Farnell

FG1 FUNCTION GENERATOR

INSTRUCTION BOOK

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FOR

FG1 FUNCTION GENERATOR

FARNELL INSTRUMENTS LIMITED • SANDBECK WAY • WETHERBY LS22 4DH • YORKSHIRE • ENGLAND. TELEPHONE 0937 3541-6

CONTENTS

SCHEDULE OF EQUIPMENT

The instrument has been carefully packed to prevent damage in transit. When you remove the unit from the box, be sure that you remove all parts and accessories from the packing material.

The complete equipment comprises:-

a) 1 off FG1 Function Generator

b) 1 off Instruction book

c) 2 off signal leads

Note:- In the event of damage in transit or shortage in delivery separate notices in writing should be given to both the carriers and Farnell Instruments Ltd., within three days of receipt of the goods, followed by a complete claim within five days. All goods which are the subject of any claim for damage in transit or shortage in delivery should be preserved intact as delivered, for a period of seven days after making the claim, pending inspection or instructions from Farnell Instruments Ltd., or an agent of this Company.

INTRODUCTION

The Farnell FG1 Function Generator is a mains operated instrument providing sine, square, triangular and ramp waveforms suitable for a variety of applications.

Layout of the controls is sectionalized so that the FG1 is simple both to operate and understand.

Internal layout employs the 'mother board' principle where a number of sub-circuit boards plug into a main circuit board. This concept makes spares holding and servicing very simple.

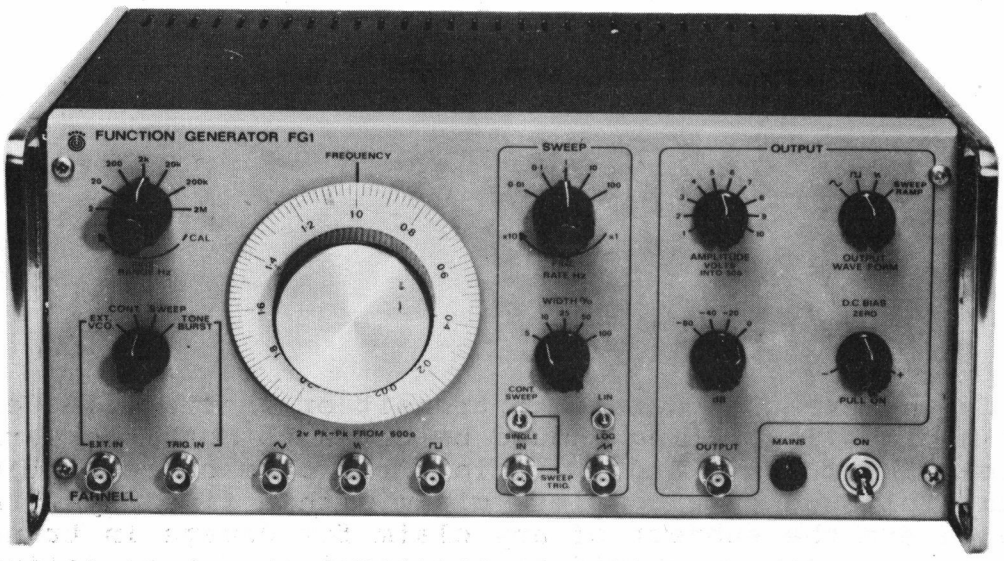
Sine, square and triangular waveforms are derived from a common oscillator extending from 0.02Hz to 2MHz in seven decade ranges. The dial covers two decades and the decade 0.02Hz to 0.2Hz is obtained on the 0.2 to 2Hz range.

The ramp waveform is from a separate oscillator which operates from 0.01Hz to 1kHz in five decade ranges.

All four signals are available from approximately 600Ω output impedance at a constant amplitude of about 2.5V pk-pk. Any of these four signals may be fed into the main amplifier to obtain an output of up to 10V pk-pk into a 50Ω load.

The frequency of the oscillator producing the sine, square and triangular waveshapes is controllable by an external voltage source or by the internal ramp generator to sweep the frequency over a 1,000:1 range.

The main oscillator may be gated with a pulse to give a burst of oscillations.



A general view of the FG1 Function Generator

SPECIFICATION

(Parameters measured after 30 minutes warm-up time)	
POWER SUPPLY REQUIREMENTS	A.C. mains 48-400Hz 190V to 260V or 95V to 130V by internal tap change
OUTPUT WAVEFORMS	Sinusoidal, square, triangular and ramp with sweep and burst facilities
FREQUENCY RANGE	0.02Hz to 2MHz in seven switched ranges for sine square and triangles. 0.01Hz to 1kHz in five switched ranges for ramps
FREQUENCY DIAL ACCURACY	±3% of range maximum 0.02Hz to 200kHz ±10% of range maximum 200kHz to 2MHz
OUTPUTS AVAILABLE	All four waveshapes are available simultaneously from four low level output sockets. One may be selected and is available from the main output socket.
LOW LEVEL OUTPUTS	Approx. 2.5V pk-pk from 600Ω, each. Fixed.
MAIN OUTPUT AMPLITUDE (at all frequencies)	20V pk-pk max. into open circuit 10V pk-pk max. into 50Ω Output is adjustable by coarse and fine controls down to 1mV pk-pk into 50Ω
MAIN OUTPUT ATTENUATOR	Switched in 20dB steps from 0dB to -60dB. Continuously variable fine control allows adjustment of output level from 1 to 10V into 50Ω
OUTPUT AMPLITUDE CONSTANCY (from main amplifier and low level outputs)	Less than 0.1dB change with frequency from 0.02Hz to 200kHz Less than 1dB change with frequency from 0.2MHz to 1MHz Less than 1.5dB change with frequency from 1MHz to 2MHz (referred to level at 2kHz)
OUTPUT OFFSET	D.C. offset up to ±5V into open circuit on unattenuated output.
SINE WAVE DISTORTION (without d.c. bias, over upper two decades of each frequency range)	Less than 1.5% from 0.2Hz to 200kHz Less than 5% on range 0.2MHz to 2MHz
RINGING AND PERTURBATION (sine and triangle)	Typically less than 2% pk-pk of waveform amplitude or 5mV whichever is greater

SQUARE WAVE RESPONSE	Less than 120nS rise and fall times from main output Less than 50nS rise and fall times from 600Ω fixed output when feeding 50Ω (0.18V)
OVERSHOOT AND PERTURBATION (main output, without d.c. bias)	Less than 10% at full output into 50Ω
SYMMETRY ERROR (over upper two decades of each frequency range)	Less than 2% from 2Hz to 0.2MHz Less than 5% from 0.2MHz to 2MHz Less than 10% from 0.02Hz to 2Hz
TRIANGULAR WAVE RESPONSE (low level output)	Less than 2% linearity error, up to 200kHz
TRIGGER PULSE	Greater than 2V peak positive going
TONE BURST GATING PULSE	Greater than 2V peak positive going
FREQUENCY PROGRAMMING	0V to +10V gives 1000:1 frequency shift up to set range maximum. Frequency proportional to input voltage, +10V giving range max. frequency
SWEEP RANGE	1000:1 up to range maximum
SWEEP MODES	Linear or logarithmic
SWEEP TIMES	1mS to 100S
SWEEP RAMP OUTPUT	0 to 2.5V pk from 600Ω, ±10%
SWEEP WIDTH	Stepped reductions to approx. 50%, 25%, 10% and 5% of maximum range frequency
AMBIENT TEMPERATURE RANGE For specified operation Max. operating range	+10°C to +35°C -10°C to +50°C
DIMENSIONS overall	Height 160 mm (6.3") Width 337 mm (13.27") Depth 252 mm (9.92")
WEIGHT	8.5 kg (18¾lb)

OPERATING INSTRUCTIONS

This section applies only to the additional facility of amplitude modulation available on FG1/AM models.

To modulate the sine wave output set the rear panel toggle switch to 'MOD ON' and apply the modulating signal to the adjacent b.n.c. socket marked 'MOD INPUT'.

Either Amplitude Modulation (A.M.) or Double Side Band Suppressed Carrier Modulation (D.S.B.S.C.M.) may be selected by operating the A.M./D.S.B.S.C.M. toggle switch.

To operate the FG1/AM without modulation the MOD switch must be in the 'OFF' position.

SPECIFICATION FG1/AM

This section applies only to the additional facility of amplitude modulation available on FG1/AM models.

Amplitude Modulation Mode

INPUT VOLTAGE FOR 80% MODULATION (for carrier frequencies up to 0.2MHz)	5V pk-pk
MAX. MODULATION & CARRIER FREQUENCY	2MHz
MIN. MODULATING FREQUENCY	d.c.
MAX. MODULATION DEPTH	80% to 0.2MHz 70% to 2MHz
CARRIER AMPLITUDE (no modulation)	5V pk-pk into 50Ω up to 0.2MHz Less than 3dB down at 2MHz

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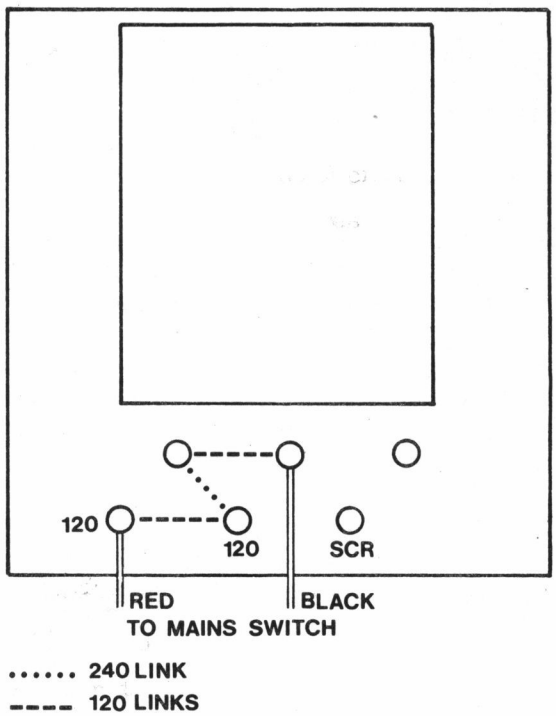
Suppressed Carrier Mode– Amplitude programming

MAX. MODULATING FREQUENCY	0.2MHz
MAX. CARRIER FREQUENCY	0.2MHz 2MHz at reduced performance for programming
A.C. MODULATION	10V pk-pk gives 10V pk-pk output waveform into 50Ω
D.C. PROGRAMMING	0-5V d.c. gives 0-10V pk-pk output into 50Ω

OPERATING INSTRUCTIONS

Installation

The FG1 is normally supplied set for use with a.c. mains supplies in the range 190V to 260V. An alternative transformer tapping to allow operation from 95V to 130V is provided (See sketch).



The mains lead is colour coded:-

Live - Brown
Neutral - Blue
Earth - Green/yellow

The unit is intended for use in an environment where the ambient temperature is between -10°C and +50°C

Operating instructions

Connect the mains lead to the supply and switch on using the toggle switch in the bottom right-hand corner of the front panel. The mains indicator lamp to the left of this switch will now illuminate.

A four position switch marked 'EXT VCO - CONT - SWEEP - TONE BURST' selects the desired operating mode.

Continuous mode

Oscillator Section:- Set the mode switch to 'CONT'. Adjust the coarse and fine controls situated above the mode switch to obtain the required frequency range.

The coarse control provides seven decade frequency ranges. The fine frequency control marked 'CAL' should be set fully clockwise in the 'CAL' position.

Output Section:- Set the switch marked 'OUTPUT WAVEFORM' for the waveshape required. Set the coarse and fine controls provided to obtain, at the main output socket, an output amplitude of suitable voltage level. The d.c. bias switch will normally be left pushed in, which is its off position.

Outputs Available:- Three outputs, sine, triangle and squarewaves, with fixed amplitudes of 2.5V pk to pk and with an output impedance of 600Ω, are simultaneously available from the appropriate B.N.C. sockets below the main frequency dial. The frequency of the waveforms is controllable by adjusting the main frequency dial which covers two decades. The 'CAL' knob provides

fine adjustment of the third decade down on the range employed except for the lowest switched range.

Depending upon the position of the 'OUTPUT WAVEFORM' switch, one of the waveforms is routed to the main amplifier and the main output socket where up to 10V pk-pk into a 50Ω load is available. Thus in the continuous mode this output may be sine, triangle or squarewaves.

The amplitude of the selected main output may be varied by means of a coarse (20dB steps) attenuator and by the fine control, both situated on the front panel above the output socket. With the coarse control in the 0dB position the waveform may be offset by ±5V with the 'D.C. BIAS' control. The bias will be attenuated with the coarse attenuator switch. A small change in output amplitude of typically less than 2% may occur when operating the 'D.C. BIAS' control.

Whilst the mode switch is still set for continuous operation ('CONT.') the sweep generator sawtooth waveform may also be selected with the 'OUTPUT WAVEFORM' switch set to the 'SWEEP RAMP' position. The waveform is a positive going ramp from zero volts. The frequency of this waveform is set by the 'RATE Hz' control in the sweep section.

Sweep mode

Oscillator Section:- Set the mode switch to 'SWEEP'.
Select the appropriate frequency range, i.e. the lowest range which covers the highest frequency required.
Set the frequency dial to the lowest frequency from which it is desired to start the sweep.

It should be noted that frequency may be swept over a 1,000:1 range but not overlapped across ranges.

The 'CAL' control allows fine adjustment of the third decade down on the range employed, except for the lowest preset range.

Sweep Section:- Set the 'SWEEP TRIG' toggle switch centrally.
Select required type of sweep - 'LIN' or 'LOG' using the other toggle switch.
Set sweep 'WIDTH %' switch to the required bandwidth of sweep. This is as a percentage of the maximum frequency for the selected range.

The sweep may now be initiated by switching the 'SWEEP TRIG' toggle switch to either 'SINGLE', for a single sweep, or to 'CONT SWEEP' for continually repetitive sweeps. Alternatively an electrical input signal (minimum of 2V) to the 'SWEEP TRIG' socket will initiate a single sweep or will, whilst the signal is present, permit repetitive sweeps depending on whether 'SINGLE' or 'CONT' sweeping has been chosen.

The time taken to complete the sweep is set by the sweep 'RATE Hz' controls which provide both coarse and fine adjustment over the range 1mS to 100S.

Outputs Available:- As in the continuous (non-sweep) mode the three waveforms are available at low level simultaneously, and also one of them may be selected for amplification and diversion to the main high level output.

In the sweep mode these outputs are all frequency swept. Alternatively, the sweep control waveform is available at the main output socket if the 'OUTPUT WAVEFORM' switch is set to 'SWEEP RAMP'.

If a voltage proportional to frequency is required this is available at the 'V ∝ F' socket at the rear (0 to 5.6V max.). Another socket is situated at the rear (serial number 101 onwards) providing a sync. pulse at the commencement of each sweep.

A low level ramp waveform is provided at a socket on the front panel (0 to 2.5V pk.). Either this, or the sync. pulse output may be used to trigger an oscilloscope, chart or X-Y recorder or similar peripheral equipment.

External voltage control (programming)

Oscillator Section:- Set the mode switch to 'EXT. VCO' and preset a suitable frequency range.

The oscillator may now be controlled by connecting an external positive voltage into the 'EXT. IN' socket. A 0 to 10V input will shift the frequency over a range of at least 1000:1. Frequency is directly proportional to the voltage with the maximum frequency for the range being obtained with an input of +10V.

