COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD No. 1965/133

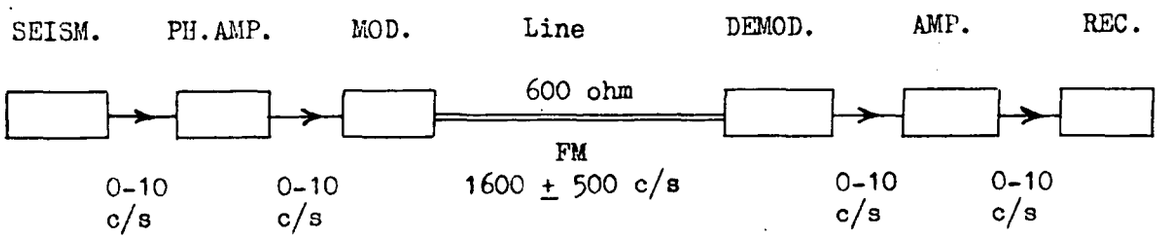
REMOTE SEISMIC RECORDING SYSTEM

1. INTRODUCTION

This system was designed to permit transmission of signals obtained from a seismometer installed at an observing station to a remote recording station. The low frequency signals are converted to frequency modulation, transmitted by telephone line, demodulated at the recording station, then recorded.

The seismometer coil movement is translated to an electrical signal of very low frequency which is amplified by a Phototube Amplifier. The output is taken to the input of the modulator which converts amplitude changes to frequencies around a centre frequency, which are then connected to the 600-ohm telephone line.

The received FM signal is fed to the demodulator, which reconverts it to amplitude variation in the form of a copy of the original seismometer signal. This signal is further amplified by the "Helicorder" recorder amplifier (which also provides the driving power), and is then recorded by the "Helicorder".



2. CIRCUIT DESCRIPTION

Modulator

The input signal from the Phototube Amplifier is fed to the base of Q1 across a 12.5K resistor and two limiting diodes. The variable frequency oscillator consists of Q1 and Q2, of which Q2 is a Unijunction transistor.

The capacitor C1 is charged with a constant current proportional to the voltage at the base of Q1. When the voltage across C1 rises above the peak voltage of Q2, then Q2 will be turned on, providing a pulse at the resistor R6.

In the absence of signal, the rate of C1 charging, and hence the repetition firing frequency of Q2, will depend on the voltage at the base of Q1 and the voltage at which Q2 turns on. This centre or carrier frequency then will depend on the values of R1, R2, R3, R4, and C1, while the peak point of Q2 is for practical purposes a fixed ratio of the network supply volts (15 V).

Hence, any linear change of voltage applied to the base of Q1 will result in a linear change of frequency around the centre frequency. The diodes CR1 and CR2 limit the input volts to ± 0.6 V and so limit the final frequency out to 1600± 500 c/s. The centre frequency can be trimmed to 1600 c/s by varying the above resistors, but from the point of temperature stability should be done with stable capacitors.

The actual centre frequency of the variable oscillator is 3200 c/s, but this is halved by a bistable multivibrator to 1600 c/s to be fed to the line. The signal is attenuated and shaped, and fed to a matching amplifier driving the output transformer.

Demodulator

The input from the telephone line passes through the isolating transformer to an R C amplifier. (Note: although only one amplifier is shown here, it may be necessary to add more to trigger the Schmitt Trigger if line losses are high). The signal will then trigger the Schmitt Trigger circuit to reshape the wave back to a rectangular form. The adjustment R6 selects the triggering point, and once set, should not need resetting.

The reshaped signal is fed to a Trigger Amplifier which, since it will not turn on until a voltage high enough to forward bias the diode is obtained, provides very sharp pulses. These pulses will trigger the Monostable multivibrator, which provides pulses of uniform width and height. These pulses are fed to an integrator circuit consisting of R23 and C9, driven by Q7. The choke L1, R25, and C10 form a filter for the very low frequencies which are the copies of the original seismometer signal. The signals are then fed to the "Helicorder" amplifier.

Power supplies

The power supplies for the Modulator and the Demodulator are identical. The mains voltage 230V is transformed to 32V and fed to a bridge rectifier. The D.C. output is filtered and then regulated by a 15V Zener diode.

3. OPERATION

Set up the seismometer, amplifiers, and recorder as per their respective handbooks.

Observing Station

After setting up the seismometer and the Phototube Amplifier, join the connecting cable from the output of the Phase Amplifier to the input J2 of the Modulator. Connect the 230V cable to J11, and switch on.

If a CRO is available, check that the Modulator is working correctly by monitoring the output frequency at J1 with the seismometer disconnected. Connect the seismometer and check for frequency variation by gently tapping around the base of the seismometer. When the checks are made, connect the telephone line plug.

Receiving Station

Set up the "Helicorder" amplifier and the "Helicorder". Connect the telephone line to the correct plug. Connect the mains 230V cable to J11, and switch on. Set the "Helicorder" amplifier to maximum attenuation, and connect the output of the Demodulator from J2 to the input of the "Helicorder" amplifier. Signals from the observing station should now be observed.

If no signals are received, the attenuation should be decreased. If still no signals, and the Modulator system is known to be working, a CRO will be needed to monitor the circuit. Refer to the maintenance section.

4. MAINTENANCE

Modulator

1. Check mains voltage 230V.
2. Check regulated volts 15V.
3. Check centre frequencies
4. Apply a 1½ V battery with a 220-ohm resistor in series to J1-1 and J1-2, then reverse leads. Approximate frequencies are f_1 = 1100 c/s and f_2 = 2100 c/s.
5. Check that the Bistable Multivibrator is dividing the centre frequency of 3200 c/s to 1600 c/s. (i.e. X2).
6. Check output is less than 250 mV r.m.s.

Demodulator

1. Check mains 230V and regulated 15V supplies.
2. Check that frequency can pass through the circuit.
3. Set R6 so that setting is between extreme limits.

5. EXTRACTS FROM PMG PUBLICATION DATA TRANSMISSION

Telephone Lines:	Open Wire Physical	D.C. - 3 kc/s
	Long Distance	300 - 3.4 kc/s

Technical Requirements

1. Maximum Power Output to be less than 1 mW in 600 ohms.

   (a) Continuous tones (FM): To be less than -10 dbm.

   (b) Discontinuous transmission: Less than -20 dbm.

2. No metallic or low impedance to be made from either line wire or associated equipment to earth.

3. Receiving amplifier has sufficient gain only so that crosstalk is kept inaudible.

4. Protection:

   (1) Wiring to be isolated and separated (in distance) from the wiring of the line. (BSS 415).

   (2) Reasonable steps taken to avoid accidental contact with line wires. (Insulated covers and shrouded terminals).

   (3) Power supply to enter equipment as far as possible from the entrance used for the telephone circuit.

   (4) Terminals clearly marked to avoid wiring transposition.

5. Testing:

   (1) Means of circuit isolation to be provided to enable equipment to be disconnected from line for testing.

   (2) PMG is responsible for the line and the facilities up to the isolating device.

   (3) Subscriber to be responsible for equipment beyond the device.

   (4) If equipment fails to meet PMG requirements, the isolating device MUST be operated.

6. Transmission Limits:

(1) Attenuation : Local 1 - 34 db. Trunk 6 - 40 db.

(2) Trunk lines (circuits and losses) may vary greatly.

(3) Frequency translation up to 10 c/s may occur on long lines.

(4) Noise will not exceed 2 mV in 600 ohms. (3 mV above 4 kc/s).

(5) Amplifiers: 1. Gain limited to render crosstalk unintelligible.

2. No spurious oscillations must occur, irrespective of magnitude or angle ($\pm 90^{o}$) of the attachment to the line.

	DATE	NAME
Orig.	20-11-69.	R.GAN.
Amend.		

