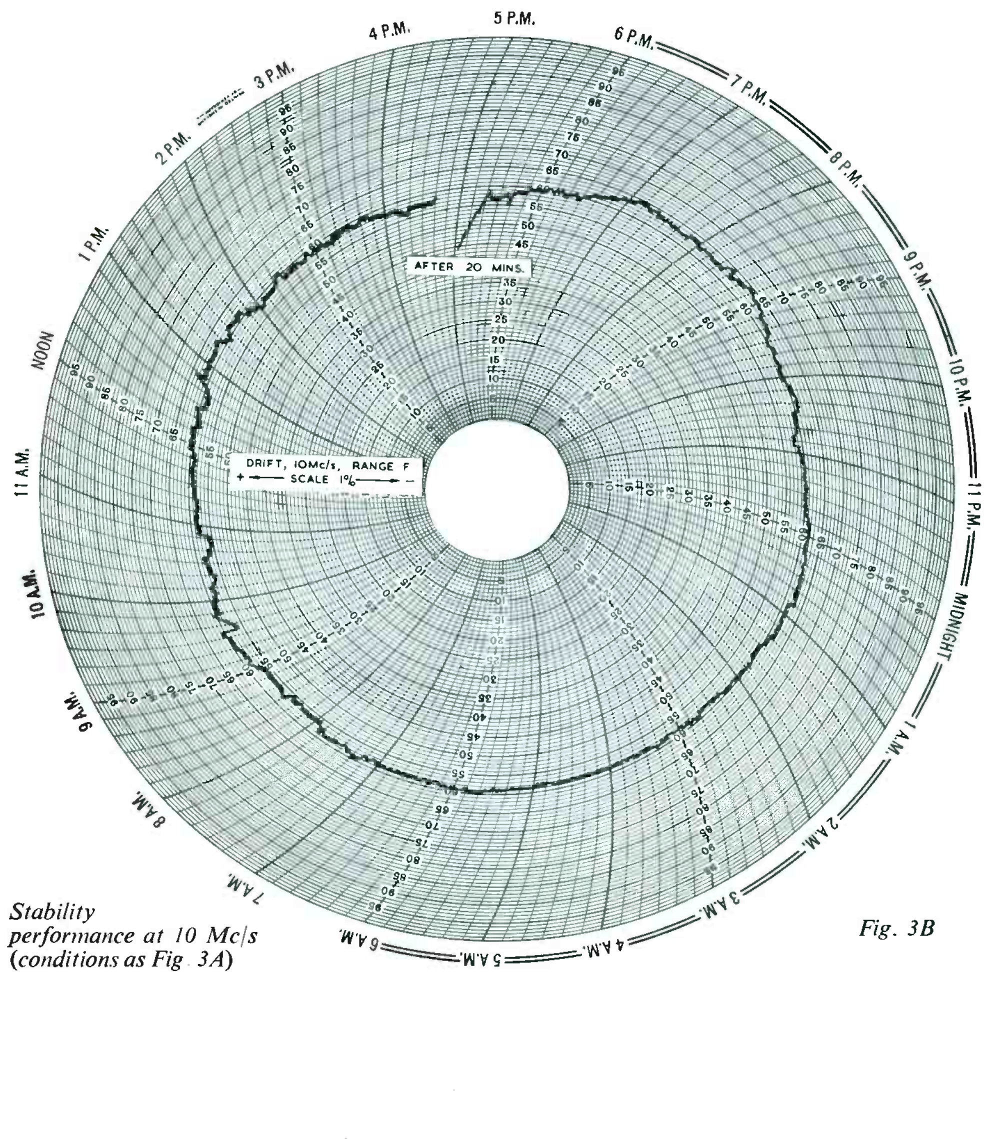
The equivalent Q-factor of a Wien bridge is, in common with most R–C tuning networks, very low compared with the values achieved in L–C tuning arrangements; so that, for good stability, considerable care has to be taken with regard to stabilizing the supply voltages for the oscillator. Nevertheless, a performance quite acceptable in a general-purpose instrument is achieved, as can be seen in the drift charts reproduced in Fig. 3, and recorded by the Counter Frequency Meter TF 1345 and Decoder TF 1392. There is a small amount of frequency shift at 10 Mc/s as the attenuator is switched to the position of minimum loss, and as the output control is operated, but, since the shift is caused by self-capacitances, it soon becomes quite negligible as the frequency is reduced. The specification indicates the magnitude of this effect.

The Auxiliary Circuits

The amplifier for providing a 30-volt signal uses a twin-triode circuit with a gain of 10, (Fig. 4). It has a bandwidth of 500 kc/s, so that up to the maximum operating frequency of 100 kc/s its response is quite flat, and the distortion is rendered negligible by the application of 26 dB of negative feedback. A twin-triode is also used for the Schmitt trigger circuit for producing squarewaves. The circuit is directly coupled to the amplifier described above via a potentiometer which controls the bias state, and hence the timing of the switchover points, or mark/space ratio. By employing an exceptionally large trigger sinewave, the triggering hysteresis is minimized, an effect which manifests itself by producing a rounded corner just before the true switchover commences. Internal self-capacitances tend to impress this sinewave on the output, so curving the flat portions at the highest frequencies, but this action is largely neutralized by an appropriate arrangement introducing an equal signal of opposite sign.

The rise-time is mainly governed by the self-capacitance concerned with the load in which the 30-volt peak wave is developed. This is arranged to be an adjustable resistance for level control, resulting in enhanced rise-time as the level is reduced. Since the majority of checks using a squarewave involve the use of a timing oscilloscope, it is easy enough to measure the rise-time of the signal as well as that of the result. In this way, a simple circuit is arranged to provide a high level, and yet at lower levels to provide a quite respectable rise-time. If specific tests involve particular values of level and rise-time, an external 75-ohm attenuator can be employed to achieve the required results.

The degree of sag at low frequencies involves only the a.c. couplings concerned with the output stage, since the squaring circuit is entirely d.c. coupled. An inadequate decoupling circuit is introduced into the squaring stage, so as to produce a rise, rather than a fall, on the flat portions at low frequencies. The effect is adjustable, and is set to provide a practically flat top at 10 c/s, the worst sag of 5% occurring when the minimum load (2,000 ohms) is applied to the direct output socket. At 50 c/s, the sag or rise can be adjusted to zero by the control.



Stability performance at 10 Mc/s (conditions as Fig 3A)

Fig. 3B

The Output System

The output stage employs a White cathode-follower[1], an arrangement shown in the schematic diagram. For operation up to 10 Mc/s, the input terminal of the attenuator is fed directly by the cathode-follower. When squarewaves or high-level sinewaves are required, the cathode-follower feeds a potentiometer with a 30-volt signal, and the switching allows the direct output socket to be fed with 30 or 10 volts, or allows the attenuator

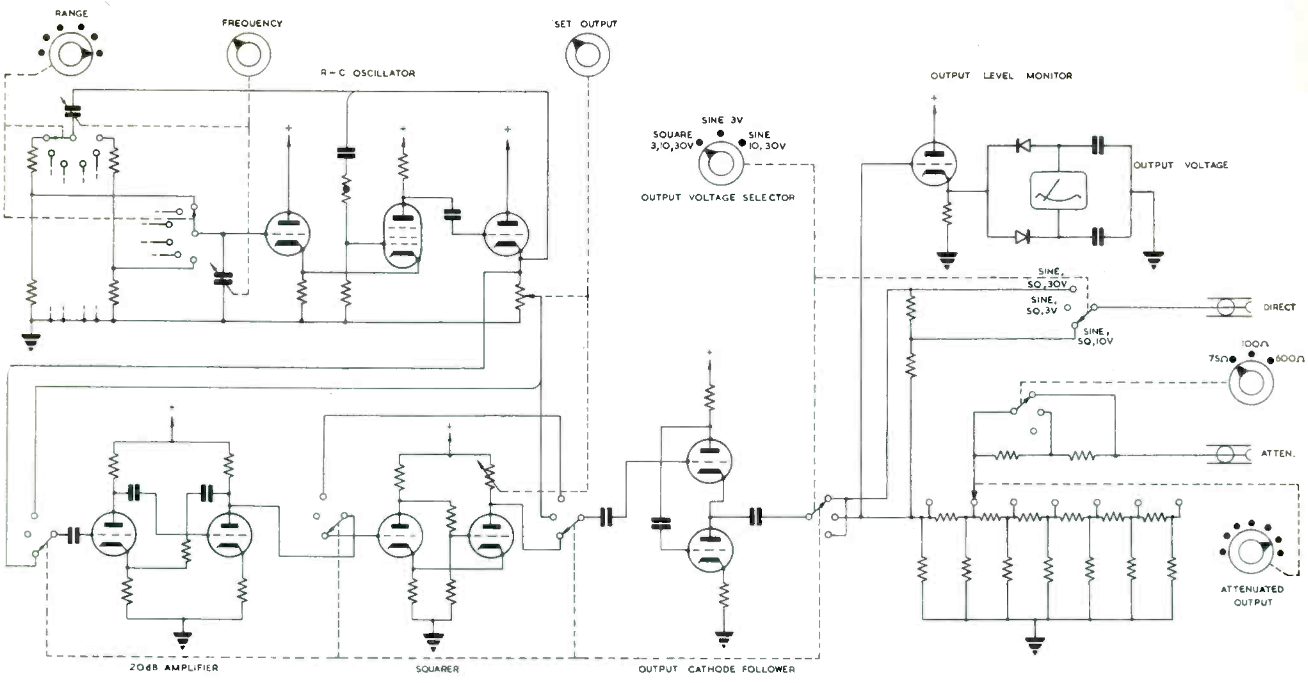


Fig. 4. Simplified Functional Diagram of Wide Range R–C Oscillator, Type TF 1370

(forming now the lowest leg of the potentiometer) to be fed with 3 volts. This unconventional method of supplying the attenuator has the disadvantage of causing a rise in output impedance on the highest step; on the other hand, the total impedance fed by the output stage is large enough to enable small sag to be achieved on the squarewaves whilst employing a manageable feed capacitor. It is noteworthy, with regard to the rise-time of squarewaves, that the 75-ohm output cable is matched to the source only on the 1-volt attenuator position and below; when arranged for 30, 10 or 3 volts, the squarewave therefore suffers an increase of rise-time as the cable is lengthened, the specification performance referring to a length of 3 ft. No such limit on length applies to the 1-volt position and below.

Under all conditions the voltmeter is connected to the input terminal of the attenuator: hence, it indicates the source voltage of attenuated signals, and the on-load voltage of direct signals. The attenuator is a simple ladder network, except for the step of zero loss, which is arranged to avoid connecting the user's load direct to the voltmeter; a common arrangement which, on this step alone, causes the meter to indicate the voltage on the load, rather than that at the source. When the attenuator is fed directly by the output stage at 10 Mc/s, the nominal output impedance of 75 ohms is within $\pm 20\%$ on the maximum step, and is within $\pm 10\%$ on all other steps. The phase angle is typically 6° when measured at the front panel; and at the end of a 3-ft length of loaded cable UR70, it is 14° on the maximum step, and 6° on the other steps. The accuracy of the 100-ohm impedance is similar at the front panel, but unless 100-ohm cable is employed for connecting the load, the use of 100 ohms should be restricted to about 2 Mc/s. With regard to the 600-ohm impedance, used with the normal 75-ohm cable, the high-frequency loss depends on the length, and as an example a 3-ft length (loaded) causes a loss of 0·25 dB at 900 kc/s, and 3-dB at 6·8 Mc/s.