The input impedance of the 'EXT. IN' socket is 10kΩ.

If the mode switch is on an internal position and the programming voltage is still being fed into the 'EXT. IN' socket, then the external voltage will add algebraically to the internal function selected.

For example, with the mode switch set to 'CONT' and the frequency dial set at 1 it is possible to frequency modulate the output about the centre frequency by applying an a.c. voltage varying about 0V.

Tone burst

Oscillator Section:- Set the mode switch to 'TONE BURST'. Preset a suitable frequency range as before and set the dial to the required frequency, the 'CAL' knob providing fine control over the setting.

The application of a gating pulse to the 'TRIG IN' socket will produce a burst of either sine or triangular cycles which will commence at 0V positive going and then complete an integral number of cycles ending at 0V.

THEORY OF OPERATION

Oscillator

The main oscillator is derived by means of switching a current either into or out of an integrated amplifier.

A simplified circuit diagram (fig 1) shows the method of switching and deriving the currents.

Operational amplifiers A1 and A2 form equal and opposite voltages at the resistors R1. When the switching circuit is positive, only the current '+I' can flow into the summing point of A3. Likewise, when the switching circuit is negative, only the current '-I' can flow. D1 and D2 compensate for the voltage drops across diodes D3 and D4. Diodes 1 to 4 are within an integrated circuit to ensure good temperature tracking.

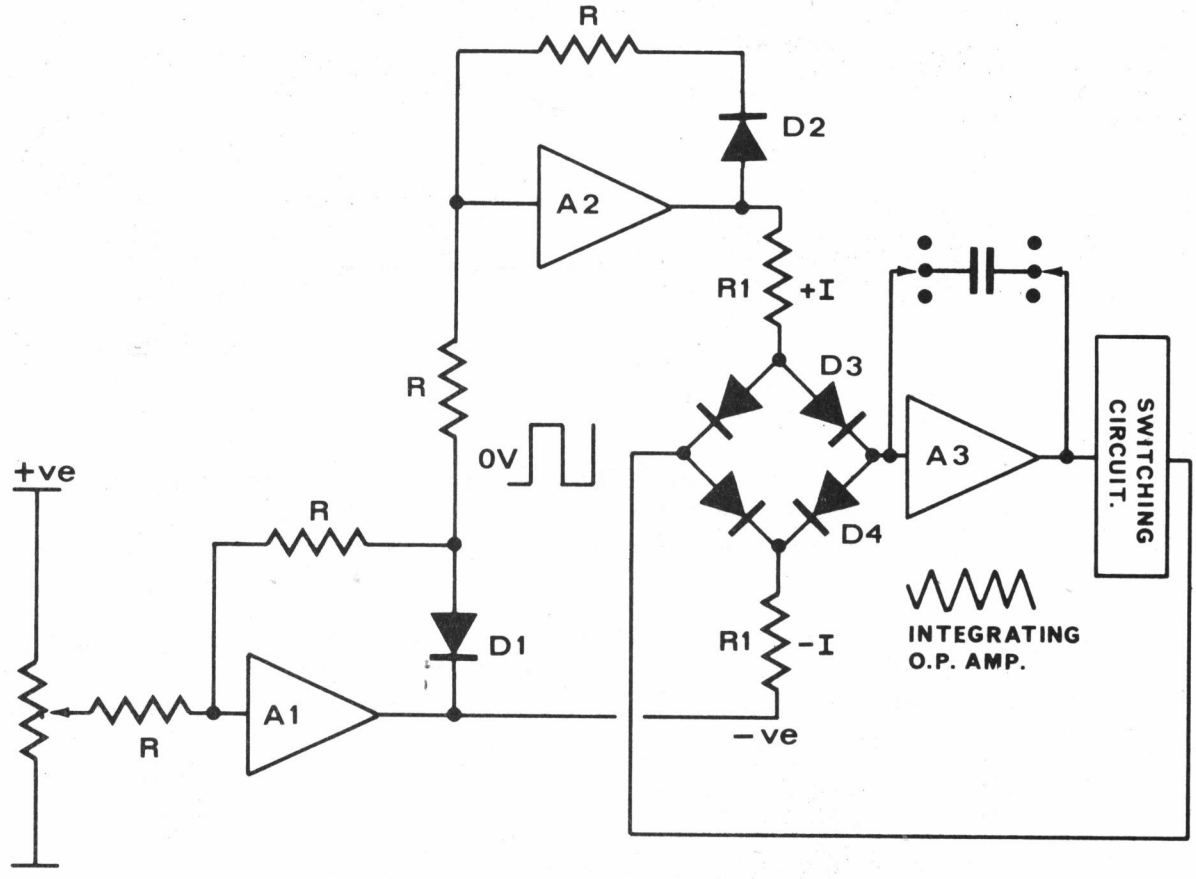


fig. 1

Sweep

A simplified sweep circuit is shown in fig. 2.

Assuming VT4 is off and therefore VT3 is off, the operational amplifier 1 will ramp down and operational amplifier 2 will invert and follow amplifier 1.

When amplifier 2 reaches a given voltage (5V) comparator 1 changes state and triggers a bistable to switch on VT4 and hence VT3. Current will now flow through VT1 sending amplifier 1 positive until VT2 conducts and switches comparator 2 which in turn switches the bistable to the position which cuts off VT4 and VT3. The process then repeats itself.

With the sweep off, the comparitor 2 is inhibited from operating the bistable.

The output of amplifier 2 is fed into the operational amplifier A1 of fig. 1 to sweep the main oscillator. Amplifier 2 output may be either linear or logarithmic but the output of amplifier 3, which is fed to the low level ramp output socket on the front panel and the main amplifier, is always linear.

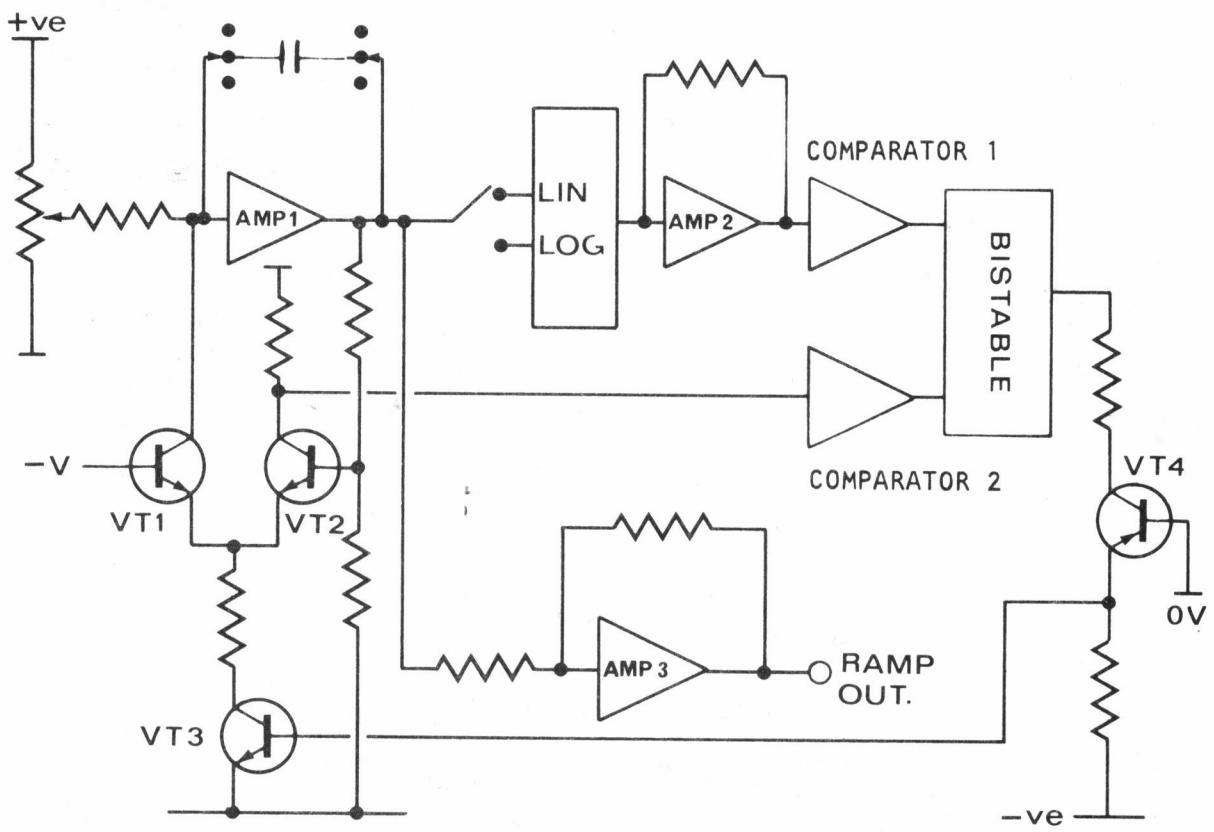


fig. 2

Tone burst

A simplified circuit of the tone burst system is shown in fig. 3.

With the mode switch in the 'TONE BURST' position and the signal to the 'TRIG IN' socket at zero, VT1 is off and RV1 and R1 are such that the integrated output is at zero.

When a positive pulse is applied to the input it is shaped by a long tailed pair and a Schmitt trigger which turns VT1 on. Current can no longer flow into the summing point and the burst starts.

When the controlling input pulse is returned to zero, the bistable needs a negative edge from a pulse derived from the integrator switching circuit before VT1 can be switched off. Since the negative edge is coincident with the negative peak of the triangular waveform, the burst always returns from the negative peak to zero.

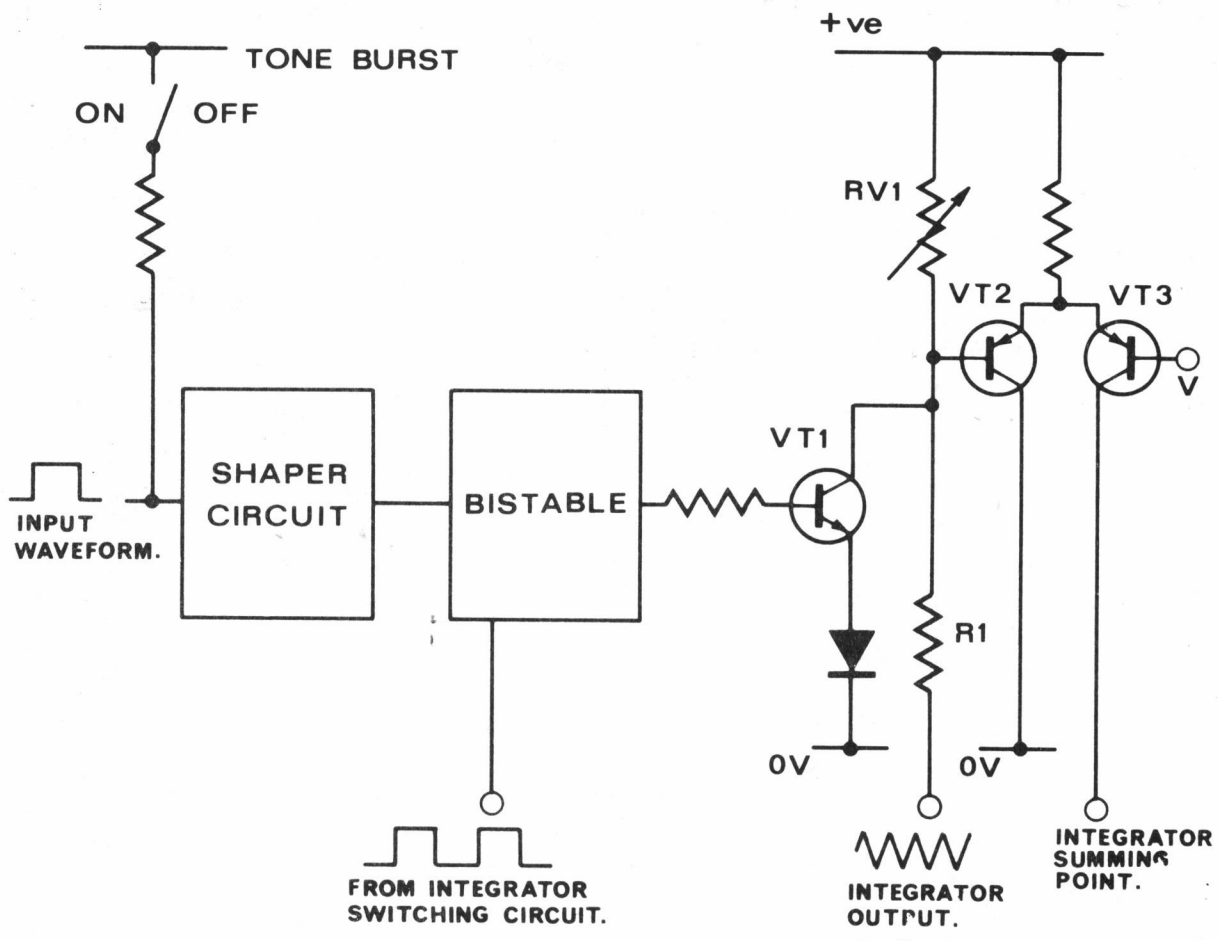


fig. 3

Modulation

Fig. 4 shows a simplified circuit of the optional amplitude modulation facility available for (or on, if specified when ordered) serial number 346 onwards.

This circuit allows both amplitude and suppressed carrier modulation of the basic sine wave. In the suppressed carrier mode, the output amplitude of the sine wave may be controlled with a d.c. voltage.

The sine wave is applied to one input of a four quadrant multiplier the output of which after amplification is selected by means of the 'MOD/NORMAL' and output selector switches.

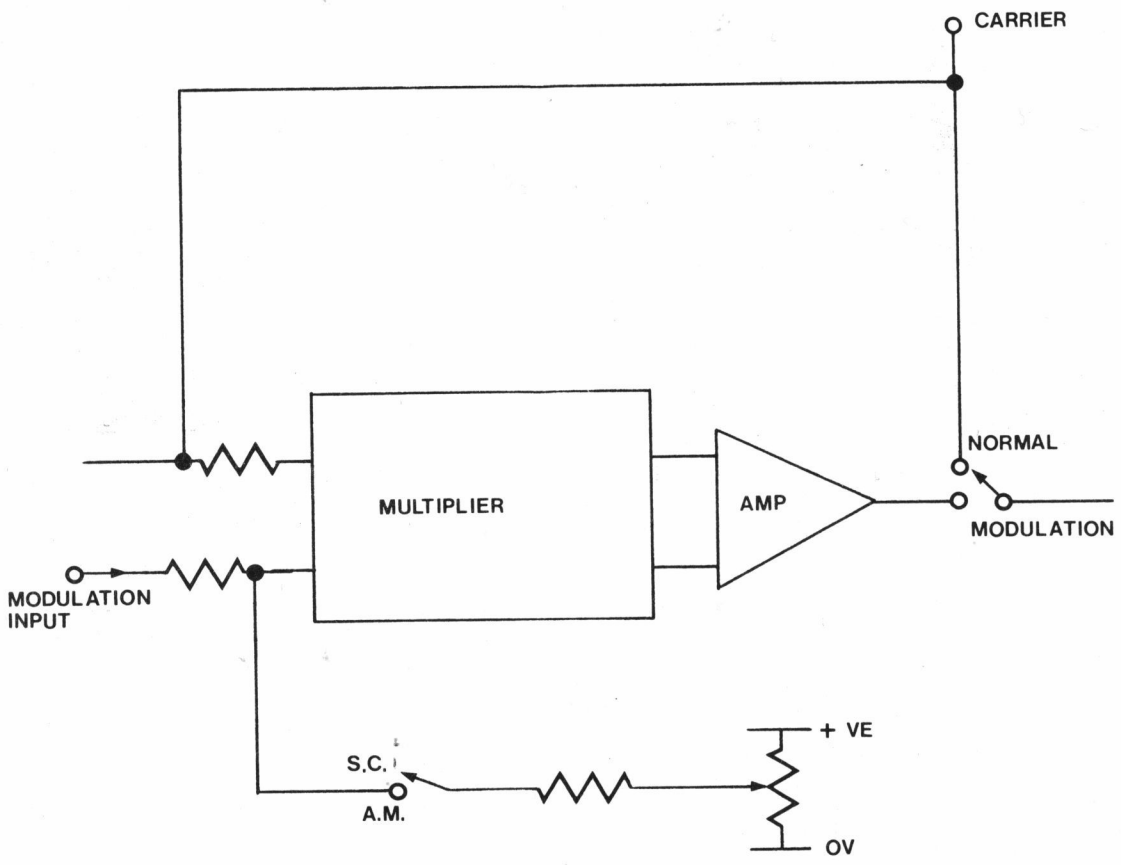


FIG. 4

MAINTENANCE

Guarantee

The equipment supplied by Farnell Instruments Ltd., is guaranteed against defective material and faulty manufacture for a period of twelve months from the date of despatch. In the case of material or components employed in the equipment but not manufactured by us, we allow the customer the period of any guarantee extended to us.