REMOTE SEISMIC RECORDING SOT-1

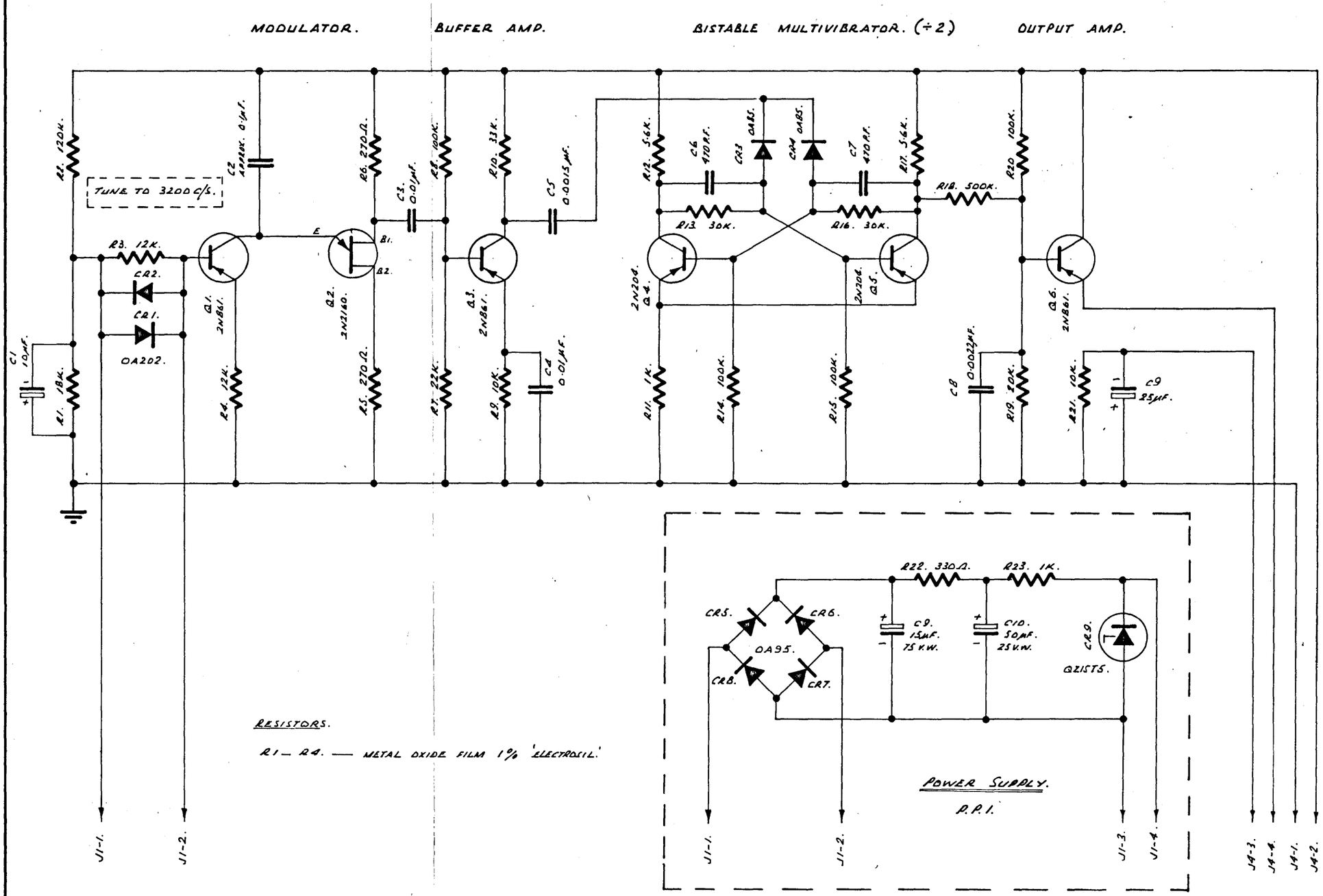
DRAWING LIST.

SHEET Nº.

1. ____ DRAWING LIST.
2. ____ MODULATOR SCHEMATIC.
3. ____ DEMOD. & MOD. & POWER SUPPLY CARD & WIRING LAYOUT.
4. ____ " SCHEMATIC.
5. ____ " FRONT PLATE DRILLING DETAILS.
6. ____ MODULATOR CHASSIS WIRING.
7. ____ DEMOD. FRONT PLATE ENGRAVING DETAIL.
8. ____ MOD. & DEMOD. BACK PLATE DRILLING DETAILS.
9. ____ " " RIGHT HAND SIDE PLATE.
10. ____ " " LEFT " " " .
11. ____ " " TRANS. MOUNTING PLATES & CROSS BAR DRILLING DETAILS.
12. ____ " " CHASSIS COVER CONSTRUCTION DETAILS.
13. ____ " " CHASSIS LAYOUT.
14. ____ MOD. FRONT PLATE DRILLING DETAILS.
15. ____ " " " ENGRAVING " .
16. ____ DEMOD. CHASSIS WIRING DIAGRAM.

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS	Drawing No. SOT SH.1	INSTRUMENT REMOTE SEISMIC RECORDING. DRAWING LIST.

	DATE	NAME
Orig.	14-8-64.	R. GAN.
Amend.	18-11-64.	R. GAN.

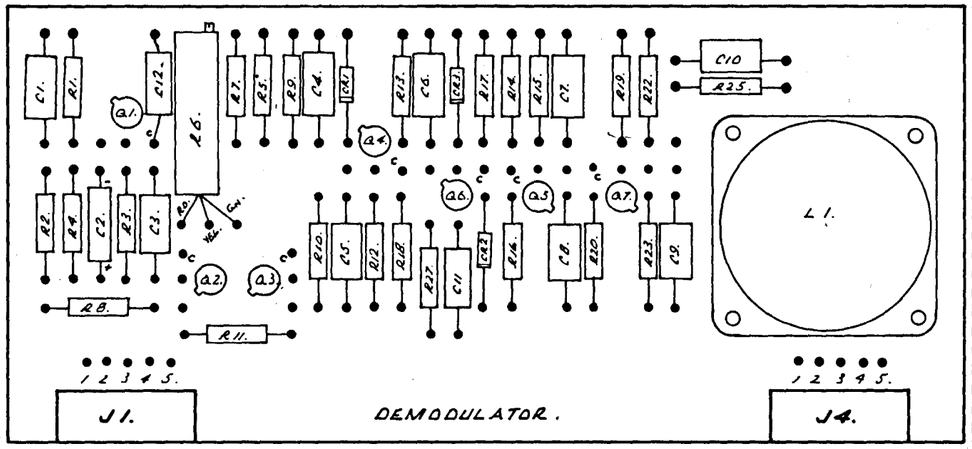


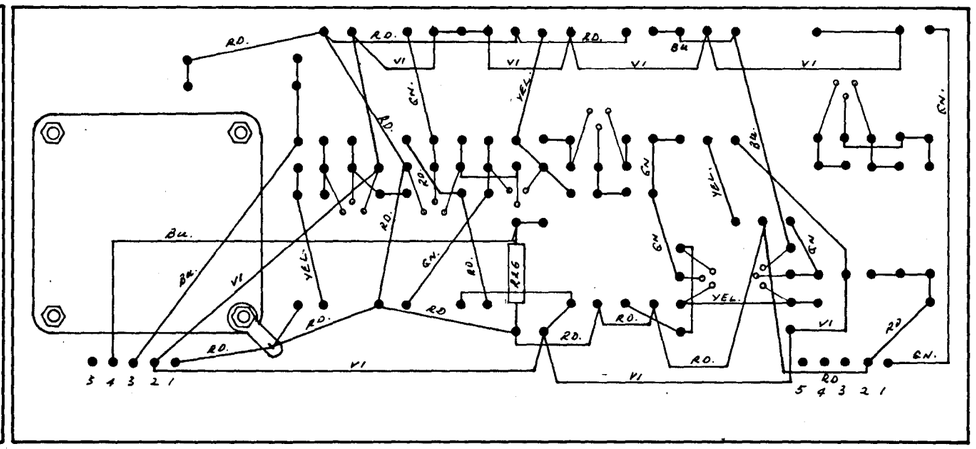
RESISTORS.

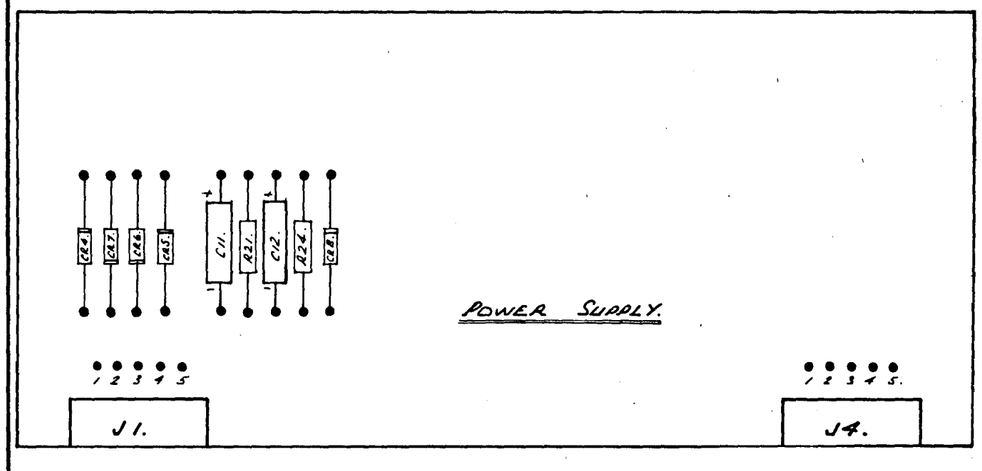
R1 – R4. — METAL OXIDE FILM 1% 'ELECTROSIL.'