As stated earlier, the measured output impedance on the 30-volt position is 15 ohms, and the minimum load to which 30 volts can be supplied is 2,000 ohms; it follows that it is also possible to supply the current thus required, into any lower resistance. Recalling the occasional

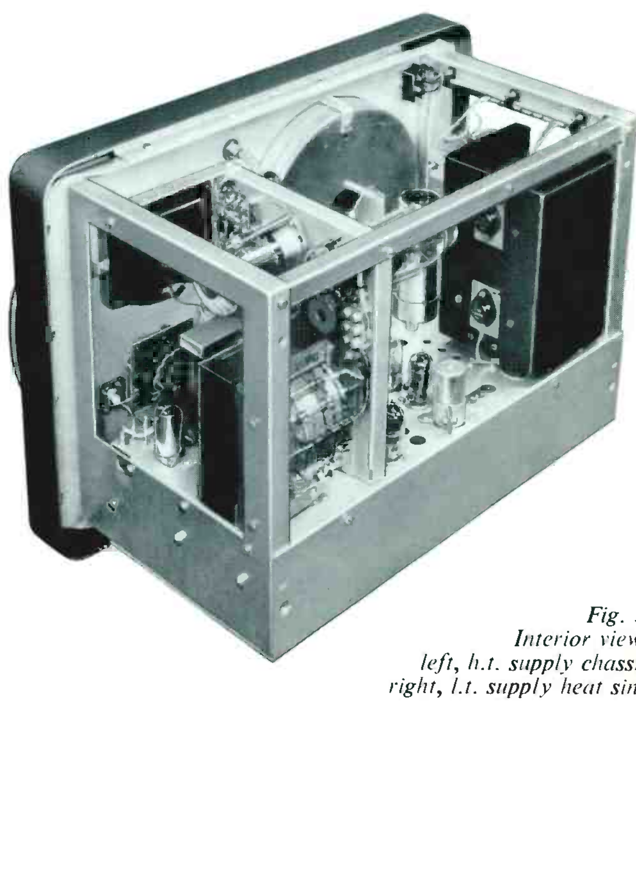


Fig. 5. Interior view; left, h.t. supply chassis right, l.t. supply heat sink

requirement of levels of +10 or +20 dBm (600 ohms), these require source voltages of 4·9 volts or 15·5 volts. Therefore, if such a voltage is set up on the output meter at the 30-volt position, and if the 600-ohm load is fed via a 600-ohm resistor, the required level will be achieved. The measured output impedance will appear to be 615 ohms. If, however, the meter, positioned after the odd 15 ohms, be reset by hand after application of the load, the equivalent output impedance then becomes 600 ohms.

The Power Supply
The power supply arrangements include a conventional h.t. supply, an electronic stabilizer with highly sensitive error amplifier for supplying important sections of the system, and a transistorized stabilizer for the l.t. supply to the oscillator. The auxiliary circuits are switched out when frequencies above 100 kc/s are required, thus optimizing the stabilizer performance by reducing the load when the oscillator most requires it. Fuses are provided in the supply, h.t. and d.c. l.t. circuits.

at the secondary are 600, 200 or 150 ohms, with centre-tap. This tap can be connected to an earth terminal, which is at chassis potential. If this connection is not desired, a d.c. voltage not exceeding 200 volts may be applied between the two windings. Since the iron laminations are likely to suffer, it is important that no direct current should be allowed to flow in either winding. The distortion introduced is of a low order.

It is allowable to take an output from half the various secondary outputs, i.e. from one terminal of a pair and the centre-tap; in these cases the output impedance will be a quarter of those quoted, and the high-frequency response will be worsened. The new impedances thus added are 50 ohms and 37·5 ohms; 150 ohms is catered for already. Neglecting the frequency characteristic, which is quite flat over the audio range, the output level on load at 600 ohms impedance (nominally one-half of the indicated source voltage) is to be multiplied, due to the insertion loss, by a factor of about 0·9. Further reductions occur at the lower impedances, due to the transformer action, and the output level as calculated above should be further multiplied by the following factors: at 200 ohms impedance, ×0·58; at 150 ohms, ×0·5; at 50 ohms, ×0·29; and at 37·5 ohms, ×0·25. Whenever the transformer is used without a load, the insertion loss can be regarded as negligible.

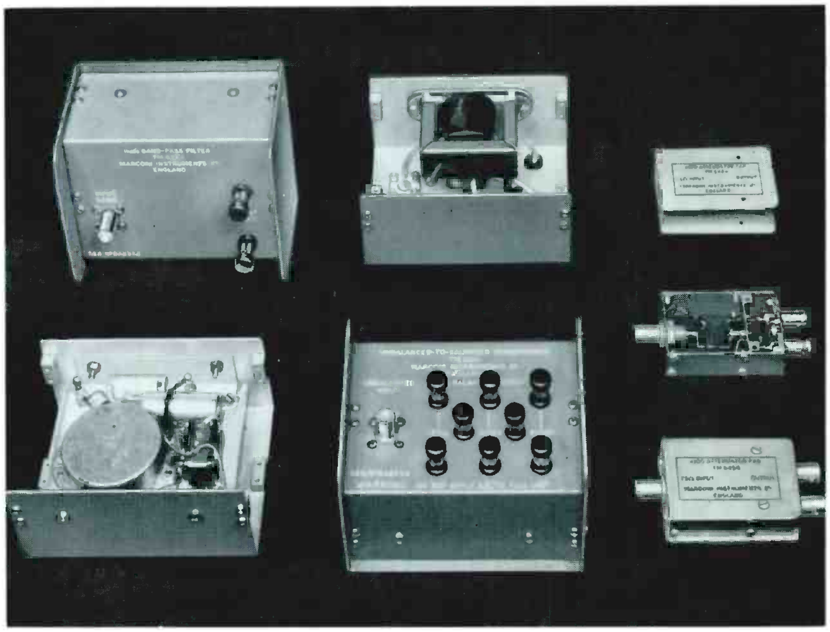


Fig. 6.
Left, exterior and interior views of TM 6222, 1-kc/s Band-Pass Filter

Centre, views of TM 6221, Unbalanced-to-Balanced Transformer

Right, views of TM 6454, × 100 Attenuator Pad

ACCESSORIES FOR TF 1370

There is a total of four accessory devices, one of them (TM 4726/136) being a 3-ft cable with BNC plugs for connecting any of the others to the oscillator. They are all optionally available to special order. The transformer and filter may also be used with the R–C Oscillator Type TF 1101.

Transformer TM 6221
This operates from 10 c/s to 100 kc/s, and is used when sinewave signals are required to be floating with respect to the oscillator chassis, or balanced with respect to chassis, or floating and balanced with respect to a centre-tap on the secondary winding. With the oscillator set for 600 ohms impedance, the alternative impedances available

Filter TM 6222
Filters are expensive devices, and this one is as simple an arrangement as possible for the purpose of providing a very pure sinewave signal at 1 kc/s, with a low insertion loss. It consists basically of a series-tuned circuit to provide minimum loss at this frequency, specially arranged to appear as a parallel-tuned circuit at about 2·5 kc/s, so as to provide maximum loss of the second and third harmonics. It is evident that the device is not a classical filter section, and the performance depends on

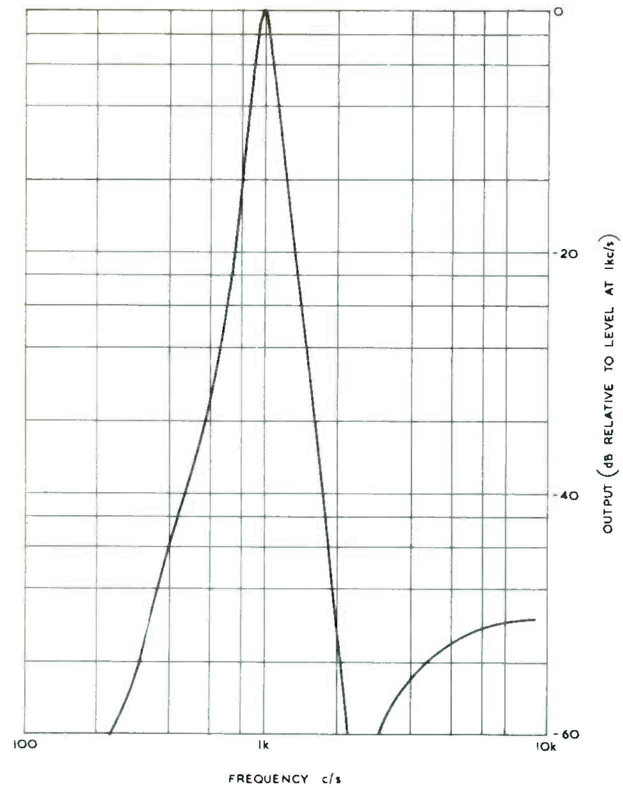


Fig. 7. Typical frequency response of TM 6222, 1-kc/s Band-Pass Filter

the presence of 600 ohms at both input and output. Nevertheless, if some worsening can be tolerated, the filter can be very helpful at lower impedances, provided that the signal level does not exceed a volt or so, otherwise the ferrite-cored chokes may introduce distortion. The performance of a typical filter is shown in Fig. 7.

Attenuator Pad TM 6454

The oscillator is set to 75 ohms impedance to accommodate this unit, which operates from d.c. to 10 Mc/s. A resistive network attenuates the source voltage (sine or square) by a factor of 100, the input impedance being 75 ohms, and the output impedance 5 ohms. A second output point, available at a third BNC socket, offers the same level of signal at 75 ohms impedance; i.e. it is 40 dB below the input signal. Since the minimum e.m.f. from the oscillator is about 1 mV, a signal as low as 10 μV can thus be obtained. However, since the oscillator is not highly screened against leakage fields as is an r.f. signal generator, a word of warning against errors due to leakage at the highest frequencies may not be out of place. When the 5-ohm output is in use, the source impedance may be adjusted to any higher value by simply adding a resistor in series with the load, the value being the difference between 5 ohms and the required value. The source voltage is still computed by dividing the indicated value by 100. If, for some reason, the 5-ohm impedance is wanted with the minimum loss, it is permissible to feed the oscillator into the 75-ohm output socket, in which case the source voltage at the 5-ohm socket will be one-thirtieth of that indicated, instead of one-hundredth.

REFERENCE 1. Elements of Pulse Circuits – F.J.M. Farley, p. 105, *Methuen Monograph*.

SPECIFICATION

Frequency

RANGE: *Sinewaves:* 10 c/s to 10 Mc/s in six decade bands.

Squarewaves: 10 c/s to 100 kc/s in four decade bands.

ACCURACY (at 20°C): ±2% ±1 c/s.

LONG-TERM STABILITY: After warm-up, ±0·2% up to 100 kc/s, and ±0·5% up to 10 Mc/s, including normal supply voltage variation.

ATTENUATOR REACTION (on load): Switching to 3-volt attenuator step: 0·1% shift at 10 Mc/s. Adjusting from 1/10th to full scale: 0·15% at 10 Mc/s. Shift is proportionately less at lower frequencies.

Sinewave output

RANGE: *Via attenuator:* 1 mV to 3·16 volts e.m.f. at switch-selected impedances of 75, 100, and 600 ohms unbalanced. Controlled by attenuator with six 10-dB steps and potentiometer in conjunction with level monitor. Attenuator accuracy: within ±1 dB overall on resistive load.

Outputs from 10 μV to 31·6 mV at 75 and 5 ohms are available by using ×100 Attenuator Pad TM 6454.

Direct: Up to 31·6 volts p.d. across loads of 2 kΩ or greater, at frequencies up to 100 kc/s. Two ranges, up to 10 and 31·6 volts, provided by switched potential divider and potentiometer in conjunction with level monitor. Nominal impedances: 950 ohms on 10-volt range, 15 ohms in series with 500 μF on 31·6-volt range.

RESPONSE: 50 c/s to 100 kc/s: within ±0·25 dB, falling by about 0·25 dB at 10 c/s.
100 kc/s to 10 Mc/s: within ±0·5 dB for outputs up to 1 volt loaded; within ±1 dB for outputs up to 3 volts loaded.

