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Colin Hinson

In the village of Blunham, Bedfordshire, UK.

116E-0231-1

TRANSMITTER, TYPES T10158, T10158A, T16719, T10158B, T16719A (MARCONI HS31 (MODIFIED), HS31A, HS31/I AND HS31A/I)

GENERAL AND TECHNICAL INFORMATION

BY COMMAND OF THE DEFENCE COUNCIL

?T.Dunntt

(Ministry of Defence)

FOR USE IN THE ROYAL AIR FORCE

(Prepared by the Ministry of Technology)

TRANSMITTER, TYPES T.10158, T.10158A, T.16719, T.10158B, T.16719A

(MARCONI 3.5 kW H.F. I.S.B. TELEGRAPH/TELEPHONE TRANSMITTER TYPES HS31, HS31 (Modified), HS31A, HS31/1 AND HS31A/1)

A.P.116E-0231-1 (Was A.P.2922D VOL.1) 2nd Edition

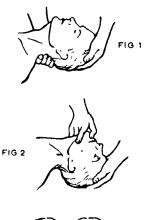
FIRST AID IN CASE OF ELECTRIC SHOCK

DO NOT TOUCH THE VICTIM WITH YOUR BARE HANDS until the circuit is broken SWITCH OFF. If this is not possible, PROTECT YOURSELF with dry insulating material and pull the victim clear of the conductor.

THE EXPIRED AIR METHOD OF ARTIFICIAL RESPIRATION

(Approved by the Royal Life Saving Society)

- 1. Lay the patient on his back with his arms to his sides. If on a slope have the stomach slightly lower than the chest. Make a brief inspection of the mouth and throat to ensure that they are clear of obvious obstruction.
- Kneel on one side of the patient level with his head, place one hand under his neck and the other on top of his head. (Fig. 1).
 LIFT THE NECK AND TILT THE HEAD BACK AS FAR AS POS-SIBLE.
- 3. Move the hand from under the neck and place it on the chin of the patient, the thumb between the chin and mouth, the index finger along the line of the jaw, the remaining fingers curled. (Fig. 2). Whilst positioning the patient, open your mouth and take deep breaths.
- 4. Using the thumb of the hand on the chin to keep the lips sealed, open your mouth wide and make a seal round the patient's nose and blow into it. (Fig. 3).
- 5. After blowing, turn your head to observe the rise of the chest. (Fig. 4). If no air enters the patient's lungs, the nose may be blocked and the mouth should be opened using the hand on the chin; open your mouth wide and making a seal round his mouth blow into it. Turn the head to observe the chest rise. This may be used as an alternative to blowing into the nose even when the nose is not blocked but the nose must be sealed either with the cheek or by moving the hand from the top of the head and pinching the nostrils. THE HEAD MUST BE KEPT AT FULL BACKWARDS TILT.
- Start with ten quick deep breaths and then continue at the rate of twelve to fifteen breaths per minute. This should be continued until the patient revives or a doctor certifies death.
- In the case of facial injuries it may be necessary to do a manual method of artificial respiration. (Holger Nielsen).
- It is ESSENTIAL to commence artificial respiration without delay and to send for medical assistance immediately.







TREATMENT FOR BURNS

If the patient is also suffering from burns, then, without hindrance to artificial respiration, observe the following:-

- (a) DO NOT ATTEMPT TO REMOVE CLOTHING ADHERING TO THE BURN.
- (b) If help is available or as soon as artificial respiration is no longer required the wound should be covered with a DRY dressing.
- (c) Oil or grease in any form should NOT be applied.

Further details of charts and books on artificial respiration may be obtained from:The Royal Life Saving Society, 14 Devonshire Street, Portland Place, London, W.1.

UNIT COMPOSITION OF EQUIPMENTS

				MITTER NSN 0-99-		
NSN and UNIT IDENTITY	933–2372 (T10158)	933-2182 & 622-8256 (T10158A)	933–2195 (T10158B)	933–2187 (T16719)	222-3831 (ex.T16719)	933–2199 (T16719A)
5820-99-622-8255 Control Power Supply		*				
5820999332183 Control Power Supply	*	*				
5820-99-933-2221 Control Power Supply			*			
5820-99-933-2168 Control Power Supply				*	*	
5820-99-933-2914 Control Power Supply						*
5820-99-971-7078 Power Supply	*	*		*	*	
5820-99-933-2171 Power Supply			*			*
5820-99-933-2222 Power Supply	*	*		*	*	
5820-99-933-2221 Power Supply			*			
5820-99-933-2915 Power Supply						*
5950-99-933-2188 R.F. Unit	*					
5950-99-933-2196 R.F. Unit			*			
5950-99-933-2217 R.F. Unit						*
5950-99-933-2169 R.F. Unit				*	*	
5950-99-933-2179 R.F. Unit		*				
5820-99-971-2012 Mixer Stage Frequency	*	*				
5820-99-933-2197 Mixer Stage Frequency			*			

UNIT COMPOSITION OF EQUIPMENTS (Cont.)

		TRANSMITTER NSN 5820–99–					
NSN and UNIT IDENTITY	933–2372 (T10158)	933-2182 & 622-8256 (T10158A)	933–2195 (T10158B)	933–2187 (T16719)	222–3831 (ex.T16719)	933–2199 (T16719A)	
5820-99-933-2200 Mixer Stage Frequency						*	
5820-99-933-2218 Mixer Stage Frequency				*			
5820-99-222-3833 Mixer Stage Frequency					*		
5820999712020 Amplifier R.F.	*	*					
5820-99-933-2913 Amplifier R.F.						*	
5820999332207 Amplifier R.F.			*				
5820-99-933-2181 Amplifier R.F.				*	*		

MODIFICATION STATE OF THE EQUIPMENT

Modification Record Labels are fitted to the units of the equipment listed below. Embodiment of a modification is indicated by scoring through the relevant number on the appropriate label.

Where the modification state has not been established at the date of issue of the manual then the date of issue of this page defines the design state.

The amendment state of this manual is related to the modification state of the equipment. To ensure that this relationship may be determined at any time, the following table is re-issued with successive amendments to the manual.

Mod. Summary Page	Unit or Sub-unit Title	Modification State of Unit or Sub-unit Related to Amendment State of Manu			_							
А	Control Power Supply Type S28/1 5820-99-933-2183	5	5	5	7							
В	Control Power Supply Type S28/2 5820-99-933-2221	3	3	3	5							
С	Control Power Supply Type S28/3 5820-99-933-2168	5	5	5	7							
D	Control Power Supply Type S28/4 5820-99-933-2914	3	3	3	5							
E	Power Supply 5820–99–971–7078	1	1	1	1							
F	Power Supply Type S62/2 5820-99-933-2171	4	4	4	4							
G	Power Supply Type S62/3 5820-99-933-2222	4	4	4	4							
Н	Power Supply Type S65/1 5820-99-933-2221	1	1	1	1							
J	Power Supply Type S65/2 5820-99-933-2915	1	1	1	1		- 46.00	mediated by a granted	1	,		i
К	R.F. Unit Type S2/1 5950-99-933-2188	7	7	7	7							
L	R.F. Unit Type S2/2 5950-99-933-2196	2	2	2	3							
M	R.F. Unit Type S2/3 5950–99–933–2217	3	3	3	3							
N	R.F. Unit Type S2/4 5950-99-933-2169	9	9	9	9							
	Amendment State of Manual	6	7	8	9							

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MODIFICATION STATE (Continued)

Mod. Summary Page	Unit or Sub-unit Title	1				n S Ame				-
Р	R.F. Unit Type S2/5 5950—99—933—2179	7	7	7	8					
a	Mixer Stage Frequency 5820-99-971-2012	3	3	3	3					
R	Mixer Stage Frequency Type S4/2 5820-99-933-2197	1	1	1	1					
S	Mixer Stage Frequency Type S4/3 5820-99-933-2200	1	1	1	1					
т	Mixer Stage Frequency Type S4/5 5820-99-933-2218	2	2	2	2					
U	Mixer Stage Frequency 5820—99—222—3833	0	0	0	0					
٧	Amplifier R.F. 5820-99-971-2020	4	4	4	4					
w	Amplifier R.F. Type S37/1 5820-99-933-2913	1	1	1	1					The state of the s
x	Amplifier R.F. Type S37/2 5820-99-933-2207	2	2	2	2					
Y	Amplifier R.F. Type S37/3 5820-99-933-2181	3	3	3	3				-	
Z	Indicator Output Power 5985–99–933–3337	_	_	-	-					
AA	Control Power Supply 5820996228255	-	_	0	2					
	Amendment State of Manual	6	7	8	9					

Control Power Supply Type S28/1 5820-99-933-2183

modified.		
Mod. Strike-off	Summary of Modification	Reason
1	RMC. Mod.6272. Removal of redundant	Existing valve
	h.t. overload relays and improvement in valve protection relays.	protection inadequate.
2	RMC. Mod.6615. Replaces existing lamps by lamps with tungsten filaments.	To improve longevity.
3	RMC. Mod.9108. Retrospective provisioning and application of identity and modification labels.	To record reference identities and mod. strike-offs.
ŽĮ.	RMC. Mod.9785. Modification to achieve bias control and backfire indication.	Reduces repair time after failure.
5	RMC. Mod.0109. Metal rectifier MRl repositioned to facilitate removal of Ventaxia fan.	Improved servicing.
6	Mod. A.3978. Fitting, on failure, of a replacement type fan assembly having ball bearings and access for external lubrication.	Bearing seizure has caused burn out of motor of fan assemblies used for air cooling on control power supply cabinet.
7	Mod. A.4745. Replacement contactor.	Old type unobtainable.

Control Power Supply Type S28/2 5820-99-933-2221

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modified.		
Mod. Strike-off	Summary of Modification	Reason
1	RMC. Mod.9110. Retrospective provisioning and application of identity and modification record labels.	To record reference identities and mod. strike-offs.
2	RMC. Mod.9785. Modification to achieve bias control and backfire indication.	Reduces repair time after valve failure.
3	RMC. Mod.0109. Metal rectifier MRl repositioned to facilitate removal of Ventaxia fan.	Improved servicing.
<u>}</u>	Mod. A.3978. Fitting, on failure, of a replacement type fan assembly having ball bearings and access for external lubrication.	Bearing seizure has caused burn out of motor of fan assemblies used for air cooling of control power supply cabinet.
5	Mod. A.4745. Replacement contactor.	Old type unobtainable.

Control Power Supply Type S28/3 5820-99-933-2168

modified.		
Mod. Strike-off	Summary of Modification	Reason
1	RMC. Mod.6272. Removal of redundant h.t. overload relays and improvement in valve protection relays.	Existing valve protection inadequate.
2	RMC. Mod.6615. Replaces existing lamps by lamps with tungsten filaments.	To improve longevity.
3	RMC. Mod.9109. Retrospective provisioning and application of identity and modification record labels.	To record reference identities and mod. strike-offs.
)	RMC. Mod.9785. Modification to achieve bias control and backfire indication.	Reduces repair time after valve failure.
5	RMC. Mod.0109. Metal rectifier MRI repositioned to facilitate removal of Ventaxia fan.	Improved servicing.
6	Mod.3978. Fitting, on failure, of a replacement type fan assembly having ball bearings and access for external lubrication.	Bearing seizure has caused burn out of motor of fan assemblies used for air cooling of control power supply cabinet.
7	Mod. A.4745. Replacement contactor.	Old type unobtainable.
)

Control Power Supply Type S28/4 5820-99-933-2914

modified.		
Mod. Strike-off	Summary of Modification	Reason
1	RMC. Mod.9111. Retrospective provisioning and application of identity and modification record labels.	To record reference identities and mod. strike-offs.
2	RMC. Mod.9785. Modification to achieve bias control and backfire indication.	Reduces repair time after valve failure.
3	RMC. Mod.0109. Metal rectifier MR1, repositioned to facilitate removal of Ventaxia fan.	Improved servicing.
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Mod. A.3978. Fitting, on failure, of a replacement type fan assembly having ball bearings and access for external lubrication.	Bearing seizure has caused burn out of motor of fan assemblies used for air cooling of control power supply cabinet.
5	Mod. A.4745. Replacement contactor.	Old type unobtainable.

Power Supply 5820-99-971-7078

Mod. Strike-off	Summary of Modification	Reason
1	RMC. Mods.9108 and 9109. Retrospective provisioning and application of identity and modification record labels.	To record reference identities and mod. strike-offs.

Power Supply Type S62/2 5820-99-933-2171

Mod. Strike-off	Summary of Modification	Reason
1	RMC. Mod.6615. Various circuit changes (incorporated before delivery on certain units).	Improved protection and performance.
2	RMC. Mods.9110 and 9111. Retrospective provisioning and application of identity and modification labels.	To record reference identities and mod. strike-offs.
3	_	
4	RMC. Mod.9785. Modification to achieve bias control and backfire indication.	Reduces repair time after valve failure.

Power Supply Type S62/3 5820-99-933-2222

Strike-off	Summary of Modification	Reason
1	As RMC. Mod.6615. Various circuit changes (included before delivery).	Improved protection and performance.
2	RMC. Mods.9108 and 9109. Retrospective provisioning and application of identity and modification record labels.	To record reference identities and mod. strike-offs.
3	RMC. Mod.7424. Valve BR.191B replaced by Valve Type ACT.70.	Improved performance.
4	RMC. Mod.9785. Modification to achieve bias control and backfire indication.	Reduces repair time after valve failure.
,		

Power Supply Type S65/1 5820-99-933-2221

Mod. Strike-off	Summary of Modification	Reason
Strike-off	RMC. Mod.9110. Retrospective provisioning and application of identity and modification labels.	Reason To record reference identities and mod. strike-offs.

Power Supply Type S65/2 5820-99-933-2915

Mod. Strike-off	Summary of Modification	Reason
Mod. Strike-off	RMC. Mod.9111. Retrospective provisioning and application of identity and modification record labels.	To record reference identities and mod. strike-offs.

R.F. Unit Type S2/1 5950-99-933-2188

Mod.	Summary of Modification	Reason
Strike-off	,	
1	RMC. Mod.6565. Protection against over- heating and entry of dust by improved ventilation, filtering and sealing.	Improved reliability.
2	RMC. Mod.6615 (part). Improved method of adjustment of sliding contacts of the anode tuning assembly.	Improved performance.
3	_	_
4	RMC. Mod.7424. Valve Type BR.191B replaced by Valve Type ACT.70.	Improved performance.
5	RMC. Mod.8281. Improved spring contacts and guide wheels.	Improved reliability.
6	RMC. Mod.8282. Improved end-stops on manual control heads.	Improved reliability.
7	RMC. Mod.8978. Protection against damage by resonance.	Improved in production.
	RMC. Mod.9136. Changes identity to 'R.F. Unit, Type S2/5, 5950-99-933-2179'. Changes transmitter identity to T10158A. Provides an r.f. output to frequency measuring equipment.	_

R.F. Unit Type S2/2 5950-99-933-2196

A Summary of modifications to the above is given below. This summary is provided for information only, and does NOT constitute an authority to demand modification kits where the equipment held has not been modified.

Mod. Summary of Modification Reason Strike-off 1 RMC. Mod.9110. Retrospective To record reference provisioning and application of identities and mod. identity and modification record strike-offs. labels. 2 RMC. Mod.9138. Provides an output Improved facilities. for remote frequency measurement. Mod. No. A.4049. Resiting of the To accommodate 3 pick-up and capacitor assembly. further modifications in this area.

R.F. Unit Type S2/3 5950-99-933-2217

Summary of Modification	Reason
RMC. Mod.9111. Retrospective provisioning and application of identity and modification record labels.	To record reference identities and mod. strike-offs.
RMC. Mod.9140. Provides an r.f. output for remote frequency measurement.	Improved facilities.
RMC. Mod.1784. Transmitter Types T16719 and T16719A fitted with r.f. filter.	To eliminate overload and resonance.
	RMC. Mod.9111. Retrospective provisioning and application of identity and modification record labels. RMC. Mod.9140. Provides an r.f. output for remote frequency measurement. RMC. Mod.1784. Transmitter Types T16719 and T16719A fitted with

R.F. Unit Type S2/4 5950-99-933-2169

Mod. Strike-off	Summary of Modification	Reason
1	RMC. Mod.6565. Protection against overheating and entry of dust by improved ventilation, filtering and sealing.	Improved reliability.
2	RMC. Mod.6615. Improved methods of adjustment of sliding contacts of the anode tuning coil assembly.	Improved performance.
3	RMC. Mod.9109. Retrospective provisioning and application of identity and modification record labels.	To record reference identities and mod. strike-offs.
4	RMC. Mod.7424. Valve Type BR.191B replaced by Valve Type ACT.70.	Improved performance.
5	RMC. Mod.8281. Improved spring contacts and guide wheels.	Improved reliability.
6	RMC, Mod.8282. Improved end-stops on manual control heads.	Improved reliability.
7	RMC. Mod.8981. Protection against damage by resonance.	Incorporated in production.
8	RMC. Mod.9139. Provides an r.f. output to operate remote frequency measuring equipment.	Improved facilities.
9	RMC. Mod.1784. Transmitter Types T16719 and T16719A, fitted with r.f. filter.	To eliminate overload and resonance.

R.F. Unit Type S2/5 5950-99-933-2179

Summary of Modification	Reason
RMC. Mod.5358. Provides an output for remote frequency measurement.	Improved facilities.
RMC. Mod.6565. Protection against over-heating and entry of dust by improved ventilation, filtering and sealing.	Improved reliability
RMC. Mod.6615. Improved method of adjustment of sliding contacts of the anode tuning coil assembly.	Improved performance.
RMC. Mod.9108. Retrospective provisioning and application of identity and modification record labels.	To record reference identities and mod. strike-offs.
RMC. Mod.7424. Valve BR.191B replaced by Valve ACT.70.	Improved performance.
RMC. Mod.8281. Improved spring contacts and guide wheels.	Improved reliability.
RMC. Mod.8282. Improved end-stops on manual control heads.	Improved reliability.
Mod. No.A.4049. Resiting of the pick-up and capacitor assembly.	To accommodate further modifications in this area.
	RMC. Mod.5358. Provides an output for remote frequency measurement. RMC. Mod.6565. Protection against over-heating and entry of dust by improved ventilation, filtering and sealing. RMC. Mod.6615. Improved method of adjustment of sliding contacts of the anode tuning coil assembly. RMC. Mod.9108. Retrospective provisioning and application of identity and modification record labels. RMC. Mod.7424. Valve BR.191B replaced by Valve ACT.70. RMC. Mod.8281. Improved spring contacts and guide wheels. RMC. Mod.8282. Improved end-stops on manual control heads. Mod. No.A.4049. Resiting of the

Control Power Supply 5820-99-622-8255

mod	1	•	•	 ((-	

modified.		
Mod. Strike-off	Summary of Modification	Reason
1	Mod.A.3978. Fitting, on failure, of a replacement type fan assembly having ball bearings and access for external lubrication.	Bearing seizure has caused burn out of motor of fan assemblies used for air cool- ing of control power supply cabinet.
2	Mod.A.4745. Replacement contactor.	Old type unobtainable.
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<u> </u>	<u> </u>	<u> </u>

Mixer Stage Frequency 5820-99-971-2012

Mod. Strike-off	Summary of Modification	Reason
1	RMC. Mod.6615. Reduction of bias to afford protection from distortion due to fluctuating mains voltage. Elimination of parasitic oscillation.	Improved protection and performance.
2	RMC. Mod.9108. Retrospective provisioning and application of identity and modification record labels.	To record reference identities and mod. strike-offs.
3	RMC. Mod.8980. To provide protection against instabilities and drift. Valve Type CV138 replaced by Valve Type CV4014.	Improved performance and protection.

Mixer Stage Frequency Type S4/2 5820-99-933-2197

Mod. Strike-off	Summary of Modification	Reason
Mod. Strike-off	RMC. Mod.9110. Retrospective provisioning and application of identity and modification record labels.	Reason To record reference identities and mod. strike-offs.

Mixer Stage Frequency Type S4/3 5820-99-933-2200

Mod. Strike-off	Summary of Modification	Reason
1	RMC. Mod.9111. Retrospective provisioning and application of identity and modification record labels.	To record reference identities and mod. strike-offs.

Mixer Stage Frequency Type S4/5 5820-99-933-2218

Mod. Strike-off	Summary of Modification	Reason
1	RMC. Mod.6615. Reduction of bias to afford protection from distortion due to fluctuating mains voltage. Elimination of parasitic oscillation.	Improved protection and performance.
2	RMC. Mod.9109. Retrospective provisioning and application of identity and modification record labels.	To record reference identities and mod. strike-offs.
_	RMC. Mod.1312. Application of this modification changes the NSN to 5820-99-222-3833.	_

Amplifier R.F. 5820-99-971-2020

Mod. Strike-off	Summary of Modification	Reason
1	RMC. Mod.6565. Protection against overheating and ingress of dust.	Improved reliability.
2	RMC. Mod.6567. Provision of mixer level control.	Improved performance.
3	RMC. Mod.9108. Retrospective provisioning and application of identity and modification labels.	To record reference identities and mod. strike-offs.
4	RMC. Mod.8979. Protection against instabilities.	Introduced during production.

Amplifier R.F. Type S37/1 5820-99-933-2913

Mod. Strike-off	Summary of Modification	Reason
1	RMC. Mod.9111. Retrospective provisioning and application of identity and modification record labels.	To record reference identities and mod. strike-offs.

Amplifier R.F. Type S37/2 5820-99-933-2207

Mod. Strike-off	Summary of Modification	Reason
1	As RMC. Mod.6615. Various circuit changes (included before delivery).	Improved protection and performance.
2	RMC. Mod.9110. Retrospective provisioning and application of identity and modification record labels.	To record reference identities and mod. strike-offs.

Amplifier R.F. Type S37/3 5820-99-933-2181

Mod. Strike-off	Summary of Modification	Reason
1	RMC. Mod.6565. Protection against overheating and entry of dust by improved ventilation, filtering and sealing.	Improved reliability.
2	RMC. Mod.6567. Provision of mixer level control.	Improved performance.
3	RMC. Mod.9109. Retrospective provisioning and application of identity and modification record labels.	To record reference identities and mod. strike-offs.

LIST 1

	MARCONI IDENTITIES							
Transmitter Frequency		Frequency Control R.F. Unit Supply						
HS31 (W.37918 Ed.B + WQ.13379 + T30-7476-01 + WQ.14666 Ed.A)		W.37908 Ed.B + T30-7476-01 + WQ.13379 Ed.A	W.37907 Ed.C + WQ.14666 Ed.A	W.37920 Ed.D + T30-7476-01	W _• 39081 Ed _• D + T30-7476- O1			
HS31 (W.37918 Ed.B + WQ.13506 Ed.A + T30-7476-02 + WQ.13379 Ed.A + WQ.14666 Ed.A)		W.37908 Ed.B + T30-7476-02 + WQ.13379 Ed.A	W.37907 Ed.C + WQ.13506 Ed.A + T30-7476- 02 + WQ.14666 Ed.A	W.37920 Ed.D + T30-7476-02	W.39081 Ed.D + T30-7476- 02			
HS31A (W.37918 Ed.B + WQ.12610 Ed.A + WQ.13379 Ed.A + T30-7476-03 + WQ.14666 Ed.A)		WQ.14953/B Ed.A	WQ.14956/B Ed.A	WQ.14957/B Ed.A	WQ.14958/B Ed.A			
HS31/1 (W.37918 Ed.C + WQ.14952/B Ed.A)	4-27.5 Mc/s	WQ.14953/B Ed.A	WQ.14956/B Ed.A	WQ.14957/B Ed.A	WQ.14958/B Ed.A			
HS31A/1 (W.37918 Ed.D + WQ.14959/B Ed.A)	2.5-20 Mc/s	WQ.14960/B Ed.A	WQ.14961/B Ed.A	WQ.14962/B Ed.A	WQ.14963/B Ed.A			

KEY TO MARCONI MODIFICATION DRAWINGS

WQ. 126101	Mod.		Conversion of HS31 to HS31A
WQ.13379	Mod.		Fitting of 6 inch fan
WQ.13506	Mod.		Fitting of additional P.U. point for monitoring
WQ. 14666	${\tt Mod}$.		Fitting of ACT70 valve
WQ.14952/B) WQ.14953/B)		-	Addition of Identity and Modification labels
WO 11.056/B	(Mod.	9110	Addition of Identity and Modification labels
11 & • 147 JO/ D	(Mod.	9138	Addition of Identity and Modification labels Fitting of additional P.U. point for monitoring
			Addition of Identity and Modification labels

LIST 2

	A.M. IDENTITIES								
Transmitter	Control Power Supply	R.F. Unit	Mixer Stage Frequency	Amplifier, R.F.					
T.10158 5820-99-933-2372 (was 10D/20455) HS31	Type S28/1 5820-99-933- 2183	Type S2/1 5950-99-933- 2188	5820 - 99 - 971 - 2012	5820 - 99 - 971 - 2020					
T.10158A 5820-99-933-2182 (was 10D/22729) HS31	Type S28/1 5820-99-933- 2183	Type S2/5 5950-99-933 2179	5820 - 99 - 971 - 2012	5820 - 99- 971 - 2020					
T.16719 5820-99-933-2187	Type S28/3 5820-99-933-	Type S2/4 5950-99-933-	Type S4/5 5820-99-933-	Type \$37/3					
(was 10D/22609) HS31A	2168	2169	2218	933-2181					
T.10158B 5820-99-933-2195 (was 10D/23678) HS31/1	Type S28/3 5820-99-933- 2221	Type S2/2 5950-99-933- 2196	Type S4/2 5820-99-933 2197	Type S37/2 5820-99- 933-2207					
T.16719A 5820-99-933-2199 (was 10D/23682) HS31A/1	Type S28/4 5820-99-933- 2914	Type S2/3 5950-99-933- 2217	Type S4/3 5820-99-933 2200	Type \$37/1 5820-99- 933-2913					

KEY TO MARCONI MODIFICATION DRAWINGS (Contd.)

W Q.14958∕B	(Mod. 6616 (Mod. 9110 (Mod. 7850	Incorporated before delivery Addition of Identity and Modification labels Improvement of neutralizing circuit response.
WQ.14959/B) WQ.14960/B)	Mod. 9111	Addition of Identity and Modification labels.
wQ. 14961/B	(Mod. 9111 (Mod. 9140	Addition of Identity and Modification labels. Fitting of additional P.U. point for monitoring.
WQ.14962/B) WQ.14963/B)	Mod. 9111	Addition of Identity and Modification labels.
T30-7476-01 T30-7476-02 T30-7476-03)	Addition of Identity and Modification labels.



Photo No.33950

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Supplement 2 to AP 116E-0231-1

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Circuit)	WZ.26509/D	Sh.1	10B
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HS31A/1 R.F. Unit (including Output			, , , ,
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HS31A R.F. Unit, Part 1 HS31/1 R.F. Unit, Modification 1785	WZ.17365/D Sh.1	3A 3B(a)
HS31/1 R.F. Unit, Part 1 HS31A/1 R.F. Unit, Modification 1784	WZ.26510/D Sh.1	3B 3C(a)
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APPENDIX 1 Feeder Monitoring Equipment for HS31 (this Appendix is filed under separate cover).

ABBREVIATIONS

I.S.B.	_	Independent Sideband
D.S.B.	_	Double Sideband
C.W.	_	Continuous Wave Telegraphy
P.E.P.	_	Peak Envelope Power
P.S.P.	_	Peak Signal Power
F.S.K.	_	Frequency Shift Keying
R.F.	_	Radio Frequency
Fils	_	Filaments
fHG Mc/s or fHG		The Frequency Output of the Harmonic Generator
fRAD Mc/s or fRAD	-	The Radiated Frequency
H.G.	_	Harmonic Generator or Frequency Multiplier
V	_	Volt
A or amp	_	Ampere
Ω	_	Ohm
W	-	Watt
m	-	Milli (0.001)
μ	_	Micro (0.000001)
k	_	kilo (1000)
М		Mega (1,000,000)

ABBREVIATIONS (Cont.)

dB	_	Decib e l
A.C.	_	Alternating Current
D.C.	-	Direct Current
IP's		Inter-modulation Product
WW	_	Wire Wound

3.5 kW H.F. I.S.B./TELEGRAPH/TELEPHONE TRANSMITTER TYPES HS31, HS31A, HS31/1 AND HS31A/1

1 INTRODUCTION

This Air Publication, with its Supplement 1, covers the HS31 series of transmitters. Where possible, the differences between the variants are dealt with in the main book, but, where necessary, reference is made to the appropriate section in the Supplement.

The HS31 series, comprising HS31, HS31A, HS31/1 and HS31A/1, are general purpose transmitters for use in the frequency range 2.5 to 27.5 Mc/s, the HS31 and HS31/1 covering 4 to 27.5 Mc/s, and the HS31A and HS31A/1 2.5 to 20 Mc/s.

External units are used to provide the drive and service of operation. Drive frequencies are normally supplied by Type HD21 Crystal Drive Units.

For F.S.K. or FS Diplex services these would normally be used in conjunction with a Type HD20 F.S.K. Drive Assembly providing the necessary Keying and Monitoring Equipment. For FS Diplex operation the Type HD61B Frequency Shift Diplex Equipment may also be employed. In this case the drive output is at radiated frequency and the HD21 Crystal Drive Units are not required.

For I.S.B. operation the Crystal Drives may be used with either Type HD51 or Type SSD2 I.S.B. Drive Equipments.

The frequency range is covered without external change of coils or components, and the transmitter may be tuned, using any one of the six input frequencies supplied by the six Crystal Oscillator Units, without adjustment of these units after the initial setting-up.

Air cooling is provided by a fan mounted in the bottom of the R.F. Cubicle. Air is exhausted from the transmitter and passes via a duct between the two cubicles, leading to a vent on the roof of the transmitter. Provision may be made for fitting ducting to remove the heated air from the transmitter room.

The transmitter is interlocked electrically and mechanically to prevent damage; and to safeguard the user. The doors of the two cabinets are fitted with locks mechanically connected to the isolating and/or earthing switches.

ON/OFF switching, of the transmitter, may be carried out by remote control.

An envelope correction circuit is incorporated in the transmitter to minimize the I.S.B. distortion.

For HS31A and HS31A/1 see Supp.1 Sect.1.

2 TECHNICAL SUMMARY

2.1 SALIENT FEATURES

Types of service available

- (a) C.W. Telegraphy ON/OFF keying with optional anti-fading Frequency Modulation (Al and F2)
- (b) Frequency Shift Telegraphy (F1)
- (c) Independent Sideband (A3b)
- (d) D.S.B. Telephony, Low Power (A3)

NOTE: To provide services (a) and (b), the Type HD22 Keying Unit or a Type HD61B Frequency Shift Diplex Equipment is used. For services (c) and (d), the Type HD51 I.S.B. Drive or a Type SSD2 Single Sideband Generating Equipment is used.

Power Supply:

Transmitter

380 - 420 three-phase, four wire a.c., 50 - or 60 c/s.

Overall

Voltage regulation ±6% Frequency Tolerance ±2.5%.

Power Consumption (at 0.9 power factor)

I.S.B. with 2 tone modulation 7 kW C.W. Mark 9 kW C.W. Space 3.7 kW

F.S.K.

9 kW.

Control

Local operation, with optional remote ON/OFF switching.

Main Unit Dimensions

Height 7 ft 6 in (2.28m)
Width 5 ft 6 in (1.67m)
Depth 4 ft 4 in (1.32m).

Output Impedance

 600Ω balanced. 50Ω can be provided using an external wideband transformer, and a coupling filter.

Cooling

Ì

The fan extracts approximately 340 cu. ft of air per minute, at a pressure of 3 inch water gauge.

2.2 PERFORMANCE

Frequency Range

4 to 27.5 Mc/s (HS31 & HS31/1) 2.5 to 20 Mc/s (HS31A & HS31A/1) covered in varying ranges in the various sub-units of the transmitter.

Power to Aerial	
from 4-21 Mc/s (HS31 & HS31/1)	
2.5-20 Mc/s (HS31A &	
HS31A/1)	

from 21-27.5 Mc/s (HS31 & HS31/1)

Harmonic Radiation

Drive Input Level

Noise Level

Pilot Carrier Compression

Non Linear Distortion I.S.B.

D.S.B. Distortion

D.S.B. Frequency Response

(3.5 kW PEP on I.S.B. (3.5 kW on C.W. (ON/OFF) and F.S.K. (1.5 kW Carrier on D.S.B.

(2.5 kW PEP on I.S.B. (2.5 kW on C.W. (ON/OFF) and F.S.K. (1.5 kW Carrier on D.S.B.

Less than 200 mW.

0.1W nominal from Primary Crystal Drive (3.45 to 6.95 Mc/s)
0.25W from I.S.B. or keyed telegraph drive (3.1 Mc/s).

- (a) Individual components in a band 200 c/s either side of a carrier up to -16 dB relative PEP are less than -30 dB relative to that carrier.
- (b) All components of a single tone up to -6 dB relative PEP are less than -50 dB relative PEP.

Less than 1.0 dB for any level of single frequency signal up to PEP.

3rd Order IP's not greater than -36 dB relative to either of two equal test tones for any power level up to PEP.

Less than 10% measured at 80% modulation depth including 2% of D.S.B. Drive Unit.

Less than $2\frac{1}{2}$ dB from 200-3500 c/s measured at 60% modulation depth (including 2 dB of D.S.B. Drive Unit).

3 EQUIPMENT LIST

3.1 LIST OF UNITS

See Lists 1 and 2 inside front cover.

3.2 LIST OF VALVES

Unit	Type No.	Z 77	Ū54.	5B255M	5B254 M	STV 280/80	Total
	Services CV No.	138 or 4014	378	391	428	1069	
Rectifier and Control Unit			2			1	3
R.F. Unit					2		2
Mixer Unit		9		2			11
Total		9	2	2	2	1	16
	Type No.	N77 (EL91)	C1112 or ** QY 4250	BR191 or ACT70*	GXU2	QS.12.06 VR 105/30	Total
	Services CV No.	136 or 4063	2131	2383	2518	686	
Rectifier and Control Unit					6	1	7
R.F. Unit			2	1			3
Mixer Unit		2					2
Total		2	2	1	6	1	12

An abridged valve data list is given in Section 11.

^{*} See Section 11.11.

^{* *} This valve is not suitable for I.S.B. service unless, on a static test, with Va=1 kV, Vg2=500V and Vg1= -25V, the Ig2 does not exceed, and is preferably less than, 16 mA. If the transmitter is used on I.S.B. service, and a new V3 or V4 is required, order CV2131/2121.

4 DESCRIPTION OF EQUIPMENT

4.1 TRANSMITTER LAYOUT

The HS31 series of Transmitters consists of two cubicles mounted side by side with an air duct between them. The left-hand cubicle is the Rectifier and Control Unit (RCU) and the right-hand cubicle is the Radio Frequency Unit (R.F. Unit).

4.1.1 Rectifier and Control Unit Cubicle

Component Layouts: HS31 & HS31A, Figs.1 & 2: HS31/1 & HS31A/1, Figs.1A and 2A.

This cubicle contains the various sub-units and component panels of the power units.

Across the front of the cubicle are mounted four separate panels bearing the control circuit relays and contactors, the control switches etc., various indicating lamps and the fuses. These panels are protected by a full length door when the transmitter is in operation. In the door are apertures giving access to the control panels, and a glass inspection window revealing the relays and contactors. Above the door is a hinged meter panel fitted with a single mechanical interlock which prevents the door being closed, and therefore prevents the supplies being switched on, while the panel is raised and the backs of the meters exposed. A six inch extractor fan is fitted in the roof of the cubicle to aid ventilation.

4.1.2 Radio Frequency Unit Cubicle

This cubicle contains all of the radio frequency circuits and the cooling fan. Various stages are contained in separate sub-units which are described in Sections 4.3.2.1, 4.3.2.2 and 4.3.2.4.

The aerial feeder terminals are mounted on the roof of the cubicle. Incoming and outgoing connections are made via plugs and sockets also on the roof. The connections to and from the drive equipment are made via the coaxial plugs PLB-PLD.

This cubicle also has a full length front door but it is not interlocked to the control circuit as access is desired when tuning the transmitter.

The three sub-units may all be withdrawn on runners from the cabinet for servicing. The Mixer Unit is not interlocked to the control circuit, as access to controls mounted on the chassis is desired when tuning the transmitter. The other two sub-units are interlocked to the control circuit; the 4th and 5th R.F. Amplifier by the switch on the panel above the unit, and the Aerial Circuit by the rear door of the cubicle which is interlocked and must be opened before the unit can be withdrawn.

4.2 CONTROLS AND THEIR FUNCTIONS

Control Layouts:

(HS31 & HS31A Fig.2 Rectifier and Control Unit: (HS31/1 & HS31A/1 Fig.2A.

Radio Frequency Unit: (HS31 & HS31A Fig.3 (HS31/1 & HS31A/1 Fig.3B.

The following section lists all the controls, meters and fuses, together with their functions, under their panel titles.

4.2.1 Meter Panel

- A.C. Volts Ml This may be switched to indicate the voltage of any phase of the supply.
- A.C. Amps M2 Indicates the current taken from the YELLOW phase of the supply.
- H.T. Volts M3 This indicates the main h.t. voltage supply (4 kV) to Stages 5 and 6.

4.2.2 Contactor Panel

This carries the relays and contactors which control filaments, bias and h.t. supplies.

- ST Start Relay
- FC Filament Relay
- FF Full Filament Relay
- OR Overload Reset Relay
- SP Remote Control Relay
- FD Filament Delay Switch
- LA Auxiliary H.T. Relay
- MC Main H.T. Contactor
- ILR External Interlock Pilot Relay (HS31/1 and HS31A/1 only).

4.2.3 Control Panel

This carries the various control switches and push buttons.

Switches

Auto/Manual Selector Switch - SWN Local/Remote Selector Switch - SWG

Frequency Selector Switch - SWL

Stage 6 Grid Current Overload - SWR (HS31/1 & HS31A/1 only).

Push Buttons

Start Button - SWC
Stop Button - SWD
H.T. ON Button - SWE
H.T. OFF & Reset Button - SWF

Also mounted on the control panel are various indicator lamps.

The six frequency indicator lamps are associated with the six-position frequency selector switch, SWL, which controls, via SWG in the Mixer Unit, the selection of primary crystal oscillator.

In line with the push buttons START and H.T. ON are the lamps which indicate the extent of control, i.e. Fils. ON, H.T. ON. etc.

50V D.C. Lamp - LP1
Filament Lamp - LP2
Auxiliary H.T. Lamp - LP3
H.T. Lamp - LP4
Trip Lamp - LP5

4.2.4 H.T. and Filaments Panel

This carries four controls.

A.C. Voltmeter Switch - SWH associated with M3 on the meter panel.

Stage 5 and Rectifier Filament Control - RV2, RV3 and RV4.

Stage 6 Filament Control - RVI.

H.T. Volts Low/Full Selector Switch - SWJ.

4.2.5 Fuse Panel

This is the bottom panel of the front assembly.

The functions of the fuses are listed below.

Fuse	Location	Rating
FSl	50V D.C. Rectifier A.C. Input	2 amps
FS2	50V D.C. Rectifier A.C. Input	2 amps
FS3	50V D.C. Rectifier A.C. Input	2 amps
FS4	*Fan Supply	10 amps
FS5	6.3V Filaments and Aux. H.T. Rectifier	_
	Filament Supply	2 amps
FS6	Spare	_
FS7	Main H.T. Fuse	25 amps
FS8	Main H.T. Fuse	25 amps
FS9	Main H.T. Fuse	25 amps
FS10	Stage 5 and Main H.T. Rectifier Filaments	2 amps
FS11	Stage 5 and Main H.T. Rectifier Filaments	2 amps
FS12	Stage 5 and Main H.T. Rectifier Filaments	2 amps
FS13	Not used	
FS14	Stage 6 Filaments	6 amps
FS15	Stage 6 Filaments	6 amps
FS16	Auxiliary H.T. Unit Supply	2 amps
FS17	Bias Unit Supply	2 amps
FS18	Filament Delay Switch Supply	0.5 amp
FS19	Spare	
FS20	Spare	:
FS21	Not used	
FS22	'Ledex' Switch Control Supply (Frequency	
	Selection)	l amp
FS23	50V D.C. Supply to Control Relays up to	
	Auxiliary H.T. Relay	3 amps
FS24	Main H.T. Contactor and Overload Reset	
	Relay Control Supply	5 amps
FS25	Indicator Lamps Supply	l amp
FS26	Spare	
FS28-35	Not used on HS31	

^{*} HS31 & HS31A only. For HS31/1 & HS31A/1 see Supp.1.

1.2.6	Meter	Panel	(R.F.	Cubicle]	١

STAGE 6 GRID CURRENT (M7)

Indicates Stage grid current.

STAGE 6 CATHODE CURRENT (M6)

Stage 6 cathode current.

FEEDER INDICATOR (M10)

Indicates the power to the aerial.

4.2.7 Top Panel (R.F. Cubicle)

RANGE (SWA, SWB, SWC & SWD)

Operates all the frequency range switches in the transmitter via chains and couplings.

FEEDER TUNE (C64, SWP, SWM)

Tunes the coupling coil L20.

STAGE 5 H.T. INTERLOCK switch (SWF)

4th and 5th R.F. Amplifier interlock switch (main h.t.).

4.2.8 4th and 5th R.F. Amplifier

STAGE 5 TUNE (L15)

Turns L15 for tuning purposes

STAGE 4 TUNE (L5-L10, C12)

Turns the coil turret L5-L10 and also capacitor C12.

STAGE 5 NEUTRALIZING (C16)

Turns Cl6 which neutralizes Stage 5.

DRIVE LEVEL (RV7) (HS31 & HS31A) (RV2) (HS31/1 & HS31A/1)

Varies drive input to Stage 4.

STAGE 4 GRID PEAK VOLTS (M1)

Indicates signal input level to Stage 4.

STAGE 4 ANODE CURRENT (M2)

Indicates anode current to Vl and V2.

STAGE 5 GRID CURRENT (M3)

Indicates grid current to V3 and V4.

STAGE 5 GRID PEAK VOLTS (M4)

Indicates signal input level to Stage 5.

STAGE 5 CATHODE CURRENT (M5)

Indicates cathode current to V3 and V4.

4.2.9 Mixer Unit

H.G. TUNE

This control is ganged to the tuning capacitors of the harmonic generator stages and their associated amplifier stages: - capacitors C5, C14, C25, C41 and C47.

MIXER TUNE

To this control is ganged the anode tuning capacitors of the mixer stage and r.f. amplifier stages 1, 2 and 3:-capacitors C65, C66, C82, C94 and C100.

fHG Mc/s (SWA)

This a three position range switch employed to select the harmonic generator stages to be used and to select the required tuned circuits for the anode circuits of the two amplifier stages which follow the harmonic generators.

NOTE: The frequency ranges marked against the positions of this switch refer to the harmonic generator output frequencies and not to the final radiated frequencies.

H.G. METERING (SWB)

This switch selects various currents in the harmonic generator circuit for measurement on Ml. Its final position (7) connects the meter to SWD.

MIXER & MONITOR METERING (SWD)

Used in conjunction with SWB (see above) it selects various currents in the mixer and Stages 1, 2 and 3 circuits for measurement on M1.

fRAD Mc/s (SWC)

This a three position range switch which selects the appropriate tuned circuit for the anode circuits of the mixer and Stages 1, 2 and 3.

NOTE: The frequency ranges marked against the positions of this switch refer to the final radiated frequency.

MONITOR (LKA)

This U-link is used to connect various monitor signals from Stages 3, 4, 5 and 6 to the Monitor Frequency Changer.

4.2.10 Bottom Panel

STAGE 6 COUPLING (L20)

This control turns a lead screw which propels L20 up or down around L19 thus varying the coupling.

STAGE 6 TUNE (L19)

This control turns L19 which propels a contact assembly up or down its length thus varying its inductance. FIL. VOLTMETER SWITCH (SWJ)

This switch selects any one of the Stage 4, 5 or 6 filament supplies for measurement on M8 (FIL. VOLTMETER)

AUX. VOLTMETER SWITCH (SWK)

This switch selects various supply voltages for measurement on M9 (AUX. VOLTMETER).

HS31 & HS31A only For HS31/1 & HS31A/1 see Supp.1 Sect.4.2.8

HS3LA only STAGE 5 FEEDBACK CONTROLS For HS31/1 1, 2, 3, 4 and 5

Individually selected by SWB (RANGE above) to provide adjustment of the envelope correction circuit by means of a.f. feedback; one for each range.

4.3 GENERAL DESCRIPTION OF EQUIPMENT

4.3.1 Rectifier and Control Unit

Component Layout: (HS31 & HS31A) Figs.1 & 2 (HS31/1 & HS31A/1) Figs.1A & 2A

The main a.c. supply enters via terminal board TBl mounted on the left-hand wall of the cabinet at the top rear.

In the upper part of the cabinet, immediately under the roof, are two brackets occupying the width of the cabinet. Mounted on the one nearest the front are the terminal boards carrying the remainder of the incoming and outgoing connections; the Stage 6 filament limiting resistor, R4; and a preset variable resistor, R2, which controls the 6.3V auxiliary filaments supply. On the bracket immediately behind, (i.e. nearer the rear door), are the 6.3V auxiliary filament transformer, TR2, and the Stage 6 filaments transformer TR3. Beside these, on the same bracket, is a terminal board, X2, not used.

Behind this bracket is mounted MR1, the metal rectifier, which provides the 50V d.c. supply for the control circuits.

Mounted on the right-hand wall of the cubicle, at the top, are the overload relays OD and OE. Relays OD and OE are operated by the current flowing in Stages 5 and 6. RV6 is in parallel with OE and provides adjustment of its operating point.

Below the relay assembly is the bias unit. This is contained on a flat chassis mounted on rails, allowing the whole unit to be slid out from the rear of the cubicle.

Immediately below the bias unit is a similarly constructed and mounted unit for the Auxiliary H.T. Supply.

Standing on the floor below the auxiliary h.t. unit are the main h.t. transformer and the smoothing capacitors C9-C11.

The h.t. rectifier valves are assembled on the left-hand wall of the cubicle, mounted on top of their filament transformers. Immediately above them are three resistors, R17, R18 and R19, which form a potentiometer chain providing 600V for the screen grid of Stage 5 from the 4 kV h.t. line. When a Type ACT70 valve is used in Stage 6, resistor R19 is returned to earth instead of to the bias supply.

Below the h.t. rectifier valves are the metal rectifiers forming MR2, which provides 5 volts d.c. for Stage 5 filaments. Mounted underneath these is SWK the Stage 5 filaments reversing switch, and alongside it L1 the filament rectifier smoothing choke, and TR4, the filament rectifier transformer.

Also mounted on the floor of the cubicle, with Ll and TB4, are TR1 the 50V d.c. supply unit transformer, and L7 the main h.t. smoothing choke.

The plug PLAJ on a flexible cable, situated on the left-hand wall of the cabinet, above the main h.t. rectifier valves, is not used in HS31.

The interconnecting cables between the rectifier cubicle and the r.f. cubicle are taken out through an aperture at the top of the lefthand wall at the front, adjacent to the terminal blocks.

In the centre of Fig.l is shown a rear view of the components mounted on the panels at the front of the cubicle.

r HS31/1 HS 3lA/l e also pp.l

Behind the h.t. rectifier valves, attached to the left-hand wall of the cabinet, are the two interlock switches, SWA and SWB. These are operated by the 'lock-handles' on the front and rear doors respectively, of the cubicle, and remove the a.c. input from all circuits and earth ct.4.3.1. the 4 kV h.t. line when either door is unlocked.

4.3.2 Radio Frequency Unit

Component Layout: (HS31) Figs.3, 4 & 5. (HS31A) Figs.3A, 4 & 5A. (HS31/1) Figs.3B, 4A, 5B. (HS31A/1) Figs.3C, 4A & 5C.

This unit is described in the following text in a functional order commencing with the mixer unit.

4.3.2.1 Mixer Unit

Component Layout: (HS31) Fig.6. (HS31A) Fig.6A. (HS31/1) Fig.6B. (HS3LA/1) Fig.6C.

This is a separate sub-unit in the front centre of the cabinet. It is mounted on runners to enable it to be easily withdrawn for maintenance and adjustment.

The unit contains the harmonic generator (or frequency doubler stages) and its power amplifier stages, a mixer stage, the first three stages of the six stage final amplifier chain and the monitor frequency changer.

Inter-unit connections are made by plugs and sockets on long flexible leads at the rear of the unit.

Also on the rear of the chassis is the Ledex switch SWG. This switch is controlled by SWL the FREQUENCY switch on the front of the Rectifier and Control Unit (R.C.U.) and selects the desired external crystal drive unit and illuminates the appropriate frequency lamp on the Control Panels of the R.C.U., and selects the appropriate gain control potentiometer.

The Monitor Frequency Changer is contained in the front right-hand corner of the unit immediately behind its associated U-link selector. Behind it are the mixer bias potentiometers and their REMOTE/MANUAL changeover switch, SWF. RV5 is the MANUAL bias control (level control) used in place of the preset potentiometers, RV6-RV11, when SWF is in the MANUAL position.

If an external Frequency Shift Diplex Equipment is used the Mixer Unit is bypassed and will have no effect on the transmitted signal, although being an integral part of the transmitter it will still function. If the transmitter is set to AUTO the wave indicator lamps will light as the FREQUENCY switch is operated but these will have no significance. The Monitor Frequency Changer is also bypassed by a link which allows the radiated frequency to be fed back to the monitoring receiver.

4.3.2.2 4th and 5th R.F. Amplifier

Component Layout: (HS31) Fig.5. (HS31A) Fig.5A. (HS31/1) Fig.5B. (HS31A/1) Fig.5C.

These stages are contained in a separate sub-unit mounted above the Mixer Unit. The unit may be withdrawn on runners and is mechanically interlocked with the Stage 5 interlock switch, SWF, mounted on the front panel immediately above the unit.