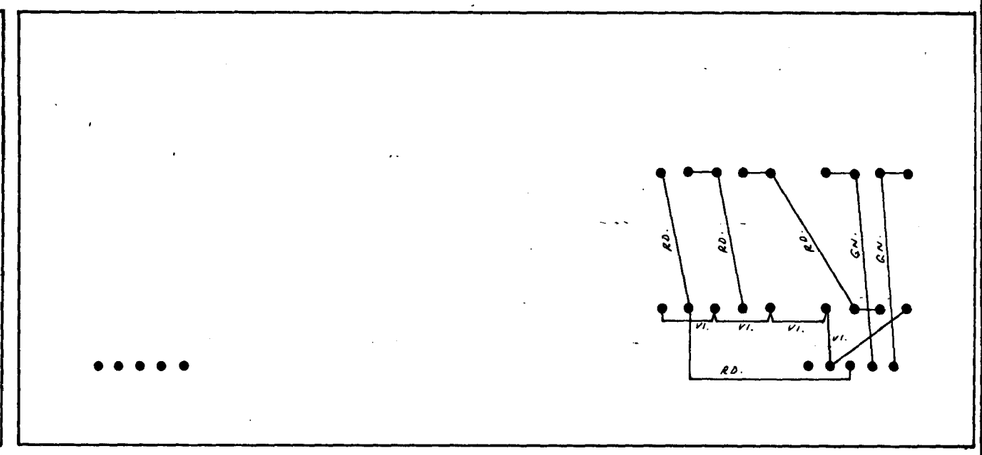
BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS	Drawing No. SOT. SH.2	INSTRUMENT MODULATOR. M.D.I. SCHEMATIC.

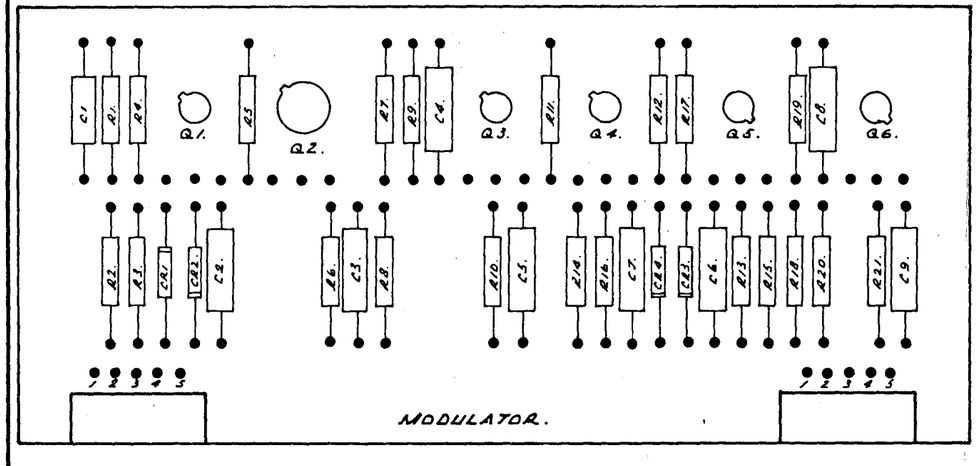
	DATE	NAME
Orig.	18-8-64.	R. GAN.
Amend.	12-11-69.	R. GAN.

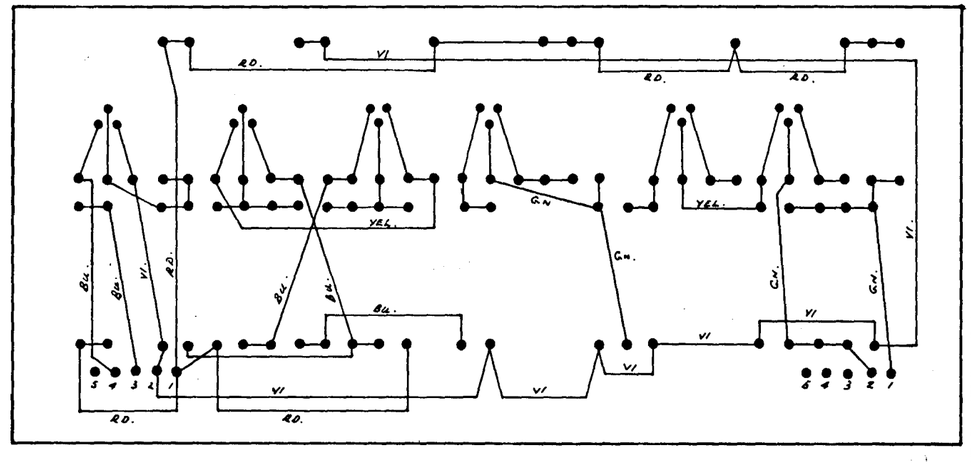








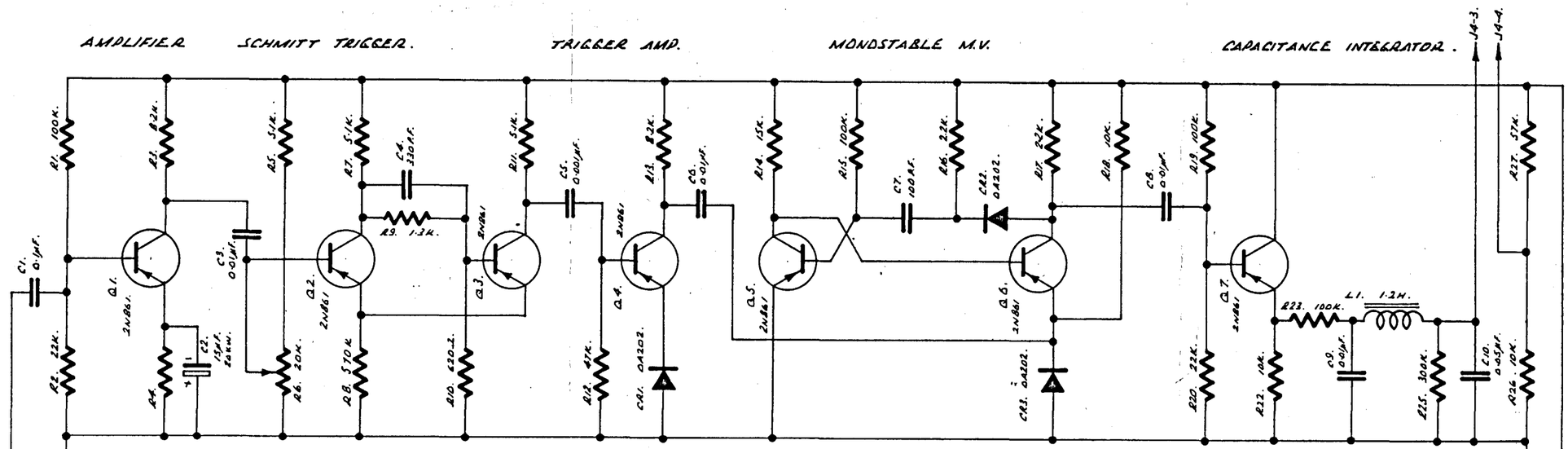




BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS	Drawing No. SOT. SH.3.	INSTRUMENT MODULATOR, DEMODULATOR & POWER SUPPLY. CARD & WIRING LAYOUT.

	DATE	NAME
Orig.	19-8-64.	R.G.AN.
Amend.		

AMPLIFIER. SCHMITT TRIGGER. TRIGGER AMP. MONOSTABLE M.V. CAPACITANCE INTEGRATOR.