DISTORTION FACTOR: Less than 0·4% from 100 c/s to 100 kc/s, less than 1% from 10 c/s to 4 Mc/s, less than 3% at 10 Mc/s.

HUM: Less than 0·1% of full-scale output above 10 mV.

D.C. CONTENT: Less than 2% of full-scale output.

Squarewave output

RANGE: 1 mV to 3·16 volts peak, via attenuator; and up to 31·6 volts peak direct. Other details as for sinewave output except that source impedance is increased by 300 ohms at the maximum output step of the attenuator.

RESPONSE: As for sinewave output.

RISE TIME: 0·65 μsec or less at full-scale output; 0·2 μsec or less at ⅓ full-scale output.

SAG: 5% approx. in a 2-kΩ load at 10 c/s; can be adjusted to zero by panel preset.

MARK/SPACE RATIO: 50/50 ±5%; can be adjusted to exactly 50/50 by panel preset.

Level monitor

VOLTAGE SCALES: 0 to 31·6 and 0 to 10; indicate r.m.s. sinewave voltages and peak squarewave with respect to zero.

DECIBEL SCALE: 0 to −20 with respect to f.s.d.; also 0-dB reference points indicating 1 volt peak-to-peak sinewave or squarewave in 75-ohm load.

ACCURACY: ±3% of full scale for sinewaves up to 1 Mc/s; additional ±2% of reading for squarewaves and for sinewaves up to 10 Mc/s.

Power supply

200 to 250 volts, or 100 to 150 volts after adjusting internal link, 45 to 65 c/s, 150 watts. Maximum permissible voltage variation: ±7½%. Models supplied ready for immediate 100- to 150-volt use if specified at time of ordering.

Temperature range

5° to 45°C.

Dimensions and weight

Height	*Width*	*Depth*	*Weight*
14 in	20 in	11¼ in	38 lb
(35·6 cm)	(50·8 cm)	(28·5 cm)	(17·1 kg)

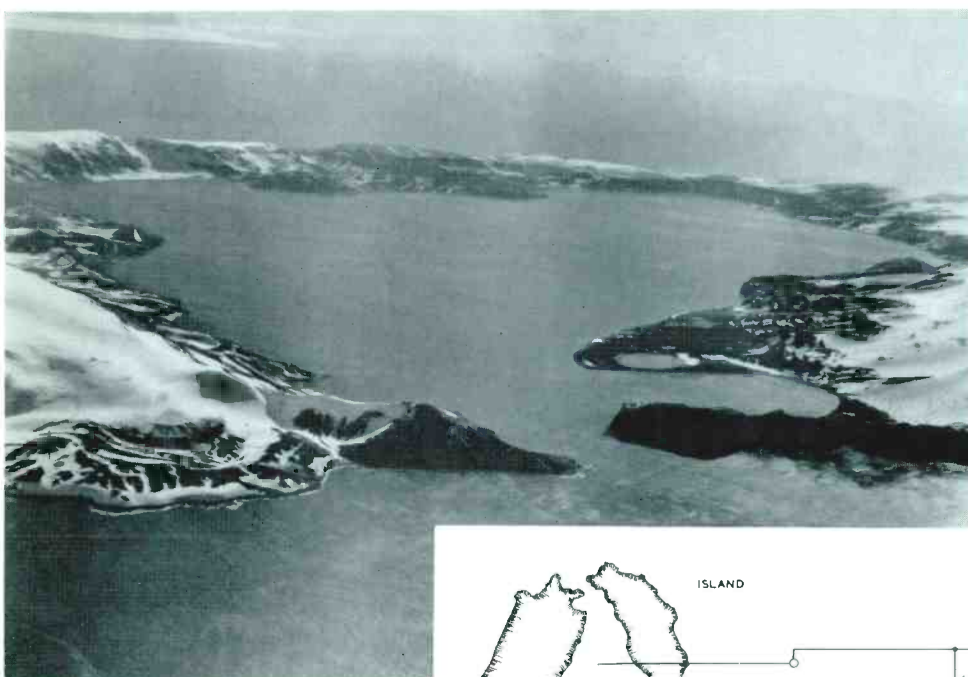
621.317.73

Two Special Bridges

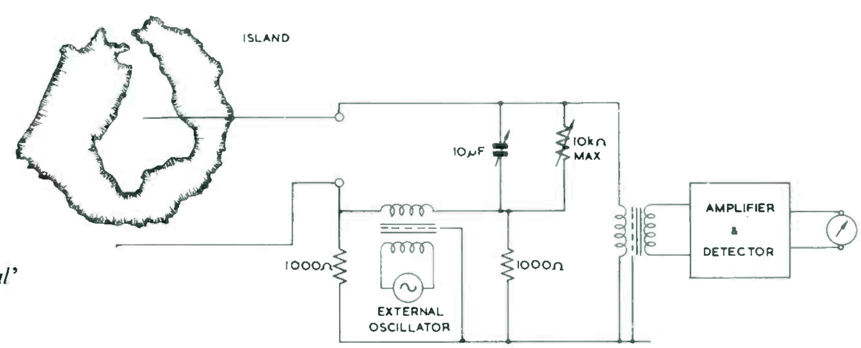
by E. C. CRAWFORD,
Graduate I.E.E.

Two specialist bridges have recently been produced to satisfy urgent requirements for unusual test facilities. One is designed to measure the radiation resistance of an island which it is proposed to use as a slot aerial for experimental transmissions at 5 kc/s. The other is a Wheatstone bridge with 0·01% discrimination and accuracy for use in the production of close-tolerance resistors for the Marconi TF 1313 Universal Bridge.

OCCASIONALLY, an urgent requirement for a particular test facility is brought to light which cannot be satisfied by the Company's existing range of equipment. At such times, it may be considered desirable to design specialist apparatus to solve the problem in question. This has happened on two occasions recently. As it is felt that readers may be interested in learning about these particular applications, we have decided to include an account of them in this bulletin. We must point out, however, that the equipment mentioned is not generally available commercially.



An aerial view of Deception Island, the island in the Southern Shetlands which is to be used as a slot aerial (F.I.D.S. photograph)



Functional diagram of the bridge showing connections to the 'slot aerial'

Measurement of an Island's Radiation Resistance

Professor M. G. Morgan, of Dartmouth College, U.S.A., had conceived the idea of using an island in the Antarctic as an insulated slot, so that the surrounding sea could be used as a long wave aerial for the radiation of artificial interference at frequencies around 5 kc/s. This experiment in transmission is based upon the discovery that lightning generates interference at this order of frequency which is propagated along the lines of magnetic force. Tests have already been carried out with artificially generated interference propagated in a North-South direction; it is now

Mr. J. Kirwan, a physicist of the Falkland Islands Dependencies Survey, with the bridge that he has taken to Deception Island

required to reverse the process and transmit the low frequency radio waves from the Antarctic to the North Polar regions.

The wavelength corresponding to a frequency of 5 kc/s is 60 kilometres, so that an aerial to be at all efficient must be dimensioned in terms of miles. As it is unpractical to erect such a normal long wave aerial in the Antarctic, recourse to a natural ready-made solution has been made. Before further steps were taken, however, Professor Morgan decided to check the possibility of using an island as an aerial by making a direct measurement of its radiation resistance.

The island in question is Deception Island in the Falkland Group, horse-shoe in shape, with an outer diameter of about 10 miles and an average width of two miles. In elevation it resembles the cross-section of an extinct volcano, which it actually is. Thus there is a ridge, 600 ft high, running all round the island, without a single road to the top. The proposal is that halfway along the horse-shoe and from the summit of this ridge, five telephone-gauge wires will be manhandled down on each side, so that they enter the ocean for a distance of approximately 20 yards. The terminals for the transmitter and hence the point for making the measurement of radiation resistance will be where the two sets of wires meet on the ridge.

The estimated capacitance of the wires to the island is 0·5 μF each side, with a power factor of almost any figure imaginable, except zero. If the sea were to form an efficient radiator, it radiation resistance as calculated by Professor Morgan should be 500 ohms, measured between the terminals.

Professor Morgan felt that the R.F. Bridge Type TME 20 might be adapted to make his measurements. Unfortunately, however, the capacitance and frequency range required proved to be unattainable. A specialist bridge was therefore proposed to be built around the following specification.

Balanced terminals, independent of ground.
Range Capacitance: 0 to 10 μF.
Resistance: 0 to 10 kΩ.
Frequency: 2 to 20 kc/s.
Measurement accuracy: ±5%.
Battery operated.

The most suitable bridge for this purpose was experimentally found to be a straightforward R-C bridge. The two ratio arms were fixed 1,000-ohm resistors and the calibrated arm consisted of a variable decade capacitor of 11 μF maximum in parallel with a series arrangement of three calibrated variable resistors totalling 11·1 kΩ. The bridge itself was isolated from an external oscillator and low-consumption transistor amplifier detector by means of transformers.

The bridge and transformers were mounted in a simple aluminium box. Tests proved that the necessary isolation of the test terminals from earth had thus been achieved by the balance settings being independent of earth connections. The R-C Oscillator Type TF 1101, modified for mains/battery operation, was used as the source. As the time to be spent on actual field measurements was to be limited by circumstances to a few hours, the expedience of using an essentially mains operated instrument was justified. A 6-volt 20-AH accumulator and two 120-volt h.t. batteries were considered adequate for the duration of the tests. The problems involved in carrying the accumulator 600 ft up a precipitous volcanic slope were small in comparison with that of manhandling the ten 150-lb reels of telephone wire for making the aerial connections!

Results of the tests on site are now awaited with interest.

Adjustment of Close-tolerance Resistors

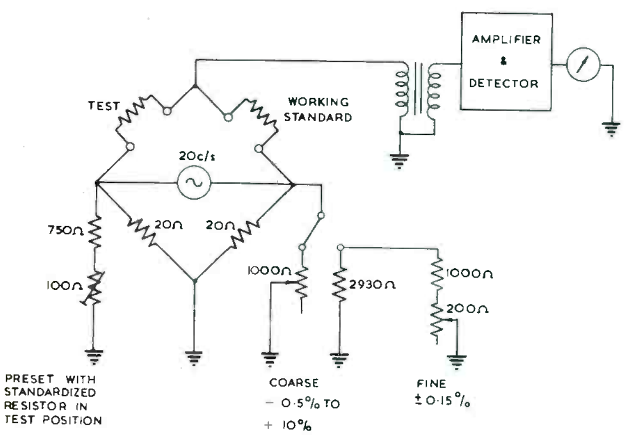
With the commencement of production of the ¼% Universal Bridge Type TF 1313, the need arose to manufacture thousands of resistors to a closer tolerance than that which is needed for other instruments.

For years this Company has been manufacturing wire-wound resistors for internal use, the usual tolerance being 0·1%. For this accuracy the use of an ordinary d.c. Wheatstone bridge and indicating galvanometer has generally been found satisfactory. With the advent of the TF 1313, resistors were now needed with an accuracy of ±0·05%. It was realised that the ordinary bridges in everyday use were not only liable to errors of ±0·02% (a small pro-

Operators adjusting resistors for the $\frac{1}{4}$% Universal Bridge, TF 1313, using the special bridges made for the purpose

portion of the 0·1% tolerance usually allowed for resistors but too large a proportion of the 0·05%), but also they lacked sufficient discrimination and were subject to contact or thermal e.m.f.'s, particularly with values of less than 100 ohms.

M.I. wire-wound resistors are wound either on slotted porcelain formers or mica cards, using d.s.c. resistance wire of copper-nickel alloy, Manganin alloy, or nickel or iron, as specified by the designer. Also specified, of course, is the wire gauge and winding technique in cases where the reactance of the resistor is critical.