The equipment has been carefully inspected and submitted to comprehensive tests at the factory prior to despatch. If, within the guarantee period, any defect is discovered in the equipment in respect of material or workmanship and reasonably within our control, we undertake to make good the defect at our own expense subject to our standard conditions of sale. In exceptional circumstances and at the discretion of the Service Manager, a charge for labour and carriage costs incurred may be made.

Our responsibility is in all cases limited to the cost of making good the defect in the equipment itself. The guarantee does not extend to third parties, nor does it apply to defects caused by abnormal conditions of working, accident, misuse, neglect or wear and tear.

Maintenance

In the event of difficulty, or apparent circuit malfunction, it is advisable to telephone (or telex) the Service Department or your local Sales Engineer or Agent (if overseas) for advice before attempting repairs.

For repairs and recalibration it is recommended that the complete instrument be returned to:-

The Service Department
Farnell Instruments Ltd.,
Sandbeck Way,
Wetherby, Yorkshire.
LS22 4DH
Tel: 0937 3541

or

Service Depot,
Farnell Instruments Ltd.,
Hermitage Road,
London N4.

Tel: 01-802-5359

Please ensure adequate care is taken with packing and arrange insurance cover against transit damage or loss.

MAINTENANCE Continued

For those who operate their own comprehensive service departments and wish to repair and maintain the equipment themselves, the following information may be of assistance.

The FG1 employs the 'mother board' principle where a number of sub-circuit boards plug into a main circuit board. This concept makes spares holding and servicing very simple.

Spare circuit boards may be ordered through the Company's Service Department (prices on application) and any faulty circuit card repaired when time permits and retained as a spare.

Each circuit card has a number screened on it from which its function may be identified. There follows a brief circuit description of each card together with maintenance procedures. A later section deals with calibration checks.

CARD 1 – POWER SUPPLY

1. Circuit description

The power supplies are derived from two separate and identical conventional series regulator circuits except that the negative line reference is derived from the positive line. The reference of the positive line is derived from Z2 which is fed from the current generator VT1.

The sensing amplifier VT5, VT6 and VT7, controls the series transistor VT12 (mounted on the transformer sub-chassis) via VT11. Transistor VT10 with R17, R20 and R21 limit the current output of the supply in the event of a short circuit.

The unstabilized supply is obtained from two bridge rectifier circuits and smoothing capacitors C1 and C2. These are mounted on the transformer sub-chassis.

Fuses 1 and 2 protect the circuit.

2. Maintenance

2.1 Equipment required:-

D.V.M. Capable of reading 10mV in 22V (Farnell DMF400P/ DSV110 or similar)

2.2 Procedure:-

The power supply card should be checked and reset if any component on it has been changed.

a) Connect D.V.M. between OV (pin 3) and positive (pin 11)

b) Adjust T1 to obtain +22V ±20mV

c) Connect D.V.M. between OV (pin 3) and negative (pin 6)

d) Adjust T2 to obtain -22V ±20mV

CARD 2 – MAIN AMPLIFIER

1. Circuit description

The amplifier consists of two emitter coupled d.c. stages, VT2, VT3 and VT5, VT6. The bias current into the amplifier is reduced by VT1, and VT4 balances VT1 stage. Transistors VT7 and VT8 increase the current to a level sufficient to drive 50Ω.

Feedback is applied via R13 and R11. Resistors R1, R3 and T1 are used to bias the amplifier. Bias shift is obtained by applying a voltage to pin 2.

2. Maintenance

2.1 Equipment required:-

Oscilloscope (Cossor CDV150 or similar)

2.2 Procedure:-

a) Set mode switch to 'CONT.'

b) Set bias control to off

c) Set coarse attenuator to 0dB

d) Set 'AMPLITUDE VOLTS' control to 1

e) Set frequency to be approx. 1kHz

f) Set 'OUTPUT WAVEFORM' switch to triangles

g) Connect 'scope to main output

h) Adjust T1 to obtain symmetrical waveform about 0V

CARD 3 – RAMP CONTROL

1. Circuit description

The circuit consists of two comparator amplifiers in a single integrated circuit I.C.1. The positive ramp output from pin 16 of the ramp generator (card 4) is connected to the comparator via pin 7 of the ramp control card. The output of this comparator goes positive when the ramp reaches 5V. The ramp 'returned' pulse from pin 4 of the ramp generator (card 4) is connected to the second comparator via pin 4 of the ramp control card.

The transistors VT2 and VT3 form a bistable, the state of which depends on which comparator last operated. VT4 controls VT2 of the ramp generator (card 4). VT5 produces the 'sync.out' pulse. VT1 is made non-conducting in the continuous mode by connecting pin 9 to pin 12. In the external sweep trigger mode, VT1 is made conducting by breaking the connection between pins 9 and 12. This prevents the comparator output from controlling VT2 thus VT2 is switched on and the ramp is at OV. The application of a positive gating pulse switches VT1 off and allows the comparator output to turn on VT2. The system will then complete a full cycle or if the gate is still applied, the system will continue.

Capacitor C4 and resistor R12 are used to take VT1 out of conduction to allow a single pulse.

2. Maintenance

No adjustments are necessary with this board after replacing faulty components.

CARD 4 – RAMP GENERATOR

1. Circuit description

The circuit consists of a sweep generator stage I.C.1., VT1, VT2 and VT3 which, in conjunction with the control card 3 produces a negative ramp waveform.

This waveform is fed via I.C.2. on the Log-Lin card to form a positive sweep output. It is also fed to I.C.3. to give the fixed low-level linear ramp output.

The operational amplifier I.C.1. is used as an integrator, with externally switched capacitors between pins 8 and 10, integrating the voltage applied at pin 13, from the wiper of the 'FINE' sweep control.

A sweep is initiated by a control pulse from the ramp control card via pin 5 which cuts off VT2 and the sweep commences. It continues until the output of I.C.2., sensed on the ramp control card, reaches 5V which switches VT2 on again to cause the sweep to return to zero by the normal action of VT1 and VT3 whilst VT2 is on.

The sweep rate is varied by the coarse and fine sweep controls, the latter being connected to pins 2, 12 and 13 on the card. The coarse control switches the integrating capacitors between pins 8 and 10.

2. Maintenance

2.1 Equipment required:-

Oscilloscope (Cossor CDV150 or similar) or alternatively a Frequency Counter (Farnell DMF400P/DFM100 or similar). A D.V.M. (Farnell DMF400P/DSV110 or similar) or alternatively a sensitive analogue meter, 10mV f.s.d.

2.2 Procedure:-

If T1 or T2 have been replaced it will be necessary to reset them as follows:-

a) Set mode switch to 'SWEEP'

b) Set sweep range coarse switch and fine control to indicate 10mS (100Hz)

c) Set sweep mode switch to 'CONT. SWEEP'

d) Connect counter or 'scope to sweep output and adjust T2 to obtain 100Hz (10mS)

e) Turn fine control to fully anti-clockwise to give the setting for 10Hz (100mS) and adjust T1 until this figure is obtained on the counter or 'scope

f) Repeat c) to d) for optimum settings

2.3 If R4, R5, R11, VT1, VT3 or T3 have been replaced, the following procedure should be followed:-

a) Set mode switch to 'SWEEP'

b) Set sweep mode switch to centre position

c) Set lin-log switch to log

d) Connect D.V.M. or voltmeter to the junction of R13 and pin 6 and to OV

e) Adjust T3 to obtain 5mV ± 500μV

2.4 If T4 has been changed the following procedure should be adopted:-

a) Set mode switch to 'SWEEP'

b) Set sweep mode switch to 'CONT. SWEEP'

c) Set sweep range coarse and fine controls to obtain 100Hz (10mS)

d) Connect 'scope to junction of R14 and T4 and adjust T4 to obtain 2.5V pk-pk

CARD 5- LOG-LIN CONVERTER

1. Circuit description

The circuit converts a negative voltage ramp into either a current directly proportional to ramp voltage or a current logarithmically proportional to the voltage.

The current is fed into a summing point of an operational amplifier (on ramp card) to produce a voltage directly proportional to the current. In the log position (input pin 12) the ramp is divided down by means of R2 and R3 and applied to the cathode of D1 via VT1. Diode D1 allows the linear voltage at its cathode to draw a current from the summing point (pin 10) logarithmically proportional to the voltage.

2. Maintenance

2.1 Equipment required:-

Oscilloscope (Farnell 12-4D, 25-4D or Cossor CDV 150 or similar) or a frequency counter (Farnell DMF400P/DFM100 or similar)

2.2 Procedure:-

If any of the components need replacing the card should be reset as follows:-

a) Set mode switch to 'SWEEP'

b) Set sweep mode switch to 'CONT. SWEEP'

c) Set lin-log switch to 'LIN'

d) Connect 'scope or counter to the sweep output

e) Set sweep to 1kHz (100µS)

f) Measure and record frequency

g) Set lin-log switch to 'LOG'

h) Set T1 to obtain the frequency recorded in f)

CARD 5 - MODULATION

(Optional - also contains Log-lin converter)

1. Circuit description

The circuit consists of a four quadrant multiplier integrated circuit (MC1495) followed by an amplifier LM318 for amplification and d.c. shift. The multiplier is used to obtain both amplitude modulation and d.c. shift and provides as well voltage control of the instruments sine wave via an external source (remote programming).

This optional card occupies position 5, normally the LOG-LIN CONVERTER, and therefore incorporates this circuitry also.

2. Maintenance

2.1 Equipment required:-

Extension card; Sinewave generator (Farnell ESG1 or similar); Oscilloscope (Farnell 12-4D, 25-4D or Cossor CDV150 or similar)

2.2 Procedure:-

If any component with the exception of T2, T3, T4, T6 or IC1 needs replacing, the following procedure should be followed:-

a) Switch unit to 'MOD' and 'AM/SC' switch to 'A.M.'. (These switches are on the back panel).

b) Set frequency of output waveform to 20kHz

c) Check output is 10V peak to peak and adjust T6 if necessary

d) Check output is about zero and adjust T5 if necessary

e) Connect sine wave oscillator to rear modulation socket and adjust it to give 5V peak to peak at 1kHz

f) Switch 'MOD' switch to 'S.C.' and check each envelope is symmetrical. If necessary, make small adjustments to T2 or T3 to make modulation envelopes symmetrical.

2.3 If T2, T3, T4, T6 or IC1 is replaced it may be necessary to proceed as follows:-

a) Switch unit to 'MOD' and 'AM/SC' switch to 'A.M.'. Set the function generator to 2kHz approximately. Connect an oscilloscope to the main output and select sine wave output. Place modulation card into extension card.

b) Adjust RV3 to obtain zero output

c) Disconnect pin 2 of extension card by unsoldering the link and connect pin 2 to zero volts (pin 3) via a 2.2kΩ resistor.

d) Adjust T2 to obtain zero output

e) Remove card 5 from extension card and refit card 5 into the instrument. Set sine wave oscillator (ESG1 or similar) to zero output and set 'AM/SC' switch to 'A.M.'½

f) Check carrier is 10V peak to peak (unterminated) on 'scope and adjust (if necessary) T6 and T4 to obtain this amplitude

g) Increase output of external sine wave oscillator to 5V peak to peak approximately. Switch 'AM/SC' switch to 'S.C.' and check envelopes have equal amplitudes. Trim T2 or T3 if necessary.

h) Adjust T5 to obtain waveform about zero.

CARD 6 – TRIANGLE TO SINE

1. Circuit description

Integrated circuits I.C.1. and I.C.2. and transistors VT1 and VT2 form a piece-wise shaping circuit. Transistors VT3 to VT10 form a buffer amplifier. The integrated circuit I.C.1. and transistor VT2 shape the negative half of the waveform with resistors R16 to R20 determining the break point and resistors R3, R5, R7 and R9 the slope.

Integrated circuit I.C.2. (with complementry components to those in the negative shaping circuit) shapes the positive half of the waveform.

2. Maintenance

2.1 Equipment required:-

Oscilloscope (Cossor CDV150 or similar). Distortion analyser.

2.2 Procedure:-

If any of the following components have been replaced it will be necessary to adjust T1 and/or T2:-

I.C.1., I.C.2., VT1, VT2, R15, R16, R21, R22

a) Set mode switch to 'CONT.' and output waveform switch to obtain sine waves.

b) Set range switch and dial to obtain 2kHz

c) Connect distortion analyser to the fixed sine wave output

d) Adjust T1 and T2 to obtain minimum distortion

If any of the other components on card 6 have been replaced it may be necessary to adjust T3.

e) Connect 'scope to low level sine wave output.

f) Set range switch and dial to obtain 2kHz

g) Adjust T3 to obtain symmetrical output waveform about OV.

CARD 7 – VOLTAGE CONTROL

1. Circuit description

The purpose of this card is to provide two outputs of equal voltage but opposite polarity proportional to the input voltages from the frequency dial pot. at pin 10, the sweep output at pin 9, the frequency 'fine' pot. at pin 8, and external programming voltages at pin 2.

Two integrated circuit operational amplifiers, I.C.1 and I.C.2, are employed in conventional pattern using R8 and R14 as feedback resistors to their respective summing points. I.C.2. is used to invert the voltage at the junction of R8 and R9 so that two antiphase outputs appear at pins 7 and 5.

It is necessary for the outputs to compensate for the voltage drop across the integrator gating diodes. This is achieved by connecting diodes in series with the feedback resistors R8 and R14. These diodes are located in the same integrated circuit as the gating diodes and on the Integrator Card (8). The two outputs from this board, pins 12 and 4, are therefore a diode drop more negative and more positive than pins 7 and 5 respectively.

Each amplifier has separate biassing enabling their summing points to be adjusted to zero when all their inputs and outputs are at zero.