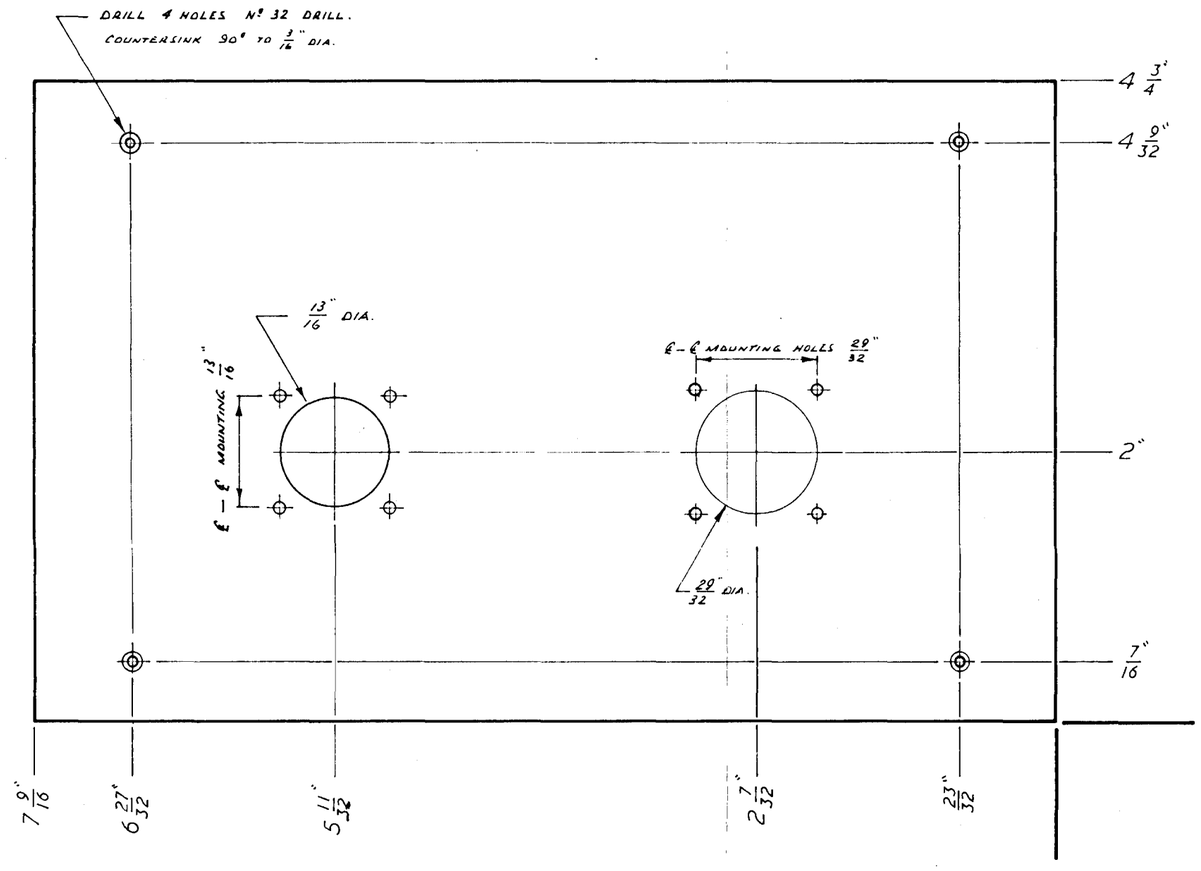


TRANSISTORS.
Q1 — Q7 TYPE 2N861.

POWER SUPPLY.

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS	Drawing No. SOT. SH. 4.	INSTRUMENT DEMODULATOR. DL. 1 SCHEMATIC.

	DATE	NAME
Orig.	20-8-64.	R. GAN.
Amend.	19-11-64.	R. GAN.



MATERIAL.

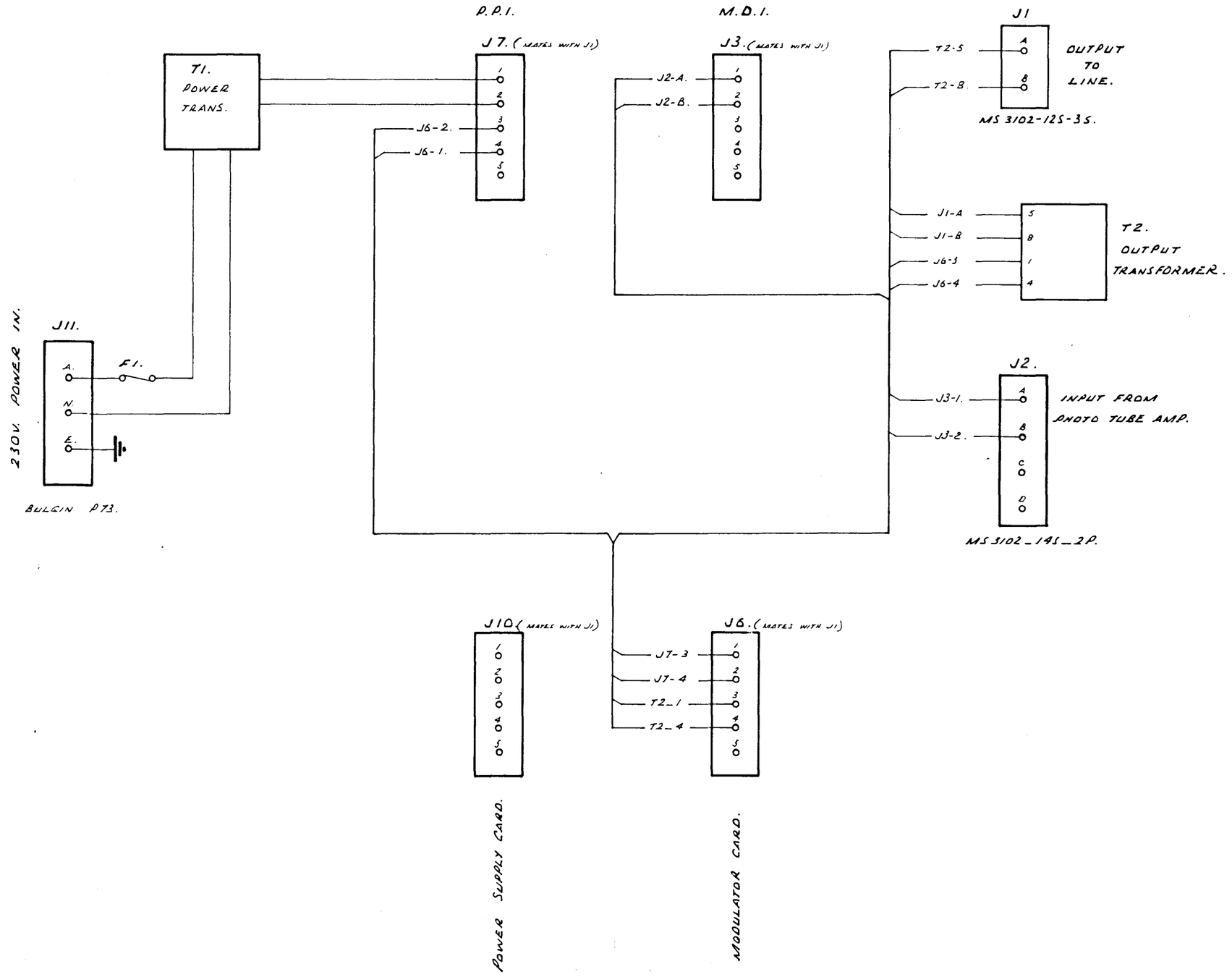
10 S.W.G. ALUMINIUM.

FINISH.

ANODISE MATT BLACK.

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS	Drawing No. SOT. SH. 5.	INSTRUMENT DEMODULATOR. MD1. FRONT PLATE DRILLING DETAILS.

	DATE	NAME
Orig.	20-8-64.	R. GAN.
Amend.		



BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS	Drawing No. SOT. SH. 6.	INSTRUMENT MODULATOR. CHASSIS WIRING DIAGRAM.

	DATE	NAME
Orig.	21-8-64.	R.GAN.
Amend.	19-11-64.	R.GAN.

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DEMODULATOR
SOT-2

LINE

RECORDER

BUREAU OF MINERAL RESOURCES
GEOLOGY AND GEOPHYSICS.

MATERIAL.

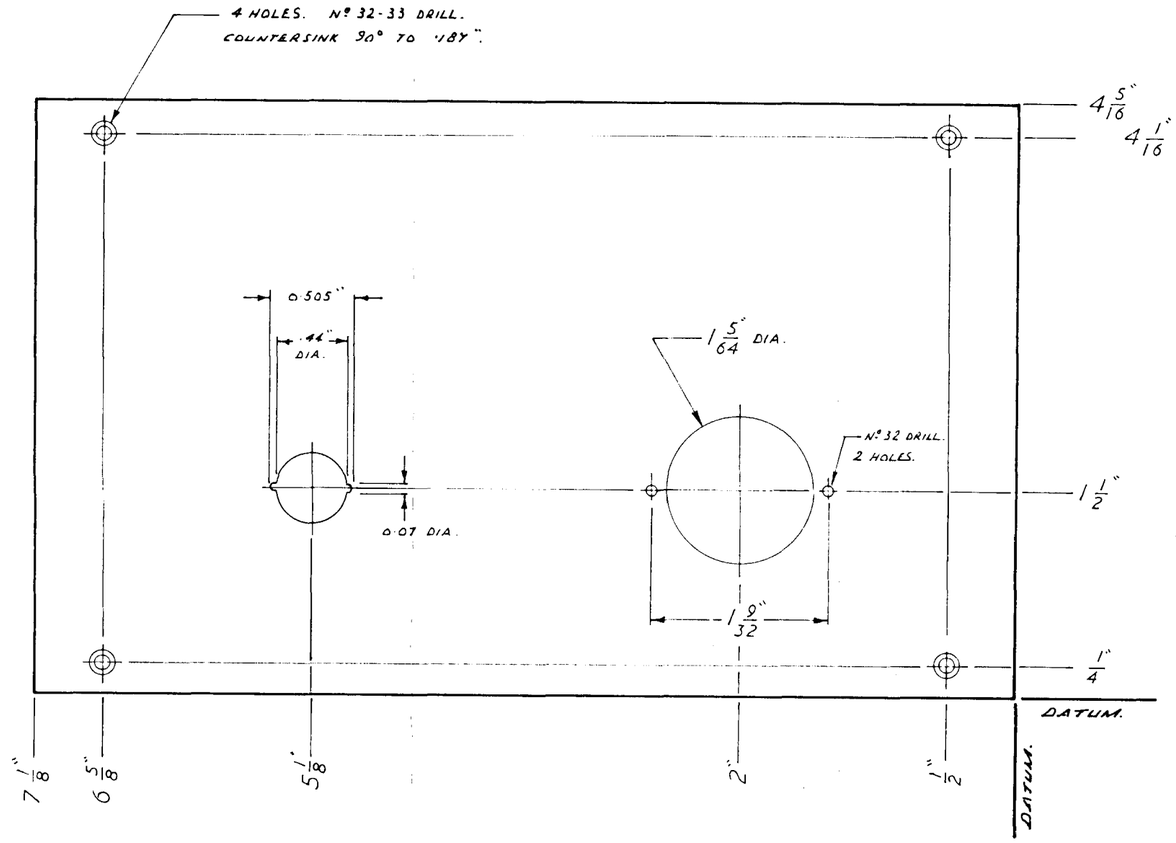
10 S.W.G. ALUMINIUM.