Functional diagram of the 20 c/s high discrimination bridge

These resistors are wound slightly high in value by a few per cent and then heat treated in various cycles to relieve the wire of winding stresses. After this aging process, which lasts a day or so, the resistor is adjusted by reducing the length of wire until it is within the specified tolerance. It is then labelled, inspected and passed to the Assembly Stores for inclusion in complete instruments.

During the initial adjustment from a few per cent high to within, say, $+\frac{1}{2}$%, the ordinary Wheatstone production bridge, with its four or five dials, requires quite a lot of manipulation. Experience brings short cuts, of course, but new personnel are often required to do this job and take some time to learn the art.

Accordingly, a bridge was designed with a discrimination of 0·01% for the final adjustment, an accuracy of better than 0·01%, freedom from thermal e.m.f.'s during soldering adjustments to the length of resistance wire, and a preliminary balance dial calibrated from +10% to $-\frac{1}{2}$%.

High sensitivity was, of course, required to obtain the required discrimination, but this could not be obtained by increasing the test voltage due to possible over-dissipation of the resistors with consequent drift in value. On the other hand a very sensitive d.c. detector would be extremely prone to thermal e.m.f.'s. For those two reasons a.c. was adopted.

If a low bridge frequency is used, the transformers and capacitors forming the bridge circuitry become inconveniently large. At high frequencies, on the other hand, it is necessary to introduce a phase balance control, otherwise the small differences in reactance between individual resistors may mask the null; this would be an undesirable feature for non-technical personnel. Another high-frequency disadvantage is the increased possibility of pick-up at mains frequency harmonics. 20 c/s was therefore selected as a compromise but, even so, it was necessary to insert a twin-T 50-c/s rejector circuit in the amplifier-detector.

The bridge form is a Wheatstone with transformer coupled input and output. Two of the ratio arms are 20-ohm resistors, with their common junction earthed. The other two arms are formed by a 'working standard' and the resistor on test, these last being of the same type and same nominal value. Across one 20-ohm resistor is a choice of two variable resistors, one of which provides an adjustment of +10% to $-\frac{1}{2}$%, and the other a range of ±0·15%. The operator commences adjustment of the resistor on test with the coarse dial but as the accuracy is increased the bridge is switched over to the ±0·15% dial, which is calibrated in steps of 0·01%.

The basic accuracy is controlled by an external standard available from the factory standards room. This is connected to the test terminals and a preset shunt variable resistor across the other 20-ohm resistor is set so that the bridge indicates balance. This adjustment may normally be made to better than 0·01%. By this means the resistor on test is really compared, by substitution, with the best available standard.

MARCONI INSTRUMENTS

621. 317. 34 : 621. 317. 353. 3

White Noise Test Set

TYPE OA 1249B

by R. A. TRUAN, B.Sc.

Top left, Noise Generator, TF 1226B

Bottom left, Band Stop Filter Unit, TM 5774

Right, Noise Receiver, TF 1225A

THE White Noise Test Set, OA 1249B, has been designed to measure intermodulation in multi-channel carrier telephone links and supersedes Type OA 1249A and OA 1249A/1. The method of measurement has been explained in a previous article[1]. The OA 1249B can be used for testing systems ranging from 12 to 960 channels, and consists of an improved Noise Generator TF 1226B, a Noise Receiver TF 1225A and a Band Stop Filter Unit TM 5774.

In previous versions of the White Noise Test Set, the Noise Generator bandwidth has been limited by the performance of the output transformer and two instruments were necessary to cover the frequency range 12 kc/s to 4028 kc/s. The Noise Generator TF 1226A had a bandwidth of 60 kc/s to 4028 kc/s and the TF 1226A/1 a bandwidth of 12 kc/s to 1052 kc/s. By redesigning the output transformer a bandwidth of 12 kc/s to 4188 kc/s has been achieved in the TF 1226B, and to facilitate operation the output meter has been calibrated in two scales and the low-pass filter made accessible from the front panel.

The TF 1226B may also be used to standardize the Noise Receiver when making out-of-band measurements.

Noise Generator Output Transformer

The output transformer is wound on a toroidal core made from high permeability 'Super Mumetal' strip, 0·002 in. thick. It has been designed to give a 75-ohm output with a frequency response flat to within $\pm 0{\cdot}5$ dB in the range 5 kc/s to 5 Mc/s and has a return loss greater than 20 dB. The frequency response of a typical transformer is shown in Fig. 1, and the return loss in Fig. 2; it can be seen that the transformer would be suitable for use up to 7 Mc/s.

Noise Power Output Meter

The Noise Generator gives a maximum power output of -19 dBm per 1 kc/s of bandwidth. The bandwidth is determined by high- and low-pass filters which are selected according to the number of channels in the system under test. The Noise Power output meter is calibrated to show the maximum available noise power for 12, 24, 36, 48, 60, 120, 240, 600 and 960 channel systems. In order to give a clear and accurate meter reading two scales are used; one for 12 to 60 channel systems using a 12 kc/s high-pass filter and the other for 60 to 960 channel systems using a 60 kc/s high-pass filter. The appropriate meter scale is selected when changing high-pass filters by adjusting a link in the meter circuit.

Filter Accessibility

Access to the low-pass filter has been made available by means of a flap in the front panel. This enables the upper bandwidth limit to be selected each time a different multi-channel system is being tested, without removing the instrument from its case. This latter operation is necessary, however, on the rarer occasions when the high-pass filter has to be changed.

Out-of-Band Testing

The White Noise Test Set is primarily designed for making acceptance and accurate calibration tests within the multi-channel signal band when the link is not in service. Using a set of out-of-band stop-filters and the Noise Receiver tuned to these frequencies, the White Noise Test Set may also be used for out-of-band testing. This method enables maintenance measurements to be made in actual traffic conditions, and involves the

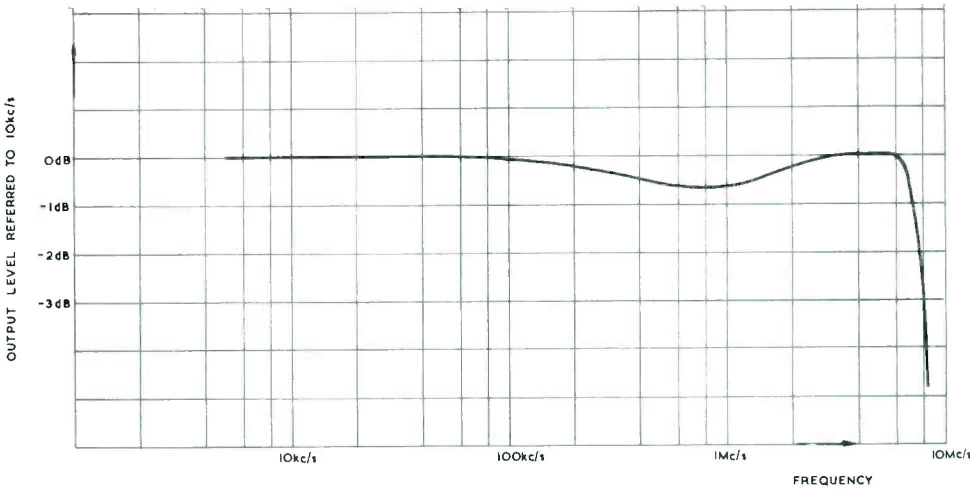


Fig. 1. Frequency response of typical output transformer

measurement of noise in narrow bands whose centre-frequencies are approximately 10% above the upper frequency limit and 10% below the lower limit of the signal band.

The following procedure may be adopted:

Band-stop filters are incorporated at the input of the equipment under test, and the Noise Receiver set to the required frequency is incorporated at the receiving end. The Noise Generator TF 1226B fitted with a 12 kc/s high-pass filter and a 4028 kc/s low-pass filter is used to standardize the receiver sensitivity as follows. Operating at a suitable output level, *e.g.* +15 dBm, the Generator output is fed into the Noise Receiver with a Noise Power Ratio setting of 0 dB, *i.e.* maximum input attenuation. Using the Receiver sensitivity control a suitable meter deflection is obtained; say, half scale. This indicates a noise input level of +15 dBm per 4016 kc/s of bandwidth or −21 dBm per 1 kc/s of bandwidth. The Noise Receiver is now connected to the equipment under test and the input attenuation is reduced by N dB, say, until the previous meter deflection is once more obtained. The noise power input to the Noise Receiver is given by the expression −(N+21) dBm per 1 kc/s of bandwidth. This may be related to the traffic power in the signal band, to give a value for signal to noise ratio. It should be noted that the range of the input attenuator permits noise power as small as −121 dBm per 1 kc/s of bandwidth to be measured to an accuracy of ±1 dB.

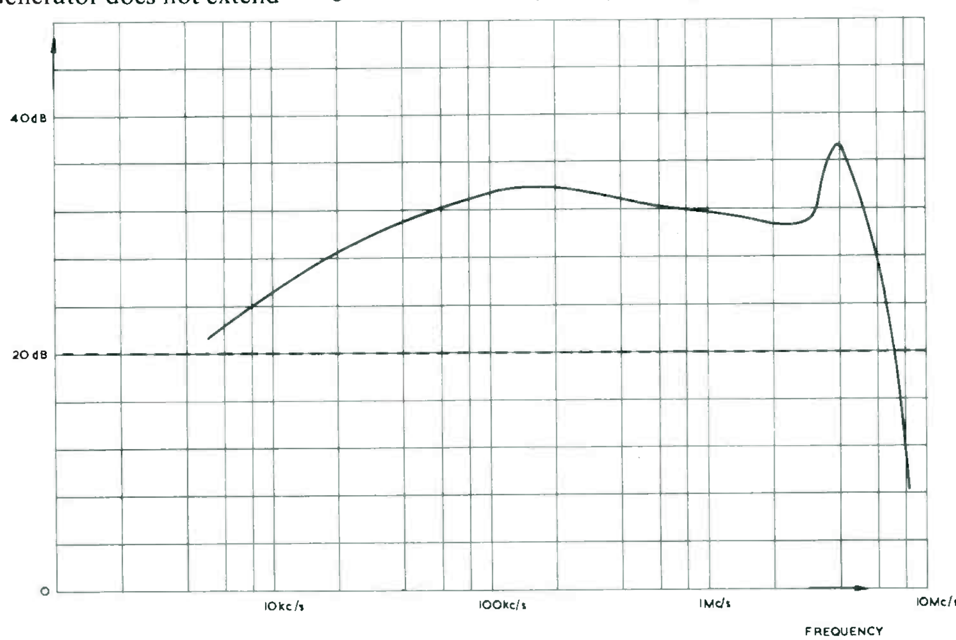
The bandwidth of the Noise Generator does not extend beyond 4028 kc/s, therefore the above method cannot be used for standardizing the Noise Receiver sensitivity at 4715 kc/s. However, this may be carried out fairly simply by first standardizing at 3200 kc/s as above, so that an input of −21 dBm per 1 kc/s of bandwidth gives half-scale meter deflection, and then using an amplitude-modulated sinewave generator as a transfer oscillator. A modulated sinewave whose carrier is the centre frequency of the receiver channel and whose modulation frequency lies between 200 and 800 c/s will give an output from the receiver mixer which is within the pass-band of the audio filter; thus it will be amplified and detected to give a meter deflection. The sensitivities of the 3200 kc/s and 4715 kc/s channels may be compared if the carrier amplitudes and modulation depths of the inputs are the same for both channels. A suitable oscillator is the M.I. Standard Signal Generator TF 867 which can be internally modulated at 400 c/s.