The plan view of the component layout shows, at the front, the Stage 5 anode tuning coil assembly, an end view of which is also shown in the separate sketch 'J'. In the back left-hand corner is the Stage 5 anode circuit range switch, SWA, which is ganged with range switches associated with Stage 6 and the output circuit and connects in circuit, with the anode tuning coil, the required tuning capacitance (C32, C33, C34). The drive to this switch from the RANGE control on the front of the r.f. cabinet, is made through a coupling so that the whole sub-unit may be withdrawn from the cabinet; care must be taken, therefore, to see that the switch is in the correct position to mate with the driven member of the coupling before the unit is pushed back into the cabinet.

For HS31/1 & HS31A/1 see also Supp.1 Sect.4.3.2.1

HS31 & HS31A only. For HS31/1 & HS31A/1 see Supp.1 Sect.4.3.2.2 Beside SWA are valves V3 and V4 of Stage 5.

HS31 & HS31A only. For HS31/1 & HS3lA/l see Supp.1

Associated with Stage 5 is a row of five potentiometers, RV1-RV5 situated at the foot of the r.f. cabinet (see front layout Fig.3); these potentiometers provide for adjustment of an envelope correction circuit to minimize i.s.b. distortion. Any one of the five potentiometers may be in circuit, making available individual adjustment of the correction Sect.4.3.2.2 circuit on each frequency range, thus ensuring best possible linearity throughout the tuning range of the transmitter. Switching the potentiometers is done by a small wafer switch, SWB, mounted on and operated by the 'RANGE' control on the front of the r.f. cabinet.

> The underside view on the component layout drawing shows the Stage 4 tuning mechanism, in the front left-hand corner (considered from underneath). Mounted immediately behind this are the valves of Stage 4. The flexible drive to the Stage 5 neutralizing capacitor (C16), is also shown. The tuning mechanism of Stage 4 is shown on sketch 'K': its single tuning control on the front panel drives a 6-coil turret, comprised of coils L5 to L10, and at the same time turns a continuouslyvariable capacitor, Cl2. Each coil in turn is switched in parallel with the capacitor, which is tuned through its full capacity range for each coil connection. By this arrangement the circuit covers the entire frequency range of the transmitter in six stages, by movement of one control.

The front panel control drives the capacitor shaft and the capacitor tunes during 180° of each revolution of the shaft. The shaft also drives a slotted cam which engages with projections on the face of a small wheel on the coil turret shaft, and during the other half of each revolution of C12, turns the turret through 60°. Thus after each tuning cycle of C12 a different coil is switched into circuit. Connection to each coil is made via sets of studs on mycalex strips adjacent to each coil; the appropriate set engages with contact springs on the framework of the assembly when the associated coil is in circuit.

During the half revolution in which the turret is turning, another cam opens an interlock switch. This is switch SWL, connected in series with the h.t. control circuit, so that h.t. is removed during coil changing.

The Stage 5 anode tuning coil with the end plates (Ref.55 and Ref.59 on the plan view) removed, is shown in sketch 'J'. The tuning control on the front panel turns the coil and an insulated jockey wheel (Ref.85) bearing on the inductor advances a contact carriage (Ref. 68) along the length of the coil. Electrical contact with the inductor is made by four ball contacts on the contact carriage.

4.3.2.3 Amplifier Stage 6

Component Layout: (HS31) Figs.3 & 4. (HS31A) Figs.3A & 4. (HS31/1) Figs.3B & 4A. (HS31A/1) Figs.3C & 4A.

This is the final amplifier and is housed at the rear of the r.f. cabinet. A general rear view is shown in Fig.3. The valve and the associated components, except for the anode tuned circuit components, are contained in the compartment in the top left of the cabinet, an interior view of this compartment appears in the separate sketch, 'B'. The anode coil assembly is contained in the lower compartment and is shown in detail in sketches 'F' and 'G' in Fig.4.

The stage uses a triode in a grounded grid arrangement; this lends itself to compact circuit construction. The valve is supported by its anode cooling fin assembly which fits into a cylinder at the top of the anode coil structure (see sketch 'G') in the lower compartment. On a level with the grid ring of the valve, and surrounding the valve, is an aluminium sheet. Thus the valve grid, together with this sheet, screens the valve input circuit from its output circuit. Mounted on the sheet, which is hinged to facilitate fitting the valve, are the grid circuit components (see sketch 'B'). The anode tuning of the stage is effected by a continuously variable helically wound inductor, L19, mounted in the lower compartment; it is shown in sketch 'G' in Fig.4. The coil is turned by a handle at the bottom right of the front panel of the cabinet, immediately below the mixer unit.

Rotation of the coil causes a four point contact assembly to move up or down the length of coil, making the variable tapping point, at the same time short-circuiting some of the turns to reduce 'end effect'.

In the sketch the valve is shown in position. The anode connection is made by spring ball contacts (item 35) which bear on a brass drum that forms part of the coil end assembly. The other end of the contact springs are attached to the support into which the anode cooling fin structure of the valve fits. An end view of the coil appears in sketch 'A', and shows the connecting clamps and the arrangement of the mycalex supports on which the coil is wound.

Coupling from the anode circuit to the output circuit is made by the coil, L20, wound around L19 (sketch 'G'). Its position with relation to L19 is variable by a lead screw turned by a control mounted beside the anode tuning control, on the front panel.

The entire assembly can be moved from the cabinet, but this is not required for normal maintenance.

HS31 & HS31A only. For HS31/1 & HS31A/1 see Supp.1 Sect.4.3.2.3. Capacitors are switched across the anode tuning coil to cover the tuning range of the transmitter. The capacitors are on the switch assembly, SWC, which is mounted in the lower compartment of Stage 6 circuit, in the top right-hand corner and is ganged with SWA and SWB, already mentioned in the description of Stage 5 Section 4.3.2.2, and with the output circuit range - switch SWD, described below. SWC is shown in more detail in sketch 'F' in Fig.4.

4.3.2.4 Output Circuit

Component Layout: (HS31) Figs.3, 4 & 5. (HS31A) Figs.3A, 4 & 5A. (HS31/1) Figs.3B, 4A & 5B. (HS31A/1) Figs.3C, 4A & 5C.

The components of the matching circuit between Stage 6 and the aerial feeder, occupy a compartment at the rear of the r.f. cabinet, in the top right-hand corner - see rear view. They are mounted between vertical cast-alloy plates, forming a rigid assembly which can be withdrawn on runners; a left-hand side view (considered from the rear) of this assembly, is shown in sketch 'A'.

The range switch, SWD (SWC in HS31/1 & HS31A/1), which alters tappings on fixed inductors L22 and L23, is ganged to SWC (SWB in HS31/1 & HS31A/1) in Stage 6 and SWA and SWB (SWA only in HS31/1 & HS31A/1) in Stage 5. All of these switches are controlled by the RANGE control on the front of the cabinet.

The drive to SWD (SWC in HS31/1 & HS31A/1) is made through a coupling to enable the unit to be withdrawn from the cabinet; therefore, when replacing the unit, care must be taken to see that the switch is in the same position as when the unit was removed to mate correctly with the driving member of the coupling.

The circuit is tuned by a variable differential capacitor C64, in conjunction with four padding capacitors C68-71, through a switch, SWP, controlled by the FEEDER TUNE control on the front of the r.f. cabinet. Operated in conjunction with SWP is an interlock switch SWM, mounted immediately behind the tuning control, which prevents arcing on SWP by removing h.t. when switching in circuit the padding capacitors.

The variable capacitor has butterfly shaped plates and is set up to turn from maximum capacity at 0° , through minimum at 90° , maximum at 180° , to minimum at 220° .

Padder capacitors C68-C71, are connected into the circuit by switch assembly SWP, which is fixed to the spindle of capacitor C64. This switch is mounted such that the padders are only in circuit when the capacitor turns through its first 120° .

On the gearbox shaft is a cam with which the roller follower microswitch, SWM, is associated. This switch is an interlock switch which ensures that the h.t. is off when SWP is in transition. The switch, due to the cam, is closed during the period of capacitor travel through the first and third quadrants and open during the second quadrant.

The	cycle	of	operation	of	the	assembly	is	as	follows	00	to	270	0	
-110	0,010	-	OPOL COLON	01	0110	abbembiy	70	αS	TOTTOWS	0	UU	2/	,	,

Capacitor Movement in Degrees	HS31 and HS31A Scale Reading	HS31/1 and HS31A/1 Scale Reading	Capacitor C64 Capacity	Switch SWM	Switch SWP	Capacitors C68-C71 in/out
0 90 120 180 270	0 33 43 67 100	0 66 87 133 200	max min max min	closed opens open closes closed	closed closed open open open	in in out out out

If the feeder tuning control is turned in the opposite direction, the sequence occurs in reverse order. If the control is turned through 0 to 100, the switching completes a full cycle and returns to its original position.

4.3.2.5 Cooling Fan

Mounted in the base of the r.f. cubicle is a suction fan which draws cooling air down through the amplifier stages from an inlet in the top of the cubicle. The inlet is on the rear facia panel and is covered by an air filter which is removable without switching off the transmitter. The hot air drawn by the fan into the duct at the base of the cubicle is expelled from the vent on the cubicle roof via a duct between the two cubicles.

5 CIRCUIT DESCRIPTION GENERAL

5.1 R.F. CIRCUITS

Block Diagram Fig.9.

Any one of the HS31 range may be used as a transmitter or a power amplifier. When used as a power amplifier, the drive at radiated frequency is applied to the grid circuit of Stage 4.

When used as a transmitter two r.f. inputs are applied to the Mixer Unit; one is a frequency from the primary crystal oscillator and is between 3.45 and 6.95 Mc/s. It is applied to the Mixer Unit where it is either doubled or quadrupled in the harmonic generator stages. The resultant frequency, described as the harmonic generator frequency (fHG),

is then fed to the control grids of the balanced mixer stage. The second input is the i.f. drive, bearing the signal intelligence to be transmitted. This is fed to the cathode circuit of the mixer stage. The sum and difference components of the two inputs appear simultaneously in the anode circuit of the mixer, and the required output is selected by tuning the anode circuit to the higher or lower component as desired. The output taken from the anode circuit is the frequency to be radiated and is applied through six amplifier stages to the aerial feeder circuit.

Stage 5 amplifier has an envelope correction circuit in its cathode circuit. This correction circuit minimizes the i.s.b. distortion in the transmitter.

The first three stages of the amplifier chain are contained in the Mixer Unit; Stages 4 and 5 are mounted in a separate sub-unit above the Mixer Unit; Stage 6 occupies most of the rear part of the r.f. cabinet.

5.1.1 Monitoring

To facilitate correct operation of the transmitter, provision is made for feeding monitor signals from various parts of the amplifier chain back to the i.s.b. drive unit for examination in a monitoring receiver. To do this, whichever monitor signal is required is fed into a frequency changer circuit in the Mixer Unit, and there combined with the output of the harmonic generator stages to be converted to a 3.1 Mc/s signal (HS31 & HS31/1 only - 2.15 Mc/s for HS31A and HS31A/1) suitable for feeding to the drive equipment.

5.2 POWER SUPPLIES

All of the various power supplies are located in the Rectifier Cabinet. An input of 380/420V, 50 or 60 c/s, 3-phase, is used.

The main h.t., for Stages 5 and 6, is 4 kV, and is produced by a 3-phase full-wave rectifier using Xenon-filled diodes.

Auxiliary h.t. supplying the remaining stages, is produced by a full-wave hard valve rectifier circuit which provides 450V unstabilized and 280V stabilized.

Bias voltages are produced from a metal rectifier circuit. Varioùs outputs are obtained from an adjustable potentiometer across the output of the rectifier.

Filament voltage for Stage 5 is 5 Volts d.c. provided by a 3-phase metal rectifier circuit. Stage 6 filament supply is 12.6V a.c., and the supply for the remainder of the r.f. valves is 6.3V a.c. All these three supplies are provided by transformers in the Rectifier Cabinet.

For i.f. drive input frequencies see Supp.1, Table 1.

The various h.t. and filament supply circuits are switched on and off by a sequenced relay and contactor control circuit, the operation of which is initiated by push button switches on the main control panel.

The control circuits are energized by 50V d.c. negative from a metal rectifier circuit.

The cooling fan is supplied direct from one phase of the a.c. input.

5.3 OVERLOAD PROTECTION AND INTERLOCKS

1 & HS31A

31/1 & HS31A/1

y. For

Supp.1

t.3.2.

An increase in the current drawn by Stage 5 or Stage 6, will cause the operation of one of the overload relays mounted in the rectifier cabinet.

The contacts of the relays will interrupt the control circuit of the main h.t. contactor switching off the 4 kV rectifier, and at the same time energizing the overload lockout relay. The lockout relay keeps the h.t. contactor isolated when the overload relays de-energize, lights the H.T. TRIP indicator lamp and operates a warning bell.

Main h.t. is reset by pressing the TRIP RESET button to de-energize the lockout relay and then pressing the H.T. ON button.

The front and rear doors of the rectifier cabinet are fitted with 'lock-handles'; these operate switches which, when the 'lock-handles' are set to 'UNLOCK', to enable the doors to be opened, 'break' the h.t. control circuit and earth the output line of the main h.t. rectifier. The rear door of the r.f. cabinet is also provided with a 'lock-handle'. This similarly operates a switch to break the h.t. control circuits and earth the h.t. line of Stage 6 before the door can be opened.

In addition to these, in the control circuits are contacts of switches associated with certain tuning controls; these remove h.t. if the controls are operated with h.t. on.

In the top centre of the front of the r.f. cabinet is a switch labelled 'STAGE 5 H.T. INTERLOCK', which 'breaks' the h.t. control circuits and earths the Stage 5 h.t. line when it is set to SAFE. A latch associated with it prevents access to Stage 4 and 5 until it has been set to SAFE. Inside the r.f. cabinet at the rear, is a switch associated with a latch on the door to the compartment containing the final amplifier anode compartments. This ensures the removal of the filament supply from the valve before the door can be opened. It protects the valve filament seals from overheating due to loss of cooling air pressure when the compartment is open.

In the air exhaust duct is an air pressure switch which switches off all supplies in the event of failure of the cooling air supply.

6 CIRCUIT DESCRIPTION DETAILED

6.1 GRID REFERENCE

To facilitate explanation, description and ease of reference, the following method of component identification is used. All drawings have a grid round them lettered horizontally and numbered vertically, thus if all these grid points were joined the drawing would be divided into a number of small squares which can be identified by a letter and a number i.e. 1A, 2A etc.

Components referred to in the text following are suffixed by a grid reference, e.g. R25 (7F) which will facilitate location on the drawing concerned. To avoid confusion, this applies, in general, only to HS31 and HS31A, but components on HS31/1 and HS31A/1 circuit diagrams which have similar functions to HS31 and HS31A components will occupy similar positions on the diagrams.

6.2 RADIO FREQUENCY CIRCUITS

6.2.1 Harmonic Generator

Circuit Diagram: (HS31) Fig.12, (HS31A) Fig.12A, (HS31/1) Fig.12B, (HS31A/1) Fig.12C.

The harmonic generator consists of three frequency multiplier stages V1, V2 and V3 followed by two amplifier stages, V4 and V5/V6 in parallel. The tuning capacitors of each stage, C5, C14, C25, C41 and C47, are ganged to a single control on the front panel of the unit.

Various combinations of the multiplier stages are selected by SWA, the harmonic generator frequency range switch (fHG Mc/s), to give an output frequency of twice or four times the primary crystal oscillator frequency (fxtal). These combinations are shown in the table below (HS31 and HS31/1 only. For HS31A and HS31A/1 see Supp.1, Table 3).

SWA Range	fxtal	Ft	unction	fHG	Mult.	
Mc/s	Mc/s	Vl	V 2	V 3	Mc/s	Factor
4-8 8-16	3.45-4 4-6.95 3.475-4	Doubler Ampl. Doubler	- Doubler Doubler	-	6.9-8 8-13.9 13.9-16	2 2 4
16-24.4	4-6.1	Ampl.	Doubler	Doubler	16.24.4	4

SWA also selects the appropriate anode tuned circuit of the amplifier stages V4 and V5/6, allowing them to be tuned over the entire frequency range without external change of components, and switches the required final harmonic generator frequency to the control grids of the mixer stage.

The tuned circuit of each amplifier stage has trimmers selected by SWA to enable the circuits to be tracked. Similarly, each tuned circuit of the amplifier stages has a separate trimmer.

The meter M1 (90) and the selector switch SWB, provide monitoring of the following:-

```
V1 cathode current - across R8(7B)
V2 cathode current - across R16(7D)
V3 cathode current - across R25(7F)
V4 cathode current - across R37(7H)
V5/V6 grid current - across R40)7I)
V5/V6 cathode current - across R44(7J)
```

In the seventh position of the switch, connection is made via point 'm' (70) to the mixer meter switch SWD, shown in Fig.13 of the circuit diagram. The connections of this switch are listed in the following sub-section.

6.2.2 Mixer Stage

NOTE: When an external Frequency Shift Diplex Equipment is used the Mixer Unit is, with the exception of the Monitor links on the front panel, bypassed. To ensure non-operation of the FREQUENCY indicator lamps on the control panel giving spurious indication the AUTO/MANUAL switch should be set to MANUAL.

Circuit Diagram Fig.13.

Valves V7 and V8 form the balanced mixer stage. The i.f. input from the drive equipment is applied to the cathode circuit across R56 and R58, via the unbalanced to balanced transformer TR12(7B) and socket SKS(7C). The output of the harmonic generator stages is applied to the control grids. The resultant output, fHG + i.f. or fHG - i.f., is taken from the anode tuned circuits. Either of these tuned circuits, TR6/C67, TR7/C68 or TR8/C69, are selected by wafers SWC15(2B) and SWC17(6B) of the range switch SWC, depending on the frequency to be radiated. Tuning is effected by the variable capacitors C65 and C66, which are ganged to the mixer tuning control on the front panel of the unit. Trimmers on each tuned circuit enable individual setting-up.

The stage is balanced by the h.t. potentiometer RV1(4B) and the capacitor C63(4B). Resistors R57 and R61(4B) decoupled by C62(4B) provide auto bias.

The output level from the mixer stage is adjusted by variable suppressor grid bias. There are two methods of control; either by variations of potentiometer RV5(5L), when switch SWF(5L), is in the MANUAL position, as drawn, or by automatic selection of six preset potentiometers, RV6-RV11(5M-5N), when SWF is set to REMOTE. Normally MANUAL control is used. Automatic selection of RV6-RV11 by remote control is

carried out by the 'Ledex' controller SWG, which also carries out the selection of the six different primary crystal oscillator drives. Thus, if desired, the six potentiometers may be used to preset the mixer output level for the six available radiated frequencies.

The 'Ledex' switch SWG referred to above, is an electrically operated switch and is caused to turn to any of the six positions by operation of the frequency selector switch, SWL, on the Rectifier Unit control panel. Its control circuit is described in Section 6.4.5., here are described only its various functions.

SWG has five wafers. The on/off contact SWGl and wafer SWG2 are associated with control of movement of the switch. SWG3 lights one or other of the six frequency indicator lamps, by connecting the 50V d.c. supply to the appropriate lamp, via pins 1-6 of PLP. Wafer SWG4 connects the 50V d.c. supply to one of the six pins of socket SKL. This connects via external wiring to the primary oscillator equipment and there controls another electro-mechanical switch which provides the automatic selection of the six different crystal oscillator frequencies.

Wafer SWG5 connects one of the potentiometers RV6-RV11 to the mixer bias supply line coming in on Pin 12 of plug PLN(20). Wafer SWG6 connects the variable points of the same bias potentiometer to the suppressor grids of the mixer valves, V7/V8, to provide the adjustment of mixer output level for each available radiated frequency as described.

6.2.3 Stages 1, 2 and 3

Circuit Diagram: Fig.13(HS.31), Fig.13A (HS31A), Fig.13B (HS31/1), Fig.13C (HS.31A/1)

NOTE: When an external Frequency Snift Diplex Equipment is used Stages 1, 2 and 3 of the internal Mixer Unit are not used but being an integral part of the transmitter will operate without being driven.

The output of the mixer stage, i.e. the frequency to be radiated, is transformer coupled by TR6, TR7 or TR8, whichever is in circuit in the mixer stage, to the grid of the first amplifier stage, V9(7E) via SWC13-(6D). Valve V9 is a buffer amplifier operating in class 'A'. It is followed by two class 'AB' amplifiers, Stage 2, V10, and Stage 3, V11.

Each amplifier has three separate tuned anode circuits, each covering a part of the frequency range of the transmitter. They are switched into circuit by the 3-position switch, SWC, which also switches the anode tuned circuits of the mixer stage. Each tuned circuit has its own trimmer capacitor, allowing individual adjustment of tuning over the frequency range covered by that circuit. The main tuning capacitors of each stage, C82(5F) for Stage 1, C94(5G) for Stage 2 and C100(4H) for Stage 3, are ganged to a single tuning control on the front panel of the unit with the tuning capacitors of the mixer stage.

Bias for Stage 1 is auto bias over R78 and R79(7E), decoupled by C77.

Grid bias for Stages 2 and 3 is adjustable by the potentiometers RV3 and RV4(5L) supplied from the 105V stabilized output of the bias rectifier unit, via Pin 3 of plug PLN.

The r.f. output, from Stage 3 is fed via SWCl and SWC2(6J) to the coaxial socket, SKQ and thence to the sub-unit containing Stages 4 and 5. Also taken from SWCl is a reduced output to a monitor plug PLBE. This is for use in the monitor frequency changer unit - Vl2 and Vl3 - which is described in Section 6.2.7.

Switch SWD(30) is the meter switch associated with harmonic generator meter switch, SWB, and the meter, Ml, as explained in Section 6.2.1. It connects to the following points:-

Position

V7/ 8	-	Mixer cathode current - across R61(4B).
V 9	-	Stage 1 cathode current - across R79(8E).
VlO	_	Stage 2 cathode current - across R88(8G).
Vll	-	Stage 3 cathode current - across R98(8H).
V12	-	Monitor Frequency Changer cathode current -
		across Rll7(4K).
V13	-	Monitor Frequency Changer output valve cathode
		current - across R130)4L).

Power supplies for the unit are brought in on plug PLN(1-2N).

There are two h.t. supplies, both provided by the auxiliary h.t. unit in the Rectifier Cabinet. Firstly, 450V on Pin 1 for Stage 2 and 3 anode supply, secondly, 280V stabilized, on Pin 2 for Stages 2 and 3 screen supplies and anode and screen supplies for all other valves in the unit. The screen supply to Stages 2 and 3 is applied through the tumbler switch, SWE(1H). This enables Stages 2 and 3 to be switched off during balancing of the mixer, to prevent oscillation due to amplification of the harmonic generator frequency through Stages 2 and 3 and subsequent feedback into the harmonic generator.

The filament supply is 6.3V a.c. from the Rectifier Cabinet, supplied via Pins 4, 5, 6 and 7, 8, 9 of plug PLN.

Supplied via Pin 3 of PLN is the 105 volts stabilized supply for Stage 2 and Stage 3 bias potentiometers, RV3 and RV4.

6.2.4 Stages 4 and 5

(HS31) Fig.10, (HS31A) Fig.10A, (HS31/1) Fig.10B, Circuit Diagram: (HS31A/1) Fig.10C.

Stage 4 which consists of two CV428 valves, VI and V2, operating in parallel as a class A amplifier stage, is fed via plug PLCB the centre pivot of link LKA, Cl and the stopper networks L2/R2 and L3/R7. positions of the link allow either: (a) the output of an external Frequency Shift Diplex Equipment to be fed into Stage 4 via SKK, the attenuator network, R34 to R52 and RV7, and plug PLCA, or (b) the output of the amplifier, Stage 3 in the Mixer Unit, via SKH and PLCC.

The attenuator, R34, to R52 and RV7, reduces the power output of the HD61B (20-40 watts) to the required power input of Stage 4 (approximately 1 watt).

Bias for Stage 4 is obtained from the bias unit in the Rectifier Cabinet, and is applied to the control grids via the r.f. choke Ll from Pin 3 of plug PLJ. H.T. is obtained from the 450V line of the auxiliary h.t. unit via Pin 2 of PLJ.

The tuned circuit comprises one of the series of coils, L5-L10, and the variable capacitor Cl2, with bandspread capacitor Cl3 switched in on the lower frequencies. Tuning is done by a single control which switches the coils into circuit one at a time and at the same time rotates Cl2.

The precise functioning of the mechanism is explained in Section 4.3.2.2. Associated with the tuning mechanism is switch SWL(7G), which breaks the control circuit of the auxiliary h.t. supply unit, see Section 6.4.1, when coil switching is in progress. Capacitor C15(4I) provides pickup for the monitoring point, socket SKM(2E), which feeds the monitor frequency changer.

Stage 5 comprises valves V3 and V4 in parallel, operating in class 'AB'. Bias provided from the bias unit in the Rectifier Cabinet is supplied via Pin 10 of plug PLJ(8I), the choke Lll(5I) and the tuning coil, L5(4H) in HS31 and HS31A, and L6 in HS31/1 and HS31A/1.

The anode tuned circuit consists of L15 and the three ceramic capacitors C32, C33 and C34, switched by the range switch SWA. On the lowest frequency range C32 and C33 are connected in parallel. On the next range C33 only is in circuit and on range 3 the padder capacitor C34 is switched in series with C33. For the highest frequencies, the self capacities of the valve and circuit only are used. It should be noted that on the HS31 the lowest range is not normally used.

1S31 & HS31/1 only. For IS31A & IS31A/1 see }upp.l 3ect.6.2.4.

The h.t. for Stage 5 is 4 kV supplied by the main h.t. rectifier and applied through the choke L27 and the anti-parasitic choke/resistor combination R28-L14. The short-circuited resistor, R16(4J), provides damping for parasitics at v.h.f. The screen grids are supplied from a 600 volt line, in the HS31 and HS31A, and from a 480 volt line in the HS31/1 and HS31A/1, derived from the 4 kV line by a potentiometer in the Rectifier Cabinet.

The overall linearity of the amplifying stages is improved by an envelope correction circuit operating on Stage 5 as follows:-

The filaments are connected across resistors R25 and R26(6J). The mid-point of these two is connected via R27 and L29 in parallel, and R19 to earth. Resistor R19 is a meter shunt and R27 provides envelope correction. It is virtually short-circuited to d.c. by L29 and therefore has no effect on standing bias, but as it is not decoupled to a.f. there is developed across it a 'Feedback' voltage dependent on the modulation component of the signal. To provide individual adjustment of the correction circuit on all frequency ranges, R27 is shunted by one of the 5 potentiometers, RV1-RV5(6M), switched into circuit by SWB, ganged to the anode circuit range switch, SWA.

The high gain of the stage necessitates neutralization. This is achieved by a bridge circuit consisting of C24 and C16/C17 and the grid filament capacity (shown dotted) and the anode/grid capacity of the valves. The circuit is adjusted by variation of C16, brought out to a front panel control. Adjustment is only required when setting-up initially and holds over the whole frequency band.

The output to Stage 6 is via C35.

6.2.5 Stage 6

Circuit Diagram: (HS31) Fig.10, (HS31A) Fig.10A, (HS31/1) Fig.10B (HS31A/1) Fig.10C.

This stage consists of a single triode, V5, in a grounded grid circuit. This arrangement avoids the need for neutralization, as the anode to grid capacitive currents due to the output voltage do not flow through the input circuit. In addition, linearity is improved, as the stage has a low and appreciable constant input impedance and thus variation of grid current over the r.f. cycle does not appreciably affect the regulation of the driving stage.

S31 & HS31A nly. For S31/1 & HS31A/1 ee Supp.1 ect.6.2.4.

ee also upp.l ect.6.2.l. Input to the stage is across C45(3M) which forms a capacity potentiometer with the coupling capacitor C35, and presents a low impedance to harmonics of the input permitting a higher operating efficiency of the stage. (In the HS31A and HS31A/1 the input to the stage is across C45 and C77, with C77 being switched out on the 6 to 20 Mc/s range).

HS31 & HS31/1 only. For HS31A & HS31A/1 see Supp.1 Sect.6.2.5 The filament choke L17 is wound from concentric cable. One leg of V5 filament is connected to the inner conductor, the other leg to the outer conductor and the filament supply is applied to the other end. Thus the supply circuit is isolated from r.f. The cathode circuit is grounded via the centre tap of RV6 in HS31 and via RV1 in HS31/1, connected between the inner and outer of L17, and the meter shunt R22.

The grid is earthed to r.f. by C43, C44 and C48, C49. Grid bias is applied via L18(4N) and the grid current meter shunt R23 from the bias rectifier in the Rectifier Cabinet.

The anode tuned circuit is L19 and one of the capacitors C56, C57 or C58, or, on the higher frequencies, the self capacitance of the valve and circuit. The range switch, SWC, (SWB in HS31/1 and HS31A/1) is ganged to SWA, the Stage 5 range switch. The h.t. supply is 4 kV provided by the main h.t. rectifier unit, fed via the r.f. chokes L21 and L28.

Coupling to the output circuit which provides impedance matching between Stage 6 and the aerial feeder, is provided by the variable mutual inductance between L19 and L20.

6.2.6 Output Circuit

Circuit Diagram: (HS31) Fig.11, (HS31A) Fig.11A, (HS31/1) Fig.10B, (HS31A/1) Fig.10C.

The coupling coil is tuned by C64 and the fixed capacitors C68-C69 and C70-C71, see Section 4.3.2.3. The fixed inductors L22 and L23 assist tuning on the lower frequency ranges, while the parallel inductor L26 is used on the highest range. These inductors are selected by the output range switch, SWD (SWC in HS31/1 and HS31A/1), which is ganged mechanically to the Stage 5 and Stage 6 range switch.

PVM4 is a peak voltmeter unit which feeds the feeder indicator M10. C65 provides pick-up for the monitor frequency changer (see Section 6.2.7).

Where the 50 ohms output impedance is provided, (by the use of an external transformer), filter W.102405 ED.B is connected to the output terminals of HS31 and HS31/1. The filter is mounted externally on the roof of the R.F. unit. Similarly, when 50 ohms output impedance is provided in transmitters HS31A and HS31A/1 filter W.102405 ED.C replaces coils L32 and L33 (in HS31A) or L30 to L33 (in HS31A/1), all located in the roof of the R.F. unit.

6.2.7 Monitor Frequency Changer

Circuit Diagram: (HS31 & HS31A) Fig.13, (HS31/1 & HS31A/1) Fig.13A.

NOTE: When an external Frequency Shift Diplex Equipment is used the Monitor Frequency Changer, being part of the Mixer Unit, is not used, but use is made of the monitor links on the front panel to feed the monitor signals at radiated frequency to the remote monitoring equipment via SKX.

This circuit consists of V12 and V13(3K-L) etc. It is used to convert signals from various monitor points throughout the amplifier chain to 3.1 Mc/s in HS31 and HS31/1 and to 2.15 Mc/s in HS31A and HS31A/1, for feeding to the monitoring equipment normally fitted in the i.s.b. drive rack.

Monitor signals at radiated frequency are applied to the cathode of V12 via plug PLBC(1J). PLBC may be connected by the U-link, LKA, to any of plugs PLBA, PLBB, PLBD or PLBE, which connect to monitor points in the output circuit, Stage 5, Stage 4 and Stage 3, respectively. To the grid of V12 is fed the output frequency of the harmonic generator. The two inputs are mixed in V12 and the resultant difference signal at 3.1 Mc/s (HS31 and HS31/1) or 2.15 Mc/s in HS31A and HS31A/1, carrying the modulation, is amplified by V13 and fed via socket SKT(2M) to the monitoring equipment.

6.3 POWER SUPPLIES

Circuit Diagram: (HS31) Figs.14 & 15. (HS31A) Figs.14A & 15. (HS31/1 & HS31A/1) Figs.14B & 15A.

6.3.1 Main H.T. Rectifier

This provides the 4 kV h.t. supply for Stage 5 and Stage 6. The circuit is a conventional 3-phase, full-wave rectifier. The valves, V1-V6, are filled with Xenon gas and will operate satisfactorily over a wide range of temperature, making an extensive air conditioning system and a long warming up period unnecessary.

Each rectifier valve has its own filament transformer, energized from the three-phase supply, via contacts FC4, FC5 and FC6(7G) of the filament contactor. The rheostats RV2, RV3 and RV4(8G) which are ganged, adjust the filaments supply and also control the input to the rectifier providing Stage 5 filament supply.

The supply to the h.t. transformer TR8(6L), is fed via contacts MCl, MC2 and MC3(8L) of the main h.t. contactor MC when it is energized by pressing the H.T. ON button.

The manner in which the overload relays control the h.t. contactor is explained in Section 6.4.4.

The output of the rectifier is smoothed by L7(1M) and C9(3N) etc.

The potentiometer chain R17, R18, R19(20 & 30) drops the 4 kV supply down to 600V, or 480V in HS31/1 and HS31A/1, for Stage 5 screen supply. M3 is the H.T. Voltmeter, mounted on the front of the Rectifier Cabinet.

Switches SWA4 and SWB4(3N) are contacts of the interlock switches on the front and rear doors of the cabinet. They close, and earth the 4 kV h.t. line when the doors are opened. At the same time other contacts of the same switches break the h.t. control circuits and disconnect the incoming a.c. supply as described in the control circuits Section 6.4.1.

6.3.2 Auxiliary H.T. Unit

This is the full-wave hard valve rectifier circuit, V7, V8 etc. It provides two outputs: - 280V, stabilized by V9, providing screen voltage for Stages 2 and 3 and anode and screen voltage for the rest of the valves in the Mixer Unit.

450V, unstabilized, for Stages 2 and 3 anodes and Stage 4 anode and screen supply.

6.3.3 Bias Rectifier Unit

This is the full-wave rectifier circuit, MR3(4H) etc. It provides five negative voltage outputs.

- (a) 105 volts, stabilized by V10, via TB9 terminal 8 to the Stages 2 and 3 grid bias potentiometers.
- (b) Grid bias for Stage 6, via TB9 terminal 5, adjustable to 110 volts approximately by RV12 on the meter panel at the front of the cabinet.
- (c) Grid bias for Stage 5, via TB5 terminal 15, adjustable to 110 volts approximately by RV11 on the meter panel at the front of the cabinet.
- (d) Grid bias for Stage 4, via TB5 terminal 14, adjustable to 25 volts approximately by RV10 on the meter panel at the front of the cabinet.

The bias supplies required depend to some extent on individual valves, and the variable resistors RV10, RV11 and RV12 may therefore require some adjustment when valves are changed (see Section 8.6).

The primary winding of the bias transformer TR5 is used as an auto transformer for the a.c. supply to the six inch ventilator fan on the roof of the cubicle.

6.3.4 Filament Supplies

Stage 6 filament voltage is 12.6 volts, supplied from TR3(3F). R4 is in series at the first instant of switching on, to limit the current in the cold filaments.

Stage 5 filament supply is 5V d.c. from the metal rectifier circuit MR2(3G) etc. The voltage output is varied by RV2, RV3 and RV4(7G) and by the preset resistors R8, R9 and R10)6G). RV2, RV3 and RV4 also control the h.t. rectifier filament voltage, therefore initial setting-up of Stage 5 filament is done by R8, R9 and R10, at the same time adjusting RV2, RV3 and RV4 for correct h.t. rectifier filament voltage.

The filaments of the remainder of the r.f. valves are supplied by 6.3V a.c. from TR2(3F).

6.3.5 Control Circuits Supplies

The majority of the control circuits are supplied by 50V d.c. negative, from the three-phase metal rectifier circuit MR1(3E) etc. The filaments delay switch FD, is energized from the RED phase of the a.c. supply.

The cooling fans in HS31 and HS31A are energized from the YELLOW phase of the a.c. input. The fans in HS31/1 and HS31A/1 are referred to in Supp.1, Sect.5.2.

6.4 CONTROL CIRCUITS

The switching on and off of the transmitter is controlled entirely from the control panel on the front of the Rectifier Cabinet. The filament, bias and h.t. circuits are energized in succession by relays and contactors, operated by pressing the push-buttons on the control panel. Each succeeding relay and contactor circuit is interlocked with the circuit preceding it, so that if, for instance, the filament control circuit failed, or was switched off, the h.t. control circuit would automatically be de-energized.

To protect the user, the a.c. input and the main h.t. control circuits are interlocked with switches operated by lock-handles on the front and rear doors of the Rectifier Cabinet.

6.4.1 Switching On Sequence

Circuit Diagram: (HS31) Figs.14, 15, 17. (HS31A) Figs.14A, 15, 17. (HS31/1 & HS31A/1) Figs.14B, 15A, 17A.

This section explains the control circuit only; operating procedure appears in Section 10.

For the purpose of this description it is assumed that the transmitter is tuned.

(a) Operate the door switches SWA and SWB. (By closing and locking the front and rear doors of the Rectifier Cabinet).

Contacts SWA1-3 and SWB1-3 will close in the a.c. supply lines. Meter M1 may be switched to show any phase of the supply. The 50V d.c. power supply unit is energized and the 50V d.c. indicator lamp will light.

Contacts SWA4 and SWB4 remove the safety 'earths' from the main h.t. line.

Contacts SWA6 and SWB6 prime the circuit of the auxiliary h.t. relay, LA.

- (b) Operate SWH, the associated door switch of the lower internal door of the Stage 6 valve compartment.
- (c) Operate SWG, the rear door switch of the r.f. cabinet, by closing and locking the door.

SWG1 removes the safety earth from the Stage 6 4 kV h.t. line.

SWG2 primes the Auxiliary H.T. Contactor LA.

(d) Operate SWF, the Stage 5 Interlock Switch.

SWF removes the safety earth from the Stage 5 4 kV h.t. line.

SWF2 primes the Auxiliary H.T. Contactor LA.

- (e) Set the LOCAL/REMOTE switch on the control panel SWG to LOCAL. This puts control of the START RELAY ST to the local START push-button SWC.
- (f) Press the START push-button SWC.

Five relays will operate in succession, switching on filaments, bias and auxiliary h.t. in turn.

1. The START RELAY ST, will be energized via SWG and SWH.

Contact ST1, bypasses the START push-button, to allow the button to be released.

ST2 closes, allowing subsequent operation of the filament contactor FC and the full filament relay FF.

ST3 closes in the circuit of the main h.t. contactor MC.

ST4 starts the fan.

ST5 primes h.t. on line.

2. As the fan speeds up the FILAMENT CONTACTOR FC will close, via ST2 and the contact of the air interlock switch SWN.

SWN is an air pressure switch in the air exhaust duct and is included to ensure filaments are switched off in the event of loss of air cooling.

When the filament contactor has closed, contact FCl, energizes the 6.3V auxiliary filaments supply and the filament supply for the auxiliary h.t. unit.

FC2-FC3 energizes the filaments supply of Stage 6, at reduced voltage, via R4.

FC4-5-6 energize Stage 5 filament supply and main h.t. rectifier filament supply.

FC7 energizes relay FD.

FC8 primes relay FF.

(FC9 is not used).

3. As soon as FC7 has closed, the filaments delay switch FD, will operate, energized from one phase of the a.c. supply.

FD1 energizes relay FF after 30 secs.

FD2 energizes the auxiliary h.t. relay LA via a contact of FF, after 35 secs.

The function of the delay switch is to allow time for the valves to warm up after initial switching on of filaments, before applying full filament voltage to Stage 6 by operation of relay FF and switching on auxiliary h.t. by operation of relay LA.

4. As soon as FD1 'makes' the full filament relay FF operates.

FF1 short-circuits R4 and puts on full filaments to Stage 6.

FF2 energizes the bias unit.

FF3 operates auxiliary h.t. relay LA - when FD2 makes.

FF4 lights FILS ON lamp.

(FF5 spare).

5. After FD2 and FF3 have closed, the auxiliary h.t. relay LA 'makes' via ST2 and 4 interlock switches connected in series thence, through SWA6-SWB6 etc. The interlocks are: switch SWF which is the Stage 5 interlock switch on the front of the r.f. cabinet, SWG which is the r.f. cabinet rear door switch, SWL the Stage 4 coil turret interlock and SWM the Feeder tune interlock.

The contacts of LA operate as follows: -

LA2 energizes the auxiliary h.t. unit. LA3 primes the main h.t. contactor. LA4 lights the auxiliary h.t. lamp. (LAl and LA5 spare).

(g) Press the H.T. ON button SWE. The main h.t. contactor, MC, will 'make', energized via: ODI and OEI which are contacts of the overload relays and are normally closed; OR1 and OR2 which are contacts of the overload reset relay and are normally closed, and ST3 and LA3 which are contacts of the START relay and the auxiliary h.t. relay previously described.

Contacts MCl, MC2 and MC3 energize the main h.t. rectifier.

MC4 bypasses the H.T. ON button allowing it to be released.

MC5 lights the h.t. lamp.

MC6 opens to remove the short-circuit across the economy resistor R28(C6).

The transmitter is now fully operating.

Interlock Circuits.

Facilities exist in this transmitter to extend the control circuit to ancillary equipment. This facility is made available to tagboard TB5 S31/1 & HS31A/1 terminals 1 and 2 where in the standard equipment a shorting link is fitted.

> The external interlock circuit is therefore connected in series with the Main H.T. Contactor and can be used in connection with feeder switching.

HS31 & HS31A only. For HS31/1 & HS3lA/l see Supp.1 Sect.6.4.1.

ect.6.4.2.

S31 & HS31A

nly. For

ee Supp.l

331 & HS31A nly. For 331/1 & HS31A/1 ee Supp.1 ect.6.4.2.

6.4.2 H.T. OFF and Trip Reset

Pressing SWF, the H.T. OFF & RESET button, will release the main h.t. contactor, MC, switching off the high voltage rectifier only.

Complete switching off may be effected simply by pressing the main STOP button SWD, when all of the control circuit is de-energized.

SWF is also used to de-energize the trip reset relay OR if this has energized subsequent to an overload - see Section 6.4.4. The main h.t. control circuit is then reset, and the contactor MC can be energized by pressing the H.T. ON button.

6.4.3 Remote Control

Control Circuit Diagram: (HS31 & HS31A) Fig.17. (HS31/1 & HS31A/1) Fig.17A.

Remote control of switching on and off is provided for by relay SP. If the Local/Remote switch SWG is set to remote, the 50V d.c. control supply voltage is connected via FS22 and SWG2 to terminal 7 of TB6 and through the remote ON/OFF switch (shown dotted) to make connection to tag 12 of TB6.

When SP is energized by closing the remote ON/OFF switch, SPl closes and the 50V control supply energizes the start relay ST through SPl and SWG (now set to remote). The remainder of the relays operate in the sequence already described. The main H.T. ON push-button SWE, is short-circuited by SWG and the h.t. contactor MC comes on automatically after the operation of LA.

6.4.4 Overload Circuits

The Penultimate and Final stages of the r.f. amplifier each have overload relays in their anode supply circuits. These relays, OD for Stage 5 and OE for Stage 6, are set to operate when excessive current is drawn from the 4 kV h.t. supply. The relay operating current is set by the relay tensioning springs in the case of Stage 5, and in the case of Stage 6 by the tensioning springs and a shunt variable resistor RV6.

When an overload occurs, i.e. a stage draws excessive current, the overload relay will be energized causing its associated contacts to change over.

The relay contacts OD1 and OE1 are connected in series in the control circuit of the main h.t. contactor; they are normally closed, opening on an overload. Contacts OD2 and OE2 are connected in parallel in the operating circuit of the overload trip relay OR; these are normally open, closing on an overload.

When an overload causes one of the relays to operate, its No.l contact will open and de-energize the main h.t. contactor, removing main h.t. At the same time the No.2 contact will close and energize the

overload trip relay OR. ORl and OR2 in series, open in the circuit of the h.t. contactor, keeping it isolated when the overload relay de-energizes on removal of h.t. OR3 makes a hold-on circuit for OR. OR4 closes to light the trip lamp, OR5 closes to ring the alarm bell.

To reset the circuit, the H.T. OFF/TRIP RESET button SWF, must be pressed. This breaks the circuit of OR. The hold-on contact OR3 opens and contacts OR1 and OR2 close. Main h.t. may then be re-applied by pressing the H.T. ON button SWE.

On remote control, the circuit may be reset remotely only by opening the ON/OFF switch. ST5 then de-energizes the reset relay, OR. The set is then switched on again by reclosing the ON/OFF switch. This procedure would not normally be used; investigation should first be made to discover the nature of the overload. (For HS31/1 and HS31A/1 see also Supp.1, Sect.6.4.4.).

6.4.5 Frequency Selector Control Circuit

NOTE: This section is not applicable when an external Frequency Shift Diplex Equipment is used.

To simplify operation of the transmitter, the primary crystal oscillators may be switched to provide six different inputs to the harmonic generator, by operation of the 'Ledex' switch, SWG, in the Mixer Unit. The various functions of the switch are described in Section 6.2.2. Here, is described its operating circuit.

SWG is controlled by the frequency selector switch, SWL, on the main control panel. $\dot{}$

SWN is the AUTO/MANUAL changeover switch. There is no requirement for the MANUAL setting on the HS31 range of transmitters; the switch is a standard fitting for this type of control panel and should always be left at AUTO.

SWG is the Local/Remote switch. When set to LOCAL; the 50V d.c control supply is applied via FS22 to one wafer of SWN and from there, in the AUTO position, to SWL. Depending on the setting of SWL, the supply will be fed via one of tags 1-6 on TB6 to pins 10-15 on plug PLP on the mixer unit. Connection is then made through wafers SWG1 and SWG2 of the 'Ledex' switch to its operating coil. The switch then turns until the 'dead' space on wafer SWG2 reaches the control lead contact carrying the 50V supply; the switch will then stop and stay in that position until the setting of the frequency selector switch, SWL, is altered.

There is no provision for remote operation of the switches as the remainder of the transmitter has to be manually tuned.

7 INSTALLATION

Installation requirements differ according to site conditions and each specific installation will normally have supplied its own Installation Folder, containing full instructional drawings. The following therefore, should be regarded as general guidance rather than specific instructions.

7.1 GENERAL

A site plan is invariably included in the installation folder. The transmitter room must be dry and well ventilated.

The overall dimensions of the transmitter are given in Section 2.1. Care must be taken when siting the transmitter, to provide sufficient access on all sides to facilitate the fitting of large components and to allow the doors to be fully opened and units to be withdrawn for maintenance and adjustment.

Provision must be made for running mains supply, traffic, telephone and control leads.

7.2 PACKING, TRANSPORT AND DELIVERY

The equipment is carefully inspected and tested prior to despatch. When it is disconnected and packed for transport, all heavy items are removed from the cabinets and packed separately. The wiring in the cabinets and the inter-unit wiring, is disturbed as little as possible. Where the wiring must be removed, the cable ends and their respective terminal points are marked with corresponding numbers. The cabinets are suitably braced internally to withstand transport.

The serial numbers of the cases and their contents will be clearly indicated on the Advice Notes and Packing Notes. The latter are usually inserted in a tin compartment on the crate or case. Any irregularities should be endorsed on the carrier's documents and the Company or its authorised agents notified immediately. Where damage has occurred, the case, its contents and the packing should be retained for examination.

The cases are despatched in a weatherproof condition, however, it does not necessarily follow that they are in that condition on arrival. Therefore, should installation be delayed, the equipment should be stored under cover as soon as possible.

7.3 ASSEMBLING THE TRANSMITTER

The cabinets are to be mounted on a wooden plinth; the surfaces of this must be level otherwise difficulty will be experienced in opening doors, operation of door switches etc. The rectifier and control cabinet is mounted on the left.

Fit transformers and other heavy items which will have been removed for purposes of transport. NOTE that transformers are not screwed down but are placed on pegs for easy fitting.

Before placing the cubicles in position, remove and discard the outer bolts from the brackets in the lower corners of the cubicles; both front and rear. Once the cubicles have been placed in position and the upper cabinet assembly mark carried out, screw the cubicles to the plinth (through the vacated holes) by means of the coach bolts found in the linen bag attached to the transmitter.

The a.c. input enters via TBl in the top left (viewed from the rear) of the rectifier cabinet - see Fig.l. The external connections to and from the r.f. cabinet are made via plugs and sockets on its roof - see Fig.3.

Connect up the inter-unit wiring. A diagram of inter-unit connections is shown on drawing Fig.16. Connections between the Rectifier Cabinet and the R.F. Cabinet are made from terminal boards on a bracket at the top of the Rectifier Cabinet. These are shown on the UPPER VIEW on drawing Fig.2 to the plugs and sockets on the roof of the R.F. Cabinet shown on drawing Fig.3. Connection between the various sub-units in the R.F. Cabinet is by plugs and sockets. The wiring is carried on channels inside the cabinet and will not normally be disturbed, therefore simply connect up each sub-unit as it is fitted. The connections between sub-units are best seen on Figs.10 and 11, the r.f. unit circuit diagram, in conjunction with the main inter-unit connections diagram Fig.16. The disposition of the various plugs and sockets may be seen on the relevant component layouts. Fit sub-units, meters and such other components as have been removed for packing and transport.

Check wiring by 'ringing through' or some other quick method. Take care not to 'ring through' any meters.

Check the fuses using the list given in Section 4.2.5. Check for continuity as well as correct rating.

7.4 VALVE INSTALLATION

Fit the valves. Ensure that connections are tight and where flexible connectors are used ensure that there is no strain on those which might damage the seals of the valves.

7.4.1 Fitting the Stage 6 Valve V5 (BR191)

- 1. Open the r.f. cubicle rear door and the Stage 6 cathode compartment door.
- 2. Remove the three wing nuts on the front of the valve connectors and lift off the connector assembly.
- 3. Undo the fasteners, open the grid deck and clip it up by the catch on the left-hand wall.