FINISH.

ANODISE MATT BLACK.

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS	Drawing No. SOT. SH.7.	INSTRUMENT DEMODULATOR. FRONT PLATE ENGRAVING DETAILS.

	DATE	NAME
Orig.	21-8-64.	R. GAN.
Amend.		



MATERIAL.

10 S.W.G. ALUMINIUM.

FINISH.

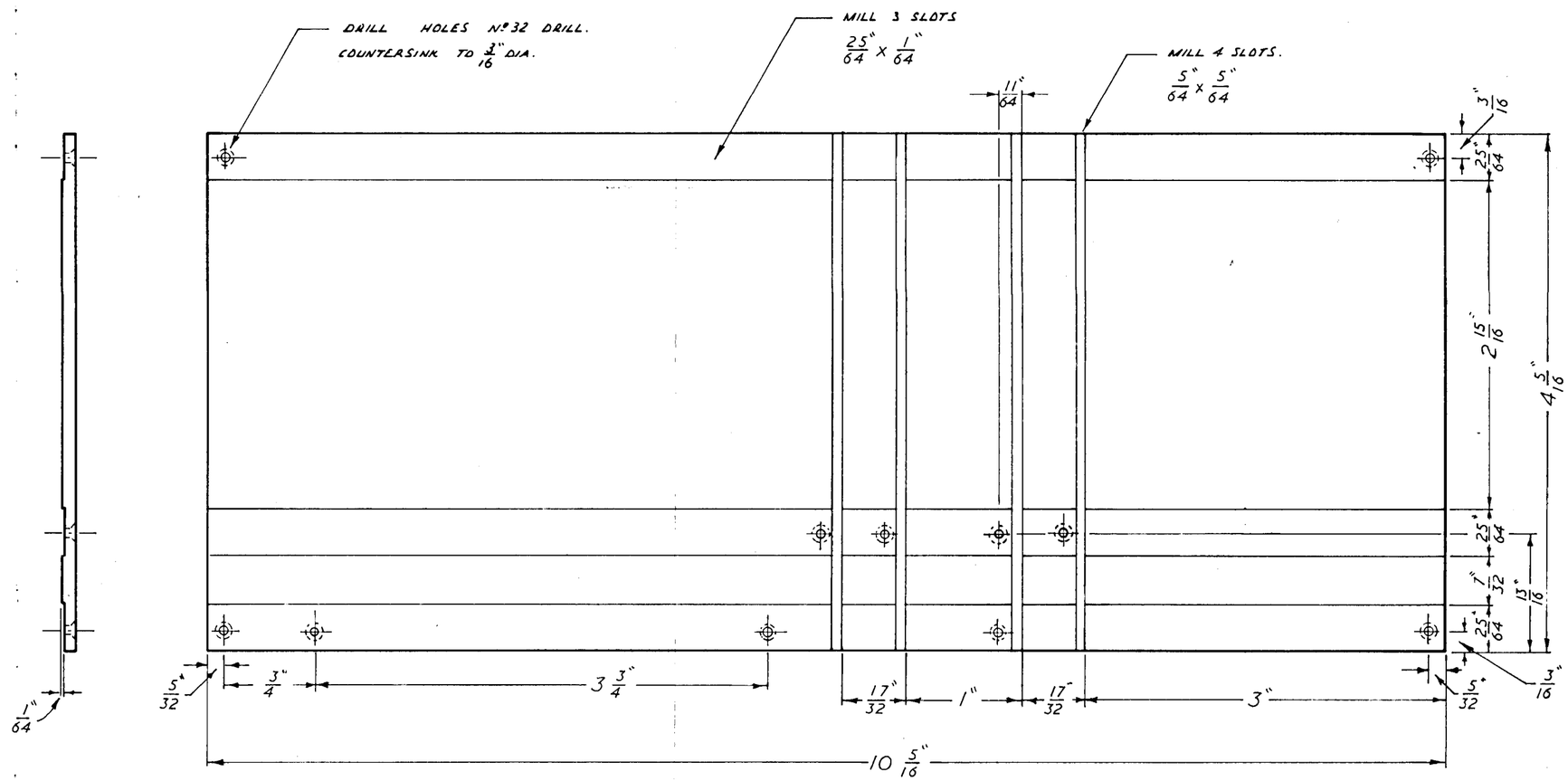
ANODISE MATT BLACK.

TOLERANCE.

0.005" ALL DIMENSIONS.

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS	Drawing No. SOT. SH.8.	INSTRUMENT AND MODULATOR DEMODULATOR. BACK PLATE DRILLING DETAILS.

	DATE	NAME
Orig.	25-8-64.	R. CAN.
Amend.	23-9-64.	R. CAN.



MATERIAL.

10 S.W.G. ALUMINIUM.

FINISH.

ANODISE MATT BLACK.

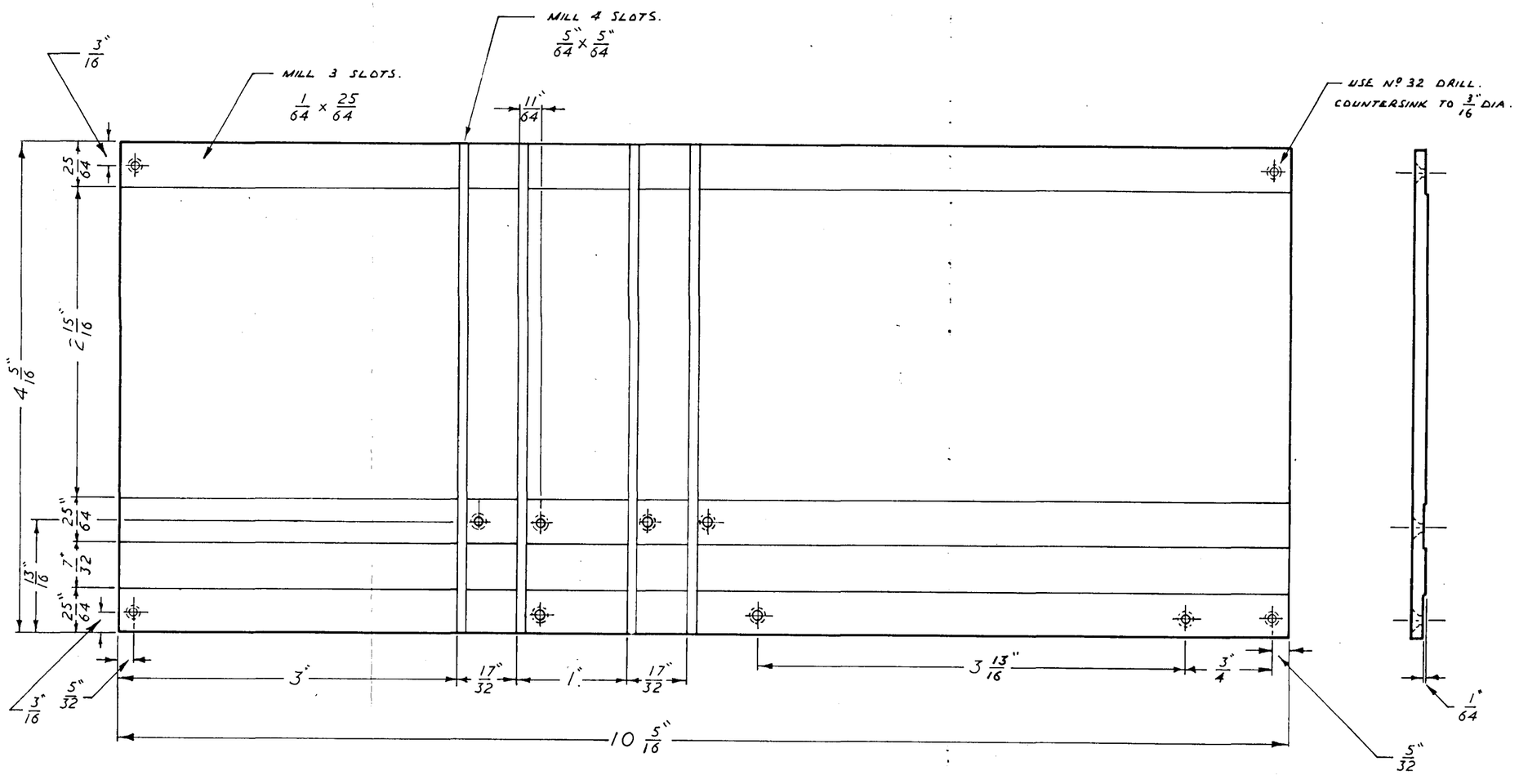
TOLERANCE.