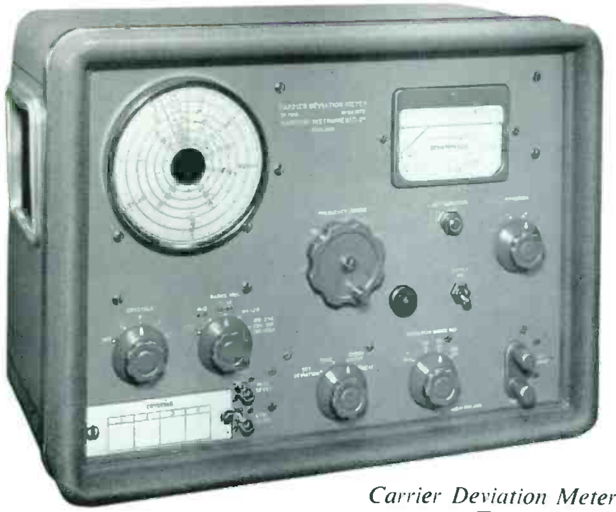
The following out-of-band stop-filters have been designed to C.C.I.R. specifications and have an attenuation exceeding 50 dB over a minimum frequency band of $\pm(0{\cdot}005f_c+2)$ kc/s where f_c kc/s is the centre frequency of the filter:

f_c = 50 kc/s, 270 kc/s, 331 kc/s, 607 kc/s, 1499 kc/s, 3200 kc/s and 4715 kc/s.

REFERENCE 1. Roper G.–Intermodulation Testing, *Marconi Instrumentation*, 7,17,1959

Fig. 2. Return loss of transformer plotted against frequency





Carrier Deviation Meter, Type TF 791D

MARCONI INSTRUMENTS

621.376.33 : 621.396.619.13

STANDARDIZATION OF F.M. DEVIATION METERS

by S. ELLAM, B.A.Sc.

ALL F.M. DEVIATION METERS manufactured by Marconi Instruments use ultra-stable, highly linear counter-type demodulators. The demodulated output is applied to a metering circuit through an amplifier with negative feedback control. Once set in the factory, this circuit seldom requires recalibration; the built-in reference signal available when switched to SET DEVIATION will normally be sufficient for standardization purposes. If, in the course of major overhaul, the absolute calibration of an instrument is to be checked, the procedure outlined below is recommended.

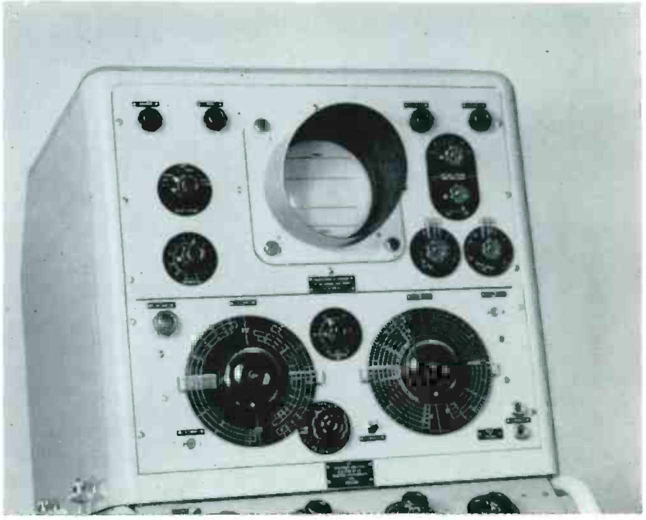
THEORY

When sinusoidal f.m. is applied to a carrier, sidebands are produced at spacing from the carrier equal to the modulating frequency. Since the total energy remains unchanged, carrier energy is exchanged for sideband energy and the carrier amplitude decreases. The change of carrier amplitude with deviation may be expressed mathematically in terms of a Bessel Function. This defines deviations for specified modulating frequencies where all energy is contained in the sidebands (carrier null). Zero carrier energy occurs when the modulation index (deviation divided by modulating frequency) is equal to 2·404 5·52, 8·65, 11·79, etc. With a knowledge of modulation frequency, the exact deviation existing at a carrier null can be calculated from this expression.

EQUIPMENT REQUIRED

1. **F.M. Signal Source**
   The generator must be capable of high quality modulation at the carrier frequency of interest. Marconi F.M. Generators Type TF 995A/2 or 1066A are recommended.
2. **Modulating Source**
   Most low distortion audio oscillators will be found suitable, *e.g.* Marconi Type TF 1101.
3. **Spectrum Analyser**
   This is used for the detection of carrier null points. It must be capable of resolving the carrier from the sidebands at the lowest modulation frequencies in use. The Marconi Spectrum Analyser Type OA 1094 is ideal for this purpose.

   Alternatively, an aural method may be employed which involves the use of a communications receiver with a b.f.o. The beat note with the carrier can be discerned from the beat with the sidebands and the carrier zero point established. Some receivers have sufficient selectivity in i.f. crystal filters, etc., to enable the carrier null point to be identified from the S-meter indication.
4. **Electronic Counter**
   The frequency of the audio modulating generator must be accurately known. This may be conveniently determined with a counter-type frequency meter, *e.g.* Marconi Type TF 1345.



Spectrum Analyser, OA 1094, manufactured under G.P.O. authority

TEST PROCEDURE

Using the Test arrangement as illustrated in Fig. 1, generate a signal with known deviation equal to near full-scale deflection of a middle deviation range of the meter under test. Correct any observed Deviation Meter error with the SET DEVIATION control on the front panel of the instrument. Switch to SET DEVIATION and readjust the meter pointer to the SET DEVIATION mark by means of the internal preset in series with the meter when in this position. For details, refer to the Instruction Book and Circuit Diagram of the instrument in question.

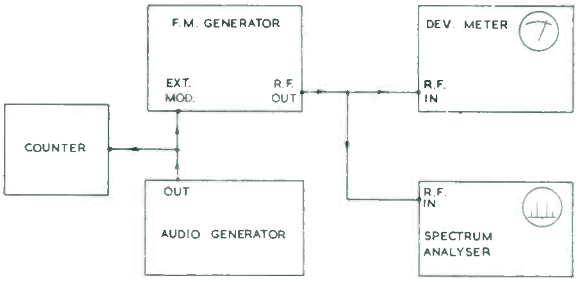


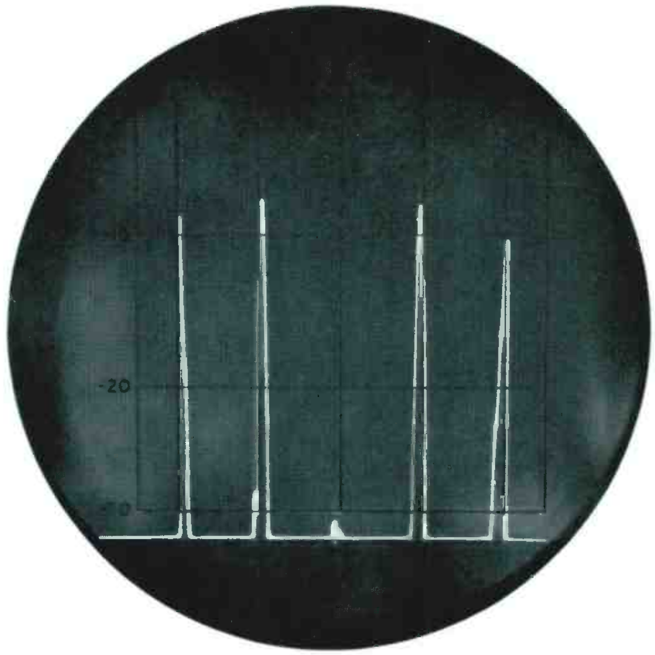
Fig. 1. Arrangement for standardizing Deviation Meters

The *accuracy* of calibration depends upon:

1. Precision of modulating frequency.
2. Resolution of carrier null.
3. Distortion on modulating tone.
4. Distortion in f.m. wave.

The modulating frequency can usually be determined to any desired degree of accuracy. If carrier null is discerned with a spectrum analyser of good dynamic range (40 dB or more), negligible error will result from this source.

Distortion of the f.m. signal, either present in the applied tone or through distortion in the modulation circuitry, gives rise to two sources of error: shift of the carrier null point and asymmetric modulation. These can introduce an apparent error roughly equal to the percentage harmonic distortion present. By analysing the modulated signal at the low frequency output terminals of the Deviation Meter with a distortion analyser, errors due to distortion can be estimated, but total harmonic distortion should not be allowed to exceed 5% for calibration purposes.



Using a modulation frequency of 5 kc/s the carrier null indicates that deviation is 12 kc/s

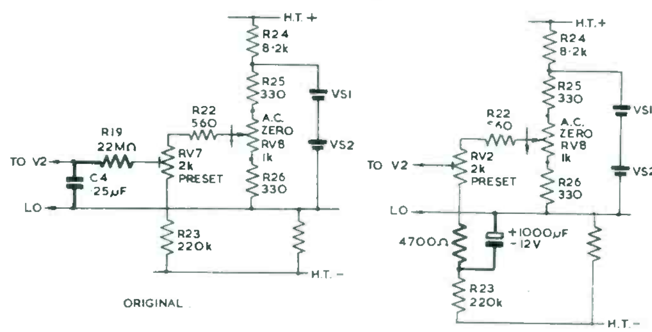
Marconi Deviation Meters read either positive or negative deviation selected at will, and peak-to-peak deviation is determined by adding the positive and negative deviations together.

TF 1300 — MODIFICATION TO IMPROVE A.C. ZERO SETTING

AS PREVIOUSLY DESCRIBED in the June 1958 issue of *Instrumentation*, the variations in diode splash voltage due to mains supply variations are balanced by a similar variation tapped off the h.t. supply and added to a fixed voltage derived from stabilizer cells. In addition, an R-C time constant of 5 seconds was added to approximate the thermal time constant of the diode cathode.

The modification, by which the operation of the Set Zero control is simplified, involves the repositioning of this time constant circuit so that it precedes the actual A.C. Zero control instead of following it, thus the control itself does not suffer the 5-second time lag. This has been made possible by the improvement in design and manufacture of high-capacitance low-voltage electrolytic capacitors. It is essential that a low-leakage type is used.

Diagrams of the original and revised sections of the circuitry with the R-C time constant elements emboldened are shown below and are self-explanatory.



621 396.615.14

MARCONI
INSTRUMENTS

F.M. Signal Generator . . . . . *TYPE TF 1066B/2*

by J. H. DEICHEN,
A.M.I.E.E.

F.M. Signal Generator TF 1066B/2 is a modified version of the more familiar TF 1066B, specifically produced to meet the exacting instrumentation requirements of telemetry equipment operating in the 400–555 Mc/s band.

Changes in the basic instrument design are outlined and a description is given of a new accessory, A.F. Signal Compressor TM 6629, by which a deviation essentially independent of the amplitude of a simple or complex modulating tone is available.

IN THE LAST ISSUE of *Instrumentation* the F.M. Signal Generators, Type TF 1066B and B/1, were discussed. In this article is described a special F.M. Signal Generator, Type TF 1066B/2, which is of the same family but, in fact, somewhat different in structure and purpose, although the outward appearance is very similar. The TF 1066B/2 has been designed specifically for instrumentation of telemetering equipment. It covers the frequency range of 400 to 555 Mc/s in one range and can be frequency modulated to a frequency deviation of up to 300 kc/s. It has two internal modulation frequencies of low order distortion and it employs a unique method of obtaining constant level of deviation for large variations of modulating signal from an external source. It provides accurate monitoring of deviation level for either single or multiple modulating signals. A functional diagram of the instrument can be seen in Fig. 1.