2. Maintenance

2.1 Equipment required:-

Frequency Counter (Farnell DMF400P/DFM100 or similar)
Two off sensitive d.c. voltmeters capable of measuring 100μV f.s.d. (Farnell TM39 or similar)
Oscilloscope (Cossor CDV150 or similar)
Distortion analyser
Stabilised Power Supply - twin outputs 0-30V (Farnell L30B/T or similar)

2.2 Procedure:-

If R5 has been replaced, the following procedure should be followed:-

a) Set mode switch to 'CONT.' and output waveform switch to give square waves

b) Set frequency by range and dial to give 20kHz

c) Connect square wave output to frequency counter to monitor frequency

d) Adjust T1 on the potentiometer circuit board which is mounted on the chassis (L.H. pot. when viewed from front) to give 20kHz

If any of the following components have been replaced then T1, T3, T5 and T7 may require adjustment:-

R1, R2, R4, R10 to R13, T1, T3, T5, T7, I.C.1., I.C.2., Z1 or Z2

e) Withdraw circuit board and use the power supply to connect +22V to pin 11, -22V to pin 6 and OV to pin 3. Link pins 7 and 12 and link pins 4 and 5. Connect pin 9 to OV.

f) Connect voltmeter 1 between OV and the function of R5, R6 etc. Connect voltmeter 2 between OV and the function of R8 and R9. Set the supplies accurately to +22V and -22V (i.e. within ±50mV)

g) Adjust T1 and T3 to obtain zero volts on both voltmeters (i.e. to within better than 20μV)

Disconnect equipment leaving pin links in position.

h) Connect pins 12 and 7 to OV. Connect voltmeter 1 between OV and function of R9 and R14. Connect voltmeter 2 between OV and pins 4 and 5. Set supplies accurately to +22V and -22V as before.

i) Adjust T5 and T7 to obtain zero volts on both voltmeters.

If R8, R9 or R14 have been replaced the following procedure should be followed:-

j) Refit card 7 back into unit. Remove Integrator card (8) and fit extension card into its socket. Plug card 8 into extension card. (Extension cards may be purchased from the Service Department of Farnell Instruments Ltd.)

k) Set frequency by range switch and dial to 20kHz

l) Connect 'scope to triangular output.

m) Adjust T3 on Integrator card to obtain equal rise and fall times.

2.3 A more accurate method is to connect a distortion analyser to the sine wave output and adjust T3 on the integrator card for minimum distortion.

When using this method the analyser may need adjustment for the small change in frequency which occurs when T3 is adjusted.

Automatic frequency tracking analysers must be allowed to stabilize after each change in the setting of T3.

CARD8 - INTEGRATOR

1. Circuit description

The circuit consists of an operational amplifier IC1 used to integrate current into and out of its summing point.

The bridge formed by diodes D2 to D5 allows current obtained by voltage across T3 and R8 to flow into the summing point when a positive pulse is applied to pin 5. Similarly, when pin 5 is negative, current flows out via R10.

R3, R11 and T4 are only in circuit on the 2Hz range.

T1 and T2 permit input offset at the summing point to be cancelled.

2. Maintenance

2.1 Equipment required:-

Oscilloscope (Farnell 12-4D, 25-4D or COssor CDV150 or similar)
Distortion analyser (optional)

2.2 Procedure:-

If any of the following components have been replaced it will be necessary to adjust T1 or T2:-

IC1, IC2, Z1, Z2, R1, R2, R4, R5, T1, T2

a) Set mode switch to 'CONT' and output waveform switch to triangular waveforms

b) Set coarse frequency scale to X10k

c) Connect 'scope to low level triangular output and adjust the function generator's dial and fine control to display a complete cycle on the screen at 2kHz

d) If waveform is not accurately symmetrical (i.e. equal rise and fall times) adjust T1 to make the asymmetry approximately double the original asymmetry

e) Adjust 'FINE' control to obtain 200Hz with one cycle displayed on the screen and adjust T3 to obtain symmetry

f) Repeat d) and e) until both are symmetrical

g) Switch coarse range to X0.1 with 'FINE' control at 'CAL' and main dial at 0.2 Switch 'scope to a.c. input

h) Adjust sensitivity of 'scope to obtain a reasonable displacement of the trace about the 'scopes zero position. The displacement is proportional to the ratio of change of the waveform and hence the symmetry may be checked by comparing the amplitude of the positive and negative displacement of the 'scope.

i) If asymmetrical adjust T5 on the voltage control card (card 7) to make the negative excursion of the trace slightly more asymmetrical and in the same direction as its asymmetry. In other words, if the negative excursion is less negative than the positive excursion is positive, adjust T5 to make it still less negative and if more negative, adjust T5 to make it still more negative.

N.B. This is a very sensitive adjustment and the amount of adjustment needed should be very small. Do not adjust by more than the thickness of the 'scope trace until familiar with the procedure.

j) Repeat from e) to i) until all waveforms are symmetrical with respect to time

2.3 If a distortion analyser is available the following method is more accurate:-

a) Set frequency of function generator to 2kHz

b) Connect analyser to sine wave output and adjust T3 for minimum distortion

When using this method the analyser may need adjustment for the small change in frequency which occurs when T3 is adjusted.

Automatic frequency tracking analysers must be allowed to stabilize after each setting of T3.

2.4 If the components R3, R11 or T4 have been replaced it will be necessary to readjust T4 as follows:-

a) Set frequency to 2Hz

b) Connect 'scope to output with square waves selected

c) Adjust T4 to obtain equal mark/space ratio

d) If C2 or C3 have been replaced the following procedure should be followed:-

e) Set mode switch to 'CONT' and output waveform switch to square waves

f) Set the range switch and dial to give a frequency of 1.4MHz

g) Connect frequency counter to square waves output socket and adjust C2 to obtain 1.4MHz

CARD 9 – INTEGRATOR SWITCHING

1. Circuit description

Main function is to produce the pulse controlling the gating diodes of the integrator.

The Schmitt trigger VT1 and VT2 determines the levels at which the triangular waveform is switched. These levels are controlled by means of the current generator VT3 and the voltage at the emitter of VT6. The switching pulse is formed at pin 2 by switching current through VT5, The square wave output is formed with VT7, and VT8 is used for controlling the tone burst bistable, VT1 and VT2 on the Tone Burst Card (10).

2. Maintenance

2.1 Equipment required:-

Oscilloscope (Cossor CDV150 or similar). Distortion analyser

2.2 Procedure:-

If any of the following components have been replaced it may be necessary to readjust T1 and T2:-

VT1, VT2, VT3, VT6, D3, Z1, R1, R2, R3, R5, R6, R7, R15, T1 or T2.

a) Set mode switch to 'CONT.' and output waveform switch to sine waves

b) Set frequency to 1kHz

c) Connect 'scope to the main output socket

d) Adjust T1 and T2 for a good visual sine wave

e) Connect a distortion analyser to the low level sine wave output

f) Adjust T1 and T2 for a minimum distortion

Since T1 and T2 effect frequency, it is necessary to readjust the analyser with each setting. With automatic tracking analyser time should be allowed after each adjustment for the instrument to stabilize.

CARD 10 – TONE BURST

1. Circuit description

When the instrument is switched to the tone burst mode, VT4 and VT5 control the current into the summing point of the integrator (Via pin 10, to the integrator card) in such a way as to keep the output from the integrator (at pin 7) at zero.

The input gating pulse from the 'Trig in' socket via pin 12 is shaped by VT6 and VT7 then switches the Schmitt trigger formed by VT8 and VT9. When a positive gating pulse is applied, VT7, VT8 and VT2 are turned off and hence VT3 holds VT4 on and VT5 off.

When the gating pulse returns to zero, VT8 turns on and current no longer flows via R10 into the base of VT1. However, VT1 stays on because VT1 and VT2 form a bistable. When the triangle wave changes from negative going to positive going, which is coincident with the negative going edge of the square wave at pin 8, this edge is differentiated by C1, R2 and then turns off VT1, resetting the bistable. VT4 and VT5 once again operate in the mode described in paragraph one, allowing the triangle wave to continue to zero and thereafter be held there.

2. Maintenance

2.1 Equipment required:-

Avo 8

2.2 Procedure:-

If any of the following components have been replaced it may be necessary to adjust P1.

VT4, VT5, Z2, R14, R15, P1.

a) Set mode switch to tone burst

b) Set frequency to 2kHz

c) Connect Avo to low-level triangular output and adjust P1 to obtain zero output

If R18, R20 or P2 are replaced it will be necessary to adjust P2.

d) Set mode switch to tone burst.

e) Connect Avo to 'trig-in' socket and adjust P2 to obtain zero.

RE– CALIBRATION

In the event of repairs having been carried out, or as routine maintenance after some years of operation, it may prove advantageous to check the calibration of the instrument.

Allow a period of 30 minutes for the instrument to attain its normal operating temperature.

Preliminary checks

Check voltage control (card 7) and Integrator (card 8) by carrying out the following procedures described in the MAINTENANCE section:-

CARD 7 2.2 a) to d)

CARD 8 2.2 a) to j)

To carry out the following procedures it will be necessary to use extension cards. These are available from the Service Department of Farnell Instruments Ltd.

1. Sweep circuits

1.1 Equipment required:-

D.V.M. (Farnell DMF400P/DSV110 or similar)
Counter (Farnell DMF400P/DFM100 or similar) or
Oscilloscope (Cossor CDV150 or similar)

1.2 Procedure:-

a) Check with D.V.M. that the +22V and -22V lines are within ±20mV of their nominal value. Adjust T1 (+ve) or T2 (-ve) if necessary. Always adjust T1 before T2 since T1 also effects the negative line. The +22V line is connected to pin 11 of all cards. The -22V line is connected to pin 6 of all cards. The 0V connects to pin 3 of all cards.

b) Set sweep coarse switch to 1mS (1kHz)

c) Set sweep fine control to X1

d) Set the sweep control toggle switch to 'CONT. SWEEP'

e) Set lin-log switch to lin

f) Connect counter to sweep output and check that frequency is 1kHz ± 10%

g) Repeat b) to f) with sweep coarse switch at 10mS (100Hz) and check frequency is 100Hz ± 10%

h) Repeat b) to f) with sweep coarse switch at 100µS (10Hz) and check frequency is 10Hz ± 10%

i) Repeat b) to f) with sweep coarse switch at 1S (1Hz) and check period is 1S ± 10%

j) Repeat b) to f) with sweep coarse switch at 10S (0.1Hz) and check period is 10S ± 10%

1.3

a) Set sweep coarse switch to 1mS (1kHz)

b) Set sweep fine control to X10

c) Set sweep control switch to 'CONT. SWEEP'

d) Set lin-log switch to lin

e) Connect counter to sweep output and check frequency is 100Hz ± 15%

f) Repeat a) to e) with coarse switch at 10mS (100Hz) and check frequency is 10Hz ± 15%

g) Repeat a) to e) with coarse switch at 100mS (10Hz) and check frequency is 1Hz ± 15%

h) Repeat a) to e) with coarse switch at 1S (1Hz) and check period is 10S ± 15%

i) Repeat a) to e) with coarse switch at 10S (0.1Hz) and check period is 100S ± 20%

If the above frequencies are out of specification, proceed as in paragraph 2.2 a) to f) of the maintenance instructions for the RAMP GENERATOR, card 4.

1.4

a) Set sweep coarse control to 10mS (100Hz)

b) Set fine control to X1

c) Set lin-log switch to lin

d) Connect counter to sweep output and note frequency

e) Set lin-log switch to log and check frequency is within 2% of that noted in d)

If the frequency differs by more than 2%, adjust T1 on Log-Lin card (5) to obtain same frequency on both log and lin positions.

2. Triangle circuits

2.1 Equipment required:-

D.V.M. (Farnell DMF400P/DSV110 or similar)
Oscilloscope (Cossor CDV150 or similar)

2.2 Procedure:-

a) Using the coarse control and dial, set frequency to 2kHz

b) Set mode switch to 'CONT.'

c) Connect 'scope to fixed low level triangular waveforms output

d) Check triangular wave is 2.5V pk-pk ± 5%

3. Sine wave circuits

3.1 Equipment required:-

Distortion analyser. Oscilloscope (Cossor CDV150 or similar)
Counter (Farnell DMF400P/DFM100 or similar)

3.2 Procedure:-

a) Set frequency to 2kHz by means of coarse control and dial

b) Set mode switch to 'CONT.'

c) Connect distortion analyser to fixed low level sine wave output

d) Adjust T1 and T2 of triangle to sine converter card (6) and T3 of integrator card (8) for minimum distortion. Distortion to be less than 0.6%. T3 on the integrator card may change the frequency slightly making it necessary to adjust the analyser each time T3 is altered. If an automatic tracking analyser is being used allow time for the analyser to stabilize to the new frequency.

e) Set frequency to 2Hz

f) Adjust T4 for minimum distortion on analyser. Distortion should be less than 0.8%. If analyser does not operate at 2Hz, connect 'scope to square waveform out and adjust T4 to obtain an equal mark to space ratio.

3.3

a) Set frequency to 20kHz. Make sure the 'CAL' control is fully clockwise

b) Connect counter to square wave output

c) Adjust T1 on potentiometer board mounted on chassis to obtain 20kHz on counter

d) Reset frequency dial to give 200Hz

e) Adjust T2 on potentiometer board mounted on chassis to obtain 200Hz on counter

f) Reset frequency to 2kHz using coarse switch and dial

g) Connect 'scope to triangular output

h) Adjust fine frequency (CAL) control to give approx. 200Hz

i) Adjust T3 on integrator card (8) to obtain equal rise and fall times at 200Hz

3.4

a) Using the coarse switch and the dial, set frequency to 1.4MHz ensuring the 'CAL' control is returned to its clockwise position. Mode switch is still in 'CONT.'

b) Connect counter to square wave output

c) Adjust C2 on Integrator card (8) to obtain 1.4MHz

Note: An extension card must not be used for this adjustment.