0.005 ALL DIMENSIONS.

NOT TO SCALE.

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS	Drawing No. SOT. SH. 9.	INSTRUMENT MODULATOR AND DEMODULATOR. RIGHT HAND SIDE PLATE.

	DATE	NAME
Orig.	24-8-64.	R. GAN.
Amend.	23-9-64.	R. GAN.



MATERIAL.

10 SWG ALUMINIUM.

FINISH.

ANODISE MATT BLACK.

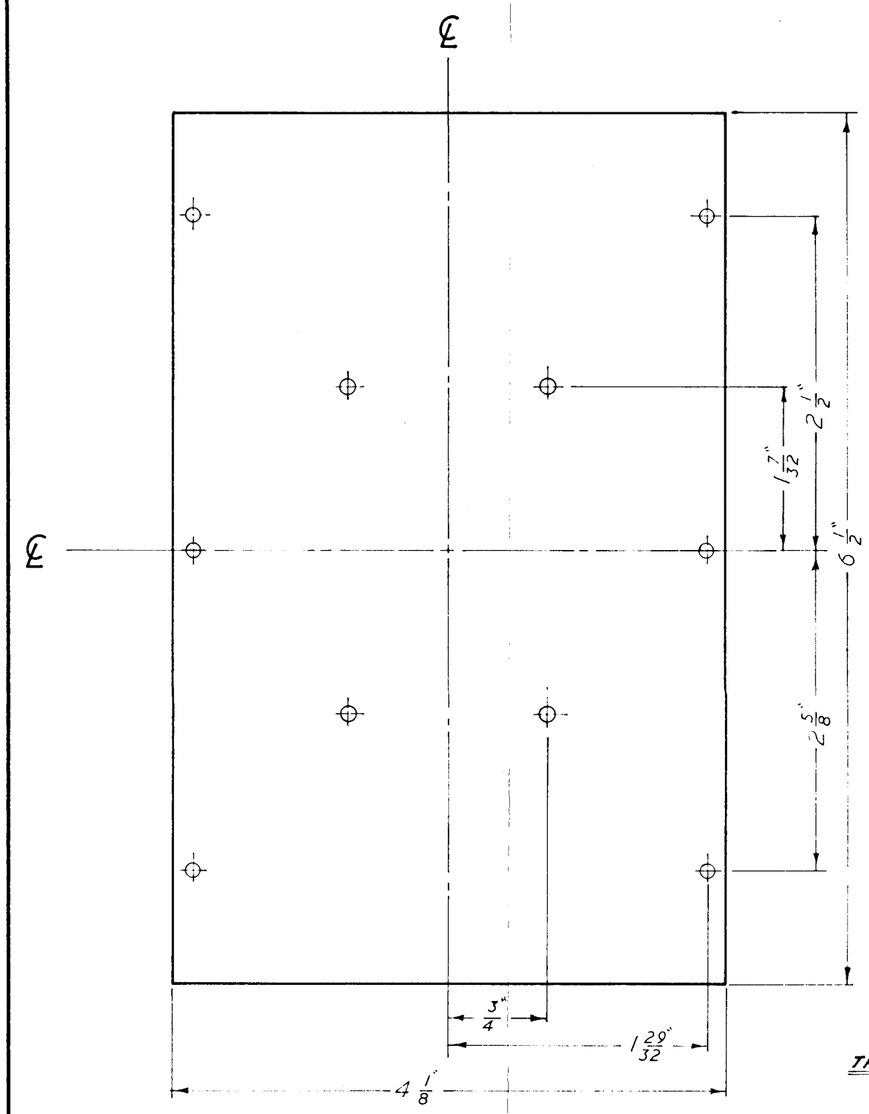
TOLERANCE.

0·005" ALL DIMENSIONS.

NOT TO SCALE.

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS	Drawing No. SOT. SH.10.	INSTRUMENT AND MODULATOR DEMODULATOR. LEFT HAND SIDE PLATE.

	DATE	NAME
Orig.	26-8-64.	R. GAN.
Amend.		



MATERIAL.

16 S.W.G. ALUMINIUM.

FINISH.

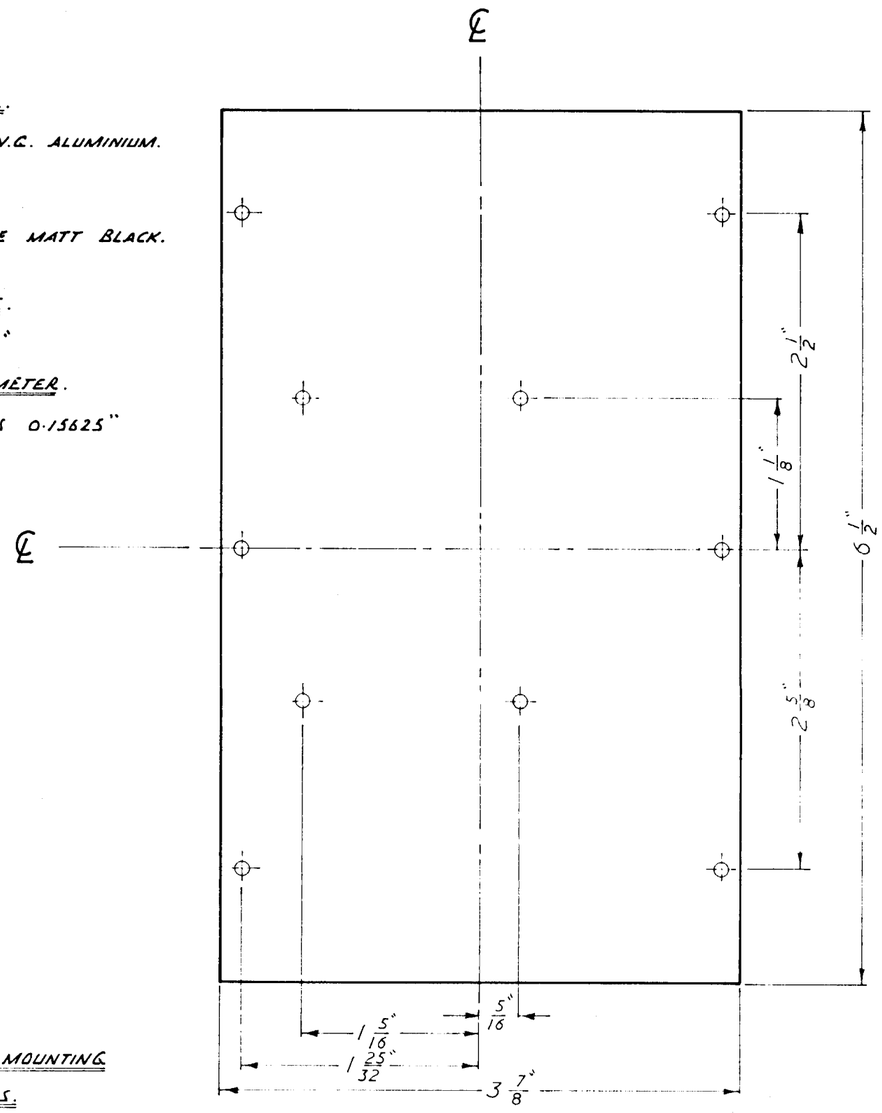
ANODISE MATT BLACK.

TOLERANCE.

0.005"

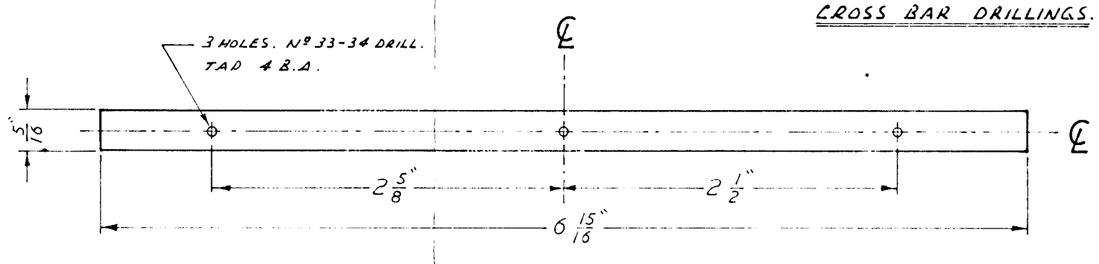
HOLE DIAMETER.