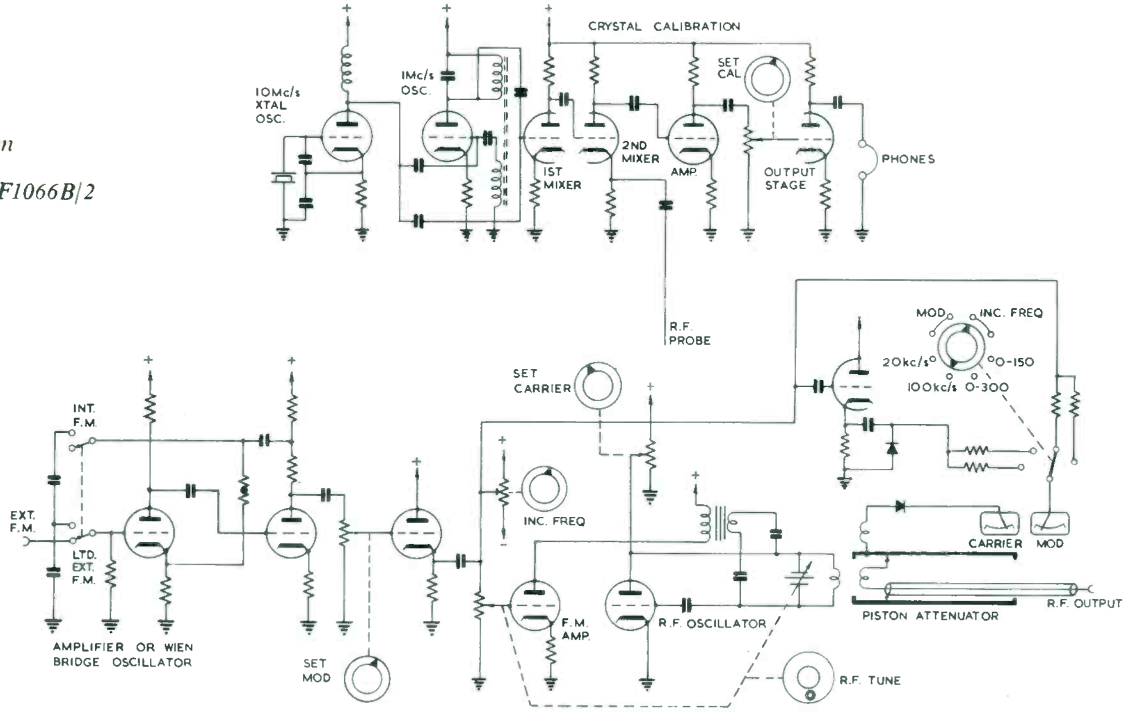
The instrument is constructed with a front panel suitable to fit into a standard 19 inch rack but is contained in a bench type case. A second model, Type TF 1066B/3, can be obtained which is identical except it is supplied with a dust cover instead of with the bench type case.

R.F. Oscillator

The oscillator, having one range only, does not require a turret. However, the turret used on the TF 1066B has been used in a modified state and is locked in a fixed position. This turret with the valve in position but with

Marconi Instruments F.M. Signal Generator, Type TF 1066B/2, specially designed for telemetry instrumentation

Fig. 1
Functional Diagram of F.M. Signal Generator, Type TF1066B/2



the oscillator coil removed is shown in Fig. 2. To obtain the high frequency of 555 Mc/s using lumped circuits it was necessary to mount the valve close to the tank circuit, thus reducing the series inductance and the parallel capacitance. The valve, which is held in position by a circlip on the anode, is cooled by its fixing brackets. The valve grid is coupled to the variable capacitor stator assembly by a fixed capacitor whose two plates are made up of the grid bracket and the stator assembly.

The oscillator circuit is a modified Colpitts type using the valve electrode capacitances as the centre tapped capacitor. Frequency modulation and incremental frequency are obtained by a ferrite modulator, which is further discussed later in this article.

The whole of the oscillator assembly is housed in a cast aluminium r.f. box which is similar to that used for the TF 1066B. Thus a rigid construction is realized and that, coupled with the solid mounting of the valve and large spacing of the variable capacitor vanes, gives a signal generator of low microphony and high stability which is very necessary for the exact frequency requirements of telemetering equipment.

The r.f. level is monitored by a crystal voltmeter indicating a set carrier level on a panel meter. The output is adjustable by a piston attenuator which has a rigidly constructed aluminium cast barrel. The piston rack is coupled to an attenuator dial which is calibrated in potential across a 50 ohm load from 0·1 μV to 100 mV and in dB relative to 1 mW into a 50 ohm load. The attenuator head is of the latest Marconi design now featured on such Signal Generators as the TF 801D series. It consists of the special component construction which gives a source impedance of 50 ohm and a v.s.w.r. of not greater than 1·2 to 1.

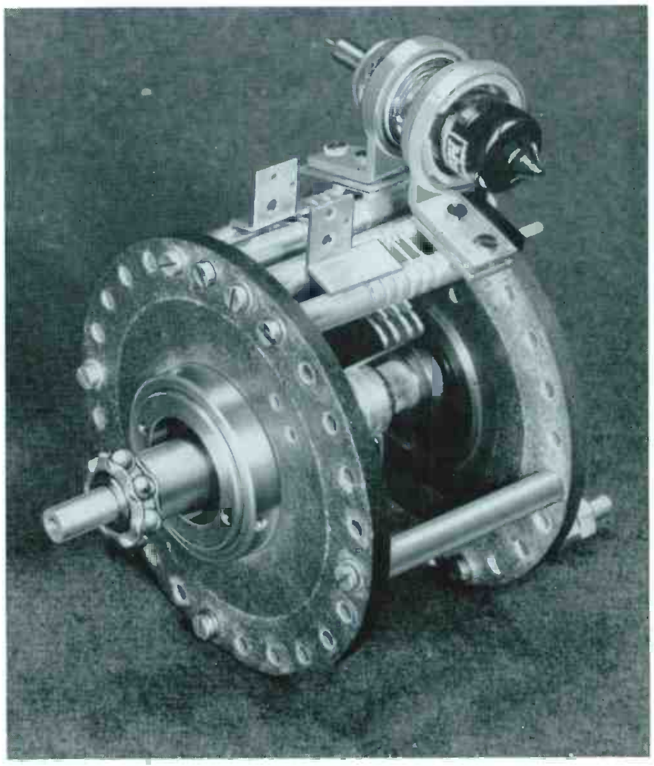


Fig. 2. The r.f. tank circuit with coil removed showing location of oscillator valve. (Approximately two-thirds full size)

Crystal Calibrator and Dial Calibration

As exact frequencies are of major importance in telemetering work it was necessary to incorporate an inbuilt calibrator capable of giving crystal accuracy at 1 Mc/s check points. This has been accomplished by using a

1 Mc/s L-C oscillator which is locked to and mixed with the signal from a 10 Mc/s crystal oscillator. To prevent misinterpretation of the frequency at the 1 Mc/s check points the 10 Mc/s oscillator is used independently of the 1 Mc/s oscillator to give check points at 10 Mc/s intervals. The front panel function control is used to switch into use either of the two calibrator check frequencies.

The frequency dial is calibrated to an accuracy of 0·5%, thus at 550 Mc/s the error can be as much as 2·75 Mc/s. As this error is well under half the frequency between the 10 Mc/s check points it is virtually impossible to misinterpret the exact frequency at these points.

To aid in determining the 1 Mc/s points when counting along from the 10 Mc/s check points the frequency dial is calibrated in a unique fashion as seen in Fig. 3. Every Mc/s from 400 to 555 Mc/s is actually hand calibrated with a dial mark by using staggered marking. As seen, every 5 Mc/s is marked on each of five lines starting with 400 Mc/s on the first line, 401 Mc/s on the second line and so on to 404 Mc/s on the fifth line. Thus 405 Mc/s appears back on the first line. To correct the calibration to crystal accuracy at the crystal check points the cursor is adjustable via the rotatable dial window.

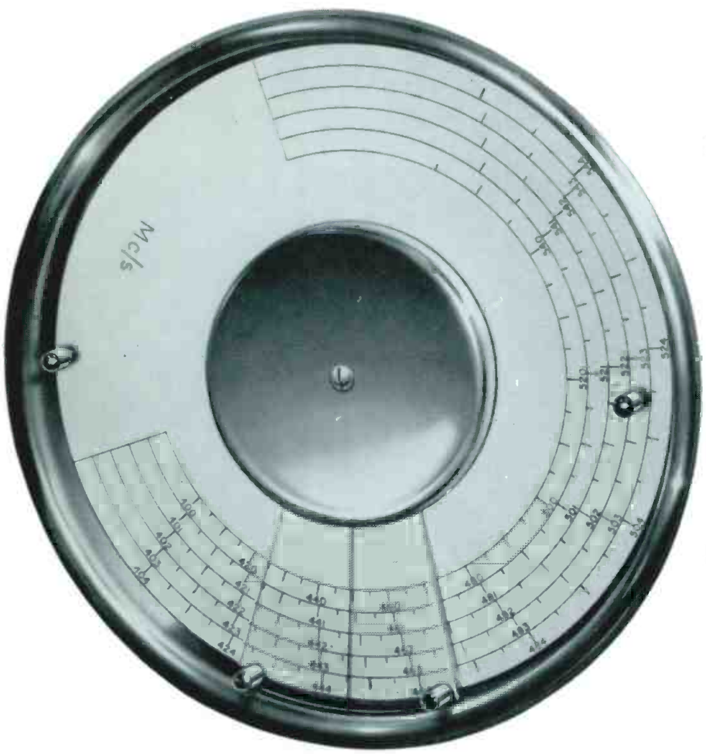


Fig. 3. Expanded view of frequency dial showing unique method of calibration permitting 1 Mc/s indication

The calibrator unit is housed in a fully screened box which is bolted to the top of the r.f. box. The top cover of the r.f. box serves as a screened partition between the two. The r.f. signal for mixing in the calibrator unit is picked-up via a probe which projects through the screened partition. Thus the oscillator check points are obtained without any alteration in the attenuator position and may be monitored during testing at c.w. conditions.

Monitoring of the zero beat note is obtained by amplifying the beat note in the calibrator unit and feeding it to the output stage via a filter. The output stage feeds a panel jack for headphones and the level is adjustable by a front panel control.

Reactor and Associated Circuitry

The reactor is of the ferrite magnetic type now used on so many Marconi instruments. It is, however, modified somewhat from that used on the TF 1066B. The number of turns on the a.f. winding has been greatly reduced to permit operation at frequencies up to 100 kc/s. This, of course, reduced the sensitivity of the modulation when, in fact, an increased sensitivity is required to produce 300 kc/s maximum deviation. A sensitivity sufficient to produce a deviation of that magnitude has been accomplished by using a high-power output valve for the reactor drive amplifier.

Normally the reactor drive valve is located in the r.f. box. However, because of the large valve required, and the consequent heat involved which would deteriorate frequency warm-up stability, this valve on the TF 1066B/2 has been positioned on the l.f. chassis. This fact coupled with the high modulating frequency required presented some difficulty regarding a suitable r.f. filter. It became necessary to use very low value lead-through capacitors, used in a 'pi' L-C filter network of three sections.

In common with standard practice the reactor is used for both frequency modulation and for an incremental frequency shift facility. Tracking over the frequency range to obtain a constant calibrated frequency shift or modulation independent of the r.f. is realized by use of a compensating variable resistor coupled to the tuning control. Incremental frequency is produced by a d.c. shift on the reactor and is monitored on the panel meter in two ranges of 20–0–20 kc/s and 100–0–100 kc/s. Frequency deviation is monitored by the same meter via a switch control and is in two ranges of 0–150 kc/s and 0–300 kc/s. Further comment about the deviation monitoring is given later in this article.

A.F. Circuitry

For an internal modulating signal a double triode is used in a Wien Bridge oscillator. This type of oscillator has an advantage over an L-C oscillator in that any required frequency can be obtained by simple changing of the resistive or capacitive elements in the positive feed-back line. In the TF 1066B/2 Signal Generator two frequencies of 1 kc/s and 10 kc/s are used for internal modulating source; one or the other can be switched in by the front panel function control switch. For amplitude stabilization of the oscillator a thermistor is used in a negative feed-back line making up one leg of the Wien bridge.