- 4. Insert the BR191 with the metal seal towards the rear of the cubicle.
- 5. Lower the grid deck and fasten down.
- 6. Reassemble the connector assembly and replace wing nuts.
- 7. Slacken off the three wing nuts on the rear of the connector assembly, insert the three flexible valve connectors between the plates and tighten up the wing nuts.
- 8. Check (a) that the capacitor caps are in their correct position,
 - (b) that all wing nuts are tight.
- 9. The valve is now installed.

When fitting a Type ACT70 valve, ensure that the black centre-tap cathode connector is towards the rear of the transmitter.

8 SETTING-UP

After installation, before any attempt is made to operate the transmitter, it must be systematically checked, commencing with the interlocks and control circuits and working through filaments, bias and auxiliary h.t. supplies, to the main h.t. supply.

8.1 PRELIMINARY

1. Check that the primary taps of all transformers, except TR9-14 are correct for the mains supply in use. In order to obtain adequate control on STAGE 5 and RECTIFIER FILAMENT regulators, the primary taps on TR9-14 must be set to 20 volts <u>less</u> than the mains voltage.

The single phase transformer primary taps are listed in Table 1 to assist setting-up.

Table 1

Function	Circuit	Identity Primary Tap					
	Ref.	No.	240 V	220 V	220 V	0	+107
6V Fils.	TR2	W.24068 Sh.59	13	11	9	5	3
12V Fils.	TR3	₩.24582 Sh.13	18	16	14	6	4
Bias	TR5	W.23241 Sh.33	13	11	9	5	3
Aux. H.T.	TR6	W.24586 Sh.26	13	11	9	5	3
Rect. Fils.	TR7	W.24743 Sh.27	7	6	5	3	2
H.T. Rect. Fils.	TR9-14	W.27206 Sh.4	14	12	10	5	3

For 4.05-4.1 kV the secondary taps on the h.t. transformer, TR8 must be set to the 3000V terminals.

2. Check the secondary taps of the following transformers.

Function Circuit Ref. Identity Secondary Taps 50V Control TR1 W.37518 Sh.2 417 5V Fils. TR4 W.37518 Sh.3 6.1V Bias TR5 W.23241 Sh.33 190V Aux. H.T. W.24586 Sh.26 TR6 435V Main H.T. W.22129 Sh.3 TR8 3000V

Table 2

- 3. Check the zero settings on all meters and adjust as necessary.
- 4. Set the following control switches:-

AUTO/MANUAL switch to AUTO. LOCAL/REMOTE switch to LOCAL.

- 5. Push the 4th and 5th R.F. Amplifier sub-unit firmly into the r.f. cabinet and set the STAGE 5 H.T. INTERLOCK control to 'WORKING'.
- 6. Test Equipment required: external voltmeter with an accuracy of 1%.
- 7. Check that TB5(1) and (2) are linked either directly or via an external interlock circuit (HS31/1 and HS31A/1).

8.2 CHECKING RELAY AND CONTACTOR OPERATION

The control circuits are explained in Section 6.4 to which, reference should be made.

- 1. Remove fuses FS5, FS7-FS12 and FS14-FS17 (see Fig.2 or 2B). This will isolate the filaments and h.t. circuits and allow the operation of the various relays and contactors to be checked without the supplies they control being switched on.
- 2. Close the external isolator switch. Set the FEEDER TUNE and ST.4 TUNE to 5, set FREQUENCY switch to A and carry out instructions 4 and 5 of Section 8.1.
- 3. Close and lock the front and rear doors of the Rectifier Cabinet The door switches SWA and SWB will close and the a.c. voltmeter, Ml on the meter panel at the top of the Rectifier Cabinet will now indicate. Using its selector switch (SWH) on the H.T. and FILAMENTS control panel, check the voltage of each phase of the supply.

The 50V d.c. indicator lamp (LP1) and frequency Lamp A (LP6) will light.

Check that the a.c. supply is switched off when either the front or rear door lock-handles are set to 'unlock', this will check the operation of the switches SWA and SWB.

4. Close and relock the doors of the cabinet.

Close the rear doors of the Stage 6 compartments in the r.f. cabinet and operate the filament interlock (SWH) adjacent to the lower door.

Close and lock the rear door of the r.f. cabinet.

5. Press the START button, SWC. The start relay ST will close and the fan start. As the air pressure builds up, the air interlock switch SWN, will close and energize the filament contactor FC, which will energize the delay relay FD.

30 secs after FD has operated, FF will operate and the FILS lamp, LP2, will light. After a further 5 secs, the auxiliary h.t. relay LA will 'make' and the AUX H.T. lamp, LP3, will light.

- 6. When satisfied that the above sequence has occurred, press the h.t. on button SWE. The main h.t. contactor MC will 'make' and the h.t. lamp, LP4, light.
- 7. In the auxiliary h.t. contactor control circuit are interlocks associated with the Stage 4 tuning control and the feeder tuning control, the STAGE 5 INTERLOCK switch on the front of the r.f. cabinet and the r.f. cabinet rear door switch; check that the auxiliary h.t. relay, LA, and the main h.t. contactor, MC, immediately de-energize and the associated lamps (LP3 and LP4) go out when either of the tuning controls are moved sufficiently to operate their associated interlocks (see Section 4.3.2.2. and 4.3.2.4 for details) and when the STAGE 5 INTERLOCK switch is set to SAFE, and when the lock-handle on the r.f. cabinet rear door is set to 'unlock', thus proving the operation of each associated interlock.

After checking each interlock relay LA should automatically operate again and LP3 should light when the interlock is reclosed. Reset the main h.t. by pressing the H.T. ON switch SWE.

8. Set the frequency selector switch, SWL, on the control panel, to each of its six positions in turn. At each setting check that the appropriate indicator lamp lights. This will prove the operation of the 'Ledex' switch in the Mixer Unit.

9. Press the H.T. OFF and TRIP RESET button. The main h.t. contactor MC will de-energize and the h.t. lamp extinguish. Press the STOP button and the remainder of the relays will de-energize and all the lights, except the 50V d.c. indicator, will be extinguished.

8.2.1 Checking the Operation of the Air Pressure Switch

Locate the two nozzles provided in the transmitter air ducting; one is in the bottom of the Stage 6 coil unit and one in the top of the valve compartment.

Remove the sealing screws from the nozzles and connect a pressure gauge. With a piece of card, block the air intake filter and switch on the transmitter. Press the START button. Relay ST will close and the fan will start. The reading on the pressure gauge will be very low. Gradually slide the card from the air intake and check that the air switch closes (indicated by the operating of FC) at 1.2 in w.g.

If the switch does not close at 1.2 in w.g., remove the cover from the air switch and adjust the spring pressure, by means of the knurled screw, until it does. Do not forget to replace the sealing screws before putting the transmitter into service.

Gradually reduce the air flow by sliding the card back over the air intake and check that the lowest point at which the switch opens is greater than 0.8 in w.g.

8.3 CHECKING FILAMENT SUPPLIES

Test Equipment required: voltmeter with accuracy of 1% at 12.6V a.c.

8.3.1 Stage 6 Filament

Replace fuse FS14, and FS15 (6 amp fuses), then close and lock the front door of the Rectifier Cabinet.

Set the Filament Voltmeter on the front of the r.f. cabinet to the Stage 6 filament position (12.6V). Turn the Stage 6 filament control on the front of the Rectifier Cabinet fully anticlockwise.

Press the START button and note the reading on the voltmeter. It should show a reduced reading at first and then after 30 seconds, when relay FF operates, rise to full value.

Adjust the Stage 6 filament control, until the indicated voltage is approximately 12.6V a.c.

Connect the external voltmeter to the filament pins on the BR191. Readjust the Stage 6 filament control for 12.6V a.c. on this meter and note the slightly higher reading on the filament voltmeter M8 on the front panel; when setting Stage 6 filaments this reading should be used Disconnect the external voltmeter.

During operation the filament voltage should be checked and maintained at the slightly higher voltage, noted on the front panel meter, by means of the Stage 6 filament control.

8.3.2 Stage 5 and Rectifier Filaments

Switch off and connect the external voltmeter across the secondary terminals of one of the main h.t. filament transformers, and secure the meter in a position in which it can be seen through the rear window of the Rectifier Cabinet, when the door is shut. Insert fuses FS10, 11 and 12 (2 Amp).

Set the Filament Voltmeter on the r.f. cabinet to show STAGE 5 filament voltage.

Set the STAGE 5 and RECTIFIER FILAMENT control on the front of the Rectifier Cabinet fully anticlockwise.

Shut doors and switch on; adjust the control for a reading of 5V a.c. on the test meter across the rectifier filaments. Note the reading of Stage 5 filament voltage on the meter on the r.f. cabinet. It should be 5 volts. If not, adjust the preset resistors, R8, R9 and R10 inside the Rectifier Cabinet, or the secondary taps on TR4. After each adjustment check the rectifier filament voltage shown on the test meter, and maintain it at 5 volts by adjustment of the front panel control.

Adjustment is correct when both filament voltages are correct with the front panel control at approximately mid-setting, this allows adequate adjustment of both supplies for variations of mains voltage.

Switch off and remove the external voltmeter.

8.3.3 Auxiliary Filaments

This is a preset adjustment for which no panel control is necessary.

Insert fuse FS5(2A) and set the filament voltmeter switch to AUX. 6.3V a.c.

Switch on. The meter should read 6.3V a.c. If not, the preset resistor R2 must be adjusted. To do this it is necessary to switch off and open the rectifier unit door to enable the meter panel to be hinged forward so allowing access to the resistor.

8.4 CHECKING BIAS AND AUXILIARY H.T. SUPPLIES

With the transmitter switched off, replace the fuse FS17 (2 amp).

Close the cabinet doors and press the START button. Wait for the filaments and auxiliary h.t. lamps to light.

Check the bias voltages on the Auxiliary Voltmeter in the r.f. cabinet, they should be approximately as follows:-

Mixer Suppressor, 75V; Stages 2 & 3, 75V; Stage 4, 25V; Stage 5, 110V; Stage 6, 110V.

Any major discrepancy in bias value should be investigated and corrected; the exact bias levels of each stage must be adjusted after application of h.t. see Section 8.6.

Switch off the transmitter and replace fuses FS16(2A). Switch on again and check the auxiliary h.t. voltages on the Auxiliary Voltmeter. They should be: - 450V and 280V. The 450V h.t. may be high if the static feed on Stage 4 has not been adjusted. See 8.6(vi).

8.5 CHECKING THE MAIN H.T. RECTIFIER OUTPUT

With the transmitter switched off, replace fuses FS7, FS8 and FS9(25A). Close the doors. Press the START button and check that the filament and auxiliary h.t. indication lamps light. Press the H.T. ON button. Check that the h.t. indicator lamp lights. The H.T. Voltmeter on the meter panel at the top of the Rectifier Cabinet should show 4 kV. Set the h.t. volts selector switch to LOW. The voltmeter should now show a lower reading, depending upon the load on the rectifier. With only static feeds on the Stage 6 valve it will be about 3.3 kV.

8.6 ADJUSTING THE BIAS VOLTAGES

The bias voltages (except mixer suppressor bias) are set up by adjusting the static feeds (i.e. with no r.f. drive) to each stage, and will require adjustment after valve replacement if optimum performance is to be obtained.

The bias voltages for the mixer and Stages 4-6 are adjusted by variable resistors; those for Stages 2 and 3 in the Mixer Unit are accessible when the unit is pulled forward on its runners, but those for Stages 4-6 are mounted on the meter panel at the front of the Control, Power Supply Cabinet, and can be adjusted without switching the transmitter off.

(i) Close the doors. Press the START button and check that the filaments and auxiliary h.t. lamps light. Press the H.T. ON button and check that the h.t. indicator lamp lights. Set H.T. VOLTS switch to FULL. Set the H.G. METERING switch to MIXER.

- (ii) Withdraw the Mixer Unit on its runners.
- (iii) Set the MIXER and MONITOR METERING switch to V10 so that the meter indicates Stage 2 cathode current.
 Adjust the Stage 2 bias potentiometer RV4 for a reading of 40 mA on the meter.
 - (iv) Set the meter switch to Vll (reading Stage 3 cathode current). Adjust RV3 the Stage 3 bias potentiometer, for a reading of 25 mA on the meter.
 - Push the Mixer Unit back into the cabinet.
 - (v) Set the AUXILIARY VOLTMETER switch on the front of the r.f. cabinet to read MIXER SUP. BIAS; it should be 105V approx.
 - (vi) Set the AUXILIARY VOLTMETER switch to read Stage 4 bias; and check the Stage 4 cathode current; it should be 90 mA when the bias reading is 20-25V. If necessary adjust the Stage 4 bias potentiometer RV10, on the meter panel on the front of the Control, Power Supply Cabinet, to obtain a reading of 90 mA. Check that the stage h.t. is approximately 450V. It may be necessary to alter the transformer taps (TR6) to obtain the correct voltage.
- (vii) Set the AUXILIARY VOLTMETER switch to read Stage 5 bias; and check the Stage 5 cathode current; it should be 60 mA when the bias reading is 100-110V. If necessary, adjust the Stage 5 bias potentiometer RVII, on the meter panel at the front of the Control, Power Supply Cabinet, to obtain a reading of 60 mA.
- (viii) Set the AUXILIARY VOLTMETER switch to read Stage 6 bias and check the Stage 6 cathode current; it should be 0.32A when the bias reading is 100-110V. If necessary, adjust the Stage 6 bias potentiometer RV12, on the meter panel at the front of the Control, Power Supply Cabinet, to obtain a reading of 0.32A

8.7 SETTING-UP THE OVERLOAD RELAYS

The overload relays are set up when the transmitter has been tuned and is operating on full power. The instructions are contained in this section for the sake of completeness.

The relays are situated in the Rectifier Cabinet, and are not accessible when the power supply is on. Accordingly, adjustments must be made progressively. It will be seen that there is a small red flag associated with each relay contact assembly; this falls into a downward position when the relay operates to provide a rapid indication of which relay has tripped when a fault occurs. Before resuming operation after a trip, the flag must be returned to its normal position manually.

See Section 11.11 when using an ACT70 valve in Stage 6.

(a) Stage 5 Relay OD

Apply r.f. drive, and set the cathode current of Stage 5 to 280 mA, detune the stage if necessary. Take care to restrict the time duration of this detune period, as excessive temperature rise in the valves may take place. It is also advisable to keep a check on Stage 6 feed, as, with an excessive feed, due to detuning Stage 5, Stage 6 relay OE will operate the overload relay.

If the relay trips before the current reaches 280 mA, switch off, remove the relay cover and tighten up the tensioning spring, then switch on again and carry on increasing the cathode current. Repeat until the relay just trips at 280 mA.

If the relay trips after the current reaches 280 mA, switch off and slacken off the tensioning spring, then switch on and slowly increase the current again. Repeat until the relay just trips at 280 mA.

(b) Stage 6 Relay OE

Setting-up this relay is done by adjustment of its tensioning spring and of shunt resistance, RV6.

Set RV6 to about mid-way. Switch on and adjust Stage 6 cathode current to 1.8 amps. If it is necessary to detune the Stage to obtain this current; it must be done only for very short periods as for Stage 5

If the relay trips at less than 1.8 amps, switch off and turn RV6 clockwise; switch on again and carry on increasing the current. Repeat until the relay just trips at 1.8 amps. If this adjustment cannot be obtained, set RV6 to its mid-position and tighten up the relay tensioning spring. Carry on checking and adjusting the spring until the relay just trips at 1.8 amps.

If the relay does not trip at 1.8 amps, reduce the current, switch off and turn RV6 a little anticlockwise; switch on again and increase the cathode current again. Repeat until the relay just trips at 1.8A. In this case if the adjustment of RV6 does not bring the relay to the required operating point, set it to mid-position and slacken off the relay tensioning spring.

In the HS31/1 and HS31A/1 there are additional overload relays; the setting-up of these is described in Supplement 1, Section 8.7.

8.8 PILOT CARRIER COMPRESSION

- (a) Set up the transmitter for Two Tone Operation as described in Section 9.2.
- (b) Set the I.F. Drive to give -26 dB carrier and one of the two tones at the level used to check PEP (see Section 9.2 (e)). Check that when the tone is switched off the change in pilot carrier level is less than 1 dB.

8.9 NOISE LEVEL

- (a) Set up the transmitter for Single Tone Operation as described in Section 9.1.
- (b) Switch off the pilot carrier. Check on the spectrum analyser with the trace running at a 30 second period and the 6 c/s filter in circuit that every noise component is more than 44 dB below the level of the tone.

8.10 METHOD OF NEUTRALIZING

Neutralizing should be carried out when the set is first tuned and subsequently should only be necessary after changing valves. It should be carried out at 20 Mc/s, or alternatively at the highest frequency normally used.

Either of two methods may be used.

(a) Adjust Stage 5 tuning control for minimum cathode current.

With the drive level reduced, detune on either side of the tuning point and note Stage 6 grid current. If Stage 5 is properly neutralized, the drop in cathode current will coincide with a peak of Stage 6 grid current. If there is an increase of Stage 6 grid current on one side of the tuning point, rotate the Stage 5 neutralizing control a little in the same direction as the tuning control was turned to give the rise. Retune Stage 4. Swing the tuning control through the tuning point again and note the cathode and Stage 6 grid currents. Continue adjusting the neutralizing control and checking the currents until the dip in Stage 5 cathode current and the rise in Stage 6 grid current exactly coincide.

NOTE: It is important to return Stage 4 after each adjustment of the neutralizing control.

(b) Completely detune Stage 5.

Adjust the level control to give approximately 100 mA Stage 5 cathode current. Tune through minimum cathode current then detune completely on the other side of the tuning point and note the current.

Adjust the neutralizing control until the cathode reading is the same when the stage is completely detuned on either side of the tuning point, readjusting Stage 4 tune as necessary.

8.11 STAGE 5-6 PRESET CAPACITOR COUPLING

In the HS31/1 and HS31A/1, Stage 5 is coupled to Stage 6 by a preset capacitor C35. The method of setting-up this capacitor is described in Supplement 1, Section 8.11.

When the transmitter is first installed or after being closed down for maintenance, it should be checked as described in Section 8 before being tuned.

Test Equipment Required: Spectrum Analyser 0A.1094 (A.P.103540)
Artificial load for transmitter (6000).

9.1 SINGLE TONE OPERATION CW/FSK

9.1.1 Calculation of Harmonic Generator and Crystal Drive Frequency

For any radiated frequency in the range 4-275 Mc/s the frequency multiplication required in the harmonic generator stages of the mixer unit and the crystal oscillator frequency to be used is calculated as follows:-

fRAD = Final radiated frequency in Mc/s.

fx = Crystal oscillator frequency in Mc/s.

i.f. = Keyed signal to mixer from keying unit (3.1 Mc/s for HS31 and HS31/1).

When fRAD is less than 10 Mc/s

m = 2

$$fRAD = 2fx - i.f. Mc/s \text{ or } fx = \frac{fRAD + i.f.}{2} Mc/s.$$

When fRAD is between 10 and 17 Mc/s

m = 2

$$fRAD = 2fx + i.f. Mc/s \text{ or } fx = \frac{fRAD - i.f.}{2} Mc/s.$$

When fRAD is greater than 17 Mc/s

m = 4

$$fRAD = 4fx + i.f. Mc/s \text{ or } fx = \frac{fRAD - i.f}{4} \cdot Mc/s.$$

An explanation of the manner of operation of the harmonic generator and the reasons underlying the selection of the primary crystal frequencies appears in Section 6.2.1.

9.1.2 Preliminary

- (a) Connect the i.f. drive to SKR and set it to give one tone.
- (b) Select the HG input crystal to the frequency required (calculated in Section 9.1.1).
- (c) With the exception of the Stage 6 Coupling set all the tuning controls to the settings shown on the calibration curves for the frequency required (calculated in Section 9.1.1).
- (d) Set Stage 6 Coupling to 0. Set the Stage 6 grid trip switch on the front of the Rectifier and Control Unit to CW/FSK depending on frequency.
- (e) Set the HG input level to 0.1 watt and the i.f. drive to 0.25 watt. Turn all the mixer bias controls to MANUAL and A-F fully counterclockwise. Set the MIXER GAIN switch to MANUAL.
- (f) Turn the Drive Control (Stage 4 input) on the 4th and 5th R.F. Amplifier to maximum.
- (g) See Supp.1, Sect.9.1.2 for setting of links in the HS31A and HS31A/1.
- (h) Press the START button and when AUX. H.T. lamp has lit tune the HG section of the Mixer Unit for Peak Ig of V5/V6 or Peak Ic of V7/V8.
- (i) Turn the mixer-gain control, MANUAL, clockwise about halfway and tune the mixer section for maximum reading of Stage 4 Vg. When the maximum has been found adjust the MANUAL control for about 10 volts on the STAGE 4 GRID VOLTS meter.
- (j) Set the mixer-gain switch to AUTO and check that the Frequency Selector switch on the control panel selects the appropriate gain control. Set up as for the Manual Control.
- (k) Return to MANUAL control.
- (1) Tune Stage 4 for a maximum reading on Stage 5 grid peak voltmeter. Adjust the reading by the MANUAL control till the grid current is just showing on Stage 5 grid current meter. Turn the front panel drive control (DRIVE LEVEL) to zero.
- (m) Turn the Main H.T. Selector to 'LOW' and increase the drive level till Stage 5 cathode current is about 30 mA.

- (n) Tune Stage 5 for minimum cathode current, in Stage 5, keeping the drive level adjusted so that the Stage 6 cathode current does not rise above 0.6A or grid current above 100 mA.
- (o) Adjust Stage 6 tuning control for minimum cathode current, taking care that the grid current does not rise above 100 mA.
- (p) Set the drive level to give approximately 100 mA Stage 6 grid current and increase the coupling till the grid current just begins to fall or the FEEDER INDICATOR shows a reading. Check the tuning of Stages 4, 5 and 6 keeping Stage 6 grid current below 100 mA.
- (q) Adjust the FEEDER TUNE for peak indicator feeding. This should correspond to a fall in grid current and a rise in cathode current indicating the loading of the valve.
- (r) Reduce the drive level control to zero and switch the h.t. to 'FULL'.
- (s) Increase the drive level to give a Stage 6 grid current of 200 mA and readjust Stage 6 tuning control for minimum cathode current.
- (t) Increase Stage 6 coupling, retuning the anode circuit and adjusting the drive level in steps until the cathode and grid currents of Stage 6 are approximately 1.5A and 200 mA respectively.
- (u) Check the feeder circuit tune by moving the FEEDER TUNE control a few degrees in each direction. This should cause an increase in grid current in both cases.
- (v) If this is not so the control should be adjusted slightly in the direction in which the grid current falls and the anode circuit retuned.
- (w) Check again the feeder circuit tune and if necessary repeat the procedure until the grid current rises slightly whichever direction the FEEDER TUNE control is moved.

9.1.3 Checking Neutralizing

Check that when Stage 5 is detuned in either direction the grid current of Stage 6 falls. If the grid current shows a marked tendency to rise, the neutralizing control should be adjusted to correct this, and the control setting logged.

After any adjustment of the neutralizing control it will be found necessary to readjust Stage 4 tune. The method of neutralizing is described in Section 8.10.

9.1.4 Final Tuning

Increase the drive level for the Stage 6 Ig required for the frequency in use, see Table 3. If necessary, readjust the coupling to obtain the requisite cathode current also shown in Table 3...

Table 3

Туре	Frequency	Stage 6 Ig	Stage 6 Ic	Stage 5 Ic	Power Output
HS31 & HS31/1	4-21 Mc/s 21.27.5 Mc/s	250 mA 160 mA	1.6A 1.25A	≯ 240 mA ≯ 240 mA	3,5 kW 2 kW
HS31A & HS31A/1	2.5-20 Mc/s	250 mA	1.6A	≯ 240 mA	3.5 kW

If a water cooled artificial load is being used for tuning purposes check the power in the load, it should not be less than the figure given in Table 3.

Check all meter readings against the typical power figures given in Fig.18 (HS31 and HS31/1) or Fig.18A (HS31A and HS31A/1).

9.2 TWO TONE OPERATION (I.S.B.)

- (a) Tune the transmitter for Single Tone Operation, Section 9.1.1 to 9.1.4.
- (b) Reduce the drive level to zero and switch the I.F. Drive to Two Tone, 0.25 watt output (zero level).
- (c) Connect the Spectrum Analyser to the monitor distribution point marked STAGE 6 on the front of the Mixer Unit and tune the analyser to the radiated frequency.
- (d) Increase the drive level till the Stage 6 grid current reads approximately 130 mA. Check the tune of Stage 6 and increase the Stage 6 coupling until the Stage 6 grid and cathode currents correspond to the figures given for the frequency in use, see Table 4.

Table 4

Туре	Frequency	Stage 6 Ig	Stage 6 Ic	Stage 5 Ic	Power Output
HS31 & HS31/1	4-21 Mc/s 21-27.5 Mc/s	100 mA 60 mA	1.1A 0.8A	160-170 mA 160-170 mA	3.5 kW 2.5 kW
HS31A & HS31A/1	2.5-20 Mc/s	100 mA	1.1A	160-170 mA	3.5 kW

NOTE: The figures given in Tables 3, 4, 5, 6 and 7 are for a BR191 valve. For figures pertaining to ACT70 valves see Section 11.11.

Check the tune of the feeder circuit (FEEDER TUNE) and if necessary readjust as described in Section 9.1.2 (r)-(w).

- (e) The levels given in (d) will give a mean output level of 1.25 kW (PEP 3.5 kW), if a water cooled load is in use, check this and note the feeder indication to provide a subsequent check of power output level.
- (f) Detune Stage 5, moving the control in an anticlockwise direction, till the cathode current increases by 10 mA (this improves the linearity of the stage) and if necessary increase the drive level to maintain the level of power output.
- (g) Now adjust the Stage 5 feedback potentiometer appropriate to the frequency range in use, to give the lowest level of IP's as indicated on the Spectrum Analyser.
- (h) Check the IP's for each level of drive in 2 dB steps down to -10 dB. In each case the highest IP should not exceed a level of -36 dB below the level of either tone.

It may be necessary to readjust the feedback to obtain a compromise between the best conditions at high and low arive levels. The worst condition is often found when Stage 6 grid current is approximately 15 mA, -6 dB to -8 dB.

NOTE: It is only necessary to adjust the Stage 5 feedback potentiometers at the centres of the frequency ranges. Therefore, if more than one frequency is used on any one range, the feedback potentiometer should be adjusted on the frequency nearest the centre of the range. It will not be necessary to make further adjustment when shifting a working frequency to anywhere else in that range, for that reason the feedback potentiometers are preset controls and no scale logging facilities are necessary.

9.2.1 Final Adjustments for Optimum Linearity

The distortion introduced by Stages 5 and 6 is dependent on bias and loading of the valves. It may be found that a considerable departure from the static feeds quoted in 8.4 give a worthwhile improvement in linearity, this applies particularly to Stage 5 valves (Clll2) not made by the English Electric Valve Company.

To obtain linearity the static feeds may be set within the limits shown in Table 5.

Table 5

Stage	Static Feed
Stage 5 Ic	45-60 mA
Stage 6 Ig	0.2-0.32A

These figures apply with an h.t. of 4.0 kV, slightly higher figures will apply if the h.t. is greater.

In consequence the loading figures of Stage 6 should be found to lie within the limits shown in Table 6.

Table 6
Stage 6 Loading Limits

Туре	Frequency	Ig	Ic	Power Output
HS31 & HS31/1	4-21 Mc/s 21-27.5 Mc/s 2.5-20 Mc/s	75-100 mA 40-60 mA 75-100 mA	0.96-1.1A 0.7-0.8A 0.95-1.1A	3.5 kW PEP 2.5 kW PEP 3.5 kW PEP
HS31A/1				

The Stage 5 cathode current however should not be allowed to exceed 180 mA, and if the drive level is sufficient to cause Stage 5 grid current to flow then the specification level IP's will be found difficult to achieve.

If Stage 5 is loaded to the limit, i.e. 240 mA at 21 Mc/s CW (HS31 and HS31/1) or 20 Mc/s CW (HS31A and HS31A/1) this will in general be found to be optimum.

The degree of mistune however may require to be slightly less than the nominal 10 mA (see Section 9.2 (f) rise Stage 5 cathode current. When the IP's either side of the two tones are unequal in amplitude it is often useful to detune to the degree required for balance; greater than 10 mA rise of cathode current should not be necessary.

9.3 D.S.B. SIGNAL ADJUSTMENT

(NOTE: HS31/1 or HS-71A/1 Stage 6 grid trip switch set to I.S.B.).

The carrier level is adjusted by first setting-up the transmitter with a two tone I.S.B. (Section 9.2) signal.

Apply the carrier via the D.S.B. equipment and adjust the gain of the mixer stage with the front panel drive control at maximum for the power output given in Table 7 with the Stage 6 Ig and Ic at the levels indicated.

Table 7 [∗]

Туре	Frequency	Stage 6 Ig	Stage 6 Ic	Power Output
HS31 & HS31/1 HS31A & HS31A/1	4-21 Mc/s 21-27.5 Mc/s 2.5-20 Mc/s	60 mA 50 mA 60 mA	0.95A 0.9A 0.95A	1.5 kW 1.0 kW 1.5 kW

Check the response from 200 to 350 c/s at a modulation depth of 60% and the distortion at a number of tone frequencies between 200 and 3500 c/s at 80% modulation depth.

The response should not vary by more than $\pm 2\frac{1}{2}$ dB and the distortion be not greater than 10%.

NOTE: These figures include the characteristics of the drive unit, i.e. ±2 dB response and 2% distortion.

10 OPERATING INSTRUCTIONS

This section contains 'switching' instructions only. It is assumed that the transmitter has been set up and tuned as described in Sections 8 and 9, and is in all respects ready for use and that the drive equipment is correctly set up and is switched ON.

10.1 STARTING-UP INSTRUCTIONS

- 1. Close and secure the front and rear doors of the Rectifier Cabinet and the rear door of the R.F. Cabinet.
- 2. Close the external wall isolator switch.

These figures apply to BR191B valve; for ACT70 valve refer to Sect.11.11.

3. Check that the various control switches are set to their correct positions as follows:-

AUTO/MANUAL switch to AUTO (when using HD61B, to MANUAL). LOCAL/REMOTE switch to LOCAL.

H.T. Volts selector switch to FULL.

The primary oscillator equipment may be set up to provide crystal drive frequencies for up to six different radiated frequencies. The crystal oscillators are selected by operation of the FREQUENCY SELECTOR switch, which must now be set to the oscillator required.

- 4. Check the voltage of each phase of the a.c. supply.
- 5. Check that the 50V d.c. indicator lamp and one of the FREQUENCY indicator lamps have lit. (When using HD61B only 50V d.c. lamp will light).
- 6. Press the START button.

The fan will start.

Check that after half a minute the filament indicator lamp lights, followed by the auxiliary h.t. lamp.

Check the filament voltages on the voltmeter on the R.F. Cabinet and adjust as necessary by the filament controls on the Rectifier Cabinet.

Check the bias and auxiliary h.t. supplies on the voltmeter on the R.F. Cabinet, and the static current of Stage 4.

7. Press the H.T. ON button.

Check that the h.t. indicator lamp lights. Check the reading on the h.t. voltmeter on the meter panel and the static currents of Stages 5 and 6.

8. Apply the i.f. drive input.

Check that the voltage and current readings of each stage are in accordance with the figures obtained when the transmitter was tuned.

10.2 OVERLOAD RESET

If the overload relays trip, the main h.t. contactor will be de-energized and the h.t. indicator lamp will be extinguished.

Unless there is an apparent defect, main h.t. may be restored by pressing the H.T. OFF & RESET button and then the H.T. ON button.

Check the meter readings.

If the overload relays trip again on reapplication of h.t., the cause must be investigated.

10.3 CLOSING DOWN INSTRUCTIONS

(a) Temporary Stoppage.

Transfer any incoming traffic.

Press the H.T. OFF & RESET switch - this will remove main h.t. only.

(b) Complete Close Down.

Transfer any incoming traffic.

Press the STOP button.

All circuits except the 50V supply will be de-energized. The 50V unit will remain on as long as the a.c. supply is connected to the transmitter and the doors of the Rectifier Cabinet are locked. If either of the doors is unlocked, the associated interlock switch will be operated and the a.c. supply disconnected from all circuits.

Finally, open the external a.c. supply switch. The transmitter is now completely disconnected from the mains.

11.1 ROUTINE MAINTENANCE

11.1.1 Daily (when the set is in use)

- (a) Take a complete set of meter readings and check them against the readings noted when the transmitter was tuned.
- (b) Check the filament, bias and h.t. meter readings.
- (c) Check the air filter and replace if dirty. Wash the dirty filter as instructed in Section 11.8.

11.1.2 Weekly

Check that the fan is running quietly and is cool.

Check that the filament connections of the high-power valves are tight. Reverse the filament connections of Stage 5 by means of the switch (SWK) every week of service.

Blow out any dust which may have accumulated in the cubicles. Remove any dust from the envelopes of the high-power valves with a soft rag moistened with white spirit. Cleaning must only be done when the valves are quite cold. Check that the dust filters are clean. (Filters of the polythene type may be cleaned in warm water, see Section 11.8.)

Check that the overload relays operate as described in the setting-up instructions, Section 8.7.

Check that the 'Ledex' switch operates when the frequency selector switch is operated.

11.1.3 Two-Monthly

Every two months, remove the caps from the grease cups of the a.c. motor used in the suction fan, and fill the cups with grease ALVAIA RA. Light pressure should be applied to ensure that the grease reaches the bearings. Refit the caps.

11.1.4 Quarterly

Check the functioning of the filament delay switch.

Examine the contactors and relays. The bearings of the contactors may be lightly oiled; over oiling is worse than not oiling at all. The relays should never be oiled.

If the contacts of contactors require cleaning, this should be done with carbon tetrachloride or one of the patent contact cleaning fluids. If they are badly burnt it may be possible to restore the surfaces by careful filling with a smooth file and then burnishing, taking care to maintain the original shape of the contact. Abrasive paper should never be used.

Relay contacts may be cleaned with a cleaning fluid. If contacts are badly burnt, the whole relay should be replaced.

Check the r.f. unit fan. This requires only the normal machine maintenance. The oil level in the bearing will require occasional topping up.

Check that all four ball contacts on the Spring Contact Assembly of the anode coil (L19) are making contact throughout the whole travel of the coil, check also that the contact pressure is approximately $2\frac{1}{2}$ lb

If all the balls do not make contact at the correct pressure, they should be adjusted as follows:-

NOTE: Reference numbers quoted in the following adjustments will be found in Fig. 4.

- 1. Wind the Spring Contact Assembly (Ref.84) to the top of the coil.
- 2. Adjust the pressure on the ball contacts by slackening the special nuts holding the top of the rod in position in the slot in the mounting plate, setting the rod nearer the coil for greater pressure and away from the coil for less pressure. Tighten the special nuts.
- 3. Wind the Spring Contact Assembly to the bottom of the coil.
- 4. Adjust the pressure on the ball contacts by slackening the special nuts holding the bottom of the rod in position, and adjusting the rods position in the same way as for (2) above. Tighten the special nuts.
- 5. Repeat (1) (4) as often as necessary until the Spring Contact Assembly exerts a uniform pressure of $2\frac{1}{2}$ lb, along the whole length of the coil (L19).

NOTE: The pressure of these contacts should not be allowed to fall below 2 lb each. Adjust or replace if this figure is not achieved.

A method of checking the pressure of the ball contacts on the coil; is to make a loop of wire around a contact and hook a spring balance through the loop. Full the contact away from the coil at its point of contact by means of the ring at the end of the spring balance, and check that the spring balance reads approximately $2\frac{1}{2}$ lb at the 'breaking' point. Check that the anode coil and ball contacts are clean. If not, clean with a soft cloth and apply a very thin film of MS5 Silicon grease to the contact surface of coil. See Section 11.7 for self-lubricating contacts.

11.1.5 Yearly

Check over all terminal connections.

Check all clamp and/or flexible cables for signs of wear.

Check the insulation of the power circuits.

Verify that all cubicles and other pieces of equipment are properly earthed, and that the earth connections are sound.

Lightly oil lock mechanism on door switch.

11.2 ALIGNMENT OF THE MIXER UNIT

Circuit Diagram Figs. 12 and 13.

Component Layout Fig.6. Calibration Curves Fig.19.

Test Equipment required:

- 1 Two Tone Test Generator TF1143 (AP.103480 and 103481)
- 1 Spectrum Analyser OA1094 (AP.103540)
- 1 Signal Generator TF1449 or CT218
- 1 Valve Voltmeter TF428 or CT854 (to be connected by 2 yards of coaxial cable and terminated in 220Ω and 33 pF in parallel).
- 2 Avometers 40, 7 or 8 or AP47A
- 1 Insulation test set.
- l Test rig for mixer panel
- 1 Artificial load for transmit (600Ω)

Also required crystal oscillator panel such as HD61B or HD21.

The drawing references against component identities throughout this section, refer to the component layout.

The Mixer Unit is set up at the factory and should not require alignment when the transmitter is first installed.

The following section described the complete procedure for alignment, but it should be noted that sub-sections 11.2.3 and 11.2.5, covering balancing and final alignment should be sufficient for normal purposes.

The alignment is to be carried out in a screened room on multi-transmitter stations to eliminate effects of r.f. fields on the test equipment using the test harness described below.

The test ring for the mixer panel is a metal stand with an angle iron framework top pivoted in the centre; it has guides and clips to hold the mixer unit firmly when placed on the rig. This allows the mixer panel to be turned over and locked in any convenient position whilst aligning it.

Around the test rig the test equipment should be placed at a convenient level for the person aligning the units. The unit requires a power supply which gives an output of 280V stabilized, 400V d.c., 6.3V a.c. and -150V d.c.

- 11.2.1 Preliminary adjustment of the Harmonic Generator.
 - (i) Withdraw the Mixer Unit on its runners and remove its baseplate.
 - (ii) Connect a valve voltmeter across R131(4J) in the Monitor Frequency Changer Unit, i.e. across the output of the Harmonic Generator Unit.

 Set all cores and trimmers to approximately their mid-positions.
 - (iii) Set the Harmonic Generator frequency range switch SWA(5K), fHG MHz, to the 4/8 MHz range.
 - (iv) Connect a Signal Generator to the 'H.G. INPUT' socket, SKR(8B), and apply an input at 4 MHz of approximately 1 to 2 volts.

Set the H.G. TUNE control to the 4 MHz tuning point given by the calibration curves.

Adjust TR1(5B), L2(2H) and TR3(2K) for maximum reading on the valve voltmeter.

- (v) Set the H.G. TUNE control to the 8 MHz point given by the calibration curves.
 - Adjust C6(3C), C32(2H) and C50(2K) for maximum on the valve voltmeter.
- (vi) Repeat (iv) and (v) as often as necessary, but tune the 'H.G.

 TUNE' control for maximum on the valve voltmeter after reference
 to the calibration curves, adjusting the coils and trimmers until
 no increase in output occurs on readjustment.
- (vii) Set the 'fHG MHz' switch to 8/16 MHz.
- (viii) Set the 'H.G. TUNE' control to the 3 MHz point given by the calibration curves.

Adjust TR2(5D), L3(3H) and TR4(3K) for maximum reading on the valve voltmeter.

(ix) Set the 'H.G. TUNE' control to the 16 MHz point given by the calibration curves.

Adjust trimmers C7(4C), C16(7E), C33(3H) and C51(3K) for maximum output on the valve voltmeter.

(x) Set the panel meter switch SWB(7N), to the 'V2' position.

Set the 'H.G. TUNE' control approximately as in (viii) and tune it about this point for maximum reading on the panel meter.

Adjust TR2, L3 and TR4 for maximum on the valve voltmeter.

(xi) Set the 'H.G. TUNE' control as for (ix) and tune it for maximum reading on the valve voltmeter.

Adjust C7, C16, C33 and C51 for maximum on the voltmeter.

(xii) Repeat (x) and (xi) as often as necessary, until no increase in output occurs on readjustment.

Check that the maximum on the panel meter and the maximum on the valve voltmeter are coincident.

- (xiii) Set the 'fHG MHz' switch, to 16/24 MHz.
- (xiv) Set the 'H.G. TUNE' control to the 16 MHz tuning point given by the calibration curves.

Adjust L1(5F), L4(4H) and TR5(4K) for maximum reading on the valve voltmeter.

(xv) Adjust the Signal Generator frequency to 6.1 MHz and set the 'H.G. TUNE' control to the 24.4 MHz point given by the calibration curves.

Adjust C8(4C), C17(7D), C26(5F), C34(4H) and C52(4K) for maximum reading on the valve voltmeter.

(xvi) Set the panel meter switch SWB, to the 'V3' position.

Adjust the Signal Generator frequency to 4 MHz and set the 'H.G. TUNE' control as in (xiv) and tune it about this point, for maximum on the panel meter.

Adjust L1, L4 and TR5 for maximum output on the valve voltmeter.

(xvii) Adjust the Signal Generator frequency to 6.1 MHz, set the 'H.G. TUNE' control as in (xv) and tune it for maximum on the valve voltmeter, then adjust trimmers C8, C17, C26, C34 and C52 for maximum on the valve voltmeter.

(xviii) Repeat (xvi) and (xvii) as often as necessary until no increasing output occurs on readjustment.

Check that the maximum on the panel meter and the maximum on the valve voltmeter are coincident.

(xix) The Voltage readings obtained on the valve voltmeter at all frequencies should be between 6.0 and 8.0 volts.

The preliminary adjustment of the Harmonic Generator is now complete.

(xx) Disconnect the valve voltmeter.

11.2.2 Preliminary Alignment of the Mixer and Stages 1, 2 and 3

- NOTE 1: If the unit has been removed from the transmitter a dummy load will now be required. The dummy load should consist of a 2200 2W resistor in parallel with 33 pF capacitor.
- NOTE 2: The frequencies involved in this Section and Sections 11.2.3 and 11.2.4 will depend on the transmitter and the Drive Units to that Transmitter. Specific frequencies are therefore not given in the text, but, for convenience, the Table 8 which gives the frequencies appears on pages facing the text concerned. The asterisked figures in text relate to the right-hand column of Table 8.
 - (i) Connect the dummy load across the output of the Unit i.e. from SKQ(1I) to earth.

Connect a valve voltmeter in parallel with the load via 2 yds of 75Ω coaxial cable.

If the unit has not been removed from the transmitter, the normal Stage 4 feed and the ST4 GRID PEAK VOLT meter should be used.

- (ii) Apply a single tone 1 input at -6 dB relative to PEP (250 mW) to socket SKS(7C).
- (iii) Set SWF(5K) to MANUAL.

Set the mixer balance controls RV1(4B) and C63(3B) to midposition and the manual gain control RV5(5L) to maximum.

(iv) Adjust AMPLIFIER control RV4(5L), the Stage 2 cathode current potentiometer, for 40 mA on the panel meter M1.

Table 8
Alignment Frequencies

Section and Paragraph	HS31 & HS31/1 Mc/s	HS31A & HS31A/1 (using 2.15 Mc/s)	HS31A & HS31A/1 (using 3.1/6.2 Mc/s)	Reference
11.2.2 (ii)	3 . 1	2 . 15	6 . 2	жl

•

Continued on Page 63

Adjust RV3(4F), the Stage 3 cathode current potentiometer, for 25 mA on the panel meter M1.

- (v) Set the mixer range switch, SWC(3M) (fRAD Mc/s), to ** 2 and set Ml to read mixer cathode current (V7/V8).
- (vi) Set the 'fHG Mc/s' switch to *3.

 Apply an input of *4 to SKR.

Set the 'H.G. TUNE' control to the ** 5 point given by the calibration curves, then tune it, about this point, for maximum on Ml.

(vii) Set the 'MIXER TUNE' control to the * 6 point given by the calibration curves.

Adjust TR6(8M), L12(6L) L16(6L) and TR9(5L) for maximum on the valve voltmeter.

(viii) Set the 'fHG Mc/s' switch to # 7 Mc/s.
Apply an input of # 8 to SKR. (see also # 9 in Table 8).
Set the 'H.G. TUNE' control to the # 10 point given by the calibration curve and then tune it about this point for

maximum on Ml.

(ix) Set the 'MIXER TUNE' control to the * ll point given by the

Adjust C67(7F), C73(6G), C84(6G) and C104(4G) for maximum on the valve voltmeter.

- (x) Repeat (vi) to (ix) as often as necessary, but tune the 'MIXER TUNE' control for maximum on the valve voltmeter after reference to the calibration curves, adjusting the coils and trimmers until no increase in output occurs on readjustment.
- (xi) Set the 'fHG Mc/s' switch to * 12.

calibration curves.

Apply an input of * 13 to SKR.

Set the 'H.G. TUNE' control to the \mathbf{x} 14 point given by the calibration curves and then tune it, about this point, for maximum on Ml.

(xii) Set the 'fRAD Mc/s' switch to * 15.

Set the 'MIXER TUNE' control to the \mathbf{x} 16 point given in the calibration curves.

Table 8 (Cont.)

Section and Paragraph	HS31 & HS31/1 Mc/s	HS31A & HS31A/1 (using 2.15 Mc/s)	HS31A & HS31A/1 (using 3.1/6.2 Mc/s)	Reference
11.2.2 (v)	4/8	2.5/5	2.5/5	ж 2
(vi)	4/8	4/8	8/16	± 3
	3.55	4.65	4.35	≭ 4
	7.1	4.65	8.7	* 5
(vii)	4	2.5	2.5	* 6
(viii)	8/16	4/8	4/ 8	ж 7
"	5•55	3 . 575	4.05	ж 8
		ing 3.1/6.2 Mc/s i.f c/s I/P and replace		¥ 9
	11.1	7.15	8.1	* 10
(ix)	8	5	5	¥ ll
(xi)	8/16	4/ 8	4/8	* 12
	5.55	3 . 575	4.05	* 13
	11.1	7.15	7.15	¥ 14
(xii)	8/16	5/10	5/10	± 15
	8	5	5	* 16

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Adjust TR7(8M), L13(7M), L17(5L) and TR10(4L) for maximum on the valve voltmeter.

(xiii) Apply an Input of * 17 to SKR.

Set the 'H.G. TUNE' control to the * 18 point given by the calibration curves and tune it about this point, for maximum on M1.

(xiv) Set the 'MIXER TUNE' control to the # 19 point given by the calibration curves.

Adjust C68(8F), C74(7F), C85(5G) and C105(4G) for maximum on the valve voltmeter.

- (xv) Repeat (xi) to (xiv) as often as necessary, but tune the 'MIXER TUNE' control for maximum on the valve voltmeter after reference to the calibration curves, adjusting the coils and trimmers until no increase in output occurs on readjustment.
- (xvi) Set the 'fHG Mc/s' switch to \pm 20.

Apply an input of * 21 to SKR. (see also * 22 in Table 8).

Set the 'H.G. TUNE' control to the * 23 point given by the calibration curves and tune it about this point, for maximum on Ml.

(xvii) Set the 'fRAD Mc/s' switch to # 24.

Set the 'MIXER TUNE' control to the * 25 point given by the calibration curves.

Adjust TR8(8M), L14(7M), L18(6M) and TR11(4M) for maximum on the valve voltmeter.

(xviii) Set the 'fHG Mc/s' switch to * 26.

Apply an input of * 27 to SKR.

Set the 'H.G. TUNE' control to the \star 28 point given by the calibration curves and tune it about this point, for maximum on Ml.

(xix) Set the 'MIXER TUNE' control to the * 29 point given by the calibration curves.

Adjust C69(8F), C75(6F), C86(6F) and C106(4F) for maximum on the valve voltmeter.

Table 8 (Cont.)

Section and Paragraph	HS31 & HS31/1 Mc/s	HS31A & HS31A/1 (using 2.15 Mc/s)	HS31A & HS31A/1 (using 3.1/6.2 Mc/s)	Reference
11.2.2 (xiii)	6.45	3.925	3.45	* 17
	12.9	7.85	6.9	* 18
(xiv)	16	10	10	x 19
(xvi)	8/16	4/ 8	4/8	ж 20
	6.45	3.925	3 . 45	¥ 2l
	Apply Single Tone input of 2.15 (3.1 Mc/s as in Section 11.2.2 (ii))			± 22
	12.9	7.85	6.9	± 23
(xvii)	16/27.5	10/20	10/20	± 24
	16	10	10	± 25
(xviii)	16/24.4	16/24.4	16/24.4	± 26
	6.1	4.4625	4.225	± 27
	24.4	17.85	16.9	± 28
(xix)	27.5	20	20	x 29

Continued on Page 67

- (xx) Repeat (xvi) to (xix) as often as necessary, but tune the 'MIXER TUNE' control for maximum on the valve voltmeter after reference to the calibration curves, adjusting the coils and trimmers until no increase in output occurs on readjustmen
- (xxi) The voltage readings obtained on the valve voltmeter at all frequencies should be between 5 and 7 volts.
- (xxii) Replace the baseplate and disconnect the external valve voltmeter if necessary.

11.2.3 Balancing the Mixer Stage

Remove the * 30 input from the mixer.

Connect a valve voltmeter across C82(6G). (Remove the perspex shield).

Set the Mixer switch to 'V7/V8'.

Set the 'fRAD Mc/s' switch to * 31.

Set the 'fHG Mc/s' switch to '8/16 Mc/s'.

Set the mixer level control RV5(7E) to maximum.

Set SWF to MANUAL.

(i) Apply an input of * 32 to SKR.

Set the 'H.G. TUNE' control to the \ast 33 point given by the calibration curves and tune it about this point for maximum reading on Ml.

Set the 'MIXER TUNE' control to the * 34 point given by the calibration curves and tune it for maximum on the valve voltmeter.

Adjust the mixer balance capacitor C63(8L) and trimmers C68(8F) and C74(7F) for maximum on the valve voltmeter.

Carefully adjust C63 and the balance potentiometer RV1(7H), alternately, to reduce the reading on the valve voltmeter to a minimum.