3.5

a) Using the coarse switch and the dial, set frequency to 2MHz

b) Leave mode switch in the 'CONT.' position

c) Connect counter to the square wave output

d) Check frequency is 2MHz ±5%

e) Set frequency to an indicated 200kHz and check with counter that it is 200kHz ±3%

f) Set frequency to an indicated 20kHz and check with counter that it is 20kHz ±3%

g) Set frequency to an indicated 2kHz and check with counter that it is 2kHz ±3%

h) Set frequency to an indicated 200Hz and check with counter that it is 200Hz ±3%

i) Set frequency to an indicated 20Hz and check with counter that it is 20Hz ±3%

j) Set frequency to an indicated 2Hz and check with counter that it is 2Hz ±3%

4. Main amplifier

4.1 Equipment required:-

Oscilloscope (Cossor CDV150 or similar). 50Ω load.
D.V.M. (Farnell DMF400P/DSV110 or similar)

4.2 Procedure:-

a) Connect 'scope to main output

b) Set coarse output attenuator to 0 dB

c) Set fine output control (marked 'amplitude volts') to 1

d) Set output waveform switch to triangles

e) Ensure bias switch is off (i.e. pushed in)

f) Using coarse frequency switch and dial, set frequency to 2kHz. The fine 'CAL' control should be fully clockwise

g) Check output waveform is symmetrical about 0V and adjust T1 on amplifier board (2) if necessary to obtain symmetry

4.3

a) Set as 4.2 a) to c)

b) Set output waveform switch to square waves

c) Measure rise and fall times between +10% and 90%
Rise and fall times should be better than 100nS

4.4

a) Set as 4.2 a) to b)

b) Set amplitude volts control to 10

c) Connect 50Ω load at output

d) Using D.V.M. check amplitude is 10V pk-pk ±5%

e) Disconnect load

4.5

a) Set as 4.4 a) to b)

b) Set coarse attenuator to -20dB

c) Check output is 1V pk-pk ±7%

4.6

a) Set conditions as 4.4 a) to b)

b) Set coarse attenuator to -40dB

c) Check output is 0.1V pk to pk ±7%

4.7

a) Set conditions as 4.4 a) to b)

b) Set coarse attenuator to -60dB

c) Check output is 10mV pk to pk ±7%

4.8

a) Set conditions as 4.2 a) to d)

b) Set bias switch to on (i.e. pull)

c) Check bias control can be adjusted to give mean position of waveform of at least -5V

d) Check bias control can be adjusted to give a mean position of at least +5V

5. Tone burst

5.1 Equipment required:-

D.V.M. (Farnell DMF400P/DSV110 or similar)
Oscilloscope (Cossor CDV150 or similar)
Pulse generator (Farnell or similar)

5.2 Procedure:-

a) set mode switch to 'TONE BURST'

b) Connect D.V.M. between 'TRIG IN' and OV

c) Measure voltage and check that it is OV (within ±50mV) Adjust P2 on tone burst card (10) if necessary

5.3

a) Set mode switch to 'TONE BURST'

b) Using the coarse frequency switch and the dial set the frequency to 10kHz

c) Connect 'scope to low level triangle output

d) Set pulse generator to give 2V amplitude and a pulse width of 100µS at a repetition rate of 1kHz

e) Connect to 'TRIG IN' socket

f) Check burst is produced which starts from zero and finishes at zero. Adjust P1 on card 10 if necessary

6. Sweep width

6.1 Equipment required:-

Oscilloscope (Cossor CDV150 or similar)
D.V.M. (Farnell DMF400P/DSV110 or similar)

6.2 Procedure:-

a) Using coarse frequency switch and dial, set frequency to 2kHz

b) Set sweep control switch to off(i.e. centre position)

c) Set sweep width control to 100%

d) Set sweep time to 10S (0.1Hz)

e) Set sweep time fine control to X1

f) Set mode switch to 'SWEEP'

g) Connect 'scope to main output

h) Set output waveform selector switch to triangle

i) Set lin-log switch to log

j) Set fine frequency (CAL) control to obtain 200Hz on 'scope

k) Set sweep control toggle switch to 'SINGLE' and a sweep from 200Hz to 200kHz ±5% should be obtained

6.3

a) Set frequency to 2kHz as 6.2 a)

b) Set fine frequency control to 'CAL'

c) Set lin-log switch to lin

d) Set sweep control to 'CONT. SWEEP'

e) Set sweep width control to 50%

f) Set sweep time to 10mS (100Hz)

g) Set sweep time fine control to X1

h) Set mode switch to 'SWEEP'

i) Connect 'scope to junction of R6 and pin 9 on voltage control card (7) and OV

j) Check ramp waveform displayed on 'scope is 2.5V pk to pk ±5%

6.4

a) Set conditions as 6.3 except

b) Set sweep width control to 25%

c) Check ramp waveform displayed on 'scope is 1.25V pk to pk ±5%

6.5

a) Set conditions as 6.3 except

b) Set sweep width control to 10%

c) Check ramp waveform displayed on 'scope is 0.62V pk to pk ±10%

6.6

a) Set conditions as 6.3 except

b) Set sweep width control to 5%

c) Check ramp waveform displayed on 'scope is 0.31V pk to pk ±10%

7. External V.C.O.

7.1 Equipment required:-

Stabilized power supply (Any general purpose metered unit capable of providing 0 to 10V positive or negative e.g. Farnell L30B). D.V.M. (Farnell DMF400P/DSV110 or similar) Oscilloscope (Cossor CDV150 or similar) or a counter (Farnell DMF400P/DFM100 or similar)

7.2 Procedure:-

a) Using coarse frequency control and dial, set frequency to 100kHz

b) Set mode switch to 'CONT.'

c) Connect variable d.c. voltage supply with positive to input pin of 'EXT.IN' socket

d) Connect 'scope or frequency meter to output

e) Adjust external voltage supply to obtain 200kHz on 'scope or counter

f) External voltage should read 5V ± 5%

7.3

a) Set conditions as 7.2 except supply to be negative

b) Adjust external c

b) Adjust external voltage to obtain 20kHz

c) External voltage should read 4V ± 5%

7.4

a) Set conditions as 7.2 except mode switch should be switched to 'EXT. VCO'

b) Adjust external voltage to obtain 200kHz

c) External voltage should read 10V ± 5%

8. V∝F

8.1 Equipment required:-

D.V.M. (Farnell DMF400P/DSV110 or similar)

8.2 Procedure:-

a) Set mode switch to 'CONT'

b) Connect DVM to V∝ F output at rear of unit

c) Set dial to 20 and measure voltage with D.V.M. should be 5.6V ± 5%

d) Set dial to 10 and measure voltage. Should be half of above reading ±1%

9. Sweep trigger

9.1 Equipment required:-

Oscilloscope (Cossor CDV150 or similar)

9.2 Procedure:-

a) Set sweep time to 1mS (1kHz)

b) Set sweep time fine control to X1

c) Connect 'scope to sweep trigger output at rear of instrument

d) Set sweep control switch to 'CONT. SWEEP'

e) Check trigger pulse is greater than 2V at 'scope

Note: Pulse is a differentiated pulse with a width of approx. 2µS.

10. Modulation

10.1 Equipment required:-

Sine wave oscillator (Farnell ESG1 or similar); Oscilloscope (Farnell 12-4D, 25-4D or Cossor CDV150 or similar)

10.2 Procedure:-

a) Set rear switches to 'MOD' and 'A.M.'

b) Connect oscillator to rear BNC socket and set to 1kHz

c) Switch function generator to 20kHz

d) Connect 'scope to main output with 'scope attenuators set at maximum output

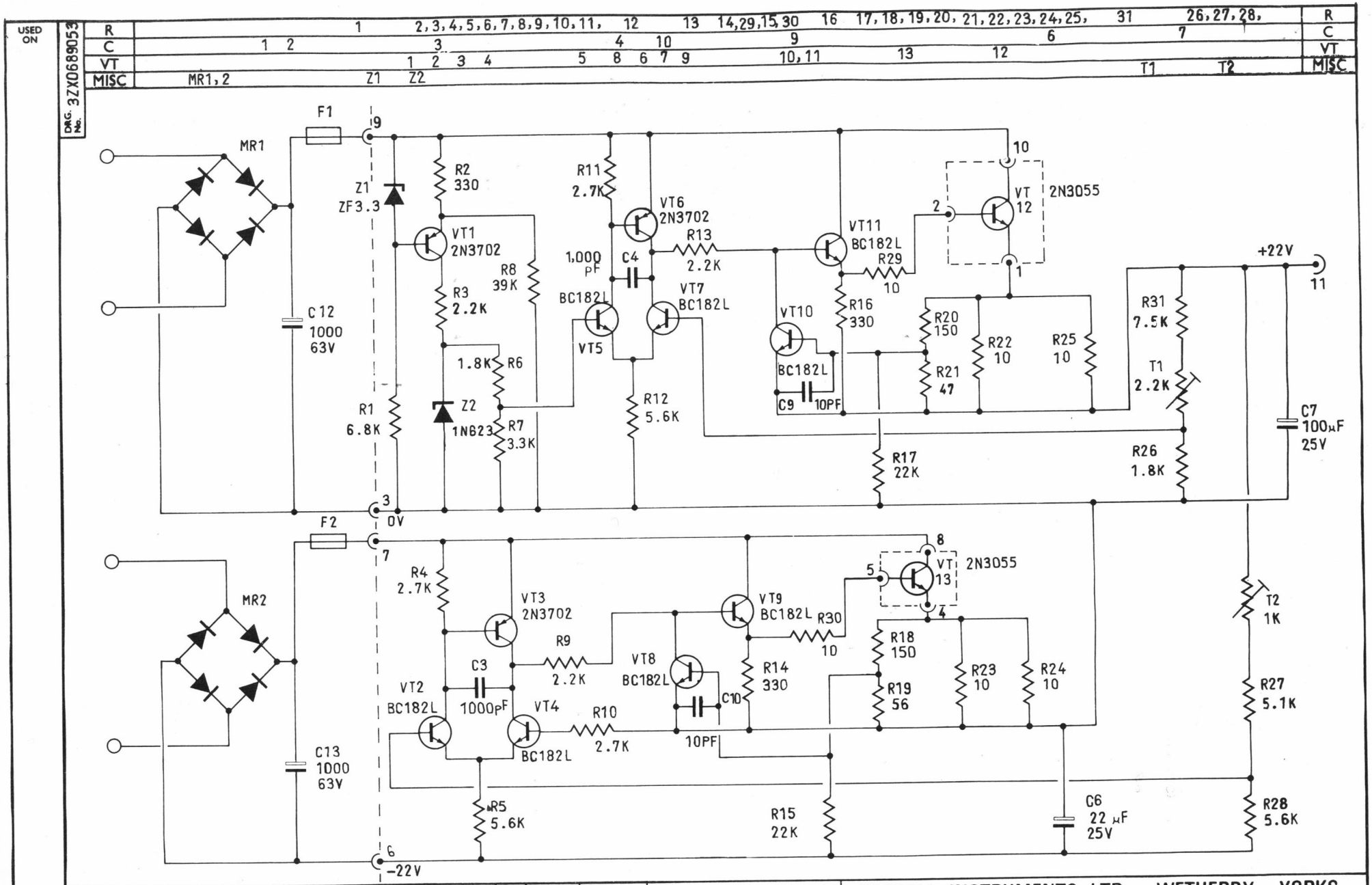
e) Adjust oscillator amplitude to obtain 80% modulation and check input volts are less than 5V peak to peak

f) Switch 'AM/SC' switch to 'S.C.' and check waveform envelopes are equal in amplitude and that waveform is symmetrical about zero volts.

ERRATA & ADDENDUM

Alternative components to those listed on the circuit diagram may be used in the event of supply difficulties.

Majcr design changes are listed below:-



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CHECKED		C	12.9.73	Q2564
DRAWN	M.H.	B	5:10:72	Q1733
		ISS.	DATE	MOD. No.
		A	1:2:72	

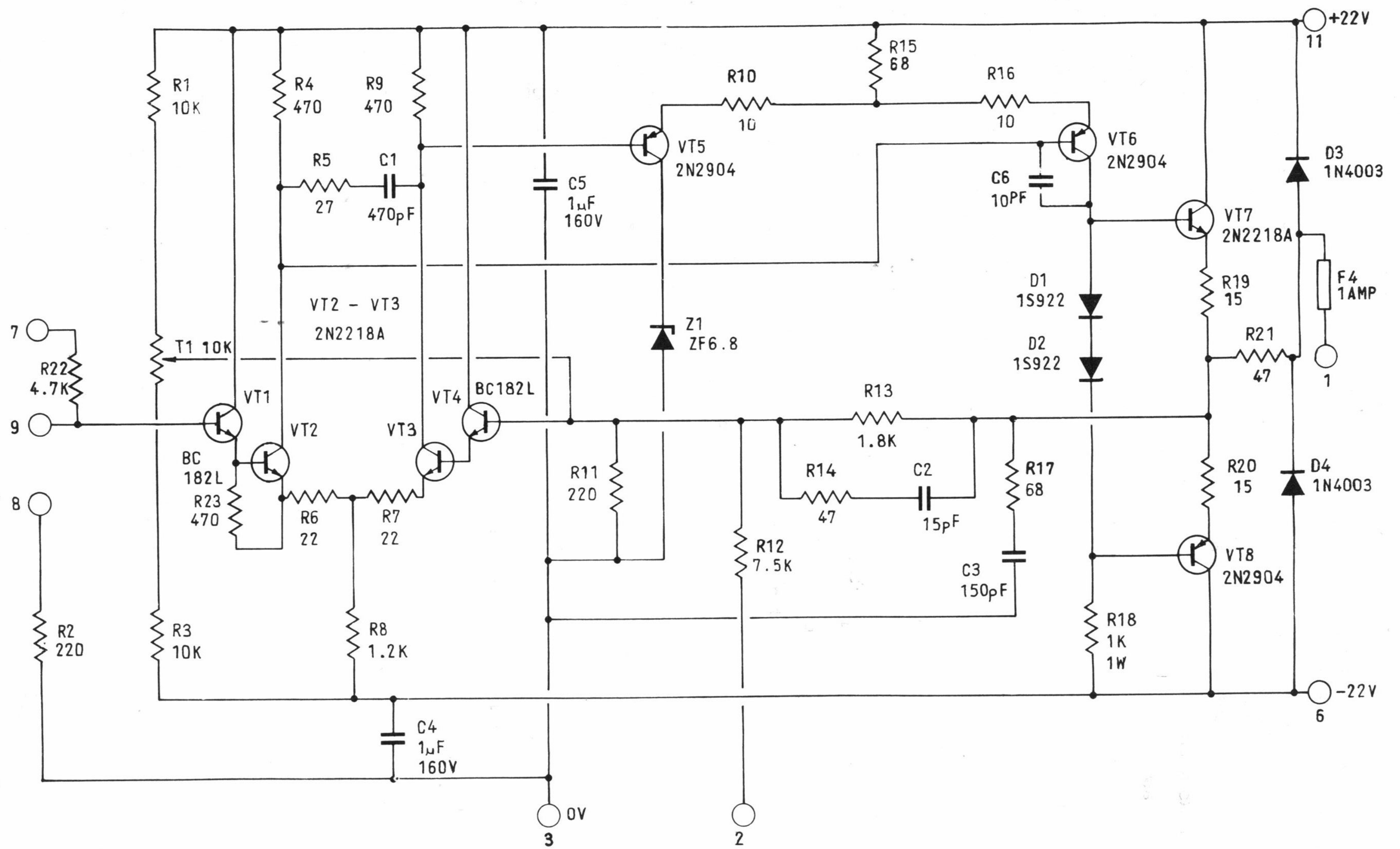
NOTE :—
CAPACITOR VALUES GIVEN IN µF
RESISTOR VALUES IN Ω
(2) REFERS TO CCT. BD. PIN CONNECTION Nos

FARNELL INSTRUMENTS LTD. WETHERBY, YORKS.

CIRCUIT DIAGRAM
POWER SUPPLY
FUNCTION GENERATOR.