ALL HOLES 0.15625"



TRANSFORMER MOUNTING PLATES.

CROSS BAR DRILLINGS.



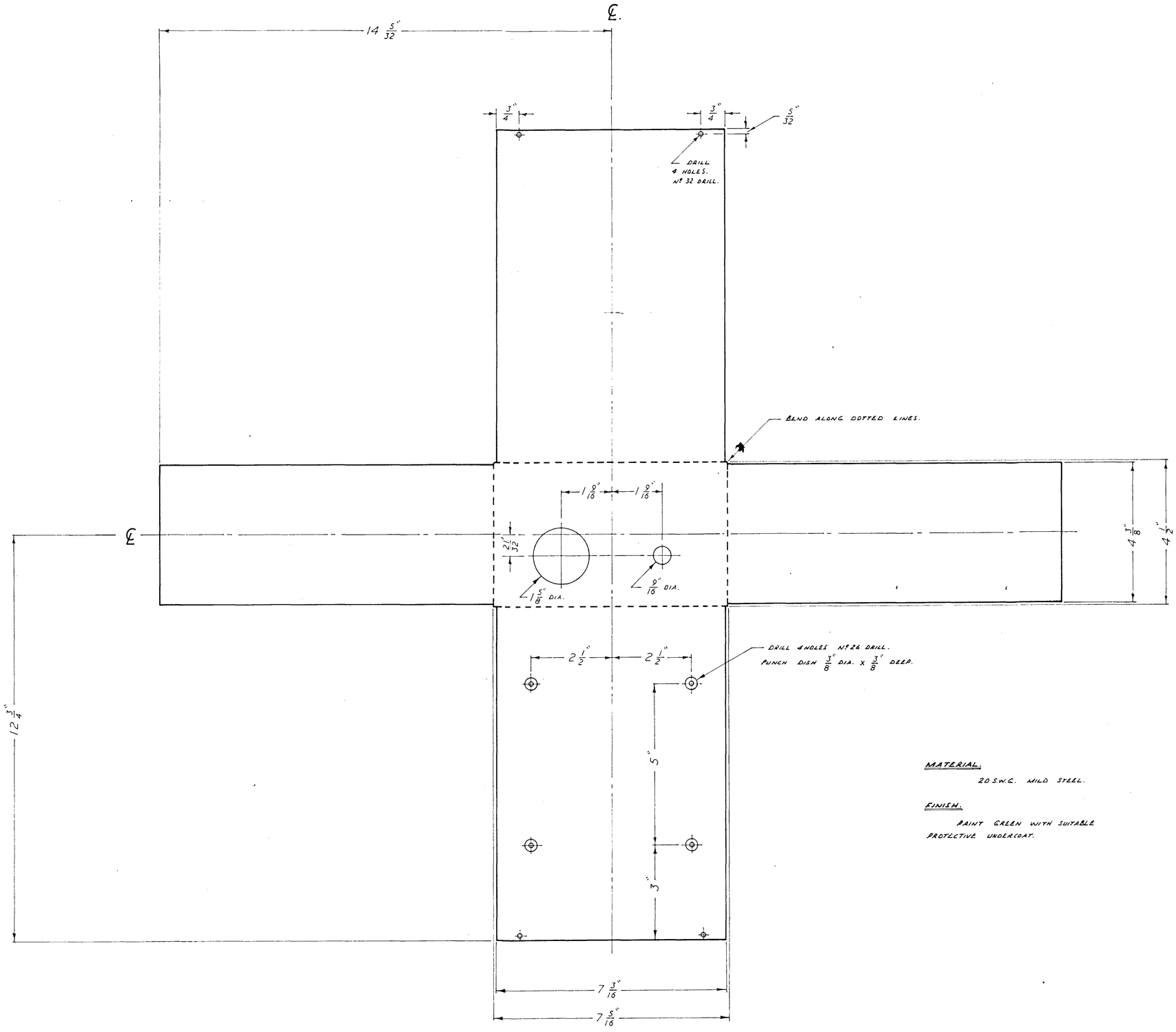
MATERIAL SUPPLIED.

2 OFF.

TOLERANCE.

0.005".

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS	Drawing No. SOT. SH.11.	INSTRUMENT MODULATOR AND DEMODULATOR. TRANSFORMER MTG. PLATES & CROSS BAR DRILLING DETAILS.



MATERIAL.

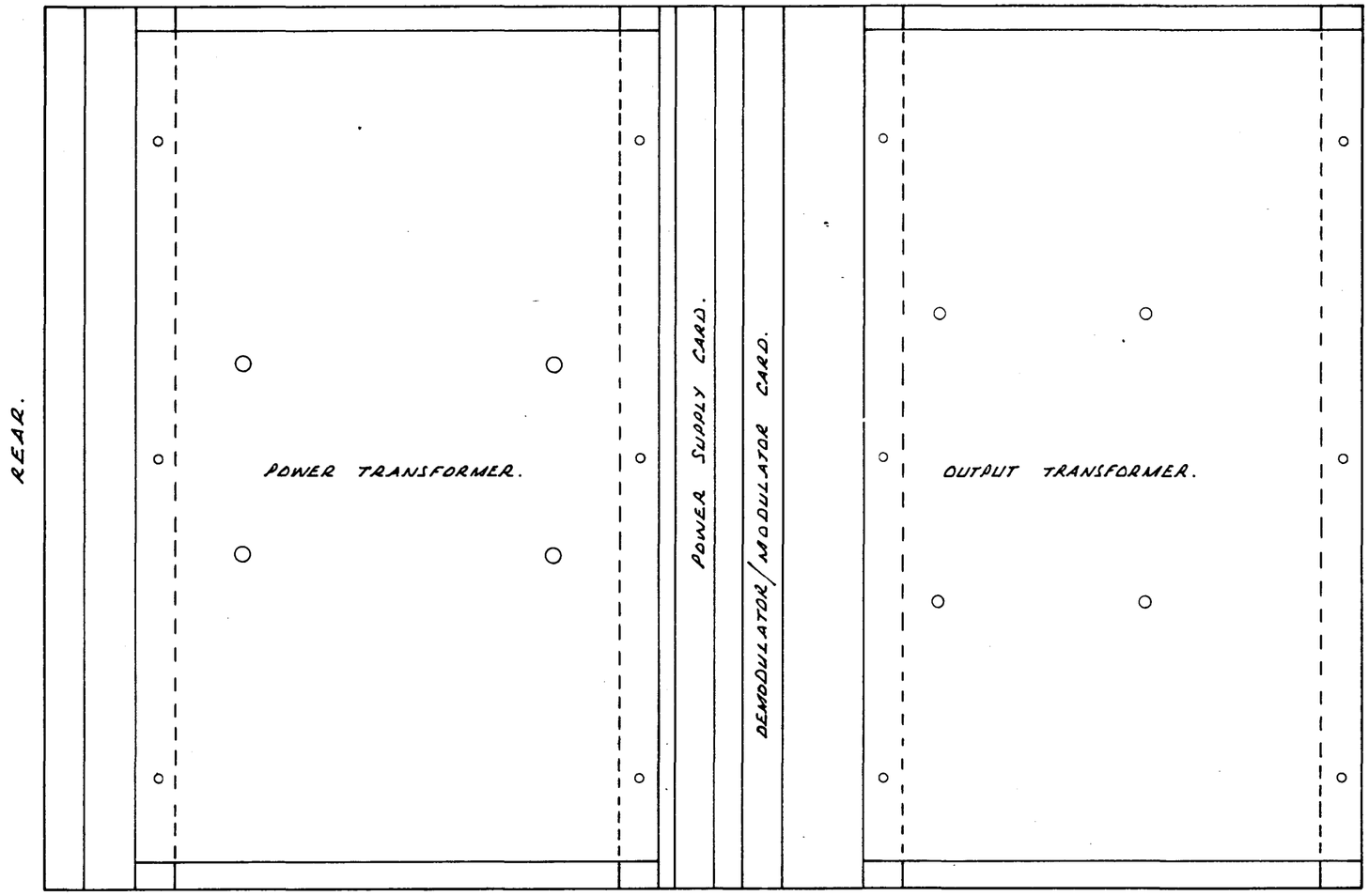
20 S.W.G. MILD STEEL.

FINISH.

PAINT GREEN WITH SUITABLE PROTECTIVE UNDERCOAT.