Remove the valve voltmeter and return SWE to NORMAL.

Repeat (xiii), (xiv) and (xv) of Section 11.2.2, if necessary use the external load and external valve voltmeter (see Section 11.2.2 note).

Table 8 (Cont.)

Section in A.P.116E-0231-1	HS31 & HS31/1 Mc/s	HS31A & HS31A/1 (using 2.15 Mc/s)	HS31A & HS31A/1 (using 3.1/6.2 Mc/s)	Reference
11.2.3 line 1	3.1	2.15	3.1 or 6.2	ж 30
line 5	8/16	5/10	5/10	x 31
line 9	4	5	5	ж 32
line 10	16	10	10	± 33
line 13	16	10	10	x 34

Continued on Page 68

11.2.4 Setting-up the Monitor Frequency Changer (See Note 2, Section 11.2.2)

Set the 'fHG Mc/s' switch and the 'fRAD Mc/s' switch to * 35/36.

Set the Monitor Frequency Changer U-link on the front panel to DRIVE (LKA from PLBC to PLBE).

Apply an input of # 37 to the h.g. input socket SKR(4H).

Apply a single tone * 38 input at -6 dB, relative to PEP(250 mW) to socket SKS(8F).

Set the 'H.G. TUNE' control to the # 39 point given by the calibration curves and tune it about this point, for maximum on Ml. (Switch setting 'V7/V8' cathode current).

Tune the 'MIXER TUNE' control for maximum output on the ST.4 peak VOLTS meter.

Connect a valve voltmeter in parallel with a 75Ω resistor, across the output of the Monitor Frequency Changer at socket SKT(5E).

Tune Cl28(4E) and Cl33(5E) for maximum output on the valve volt-meter.

Remove the valve voltmeter and 75Ω load.

The Monitor Frequency Changer is now set-up.

Table 8 (Cont.)

Section in A.P.116E-0231-1	HS31 & HS31/1 Mc/s	HS31A & HS31A/1 (using 2.15 Mc/s)	HS31A & HS31A/1 (using 3.1/6.2 Mc/s)	Referen c e
11.2.4 line l	8/16	4/8	4/8	± 35
line 1	8/16	10/20		¥ 36
line 4	6.45	3.925	-	± 37
line 5	3.1	2.15	_	ж 38
line 7	12.9	7.85		ж 39

11.2.5 Final Adjustment of the Mixer Unit

The final adjustment of the unit must be carried out, working into its normal load, in the transmitter.

Set the meter Ml to show mixer cathode current (position 'V7/V8').

Apply an input of 4 Mc/s to the H.G. INPUT socket, SKR.

Set the 'fHG Mc/s' switch to '4/8 Mc/s'.

Set the 'H.G. TUNE' control to the 4 Mc/s point given by the calibration curves and tune it about this point, for maximum on Ml.

Carefully adjust the tuning coils L2 and TR3, of the h.g. amplifier stages, for maximum on M1.

Set the 'H.G. TUNE' control to the 8 Mc/s point given by the calibration curves and tune it about this point, for maximum on Ml.

Carefully adjust the trimmers C32 and C50.

NOTE: Only very slight adjustments will be necessary to obtain optimum results.

Set the 'fHG Mc/s' switch to '8/16 Mc/s'.

Align the tuning coils, L3 and TR4 at 8 Mc/s and the trimmers C33 and C51 at 16 Mc/s in the same manner as range 4/8 Mc/s has been described.

Set the 'fHG Mc/s' switch to 16/24.4 Mc/s.

Align the tuning coils, L4 and TR5, at 16 Mc/s.

Apply an input of 6.1 Mc/s to SKR.

Align the trimmers C34 and C52 at 24.4 (fHG). This should be carried out in a manner similar to that of the 4/8 Mc/s range the only difference being change in the tuning frequency.

Having completed the final adjustment of the Harmonic Generator, carefully repeat the alignment of the Mixer and Stages 1, 2 and 3 as described in Section 11.2.2, using Stage 4 as the output load and the ST.4 GRID PEAK Volts as the output indicator.

11.3 SPARE PARTS

Three types of Components Lists are used, as follows:-

- Use (a) AP.116E-0231-3 or (b) existing Marconi list retained in this Air Publication as Pages 73-111 (Components List No.1); this has been amended (by AL8) to cover Mod.9785 (External control of bias, and fitting of back-fire indicators).
- HS31A Use Components List No.2, identified by T4260 in bottom inside corner of pages, and following the HS31 list, in conjunction with the Cross Reference Lists facing the circuit diagrams for HS31A.

For components used in Mod. 9785 see list for HS31.

HS31/1 Use Components List No.3, identified by T5553 in bottom inside corner of pages, and following the HS31A Master Components List, in conjunction with the Cross Reference Lists facing the circuit diagrams for HS31A.

For components used in Mod.9785 see list for HS31.

HS31A/1 Use AP.116E-0243-3

For components used in Mod.9785 see list for HS31.

11.4 SETTING-UP THE MANUAL DRIVE ASSEMBLIES (HS31 & HS31A)

All the variable tuning controls are driven by manual drive assemblies mounted on the front panel. There are basically two types of drive assembly used, these are the single turn type and the multi-turn type. The single turn types, the handles of which rotate less than 360°, are used for the RANGE switch and the FEEDER TUNE controls. The multi-turn types, the handles of which rotate a number of complete revolutions, are used for STAGE 4 TUNE, STAGE 5 TUNE, STAGE 6 TUNE and the STAGE 6 COUPLING.

To set-up the manual drive assemblies it is necessary to check that:-

- (a) the dial stops are correctly set.
- (b) the components are set in the correct position.
- (c) the dials are correctly set.

The correct positions of (a), (b) and (c) for HS31 and HS31A are listed under the control names; for HS31/1 and HS31A/1 refer to Section 11.4 in Supplement 1.

RANGE switch

- (a) Dial Stops: 1, 2, 3, 4 & 5.
- (b) Components: Set the driving spindle so that the wiper arm of SWB (immediately below it) is in the fully clockwise contact position.
- (c) Dial set to: 1.

FEEDER TUNE

- (a) Dial Stops: 0 and 100.
- (b) Components: Set the capacitor C64 to maximum capacity with the padders C68, 69, 70 and 71 connected by switch SWP.
- (c) Dial set to: 0.

STAGE 4 TUNE

- (a) Dial Stops: 0 and 210.
- (b) Components: Set the turret with the largest inductor (L5) connected across the capacitor Cl2. Set Cl2 to maximum capacity (ready to tune L5).
- (c) Dial set to: 0.

STAGE 5 TUNE

- (a) Dial Stops: 0 and 210.
- (b) Components: Set the inductor (L15) wiper contacts to within approximately 1/8 turn (2 in) from the right-hand end of inductor.
- (c) Dial set to: 210.

STAGE 6 TUNE

- (a) Dial Stops: 0 and 210.
- (b) Components: Set the inductor (L19) wiper contacts approximately 1/4 turn (3 in) from the top of the inductor.
- (c) Dial set to: 210.

STAGE 6 COUPLING

- (a) Dial Stops: 0 to 210.
- (b) Components: Lower the inductor to the full extent of the extension rods, and set the inductor by rotating the front driving shaft approximately $\frac{1}{2}$ turn.
- (c) Dial set to: 0.

Slight adjustment may be required when fitting the assemblies to the coupling but the settings given allow for this. After fitting check the complete range coverage.

11.5 SETTING-UP THE RANGE CONTROL

Layout: (HS21) Fig.21, (HS31A) Fig.21A, (HS31/1 & HS31A/1) Fig.21B.

It may be necessary to strip the mechanical drive of the range switch assembly for various reasons. Sketch A shows the positions of the drive components:-

HS31 and HS31A

HS31/1 and HS31A/1

SWA in Stage 5	SWA in Stage 5
SWB in Stage 6	SWB in Stage 6
SWC in Stage 6	SWC in the output circuit
SWD in the output circuit	

relative to the spindles and pins.

11.6 SETTING-UP THE FEEDER TUNE CONTROL

Layout: (HS31) Fig.21, (HS31A) Fig.21A, (HS31/1 & HS31A/1) Fig.21B.

It may also be necessary to strip the mechanical drive of the Feeder tune assembly for various reasons. Sketch 'B' shows the positions of the driven components:-

C64)
SWP) In the output circuit
SWM))

relative to the spindles and pins.

11.7 SELF-LUBRICATING CONTACTS

Where the sintered type of self-lubricating contacts are fitted, no oil is required on the coil, which should be kept perfectly clean. If there are any signs of excess wear on the contacts they may require re-impregnating with oil. In this case, the contact should be removed

and immersed in a light machine oil warmed to about 60°C. Excess oil should be removed before replacing and after first switching on. When the contact has reached operating temperature, it should again be wiped to remove excess oil exuded from the pores.

NOTE: Should L19 contacts (see Figs.4 or 4A Sketch G, item 40) require replacing, fit Spring Contact and Guide Wheel Assembly Ref.10AS/5950-99-933-2057 (Marconi WZ.31079/B): this uses silver graphite contacts and incorporates a 1½ inch diameter Guide Wheel (original was 1½ inch diameter).

To ease running-in of new contacts, apply the thinnest possible film of medium grease to the coil, then wipe it off again immediately - the trace of grease remaining will be adequate for running-in purposes.

In normal use, no lubricant whatever should be applied.

11.8 AIR FILTERS

The air filters consist of closely folded polythene filtering medium rigidly welded at every fold to transverse polythene supports, the whole being mounted into a synthetic resin frame, which is made to make an airtight seal with the filter holder.

To clean the filters they should be removed from the holder and washed in luke warm (not more than 120 F) solution of any of the common industrial or household detergents. The detergent has no harmful effect on either polythene or resin frame and so in obstinate cases a strong solution may be used. However in normal atmosphere and if washing is carried out regularly the filter should come completely clean in quite a weak solution.

The filter may be soaked and agitated in the solution to help remove the dirt.

When clean the filter should be removed from the detergent solution and rinsed in a cold water bath or under the tap until all signs of the detergent have been removed. The filter should then be allowed to dry naturally before replacing in the filter frame. Artificial heat should not be used to accelerate the drying process.

11.9 REMOVAL OF FRONT PANELS

The upper and lower front panels of the R.F. Unit are removable. The upper panel, containing the RANGE control handle and FEEDER TUNE control can be removed by:

(a) removing the screw in the handle of the STAGE 5 H.T. INTERLOCK switch and pulling off the handle.

(b) releasing the 4 hexagonal headed captive screws, two on each side of the panel and pulling the panel forward.

The lower panel containing the STAGE 6 TUNE and STAGE 6 COUPLING can be removed by:

(a) releasing the 4 hexagonal headed captive screws, two on each side of the panel and easing forward the right-hand side. Care must be taken as the panel is connected to the cabinet cableform at the left-hand side by a tag-board.

11.10 REMOVAL OF THE MANUAL DRIVE ASSEMBLIES

The manual drive assemblies are removed by unscrewing the four retaining screws and lifting off.

11.11 USE OF TYPE ACT70 VALVE IN STAGE 6

The Type ACT70 valve is mechanically a direct replacement for the Type BR191B. Power output and distortion are not affected by the change, but slightly different setting-up conditions are required as follows:

- 1. The screen potentiometer of Stage 5 should be connected to earth instead of being returned to the negative side of the bias supply.
- 2. The static cathode current of Stage 5 should be set initially to 100 mA. This value may be adjusted within the range 60 mA to 100 mA during adjustments for optimum linearity. Similarly Stage 6 may be set between 0.2 and 0.32A.
- 3. The grid and cathode currents of Stage 6 should be set by adjustment of feeder coupling and drive level as follows:-

```
2.5/21 Mc/s C.W./F.S.K. 3.5 kW Ig = 250 mA Ic = 1.6A

2.5/21 Mc/s I.S.B. (2 tone) 3.5 kW P.E.P. Ig = 100 mA Ic = 1.1A

2.5/21 Mc/s D.S.B. (Carrier) 1.5 kW Ig = 60 mA Ic = 0.95A

21/27 Mc/s C.W./F.S.K. 2.5 kW Ig = 160 mA Ic = 1.25A

21/27 Mc/s I.S.B. (2 tone) 2.5 kW P.E.P. Ig = 60 mA Ic = 0.8A

21/27 Mc/s D.S.B. (Carrier) 1.0 kW Ig = 50 mA Ic = 0.9A
```

N.B. Stage 5 Cathode current should not be greater than 240 nA on C.W./F.S.K. and 180 mA on I.S.B. (2 tone).

11.12 SIX-INCH VENTILATOR FAN

The fan is mounted on a mild steel plate on top of the Rectifier and Control Unit. For maintenance, the fan (Identity WIS.8262/B Sh.1 Ref.1) is removed by undoing 3 cleats on the power lead, disconnecting the 4-pin plug (WIS.3733/C Sh.1 Ref.1) and socket (WIS.3727/C Sh.1 Ref.2), and unscrewing 10 screws which fix the plate to the Rectifier and Control Unit. The fan and plate can then be dismantled for oiling and surface cleaning; it is recommended that this should be carried out every 3 months.

(i) Oiling

Access to the oil holes is obtained by unscrewing the oiler plugs. At the rear end, the plug will be found under the plastic end cover. Care should be taken to avoid over-oiling.

The fan is fitted with porous metal sleeve bearings having felt oil reservoirs. Oil should be added as required but DO NOT use more than ten drops of high grade thin machine oil for each bearing.

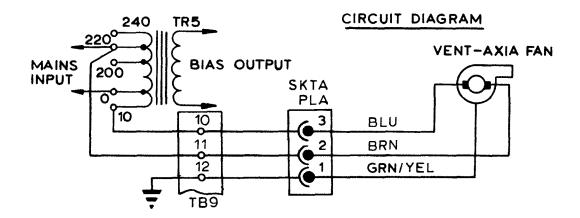
(ii) Surface Cleaning

Frequency of surface cleaning will depend on the type of duty that the unit has to perform.

The plastic components should be wiped over with lukewarm water and soap and polished with a clean dry cloth.

When Modification No.A.3978 has been incorporated, fan Identity WIS.8262/B Sh.1 Ref.1 is replaced by ventilating fan Ref.No.10K/4140-99-633-2694. This requires bearing lubrication (34B/9100510 Grease XG271) to be replenished at six monthly intervals.

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11.13 BACK-FIRE INDICATORS

The blowing of one or more of the h.t. fuses FS7-9 in the Control Power Supply unit can be due to reverse current i.e., back-fire in one or more of the six GXU2 rectifiers. To ascertain whether any of these have back-fired, use the compass WIS.7204/C provided with the modification kit to check the polarity of the cores of the chokes L11-16 in the anode circuits of the valves V1-V6 as shown in the Figs.l and lA facing diagrams. Normally the polarity of all six should be the same, and reversed polarity of any core indicates that the associated rectifier valve has back-fired. After changing the valve, and before switching on, reverse the core of the associated choke so that it will give the same polarity indication as the others.

11.14 SUCTION FAN - MOTOR BEARING AND SWITCH REPLACEMENT

11.14.1 General

An exploded view of the a.c. motor in the suction fan assembly is given in Fig.25. All references in the following procedures are to this illustration

11.14.2 To Remove Motor from Fan Assembly

- (a) Gaining access through the fan-casing inlet, slacken off the grub-screws retaining the impeller to the motor shaft.
- (b) Supporting the motor in position, remove and retain the four bolts securing the motor to the fan casing.
- (c) Holding the fan impeller in position, withdraw the motor from the casing. Lower the impeller gently until it rests on the bottom of the casing.

11.14.3 To Refit the Motor to the Fan Casing

- (a) Lift the impeller and position centrally within the casing.
- (b) Offer up the motor, aligning the motor shaft with the impeller boss, and ensure that the key on the shaft lines up with the keyway in the boss.
- (c) Insert the motor shaft in the impeller boss, and push home. Align and insert the motor-retaining bolts, and tighten fully.
- (d) Ensure that the impeller is central within the casing, then tighten fully the retaining grub-screws.

11.14.4 Drive End Bearing Removal

- (a) Remove the motor from the fan casing as in para.11.14.2.
- (b) Remove and retain the key (5) from the motor shaft.
- (c) Remove and retain the three screws (25) securing the bearing caps.
- (d) Remove and retain the outer bearing cap (1). Remove and discard the wave washer (24).
- (e) Remove and retain the nut (2), spring washer (3) and plain washer (4) from each of the four through studs (6).
- (f) Remove the motor end cover (23).

NOTE: If the cover is difficult to remove, it is permissible to tap it gently, using a hide or rubber mallet.

(g) Using a suitable extractor, withdraw the bearing (22) from the shaft.

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11.14.5 Drive End Bearing Replacement

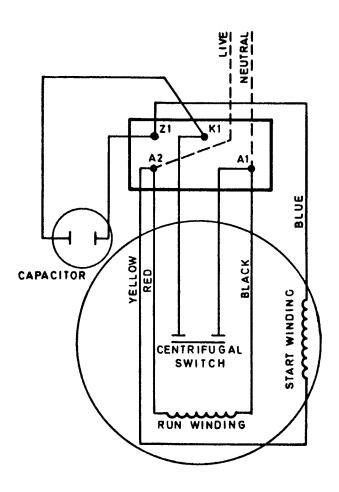
- (a) Using a suitable hollow drift or tube, with an outer diameter such that it bears only on the inner race of the bearing, press the new bearing (22) on to the motor shaft. The ends of the tube or drift must be parallel to ensure that the bearing is pressed on square to the shaft.
- (b) Screw a suitably threaded rod of ample length into one of the tapped holes in the inner bearing cap. Refit the motor end cover (23) passing the rod through one of the three bearing cap securing holes. Secure the end cover to the motor body, using the nuts, spring washers and plain washers retained from 11.14.4(e), and ensuring the ventilation holes line up with those in the opposite end cover.
- (c) Slide a new wave washer (24) over the motor shaft.
- (d) Position the outer bearing cap (1) over the rod inserted in sub-para.(b), and secure by two screws (25) in remaining holes.
- (e) Withdraw the threaded rod and refit the third securing screw (25) to the bearing cap.
- (f) Fit the key to the motor shaft.
- (g) Refit the motor to the fan casing (see 11.14.3).

11.14.6 Non-drive End Bearing Removal

- (a) Remove the motor from the fan assembly (11.14.2).
- (b) Remove and retain the three screws (12) securing the bearing caps, and withdraw the outer cap (13).
- (c) Remove and retain the four screws (8) securing the terminal block cover (7) and withdraw the cover.
- (d) Remove the leads from the four terminals, noting carefully the position of each lead on the terminals.
- (e) Remove and retain the nut (11) spring washer (10) and plain washer (9) from each of the four through studs (6). Withdraw the motor end cover (16).

NOTE: If the end cover is difficult to remove it is permissible to tap it gently, using a hide or rubber mallet.

- (f) Remove and discard the external circlip (14).
- (g) Force the weights of the centrifugal switch (21) outwards to move the inner bearing cap away from the bearing (15), then remove the bearing, using a suitable extractor.



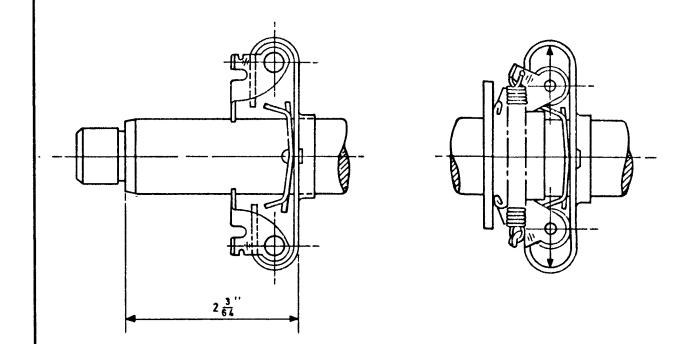
WIRING DETAILS

11.14.7 Non-drive End Bearing Replacement

- (a) Using a suitable hollow drift or tube, with an outer diameter such that it bears only on the inner race of the bearing, press the new bearing (15) on to the motor shaft. The ends of the tube or drift must be parallel to ensure that the bearing is pressed on square to the shaft.
- (b) Fit a new external circlip (14), ensuring that it beds fully into the groove on the motor shaft.

- (c) Offer up the motor end cover (16). Pass a suitably threaded rod of ample length through the uppermost of the three bearing cap securing holes, and through the appropriate hole in the inner bearing cap. Ensure that the stationary switch (17) is positioned with the terminal leads uppermost (i.e. towards the terminal block).
- (d) Secure the end cover (16) to the motor body, using the nuts (11) spring washers (10) and plain washers (9) retained from para.11.14.6(e). Do NOT tighten at this stage.
- (e) Position the outer bearing cap (13) over the rod inserted in sub-para.(c), and secure by two screws (12) in the lower holes.
- (f) Withdraw the threaded rod, and refit the third securing screw (12) to the bearing cap.
- (g) Tighten fully the four end-cover retaining nuts (11) and the three bearing cap securing screws (12).
- (h) Refit the leads to the four terminals, ensuring they are correctly positioned as noted in para.11.14.6(d).
- (j) Refit the terminal block cover (7) and secure with the four screws (8).
- (k) Refit the motor to the fan assembly, using the procedure given in para.11.14.3.
- 11.14.8 Removal and Replacement of Stationary Switch
 - (a) Remove the motor from the fan assembly (para.11.14.2).
 - (b) Remove the non-drive end end cover and bearing (para.11.14.6).
 - (c) Remove the inner bearing cap complete with stationary switch (17).
 - (d) Remove and retain the two screws (19) and spring washers (18) securing the stationary switch to the inner bearing cap. Discard the switch (17).
 - (e) Secure new stationary switch to the inner bearing cap using the two screws and spring washers retained in (d). Refit switch and inner bearing cap to motor shaft.
 - (f) Refit bearing and end cover (para.11.14.7).
 - (g) Refit motor to fan assembly (para.11.14.3).

- 11.14.9 Removal and Replacement of Centrifugal Switch
 - (a) Remove motor from fan assembly (para.11.14.2).
 - (b) Remove non-drive end end cover (16) (para.11.14.6, sub-paras.(b) to (e) inclusive).
 - (c) Remove drive end end cover (23) (para.11.14.4, sub-paras.(b) to (f) inclusive).
 - (d) Withdraw the non-drive end bearing (15) from the rotor (para.11.14.6, sub-paras.(f) and (g)).
 - (e) Withdraw the inner bearing cap complete with stationary switch (17).
 - (f) Refer to the illustration below. Remove the tension springs from the centrifugal switch and withdraw the bakelite ferrule. Withdraw the switch from the rotor.
 - NOTE: As the switch is a force fit on the rotor, care must be taken not to damage the rotor or windings.
 - (g) Remove the tension springs and bakelite ferrule from the new switch.
 - (h) Press the switch on to the motor shaft to the dimensions given in the illustration below.
 - IMPORTANT: Great care must be taken not to touch the phosphor-bronze stop, pressure on which during this operation can render the switch non-operative.
 - NOTE 1: Accuracy of positioning to obtain the dimension shown is essential for correct operation.
 - NOTE 2: It is important to ensure that the back face of the switch is square with the axis of the shaft,
 - (j) Refit ferrule and tension springs.
 - (k) Check the action of the switch by pulling the roller spindles outwards (see illustration).
 - (1) Refit the inner bearing cap complete with stationary switch (17).



CENTRIFUGAL SWITCH - FITTING DIAGRAM

- (m) Refit bearing (15) (para.11.14.7, sub-para.(a)).
- (n) Refit end covers (para.11.14.5, sub-paras.(b) to (f) inclusive, and para.11.14.7, sub-paras.(b) to (j) inclusive).
- (p) Refit the motor to the fan assembly (para.11.14.3).

COMPONENTS LIST

FOR

RECTIFIER AND CONTROL UNIT

(Drg. No. W.37908 Sh.3 Ed.B)

MOTES

- 1. When ordering spares quote information from all columns for identities marked * or identity only for all other items.
- 2. The references in column 1 are shown on circuit diagram Figs.14 and 15 and component location diagrams Figs.1 and 2.
- 3. For identical items the total quantity is given at the first entry.

Ref.	Description	Value	Tol.	Rating	Identity	Service Ref.	Qty.
_ " _	CAPACITORS						
Cl	Paper	10 µF	15	250V DC	WIS.4321/B Sh.1 Ref.11	AP.104384	4
C2 C3 C4 C5	As Cl As Cl As Cl Paper	8 µF	20	600V DC		Z. 112825	3
C6 C7 C8	As C5 As C5 Paper	4 μF	15	750V DC	WIS.2354/B	Z.112782	1
C9	Paper	4 µF	10	6 kV DC	Sh.1 Ref.6 WIS.4451/B Sh.1 Ref.4	AP.104325	3
ClO	As C9				DIL®I Kel®4		
C13 C14	As C9 Not Used Not Used Not Used Not Used						
C17	Not Used Mica	10,000 pF	5	350V DC	PC.18801/10	Z.124743	2
C19	As C17 Paper foil, tub., moulded	.Ol µF	20	lO kV	PC.19226/2	5910 - 99 - 011 - 6409	2
 C20 C21	As Cl9 Electrolytic	100 - 200 μF	+50 - 20	350V DC	PC.18408/4	Z.145606	l

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2nd Edn. Oct. '67 GS

Ref.	Description	Value	Tol.	Rating	Identity	Service	Qty.
			<u>+</u>		_	Ref.	
	RESISTORS FIXED						
Rl	Mica Card WW.	1062	10	220W	WIS.3852/B	AP.104443	1
R2	Mica Card WW.	1078	10	45W	Sh.1 Ref.24 WIS.3852/B Sh.1 Ref.25	AP.1014444	l
R3	Comp.Grade 2 Non-Insul.	1.5 kΩ	10	ıw		Z.222231	1
R/ ₊ R5	Non-Insur. Non-Vit.WW Double Tube Not Used	68Ω	10	2 Amps.	WIS.3320 Sh.2 Ref.18	AP.104446	1
R6 R7	WW Vit. Enam. As R6	33Ω	5	3W	PC.67008/4	Z.243325	2
R8	Mica Card, WW.	53Ω	10	45W	WIS.4006/B Sh.1 Ref.20	AP.104445	3
R9 R10	As R8 As R8						
Rll	Non-Vit. WW	2,160Ω	10	90W	WIS.6265/C Sh.1 Ref.1	AP.104347	ı
Rl2	Non-Vit. WW.	419Ω	10	90W	WIS.3615/C Sh.1 Ref.6	AP.104348	1
R13	Vit. WW.	16,500Ω	5	35Ω	P.18282/KP JSh.6	AP.104349	1
R14	Carbon Wire Ends	220 kΩ	20	lW	*WIS.3903 Sh.1 Ref.3	Z.213080	3
R15	As Rl4				bii i noi j		
R16 R17	As Rl4 Vit. WW.	4 3, 750Ω	5	150W	P.18282/KK Sh.6	Z.242210	2
R18 R19.	As Rl7 Vit. WW.	15,000Ω	5	100W	PC.67006/20	7.21.2167	1
R20 R25	to R24 Not Used Vit. WW.	1800Ω	5	35W	10,0,000,20	AP.104350	
R26	Not Used Not Used	1000m))) 11		AL • 104770	J
R28	Mica, WW. H.T. Volt. Resistor				WIS.5675/B Sh.1 Ref.1	AP.103523 AP.104456	1
	RESISTORS VARIABLE						
RVl	ww.	12Ω	10	100W	WIS.3147 Sh.l Ref.4	AP.104447	1
RV2 RV3 RV4	WW. 3 Gang	802	10	50W	WIS.3337 Sh.1 Ref.34	AP.104448	1

Schedule WZ.12784/A

AP.116E-0231-1 2nd Edn. 0ct. '67 GS

Ref.	Description	Value	Tol. % ±	Rating	Identity	Service Ref.	Qty.
	RESISTORS VARIABLE (Cont'd.)					
RV5 RV6	Not Used WW.	259	10	80	WIS.5865/B Sh.2 Ref.46	-	1
RV7-9 RV10 RV11	Not Used WW. As RV10	10002	10	20	PC.67405/43	-	2
RV11	ww.	200Ω	10	120	PC.67409/50	-	1
Ll	INDUCTORS 35A	•0075Н			W.24581/B	AP.194321	1
L2	600 mA	3.5H			Sh.11 W.31577/B Sh.3	AP.104345	2
L3 L4 L5	As L2 Not Used O.4A	5•5H			W.31577/B Sh.1	AP.104346	2
L6 L7	As L5 1.5A	3. 8H			W.24581/B Sh.10	AP.104320	1
Lll	Not Used Backfire Indicator As Lll				W.65949/B Ed.B		6
FS1	FUSES Cartridge			2A	WIS.5703/C Sh.1 Ref.1	AP.104329	7
FS2 FS3 FS4	As FS1 As FS1 Cartridge			loA	WIS.5703/C Sh.1 Ref.4		1
FS5 FS6 FS7 FS8-9	As FS1 Not Used Cartridge As FS7			15A	WIS.4806/B Sh.1 Ref.5	AP.104200	3
	2 As FS1						
FS13	Not Used					İ	
FS14	Cartridge			6A	WIS.5703/C Sh.1 Ref.3	AP.104331	2
FS15 FS16	As FS14 Cartridge			2A	WIS.2947 Sh.1 Ref.9	z. 590110	2
FS17	As FS16						

P.116E-231-1 ad Edn. AL.1 aly, 1968

Schedule WZ.12784/A

Ref.	Description	Value	Tol. % +	Rating	Identity	Service Ref.	Qty.
	FUSES (Cont'd)						
FS18	Cartridge			500 mA	WIS.2947 Sh.1 Ref.5	z.590108	
F310 F320	Mot Used As FS18					i	
FS21 FS22	Not Used Cartridge			1 A	WIS.2947	Z.590109	2
FS23	Cartridge			3A	Sh.1 Ref.7 WJS.2947 Sh.1 Ref.10	Z.590111	1
FS2/∟	Cartridge			5A	WIS.29/ ₊ 7 Sh.1 Ref.11	Z.590112	1
F325	As FS22					<u></u>	
FS28	Not Used Not Used Not Used Not Used Not Used						
FS32 FS33	Not Used Not Used Not Used Not Used Not Used						
	LAMPS						
LP1 LP2 LP3 LP4 LP5	No.2 Carbon Tubular As LP1 As LP1 As LP1 As LP1	5.35W		50V	PC.48601/5	x.959220	11
LP6 LP7 LP8 LP9 LP10	As LP1 As LP1 As LP1 As LP1 As LP1						
LPll	As LP1						
	METERS						
Ml	0-300V AC Voltmeter				WIS.4235 Sh.9	AP.104558	1
M2	0-25A Ammeter				Ref.158 WIS.4235 Sh.9 Ref.159	AP.104559	1

Schedule WZ.12784/A

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Ref.	Description	Value	Tol.	Rating	Identity	Service Ref.	Qty.
M3	METERS (Cont'd) 0-6 kV Voltmeter				WIS.4235 Sh.9 Ref.160	AP.104560	1
	PLUGS						
PLAJ	∠4 Kay				WIS.3738/C Sh.1 Ref.2	AP.104177	1
	RECTIFIERS (METAL)						
MRl	Sclenium 3 Phase Full Wave				WIS.4609/B Sh.2 Ref.15	AP.104332	1
MR2	Selenium 3 Phase Full Nave 2 Units Wired in Paral	 Llel			WIS.4669/B Sh.1 Ref.13	AP.104333	2
MR3	Making l Rectifier Selenium				WIS.3222/C Sh.4 Ref.22		1
1	Not Used Not Used						
MR6	Not Used						
	RELAYS & CONTACTORS						
FC	9 Pole Making Contactor)	(AP.104339	1
ST	5 Pole Making					AP.104 <i>3</i> 40	1
FF	Contactor 5 Pole Making				WIS.5609	AP.104340	1
LΑ	Contactor 5 Pole Making				Sh.l Ref.l	AP.104340	1
MC	Contactor 3 Pole Making Contacto with 3 Aux. Contacts	r *)		AP.104341	1
OR	(2 Make 1 Break) Relay - Plug-In Type 3 Making and 2 Break-				.~Q.8740 Sh.1 Ed.M	AP.104337	1
SP	ing Contacts Relay - Plug-In Type				77Q.8740	AP.104338	1
FD	2 Making Contacts Time Switch				Sh.2 Ed.L T31-0964-01	6645-99-955	- 1
OD	Valve Protecting Relay				WIS.4373/B	7533 AP.104510	2
OE OA	As OD Not Used				Sh.2 Ref.7		
511	2.00						
						10 W/ 1278	

* Wotsac replacement for MC: CC 270003 (Type UCA7)(Mod.A.4745) Schedule W3.12784/A

Ref.	Description	Value	Tol.	Rating	Identity	Service Ref.	Qty.
	RELAYS & CONTACTORS	(Cont'd)					
OB OC	Not Used Not Used						
	SOCFETS						
SKAJ	24 Waj				41061 Sh.1 Ref.81	AP.104203	1
	SWITCHES						
S.A 1-4 (4 Pole				7.50027 Sh.1	AP.104470	2
S .A6	Micro S.P. C/Over					AP.104462	1
S.E 1-5 (As S.A incl)						
	Micro S.P. C/Over				#.40269/C Sh.1 Ed.A	AP.104463	1
STYC	Push Button D.P.					AP.104206	6
C.D	As SUC As S C						
CE	Purh Button 2 Gang D.P. Or/Orr					AP.104471	ī
56	2 hafer 4 Pole				::TS.3456/B Sh.148	AP.104464	1
SÆ	C. Over 1 Nafer 1 Pole				::IS.3456/B Sh.111	AP.104465	1
SNJ	3 Posn Single Pole			20A	WIS.5197/B	AP.104475	1
SF	C/Over Knife D.P. C/Over			30A	Sh.11 MIS.4095/B		1
S.ïL	l Wafer Single				Sh.1 Ref.1C IS.3456/B	AP.104466	1
S.7M	Pole & Posn. Micro S.P. C/Over				Sh.155 WIS.5586/C	₩.4639	1
SATA	3 Nafer 4 Pole C/Over				Sh.1 Ref.1 "IS.3456/B Sh.133	AP.104467	3
	TERMINAL BLOCKS						
TUI	6 hay 30 Amp. Terminals				57404/C Sh.l Ref.l	AP.104577	1
TES	2.1/2 * Porcelain				SK.48864 Sh.1 Ed.H	AP.101043	3
TB3 TB4	Stand Off Type As TB2 As TB2				Su•T Fu•u		

Ref.	Description	Value	Tol. % ±	Rating	Identity	Service Ref.	Qty.
	TERMINAL BLOCKS (Cont'd)					
TB5	20 Way				W.22469/B Sh.1 Ed.U	W300+ W301+ W1003	3
TB7	As TB5 As TB5						7
TB8	4 Way				W.40168/B Sh.2 Ed.A		1
TB9	10 Way				W.22469/B Sh.1 Ed.K	W300+ W301+	1
TB10	8 Way				W.22469/B Sh.1 Ed.H	W1003 W300+ W301+ W1003	1
TB12 TB13 TB14	Not Used Not Used Not Used Not Used 4 Way				WIS.1631 Sh.1 Ref.4		
	TRANSFORMERS						
TRl	Sec. Winding				W.37518 Sh.2	AP.104323	1.
TR2	Sec. Winding 6.3V				₩.24068 Sh.59	AP.104460	1
TR3	Sec. Winding 15V				W.24582 Sh.13	AP.104461	1
TR4	Sec. Winding 6.3/6.0/5.7V				W.37518 Sh.3	AP.104322	1
TR5	Sec. Winding 180/160/140/0/10V				W.23241 Sh.33	AP.104459	1
TR6	Sec. Winding 450/425/400/0/400/ 425/450V				W.24586 Sh.26	AP.104457	1
TR7	Sec. Winding 5V				₩.24743 Sh.27	AP.104458	1
TR8	Sec. Winding 2900/3000/3100V				#.22129 Sh.3	AP.104324	1
TR9	Sec. Winding 5V.C.T.				W.27206 Sh.4	AP.104535	6
TR10	As TR9						
TR12 TR13	As TR9 As TR9 As TR9 As TR9						

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GS

Ref.	Description	Value	Tol. % ±	Rating	Identity	Service Ref.	Qty.
	VALVES						
V1 V2 V3 V4 V5	CV.2518 (GXU-2) As V1 As V1 As V1 As V1					cv.2518	6
V6 V7 V8	As V1 CV.378 (U54) As V7					CV.378	2
V9 V10	CV.1069 (STV280/80) CV.686 (VR.105/30)					CV.1069 CV.686	1 1
	MISCELLANEOUS MECHANIC	AL ITE	MS				
l	Fuseholder				WIS.4809/C	AP.104328	3
2	Fuseholder				Sh.1 Ref.9 WIS.5612/C	AP.104327	12
3	Fuseholder				Sh.1 Ref.1 WIS.4154/C	Z.590100	20
4	Valveholder, Inter-				Sh.1 Ref.1 PC.81814	z.560031	2
5	national Octal. Valveholder B5				PC.81805	z.560013	1
6	Lamp Jack				WIS.1877	AP.104227	11
7	Resistor Mounting				Sh.l Ref.l WIS.5742/C Sh.l Ref.l		4
8	Resistor Mounting	:			WSK.3172 Sh.1 Ed.K		6
9	Anode Clip				7.30330/C Sh.1 Ref.2	AP.104543	6
10	Resistor Mounting				7.40253/B		1
11	Valve Retainer				Sh.l Ed.A WIS.3449/C Sh.l Ref.l	AP.104412	1
12	Valve Retainer				WIS.3701/C Sh.1 Ref.22	AP.68388	2
13	Not Used				DII TIOT OCY		
14 15	Not Used Stand Off Insulator				WIS.5416/C	AP.104441	3
19	poand off Tuentator,				Sh.l Ref.l	ΨL • ΤΛ ΛΙΛΙΑ Τ	
16	Valve Retainer				WIS.6271/C Sh.1 Ref.1	AP.70240	
L							_

Ref.	Description	Value	Tol.	Rating	Identity	Service Ref.	Qty.
	MISCELLANEOUS ELECTRIC	AL ITEM	S				
Xl X2	Alarm Indicator Terminating Board				W.41618/C Sh.1 Ed.A	AP.104586	1
х3	Fan Axial					10K/ 1070564	1
	Wotsac replacement for X3: Fan Ventilating (Mod. A.3978).					10K/4140- 99-633- 2694	1

COMPONENTS LIST

FOR

R.F. UNIT

(Drg.No. W.37907 Sh.9 Ed.C)

NOTES

- 1. When ordering spares quote information from all columns for identities marked * or identify only for all other items.
- 2. The references in column 1 are shown on circuit diagrams Figs.10 & 11 component location diagrams Figs.3,4,5.
- 3. For identical items the total quantity is given at the first entry.

Ref.	Description	Value	Tol. % ±	Rating	Identity	Service Ref.	Qty.
	CAPACITORS						
Cl	Mica Metallised Moulded Case	6.800 pF	5	350V DC	PC.18801/8	Z.124737	1
C 2	Mica, Disc	.003 μF	20	DC 008	WIS.4522/C Sh.1 Ref.5	Z.104484	15
C3 C4 C5	Paper Foil, Tubular, Metal Case, Insul. As C3 As C3	.01 µF	25	350V DC	PC.19202/7	Z•115625	17
C6 C7 C8 C9 C10	As C3 As C3 Ceramic, Tubular, Insulated As C3 As C3	33 pF 16 - 250 pF	10	500V DC	PC.18202/7	Z.132283	1
C11 C12	As C3 Variable, Air	16-250 pF		•	WIS.3699/C	AP.104190	1
C13	Ceramic, Tubular	200 pF	5		Sh.1 Ref.11 *WIS.3450/B Sh.1 Ref.9	Z.132344	1
C14 C15	As C3 Ceramic, Tubular	2.2 pF	10	500V DC	PC.18201/3	Z.132250	1
C16	Variable Air,	0-210.6 pF			WIS.9367/C Ref.1		1
C17	Ceramic, Tubular, Insulated	270 pF	2	750V DC	PC.18223-18	5910-99- 012-7123	1
C18	Mica, Disc.	500 pF	20	800V DC	WIS.4522/C Sh.1 Ref.2	AP.104485	1

Ref.	Description	Value	Tol.	Rating	Identity	Service	Ref.
	CAPACITORS (Cont'd)						
C19 C20	As C3 As C2						
C21 C22 C23 C24 C25 C26 C27 C28 C29 C30	As C2 As C2 Air Dielectric Fixe As C2 As C3 As C2	d					1
C31 C32	As C2 Hi-Load	200 pF	20	7.5 kV	*NIS.5080/B	AP.104479	2
		_		peak	Sh.l Ref.3D		2
C33	Hi-Load	125 pF	20	7.5 kV peak	Sh.1 Ref.3D	AP.104480	
C34	Hi-Load	2 0 0 pF	20	7.5 kV peak	*WIS.5080/B Sh.1 Ref.3C	AP.104481	1
C35	Vacuum	25 pF	10	32 kV peak	l .	AP.67742	1
c36	Hi-Load	125 0 pF	20	7.5 kV peak	*WIS.5080/B Sh.1 Ref.1E	AP.104482	1
C37 C38 C39 C40	Not Used Not Used Not Used Not Used			poun	biret Roteth		
C41	Mica Foil	2.200 μF	20	750V DC	PC.18702/B	AP.5910- 115729	1
C42 C43	As C2 Mica Disc.	.01 µF	20	2000V DC	WIS.4721/C Sh.1 Ref.1A	AP.104486	4
C44 C45	As C43 Hi-Load Capacitor	130 pF	10	7.5 kV peak	WIS.4418/C Sh.1 Ref.4	AP.104487	1
C46	Hi-Load	50 pF	20	7.5 kV	*WIS.4114/C	AP.63494	2
C47 C48 C49 C50	As C46 As C43 As C43 As C2		;	peak	Sh.1 Ref.4		
C51 C52	As C3 As C2						

Ref.	Description	Value	Tol.	Rating	Identity	Service Ref.	Qty.
C53	CAPACITORS (Cont'd) Mica Foil	.Ol μF	20	350V	PC.18701/5	Z.124484	2
	As C2 As C3			DC			
C56	As C32 As C33 Hi-Load Capacitor	125 p F	20	7.5 kV	*WIS.5080/B		1
1	Hi-Load Capacitor	1250 pF	20	peak 7.5 kV peak	Sh.l Ref.3C *WIS.5080/B Sh.l Ref.1		2
C61 C62 C63	As C59 As C3 As C3					AD 301 577	Ţ
c 65	Variable Air Dielectric Preset Air Dielectric				W.48433 Sh.1 Ed.A W.49688 Sh.1 Ed.A	AP .104533 AP .104534	2
C67	As C65 As C3 Hi-Load Capacitor	125 pF	20	7.5 kV peak	WIS.5080/B Sh.1 Ref.3F	AP.104483	4
C69 C70	As C68 As C68						
1 - 1 -	As C68 Mica Foil	10.000 pF	RO	750V DC	H.31 -8847-01 WIS.4342/B Sh.1 Rof.7	624-648 2.124382	<u> </u>
	As C53 Mica Disc	.002 µF	20			5910 - 99 - 972 - 9622	1
C75	Not Used	Ì					
C80	Silvered Ceramic	10 pF	20	4 kV DC	WIS.4240/C Sh.1 Ref.2		2
C81	As C80 RESISTORS (FIXED)						
R1 R2 R3 R4 R5	Comp.Grade 2 Comp.Grade 1 WW Vit. Enam. WW Vit. Enam. Comp.Grade 2	220Ω 33Ω 10 kΩ 15 kΩ 100Ω	5 5 5 10	1/2W 1/4W 4.1/2W 6W 1/4W	PC.67009/19 PC.67010/20 PC.66610/13	Z.219016 Z.244097 Z.244114 Z.221110	1 2 1 1 2
R6 R7 R8 R9	Shunt, WW 250 mA 100 mV As R2 As R5 Comp.Grade 2	10 kΩ	1	l D 1W	WIS.3914/C Sh.2 Ref.19 PC.66612/31		3
R10	As R9	TO 1201			- 0 • 00012/ 71		Ĺ

Schedule WZ.17588/A 89

Ref.	Description	Valu e	Tol. % ±	Rating	Identity	Service Ref.	Qty.
	RESISTORS (FIXED) (ont'd)					
Rll Rl2 Rl3	As R9 Comp.Grade 2 Shunt WW 5 mA 100 mV	15 kΩ	10 1	ıw	PC.66612/33 WIS.3914/C Sh.3 Ref.31	AP.104450	3 1
R14 R15	Comp.Grade 2 Comp.Grade 2	3 3 Ω 1 00 Ω	10 10	1/2W 1W	PC.66611/7 PC.66616/13	Z.221048	2 2
R16	Carbon	2 0 Ω	20	50W	WIS.5161/C Sh.1 Ref.22	AP.104511	1
R17 R18 R19	As R15 As R14 Shunt 400 mA 100 mV Not Used		1.		WIS.3914/C Sh.3 Ref.45	AP.104451	1
R21 R22	Not Used Shunt 2A 100 mV		1		WIS.3914/C	AP.104452	1
R23	Shunt 350 mA 100 mV		1		Sh.3 Ref.46 WIS.3914/C Sh.4 Ref.51	AP.104453	1
R24	Wirewound			600V Wkg.	WIS.4235 Sh.7 Ref.129		l
R25	WW Vit. Enam.	2 .2 Ω	10	3W	PC.67008/25		2
R26 R27 R28	As R25 WW Vit. Enam. Carbon	1 kΩ 20Ω	5 10	4.1/2W 35W	PC.67009/13 WIS.5161/C Sh.1 Ref.21		1 1
R29 R30	As Rl2 As Rl2						
R31	Carbon	2 0 Ω	20		WIS.5161/C Sh.1 Ref.21	AP.104512	1
R32 R33 R34 R35	Comp.Grade 2 Comp.Grade 2 Comp.Grade 2 Comp.Grade 2	75Ω 100Ω 1.2 kΩ 18Ω	10 10 10	3/4W 1/2W 2W 2W	PC.66619/5 PC.66611/13 PC.66616/26 PC.66616/4	Z.215383 Z.221111 Z.212017	1 2 2
R36 R37 R38 R39 R40	As R35 As R34 Comp.Grade 2 Comp.Grade 2 As R39	1 kΩ 22Ω	10 10	2W 2W	PC.66616/25 PC.66616/5	Z.212005 Z.211026	2
R41 R42 R43	As R38 Comp.Grade 2 Comp.Grade 2 As R43	82 0 Ω 33Ω	10 10	2W 2W	PC.66616/24 PC.66616/7		1 2
R44 R45 R46	As R45 Comp.Grade 2 As R45	56 0 Ω	10	2W	PC.66616/22	z.211206	2

Schedule WZ.17588/A

Ref.	Description	Value	Tol. % ±	Rating	Identity	Service Ref.	Qty.
	RESISTORS (FIXED) (Cont'd)					
R47	Comp.Grade 2	47Ω	10	2 W	PC.66616/9	z.211068	2
R48 R49 R50	As R47 Comp. Grade 2 Comp.Grade 2	39 0 Ω 22 0 Ω	10 10	2W 2W	PC.66616/20 PC.66616/17	Z.211185 Z.211152	1 3
R51 R52 R53 R54 R55 R56	As R50 As R50 Comp.Grade 2 Ins. As R53 As R53 As R53	33Ω	10	1/4W	PC.66610/7	Z•221047	4
R57	Carbon, Silohm.	50Ω	20	25W	WIS.5161	5905 - 99 -	1
R69	Type 712 Grade 7	1502	20	40	Sh.1 Ref.6 WIS.7663/B Ref.9	918 - 9047	1
	RESISTORS VARIABLE						
RV1 RV2 RV3 RV4 RV5	Preset WW Pot As RV1 As RV1 As RV1 As RV1	l kΩ	10	2.1/2W	PC.67403/29	Z.271607	5
RV6 RV7	Preset WW Pot. Comp.Linear Pot.	39 1 k9	10 20	60W 3/47;	PC.67407/39 PC.67203/2	AP.104536 Z.261179	1
į	INDUCTORS						
Ll	Choke	1.5 mH	5		WIS.3069	AP.100643	1
L 2 L 3	Choke 3 Turns As L2				Sh _• 1 68/W32056/C		4
L4	Choke	2500 -			WCP.341	AP.104579	1
L 5	34 Turns	3000 μF	1		Sh.1 Ed.BC W.40509/C Sh.1 Ed.A	AP.104377	1
L6	15 5 Turns				₩.40509/C	AP.104378	1
L7	9 Turns	2 . 15 μΗ	H 5		Sh.1 Ed.B W.34446/C Sh.1 Ed.B	AP.104379	1
L8	5 Turns	0.83 μΙ	± 5		₩•34445/C	AP.104380	1
L 9	8 Turns 6 Turns				Sh.1 Ed.B 74/W32738/C 75/W32738/C	AP.104381 AP.104382	1 1
Lll	Choke Assembly 150 Turns				7.32060/B Sh.1 Ed.A	AP.104383	1
L12 L13 L14	As L2 As L2 Choke 34 Turns				W.49681 Sh.1 Ed.A	AP.104544	1

Ref.	Description	Value	Tol. % ±	Rating	Identity	Service Ref.	Qty.
	INDUCTORS (Cont'd)						
L15	Variable, Complete Assy.				W.39080 Sh.1 Ed.A	AP.104550	1
L16 L17	Not Used Choke				₩.40912 Sh.1 Ed.A	AP.104568	1
L18	Choke 20 Turns				N.32060/B Sh.1 Ed.C	AP.104546	1
L 19	Anode Coil Assy.				W.40700 Sh.1 Ed.B	AP.104313	1
L20	Coupling Coil Assy.				W.49270 Sh.1 Ed.A	\ 13 3	2
L 21	Choke 43 Turns				W.33076/B Sh.1 Ed.D	AP.104545	1
L22 L23 L24	22.1/2 Turns As L22 Not Used Not Used				104/W40408/C	AP.104547	2
L25 L26	Single Loop				7.49 0 84/B	AP.104548	1
L27	Choke 1600 Turns				Sh.1 Ed.A WSK.13422	AP.104570	1
L 28	Choke 76 Turns	350 µН			Sh.1 Ed.H W.6171	AP.104567	
	·	<i>μ</i> π ο μπ			Sh.1 Ed.V		
L 29	Choke				₩.24575/B Sh.6	AP.104569	
	LINKS						
LKA	Coaxial				"IS.3408/C Sh.1 Ref.1	AP.100830	l
	METERS		:				
Ml	D.C. Moving Coil Scaled 0.15V	500 μA 100 mV	1		IS.3954/B Sh.13	AP.104388	1
M2	D.C. Moving Coil	l mA	1		Ref.11 WIS.3686	AP.104243	1
M 3	Scaled 0.250 mA D.C. Moving Coil Scaled 0-5 mA	100 mV 1 mA 100 mV	1		Sh.6 Ref.85 WIS.3954/B Sh.13	AP.104385	1
M4-	D.C. Moving Coil Scaled 0-250 mA	500 μA 100 mV	1		Ref.113 WIS.3954/B Sh.13 Ref.114	AP.104386	1

Ref.	Description	Value	Tol. % ±	Rating	Identity	Service Ref.	Qty.
	METERS (Cont'd)						
M 5	D.C. Moving Coil Scaled 0.400 mA	l mA 100 mV	1	:	WIS.3686 Sh.12 Ref.189	AP.104387	
м6	D.C. Moving Coil Scaled 0-2A	l mA loo mV	1		WIS.4235 Sh.14 Ref.218	AP.104555	1
м7	D.C. Moving Coil Scaled 0-350 mA	l mA 100 mV	1		WIS.4235 Sh.16	AP.104556	1
M 8	D.C. Moving Coil Rectifier Dual Scale to Read	0-15V	1		Ref.247 WIS.4235 Sh.14 Ref.214	AP.104551	1
M9	A.C. or D.C. D.C. Moving Coil Scaled O-600V D.C.	l mA 100 mV	1		WIS.4235 Sh.7	AP.104259	1
Mlo	D.C. Moving Coil Scaled O-1000	500 µA 50 mV	1		Ref.129 WIS.4235 Sh.10 Ref.174	AP.104557	1
	PEAK VOLTMETERS						
PVMl					₩.38793	AP.104410	1
PVM2					Sh.1 Ed.D W.38793	AP.104389	2
1 -	Not Used As PVM2				Sh.l Ed.A		
	PLUGS						
PLA	Coaxial				W.36715/B Sh.1 Ref.2	AP.64650	1
PLB	Coaxial				77.36715/B Sh.1 Ref.3	AP.64650	1
PLC	Coaxial				₩.36715/B	AP.64650	2
PLD	Coaxial				Sh.1 Ref.4 W.36715/B	AP.64650	1
PLE	18 Way				Sh.1 Ref.5 W.41113 Sh.1 Ref.1	AP.104585	1
PLF	18 Wa y				WIS.3738/C Sh.1 Ref.1	AP.104176	5
PLG PLH PLJ	As PLF As PLC As PLF						

Ref.	Description	Value	Tol. % ±	Rating	Identity	Service Ref.	Qty.
	PLUGS (Cont'd)						
PLK	Coaxial				WIS.5355/B Sh.1 Ref.8	AP.67169	1
PLL	6 Way (Red)				W.41113 Sh.1 Ref.2	AP.104584	1
PLM	Coaxial (Yellow)				W.36715/B Sh.1 Ref.6	AP.64650	1
PLN PLQ	to PLP Not Used Coaxial (Black)	:			W.51158/C	AP.61032	1
PLR	Coaxial (Green)				Sh.1 Ref.1 W.51158/C Sh.1 Ref.2	AP.61032	1
PLS	Coaxial (Blue)				W.51158/C Sh.1 Ref.3	AP.61032	1
PLT	Coaxial (Red)				W.51158/C Sh.1 Ref.4	AP.61032	1
PLU	Coaxial (Yellow)				W.51158/C Sh.1 Ref.5	AP.61032	1
PLV	Coaxial (Grey)				W.51158/C Sh.1 Ref.6	AP.61032	1
PLW	Coaxial (Brown)				W.51158/C Sh.1 Ref.7	AP.61032	1
PLCA	Coaxial				7718.3106/C	AP.101016	3
PLCB PLCC PLAB PLAC	As PLCA As PLCA As PLF to PLAY Not Used				Sh.1 Ref.3		
$\mathtt{PLA}Z$	As PLF						
	SOCKETS						
SKA	Coaxial				WIS.5355/B Sh.1 Ref.9	AP.104571	7
SKB SKC SKD	As SKA As SKA As SKA						
SKE	18 Way				WIS.3732/C Sh.1 Ref.1	AP.104204	1
SKF	18 Way				W.41061 Sh.1 Ref.6	AP.104202	1
SKG	18 Way				W.41061 Sh.1 Ref.7	AP.104202	1
SKH	As SKA						
				.			