DRAWING No. 3 ZX 0689 053

USED ON			DRG. No. 3ZX0689056
R	2 · 1,3 · 4 5,6 · 8 · 7,9 · 11 · 12,10 · 14 · 13,15 · 16,17 · 18 · 19,20	R	
C	1 4 · 5 · 2 · 3 6	C	
VT	1 · 2 · 3 · 4 · 5 · 6 · 7,8	VT	
MISC	T1 · Z1 · D1,D2 · D3,D4 F4	MISC	



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CHECKED		C	11:9:72	Q1673	G	20·12·73	Q2720
		B	20·6·72	Q1497	H	19·3·74	Q2862
DRAWN	D.W.	ISS.	DATE	MOD. No.			
		A	1:2:72	–			

NOTE

CAPACITOR VALUES GIVEN IN μF

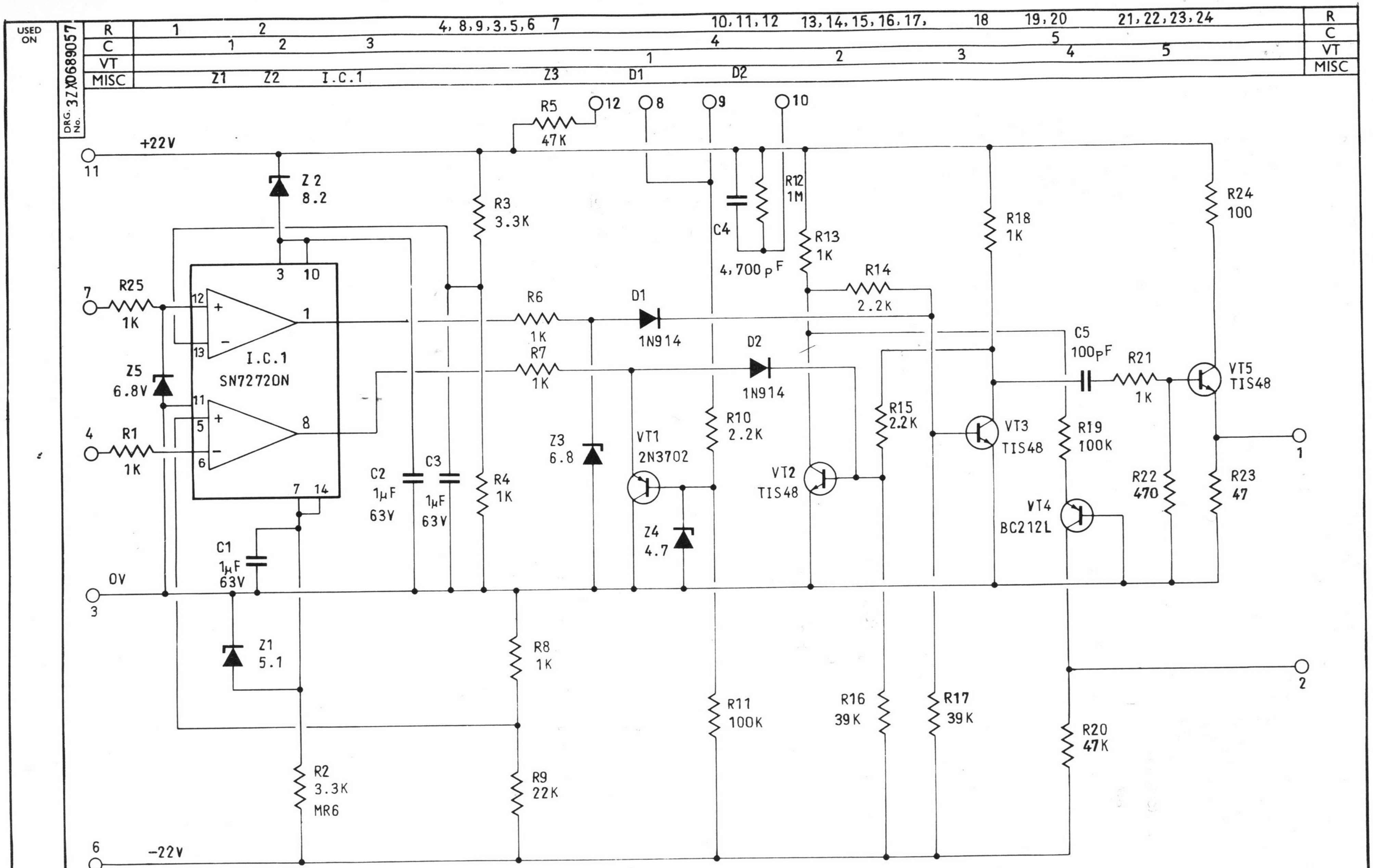
RESISTOR VALUES IN Ω

(2) REFERS TO CCT. BD. PIN CONNECTION Nos

FARNELL INSTRUMENTS LTD. WETHERBY, YORKS.

FUNCTION GENERATOR
CIRCUIT DIAGRAM
MAIN AMPLIFIER

DRAWING No. 3 ZX 0689 056



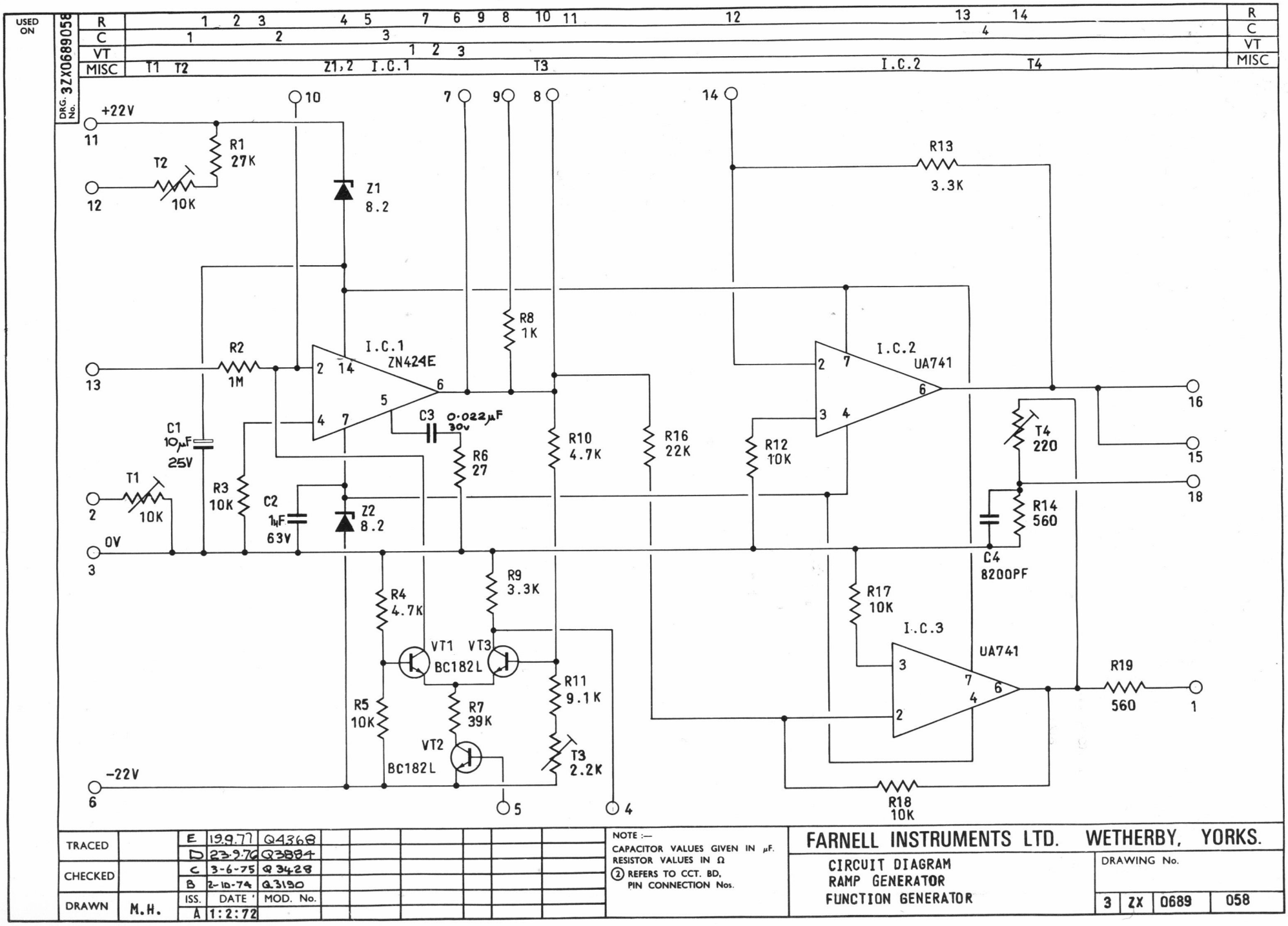
TRACED								
CHECKED		B	15·12·72	Q 1953				
		ISS.	DATE	MOD. No.				
DRAWN	M.H.	A	1:2:72					

NOTE
CAPACITOR VALUES GIVEN IN μF
RESISTOR VALUES IN Ω
(2) REFERS TO CCT. BD. PIN CONNECTION No.

FARNELL INSTRUMENTS LTD. WETHERBY, YORKS.

CIRCUIT DIAGRAM
RAMP CONTROL
FUNCTION GENERATOR.

DRAWING No. 3 ZX 0689 057



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		D	23.9.76	Q3884						
CHECKED		C	3-6-75	Q3428						
		B	2-10-74	Q3190						
DRAWN	M.H.	ISS.	DATE	MOD. No.						
		A	1:2:72							

NOTE :—
CAPACITOR VALUES GIVEN IN µF.
RESISTOR VALUES IN Ω
(2) REFERS TO CCT. BD. PIN CONNECTION Nos.

FARNELL INSTRUMENTS LTD. WETHERBY, YORKS.

CIRCUIT DIAGRAM
RAMP GENERATOR
FUNCTION GENERATOR

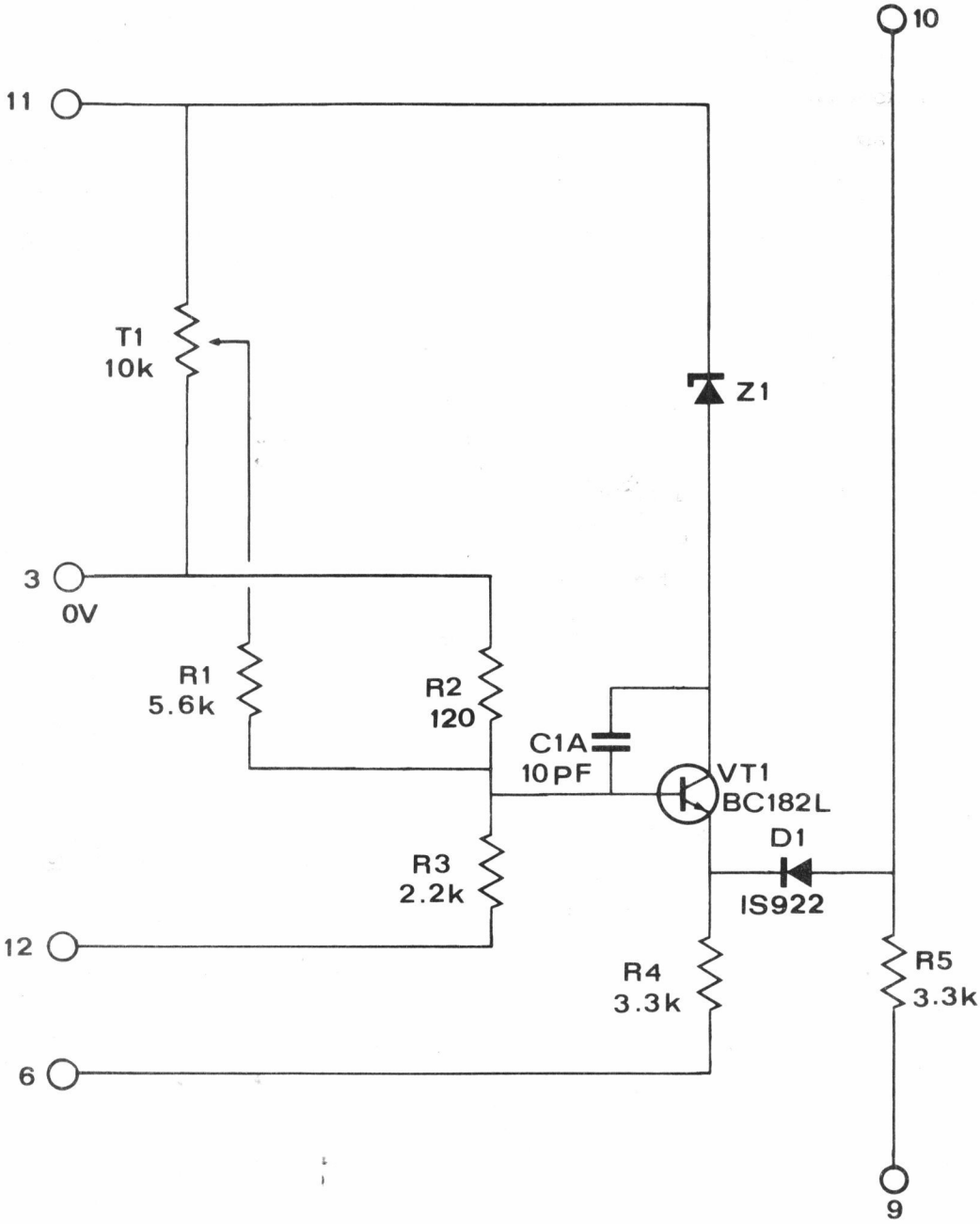
DRAWING No. 3 ZX 0689 058

THIRD ANGLE PROJECTION
DO NOT SCALE

ALL ERRORS TO BE REPORTED TO DRAWING OFFICE
DRAWN IN ACCORDANCE WITH BS308

DRAWING No. 4ZX 089 059

USED ON



ISS.	DATE	MOD. No.
D	19:3:74	Q2862
C	1:10:73	Q2550

PROTECTIVE FINISH

MATERIAL

NOTE :
REMOVE ALL BURRS
AND SHARP EDGES

TRACED

CHECKED

DRAWN J.N

TOLERANCES

SCALE

DIMENSIONS IN M.M.

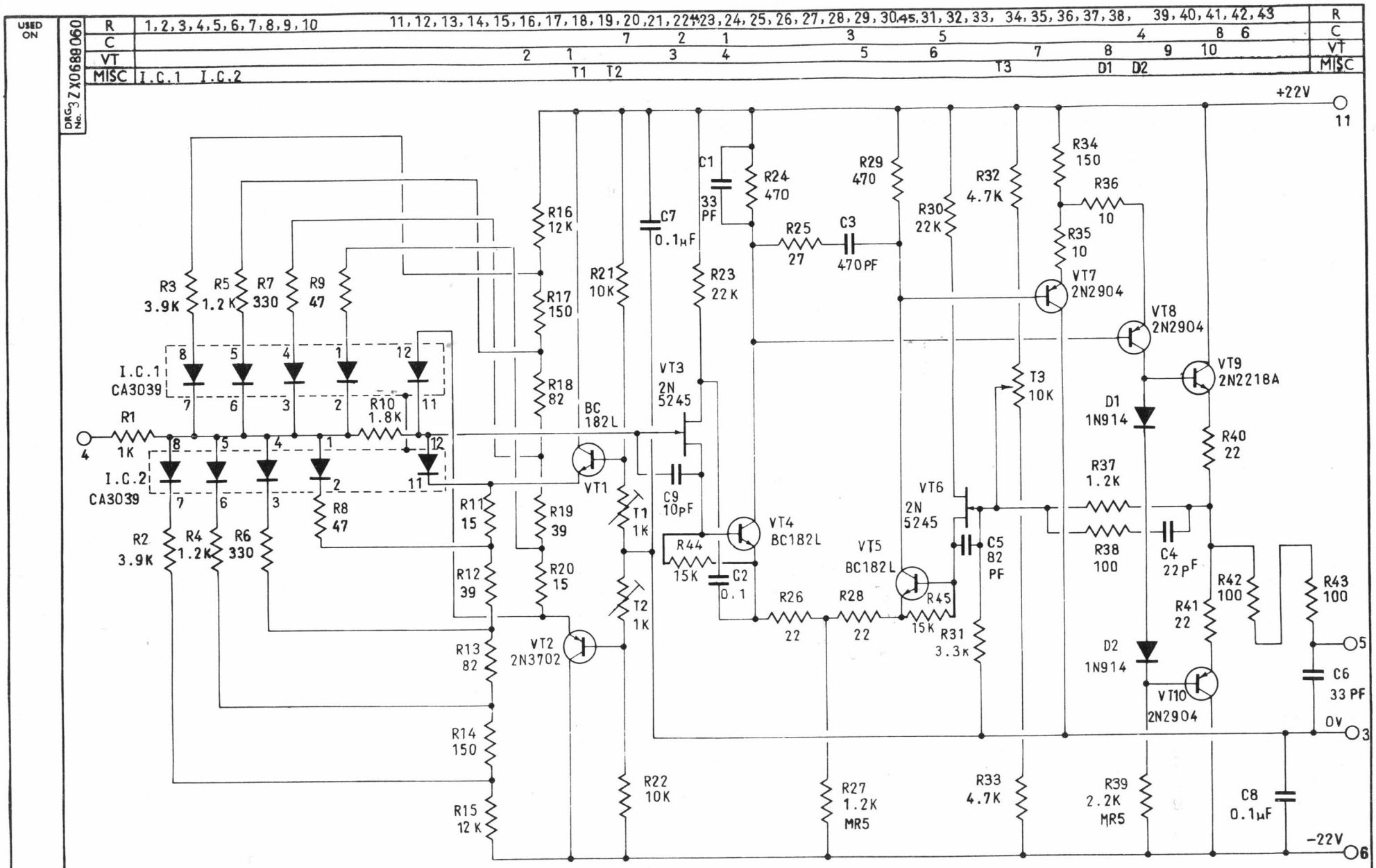
FARNELL INSTRUMENTS LTD. WETHERBY, YORKS.