Following the Wien bridge oscillator a cathode follower is used to give impedance matching into the low impedance of the reactor compensating network and modulation monitoring circuit. Thus it is possible to obtain an a.f. signal of approximately 20 volts r.m.s. from the Wien bridge oscillator, which is necessary to produce the high deviation required. Modulation level control is actuated by a front panel control which constitutes one section of a ganged variable resistor feeding the grid of the cathode follower. In series with the hot end of this variable resistor is a second thermistor which compensates for amplitude changes due to the variation of the first thermistor caused by ambient temperature changes.

For external modulation the positive feed-back resistive and capacitive components and the thermistors are switched out of the circuit but a resistive element is switched in to replace the control thermistor, thus changing the circuit to a two stage amplifier. Also the modulation level control used with the oscillator is rendered inactive but a second control ganged to the first is switched in at the input stage thus preventing overloading of the amplifier and consequent distortion. With this method overloading becomes immediately visible by the over full scale reading on the monitor meter. The amplifier has a flat response between 100 c/s and 100 kc/s and requires not more than 2 volts r.m.s. input for the maximum deviation of 300 kc/s.

Another position on the front panel function switch brings into operation a limited external modulation network. This position, in fact, switches back into the circuit the control thermistor and brings back into operation the level control preceding the cathode follower. With this system for an input varying from 2 to 8 volts r.m.s. for a sinusoidal signal the deviation will not noticeably alter in level and will not appreciably distort. In fact the distortion introduced is not any greater than that introduced by the conventional amplifier. There is, however, a short time constant involved which is the thermal time constant of the control thermistor. For a complex signal the limiting will be on the r.m.s. value and not the peak so an error of up to 1·4 can be introduced depending upon the combination of the signals making up the complex signal. Therefore if a complex signal made up of multiple sinusoidal signals is required to be used, an accessory, the A.F. Signal Compressor, TM 6629, described at a later stage in this article, is available for that purpose.

Monitoring for the deviation is obtained by a panel meter fed from a voltage doubler rectifier network. Thus the monitor reads peak to peak, however, the calibration of the meter gives the average between the positive and negative peaks. Thus for complex signals the meter error for peak deviation will be less than for single peak monitoring.

The monitor gives a flat response down to 30 c/s. Therefore if up to six external sinusoidal signals, in the frequency range between 100 c/s and 100 kc/s, are used simultaneously for modulation, the monitor meter will read correctly the maximum peak to peak deviation providing the time interval between the maximum peaks occur frequently enough to correspond to 30 c/s. However, it must be pointed out that with certain combinations of signals and phases the maximum voltages of the individual signals may coincide on one side of the zero position and never coincide on the opposite side; thus the complex signal would not be symmetrical. Therefore it is important that the signals to be used should be carefully selected which, no doubt, is necessary in any case for telemetering equipment.

A.F. Signal Compressor

As stated above for peak limiting of the signal for modulating purposes the accessory, A.F. Signal Compressor TM 6629, can be used. This is a self-contained unit with its own power supply and can be situated under the Signal Generator. For permanent usage it can be bolted to the Signal Generator by removing the unit from its case, removing the screws from the feet of the generator and then using longer screws to bolt the unit case to the generator via the generator feet. The accessory gives a

Fig. 4. A.F. Signal Compressor, Type TM 6629, used for limiting external a.f. modulating signals

constant output, without undue distortion, for varying peak amplitudes of a complex modulating signal which may be made up of several unharmonically related sinewaves; deviation is therefore independent of the number and amplitude of modulating tones. The method of use is to feed the external a.f. signal to the input socket of the unit at a level between 0·5 and 6 volts r.m.s. sinusoidal or not more than 8·5 volts peak for the complex or multiple signal. The output is taken from a socket to the modulation input socket of the generator at a fixed level of 2 volts r.m.s. sinusoidal or 2·8 volts peak for the complex or multiple signal. The terminals in each case are of the BNC coaxial type.

The unit is housed in a bench type case but is fitted with a front panel suitable for standard 19 inch rack mounting. It operates by using a d.c. feedback to the suppressor grids of a two stage signal amplifier. Without an a.f. input signal applied, the suppressor grids are slightly negative and become more negative as signal is applied. As the time constant of the circuit involved is of a finite time, the system would not be able to settle to a determined level but would 'hunt' except for a transient amplifier associated with each of the valves in the two stage amplifier. These transient amplifiers are arranged for similar feedback control on their suppressor grids and are coupled to the amplifiers from anode of amplifier to screen of transient amplifier and vice versa. With this arrangement it was possible to select circuit components so that hunting is eliminated and the unit still has a flat response from 1 kc/s to 100 kc/s. Limiting will go down to 300 c/s but the response rises at the lower frequency. The two stage amplifier, in fact, has a negative gain for inputs above 1 volt; therefore to obtain sufficient output from the unit to operate the modulating system of the Signal Generator up to maximum deviation, a conventional amplifier follows the compressor circuitry. The output is taken via a cathode follower thus giving a low output impedance so that coaxial cable may be used between the unit and the generator.

The points regarding maximum peaks for multiple signals given in a previous paragraph apply somewhat to the operation of this unit. By experiment it was found that with two signals the difference between the two frequencies must be at least 350 c/s to give effective limiting. Furthermore it is possible with a number of signals to obtain a low frequency component which has a time cycle of too long a period to be controlled by the compressor.

This unit can be used with the Signal Generator on either external modulation or on the limited external modulation. If used on the limited external modulation one has the advantage of the effect of both the external and internal limiters.

Power Supplies

In common with most Marconi Signal Generators the TF 1066B/2 has a conventional series regulator for positive h.t. supplies. The instrument also has the latest transistorized series regulator for some l.t. supplies. This l.t. regulator is similar to that used on the TF 1066B except that a current of 1·16 amperes is being used so that a greater handling capacity series transistor is required. However, instead of using one larger transistor, two transistors are used in parallel and are separated to remote places on the l.f. chassis so that cooling is effected with only small heat sinks.

The power supplies for this instrument use entirely silicon rectifiers for all the d.c. supplies. This fact has offset the extra heat for added valves used so that the instrument runs at a similar temperature to the TF 1066B, thus drift of the frequency against warm-up is of a similar magnitude. Because of the high degree of regulation it has been possible to hold the frequency to within 0·002% for a 10% change in mains supply voltage.

The A.F. Signal Compressor unit contains its own power supply with the conventional h.t. and l.t. supplies.

ABRIDGED SPECIFICATION

Frequency

RANGE: 400 to 555 Mc/s in one band.

CALIBRATION ACCURACY: Direct accuracy: ±0·5%.
Using crystal calibrator: ±0·01% at all 1 Mc/s check points for temperatures between 20° and 60°C. 10 Mc/s markers ensure accurate frequency identification.

FREQUENCY STABILITY: After warm-up, drift is not more than 0·0025% in a 10 minute period, and not more than 0·002% for a 10% change in supply voltage.

INCREMENTAL FREQUENCY CONTROL: Continuously variable from −100 to +100 kc/s. Shift is monitored by a meter with two ranges, −20 to +20 kc/s and −100 to +100 kc/s. Accuracy: within ±10% of full scale.

R.F. Output

LEVEL: Continuously variable from 0·1 μV to 100 mV across a 50 ohm load.
Attentuator dial calibrated in volts across 50 ohms and power in decibels relative to 1 mW in 50 ohms.

OUTPUT ACCURACY: ±1 dB for supply voltage variations up to ±10%.

SOURCE IMPEDANCE: 50 ohms; v.s.w.r. not greater than 1·2 to 1.

Frequency Modulation

INTERNAL: Modulation frequencies: 1 and 10 kc/s.
Deviation variable up to 300 kc/s and indicated on meter with two ranges, 0 to 150 and 0 to 300 kc/s.

EXTERNAL: Modulation frequency range: 100 c/s to 100 kc/s. Deviation as for internal.

DEVIATION ACCURACY: Within ±10% of f.s.d. Accuracy over external modulation range is within ±5% of accuracy at 10 kc/s for a constant level of sinewave input.

EXTERNAL MODULATION REQUIREMENTS: Normal Ext. f.m.: not more than 2 volts r.m.s. into 50 kΩ or greater for 300 kc/s deviation. Limited Ext. f.m.: inputs between 2 and 8 volts r.m.s. into 50 ohms or greater gives substantially constant deviation at any value up to 300 kc/s. Maximum peaks for complex signals should not exceed 11 volts (20 volts if more than 3% distortion can be tolerated). Complex Ext. f.m.: up to six sinusoidal inputs can be applied simultaneously in either 'normal' or 'limited' operation. (See also A.F. Signal Compressor specification given below.)

MODULATION MONITOR: A peak-to-peak monitor comprising a voltage doubler with long time constant.
The meter indicates the peak deviation within ±10% provided the maximum peaks occur at least 30 times a second.

MODULATION DISTORTION: Not greater than 3% of fundamental at maximum deviation.

A.F. Signal Compressor

Type TM 6629; a peak limiter for use with multiple-tone external modulation.

INPUT REQUIREMENTS: 0·5 to 6 volts sinewave, or up to six simultaneous sinewaves providing maximum peaks do not exceed 8·5 volts peak.

OUTPUT: 2 volts r.m.s. ±10% for single sinewave, or 2·8 volts peak ±10% for multiple signals.

DISTORTION: Not more than 2%.

FREQUENCY RANGE: 1 to 100 kc/s.

Power Supplies

Signal Generator and A.F. Signal Compressor have independent power supplies. Both accept 200 to 250 volts, or 100 to 150 volts, 40 to 500 c/s. For the Signal Generator, 90 watts. For the Compressor, 30 watts.

Dimensions and weight

Height	*Width*	*Depth*	*Weight*
14½ in	23½ in	10½ in	54 lb
(37 cm)	(60 cm)	(27 cm)	(24·5 kg)

Summaries of Articles appearing in this issue

RESUME D'ARTICLES PUBLIES DANS LE PRESENT NUMERO

OSCILLATEUR A RESISTANCE-CAPACITANCE A GAMME LARGE TYPE TF 1370

Ce générateur à usages multiples d'ondes sinusoïdales et carrées a une gamme de fréquence allant de 10 c/s à 10 Mc/s et utilise un oscillateur simple à résistance-capacitance. On peut obtenir jusqu'à 10 Mc/s des ondes sinusoïdales de 1 mV à 3 volts par l'intermédiaire d'un atténuateur de 75, 100 ou 600 ohms (non équilibré) et des ondes carrées jusqu'à 100 kc/s. Au-dessous de cette fréquence, on peut aussi obtenir des ondes sinusoïdales et des ondes carrées à des niveaux allant jusqu'à 30 volts pour une charge de 2.000 ohms. Trois accessoires fournissent une sortie équilibrée, une tonalité pure de 1 kc/s et une sortie de niveau et d'impédance très bas.

Page 3

DEUX PONTS SPECIAUX

Deux ponts spéciaux ont été récemment produits pour répondre aux demandes urgentes d'installations d'essai inhabituelles. L'un de ces ponts est destiné à mesurer la résistance de radiation d'une île que l'on se propose d'utiliser comme antenne à fente pour des émissions expérimentales à 5 kc/s. Quant à l'autre, c'est un pont de Wheatstone d'une précision et d'une discrimination de 0,01 % destiné à être utilisé dans la production de résistances à tolérance étroite pour le Pont Universel TF 1313 Marconi.