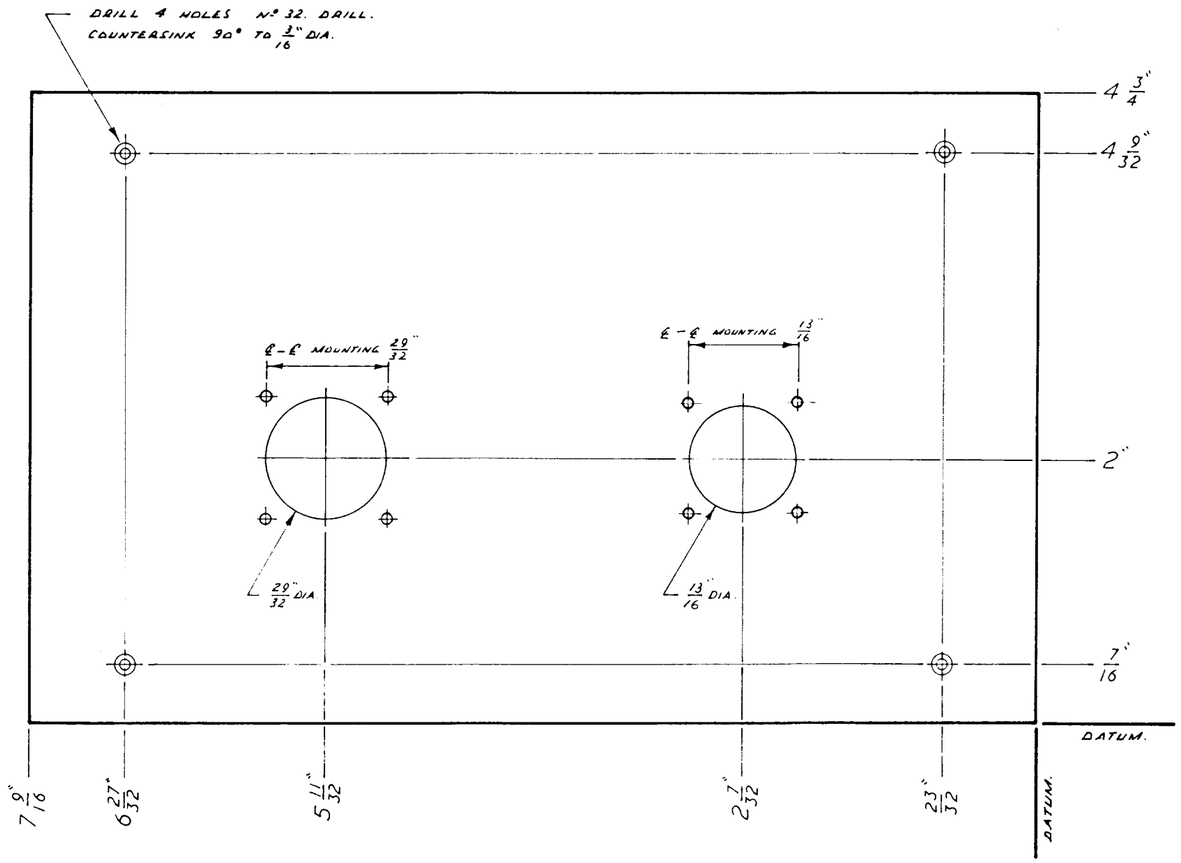
BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS 485 BOURKE STREET, MELBOURNE, VICTORIA GEOPHYSICAL LABORATORIES, FOOTSCRAY	MATERIAL	DATE 24-8-64.	INSTRUMENT MODULATOR AND DEMODULATOR. CHASSIS COVER CONSTRUCTION DETAILS.	DRAWING No. SOT. SH 12.
	SCALE HALF FULL SIZE.	NAME A.GAN.		

	DATE	NAME
Orig.	26-8-64.	R. GAN.
Amend.		



BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS	Drawing No. SOT. SH.13.	INSTRUMENT AND MODULATOR DEMODULATOR. CHASSIS LAYOUT.

	DATE	NAME
Orig.	20-8-64.	R. CAN.
Amend.	19-11-64.	R. CAN.



MATERIAL.

10 S.W.G. ALUMINIUM.

FINISH.

ANODISE MATT BLACK.

TOLERANCE.

0.005".

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS	Drawing No. SOT. SH.14.	INSTRUMENT MODULATOR. FRONT PANEL DRILLING DETAILS.

	DATE	NAME
Orig.	26-8-64.	R. CAN.
Amend.	19-11-60.	R. CAN.

℄

MODULATOR
SOT-1

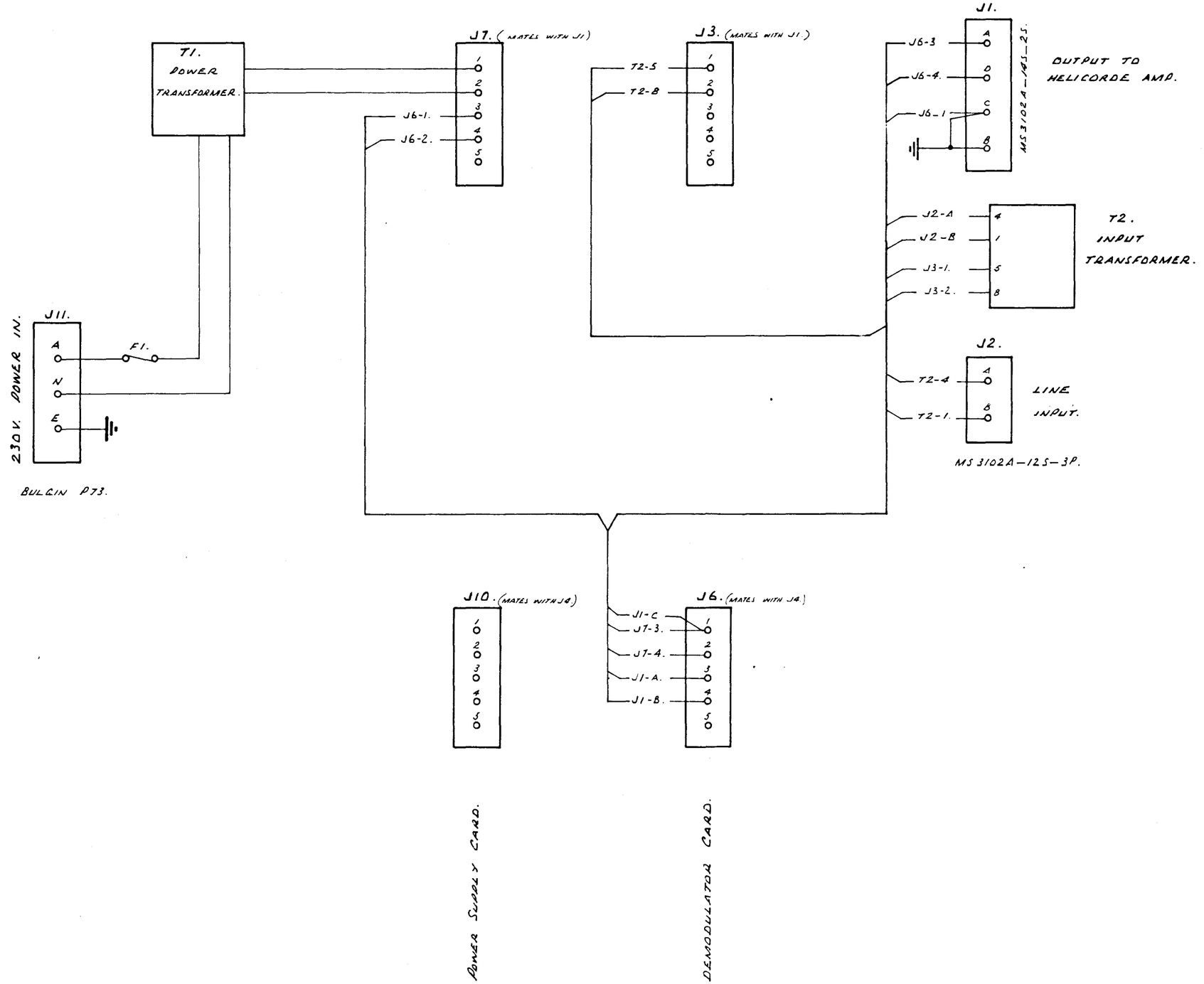
PHOTOTUBE
AMP

LINE

BUREAU OF MINERAL RESOURCES
GEOLOGY AND GEOPHYSICS

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS	Drawing No. SOT. SH. 15.	INSTRUMENT MODULATOR. FRONT PANEL ENGRAVING DETAIL.

	DATE	NAME
Orig.	27-8-64.	R. CAN.
Amend.	19-11-64	R. CAN.



BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS	Drawing No. SOT. SH.16.	INSTRUMENT DEMODULATOR. CHASSIS WIRING DIAGRAM.