TITLE : LOG LIN CONVERTER
CIRCUIT DIAGRAM
FUNCTION GENERATOR

DRAWING No.
4ZX 0689 059

SHEET 1 OF 1 SHEETS

GAF 3363/72



TRACED		E	20-12-73	Q2720	F	19-3-74	Q2862			
		D	20-9-73	Q2550	G	22-4-74	Q2925			
CHECKED		C	14:2:73	Q2063	H	9-5-74	Q2945			
		B	11:9:72	Q1673	J	16-7-74	Q3065			
DRAWN	M.H.	ISS.	DATE	MOD. No.						
		A	1:2:72							

NOTE :—
CAPACITOR VALUES GIVEN IN µF
RESISTOR VALUES IN Ω
(2) REFERS TO CCT. BD. PIN CONNECTION Nos.

FARNELL INSTRUMENTS LTD. WETHERBY, YORKS.

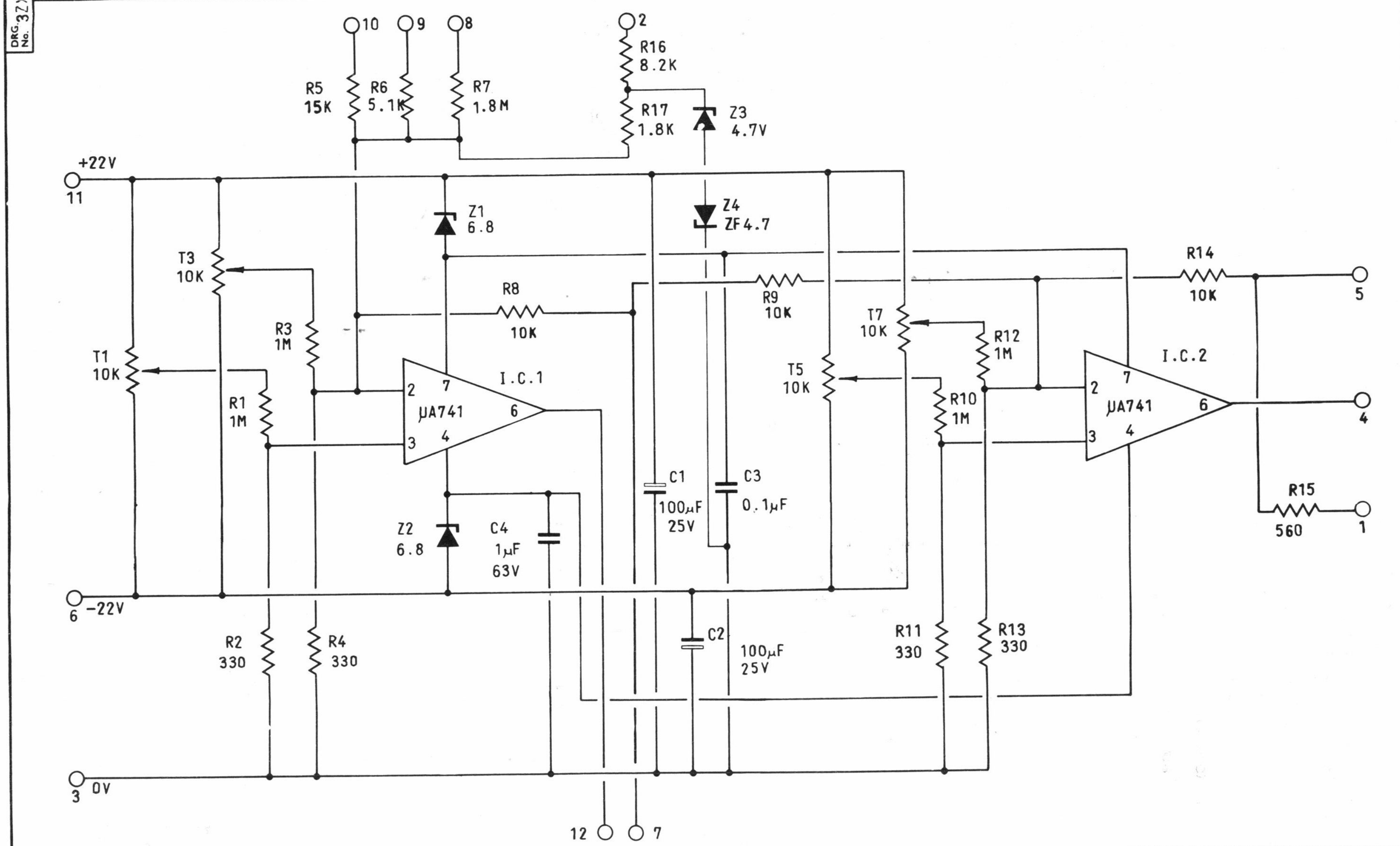
CIRCUIT DIAGRAM
▽ TO SINE CONVERTOR
FUNCTION GENERATOR .

DRAWING No. 3 ZX 0689 060

USED ON

DRG. No. 3ZX0689061

R	1,2,3,4 5 6 7 8 9 10,11 12,13 14,15
C	1 2 3 4
VT	
MISC	T1 T2 T3 T4 I.C.1 Z1 Z2 T5 T6 T7 T8 I.C.2



TRACED		E	14-12-72	Q1953	F	14:2:73	Q2063
		D	31-10-72	Q1764	G	18.9.73	Q2550
CHECKED		C	12:8:72	Q1673			
		B	20-7-72	Q1547			
DRAWN	M.H.	ISS.	DATE	MOD. No.			
		A	1:2:72				

NOTE :—
CAPACITOR VALUES GIVEN IN µF.
RESISTOR VALUES IN Ω
(2) REFERS TO CCT. BD. PIN CONNECTION Nos.

FARNELL INSTRUMENTS LTD. WETHERBY, YORKS.

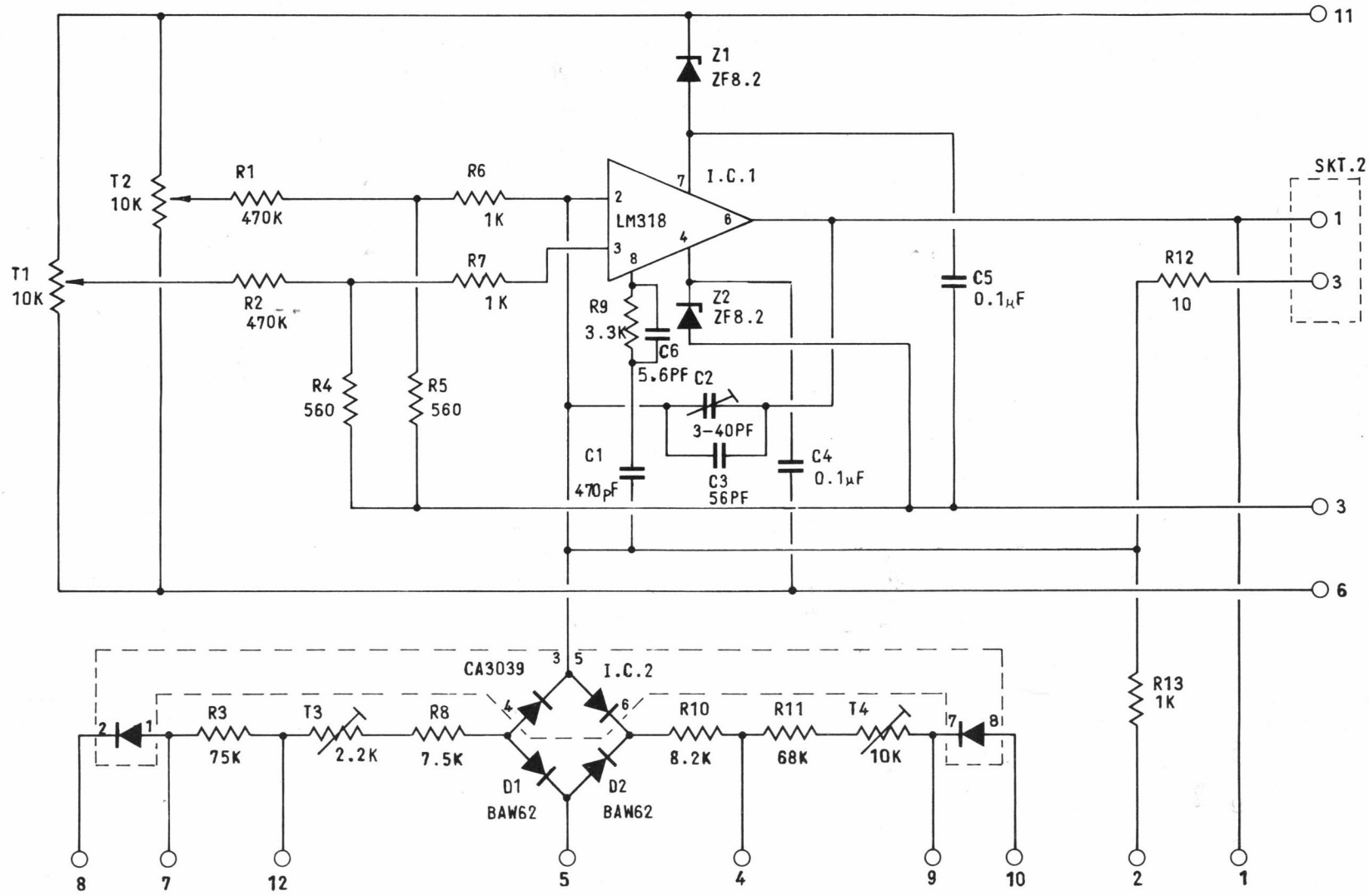
CIRCUIT DIAGRAM
VOLTAGE CONTROL
FUNCTION GENERATOR

DRAWING No. 3 ZX 0689 061

USED ON

DRG No. 3ZX0689062

R	1 3 2 4 5 6 8 7 9 10 11 12, 13
C	1 2 6 3 4 5
VT	
MISC	T1, 2 D1 T3 I.C.2 Z2 Z1 I.C.1 T4 D2



TRACED		G	18.9.73	Q2550	H	5-2-76	Q3748				
		F	14-12-72	Q1953							
CHECKED		E	18-10-72	Q1782							
		D	5:10:72	Q1733							
RE-DRAWN	M.H.	ISS.	DATE	MOD. No.							
		C	11:9:72	Q1673							

NOTE —
CAPACITOR VALUES GIVEN IN μF
RESISTOR VALUES IN Ω
(2) REFERS TO CCT. BD. PIN CONNECTION Nos.

FARNELL INSTRUMENTS LTD. WETHERBY, YORKS.

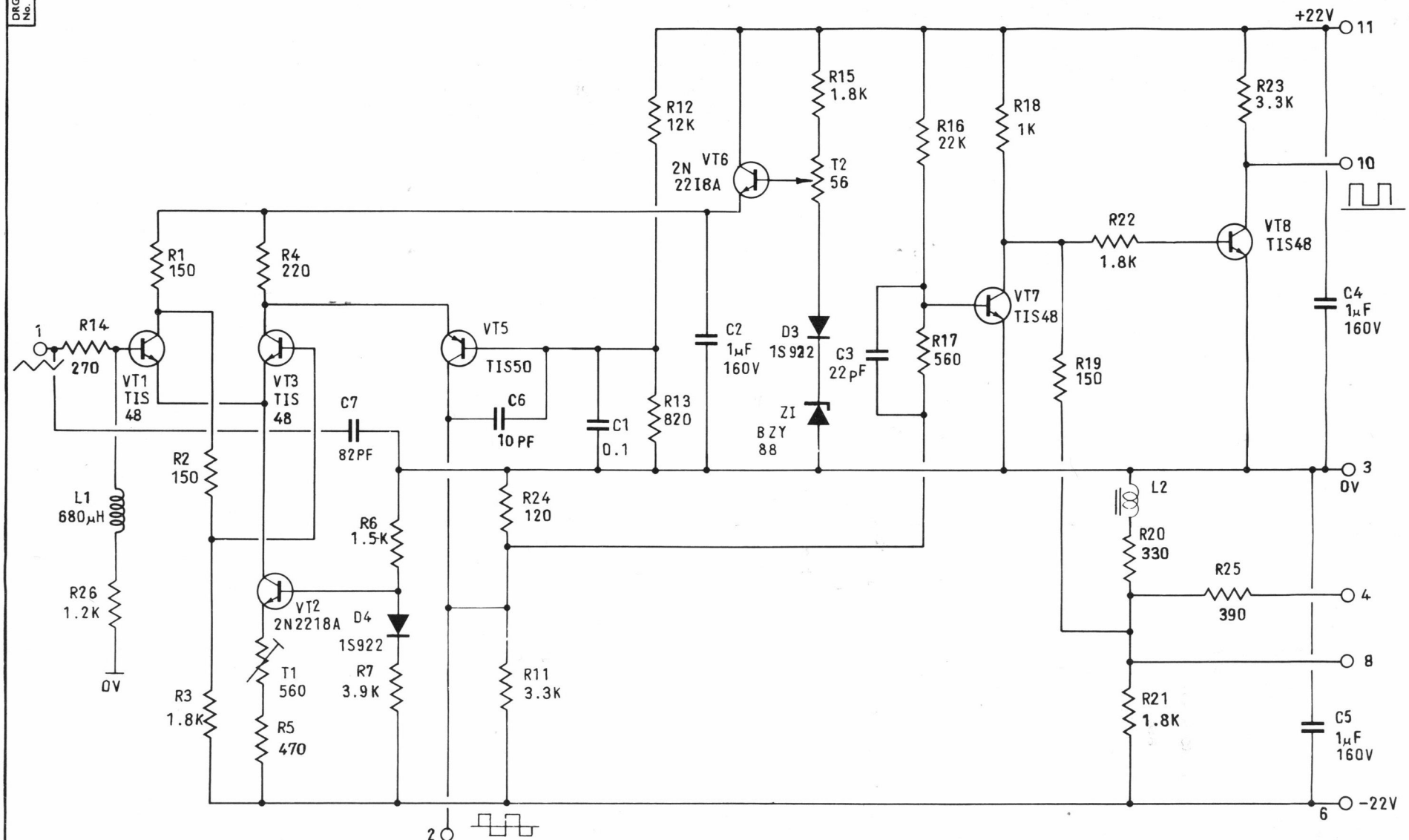
CIRCUIT DIAGRAM
INTEGRATOR BOARD
FUNCTION GENERATOR.