Ref.	Description	Value	Tol. % ±	Rating	Identity	Service Ref.	Qty.
SKJ SKK	SOCKETS (Cont'd) 18 Way (Green) As SKA				W.41061 Sh.1 Ref.9	AP.104202	1
SKL SKM SKN	Not Used As SKA 12 Way (Light Grey)				W.41061 Sh.1 Ref.	AP.104202	1
SKP	18 Way (Tan)				102 W.41061 Sh.1 Ref.105	AP.104202	1
SKR -	to SKZ Not Used						
SKAA SKAB	Not Used 18 Way				W.41061 Sh.1 Ref. 26	AP.104202	1
SKAC	to SKAY Not Used						
SKAZ	18 Way (Tan)				W.41061 Sh.1 Ref.106	AP.104202	1
	SWITCHES					•	
SWA	l Pole, 5 Pos.				W.38959 Sh.1 Ed.A	AP.104369	1
SWB	l Wafer, Single Pole, 5 Way				WIS.5670/C		1
swc	1 Pole, 5 Pos.				Sh.97 W.40066 Sh.1 Ed.A	AP.104472	1
SWD SWE	4 Pole, 5 Pos. Not Used				6/w.40408/c	AP.104573	1
SWFl	Complete Assy.				W.39161	AP.104474	1
SWF2	l Pole c/o				Sh.1 Ed.A WIS.5586/C		4
SWGl	Complete Assy.				Sh.1 Ref.2 W.36725 Sh.1 Ed.B	AP.104473	1
SWG2					W.40269/C	AP.104463	1
SWH	l Pole			2.5 kVA	Sh.1 Ed.B WIS.5197/B	AP.104476	1
SWJ	2 Pole l Wafer				Sh.6 WIS.5820/B	AP.104468	1
SWK	l Pole, 2 Wafers				Sh.34 WIS.5820/B Sh.34	AP.104468	1

Ref.	Danamintian	We like	Tol.	Do to a se	Identity		04
Kei.	Description	Value	<u>+</u>	Rating	Identity	Service Ref.	Qty.
	SWITCHES (Cont'd)						
SWM SWN SWP	As SWF2 As SWF2 Part of Tuning Capacitor C64 for Contacts see Ref.87						
	TERMINAL BLOCKS			,			
TBl	20 Way				W.33265 Sh.1 Ed.Q	AP.104574	
TB2 TB3	2 Way 3 Way				42/W39081/C WIS.1632 Sh.1 Ref.3	AP.104576	
TB4	10 Way				W.33265 Sh.1 Ref.W	AP.104575	1
	VALVES						
Vl V2	CV.428 As Vl					CV.428	2
V 3	QY.4250 *					CV.2131	2
V4 V5	As V3 BR.191 or ACT70					CV.2383	1
	MISCELLANEOUS ELECTRI	l CAL ITEI	I VIS				
Хl	Suction Unit				WIS.5731/B	AP.104318	1
Х2	Ball Contactor				Sh.2 Ref.3 W.40987/C	AP.104506	1
X3 X4	Spring Contact Ball Contact				Sh.1 Ed.A 47/W39081/C W.41074/C Sh.1 Ed.A	AP.104507 AP.104504	, ,
X 5	As X4				Direct Dates		
х6 х7	Spring Contact As X6				41/w35056/c	AP.104505	2
	MISCELLANEOUS MECHANI appear on the Circuit			ote the	following item	s do not	
1 2	Insulator Ceramic Air Filter				WP.984 WIS.4726/B Sh.1 Ref.4	AP.104477 AP.104342	
3 4	Not Used Mounting Board					. D. 7.01 E00	,
5	Mycalex Mounting Board				1/W49688/C	ьР.104529	
	Mycalex				177/\\37907/C	AP.104530	1
6	Insulator				SP.10996	AP.101034	2

Schedule WZ.17588/A

If required to operate on I.S.B., so Note at bottom of Page 4.

Ref.	Description	Value	Tol. % ±	Rating	Identi ty	Service Ref.	Qty.
7 8 9 10	MISCELLANEOUS MECHAN Not Used Not Used Not Used Not Used	ICAL ITE	MS (Con	t'd)			
11 12 13 14 15	Coil Mounting Plate Mycalex Top Panel Mycalex Contact Mounting Mycalex End Cheek Mycalex Contact Mounting				107/W40408/C 108A/W40408/B 3/W40408/C 1/W48433/C 51/W40408/C	AP.104524 AP.104525 AP.104525 AP.104526 AP.104527	4 1
16 17	Mycalex Rotor Mounting Mycalex Contact Assy.				5/W40408/C W.41075/C Sh.1 Ed.A	AP.104528 AP.104488	2
18 19 20 21	Contact Assy. Not Used Spring Contact Stand-Off Insu-				7.18195/C Sh.1 Ed.A 101/W37907/C VIS.5416/C	AP.104489 AP.104500 AP.104441	
22 23 24	lator Mounting Board Mycalex Spring Contact Grid Contact Spring				Sh.1 Ref.3 49/W32056/C 101A/W37907/C 94/W37907/C	AP.104513	1 3
25 26	Stand-Off Insu- lator Ball Contact Assy.				WIS.5416/C Sh.1 Ref.4 W.18195/C Sh.1 Ed.A	AP.10442 AP.104489	10
27 28 29	Spring Switch Blade Assy. Contact Panel				W.7447/C Sh.1 Ref.28B W.39454/B Sh.1 Ed.A 15/W39161/C	AP.104538 AP.104565 AP.104514	1
30 31	Mycalex Insulating Pillar Mounting Plate,				WSK.10464 Sh.1 Ref.9	AP.104562 AP.104515	
32 33 34	Mycalex Ball Contact Assy. End Plate Mycalex Bearing Plate Mycalex				38961/C Sh.1 Ed.A 5/W37919 65/W37919	AP.104490 AP.104516 AP.104517	16 1

Ref.	Description	Value	Tol. % ±	Rating	Identity	Service Ref.	Qty.
	MISCELLANEOUS MECHANICA	LITEMS	S (Cor	nt'd.)			
35	Spring Contact Assy.	 			W.40784/C Sh.1 Ed.A	AP.10449.	3
36 37	End Plate Mycalex Spring Contact Assy.				109/w.37919 w.40785/C	AP.104518 AP.104492	
38	Spring Contact Assy.	·			Sh.1 Ed.A W.49276/C	AP.104493	1
39	Spring Contact Assy.				Sh.1 Ed.A W.40785/C Sh.1 Ed.A	AP.104492	
40	Spring Contact Assy.				W.50138/B Sh.1 Ed.A	AP.104494	1
41 42	Spring Flat Coupling Coil Mtg. Plate Mycalex				127/W.37919/C 34A/W.37919/B		
43	Spring Contact Assy.				W.40712/C Sh.1 Ed.A	AP.104495	2
7+7+	Spring Contact Assy.				W.40713/C Sh.1 Ed.A	AP.104496	2
45	Spring Contact				72/w.37919/c	AP.104502	6
46	Spindle Assy.				W.40693 Sh.1 Ed.A	AP.104562	1
47 48 49 5 0	Coil Support Mycalex Coil Support Mycalex Coil Support Mycalex Coil Support Mycalex				3/W•40700/B 4/W•40700 4A/W•40700 4B/W•40700	AP.104433 AP.104434 AP.104435 AP.104436	1
51 52 53	Coil Support Mycalex Coil Support Mycalex Insulator - Conical Porcelain				4C/W.40700 8/W.40700/B SP.10996	AP.104437 AP.104438 AP.101034	1
54	Insulating Piece Mycalex				3/W•40203/C	AP.104531	
55	Mounting Board, Mycalex				1/W.39080/B	AP.104439	1
56	Support Plate, Mycalex				2/w.38959/B	AP.104419	1
57	Coupling Bar, Mycalex				W.21029/C Sh.1 Ref.8	AP.104420	1
58	Mounting Plate, Mycalex				1/W.38959/B	AP.104421	1
59	Mounting Board, Mycalex				la/w.39080/B	AP.104422	1
60	Spring Assy.				W.39660/C Sh.1 Ed.A	AP.104540	2

Ref.	Description	Value	Tol.	Rating	Identity	Service Ref.	Qty.
	MISCELLANEOUS MECHAN	ICAL IT	EMS (Cont'd)			
61	Shaft Assy.			ŕ	W.39617/B Sh.1 Ed.A	AP.104561	1
62	Former Mycalex				10/W.39080/B	AP.104423	1
63	Former Mycalex				10A/W.39080/B		1
64	Former Mycalex				10B/W.39080/B		1
65	Former Mycalex				10C/W.39080/B	AP.104426	1
66	Former Mycalex				14/W.39080/B	AP.104427	1
67	Former Mycalex				15/w.39080/B	AP.104428	1
68	Contact Assy.				W.49358/B		1 1
69	Insulating Rod				Sh.1 Ed.B WSK.10464 Sh.1 Ref.10	AP.104532	4
70	Conical Insulator				WIS 626/C Sh.1 Ref.1		1
71	Valveholder Ceramic 5 Pin				WIS.4844/C Sh.1 Ref.2	AP.104411	2
72	Insulator Stand-				WIS.5416/C	AP.194442	10
73	Off Insulator Stand- Off				Sh.1 Ref.4 WIS.5416/C Sh.1 Ref.1	AP.104440	2
74 75	Base Mycalex Terminal Block Mycalex					AP.104429 AP.104430	1 6
76	Spring Contact				30/w.32738/c	AP 104503	4
77	Spring Contact				28/w .32738/c	AP.104431	ī
	Plate Mycalex				r. 4 70770 /g	4D 701170	,
78	Condenser Plate Myca	Tex	Į		54/w.32738/c wis.5716/c	AP.104432 AP.104414	1 1
7 9	Flexible Drive Assembly				WID • 5/10/0	AF •104414	†
80	Manual Drive Assembly				W.38958 Sh.1 Ed.A	AP.104415	3
81	Manual Drive				₩.38958	AP.104416	1
82	Assembly Manual Drive Assembly				Sh.2 Ed.B W.39163 Sh.1 Ed.A	AP.104417	1
83	Manual Drive Assembly				W.39340 Sh.2 Ed.B	AP.104418	1
84	Spring Contact Assembly				N.49274/C Sh.1 Ed.A	AP.104497	2
85	Spring				23/w.39080/C	AP.104541	4
86	Contact Mounting			i	3A/W.404 0 8/C	AP.104520	1
87	Mycalex Contact Assembly				W.18195/C Sh.1 Ed.A	AP.104489	
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Ref.	Description	Value	Tol. % ±	Rating	Identity	Service Ref.	Qty.
	MISCELLANEOUS MECH	ANICAL	ITEMS	(Cont'	d) 		†
88 89	End Cheek Mycalex Contact Assembly				2/W.48433/C W.18195/C Sh.1 Ed.D	AP.104521 AP.104498	8
90 91	Coupling Mycalex Suction Fan Motor				16/W _• 38936/C	AP.104522 6105-99-	1
92	a.c. Bearing, Ball				S.E.M. Ltd. FAFNIR 6203	622 – 3206 3110 – 99	1
93	Journal Bearing, Ball				SKEFCO 6004Z	710–3460 3110–99–	1
94	Journal Switch, Centrifuga	L			ECP 8098 S.E.M. Ltd.	622–3756 5930–99 622–3732	1
95	Switch, Stationary				ECP 8100 S.E.M. Ltd.	4450-99- 622-2217	1
96	Capacitor, fixed Electrolytic	50/65 pF		275 r.m.s.	ECP 14208	5910 – 99 – 622 – 4408	1
97 98	Wave Washer Circlip			wkg.	EP 36285 EP 25676		1 1
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COMPONENTS LIST

FOR

MIXER UNIT

(Drg. No. W.37920 Sh.7-9 Ed.D)

NOTES

- 1. When ordering spares quote information from all columns for identities marked * or identity only for all other items.
- 2. The references in column 1 are shown on circuit diagrams Figs.12 and 13 and component location diagrams Fig.6.
- 3. For identical items the total quantity is given at the first entry.

Ref.	Description	Value	Tol. % ±	Rating	Identity	Service Ref.	Qty.
Cl	CAPACITORS Ceramic	.001 μF	20	350V DC	PC.18203/5	Z.132630	2
C2 C3 C4	Paper As C2 As C2	.01 µF	20	500V DC	PC.19203/14		29
C5	Variable. Air spaced. Two 3 Gangs Coupled	9.5-225 pF per Sect.			WIS.5537 Sh.1 Ref.2	Part of AP.104343	10
C6 C7	Variable, Air Spaced As C6	3 -30 p F		75V	W.53587/C Sh.1 Ed.A		6
1	As C6 Ceramic Ceramic As C2	10 μμF 100 μμF	2 0 10	500V 500V DC	PC.18202/1 PC.18202/13	Z.132253 Z.132300	1 3
C13 C14 C15 C16	As C2 As C5 Not Used As C6 As C6 Ceramic Tubular	47 μμ 	10	500V DC	PC.18202/9	z. 132289	5
C19 C20 C21 C22	Insulated Temp. Coeff750 As ClO As C2 As C18 As C2						

Ref.	-	Value	Tol. % ±	Rating	Identity	Service Ref.	Qty
	CAPACITORS (Cont	d.) 1000 PF			H.31 8547-01	624-6698	25
C23	Mica	Huy-do.	10	750V DC	*WIS.4342/B		25
	CAPACITORS (Cont	d.) 1000 PF	<u>±</u>	_	H.311 8847-01	Ref. 624-6298	25
. c 56	Paper As C2	.Ol μF	20	400V DC	PC.19308/7	Z.115827	7
C58 C59	As C2 Silvered Mica	220 μ μF	5	350V DC	*WIS.4483/B Sh.1 Ref.1	Z.123288	1
C60	Silvered Mica	390 μμ F	5	350V DC	¥WIS.4483/B	Z.123376	1
061 062	As C56 As C56				Sh.l Ref.l		

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Ref.	Description	Value	Tol. % ±	Rating	Identity	Service Ref.	Qty.
c63	CAPACITORS (Cont Variable Air	3 . 3-			WIS.3534/C	AP.104344	1
c67 c68	Spaced As C2 As C5 As C5 As C32 As C32	34 . 5 μμ F			Sh.1 Ref.2		
070 071 072 073	As C32 Mica, Foil As C2 Not Used As C32 As C32 As C32	150 цц. Г	10	750V DC	PC.18802/15	z.123663	1
c76	Mica Metallised	68 μμ F	10	750V DC	PC.18802/11	Z.123918	1
C80 C81 C82 C83 C84 C85 C86 C87 C88 C89 C91 C92 C93 C94 C95 C96 C97 C98 C99 C100	As C2 Paper As C23 As C23 As C23 As C5 As C32 As C32 As C32 As C32 As C23	.05 µF	20	500V DC	PC.19203/17	Z.115505	1
C103 C104 C105	Paper As C32 As C32 As C32	.25 μF	25	150V DC	PC.19301/2	z . 115563	2

Schedule WZ.17590A

Ref.	Description	Value	Tol. % ±	Rating	Identity	Service Ref.	Qty.
	CAPACITORS (Contd.)						
C108	Mica, Foil, Moulded Case Not Used	.001 µF	20	350V DC	PC.18701/2	Z.124479	٠4
C110 C111	Mica Foil, Moulded Case As C23 Not Used	220 μμ. F	20	750V DC	PC.18702/2	Z.123293	1
C113 C114 C115 C116 C117 C118 C119 C120	As ClO3 Not Used Not Used As ClO7 As C2 As ClO7 As C2 As C56						
C122 C123 C124 C125 C126 C127	As C107 Not Used Not Used Paper Mica As C2 As C2 As C32	•l μF 100 μμF	20 10	350V DC 750V DC	PC.19207/15 PC.18802/13		
C130	As C2 Mica, Metallised, Moulded Case	470 μμ F	5	750V DC	PC.18802/21	Z.123948	1
C132 C133 C134 1135	Mica, Metallised, Moulded Case As C2 As C32 As C2 As C56 As C57	Тирц ОГ	10	750V DC	PC.18802/1	Z.123900	1
	RESISTORS						
R1 R2 R3 R4 R5	Comp. Grade 2 Comp. Grade 2 Comp. Grade 2 Comp. Grade 2 As R4	22Ω 56Ω 33 kΩ 33Ω	10	1/2W 1/2W 1/2W 1/4W	PC.66611/5 PC.66611/10 PC.66611/43 PC.66610/7	Z.222195	1 6
R6 R7	Comp. Grade 2 Comp. Grade 2	100 kΩ 2.2 kΩ		1/2W 1/2W	PC.66611/49 PC.66611/29	Z.223039 Z.222048	5 4

Ref.	Description	Value	Tol.	Rating	Identity	Service Ref.	Qty.
	RESISTORS (Contd.)						
R8	Wirewound	5.55Ω	1	3W	*WIS.2896/C Sh.2 Ref.10	AP.103023	6
R9	Comp. Grade 2	6.8 kΩ	10	1/2W	PC.66611/35	Z.222111	10
RlO	As R4			,	,		
Rll	As R6						
R12	As R3						
R13	As R4						
R14	As R4						
R15 R16	As R7 As R8						
R17	As R9						
R18	As R4						
Rl9	Comp. Grade 2	10 kΩ	10	1/27	PC.66611/37	Z.222132	6
R20	As R3			,	, , ,	-	
R21	As R4						
R22	As R4						
R23	As R6						
R24	As R7					•	
R25	As R8						
R26 R27	As R9 As R4						
R28	As R9						
R29	Comp. Grade 2	150 kΩ	10	1/2W	PC.66611/51	Z.223060	1
R30	Comp. Grade 2	$1 \text{ k}\Omega$	10	1/2W	PC.66611/25		5
R31	As R9			,	•		
R32	Comp. Grade 2	8.2 kΩ	10	1/27	PC.66611/36	Z.222123	4
R33	As R4						
R34	As R4						
R35	As R4	77 0 0	10	יייכ/ ד	PC.66611/19	Z.221174	3
R36 R37	Comp. Grade 2 As R8	330Ω	1 10	1/211	FC.00011/19	4.564	
R38	Comp. Grade 2	22 kΩ	10	1/2W	PC.66611/41	Z-222174	2
R39	As R9		- "		10,000,12		
R40	As R8						
R41	As R4						
R42	As R4						
R43	As R36	E05-	_		a coc/a	AD 303001	
R44	Wirewound	.505Ω	5	3W	*"IS.2896/C	AP.103024	6
D1. E	A a Di				Sh.2 Ref.10		
R45 R46	As R4 As R4						
R47	Comp. Grade 2	22 0 Ω	10	1/2W	PC.66611/17	Z.221153	9
R48	As R47	+ ••		_,			
R49		3.3 kΩ	10	1/2W	PC.66611/31	z.222069	2
"	*				,		
L			<u> </u>				

Ref.	Description	Value	Tol.	Rating	Identity	Service Ref.	Qty.
R50 R51 R52	RESISTORS (Contd.) Comp. Grade 2 As R50 As R6	180Ω	10	1/2W	PC.66611/16	ℤ•2211¼4	2
R53 R54 R55 R56 R57 R58 R59 R60	As R47 As R47 As R4 Comp. Grade 2 As R36 As R56 As R4 Not Used	33 Ω	10	1/47	PC.66609/1	Z.221046	2
R62 R63 R64 R65 R66 R67 R68 R69	As R9 As R32 As R9 Not Used Not Used	3.9 kΩ	10	1 / 2W	PC.66611/32	Z.222081	1
R75 R76 R77	As R30 As R49 As R19 As R4 As R30 As R47 As R47			7.4.44			
R78	Carbon	330Ω	10	3/4W	*WIS.3903 Sh.1 Ref.5	Z.221174	1
R79 R80 R81 R82 R83 R84	As R8 Comp. Grade 2 As R19 As R9 As R32	120Ω	10	1/4W	PC.66609/8	Z.221121	1
R85 R86	As R4 WW Enam. Vit. As R4	l kΩ	5	4.1/2W	PC.67009/13	Z.244001	1
R86 R87 R88 R89 R90 R91 R92	As R4 Comp. Grade 2 Insulated As R44 Not Used As R19 Not Used Not Used	100Ω	10	1/2+W	PC.66609/7	Z.221109	1

Ref.	Description	Value	Tol.	Rating	Identity	Service Ref.	Qty.
	RESISTORS (Contd.)						
R99 R100 R101 R102 R103	As R47 As R47 Not Used Not Used Not Used As R44 Comp. Grade 2 As R4 As R30 As R3 Not Used As R19	100ດ	10	1/4W	PC.66610/13	z•221110	2
R105 R106 R1 0 7	Comp. Grade 2 Comp. Grade 2 Thermistor	33 0 Ω 270Ω	10	1/4W 1/4W	PC.66610/19 PC.66610/18 VIS.5740/C Sh.1 Ed.4	Z.221173 Z.221164 AP.104326	1 1 1
R109 R110	As R19 Comp. Grade 2 Comp. Grade 2 As R99	63 0 ନ 68ନ	10 10	1/2W 1/2W	PC.66611/23 PC.66610/11	Z.221216 Z.221089	2
R112	Comp. Grade 2 As R38	47 kΩ	10	1/27/	PC.66611/45		1
R114 R115 R116	Comp. Grade 2 Comp. Grade 2 As R7	4.7 kΩ 10 0 Ω	10 10	1/2W 1/2W	PC.66611/33 PC.66611/13	Z.222096 Z.221111	1 2
R118	As R44 Comp. Grade 2	56Ω	10	1/2W	PC.66611/10	Z.221081	3
R120	As R118 Comp. Grade 2	222	10	1/2.7	PC.66611/5	Z.221027	3
R122 R123 R124 R125 R126 R127 R130 R131 R132 R133	As R120 Comp. Grade 2 As R120 As R118 As R6 As R4 As R30 As R115 As R109 As R44 As R47 As R47 As R43 As R3	68Ω	10	1/277	PC.66611/11	Z.221090	1

Ref.	Description .	Value	Tol. % ±	Rating	Identity	Service Ref.	Qty.
	RESISTORS VARIABLE						
RV1 RV2	Comp. Linear Not Used	5 kΩ	20	3/4W	PC.67203/9	z.261510	1
R V 3	Wirewound	25 kΩ	10	3W	WIS.4175/B Sh.1 Ref.63	Z.272301	8
RV4 RV5	As RV3 Wirewound	25 [°] kΩ	10	<i>3</i> ₩	WIS.4175/B Sh.1 Ref.64	Z.272302	1
RV7 RV8 RV9 RV10	As RV3 As RV3 As RV3 As RV3 As RV3						
	INDUCTORS						
Ll	3.1/2 Turns				W.26958/B Sh.154 W.36413/C	AP.104370	1
L 2	21 Turns				Sh.1 Ed.0 W.50593 Sh.1 Ed.F	AP.104372	2
L3	10 Turns				W.37149 Sh.1 Ed.C		2
L4	4 Turns				W.50593 Sh.1 Ed.B	AP.104373	
L5 L6	3.1/2 Turns 600 Turns & 400 Turns				147/737628/C W.18936/C Sh.1 Ed.A	AP.104566	10 2
L7 L8 L9 L10	As L5 As L5 As L5 As L5						
Lll					WIS.1161 Sh.1 Ref.1	AP.104567	1
L12	22 Turns				W.37206/B Sh.1 Ed.A	AP.104374	1
L13	9 Turns				W.37207/B Sh.1 Ed.A	AP.104375	
L14	3 Turns				W.37208/B Sh.1 Ed.A	AP.104376	1
L 15	As L5 21 Turns				W.50593 Sh.1 Ed.F	AP.104372	1

Ref.	Description	Value	Tol. % ±	Rating	Identity	Service Ref.	Qty.
L17	INDUCTORS (Contd.) 10 Turns				W.37149 Sh.1 Ed.C		1
L19 L20 L21 L22 L23 L24	As L4 As L5 As L6 Not Used Not Used As L5 As L5						
	As L5 A6 Turns				W.33035/B Sh.1 Ed.D	AP.104363	1
1	Not Used Not Used 'Ledex' Selector				WIS.5540/B Sh.7	AP.104368	ı
	LINKS	; ;					
LKA	Coaxial				WIS.3409/C Sh.1 Ref.1	AP.100830	1
	METERS						
Ml	M.C. F.S.D. = 1 mA DC Scale 0-10 Res. 50Ω				WIS.3686 Sh.4 Ref. 61	AP.104351	1
	PLUGS						
PLA to PLM	Not Used 12 Way				WIS.3737/C Sh.1 Ref.9	AP.70371	1
PLO PLP	Not Used 18 Way				WIS.3738/C Sh.1 Ref.1		1
PLQ to PLZ PLAB to	Not Used Not Used						
PLAZ	1						

Ref.	Description	Value	Tol. % ±	Rating	Identity	Service Ref.	Qty.
PLBA	PLUGS (Contd.) Coaxial				WIS.3106 Sh.1 Ref.1	AP.101024	5
PLBC PLBD PLBE PLBF PLBG	As PLBA As PLBA As PLBA As PLBA Not Used Not Used SOCKETS				WT 2 705 (/g	AD (7007	0
SKQ	Coaxial				WIS.3956/C Sh.1 Ref.3	AP.67823	8
SKR SKS SKT SKU SKV SKW SKX	As SKQ						
	SWITCHES						
SWA	8 Wafer 12 Way				WIS.3421/C Sh.50	AP.104364	1
SWB	2 Wafer 7 Way				WIS.1197/C Sh.1099	AP.104366	1
swc	9 Wafer 12 Way				WIS.3421/C Sh.51	AP.104365	1
SWD	l Wafer 6 Way					AP.104367	1
SWE SWQ	l Pole On-Off l Pole Double				2/WIS.1012 WIS.2834	AP.100811 W.3893	1
SWG	throw 'Ledex' Selector (Part)				Sh.1 Ref.3 WIS.5540/B Sh.7		1
TRI	TRANSFORMERS 24 Turns & 20 Turns				W.26958/B Sh.152	AP.104352	1

Ref.	Description	Value	Tol. % ±	Rating	Identity	Service Ref.	Qty.
	TRANSFORMERS (Contd)					
TR2	12 Turns & 9 Turns				W.26958/B	AP.104353	1
TR3	21 Turns & 6 Turns				Sh.153 W.50593 Sh.1 Ed.G	AP.104360	2
TR4	9 Turns & 2 Turns				₩.50593	AP.104355	2
TR5	4 Turns & 1 Turns				Sh.1 Ed.D W.50593 Sh.1 Ed.E	AP.104356	1
TR6	28 Turns & 1 Turns				W•41184/B	AP.104357	1
TR7	13 Turns & 1 Turns				Sh.45 W.41184/B Sh.46	AP.104358	1
TR8	7 Turns & 1 Turns				W.41185/B Sh.6	AP.104359	1
TR9	As TR3 As TR4				_		
TR11	4 Turns & 1 Turns				W.37149 Sh.1 Ed.M	AP.104361	1
TR12	Input Transformer				W.33035/B Sh.1 Ed.E	AP.104362	1
TR13	Output Transformer				W.33035/B Sh.1 Ed.D	AP.104363	1
	VALVES						
V1 V2 V3 V4 V5 V6 V7 V8 V9	CV138 As V1 CV.4014 As V7 As V1				CV.138		9
VlO	CV.391				CV.391		2
V11 V12 V13	As V10 N77 As V12				CV.136		2
V L <i>J</i>	₩ A TC						

Ref.	Description	Value	Tol. % ±	Rating	Identity	Service Ref.	Qty.
	MISCELLANEOUS ME	CHANICA	L ITE	MS			
1 2 3 4	Spring Contact Valveholder B8G Valveholder B7G Insulator				54/".36728/C PC.81813/1 PC.81811/1 "IS.5593/C Sh.1 Ref.5	AP.104542 Z.561146 Z.560127 AP.103779	3 2 11 11

COMPONENTS LIST

FOR

PEAK VOLTMETER

(Drg. No. W.38793 Sh.1 Ed.A)

NOTES

- 1. When ordering spares quote information from all columns for identities marked * or identity only for all other items.
- 2. The references in column 1 are shown on circuit and component location diagram Fig.7.
- 3. For identical items the total quantity is given at the first entry.

Ref.	Description	Value	Tol. % ±	Rating	Identity	Service Ref.	Qty.
	CAPACITORS						
Cl	Silvered Ceramic	10 pF	20	4 kV DC	*WIS.4240/C	AP.102961	1
C2	Ceramic Tubular	47 pF	5	750V DC	Sh.1 Ref.2 *WIS.3450/B Sh.1 Ref.7	Z.132288	1
C 3	Ceramic Tubular	2,200 pF	20	350V DC	PC.18203/7	z.132631	1
	RESISTORS FIXED						
Rl R2	Comp. Grade 1 Comp.	3.9 kg 62 kg	5 5	1/4W 1/4W	PC.66604/32 WIS.3903 Sh.1 Ref.5	Z.215311 Z.216097	1
	INDUCTORS						
Ll	250 mA	1.5 mH	5		WIS.3069 Sh.1	AP.100643	1
	RECTIFIERS						
MRL	Germanium Crystal] 		WIS.4203/C Sh.1 Ref.2	CV • 44+8	1
;	MISCELLANEOUS MEC	 HANICAL ITE	I EMS				
1	Terminal				WIS.4793/C Sh.1 Ref.7	Z.560882	3

COMPONENTS LIST

FOR

PEAK VOLTMETER

(Drg. No.W.38793 Sh.1 Ed.D)

NOTES

- When ordering spares quote information from all columns for identities marked ** or identity only for all other items.
- 2. The references in column 1 are shown on circuit and component location diagram Fig. 8.
- 3. For identical items the total quantity is given at the first entry.

Ref.	Description	Value	Tol. +	Rating	Identity	Service Ref.	Qty.
Cl C2	CAPACITORS Ceramic, Tubular Ceramic, Tubular	330pF 2,200 pF		350V DC 350V DC	PC.18203/2 PC.18203/7	Z.132627 Z.132631	1
Rl	RESISTORS FIXED	Z O 1~0	E	1/4₩	PC •66604/32	7 01571	1
R1 R2	Comp. Grade 1 Comp. Insul.	3.9 kg 62 kg	5 5	1/4W	WIS.3903 Sh.1 Ref.5	Z.215311 Z.216097	1
Ll	INDUCTORS 250 mA	1.5 mH	5		WIS.3069 Sh.1	AP.100643	1
MRl	RECTIFIERS Germanium Crystal				WIS.4203/C Sh.1 Ref.2	CV.448	1
1	MISCELLANEOUS MEC	HANICAL II	rems		WIS.4793/C		
					Sh.1 Ref.7	Z.560882	3

MCL:- T.4260 Issue:- 3 Date:- 15-3-66

MASTER COMPONENTS LIST

FOR

TRANSMITTER TYPE HS.31A TYPE NO.3975A

Technical Handbook Ref. T.4260

NOTES:

- 1. Component schedules in this handbook are presented in the form of a master components list, which includes all components used in this equipment. Each component is identified by means of a spares reference number, column 1, in addition to the normal part identity in column 6.
- 2. Components shown on individual circuit diagrams may be identified in the master list by means of the cross-reference tables associated with each circuit diagram. The numbers given are the spares reference numbers.
- 3. For spares ordering purposes it is only necessary to quote the exact hand-book reference at the top of this page together with the spares reference number. Individual part identities can be given as a cross check if desired, but are not necessary.
- 4. Prices are subject to change without notice.
- 5. The following abbreviations are used throughout this Master List:

Cap.	Capacitor	Osc.	Oscillator
Carb.	Carbon Ceramic	Pap.	Paper
C/O	Changeover	pF	Picofarad Micro-Microfarad
Coef. Comp.	Coefficient Composition	Psn.	Position
DP	Double Pole	Potr. Prim.	Potentiometer Primary (winding)
DT	Double Throw	PVC	Polyvinyl Chloride
En.	Enamelled	Deat	Compound Insulated
Elyc. Fil.	Electrolytic Filament	Rect. Res.	Rectifier Resistor
FSD	Full Scale Deflection	Sec.	Secondary (winding)
Gd.	Grade	Sil.Mica.	Silver Mica
HS	High Stability	Sil.Mica.Prot.	Silver Mica Protected Single Pole
Indr. Insd.	Inductor Insulated	Temp.	Temperature
Insr.	Insulator	Term. Transf.	Terminal Transformer
Lg.	Long	Tub.	Tubular
Lin.	Linear	Vble.	Variable
Metd.	Metallised	Vit.	Vitreous
Mld.	Moulded	W/W	Wirewound
Neg.	Negative		

T.4260 1736 CP **A** Nos.1-506

<u> </u>		-	:					
No.	Description	Value	Tol. \$ ±	Rtg.	Identity	Qty.	Price † Each £. s. d.	Scale
1	Cap. Cer. Insd.	330pF	20	500 v	PC.18208-2	1	1.0	18
2	Cap. Cer. Insd.	2200pF	20	500V	PC.18208-7	2	1.0	18
3	Cap. Cer.	10pF	20	4kV	WIS.4240-C-1-2	1	11.0	1S
4	Cap. Cer. Tub.	47pF	5	750V	WIS.3450-B-1-7	1	2. 6	1S
5	Cap. Pap.	10µF	15	250V	WIS.4321-B-1-11	4	1. 3. 0	1S
6	Cap. Pap.	8 μ F	20	600V	WIS.4172-B-1-4	3	1.17. 0	
7	Cap. Pap.	4μF	15	750V	WIS.2354-B-1-6	1	19.6	1S
8	Cap. Pap.	4μF	10	6kV	WIS.4451-B-1-4	3	28. 9. 0	18
9	Cap. Mica	0.01µF	5	350 v	PC.18801-10	2	6.0	
10	Cap. Pap.	0.01µF	20	10kV	PC.19226-2	2	16.0	18
11	Cap. Elyc. Double Section		+50 -20	350V	PC.18408-4	1	12. 0	ıs
12	Cap. Mica	6800pF	5	350V	PC.18801-8	1	10.0	18
13	Cap. Mica	3000pF	20	800V	WIS.4522-C-1-5	15	12.0	
14	Cap. Pap.	0.01µF	25	350V	PC.19202-7	16	2. 0	
15	Cap. Cer.	33p F	5	750V	PC.18223-7	1	1.0	
16	Cap. Vble.	16-250p		-	WIS.3699-C-1-11	1	1.10.6	
17	Cap. Cer.	270pF	2	750V	PC.18223-18	1	1.0	1 1
18	Cap. Cer.			750V	PC.18212-3	1	1.0	
19	Cap. Vble. 2 Gang	7-100pF				1	1. 2. 6	
20	Cap. Cer.	270pF	20	350V		1	1.0	
21	Cap. Mica	500pF	20	800v	WIS.4522-C-1-2	1	7. 6	1S
22		-						
23	Cap. Hi-Load	150pF	20	7.5kV	WIS.5080-B-1-3C	1	3. 9. 0	1S
24	Cap. Vacuum	25pF	10	32kV	WIS.4735-C-1-2	2	15. 0. 0	1S
25	Cap. Hi-Load	1250pF	20	7.5kV	WIS.5080-B-1-1E	1	3. 0. 0	1S
26	Cap. Mica Foil	2200pF	20	750V	PC.18702-8	1	2.0	1S
27	Cap. Mica Disc	0.01µF	20	2000V	WIS.4721-C-1-LA	4	4.14. 6	1S
28	Cap. Hi-Load	130p F	10	7.5kV	WIS.4418-C-1-4	1	4. 6. 0	1S
29	Cap. Hi-Load	50pF	20	7.5k:V		2	2.11. 6	
30	Cap. Mica Foil	0.01µF	20	350V	PC.18701-5	2	2.6	18
31	Cap. Hi-Load	200pF	20	7.5kV		1	3. 9. 0	18
32	Cap. Hi-Load	125pF	20	7.5kV		1	3. 9. 0	1S
33	Cap. Hi-Load		20	7.5kV		1	3. 9. 0	
34	Cap. Hi-Load	1250pF	20	7.5kV		2	3. 0. 0	1S
35	Cap. Vble. Air				W.48433-1-A	1	95. 0. 0	
36	Cap. Preset Air				W.52596-C-1-A	2	3. 0. 0	
37	Cap. Hi-Load	125pF	20	7.5kV		4	3. 9. 0	18
38	Cap. Mica	0.01µF	20	750V	WIS.4342-B-1-7	1	9.0	1S
39	Cap. Mica Disc	.002µF	20	800V	1] 1	11.0	1S
40	Cap. Sil. Cer.	80pF	20	7.5kV		1	1.18. 6	18
41	Cap. Hi-Load	200pF	20	4.5kV		1	1.18. 0	
42	Cap. Hi-Load	200pF		7.5kV		2	3.12.6	, ,
43	Cap. Sil. Cer.		20	4kV	1	2	11.0	18
44	Cap. Cer. Insd.	.001µF	3	500V		2	1.0	18
45	Cap. Pap. Metd.	0.01µF	20	5cov	PC.19203-14	29	1. 6	5S
ļ .	Can This May 2 man a	9.5-225	pF p	ėr	WIS-5537-1-2	2	9.10.0	
46	Cap. Vble. Two 3-gang	section	in		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	-	1 /3+0. %	

В

							,	
No.	Description	Val ue	Tol. \$ ±	Rtg.	Identity	Qty.	Price † Each £. s. d.	Scale
47 48 49 50 51 52 53 55 55 55 55 55 56 66 66 66 66 67 71	Cap. Vble. Cap. Cer. Insd. Cap. Cer. Insd. Cap. Cer. Insd. Cap. Mica Cap. Cer. Cap. Vble. Cap. Pap. Cap. Mica Metd. Cap. Mica Cap. Mica Cap. Mica Cap. Pap. Cap. Mica Cap. Pap. Cap. Mica Cap. Pap. Cap. Mica	3-30pF 10pF 100pF 47pF 47pF 6.8pF 4.8-100 0.01µF 47pF 3.3-34. 150pF 68pF 0.05µF 0.05µF 1000pF 220pF 0.1µF 100pF 470pF 10pF 0.01µF	2 10 10 pF 20 5 5 FF 10 20 20 20 20 10 5	75V 750V 750V 750V 750V 750V 750V 750V 7	W.53587-C-1-C PC.18223-1 PC.18223-13 PC.18223-9 WIS.4342-B-1-7 PC.18201-7 PC.19308-7 PC.19308-7 PC.18802-9 WIS.3534-C-1-2 PC.18802-15 PC.18802-11 PC.19203-17 PC.19301-2 PC.18702-2 PC.18702-2 PC.18802-15 PC.18802-15 PC.18802-15 PC.18802-15 PC.18802-17 PC.18802-17 PC.18802-17 PC.18802-17 PC.18802-1	6 1 3 5 2 5 1 20 7 2 1 1 1 1 1 1 1	6. 6 1. 0 1. 0 9. 0 1. 0 9. 0 2. 6 3. 0 3. 0 2. 0 1. 6 2. 6 3. 0 2. 6 3. 6 2. 6 3. 6 2. 6 3. 6 2. 6 3. 6 2. 6 3. 6 2. 6 3. 6 2. 6 3. 6 3. 6 3. 6 4. 6 5. 6 6. 7 8. 6 8. 7 8. 7 8. 8 8. 6 8. 6 8. 7 8. 8 8. 8	1S 1S 2S 5S 1S 2S 2S 1S 1S 1S 1S 1S 1S 1S 1S 1S 1S 1S 1S
72 73 74 75 76 77 78 79 81 82 83 84	Fuse Cartridge	2A 10A 15A 6A 2A 500mA 1A 3A			WIS.5703-C-1-1 WIS.5703-C-1-4 WIS.4806-B-1-5 WIS.5703-C-1-3 WIS.2947-1-9 WIS.2947-1-5 WIS.2947-1-7 WIS.2947-1-10 WIS.2947-1-11	7 1 3 2 2 2 2 2 1	2. 0	12S 6S 12S 6S 6S 6S 6S 6S 6S
85 86 87 88 89 90 91 93	Indr. Indr. Indr. Indr. Indr. Choke 3 Turns Choke Indr. 34 Turns	1.5mH .0075H 3.5H 5.5H 3.8H 2500—30	±5 000µH	250mA 35A 600mA 0.4A 1.5A	W.24581-B-11	2 1 2 2 1 4 1	4. 0 42.15. 0 6.10. 0 16. 5. 0 41. 0. 0 19. 0 2.14. 0 2. 4. 0	1S 1 B 1B

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		<u> </u>		-		1	Τ	
No.	Description	Value	Tol. \$ ±	Rtg.	Identity	Qty.	Price † Each £. s. d.	Scale
94	Indr. 15.5 Turns	<u> </u>			W.40509-C-1-B	1	2. 4. 0	1B
95	Indr. 9 Turns	2.15µH	5		W.34446-C-1-B	1	3. 0. 0	
96	Indr. 5 Turns	0.483µH	5		W-34445-C-1-B	1	2.10. 0	
97	Indr. 8 Turns	, , , , , , , , , , , , , , , , , , ,			74-W.32738-C	1	1.8.0	
98	Indr. 6 Turns				75A-W-32738-C	1	19.0	
99	Choke 150 Turns				W.32060-B-1-A	1	4. 7. 6	
100	Choke 34 Turns				W-49681-1-A	1	7.10. 0	
101	Indr. Vble. Assembly				W.58081-1-A	1	462.10. 0	
102	Choke 20 Turns				W.32060-B-1-C	1	3. 2. 6	
103	Anode Coil Assembly				W.40700-1-B	1	137.16. 0	
_	Coupling Coil		Pa	rt of	l -	1	8.15. 0	
	Coupling Coil		Pa	rt of	· ·	1	8.15. 0	
105	Indr. 43 Turns				W.33076-B-1-D	1	3. 6. 6	
106	Indr. 221 Turns				104-W-40408-C	2	2. 9. 6	
107	Indr. 2 Turns				W.53021-B-1-B	1	4.4.0	1B
108	Choke 1,600 Turns				WSK . 13422-1-H	1	2.15. 0	
109	Choke 76 Turns	350µH			W.6171-1-V	1	14. 7. 6	
110	Choke	,			₩.24575-B-6	1	13.15. 0	
111	Choke				W-57573-1-A	1	52.10. 0	-
112	Choke				W-40912-1-A	1	22. 6. 6	
113	Choke 7 Turns				2-W•52576-B	2	6.11. 6	
114	Indr. 3½ Turns		•		W.36413-C-1-0	1	4.14. 0	1B
115	Indr. 21 Turns				₩-50593-1-F	1	1. 2. 0	1B
116	Indr. 10 Turns				₩.37149-1-C	1	2. 7. 6	1B
117	Indr. 4 Turns				₩.50593-1-B	1	1. 2. 0	1B
118	Indr. 3½ Turns				147-W-37628-C	10	1.0.0	
119	Indr. 600 & 400 Turns				W.18936-C-1-A	2	17. 6	1S
120	Indr.				WIS.1161-1-1]	3.0	
121	Indr. 34 Turns				W. 41184-B-36	1	3. 0. 6	
122	Indr. 15 Turns				W. 41184-B-37	1	3. 0. 6	1B
123	Indr. 7 Turns				₩.41185-B-3	1	3. 3. 0	1B
124	Indr. $33\frac{1}{2}$ Turns Indr. $16\frac{1}{2}$ Turns				W.48441-1-A	1	6.11. 6	1B
125	Indr. $16\frac{1}{2}$ Turns				₩.48441-1-B	1	6.11. 6	
126	Indr. 7½ Turns				₩. 48441 - 1-C	1	6.11. 6	1 1
127	Indr.				₩. 33035–B–1 <i>-</i> G	1	5.10. 0	1B
128								
129								
130								
131								1
132								[
133				-	0.40===		7 -	
134	Lamp Tub.	0.24 W		6V	PC-48601-2	11	3. 0	6S
135]]
136							1	
137	Link Coaxial				PC.60211-1	2	12. 0	
138	Link				W-57575-C-1-1	1	3.19. 0	
139	Link				₩•57575-C-1-2	1	3. 5. 6	
140			:			I		ii