Page 11

APPAREIL DE VERIFICATION DE BRUIT BLANC OA 1249 B

L'appareil de vérification de bruit blanc OA 1249B est destiné à mesurer l'intermodulation dans les liaisons téléphoniques à canaux multiples allant de 12 à 960 canaux et remplace les instruments types OA 1249A et OA 1249A/1. Le générateur de bruit amélioré TF 1226B comporte un nouveau transformateur de sortie ayant une gamme de fréquences allant de 12 kc/s à 4188 kc/s. L'accessibilité du filtre passe-bas a été améliorée et l'appareil de mesure de sortie comporte deux graduations pour une plus grande précision. L'article explique aussi comment le générateur de bruit peut être utilisé en conjonction avec un jeu de filtres d'arrêt hors-bande et un récepteur de bruit pour les essais "hors-bande".

Page 14

GENERATEUR D'ESSAI F.M. TYPE TF 1066B/2

Le générateur d'essai F.M. TF 1066B/2 est une version modifiée du type TF 1066B plus connu, produit spécialement pour répondre aux besoins exigeants en instrumentation de l'équipement de télémetrie opérant dans la bande 400–555 Mc/s.

L'article souligne les modifications apportées à l'instrument de base et décrit un nouvel accessoire, le compresseur d'amplitude de signal basse fréquence TM 6629, grâce auquel on obtient une déviation essentiellement indépendante de l'amplitude d'une tonalité de modulation simple ou complexe.

Page 18

ZUSAMMENFASSUNG DER IN DIESER NUMMER ERSCHEINENDEN ARTIKEL

BREITBAND-RC-OSZILLATOR MODELL TF 1370

Dieser Universalgenerator für Sinus– und Rechteckwellen hat einen Frequenzbereich von 10 Hz bis 10 MHz und arbeitet mit einem einfachen Widerstands-Kapazitäts-Oszillator. Er liefert Sinuswellen bis 10 MHz von 1 mV bis 3 V Spannung über einen unsymmetrischen Eichteiler von 75–, 100– oder 600 Ohm sowie Rechteckwellen bis 100 kHz. Unterhalb dieser Frequenz werden Sinus– und Rechteckwellen mit Spannungen bis 30 V bei einer Ausgangsbelastung von 2000 Ohm geliefert. Drei Zusatzgeräte geben einen symmetrischen Ausgang, einen reinen 1 kHz-Ton bezw. einen Ausgang mit sehr kleiner Impedanz und Spannung.

Seite 3

ZWEI SPEZIALBRÜCKEN

Zwei Spezialbrücken wurden kürzlich mit Rücksicht auf die dringende Nachfrage nach ungewöhnlichen Prüfeinrichtungen hergestellt. Die eine ist speziell für die Messung des Strahlungswiderstandes einer Insel vorgesehen, die als Schlitzantenne für experimentelle Sendungen auf 5 kHz benutzt werden soll. Die andere ist eine Wheatstonebrücke mit 0,01 % Auflösung und Genauigkeit zum Gebrauch bei der Herstellung von Widerständen enger Toleranz für die Marconi TF 1313 Universalbrücke.

Seite 11

WEISSRAUSCH-PRÜFGERÄT OA 1249B

Das Weissrausch-Prüfgerät OA 1249B dient zur Messung der gegenseitigen Modulation in Mehrfach-Fernsprechverbindungen mit 12 bis 960 Kanälen. Es ersetzt die Modelle OA 1249A und OA 1249A/1. Der verbesserte Rauschgenerator TF 1226B hat einen neuen Ausgangstransformator mit einer Bandbreite von 12 kHz bis 4188 kHz. Das Tiefpassfilter ist leichter zugänglich und das Ausgangs-Messgerät besitzt zwei Skalen zwecks höherer Ablesegenauigkeit. Der Artikel beschreibt ausserdem die Verwendung des Rauschgenerators in Verbindung mit einem Satz von "ausser Band"-Sperrfiltern und Rauschempfänger zur "ausser Band"-Prüfung.

Seite 14

FM-MESS-SENDER MODELL TF 1066B/2

Der FM-Mess-sender TF 1066B/2 ist eine abgeänderte Ausführung des bekannten TF 1066B. Er wurde speziell im Hinblick auf die hohen Anforderungen von im 400–555 MHz-Band arbeitenden telemetrischen Geräten gebaut.

Die Änderungen im grundsätzlichen Aufbau werden gezeigt und ein neues Zusatzgerät, der TF-Signalkompressor TM 6629, beschrieben, mit dem sich einen praktisch von der Amplitude eines einfachen oder zusammengesetzten Modulationstons unabhängigen Hub erzielen lässt.

Seite 18

SOMMARIO DEGLI ARTICOLI PUBBLICATI IN QUESTO NUMERO

OSCILLATORE R–C A LARGA GAMMA TIPO TF 1370

Questo generatore di sinussoide e onde quadrate, per impieghi generali, ha una gamma di frequenze che si estende da 10 c/s a 10 Mc/s, e fa uso di un oscillatore a semplice capacitanza–resistenza. Sono ottenibili sinussoidi da 1mV a 3 volt tramite un attenuatore (squilibrato) a 75, 100, 600 ohm, fino a 10 Mc/s, e onde quadre fino a 100 kc/s. Sotto questa frequenza sono inoltre ottenibili sinussoidi e onde quadrate ad un livello fino a 30 volt con un carico a 2.000 ohm. Tre accessori provvedono una uscita equilibrata, un tono puro di 1 kc/s ed una uscita di bassissimi livello e impendenza.

pagina 3

DUE PONTI SPECIALI

Sono stati recentemente progettati due ponti per soddisfare alle richieste di strumenti per prove insolite. Uno è stato appositamente studiato per misurare la resistenza alla radiazione di un isola che si voglia adibire come antenna a fessura per trasmissioni sperimentali di 5 kc/s. L'altro è un ponte di Wheatstone con discriminazione e precisione dello 0,01 %, usato per la produzione di resistori, con tolleranza minima, per il Ponte Universale Marconi tipo TF 1313.

pagina 11

EQUIPAGGIAMENTO PER PROVE CON RUMORE BIANCO OA 1249B

L'apparecchio per prove con rumore bianco OA 1249B è progettato per misurare l'intermodulazione su collegamenti telefonici multiplex con una portata da 12 a 960 canali, e sostituisce la strumentazione del tipo OA 1249A e del tipo OA 1249A/1. Il generatore perfezionato di rumore **TF** 1226B incorpora un nuovo trasformatore di uscita con una gamma de frequenze variante da 12 a 4188 Kc/s. È stata migliorata l'accessibilità al filtro passa basso e il misuratore di uscita comprende due scale per una maggiore precisione. L'articolo inoltre spiega come il generatore di rumore possa essere collegato con una serie di filtri eliminatori di fuori banda e con un ricevitore di rumore per prove di 'fuori banda'.

pagina 14

GENERATORE DI SEGNALI A M.F. TIPO 1066B/2

Il generatore di segnali a M.F. tipo **TF** 1066B/2 è una versione modificata del piú noto TF 1066B, appositamente progettato per soddisfare alle esigenze severe di strumentazione di apparecchi telemetrici operanti su una banda da 400 a 555 Mc/s.

Si descrivono succintamente i cambiamenti nella progettazione fondamentale degli strumenti, e viene inoltre fornita una descrizione di un nuovo accessorio, il Compressore di Segnali ad A.F. tipo TM 6629, con il quale, è ottenibile la deviazione indipedentemente dall'ampiezza di un tono modulato semplice o composto.

pagina 18

RESUMENES DE ARTICULOS QUE APARECEN EN ESTE NUMERO

OSCILADOR DE R–C DE AMPLIA GAMA TIPO TF 1370

Este generador de onda sinusoidal y ondas rectangulares, de uso general, tiene una gama de frecuencias que alcanza desde los 10 c/s a los 10 Mc/s y emplea un oscilador simple de resistencia-capacitancia. Se obtienen ondas sinusoidales desde 1 mV a 3 voltios a través de un atenuador de 75–, 100– ó 600 ohmios (sin equilibrar) hasta 10 Mc/s y ondas rectangulares hasta 100 kc/s. A frecuencias inferiores también pueden obtenerse ondas sinusoidales y rectangulares a niveles de hasta 30 voltios en carga de 2.000 ohmios. Tres accesorios proporcionan una salida equilibrada, un tono puro de 1 kc/s y una salida de impedancia y nivel muy reducidos.

Página 3

DOS PUENTES ESPECIALES

Recientemente se han producido dos puentes especiales para satisfacer exigencias urgentes de pruebas de carácter poco corriente. Uno está destinado a la medida de la resistencia a la radiación de una isla que se tiene la intención de emplear como antena de ranura para una transmisión experimental a 5 kc/s. El otro es un puente de Wheatstone con descriminación y precisión de 0,01 % para empleo en la producción de resistores de fina tolerancia para el puente universal Marconi TF 1313.

Página 11

EL COMPROBADOR DE RUIDO BLANCO OA 1249B

El Comprobador de Ruído Blanco OA 1249B ha sido concebido para medir la intermodulación en equipos de enlace telefónico de canales múltiples de 12 a 960 canales, y reemplaza los instrumentos tipos OA 1249A y OA 1249A/1. El generador de ruído TF 1226B perfeccionado está dotado de un neuvo transformador de salida con una gama de frecuencia de 12 a 4188 kc/s. Se ha mejorado la accesibilidad del filtro de paso bajo y el medidor de salida tiene dos escalas para mayor precisión. Este artículo también explica como puede emplearse el generador de ruído en combinación con un juego de filtros de supresión fuera de banda y un receptor de ruído para pruebas 'fuera de banda'.

Página 14

GENERADOR DE SEÑALES DE F.M. TIPO TF 1066B/2

El generador de señales de F.M. tipo TF 1066B/2 es una versión modificada del TF 1066B, ya bien conocido, que se produce específicamente para satisfacer las exigencias precisas de los instrumentos para equipos de telemetría que funcionan en la banda de 400/555 Mc/s.

Se esbozan los cambios introducidos en el instrumento base y se describe un nuevo accesorio, el Compresor de Señales de A.F. TM 6629, mediante el cual se dispone de una desviación esencialmente independiente de la amplitud de un tono de modulación simple o complejo.

Página 18

SIGNAL GENERATORS

NOISE GENERATORS

OSCILLATORS

OSCILLOSCOPES

PULSE GENERATORS

MODULATION METERS

DISTORTION ANALYSERS

SPECTRUM ANALYSERS

FREQUENCY COUNTERS AND METERS

POWER METERS

VOLTMETERS

IMPEDANCE BRIDGES, DIELECTRIC AND Q METERS

MOISTURE METERS

pH METERS

IMAGE AMPLIFIERS FOR INDUSTRIAL AND MEDICAL X-RAY EQUIPMENT

ATOMIC POWER INSTRUMENTATION

MARCONI INSTRUMENTS
111 Cedar Lane
Englewood, N.J.

BULK RATE
U.S. POSTAGE
PAID
Englewood, N.J.
Permit No. 313

Form 3547 Requested

MARCONI INSTRUMENTS LIMITED

SALES AND SERVICE OFFICES

London and the South
ENGLISH ELECTRIC HOUSE, STRAND, LONDON, W.C.2
Telephone: Covent Garden 1234

Midland
MARCONI HOUSE, 24 THE PARADE, LEAMINGTON SPA
Telephone: Leamington Spa 1408

Northern
23/25 STATION SQUARE, HARROGATE
Telephone: Harrogate 67455

U.S.A.
111 CEDAR LANE, ENGLEWOOD, NEW JERSEY
Telephone: LOwell 7-0607

Head Office and Works:
ST. ALBANS · HERTFORDSHIRE · ENGLAND
Telephone: St. Albans 59292 *Telegrams:* Measurtest, St. Albans

ASSOCIATED COMPANIES AND DISTRIBUTORS THROUGHOUT THE WORLD

Printed in England by Geo. Gibbons Ltd. Leicester