DRAWING No.
3 ZX 0689 062

USED ON

DRG No. 3ZX0689063

R	14, 1 2 3 4 5 6, 7 24, 11 12, 13 14 15 16 17 18 19 20, 21, 22, 25, 23,
C	7 6 1 2 3
VT	1 2 3 4 5 6 7 8
MISC	T1 D3, ZI, T2



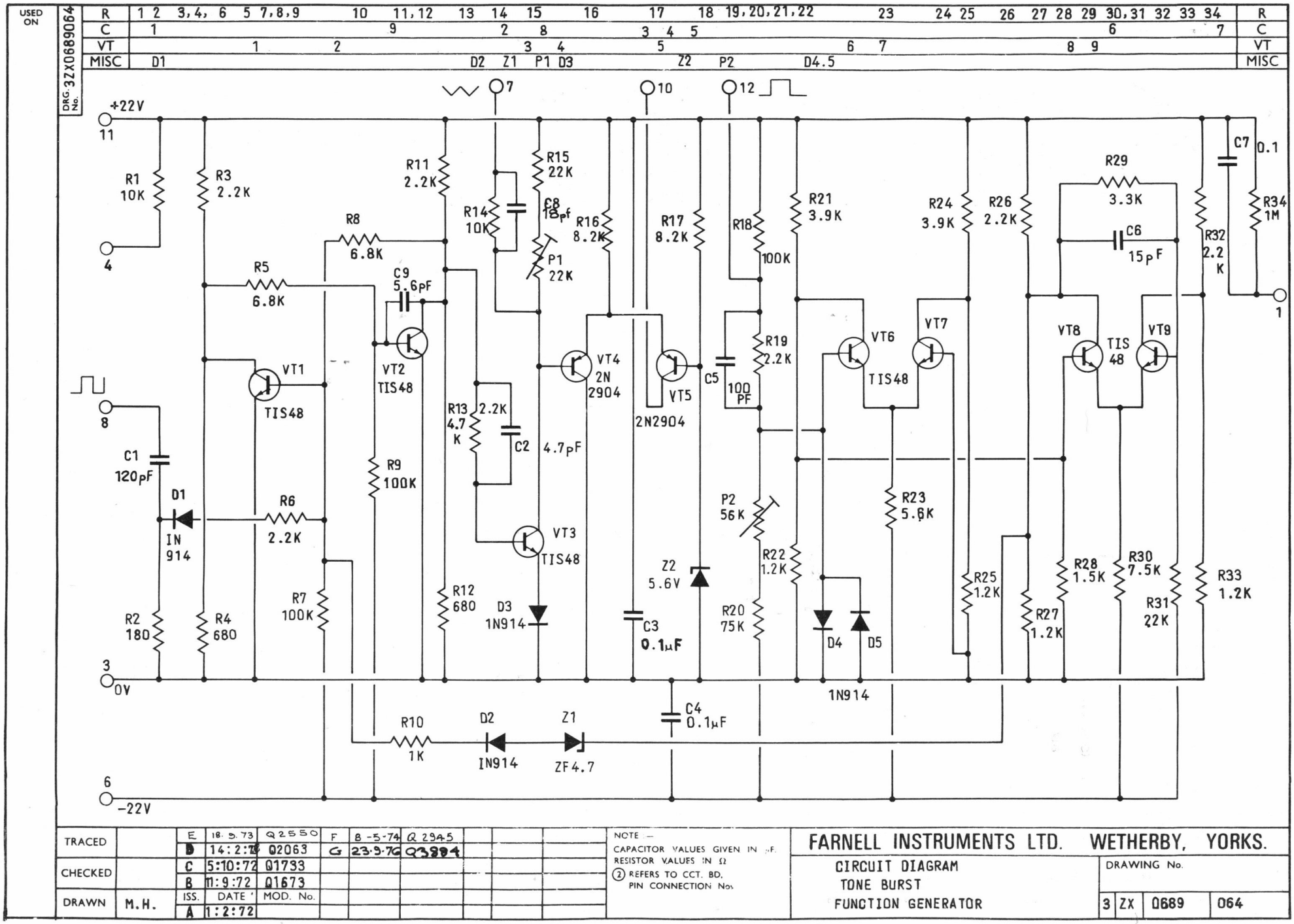
TRACED		E	21:9:73	Q2550	F	20-12-73	Q2720			
		D	14:2:73	Q2063	G	8:2:74	Q2791			
CHECKED		C	14:12:72	Q1953	H	19·3·74	Q2862			
		B	11:9:72	Q1673	I	9-5-74	Q2945			
DRAWN	M.H.	ISS.	DATE	MOD. No.	J	12.12.74	Q3278			
		A	1:2:72							

NOTE –
CAPACITOR VALUES GIVEN IN µF
RESISTOR VALUES IN Ω
(2) REFERS TO CCT. BD. PIN CONNECTION Nos

FARNELL INSTRUMENTS LTD. WETHERBY, YORKS.

CIRCUIT DIAGRAM
INTEGRATOR SWITCHING
FUNCTION GENERATOR

DRAWING No. 3 ZX 0689 063



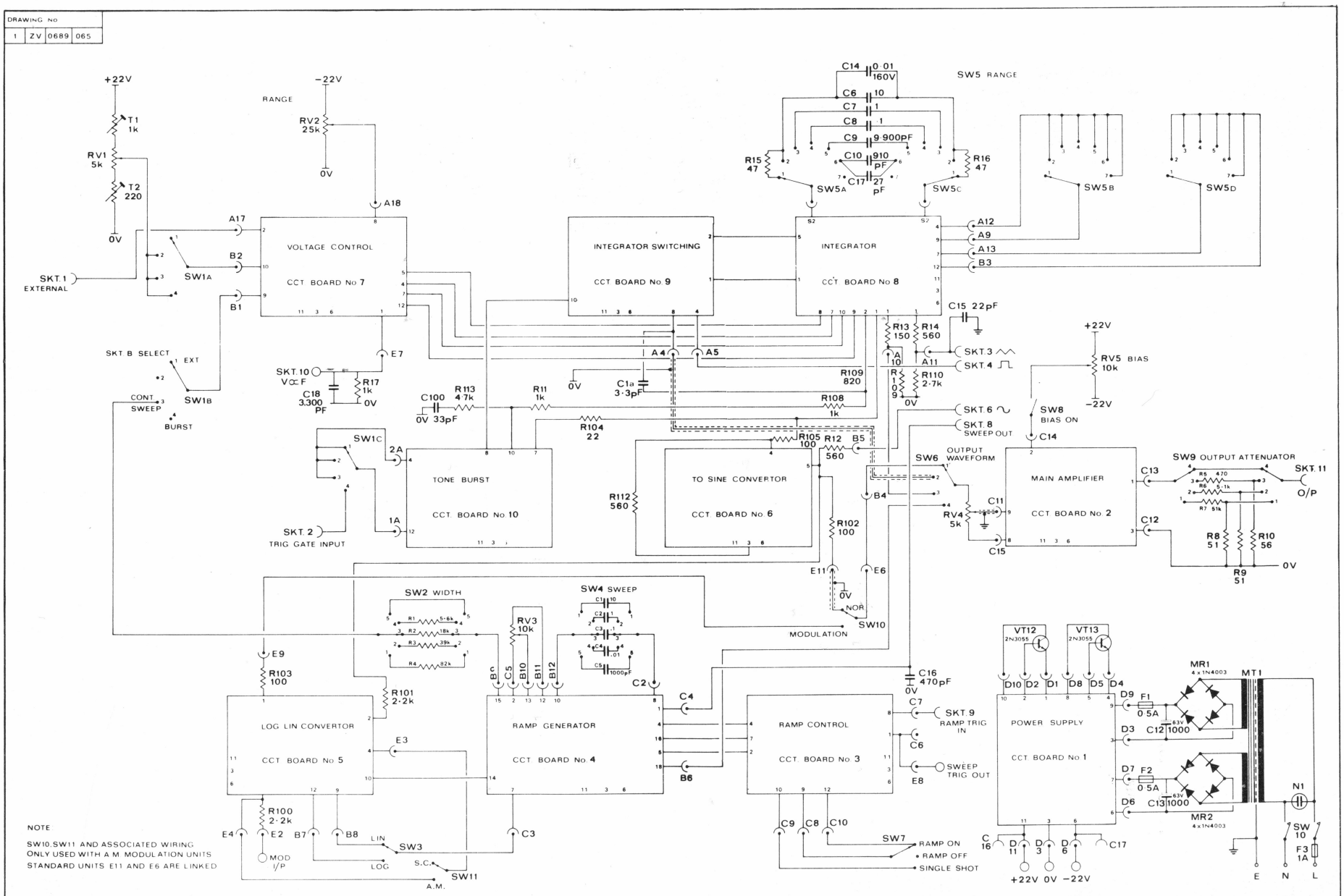
TRACED		E	18.5.73	Q2550	F	8-5-74	Q2945			
		D	14:2:73	Q2063	G	23.9.74	Q3894			
CHECKED		C	5:10:72	Q1733						
		B	11:9:72	Q1673						
DRAWN	M.H.	ISS.	DATE	MOD. No.						
		A	1:2:72							

NOTE —
CAPACITOR VALUES GIVEN IN µF.
RESISTOR VALUES IN Ω
② REFERS TO CCT. BD. PIN CONNECTION Nos

FARNELL INSTRUMENTS LTD. WETHERBY, YORKS.

CIRCUIT DIAGRAM
TONE BURST
FUNCTION GENERATOR

DRAWING No.
3 ZX 0689 064



TRACED	U	29.4.77	Q4203	V	14.9.77	Q4170	
	T	29.9.76	Q3947	W	20.9.77	Q4380	
CHKD	S	4.6.75					
	R	31.2.74	Q3258				
DRAWN D.WOJ	ISSUE	DATE	MOD NO.				
	Q	14.8.74	Q3121				

NOTE:- ALL CAPACITORS IN MICROFARADS UNLESS OTHERWISE STATED
ALL RESISTORS IN OHMS UNLESS OTHERWISE STATED
PIN 3 = 0V
PIN 6 = −22V ON ALL CCT BOARDS
PIN 11 = +22V

FARNELL INSTRUMENTS LTD., WETHERBY, YORKS.

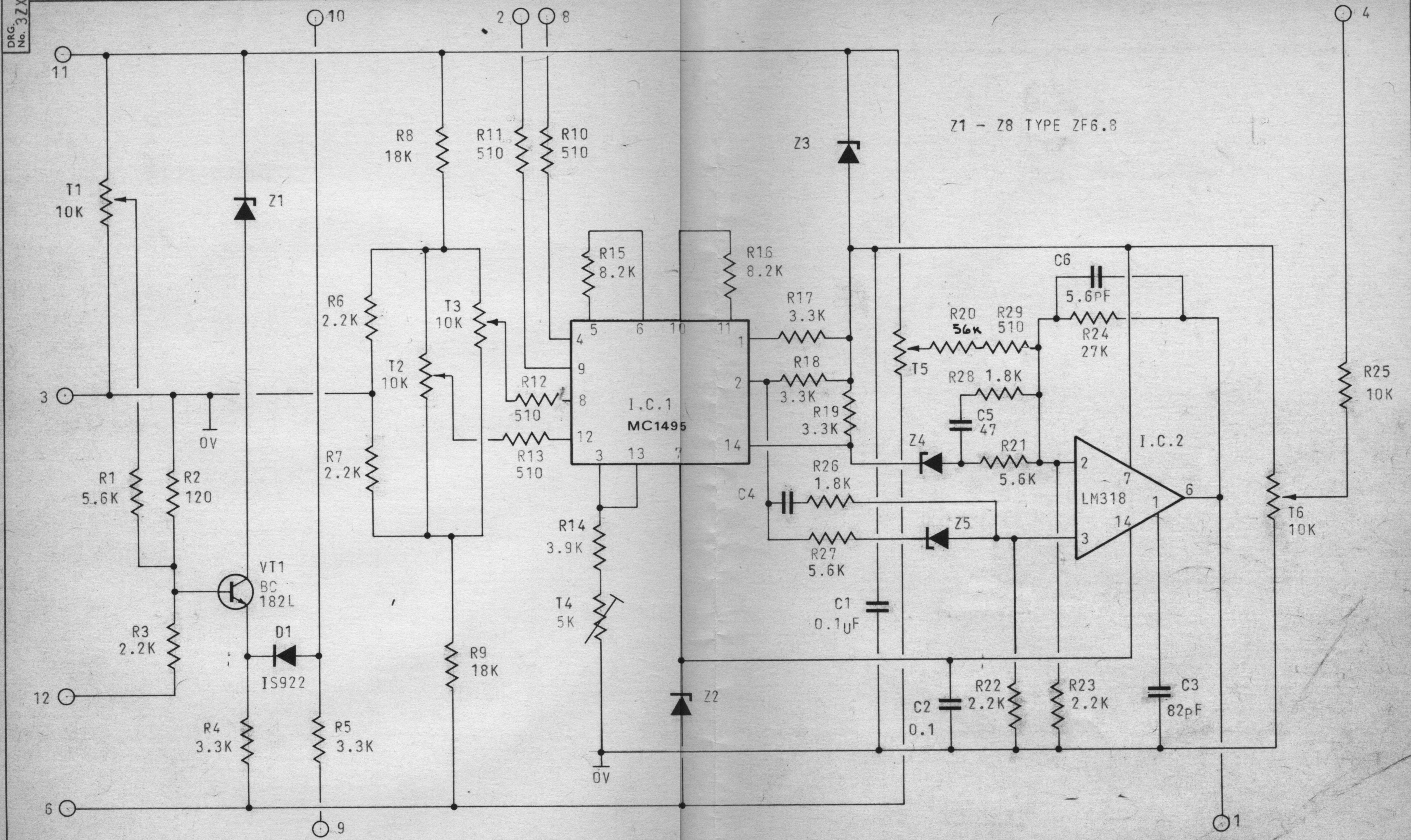
TITLE:- WIRING DIAGRAM
FUNCTION GENERATOR
FG1

DRAWING NO. 1 ZV 0689 065
SHEET 1 OF 1 SHEETS

USED ON

DRG. No. 3ZX0736100

R	1 3 2, 4, 5, 6,7, 8,9, 12,11,13,10,14, 15, 16, 17,18,19,26,27, 20, 28,29,21,22,23,24, 25
C	4, 1, 2, 5, 6, 3
VT	1
MISC	T1, Z1,D1, T2,T3, T4, I.C.1, Z2, Z3, T5, Z4 Z5, D2, I.C.2, T6



TRACED			
CHECKED		B	14-8-74	Q 3121
DRAWN	M.H.	ISS.	DATE	MOD. No.
		A	21·9·73	

NOTE :—
CAPACITOR VALUES GIVEN IN μF.
RESISTOR VALUES IN Ω
(2) REFERS TO CCT. BD, PIN CONNECTION Nos.

FARNELL INSTRUMENTS LTD. WETHERBY, YORKS.

CIRCUIT DIAGRAM.
MODULATOR CIRCUIT BOARD.

DRAWING No.
3 ZX 0736 100