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No.	Description	Value	Tol. \$ ±	Rtg.	Identity	Qty.	Scale
87 88 89 90	Contact Assembly W.41075-C-Contact Assembly W.18195-C-Contact 101-W.37907-C					4 61 4 3	15 65 15 15
91 92	Contact 94-W.37907-C					12	15
93 94 95	Contact W.38961-C-1-A Contact Assembly W.40784-C- Contact Assembly W.40785-C-					16 1 4	2S 1S 1S
96 97 98 99 100	Contact Assembly W.49276-C-Contact Assembly W.50138-B-Contact Assembly W.40712-C-Contact Assembly W.40713-C-Contact 72-W.37919-C	1-A (To	be s	upplie	d with No.531)	1 1 2 2 6	1S 1S 1S 1S 2S
101 102 103 104	Contact Assembly W.49358-B-Contact 30-W.32738-C Contact Assembly W.49274-C-	:				1 4 2	1S 1S 1S
105	Contact Assembly W.18195-1-	D				8	2S
106 107 108 109 110	Contact Spring 47-W.39081-0 Contact Ball W.41074-C-1-A Contact Spring 41-W.32056-0					5 2 5	1S 1S 2S
111 112 113 114	Contactor Panel WIS.9273-1- Contactor 250V PC.64911-7 Contact Ball W.40987-C-1-A	-1			·	1 1 1	lB lS
115	Coupling Mycalex 16-W.38936					1	
116	Coupling Bar Mycalex W.2102	9-C-1-8				1	
118 119 120	Drive Flexible Assembly WISDrive Manual Assembly W.389 Drive Manual Assembly W.389	58-1-A	-1-1			1 4 1	a characteristic de la constantina della constan
121	Drive Manual Assembly W.391	.63 - 1-A				1	
122 123 124	Fan Axial 10K/1070564*					1	
125	Filter Air W.65675-2-B					1	
126 127 128 129	Former Mycalex 10-W.39080-F Former Mycalex 10A-W.39080-Former Mycalex 10B-W.39080-	В				1 1 1	

^{*} Wotsac replacement for item 123: Fan Ventilating 10K/4140-99-633-2694 (Mod.A.3978)

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No.	Description	Value	Tol. % ±	Rtg.	Identity	Qty.	Scale
130	Former Mycalex 10C-W.39080-	В				1	
131 132 133	Former Mycalex 14-W.39080-Former Mycalex 15-W.38080-F					1	
134 135	Fuse Cartridge 2A WIS.5703- Fuse Cartridge 10A WIS.570					7	12S 6S
136 137 138 139 140	Fuse Cartridge 25A WIS.4806 Fuse Cartridge 6A WIS.5703 Fuse Cartridge 2A WIS.2947 Fuse Cartridge 500mA WIS.29	3-C-1-3 7-1-9 947-1-5				3 5 2 2 2	12S 12S
141 142 143	Fuse Cartridge 3A WIS.2947- Fuse Cartridge 5A WIS.2947-					1	
144 145	Fuseholder WIS.4809-C-1-9 Fuseholder WIS.5612-C-1-1					3 12	
146	Fuseholder WIS.4154-C-1-3					20	
147 148 149 150	Indr. 250mA 1.5mA WIS.3069- Indr. 30A 0.0075H W.24581-E Indr. 600mA 3.5H W.31577-B	3-11				1 2	1S 1B
151 152 153	Indr. 0.4.A 5.5H W.31577-B- Indr. 1.5A 3.8H W.24581-B-1					2	1 B
154 155	Indr. 68-W.32056-C Indr. 2500-3000µH ±5% WCP.3	34 1-1- BC				1 1	
156 157 158 159 160	Indr. W.40509-C-1-A Indr. W.40509-C-1-B Indr. 2.15µH ±5% W.34446-C-1 Indr. W.34445-C-1B Indr. 74-W.32738-C	• 1− B				1 1 1 1	
161 162 163 164 165	Indr. 75A-W.32738-C Indr. W.32060-B-1-A Indr. W.49681-1-A Indr. W.39080-1-A Indr. W.40912-1-A					1 1 1 1	
166 167 168 169 170	Indr. W.32060-B-1-C Indr. W.40700-1-B Indr. W.49270-1-A Indr.,W.33076-B-1-D Indr. 104-W.40408-C					1 2 1 2	
171 172	Indr. W.49084-B-1-A Indr. WSK.13422-1-H					1	

						1		1
No.	Description	Val ue	Tol.	Rtg.	Identity	Qty.	Price † Each £. s. d.	Scale
236	Res. Comp. Non-Insd.	22Ω	10	2 W	PC.66616-5	2	1. 0	
237	Res. Comp. Non-Insd.	820Ω	10	2₩	PC.66616-24	1	1.0	
238	Res. Comp. Non-Insd.	33Ω	10	2₩	PC.66616-7	2	1.0	
239	Res. Comp. Non-Insd.	560Ω	10	2₩	PC.66616-22	2	1.0	
240	Res. Comp. Non-Insd.	47Ω	10	2₩	PC-66616-9	2	1.0	
241	Res. Comp. Non-Insd.	390Ω	10	2₩	PC.66616-20	1	1.0	
242	Res. Comp. Insd.	33Ω	10	1/4W	PC.66610-7	32	1.0	
243	Res. Carb.	50Ω	20	,	WIS.5161-C-1-6	1	4. 4. 0	
244	Res. Comp. Non-Insd.	3•9kΩ	•	1/4W		2	1.0	18
245	Res. Comp. Insd.	62kΩ	5	1/4W	WIS-3903-1-5	2	2. 0	
246	Res. Comp. Insd.	22Ω	10		1	4	1.0	
247	Res. Comp. Insd.	56Ω	10	1/2W	PC.66611-10	i .	1.0	1
248	Res. Comp. Insd.	33 k Ω	10	1/2W	PC.66611-43	5 5	1.0	
249	Res. Comp. Insd.	100 k Ω	10	1/2W	PC.66611-49	5	1. 0	-
250	Res. Comp. Insd.	2.2kΩ	10	1/2W	PC.66611-29	4	1.0	
251	Res. W/W	5•55Ω	1	3 W	WIS.2896-C-2-10	6	7. 6	28
252	Res. Comp. Insd.	6.8 k Ω	10	: -,	PC.66611-35	10	1.0	
253	Res. Comp. Insd.	10kΩ	10		PC.66611-37	6	1.0	
254	Res. Comp. Insd.	150kΩ	10		PC.66611-51	1	1.0	1
255	Res. Comp. Insd.	lkΩ	10		PC-66611-25	5	1.0	
256	Res. Comp. Insd.	8.2kΩ	10		PC.66611-36	4	1.0	
257	Res. Comp. Insd.	330Ω	10		PC.66611-19	3	1.0	i .
258	Res. Comp. Insd.	22k	10		PC.66611-41	2	1.0	1
259	Res. W/W	0.505Ω	5	3 W	WIS-2896-C-2-10	6	5. 0	1
260	Res. Comp. Insd.	220Ω	10	1/2W	PC-66611-17	9	1.0	1
261	Res. Comp. Insd.	3•3 k Ω	10	1/2W	PC.66611-31	2	1.0)
262	Res. Comp. Insd.	180Ω	10		PC.66611-16	2	1.0	
263	Res. Comp. Insd.	3•9kΩ	10		PC.66611-32	1	1.0	3
264	Res. Carb. Insd.	330Ω	10	3/4W		1 1	2. 0	
265	Res. Comp. Insd.	120Ω	10	1/4W	•	1	1. 0)
266	Res. Comp. Insd.	100Ω	10	1/4W		1	1.0)
267	Res. Comp. Insd.	330Ω	10		PC.66610-19	1	1.0)
268	Res. Comp. Insd.	270Ω	10		PC.66610-18	1	1.0	
269	Res. Thermistor	_, -,-,,			WIS.5740-C-1-4	1	1.0.0	1S
270	Res. Comp. Insd.	68 ο Ω	10	1/2W	PC.66611-23	2	1.0	
271	Res. Comp. Insd.	68Ω	10		PC.66610-11	ī	1. 0)
272	Res. Comp. Insd.	47 k Ω	10		PC.66611-45	1	1.0	
273	Res. Comp. Insd.	4.7kΩ	10		PC.66611-33	ī	1. 0	1
274	Res. Comp. Insd.	68Ω	10		PC.66611-11	1	1. (1
275	Res. Comp. Insd.	15kΩ	10		PC.66611-39	1	1. (1
276	Res. Comp. Insd.	82Ω	10		PC.66610-12	2	1. (1
277	Res. Comp. Insd.	22 Ω	10		PC.66610-17	1	1. 0	i i
278	Leas combs misc.	2201	10	1/4M	1,0.00010-11	1 +	1.	
279							1 .	
280	1						1	
281							1	
282			1				1	
1202			1				1	i

No.	Description	Value	Tol.	Rtg.	Identity	Qty.	Price † Each £. s. d.	Scale
283 284 285 286								
287 288 289 290 291 292 293 294 295 296	Res. Vble. W/W Res. Vble. Comp. Lin. Res. Vble. W/W Res. Vble. W/W	120 800 250 1k0 30 5000 5k0 25k0	10 10 10 10 20 20 10	50 W 80 W 2½ W 60 W 1/2W	WIS.3147-1-4 WIS.3337-1-34 WIS.5865-B-2-46 PC.67403-29 PC.67407-39 PC.67401-18 PC.67203-9 WIS.4175-B-1-63 WIS.4175-B-1-64	1 1 5 1 1 8	4. 0. 0 10.11. 6 3. 4. 6 12. 0 2. 8. 0 9. 6 11. 0 11. 0	18 1S 2S 1S 1S 1S 2S
297 298 299 300 301 302 303 304 305 306 307 308 309 310	Socket 24 way Socket Coaxial Socket 18 way Socket 18 way Socket 18 way Socket 12 way Socket 18 way Socket 6 way				W.41061-1-81 WIS.5355-B-1-9 W.41061-1-6 WIS.3732-C-1-1 W.41061-1-7 W.41061-1-102 W.41061-1-105 W.41061-1-26 W.41061-1-26 W.41061-1-106 WIS.3956-C-1-3 WIS.3731-C-1-7	1 7 1 1 1 1 1 1 1 8 1	2.15. 0 6. 6 2. 8. 0 12. 6 2. 8. 0 1.18. 0 2. 4. 0 2. 8. 0 2. 8. 0 1. 0 7. 6	1B
311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330	Switch 2 Wafer 4 Pole C/O Switch 1 Wafer 1 Pole 3 Psn Switch SP C/O Switch Knife DP C/O Switch SP 1 Wafer 6 Psn. Switch Micro SP C/O Switch 3 Wafer 4 Pole C/O Switch Assembly SP 5 Psn. Switch Assembly SP 5 Psn. Switch Assembly SP 5 Psn. Switch 4 Pole 5 Psn.			20 A 30 A	W.50027-1-A W.40269-C-1-A W.50027-1-B W.40269-C-1-B W.13433-B-1-A WQ.7640-1-C WIS.3456-B-111 WIS.5197-B-11 WIS.4095-B-1-1C WIS.3456-B-155 WIS.5586-C-1-1 WIS.3456-B-133 W.38959-1-A WIS.5670-C-97 W.40066-1-A 6-W.4C408-C W.39161-1-A		24. 5. 6 2.17. 6 22.10. 0 2.17. 6 2. 6. 6 33.15. 0 5.17. 0 4. 6. 6 18. 0 3. 6. 0 4. 6. 6 12. 0 6. 7. 6 175. 0. 0 1. 1. 0 131. 5. 0 7.10. 0 90. 0. 0	

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No.	Description	Value	Tol.	Rtg.	Identity	Qty.	Scale
331 332 333 334 335 336 337 338 339 340 341 342 343 344 345	Switch SP C/O Switch Assembly Switch Switch 1 Pole Switch 2 Pole 1 Wafer Switch 1 Pole 2 Wafer Switch 8 Wafer 12 Way Switch 2 Wafer 7 way Switch 9 Wafer 12 way Switch 1 Wafer 6 way Switch SP Switch SP DT Switch Ledex			2.5 kVA	WIS.5586-C-1-2 W.36725-1-B W.40269-C-1-B WIS.5197-B-6 WIS.5820-B-35 WIS.3421-C-50 WIS.1197-C-1099 WIS.3421-C-51 WIS.1197-C-1205 2-WIS.1012 WIS.2834-1-3 WIS.7166-B-3	1 1 1 1 1 1 1 1	1S IS
347 348 349 350 351 352 353 354 355 356 357 358 360 361	Term. Block 6 way Term. Block Term. Block 20 way Term. Block 4 way Term. Block 10 way Term. Block 8 way Term. Block 4 way Term. Block 20 way Term. Block 2 way Term. Block 3 way Term. Block 10 way				W.57404-C-1-1 SK.48864-1-H W.22469-B-1-U W.40168-B-1-A W.22469-B-1-H WIS.1631-1-4 W.33265-1-Q 42-W.39081-C WIS.1632-1-3 W.33265-1-W	1 3 3 1 1 1 1 1 1	
362 363 364 365 366 367 368 369 370 371 372 373 374 375 376	Transf. Sec. 45/43/41V Transf. 24 & 20 Turns Transf. 12 & 9 Turns Transf. 21 & 6 Turns Transf. 9 & 2 Turns Transf. 4 & 1 Turns Transf. 44 & 2 Turns				W.37518-2 W.24068-59 W.24582-13 W.37518-3 W.23241-33 W.24586-26 W.24743-27 W.22129-3 W.27206-4 W.26958-B-152 W.26958-B-153 W.50593-1-G W.50593-1-E W.41184-B-79	1 1 1 1 1 1 1 1 1 1 1	1B 1B 1B 1B 1B 1B 1B 1B 1B

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No.	Description	Value	Tol.	Rtg.	Identity	Qty.		Scale
378	Transf. 22 & 2 Turns				W.41184-B-80	1		18
379	Transf. 13 & 2 Turns				W.41185-B-8	1		1B
380	Transf. $33\frac{1}{2}$ & 9 Turns				W.48442-1-K	1		1B
381 382	Transf. $16\frac{1}{2}$ & 4 Turns				W.48442-1-D W.48442-2-L	1		1B
383	Transf. 7½ & 2 Turns				WIS.5680-B-88	1 1		1B
384	Transf. Input Transf. Output				1	1		1B
385	Transi. Output				W.33035-B-1-G	1.1		1B
386						}		1
387				:				
388								
389	Valve GXU-2				cv2518	6		
390	Valve U54			:	CV378	2		
391	Valve STV280/80				CV1069	ı		
392	Valve OA3 or VR75/40	}			cv3798	1		
393	Valve				CV428	2		
394	Valve QY4250					2		
395	Valve BR.191					1		
396	Valve CV138				CV138	7		
397	Valve				CV4014	2		
398	Valve				CV391	2		
399	Valve N77					2		
400	•							İ
401 402								
402	Alarm Indicator		mo c	tomo	r's Requirements.			1
404	Terminating Board		10 0	us come.	W.41618-C-1-A	1		
405	Suction Unit				WIS.5731-B-2-3	1		
406	Ball Contact				W.40987-C-1-A	li		1S
407	Spring Contact				47-W.39081-C	ī		18
408	Ball Contact				W.41074-C-1-A	2		ıs
409	Spring Contact				41-W.32056-C	2		18
410								
411	Fan Axial*				10K/1070564	1		
412								
413	Air Filter	:			W.65675-2-B	1	1	1 B
414	Anode Clip	:			W.30330-C-1-2	6	ì	
415	Ball Contact Assembly				W.18195-C-1-A	4		1S
416	Ball Contact Assembly				W.38961-C-1-A	16		28
417 418	Bearing Plate Mycalex Base Mycalex				65-W.37919 49-W.32056-C	1		
410	Coil Support Mycalex				3-W.40700-B	1:		
420	Coil Support Mycalex				4-W.40700	1		
421	Coil Support Mycalex				4A-W.40700	i		-
422	Coil Support Mycalex				4B-W.40700	i		
423	Coil Support Mycalex				4C-W.40700	i		
424	Coil Support Mycalex				8-W.40700-B	ī		
L	,	L	<u>:</u>	<u>:</u>		i	i	

^{+ *} Wotsac replacement for item 411: Fan ventilating 10K/4140-99-633-2694 (Mod.A.3978)

No.	Description	Val ue	Tol. \$ ±	Rtg.	Identity	Qty.	Price † Each £. s. d.	Scale
425	Coil Mounting Plate Mycalex				107-W.40408-C	2	15. 6	
426	Contact Assembly				W-41075-C-1-A	4	1. 5. 0	
427	Contact Assembly				W.18195-C-1-A	54	11. 6	
428	Contact Assembly				W.18195-D-1-D	8	12. 0	
429	Contact Assembly				W-49358-B-1-B	1	1. 5. 0	
430	Contact Mounting Mycalex				3-W-40408-C	4	2. 9. 6	
431	Contact Mounting Mycalex				51-W.40408-C	l	1. 7. 0	
432	Contact Mounting Mycalex				3A-W.40408-C	1	2.11. 0	
433	Contact Panel Mycalex				15-W.39161-C	1	16. 6	
434	Condenser Plate Mycalex				54-W.32738-C	1	16.0	
435	Conical Insr.				WIS.626-C-1-1	1	1.0	
436	Coupling Coil Mounting Plate	. Mycale	x		34A-W-37919-B	1	4.16. 6	,
437	Coupling Bar Mycalex	_v			W-21029-C-1-8	1	1. 3. 6	
438	Coupling Mycalex				16-W-38936-C	1	3.13. 0	
439	End Cheek Mycalex				1-W.48433-C	1	2. 7. 0	
440	End Cheek Mycalex				2-W-48433-C	1	2.11.0	
441	End Plate Mycalex				5-W-37919	l	8.1.6	
442	End Plate Mycalex				109- W •37919	ī	19.8.6	
443	Flexible Drive Assembly				WIS.5716-C-1-1		3. 5. 0	
444	Fuseholder				WIS.5612-C-1-1	12	6. 6	
445	Fuseholder				WIS-4154-C-1-1	20	3. 6	28
446	Fuseholder				WIS.4809-C-1-9	3	6. 0	
447	Grid Contact Spring				94-W-37907-C	12	11.6	
448	Insr.				WIS.5593-C-1-5	11	1.6	
449	Insr. Stand-Off				WIS.5416-C-1-1	5	6.6	
450	Insr.				SP.10996	4	2.0	
451	Insr. Cer.				WP.984	2	1.10.0	
452	Insr. Pillar				WSK.10464-1-9	$\frac{1}{4}$	4. 4: 6	
453	Insr. Rod				WSK . 10464-1-10	4	3.6	
454	Insr. Stand-Off				WIS.5416-C-1-4	10	4. 6	
455	Lamp Jack				WIS.1877-1-1	11	5. 0	1
456	Manual Drive Assembly				W.38958-1-A	3	87.10. 0	1
457	Manual Drive Assembly				W.39163-1-A	ĺí	120.0.0	
458	Manual Drive Assembly				W.39340-2-B	1	137.10. 0	
459	Manual Drive Assembly				W.38958-2-B	ı	87.10.0	
460	Mounting Board Mycalex				1-W.49688-C	l	4.15. 6	
461	Mounting Board Mycalex				177-W·37907-C	2	1.11.0	
462	Mounting Board Mycalex				49-W.32056-C	1	7.0	
463	Mounting Plate Mycalex				1-W.40066-B	1	3.18. 0	
464					1-W.38959-B	1	4.19. 0	
465					WIS.5742-C-1-1	4	3. 0	
466					WSK • 3172-1-K	6	5.12. 6	
467					W-40253-B-1-A	1	6.11. 6	
468	Rotor Mounting Mycalex				5-W-40408-C	2	1. 7. 0	
1 4 6 6		•	•	1	23-W.39080-C	4	2.0	
469	Darrie	:	:	•		1 7		ł
469	Spring	• • • • •			W.7447-C-2-28B	l	2. 6	

No.	Description V	alue	Tol. % ±	Rtg.	Identity	Qty.	Price † Each £. s. d.	Scale
472	Spring Assembly				W.58293-C-1-B	1	6.11.0	
473	Spring Assembly				W.58293-C-1-A	1	6.11. 0	
474	Spring Assembly				W.58294-C-1-A	2	4.12. 0	1
475	Spring Contact				30-W-32738-C	4	7. 6	1
476	Spring Contact				72-W-37919-C	6	6. 6	
477	Spring Contact				101-W-37907-C	4	1.0.0	t
478	Spring Contact				101A-W-37907-C	3	15. 0	1
479	Spring Contact				54-W-36728-C	3	6. 0	ı
480	Spring Contact Assembly				W-49274-C-1-A	2	2. 2. 6	1
481					W-40784-C-1-A	3	1. 4. 0	Į.
401 482	Spring Contact Assembly					1	13. 0	ŀ
	Spring Contact Assembly				W-40785-C-1-A	4	1.10. 0	ſ
483	Spring Contact Assembly				W-49276-C-1-A	1	2.10. 0	1
484	Spring Contact Assembly				W-50138-B-1-A	ø1	2.10.0	į.
485	Spring Contact Assembly				W-40712-C-1-A	2		ı
486					W-40713-C-1-A	2	2. 4. 0	12
487	Spring Flat				127-W.37919-C	2	5. 0	
488	Switch Blade Assembly				₩.39454-B-1-A	1	4. 1. 6	
489	Spring Contact Plate Mycalex				28-W.32738-C	1	10.0	
490	Support Plate Mycalex				2-W·38959-B	1 1	4.14. 0	
491	Stand-Off Insr.				WIS.5416-C-1-3	2	5. 6	
492	Stand-Off Insr.				WIS.5416-C-1-4	10	4. 6	
493	Term.				WIS.4793-C-1-7	6	1. 6	
494	Term. Block Mycalex				16-W.32738-C	6	8 . 0	ı
495	Top Panel Mycalex_				108A-W.40408-B	1	9. 0. 0	ĺ
496	Valveholder Cer. 5 Pin				WIS.4844-C-1-2	2	17.0	
497	Valveholder International Octa	.1			PC.81814-1	2	1.0	
498	Valveholder B5				PC.81805-1	1	1. 6	ı
499	Valve Retainer				WIS.3449-C-1-1	1	3. 6	
500	Valve Retainer				WIS.3701-C-1-22	2	2.0	
501	Valve Retainer				WIS.6271-C-1-1	1	5. 0	
502	Wheel				22 -W .39080-C	1	5. 7. 6	
503					WIS.5609-1-1E	2	13. 6	
504	Valveholder B8G				PC.81813-1	2	3. 6	
505	Valveholder B7G				PC-81811-1	11	1.0	1
506	Wheel (to be supplied with No	484)			134A-W37919-C	1	2. 4. 0	
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MCL:- T.5553 Issue:- 5

MASTER COMPONENTS LIST

FOR

3.5kW HF ISB/TELEGRAPH/TELEPHONE TRANSMITTER TYPE HS.31/1

(W.37918 Ed.C)

NOTES:

- 1. Component schedules are presented in the form of a master components list, which includes all components used in this equipment. Each component is identified by means of a spares reference number, column l. in addition to the normal part identity.
- 2. Components shown on individual circuit diagrams may be identified in the master list by means of the cross-reference tables associated with each circuit diagram. The numbers given are the spares reference numbers.
- 3. For spares ordering purposes it is only necessary to quote the exact reference at the top of this page together with the spares reference number. Individual part identities can be given as a cross check if desired, but are not necessary.
- 4. Prices are subject to change without notice.
- 5. All items reference PC are standardised items and comply with Government specifications where these exist.
- 6. All items reference WIS are manufactured by component or other supplier: to a Marconi specification which, where appropriate, complies with a Government specification.
- 7. All items reference W are manufactured by MWT and while materials and practices are in accordance with appropriate Government specifications, these items cannot be regarded as 'Standard Items'.
- 8. The scale column shows the suggested spares per equipment edition or type. Where applicable, S & B relate to Station and Base spares respectively.

P.T.0.

T.5553 CP 16.6.67 A Nos.1-532

9. The following abbreviations are used throughout this Master List:

Cap.	Capacitor	Osc.	Oscillator
Carb. Cer.	Carbon Ceramic	Pap.	Paper
c/o	Changeover	pF	Picofarad Micro-Microfarad
Coef. Comp.	Coefficient Composition	Psn. Potr.	Position Potentiometer
DP DT	Double Pole Double Throw	Prim. PVC	Primary (winding) Polyvinyl Chloride
En. Elyc.	Enamelled Electrolytic	Rect.	Compound Insulated Rectifier
Fil.	Filament	Res.	Resistor
FSD	Full Scale Deflection		Secondary (winding) Silver Mica
Gd.	Grade	Sil.Mica. Sil.Mica.Prot.	Silver Mica Protected
HS	High Stability	SP	Single Pole
Indr. Insd. Insr.	Inductor Insulated Insulator	Temp. Term. Transf.	Temperature Terminal Transformer
Lg. Lin.	Long Linear	Tub. Vble.	Tubular Variable
Metd.	Metallised	Vit.	Vitreous
Mld.	Moulded	w/w	Wirewound
Neg.	Negative		

No.	Description and Identity	Qty.	Price Each FO.B. U.K. £ Sterling	Scale
1 2	Base Mycalex 49-W.32056-C	1	1.45	
- 3 4 5	Cap. Cer. 10pF ±207 4kV PC.18220-2 Cap. Cer. 47pF ±5% 750V PC.18120-23 Cap. Cer. 2200pF ±20% 500V PC.18208-7	1 1 2	0.60 0.15 0.05	1S 1S 1S
6 7 8 9 10	Cap. Cer. 330pF ±20% 500V PC.18208-2 Cap. Pap. 10uF ±10% 250V WIS.4321-B-1-11 Cap. Pap. 8uF ±20% 600V WIS.4172-B-1-4 Cap. Pap. 4uF ±15% 750V PC.19072-6 Cap. Pap. 4uF ±10% 6kV PC.19185-4	1 4 3 1 3	0.05 1.40 1.85 1.70 24.50	1S 1S 1S 1S
11 12 13 14 15	Cap. Mica 0.01uF ±5% 350V PC.18801-10 Cap. Pap. 0.25uF ±25% 350V PC.19303-3 Cap. Mica 10000pF ±5% 350V PC.18801-10 Cap. Pap. 0.01uF ±20% 10kV PC.19226-2 Cap. Elyc. 100-200uF +50% -20% 350V PC.18408-4	3 1 2 2 1	0.35 0.20 0.35 0.85 0.80	1S 1S 1S 1S 1S
16 17 18 19 20	Cap. Mica 6800pF ±5% 350V PC.18801-8 Cap. Mica 3000pF ±20% 8000V PC.18738-1 Cap. Pap. 0.0luF ±25% 350V PC.19202-7 Cap. Cer. 33pF ±5% 750V PC.18223-7 Cap. Vble. Air 16-250pF PC.20144-11	1 16 16 1	0.35 0.60 0.10 0.05 4.70	1S 3S 3S 1S
21 22 23 24 25	Cap. Cer. 200pF ±5% WIS.7326-B-1-8 Cap. Cer. 2.2pF ± ½pF 750V PC.18212-3 Cap. Vble. Air 7-100pF per Section PC.20008-3 Cap. Cer. 270pF ±20% 750V PC.18223-18 Cap. Mica 500pF ±20% 800V PC.18738-5	1 1 0 1	0.15 0.05 1.30	1S 1S
26 27 28 29 30	Cap. Air Dielectric ST.5 Neutralising Pick-Up W.49362-C-1-A Cap. Hi-Load 200pF ±20% 7.5kV PC.18333-7 Cap. Hi-Load 125pF ±20% 7.5kV PC.18333-8 Cap. Hi-Load 200pF ±20% 7.5kV PC.18333-9 Cap. Vble. Vacuum 8-50pF 15kV PC.20408-1	1 2 2 1 1	10.00 3.80 3.95 3.80 97.00	
31 32 33 34 35	Cap. Hi-Load 1250pF ±20% 7.5kV PC.18333-6 Cap. Pap. 4uF ±20% 600V PC.19212-3 Cap. Mica 0.0luF ±20% 2000V D.C. WIS.4721-C-1-1 Cap. Mica 10000pF ±20% 250V PC.18701-5 Cap. Mica 0.0luF ±20% 2000V WIS.4721-C-1-1A	1 1 2 4	3.80 0.95 6.95 0.15 5.90	1S 1S
36 37 38 39 40	Cap. Hi-Load 130pF ±10% 7.5kV PC.18304-7 Cap. Hi-Load 50pF ±20% 7.5kV PC.18216-5 Cap. Hi-Load 125pF ±20% 7.5kV PC.18333-10 Cap. Hi-Load 1250pF ±20% 7.5kV PC.18335-7 Cap. Air Dielectric W.48433-2-B	1 2 1 2 1	2.85 2.60 3.80 3.65 160.00	1S 1S
41 42 43	Cap. Air Dielectric W.49688-1-A Cap. Cer. 125pF ±20% 70kVA PC.18219-1 Cap. Mica 10000pF ±20% 350V PC.18701-5	2 4 1	26.00 3.80 0.20	18

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			Price Each FOB. U.K.	
Nó.	Description and Identity	Qty.	£ Sterling	Scale
44 45	Cap. Mica 0.002uF ±20% 800V PC.18738-3 . Cap. Cer. 10pF ±20% 4kV WIS.7711-C-1-4	1 2	0 • 50 0 • 55	1S 1S
46 47 48 49 50	Cap. Cer. 0.001uF ±20% 500V PC.18208-5 Cap. Pap. 0.01uF ±20% 500V PC.19203-14 Cap. Vble. 3-Gang 9.5-225pF per Section WIS.5537-1-2 Cap. Vble. 3-30pF 75V W.53587-C-1-C Cap. Cer. 10pF ± 2pF 750V PC.18223-1	2 29 2 6 1	0.05 0.05 xll.00 0.45	1S 5S
51 52 53 54 55	Cap. Cer. 100pF ±2% 750V PC.18223-13 Cap. Cer. 47pF ±2% 750V PC.18223-9 Cap. Mica 0.0luF ±10% 750V WIS.7494-B-1-1 Cap. Cer. 6.8pF ±½pF 750V PC.18212-7 Cap. Vble. 4.8-100pF PC.20002-7	3 5 23 1	0.05 0.05 0.05 0.45 0.05 0.40	1S 1S 2S 5S 1S
56 57 58 59 60	Cap. Mica 220pF ±5% 350V PC.18802-17 Cap. Mica 390pF ±5% 350V PC.18802-20 Cap. Pap. 0.0luF ±20% 400V PC.19308-7 Cap. Vble. 3.3-34.5pF WIS.3534-C-1-2 Cap. Vble. 4.8-16pF PC.20002-4	1 1 4 1	0.10 0.15 0.15 2.20 0.35	1S 1S 1S
61 62 63 64 65	Cap. Mica 150pF ±10% 750V PC.18802-15 Cap. Mica 68pF ±10% 750V PC.18802-11 Cap. Pap. 0.05uF ±20% 500V PC.19203-18 Cap. Pap. 0.25uF ±25% 150V PC.19301-2 Cap. Mica 1000pF ±20% 350V PC.18701-2	1 1 2 4	0.10 0.10 0.10 0.15 0.05	1S 1S 1S 1S
66 67 68 69 70	Cap. Mica 220pF ±20% 750V PC.18702-2 Cap. Pap. 0.luF ±20% 350V PC.19202-15 Cap. Mica 100pF ±10% 750V PC.18802-13 Cap. Mica 470pF ±5% 750V PC.18802-21 Cap. Mica 10pF ±10% 750V PC.18610-1	1 1 1 1	0.05 0.05 0.10 0.15 0.10	1S 1S 1S 1S 1S
71 72 73 74 75	Cap. 0.01uF ±10% WIS.7494-B-1-15 Cap. Cer. 0.01uF -20% +80% 500V PC.18207-7 Cap. Pap. 0.02uF ±20% 500V D.C. PC.19203-16 Cap. Mica 330pF ±20% 750V PC.18702-3	1 4 2 1	0.45 0.05 0.05 0.05	1S 1S 1S 1S
76 77 78 79 80				
81 82 83	Cheek End Mycalex 1-W.48433-C Cheek End Mycalex 32-W.48433-C	1 1	4•30 4•30	,
84 85	Clip Anode W.30330-C-1-2D	6	1.00	2 S
86	Contact 54-W.37628-C	3	0.40	18

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₩э.	Description	Value	Tol. % ±	Rtg.	Identity	Qty.	Scale
141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 157 158	Meter 0-300V AC Voltmeter Meter 0-25A Ammeter Meter 0-6kV Voltmeter Meter 0-15V Meter 0-250mA Meter 0-5mA Meter 0-250mA Meter 0-400mA Meter 0-2A Meter 0-350mA Meter 0-15V Meter 0-15V Meter 0-1000V Meter 0-100V Meter 0-10V Meter Peak Voltmeter Meter Peak Voltmeter		±1 ±1 ±1 ±1 ±1 ±1 ±1 ±1		WIS.4235-9-158 WIS.4235-9-159 WIS.4235-9-160 WIS.3954-B-13-112 WIS.3686-6-85 WIS.3954-B-13-111 WIS.3686-12-189 WIS.4235-14-218 WIS.4235-14-218 WIS.4235-14-214 WIS.4235-7-129 WIS.4235-10-174 WIS.3686-4-61 W.38793-1-D W.38793-1-A	1 3 1	
160 161 162 163 164 165	Rect. Selenium Rect. Selenium Germanium Crystal Rect. Rect. Selenium				WIS.4669-B-1-13 WIS.3222-C-4-22 WIS.4203-C-1-2 WIS.4669-B-2-15	2 1 2 1	1B 1B 1S 1B
166 167 168 169 170 171 172 173 174 175 176 177 180 181 182 183 184	Plug Coaxial Plug 6 way Plug Coaxial Plug Coaxial Plug Coaxial Plug Coaxial Plug Coaxial Plug Coaxial Plug Coaxial Plug Coaxial Plug Coaxial Plug Coaxial				WIS.3738-C-1-2 W.36715-B-1-2 W.36715-B-1-3 W.36715-B-1-4 W.36715-B-1-5 W.41113-1-1 WIS.3738-C-1-1 WIS.5355-B-1-8 W.41113-1-2 W.36715-B-1-6 W.51158-C-1-1 W.51158-C-1-2 W.51158-C-1-3 W.51158-C-1-5 W.51158-C-1-6 W.51158-C-1-6 W.51158-C-1-7 WIS.3106-C-1-3 WIS.3737-C-1-9	1 1 2 1 1 6 1 1 1 1 1 1 1 1 3 5 1	

			Tol.			04		
No.	Description	Value	\$ ±	Rtg.	Identity	Qty.		Scale
188 189	Contactor*				WIS.5609-1-1B*	1		
190	Contactor 5 Pole				WIS.5609-1-1C	3		
191	Contactor 9 Pole				WIS.5609-1-1D	1		
192	Relay 3M 2B				WQ.8740-1-M	1		1B
193	Relay 2M				WQ.8740-1-L W.88142-B-1-A	1		1B 1B
194 195	Relay Time Switch Relay Valve Protecting				WIS.4373-B-2-7	2		1B
196	neray varve fromecoming				WID: 4212 D E 1	-		1
197					•			
198	Res. W/W	106Ω	10	220W	WIS.3852-B-1-24	1		1S
199	Res. W/W	107Ω	10	45W	WIS.3852-B-1-25	1		18
200	Res. W/W	1.8 k Ω	2	14W	WIS.7415-B-1-37	1		1S
201	Res. W/W	68 n	10	2Amp	WIS.3320-2-18 PC.67008-4	1 2		1S 1S
202 203	Res. W/W Res. W/W	33 Ω 53 Ω	5 10	3W 45W	WIS.4006-B-1-20	3		1S
204	Res. W/W	2160Ω	10	90W	WIS. 6265-C-1-1	i		15
205	Res. W/W	419Ω	10	90W	WIS.3615-C-1-6	l		18
206	Res. W/W	16.5kΩ	5	35W	P.18282-KP-6	1		15
207	Res. Carb.	220 kΩ	20	lW	WIS.3903-1-3	3		
208	Res. W/W	43.750n		150W	P.18282-KK-6	2		18
209	Res. W/W	15kΩ	5	100W	PC.67006-20	1		15
210	Res. W/W	1.8kΩ	5	35W	PC.67919/1 WIS.5675-B-1-1	1 1		ls
211	Res. H.T. Voltmeter Res. W/W	1.2kΩ	5	3W	WIS.7417-B-1-7	li l		38
213	Res. Comp. Non-Insd.	220Ω	10	2W	PC.66616-17	3).)
214	Res. Insd.	33Ω	5	1/4W	PC.66602-2	2		ıs
215	Res. W/W	$10 \mathrm{k}\Omega$	5	4 <u>2</u> W	Pc.67009-19	1		18
216	Res. W/W	15kΩ	5	6W	PC.67010-20	1		ls
217	Res. Insd.	100Ω	10	1/4W	PC.66610-13	4		
218	Res. W/W Shunt	250mA	±1	•	WIS.3914-C-2-19	1		1S
219	Res. Insd.	10kΩ	10	1W	PC.66612-31	3	1	
220 221	Res. Insd. Res. W/W Shunt	15kΩ 5mA	10 1	IW IOOmV	PC.66612-33 WIS.3914-C-3-31	3		ıs
222	Res. Comp. Insd.	33Ω	10		PC.66611-7	2		1.0
223	Res. Comp. Non-Insd.	100Ω	10	lW	PC.66616-13	2		
224	Res. Carb.	200	20	50W	WIS.5161-C-1-22	1		
225	Res. W/W Shunt	400mA	1		WIS.3914-C-3-45	1	-	1S
226	Res. W/W Shunt	2A	1		WIS.3914-C-3-46	1	,	1 S
227	Res. W/W Shunt	350mA	1	100mV	WIS.3914-C-4-51	1		18
228	Res. W/W	0.00	7.0	21.1	WIS.4235-7-129 PC.67008-25	1:		ıs
229 230	Res. W/W	2.2Ω lkΩ	10 5	3W 4½W	PC.67009-13	2		1S
231	Res. Carb.	20Ω	20		WIS.5161-C-1-21	2		1
232	Res. Comp. Insd.	100Ω	10		PC.66611-13	3		
233	Res. Comp. Non-Insd.	1.2kΩ	10	2W	PC.66616-26	2		
234	Res. Comp. Non-Insd.	18Ω	10	2W	PC.66616-4	2		
235	Res. Comp. Non-Insd.	lkΩ	10	2W	PC.66616-25	12	<u> </u>	

^{+ *}Wotsac replacement for item 189: CC 270003 (Type UCA7) (Mod. A.4745)

No.	Description and Identity	Qty.	Price Each F.O.B. U.K. £ Sterling	Scale
173 174 175	Indr. 350uH W.6171-1-V Indr. W.24575-B-6 Indr. W.91388-B-1-A	1 1 2	14.00 13.50 20.50	
176 177 178 179 180	Indr. W.92003-C-1-A Indr. (Former) W.26958-B-154 Indr. (Winding) W.36413-C-1-0 Indr. W.50593-1-F Indr. W.37149-1-C	2 1 1 2 2	2.40 2.25 5.50 2.20 2.40	
181 182 183 184 185	Indr. W.50593-1-B Indr. 147-W.37628-C Indr. W.18936-C-1-A Indr. WIS.1161-1-1 Indr. W.37206-B-1-A	2 10 1 1	1.20 0.40 1.35 0.15 2.05	1S 1S
186 187 188 189 190	Indr. W.37207-B-1-A Indr. W.37208-B-1-A Indr. W.33035-B-1-D Indr. 'Ledex' Selector WIS.7166-B-3 Indr. W.91403-C-1-A	1 1 1 1 5	2.05 1.65 1.35 7.85 1.25	
191 192 193 194 195	•			
196	Indicator (Alarm) To Customer's requirements.			
197 198 199 200	Insr. Cer. PC.43003-1 Insr. Conical PC.43312-1 Insr. Stand-Off WIS.5416-C-1-3	2 4 2	6.40 0.15 0.30	1S 1S 1S
201 202 203 204 205	Insr. Stand-Off WIS.5416-C-1-4 Insr. (Pillar) WSK.10464-1-9 Insr. (Piece Mycalex) 3-W.40203-C Insr. (Rod) WSK.10464-1-10 Insr. Conical PC.43311-1	21 4 1 4 1	0.25 4.25 4.30 4.35 0.05	3S 1B 1B 1B 1B
206 207 208 209	Insr. Stand-Off WIS.5416-C-1-1 Insr. WIS.5593-C-1-5	3 11	0.35	1S 3S
210	Jack Lamp WIS.1877-1-1	11	0.25	
211 212 213	Lamp 0.24W 6V PC.48601-2	11	0.05	128
214 215	Link R.F. Coaxial PC.60211-1	2	0.65	ls

No.	Description and Identity	Qty.	Price Each F.O.B. U.K. £ Sterling	Scale
216 217 218 219 220	Meter Volt W.38793-1-D Meter Volt 0-300V WIS.4235-9-158 Ammeter 0-25A WIS.4235-9-159 Meter Volt 0-6kV WIS.4235-9-160 Meter 0-15V WIS.3954-B-13-112	1 1 1 1	80 • 50 7 • 35 4 • 20 5 • 55 6 • 45	
221 222 223 224 225	Meter 0-250mA ±1% WIS.3686-6-85 Meter 0-5mA ±1% WIS.3954-13-113 Meter 0-250mA ±1% WIS.3954-13-114 Meter 0-400mA ±1% WIS.3686-12-189 Meter 0-2A ±1% WIS.4235-14-218	1 1 1 1	5.85 5.50 6.20 3.30 9.90	
226 227 228 229 230	Meter 0-350mA ±1% WIS.4235-16-247 Meter ±1% WIS.4235-14-214 Meter ±1% WIS.4235-7-129 Meter ±1% WIS.4235-10-174 Meter M.C. F.S.D. 1mA D.C. 0.10V 50 ohms WIS.3686-4-61	1 1 1 1	10.50 7.90 4.05 10.00 6.10	
231 232 233 234 235	Meter Volt W.38793-1-A Mounting Res. WIS.5742-C-1-1 Mounting Res. WSK.3172-1-K Mounting Res. W.40253-B-1-A	2 4 6 1	28.00 0.20 14.50 7.50	
236 237 238 239 240	Mounting Board Mycalex 1-W.49688-C Mounting Board Mycalex 177-W.37907-C Mounting Plate Coil 107-W.40408-C Mounting Contact 3-W.40408-C Mounting Contact 51-W.40408-C	1 2 2 4 1	9.95 0.95 4.30 2.00 1.70	
241 242 243 244 245	Mounting Rotor 5-W.40408-C Mounting Board 49B-W.32056-C Mounting Plate 1-W.40066-B Mounting Coupling Coil Plate 34A-W.37919-B Mounting Board 1-W.39080-B	2 1 1 1	1.80 1.45 4.30 7.65 4.30	
246 247 248 249 250	Mounting Plate 1-W.38959-B Mounting Board 1A-W.39080-B Mounting Contact 3A-W.40408-C-1	1 1 1	9•20 4•30 4•30	
251 252 253	Panel Mycalex 108B-W.40408-B Panel Contact 15-W.39161-C	1 1	16.50 1.60	
254 255	Plate 65-W.37919 Plate 109-W.37919	1 1	1.95 15.95	
256 257 258	Plate 2-W.38959-B Plate 5-W.37919 Plate 54-W.32738-C	1 1 1	4.30 13.50 4.30	

No.	Description and Identity	Qty.	Price Each F.O.B. U.K. £ Sterling	1 1
259 260	Plate 28-W.32738-C	1	0.45	
261 262 263 264 265	Plug 24-way WIS.3738-C-1-2 Plug Coaxial PC.60207-1 Plug 18-way W.41113-1-1 Plug 18-way WIS.3738-C-1-1	1 15 1 6	0.80 0.20 2.90 0.55	
266 267 268 269 270	Plug Coaxial (Blue) W.36715-B-1-2 Plug Coaxial WIS.5355-B-1-8 Plug 6-way (Red) W.41113-1-2 Plug Coaxial (Yellow) W.36715-B-6 Plug Coaxial (Black) W.51158-C-1-1	1 1 1 2	0.70 0.45 7.35 5.65 1.90	
271 272 273 274 275	Plug Coaxial (Green) W.51158-C-1-2 Plug Coaxial (Blue) W.51158-C-1-3 Plug Coaxial (Red) W.51158-C-1-4 Plug Coaxial (Yellow) W.51158-C-1-5 Plug Coaxial (Grey) W.51158-C-1-6	1 1 1 1	2.05 2.05 2.15 2.00 2.00	
276 277 278 279 280	Plug Coaxial (Brown) W.51158-C-1-7 Rect. Germanium Crystal CV448 Rect. Selenium 3 Phase Full Wave WIS.4669-2-15	1 2 1	0.20 10.50	3S
281 282 283	Rect. Selenium 3 Phase Full Wave WIS.4669-1-13 Rect. Selenium WIS.3222-C-4-22	2	14.50 6.50	
284 285	Relay 3M & 2B WQ.8740-1-M Relay 2M WQ.8740-1-L	1	13.50 13.50	
286 287 288 289 290	Relay WIS.5551-1-4 Relay PC.64903-16 Relay Valve Protecting PC.63706-7 Res. Comp. 3.9k ohms ±5% 0.25W PC.66604-32 Res. Comp. 62k ohms ±5% 0.25W L/PC.66773-49	1 1 2 2 2	10.00 2.05 43.00 0.05 0.10	1S 1S 1S
291 292 293 294 295	Res. W/W 106 ohms ±10% 220W WIS.3852-B-1-24 Res. W/W 107 ohms ±10% 45W WIS.3852-B-1-25 Res. W/W 1.8k ohms ±2% 14W P ^C .67103-37 Res. W/W 68 ohms ±10% 2A WIS.3320-2-18 Res. W/W 33 ohms ±5% 3W PC.67008-4	1 1 1 1 2	2.20 0.70 0.20 6.75 0.10	1s 1s 1s 1s
296 297 298 299 300	Res. W/W 53 ohms ±10% 45W WIS.4006-B-1-27 Res. W/W 2160 ohms ±10% 90W WIS.6265-C-1-1 Res. W/W 419 ohms ±10% 90W WIS.3615-C-1-6 Res. W/W 16500 ohms ±5% 35W P.18282-KP-6 Res. Carb. Wire Ends 220k ohms ±20% 1W PC.66321-76	3 1 1 1 3	0.65 0.95 0.80 0.60 0.05	1S 1S 1S 1S
301	Res. W/W 43750 ohms ±5% 150W P.18282-KK-6	2	1.45	18

No.	Description and Identity	Qty.	Price Each F.O.B U.K. £ Sterling	Scale
302 303 304 305	Res. W/W 1800 ohms ±5% 35W P.18282-KT	1 1	0.80 0.35 7.40 35.00	1S 1S
306 307 308 309 310	Res. W/W 15 ohms ±5% 6W PC.67010-2	11 3 1 1	0.25 1.65 0.10 0.10	38 18 18 18 18
311 312 313 314 315	Res. Comp. 33 ohms ±5% 0.5W PC.66611-7 Res. W/W 47 ohms ±5% 1.5W PC.67007-5 Res. W/W 150 ohms ±5% 1.5W PC.67007-8 Res. W/W 330 ohms ±5% 1.5W PC.67007-10 Res. W/W 680 ohms ±5% 1.5W PC.67007-12	3 1 1 1	0.05 0.15 0.15 0.15 0.15	1S 1S 1S 1S
316 317 318 319 320	Res. W/W 2.2k ohms ±5% 1.5W PC.67007-15 Res. Comp. 220 ohms ±10% 2W PC.66616-17 Res. Comp. 33 ohms ±5% 0.25W PC.66602-2 Res. W/W 10k ohms ±5% 4.5W PC.67009-19 Res. W/W 15k ohms ±5% 6W PC.67010-20	1 3 2 1	0.15 0.05 0.05 0.15 0.15	1S 1S 1S 1S
321 322 323 324 325	Res. Comp. 100 ohms ±10% 0.25W PC.66610-13 Res. W/W ±1% WIS.3914-C-2-19 Res. Comp. 10k ohms ±10% 0.75W PC.66612-31 Res. Comp. 15k ohms ±10% 0.75W PC.66612-33 Res. W/W ±1% WIS.3914-C-3-31	4 1 3 3 1	0.05 0.95 0.05 0.05 0.95	1S
326 327 328 329 330	Res. Comp. 20 ohms ±20% 50W WIS.5161-C-1-22 Res. W/W 400mA 100mV ±1% WIS .3914-C-45 Res. W/W 2A 100mV ±1% WIS.3914-C-46	2 1 1 1	0.05 5.15 0.95 0.95 0.95	1S 1S 1S
331 332 333 334 335	Res. W/W 600V Operation WIS.4235-7-129 Res. W/W 2.2 ohms ±10% 3W PC.67008-25 Res. W/W lk ohms ±5% 4.5W PC.67009-13 Res. Comp. 20 ohms ±10% 35W PC.66408-21 Res. Comp. 100k ohms ±10% 2W PC.66616-49	1 2 1 2 1	0.95 0.15 0.15 4.85 0.05	1S 1S 1S
336 337 338 339 3 40	Res. Comp. 100 ohms ±10% 0.5W PC.66611-13 Res. Comp. 1.2k ohms ±10% 2W PC.66616-26 Res. Comp. 18 ohms ±10% 2W PC.66616-4 Res. Comp. 1k ohms ±10% 2W PC.66616-25 Res. Comp. 22 ohms ±10% 2W PC.66616-5	1 2 2 2 2	0.05 0.05 0.05 0.05 0.05	
34-1 34-2 34-3 344	Res. Comp. 820 ohms ±10% 2W PC.66616-24 Res. Comp. 33 ohms ±10% 2W PC.66616-7 Res. Comp. 560 ohms ±10% 2W PC.66616-12 Res. Comp. 47 ohms ±10% 2W PC.66616-9	1 2 2 2	0.05 0.05 0.05 0.05	

No.	Description and Identity	Qty.	Price Each F.O.B. U.K. £ Sterling	
345	Res. Comp. 390 ohms ±10% 2W PC.66616-20	1	0.05	
346 347 348 349 350	Res. Comp. 33 ohms ±10% 0.25W PC.66610-7 Res. Comp. 50 ohms ±20% WIS.5161-C-1-6 Res. Comp. 22 ohms ±10% 0.5W PC.66611-5 Res. Comp. 56 ohms ±10% 0.5W PC.66611-10 Res. Comp. 33k ohms ±10% 0.5W PC.66611-43	4 1 1 5	0.05 2.10 0.05 0.05 0.05	
351 352 353 354 355	Res. Comp. 33 ohms ±10% 0.25W PC.66610-7 Res. Comp. 100k ohms ±10% 0.5W PC.66611-49 Res. Comp. 2.2k ohms ±10% 0.5W PC.66611-29 Res. W/W 5.55 ohms ±1% 3W PC.66902-30 Res. Comp. 6.8k ohms ±10% 0.5W PC.66611-35	28 5 4 6	0.05 0.05 0.05 0.30 0.05	25
356 357 358 359 360	Res. Comp. 10k ohms ±10% 0.5W PC.66611-37 Res. Comp. 150k ohms ±10% 0.5W PC.66611-51 Res. Comp. 1k ohms ±10% 0.5W PC.66611-25 Res. Comp. 8.2k ohms ±10% 0.5W PC.66611-36 Res. Comp. 330 ohms ±10% 0.5W PC.66611-19	6 1 5 4 4	0.05 0.05 0.05 0.05 0.05	
361 362 363 364 365	Res. Comp. 22k ohms ±10% 0.5W PC.66611-41 Res. Comp. 220 ohms ±10% 0.5W PC.66611-77 Res. Comp. 3.3k ohms ±10% 0.5W PC.66611-31 Res. Comp. 180 ohms ±10% 0.5W PC.66611-16 Res. W/W 0.505 ohms ±5% 3W PC.66902-33	2 9 2 2 5	0.05 0.05 0.05 0.05 0.35	28
366 367 368 369 370	Res. Comp. 3.9k ohms ±10% 0.5W PC.66611-32 Res. Comp. 120 ohms ±10% 0.25W PC.66609-8 Res. W/W lk ohms ±5% 4.5W PC.67009-13 Res. Comp. 100 ohms ±10% 0.5W PC.66611-13 Res. Comp. 330 ohms ±10% 0.25W PC.66610-19	1 1 1 3 1	0.05 0.05 0.10 0.05 0.05	1S
371 372 373 374 375	Res. Comp. 270 ohms ±10% 0.25W PC.66610-18 Res. Thermistor WIS.5740-C-1-4 Res. Comp. 680 ohms ±10% 0.5W PC.66611-23 Res. Comp. 168 ohms ±10% 0.25W PC.66610-11 Res. Comp. 47k ohms ±10% 0.5W PC.66611-45	1 1 2 1	0.05 1.00 0.05 0.05 0.05	28
376 377 378 379 380	Res. Comp. 4.7k ohms ±10% 0.5W PC.66611-33 Res. Comp. 56 ohms ±10% 0.5W PC.66611-10 Res. Comp. 22 ohms ±10% 0.5W PC.66611-5 Res. Comp. 68 ohms ±10% 0.5W PC.66611-11 Res. Comp. 15k ohms ±10% 0.5W PC.66611-39	1 4 4 1	0.05 0.05 0.05 0.05 0.05	
381 382 383 384 385	Res. Comp. 10 ohms ±10% 0.25W PC.66610-1 Res. Comp. 150 ohms ±20% 40W WIS.7663-B-1-9	1	0.05	
386 387				

No.	Description and Identity	Qty.	Price Each F.O.B. U.K. £ Sterling	1
388 389 390	Res. Vble. W/W 12 ohms ±10% 100W WIS.3147-1-4 Res. Vble. W/W 3-Gang 80 ohms ±10% 50W WIS.3337-1-34	1 1	2.40 11.10	
391 392 393 394 395	Res. Vble. W/W 25 ohms ±10% 80W PC.47408-60 Res. Vble. W/W 500 ohms 0.5W PC.67401-18 Res. Vble. W/W 3 ohms ±10% 60W PC.67407-39 Res. Vble. W/W 500 ohms ±20% 0.5W PC.67401-18 Res. Vble. W/W 250 ohms ±10% 2.5W PC.67403-22	1 2 1 0 1	2.85 0.50 2.45 0.50 0.70	1S 1S 1S
396 397 398	Res. Vble. Comp. 5k ohms $\pm 20\%$ 0.75W PC.67203-9 Res. Vble. W/W 25k ohms $\pm 10\%$ 2.5W PC.67403-46	1 9	1.15	1S 2S
399 400	Retainer Valve WIS.3449-C-1-1 Retainer Valve WIS.3701-C-1-22	1 2	0.20	1S 1S
401 402	Retainer Valve WIS.6271-C-1-1	1	0.35	18
403 404	Shaft Assembly W.39617-B-1-A	1	15.00	
405	Socket Coaxial PC.60204-1	10	0.05	
406 407 408 409 410	Socket Coaxial PC.60209-1 Socket 18-way WIS.3732-C-1-1 Socket 18-way W.41061-1-6 Socket 18-way W.41061-1-7 Socket Coaxial WIS.5355-B-1-9	5 1 1 3	0.55 0.65 1.15 1.15 0.45	
411 412 413 414 415	Socket 18-way Green W.41061-1-9 Socket 12-way Light Grey W.41061-1-102 Socket 18-way W.41061-1-118 Socket 18-way W.41061-1-119 Socket 18-way W.41061-1-26	1 1 1 1	1.15 0.85 4.15 1.15	
416 417	Socket 24-way W.41061-1-81	1	4.15	
418 419 420	Spring W.7447-C-2-28B Spring Flat 127-W.37919-C	1 2	0.15	1S 1S
421 422 423	Spring Assembly W.39660-C-A Spring (Contact Angle) 23-W.40408-C	2 1	3.00 2.85	18
424 425 425	Spindle Assembly W.40693-1-A	1	13.00	
426 427	Starter WIS.8063-B-1	0		
428 429	Suction Unit WIS.6412-B-5-7	1	87.00	
430	Support Mycalex 3-W.40700-B	1	4.30	

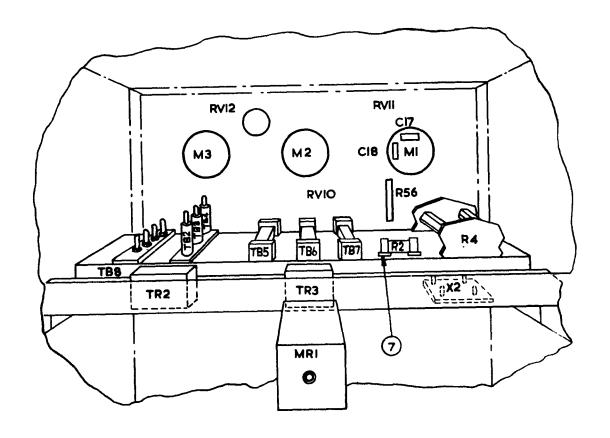
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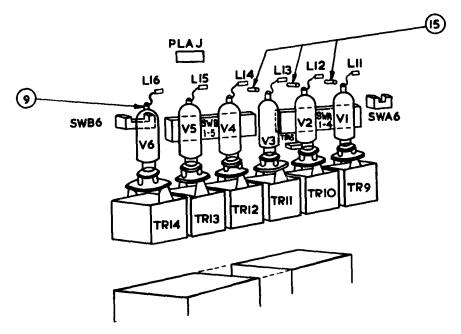
				·
No.	. Description and Identity	Qty.	Price Each F.O.B. U.K. £ Sterling	Scale
431 432 433 434 435	Support Mycalex 4-W.40700 Support Mycalex 4A-W.40700 Support Mycalex 4B-W.40700 Support Mycalex 4C-W.40700 Support Mycalex 8-W.40700-B	1 1 1 1	4.30 4.30 4.30 4.30 4.30	
436 437 438 439 440	Switch 5 Pole W.50027-1-A Switch Micro W.40269-C-1-A Switch 5 Pole W.50027-1-B Switch Micro W.40269-C-1-B	1 1 1	22.50 2.90 23.00 2.90	1S 1S
441 442 443 444 445	Switch Push Button W.13433-B-1-A Switch Push Button WQ.7640-1-C Switch 4 Pole C/O WIS.3456-B-148 Switch SP WIS.3456-B-111 Switch SP C/O 20A WIS.5197-B-11	3 1 1 1	1.85 16.50 4.60 2.90 1.35	
446 447 448 449 450	Switch Knife 2 Pole 30A WIS.4095-B-1-1C Switch SP WIS.3456-155 Switch Micro SP WIS.5586-C-1-1 Switch 4 Pole WIS.3456-133 Switch 2 Pole WIS.5670-C-138	1 1 1 1	4.65 3.70 0.70 5.45 1.00	ls
451 452 453 454 455	Switch 12-way WIS.3421-C-50 Switch 7-way WIS.5670-C-145 Switch 12-way WIS.3421-C-51 Switch 6-way WIS.5670-C-146 Switch SP On/Off PC.71301-2	1 1 1 2	5.70 1.25 7.95 1.00 0.35	ls
456 457 458 459 460	Switch 'Ledex' Selector WIS.7166-B-3-1 Switch SP 5 Psn. W.38959-1-C Switch SP 5 Psn. W.40066-1-A Switch 4 Pole 5 Psn. 6-W.40408-C Switch SP C/O WIS.5586-C-1-2	1 1 1 3	16.50 275.00 230.00 4.10 0.65	
461 462 463 464 465	Switch Assembly W.39161-1-A Switch Assembly W.36725-1-B Switch W.40269-C-1-B Switch SP 2.5kVA WIS.5197-B-6 Switch 2 Pole WIS.5820-B-34	1 1 1 1	71.50 46.50 2.90 0.90 3.70	
466 467 468 469 470	Switch SP WIS.5820-B-35 Switch SP WIS.12824-4 Switch. Output Circuit Pad Switch - Part of No.40 (Tuning Cap) Switch Time T31-0964-Ol	1 1	3.75 22.50 39.00	
471 472 473	Switch Blade Assembly W.39454-B-1-A	1	4.25	

		· · · · · · · · · · · · · · · · · · ·	 	T
No.	Description and Identity	Qty.	Price Each F.O.B. U.K. £ Sterling	Scale
474 475	Term. PH.76201-3 Term. 6-way 30A W.57404-C-1-1	6 1	0.10 11.50	18
476 477 478 479 480	Term. Porcelain SK.48864-1-H Term. 20-way W.22469-B-1-U Term. 4-way W.40168-B-1-A Term. 10-way W.22469-B-1-K Term. 8-way W.22469-B-1-H	3 3 1 1	0.85 4.00 10.00 8.50 7.30	lS
481 482 482A 483 484 485	Term. 4-way WIS.1631-1-4 Term.: W.21988-C-1-2 Term. 20-way W.33265-1-Q Term. 2-way 42-W.39081-C Term. 3-way WIS.1632-1-3	1 1 1 1 1	0.25 0.35 4.55 7.70 5.30 0.25	
486 487 488 489 490	Term. 10-way W.33265-1-W Term. Block 16-W.32738-C Term. Board W.41618-C-1-A	1 6 1	10.50 4.30 9.15	
491 492 493 494 495	Transf. 6.3V W.24068-59 Transf. 15V W.24582-13 Transf. W.37518-3 Transf. W.23241-33 Transf. W.24586-26	1 1 1 1	24.00 60.50 70.00 27.50 48.50	1B 1B 1B 1B 1B
496 497 498 499 500	Transf. W.24743-27 Transf. W.22129-3 Transf. W.27206-4 Transf. W.37518-2 Transf. W.26958-B-152	1 1 6 1	21.50 575.00 33.50 93.00 2.70	1B 1B 1B 1B
501 502 503 504 505	Transf. W.26958-B-153 Transf. W.50593-1-G Transf. W.50593-1-D Transf. W.50593-1-E Transf. W.41184-B-45	1 2 2 1 1	2.85 3.20 2.95 2.95 2.20	lB
506 507 508 509 510	Transf. W.41184-B-46 Transf. W.41185-B-6 Transf. W.37149-1-17 Transf. Input W.33035-B-1-E Transf. Output W.33035-B-1-D	1 1 1 1	2.15 2.15 2.40 2.25 1.35	
511 512 513 514 515	Valve GXU-2 CV2518 Valve U.54 CV378 Valve STV.280 - 80S	6 2 1		

+

							
No.	Description	Value	Tol. % ±	Rtg.	Identity	Qty.	Scale
516 517 518 519 520	Valve OA3 or 75/40 CV3798 Valve CV428 Valve C.1112 Valve BR.191 Valve CV138					1 2 2 1 7	
521 522 523 524 525	Valve CV4014 Valve CV391 Valve N.77					2 2	
526 527 528 529 530	Valveholder B8G PC.81813-1 Valveholder B7G with Skirt F Valveholder I.O. PC.81814-1 Valveholder B5 PC.81805-1 Valveholder Cer. WIS.4844-C-		1			2 11 2 1 2	1S 3S 1S 1S 1S
531	Wheel 134A-W.37919 (To be su	pplied a	with 1	No.97)			
532 533 534	Starter T31-2589-01 Contactor, 9 pole making (FC Contactor, 5 pole making (ST) WIS.9		-2D			
And described the second of th							
And the deposition of the contraction of the contra							





COMPONENT LAYOUT CHANGES ARISING FROM MODIFICATION NO.9785 (Fitting of Back-fire Indicators and Remote Bias Control)

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A.P.1161 2nd Edn Oct. '6

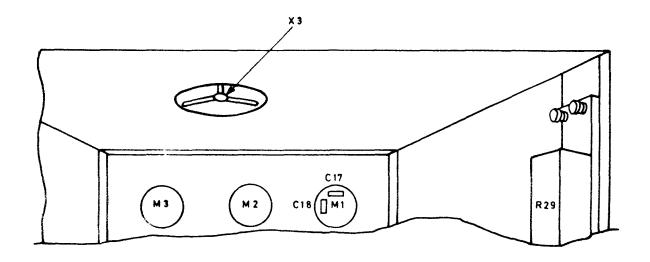


FIG. I(a) PART VIEW OF R.C.U. SHOWING LOCATION OF FAN X3 (MOD. 3978)

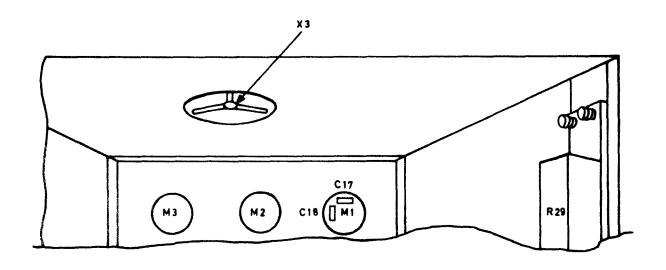
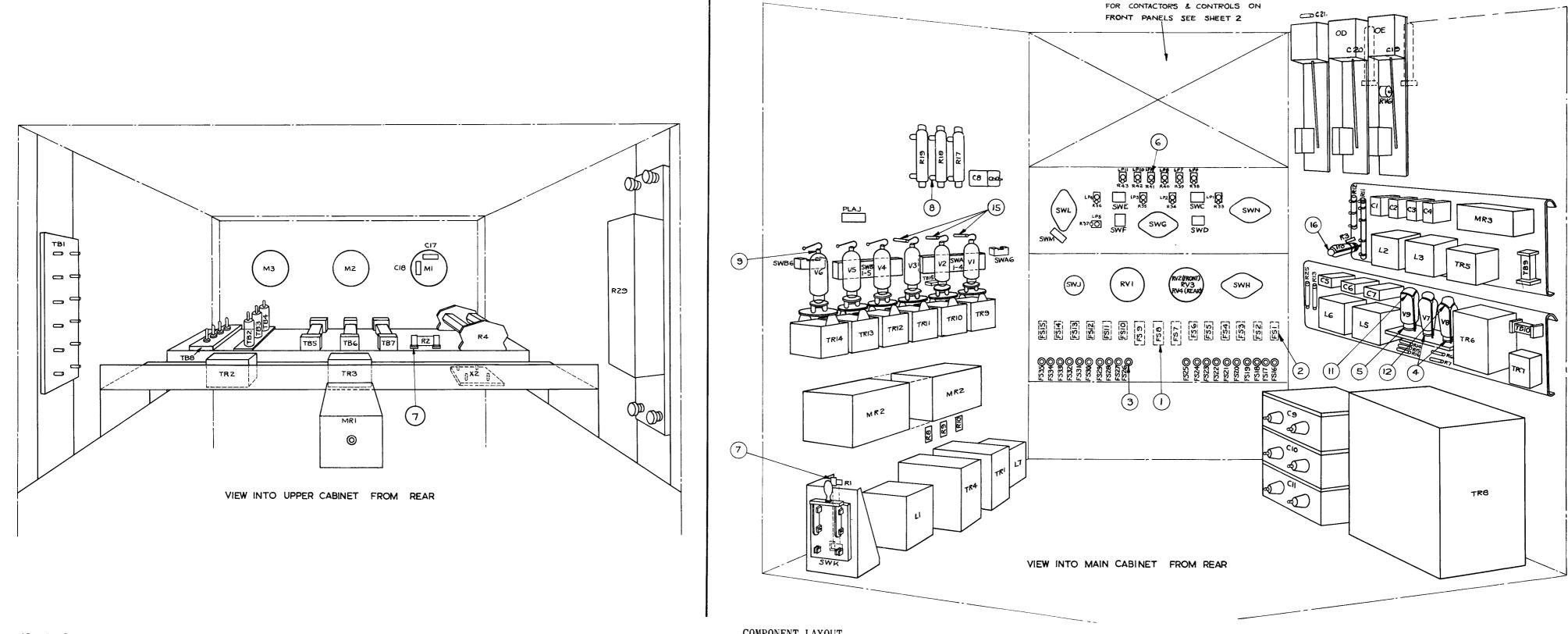
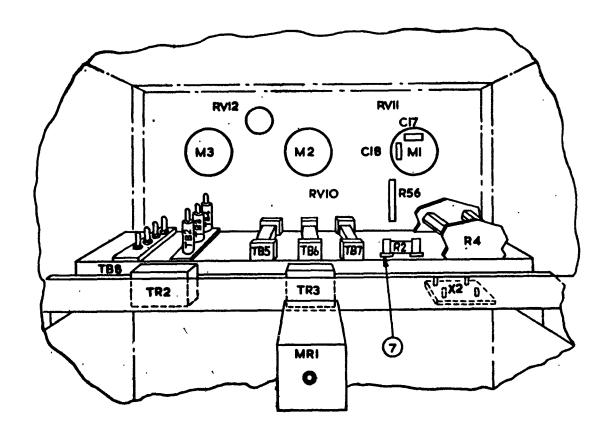


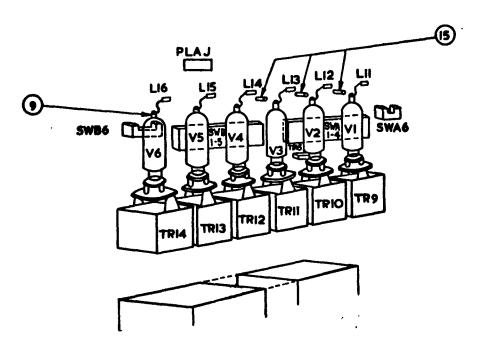
FIG. 1A(a) PART VIEW OF R.C.U. SHOWING LOCATION OF FAN X3 (MOD. A3978)



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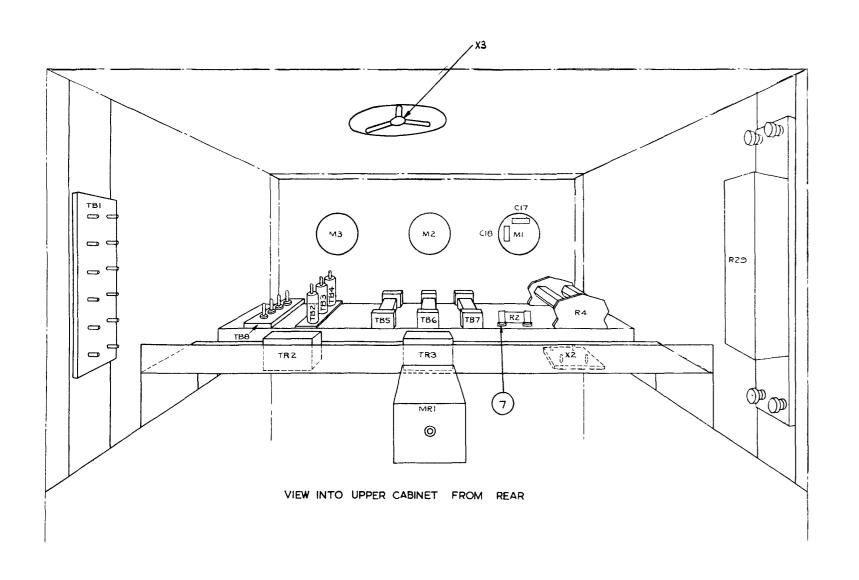
COMPONENT LAYOUT
RECTIFIER AND CONTROL UNIT, SHEET 1
WZ.12785/D Sh.1 Iss.11

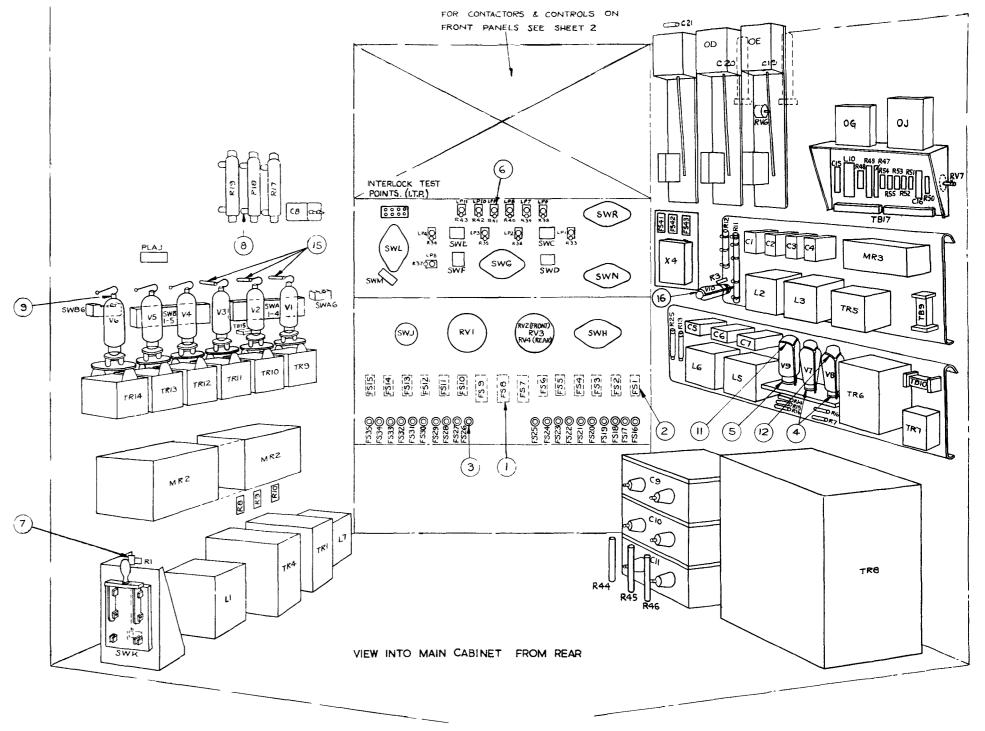




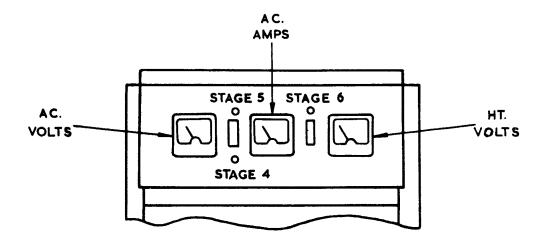
COMPONENT LAYOUT CHANGES ARISING FROM MODIFICATION NO.9785 (Fitting of Back-fire Indicators and Remote Bias Control)

A.P.116 2nd Edn Oct. '6 IA





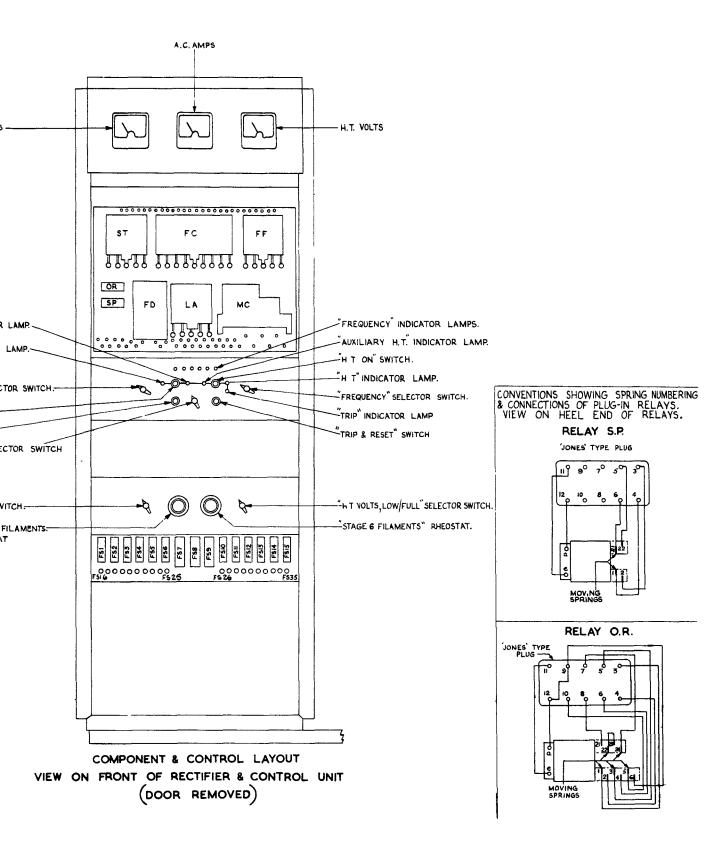
COMPONENT LAYOUT
RECTIFIER AND CONTROL UNIT, PART 1
HS31/1 AND HS31A/1



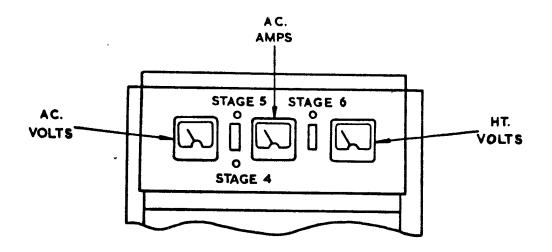
COMPONENT LAYOUT CHANGES ARISING FROM MODIFICATION NO.9785 (Fitting of Back-fire Indicators and Remote Bias Control)

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A.P.116E 2nd Edn. Oct. '67 IA

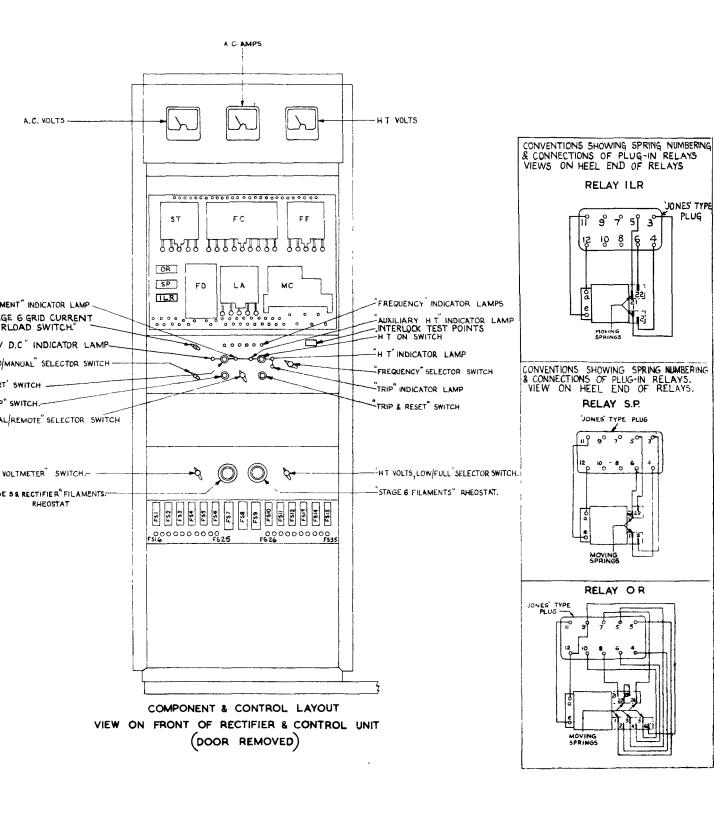


COMPONENT LAYOUT
RECTIFIER AND CONTROL UNIT, SHEET 2
WZ.12785/B Sh.2 Iss.5



COMPONENT LAYOUT CHANGES ARISING FROM MODIFICATION NO.9785 (Fitting of Back-fire Indicators and Remote Bias Control)

face .g.2A) A.P.1163 2nd Edn Oct. '53 IA



COMPONENT LAYOUT
RECTIFIER AND CONTROL UNIT, PART 2
HS31/1 AND HS31A/1

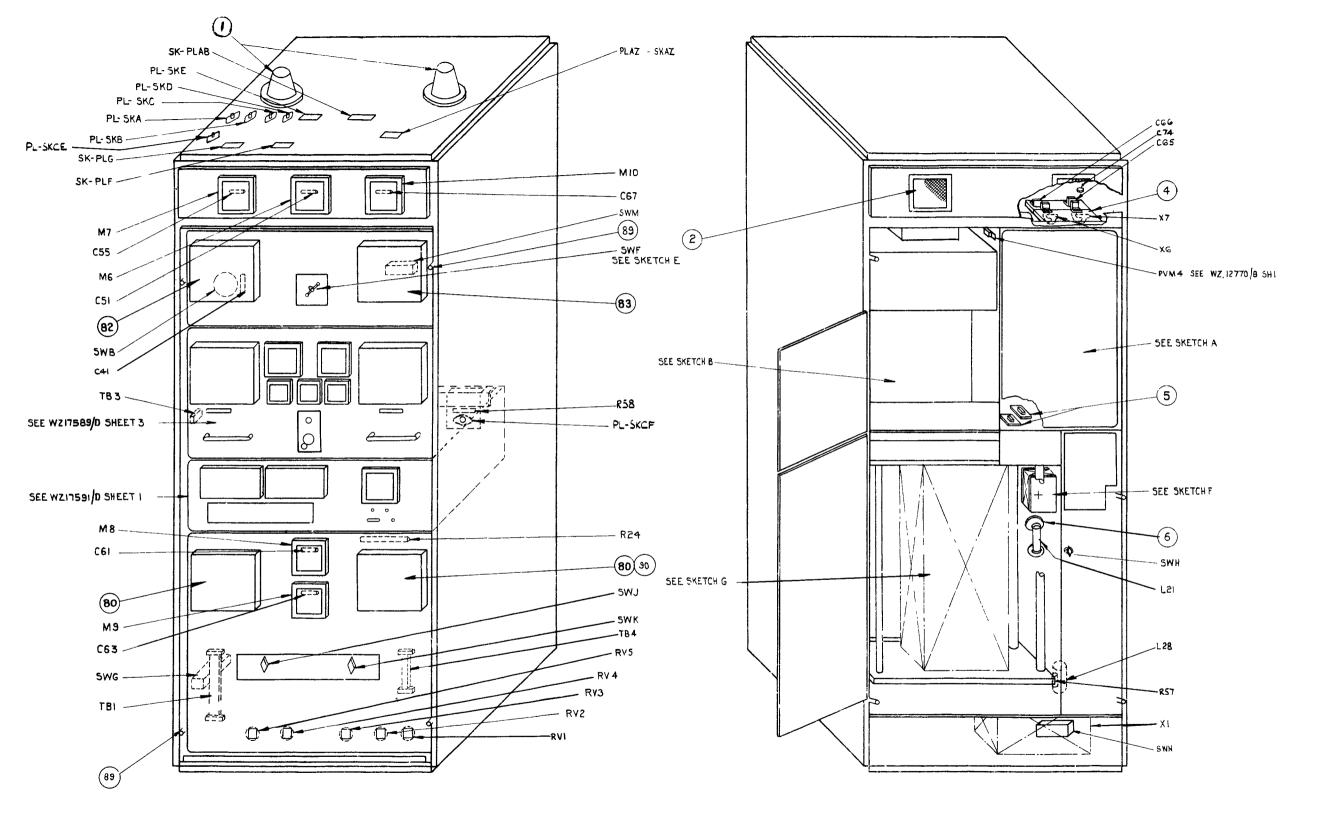
FIG.2A WZ.26507/B SH.2 ISS.1

Component Layout R.F. Unit HS31 (WZ.17589/D Sh.1)

Modification No.1785

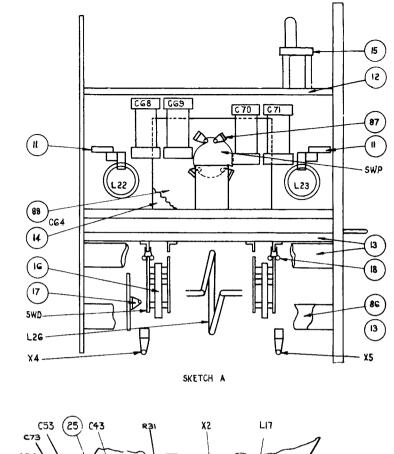
Modification No.1785 entails the addition of R.F. Filter Type W.102405 Ed.B to the R.F. unit of HS31 when 50 ohms output impedance is provided by the use of Transformer Type HA112. The filter and the transformer are both located on the roof of the cabinet.

A.P.116E-0231-1 2nd Edition A.L.4, June 1970 Fig.3(a)





COMPONENT LAYOUT
RADIO FREQUENCY UNIT, SHEET 1
WZ.17589/D Sh.1 Iss.6



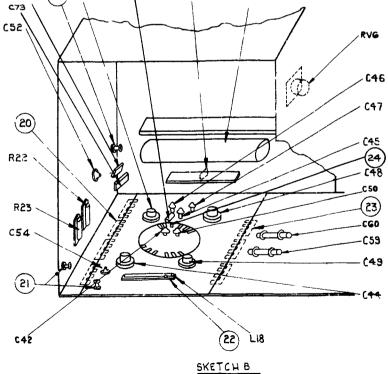


FIG.3

R.F. UNIT 3.5kW ISB TRANSMITTER TYPE HS.31A (WQ.12610 Ed.A & W.37907 Ed.C)

Cross Reference List for WZ.17365/D Sh.1

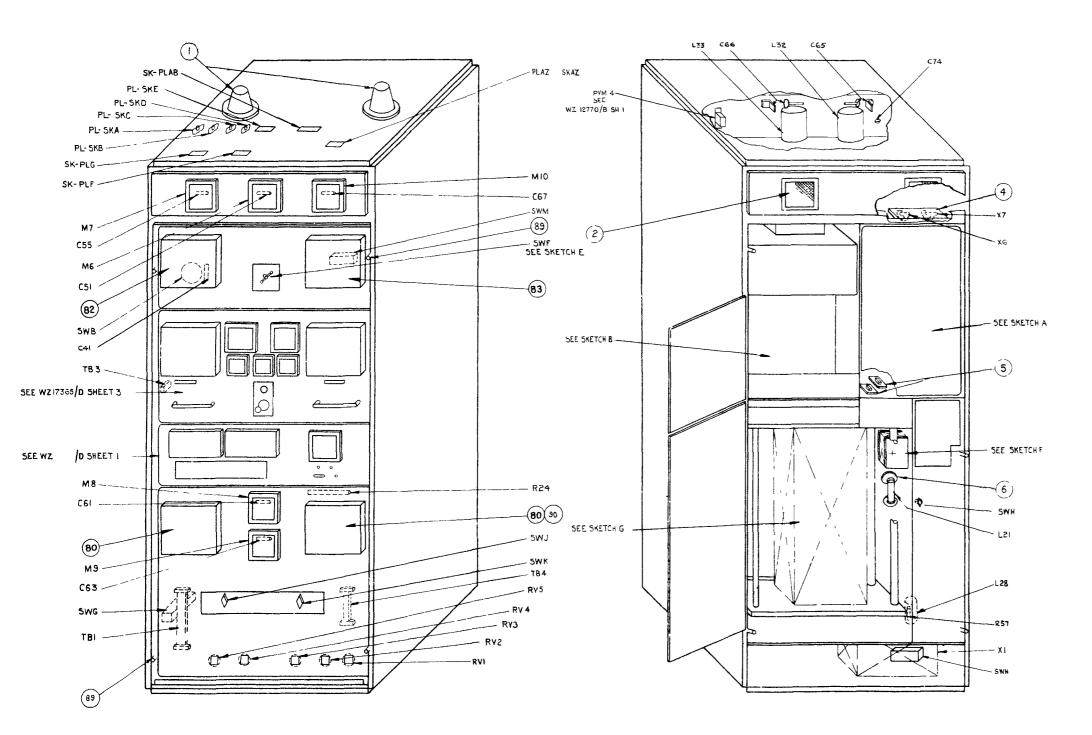
Ref. 1	Insulator Ceramic	No.451
Ref. 2	Air Filter	No.413
Ref. 4	Mounting Board Mycalex	No.460
Ref. 5	Mounting Board Mycalex	No.461
Ref. 6	Insulator	No.450
Ref.11	Coil Mounting Plate Mycalex	No.425
Ref.12	Top Panel Mycalex	No.495
Ref.13	Contact Mounting Mycalex	No.430
Ref.14	End Cheek Mycalex	No.439
Ref.15	Contact Mounting Mycalex	No.431
Ref.16	Rotor Mounting Mycalex	No.468
	<u> </u>	
Ref.17	Contact Assembly	No.426
Ref.18	Contact Assembly	No.427
Ref.20	Spring Centact	No.477
Ref.21	Stand-Off Insulator	No•491
Ref.22	Mounting Board Mycalex	No.462
Ref.23	Spring Contact	No.478
Ref.24	Grid Contact Spring	No.447
Ref.25	Stand-Off Insulator	No.492
Ref.80	Manual Drive Assembly	No.456
Ref.82	Manual Drive Assembly	No.457
Ref.83	Manual Drive Assembly	No.458
Ref.86	Contact Mounting Mycalex	No.432
Ref.87	Contact Assembly	No.427
Ref.88	End Cheek Mycalex	No.440
Ref.89	Contact Assembly	No.428
Ref.90	Coupling Mycalex	No.438
Ref.91	Wheel	No.502
1.01 = /1	111001	1100000

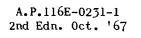
R.F. Unit of Transmitter HS31A (WZ.17365/D Sh.1)

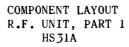
Modification No.1784

L32 and L33 are replaced by R.F. Filter W.102405 Ed.C when 50 ohms output impedance is provided by the use of Transformer Type HA112. The filter is located in the top section of the cabinet in place of L32 and L33 and the transformer is located on top of the cabinet.

A.P.]16E-0231-1 2nd Edition A.L.4, June 1970 Fig.3A(a)







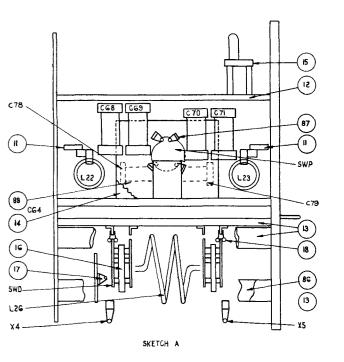


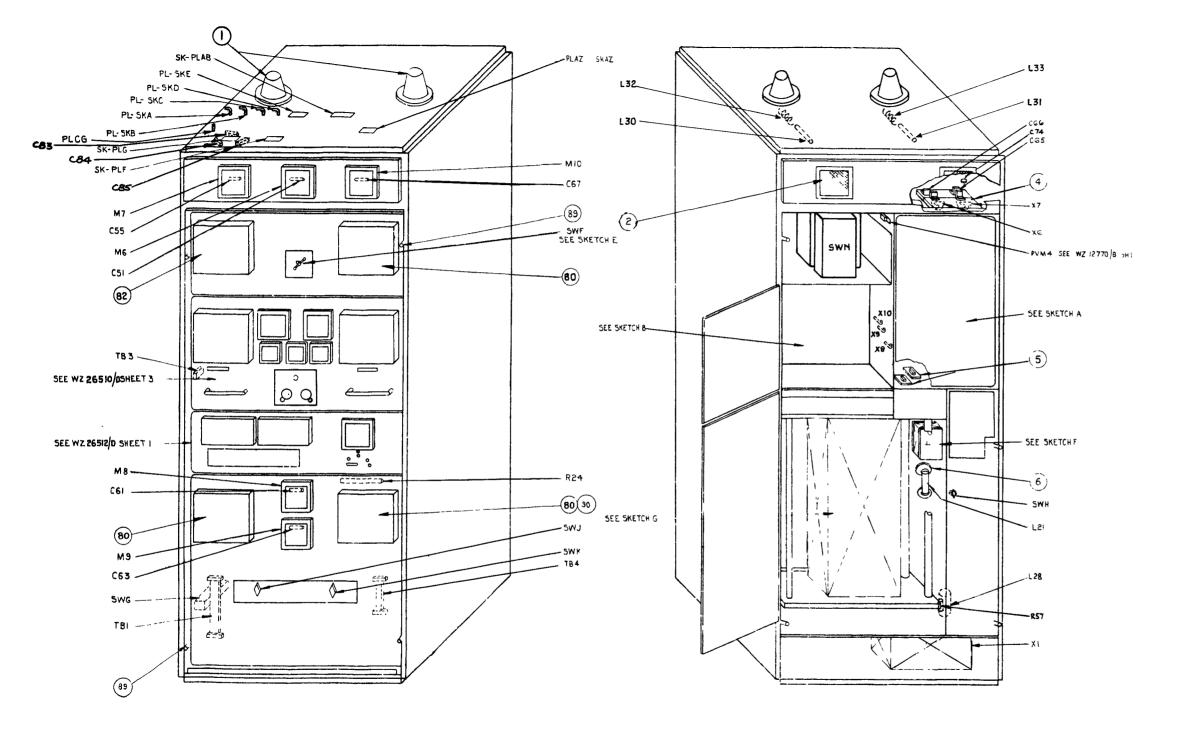
FIG.3A WZ.17365/D SH. ISS.6

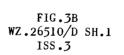
Component Layout R.F. Unit HS31/1 (WZ.26510/D Sh.1)

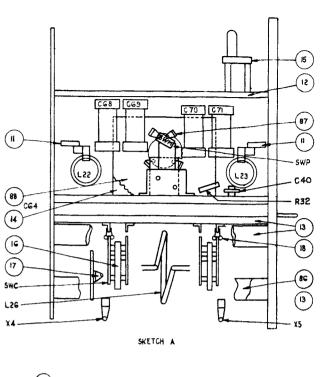
Modification No.1785

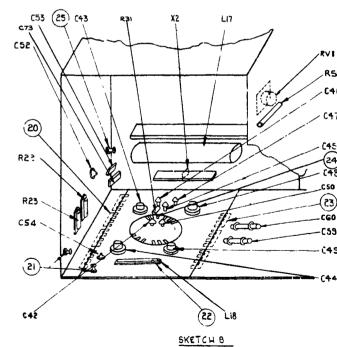
Modification No.1785 entails the addition of R.F. Filter Type W.102405 Ed.B to the R.F. unit of HS31/1 when Transformer Type HA112 is used to provide 50 ohms output impedance. The filter and the transformer are both located on top of the cabinet.

A.P.116E-0231-1 2nd Edition A.L.4, June 1970 Fig.3B(a)



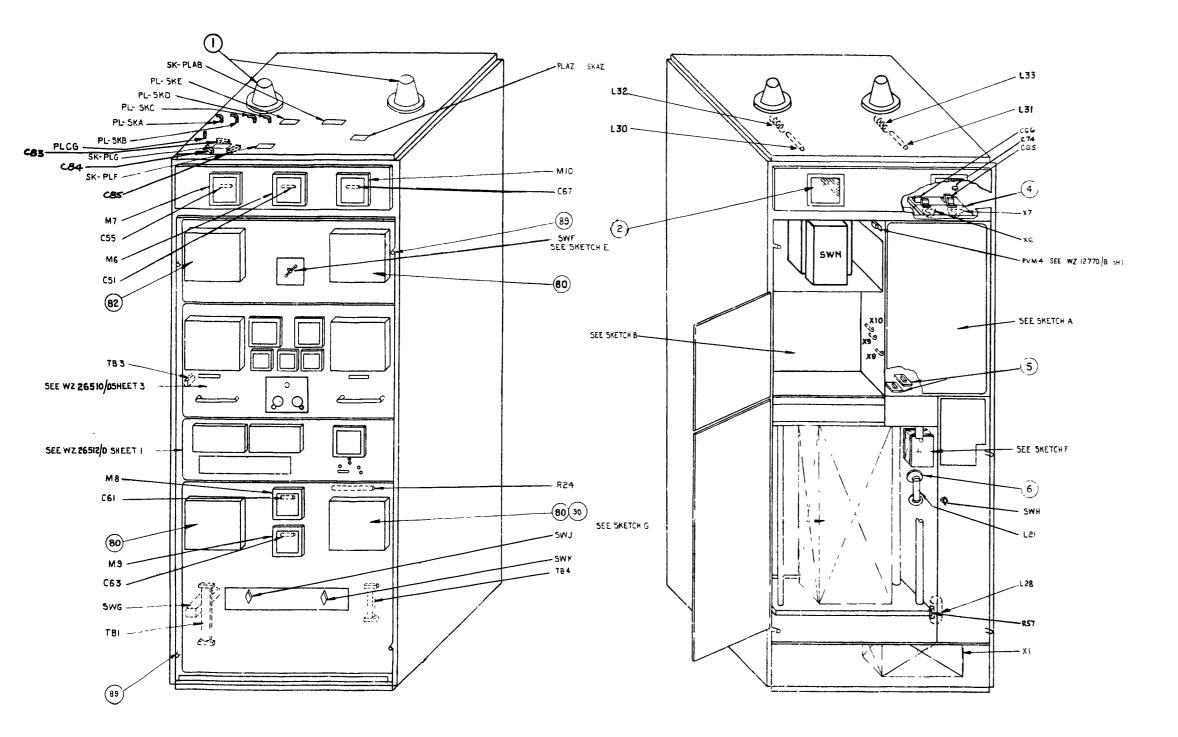


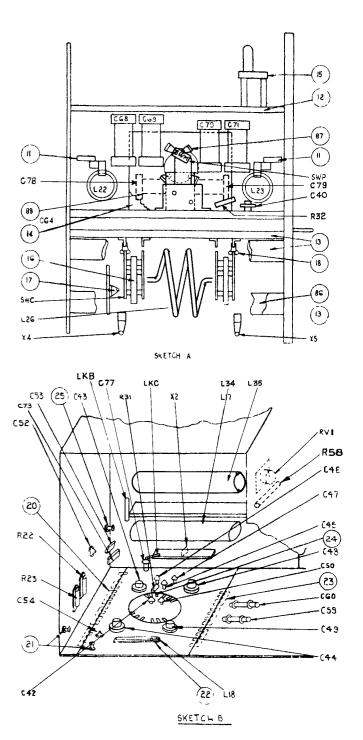




A.P.116E-0231-1 2nd Edn. Oct. '67

COMPONENT LAYOUT R.F. UNIT, PART 1 HS 31/1





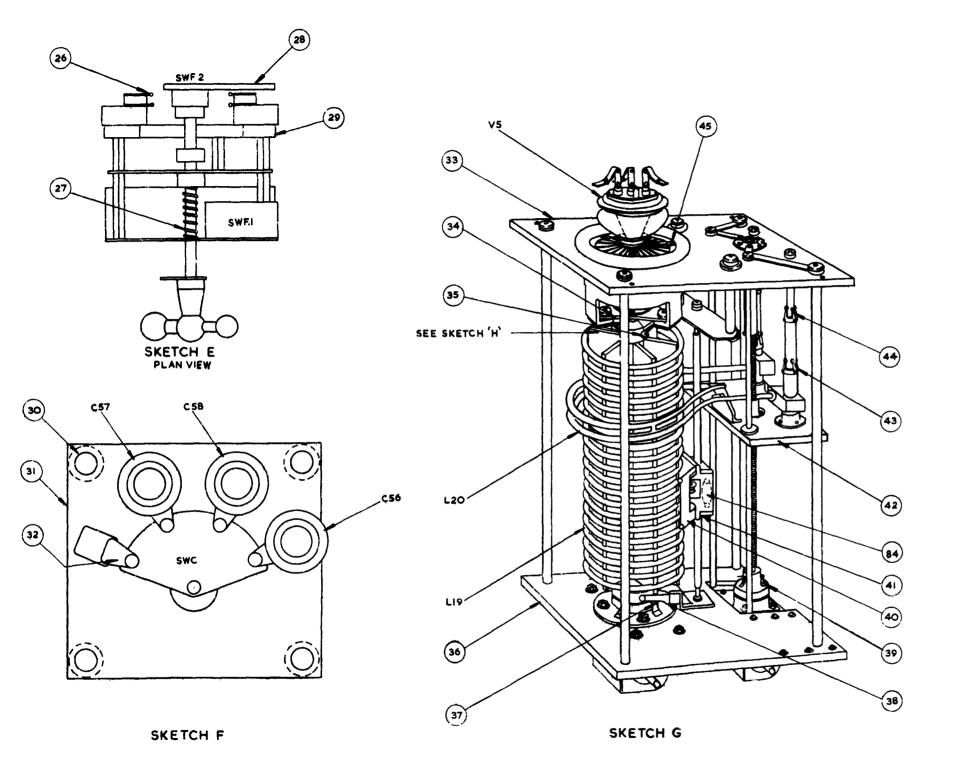
COMPONENT LAYOUT R.F. UNIT, PART 1 HS 31/1

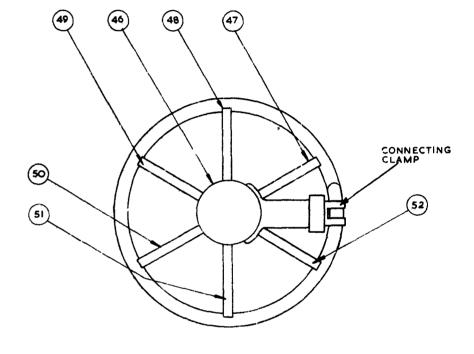
R.F. Unit of Transmitter HS31A/1 (WZ.27280/D Sh.1)

Modification No.1784

L30, L31, L32, and L33 are replaced by R.F. Filter Type W.102405 Ed.C when 50 ohms output impedance is provided by the use of Transformer Type HAll2. The filter is located in the top section of the cabinet in place of L30, L31, L32, and L33, the transformer is located on top of the cabinet.

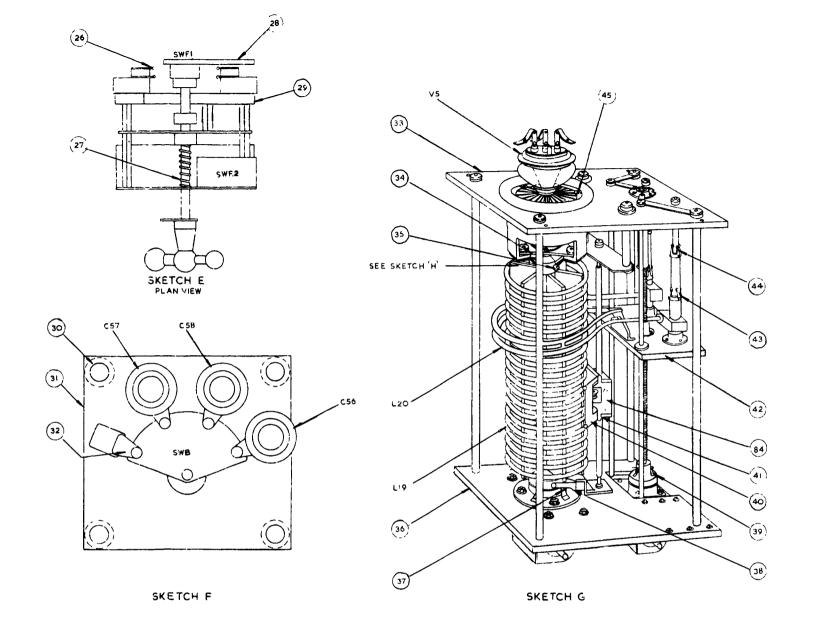
A.P.116E-0231-1 2nd Edition A.L.4, June 1970 Fig.3C(a)

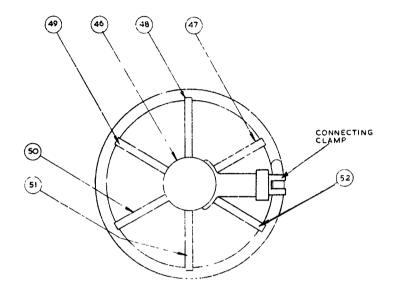




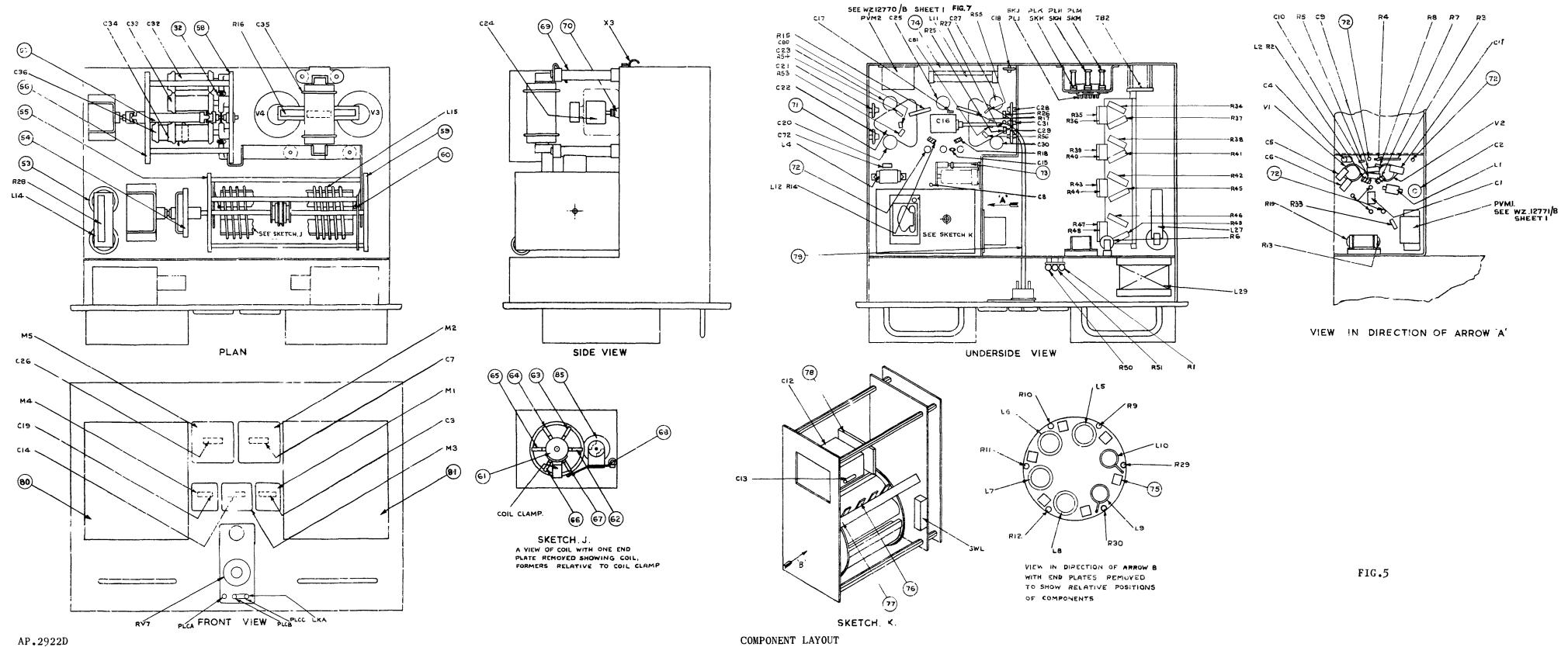
SKETCH H
A VIEW LOOKING ON TOP OF THE
ANODE COIL ASSEMBLY SHOWING
POSITIONS OF MYCALEX COIL
SUPPORTS RELATIVE TO CONNECTING
CLAMP

AP.2922D Vol.1 April 1965 COMPONENT LAYOUT
RADIO FREQUENCY UNIT, SHEET 2
WZ.17589/D Sh.2 Iss.1





SKETCH H
A VIEW LOOKING ON TOP OF THE
ANODE COIL ASSEMBLY SHOWING
POSITIONS OF MYCALEX COIL
SUPPORTS RELATIVE TO CONNECTING
CLAMP



COMPONENT LAYOUT

RADIO FREQUENCY UNIT, SHEET 3

WZ.17589/D Sh.3 Iss.4

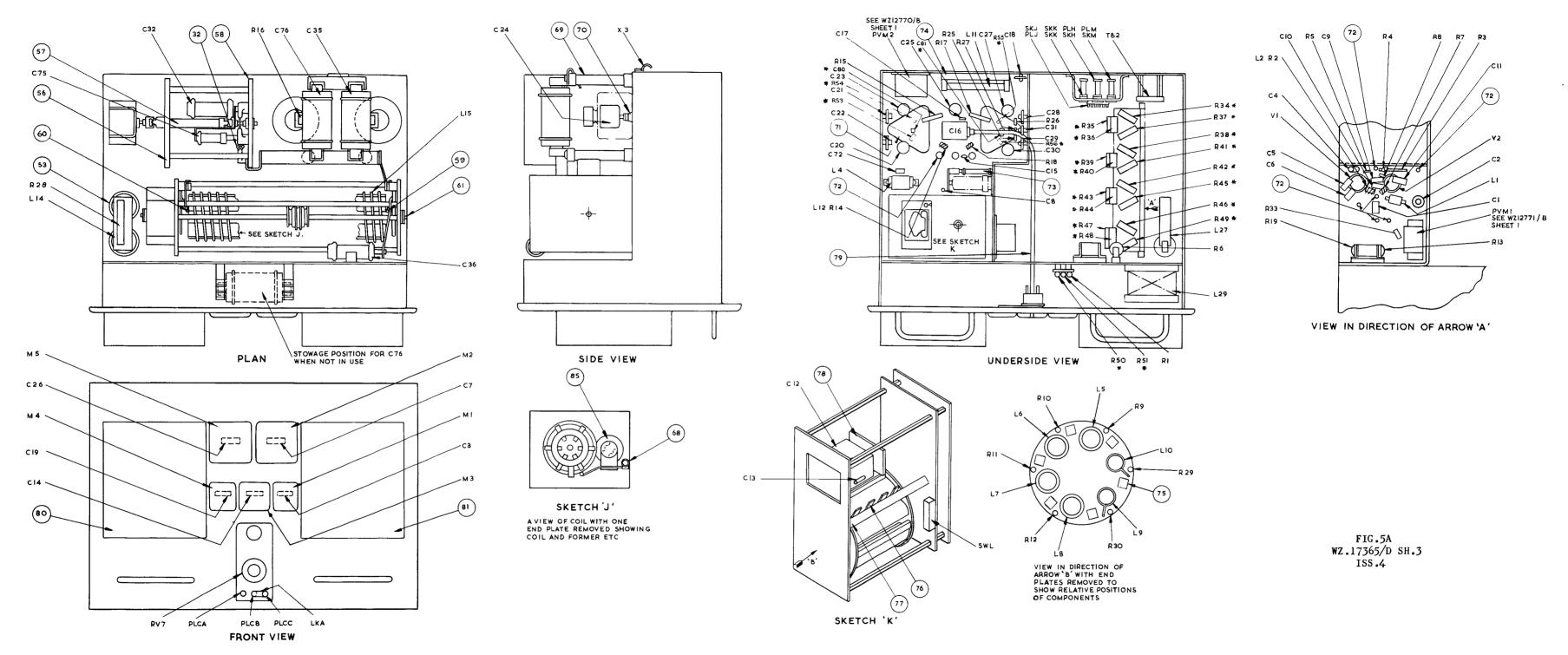
Vol.1

April 1965

R.F. UNIT 3.5kW ISB TRANSMITTER TYPE HS.31A (WG.12610 Ed.A & W.37907 Ed.C)

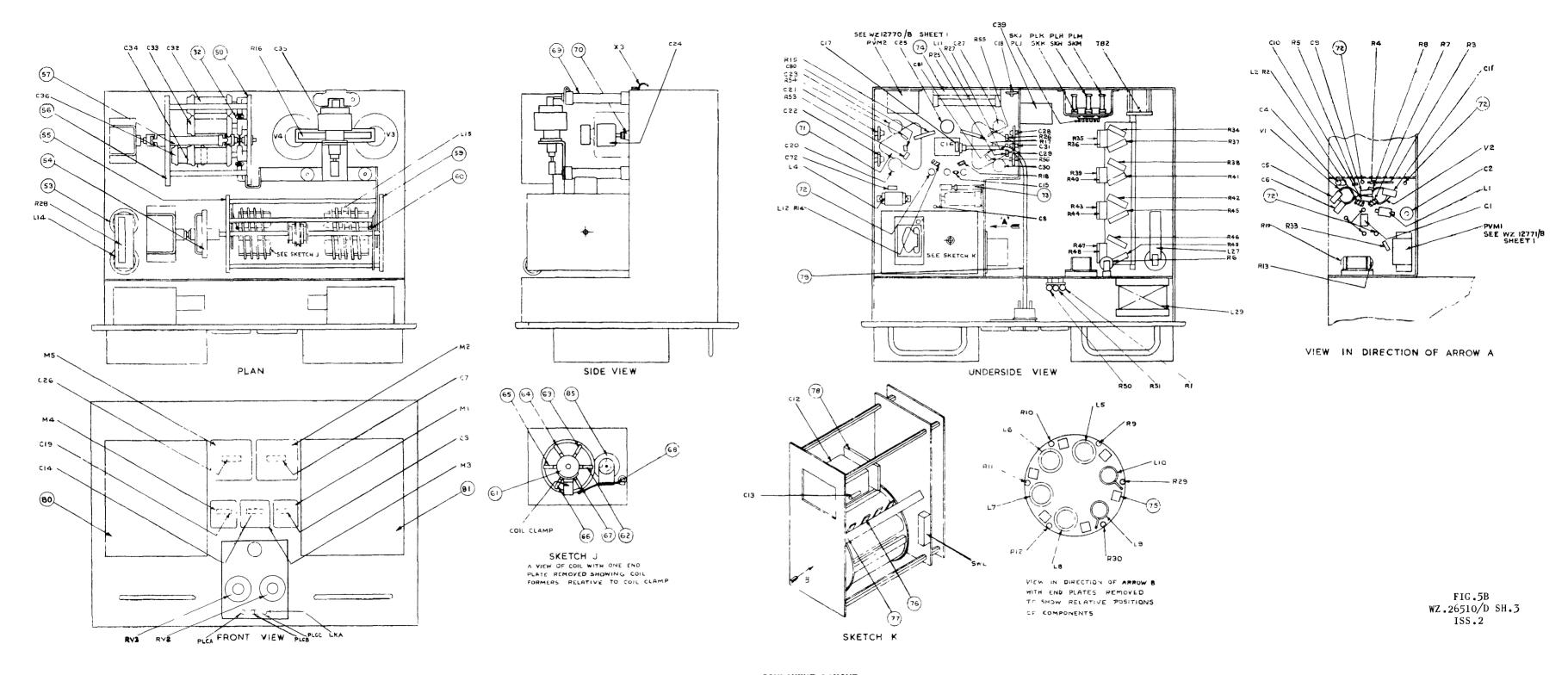
Cross Reference List for WZ.17365/D Sh.3

Ref.32	Ball Contact Assembly	No.416
Ref.53	Insulator Conical Porcelain	No.450
Ref.56	Support Plate Mycalex	No.490
Ref.57	Coupling Bar Mycalex	No.437
Ref.58	Mounting Plate Mycalex	No.464
Ref.59	Spring Assembly	No.472
Ref.60	Spring Assembly	No.473
Ref.61	Spring Assembly	No.474
Ref.68	Contact Assembly	No.429
Ref.69	Insulating Rod	No.453
Ref.70	Conical Insulator	No.435
Ref.71	Valveholder Ceramic	No•496
Ref.72	Insulator Stand-Off	No.454
Ref.73	Insulator Stand-Off	No.449
Ref.74	Base Mycalex	No.418
Ref.75	Terminal Block Mycalex	No.494
Ref.76	Spring Contact	No.475
Ref.77	Spring Contact Plate Mycalex	No.489
Ref.78	Condenser Plate Mycalex	No.434
Ref.79	Flexible Drive Assembly	No.443
Ref.81	Manual Drive Assembly	No.459
Ref.85	Spring	No.469

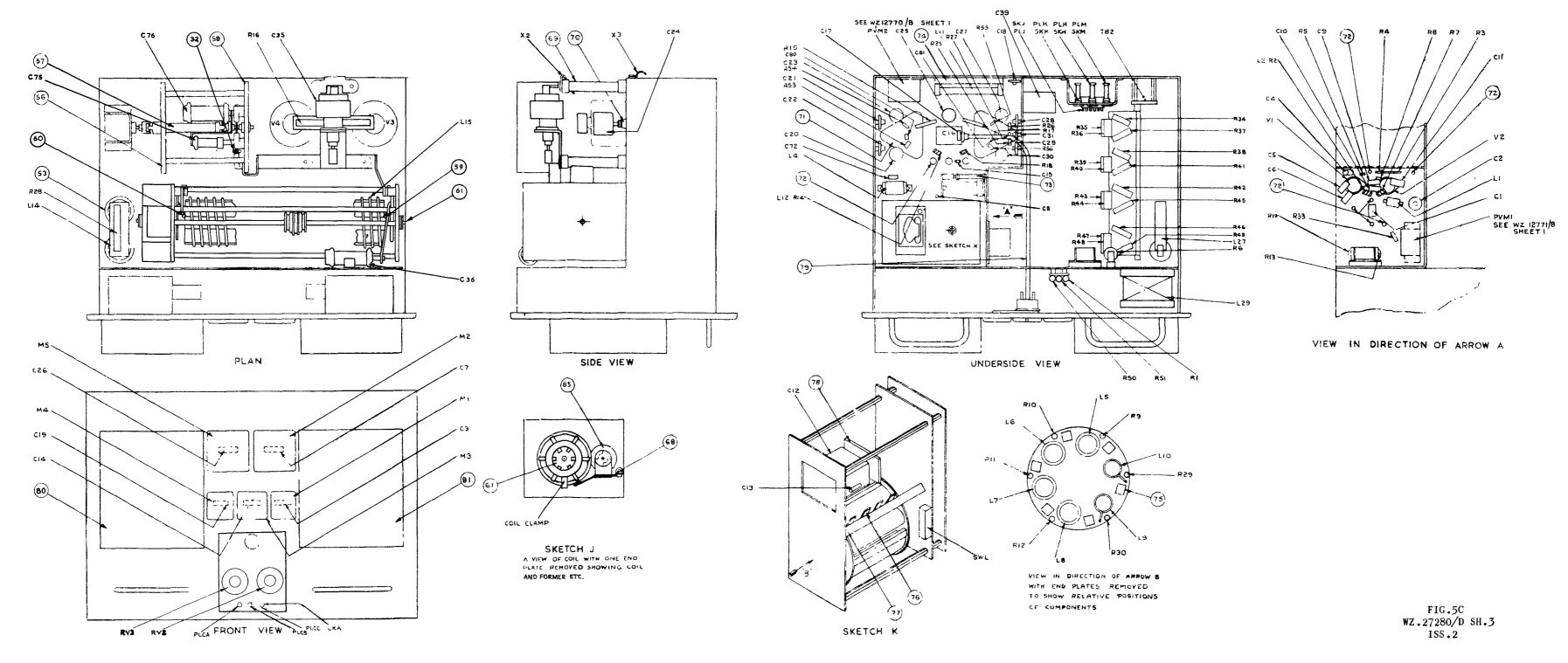


A.P.116E-0231-1 2nd Edn. Oct. '67

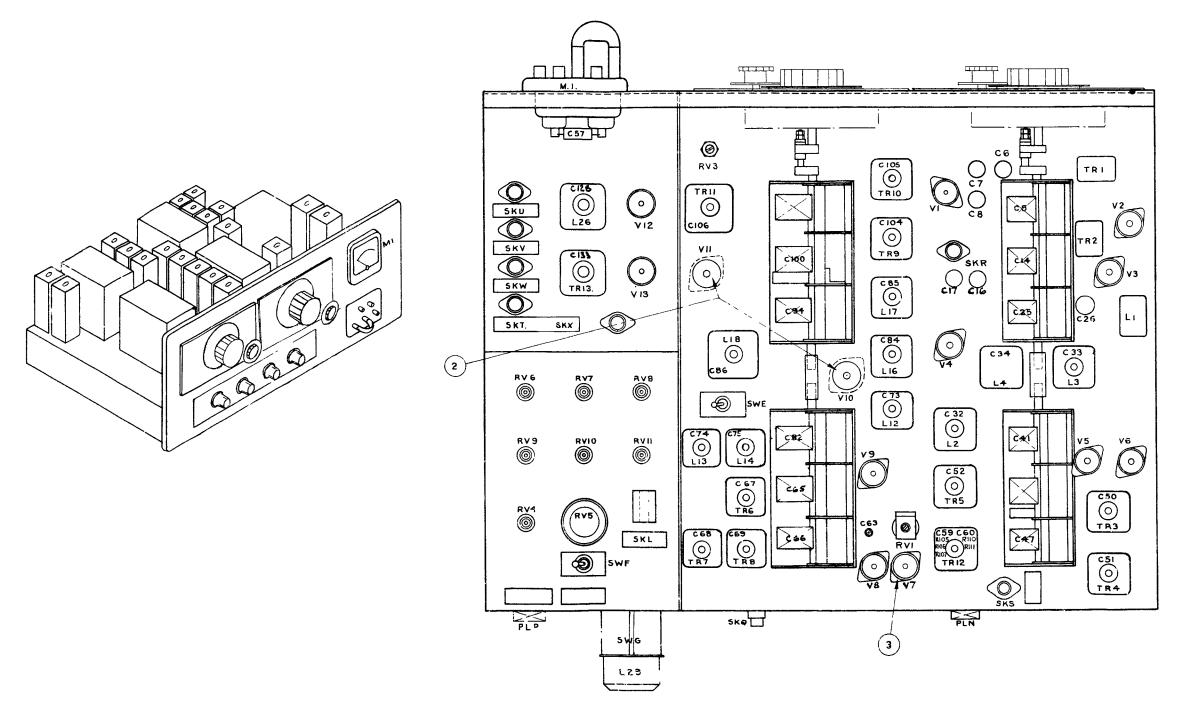
COMPONENT LAYOUT R.F. UNIT, PART 3 HS31A

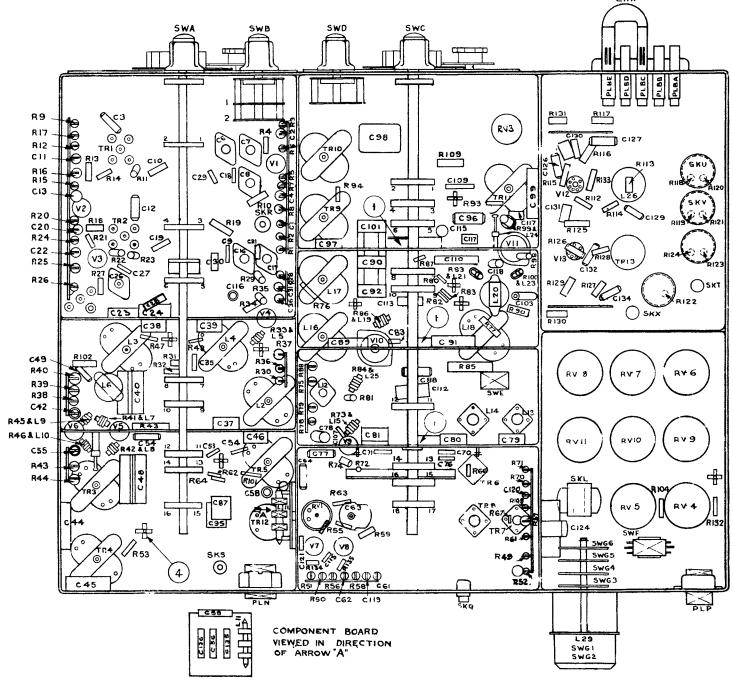


A.P.116E-0231-1 2nd Edn. Oct. '67 COMPONENT LAYOUT
R.F. UNIT, PART 3
HS31/1



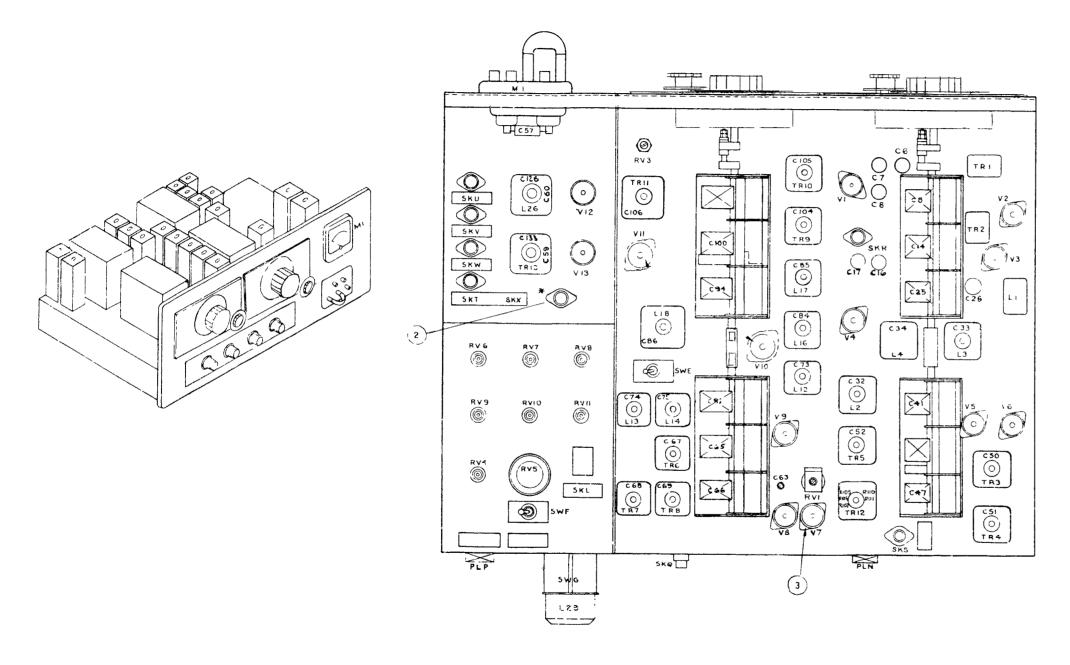
COMPONENT LAYOUT R.F. UNIT, PART 3 HS31A/1

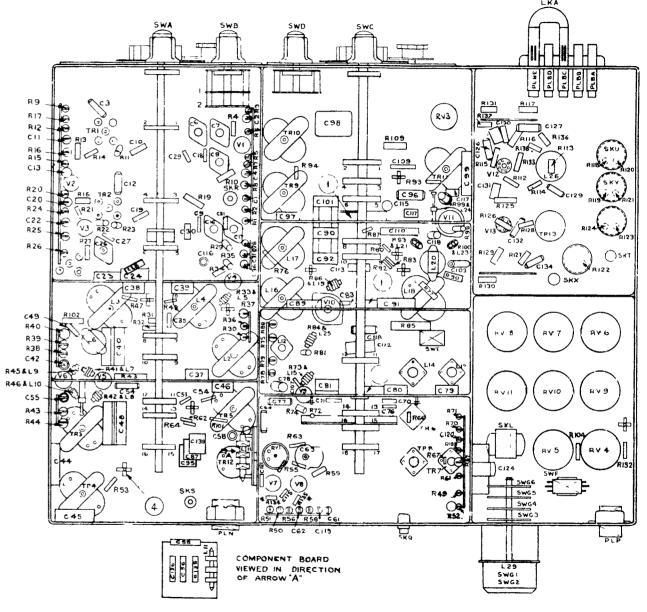




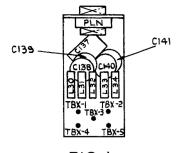
AP.2922D Vol.1 April 1965

COMPONENT LAYOUT
MIXER UNIT
WZ.17591/D Sh.1 Iss.2



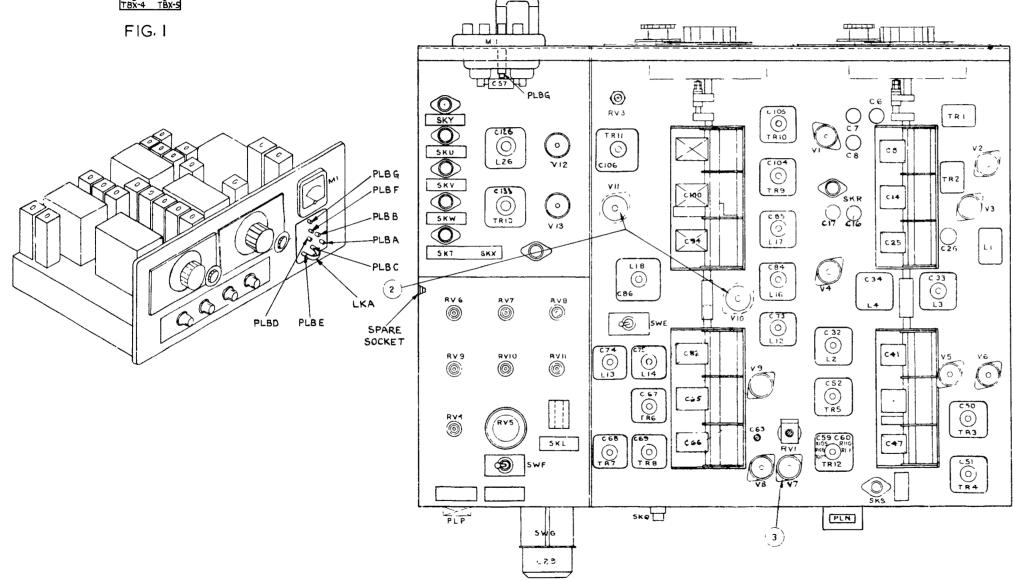


A.P.116E-0231-1 2nd Edn. Oct. '67



PLAN VIEW

UNDERSIDE VIEW



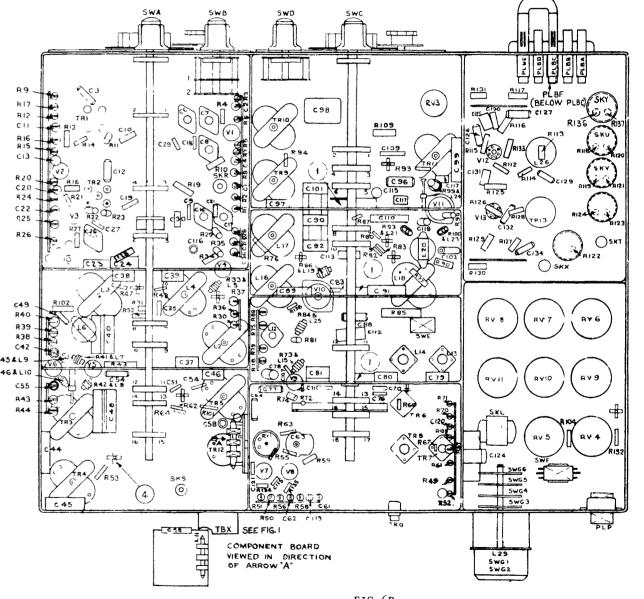
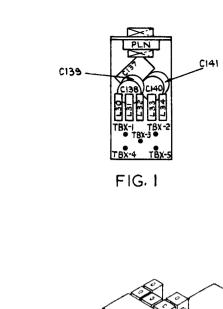
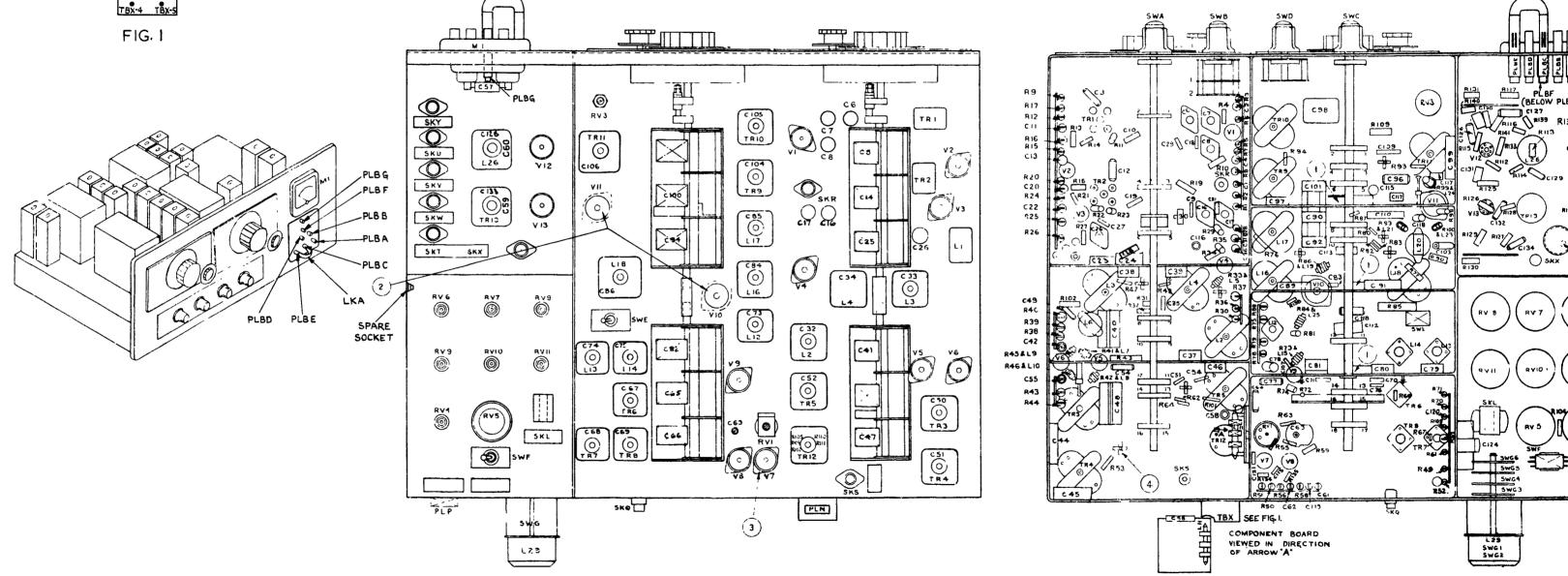


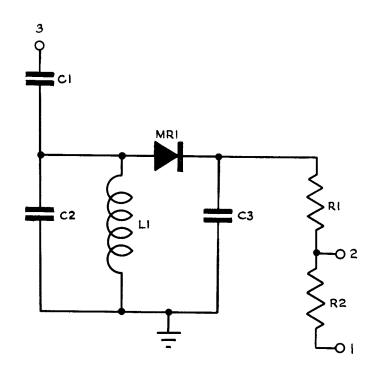
FIG.6B WZ.26512/D SH.1 ISS.1

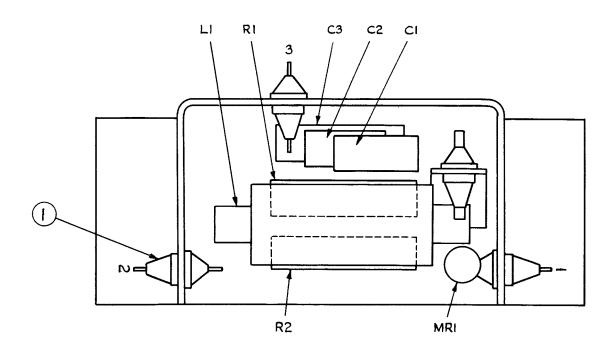


PLAN VIEW

UNDERSIDE VIEW



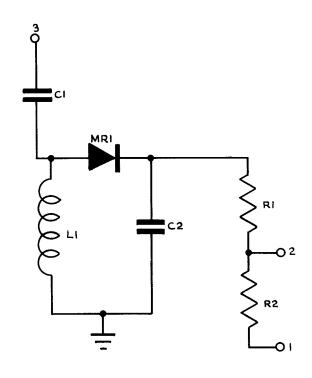


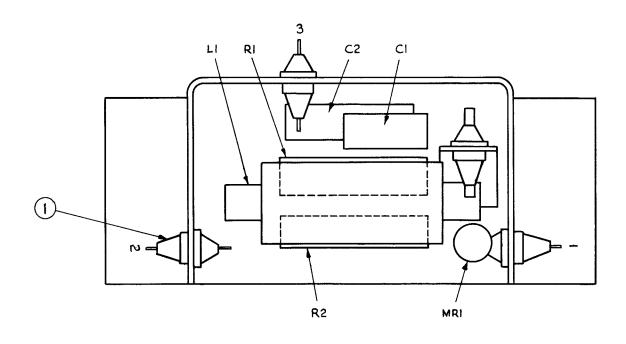


O- 250 VOLTS WHEN CONNECTED TO TERMINAL! & EARTH.

2D

CIRCUIT AND COMPONENT LAYOUT
PEAK VOLTMETER UNIT
WZ.12770/B Sh.1 Iss.1





RANGE 0-15 VOLTS WHEN CONNECTED TO TERMINAL I & EARTH O- 5 VOLTS WHEN CONNECTED TO TERMINAL 2 & EARTH.

AP.2922D Vol.1 April 1965 CIRCUIT AND COMPONENT LAYOUT PEAK VOLTMETER UNIT WZ.12771/B Sh.1 Iss.1

FIG. 9 BLOCK DIAGRAM

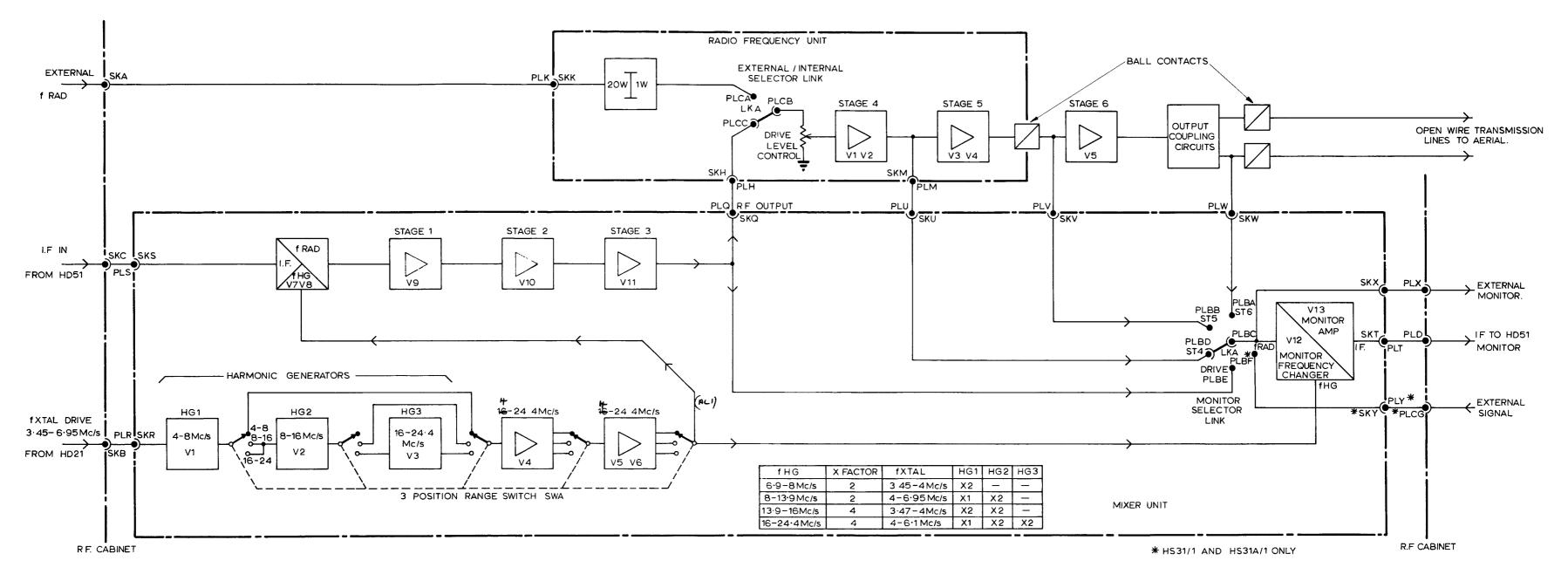
Changes arising from Modification 1312.

(Monitoring of Transmitter, Radio Type T.16719 when radiating on frequencies between 2.5 and 20 Mc/s).

The modification applies only to Transmitter, Radio, Type 16179 (HS31A) in the HS.31 series, and involves the use of an I.F. of 3.1 Mc/s throughout the fRAD range.

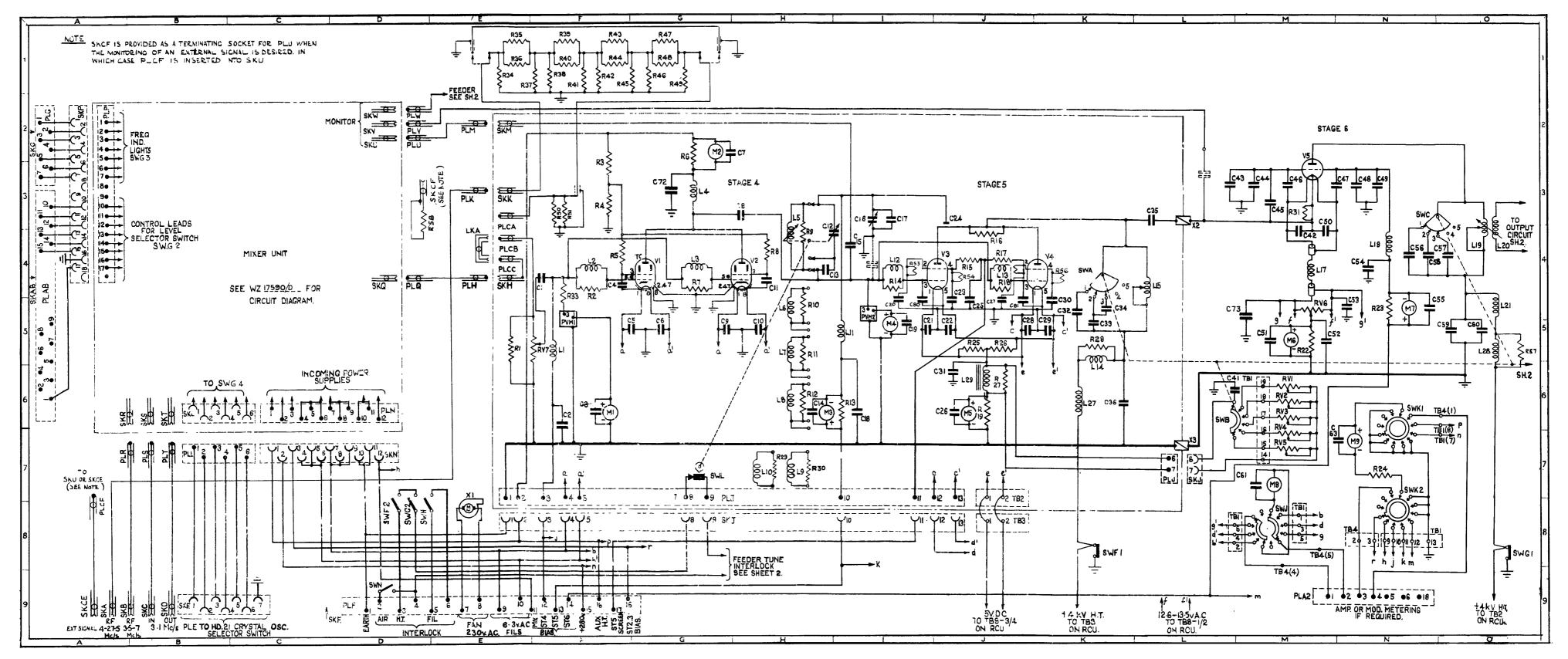
The fxtal/fHG conversion table on Fig. 9 applies to HS.31 and HS.31/1 (fRAD 4 - 27.5 Mc/s) when using an I.F. of 3.1 Mc/s. The conversion table relating to HS.31A when using an I.F. of 3.1 Mc/s to permit the use of Monitor, R.F., Type 10160 (Marconi HD.24) under Modification 1312 is given below. The fxtal DRIVE input to SKB will then range from 3.2 to 6.55 Mc/s.

Trans	mitter, I	Radio, Type	T.16719	(HS.3lA)	Using 3.1 N	ſc/s I.	F.	•
fRAD (Mc/s)	fRAD switch (SWC) setting	fHG (Mc/s)	Mult. Factor	fHG switch (SWA) setting	fxtal (Mc/s)	HG .1 (V1)	HG.2 (V2)	HG.3 (V3)
2.5-2.9	. r r	5.6-6.0	1	4 - 8	5.6-6.0	Amp.	_	
3.3-4.9 4.9-5.0	2.5-5	6.4-8.0 8.0-8.1	2		3.2-4.0 4.0-4.05	X2	x 2	-
5.0-10.0	5-10	8.1-13.1	2	8 - 16	4.05-6.55	Amp.	X 2	-
10.0-19.1	10-20	13.1-16.0	4		3 . 275 - 4 . 0	X 2	X 2	
19.1-20.0		16.0-16.9	4	16 - 24.4	4.0-4.225	Amp.	X 2	X 2



A.P.116E-0231-1 2nd Edn. Oct. '67 BLOCK DIAGRAM R.F. CABINET HS31 SERIES

FIG.9 WZ.31711/D SH.1 ISS.1

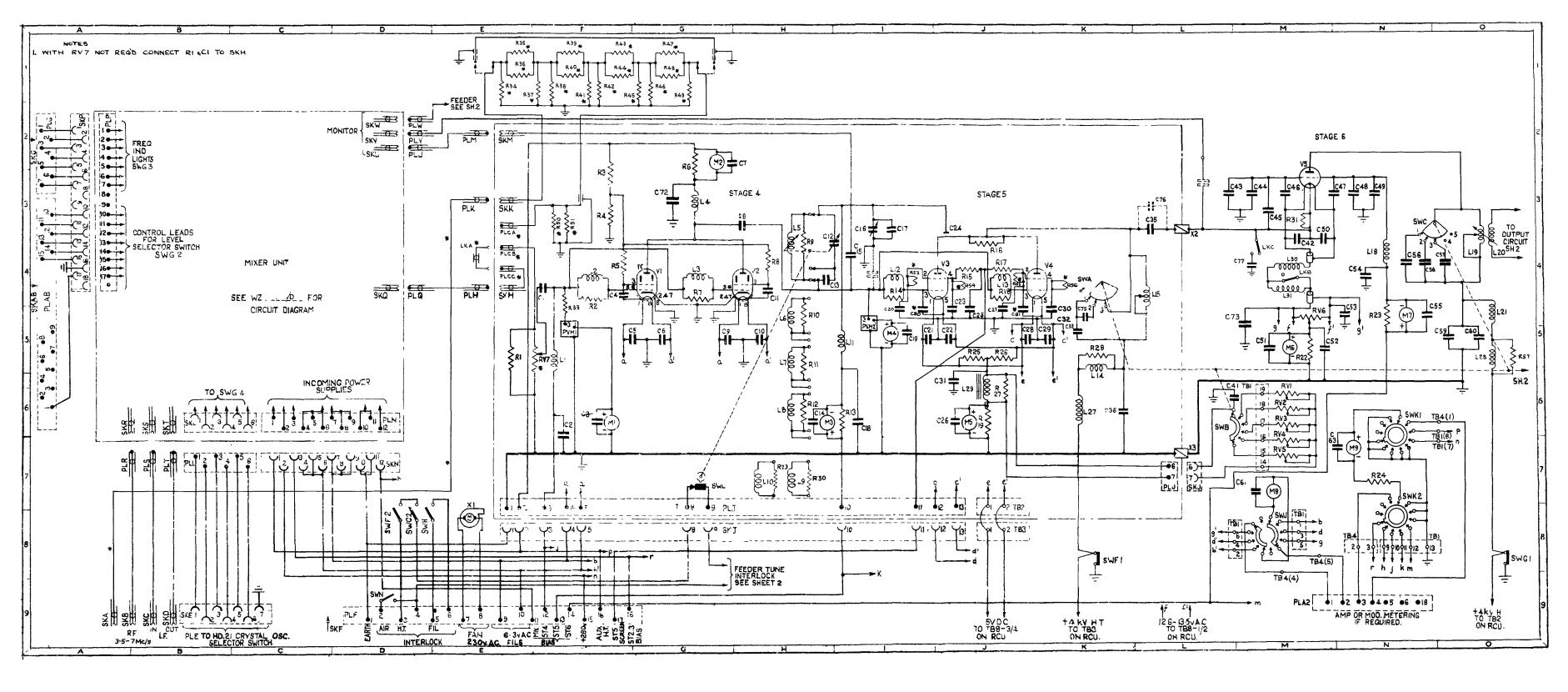


AP.2922D Vol.1 April 1965 CIRCUIT
RADIO FREQUENCY UNIT, SHEET 1
WZ.17588/D Sh.1 Iss.7

R.F. UNIT 3.5kW ISB TRANSMITTER TYPE HS.31A WQ.12610 Sh.1-6 Ed.A W.37907 Sh.9 Ed.C

Oross Reference List for MZ.1736A/D Sh.1

		326 725 828	ZMAB ZMAB ZMAY	243 243	857 856	225 225 225 225 225 225	818 R22 R23 R23 R24		PLV PLA PLA PLA PLA	8£ I	IKC IKB IK Y			13 23 23 25 21	035 035 031 031
207 907 907	XZ XS X3	308	ZKYS ZKYB ZKL ZKU ZKU	242 242 213 213 213	BEST BEST BEST BEST BEST BEST BEST BEST	223 224 224 223	RIS RIS RIS RIS RIS RIS RIS RIS	08T 6LT 9LT 9LT 9LT	PLQ PLS PLS PLS	ITI OTT	130 120 128 128 128	27 17 72 07 08	575 675 677 680 180	13 13 13 13	029 026 026 026 026
268 768 768 768 768	77 78 78 79	303 303	ZKK ZK1 ZKH ZKG ZKL ZKL	238 239 239 240 240	847 845 845 845 845 845	218 217 219 219 219 219	78 88 89 810 811 811	271 671 671 871 471	bľk bľh bľh	105 1048 1048 1048	IZI DZI	33 34 34 14 38	220 290 290 690 690 690	13 13 14 17 17	CSS CSI CSO CSO CIO
97£ 87£ 87£ 95£	TBI TB2 TB3 TB4	562 562	ZKD ZKC	235 236 236 237 237 237	R38 R40 R40 R40 R42 R42	213 214 215 217 217	RZ RS R4 R5 R5	0/1 0/1 691	PLA PLC PLC PLC	001	177 173 171 171 170 170	13 14 14 31 32	055 055 055 055 055 055 055	16 18 18 19 19 19	C12 C15 C17 C17 C17
155 155 955 955 755	SMI SMI SMY SMH SMH	290 290	EVS EV3 EV2	220 232 232 234 234 234 234	#36 #35 #31 #31 #30 #36 #36 #36		baws bawi	152 151 150 140 140 140 140 140 140 140	5m 5m 5m 7m 7m 6m	95 93 93 93 93 93 93 93 93 93 93 93 93 93	22 23 24 25 26 27 28	28 29 27 27 27 27 28	020 020 040 045 045 045 045	カロ カロ カロ タロ カロ カロ	110 010 60 80 40 90 90
055 155 255	Fet.	•0N	•1•я	.08 229 230 230	Ref. R25 R26 R27 R27 R28	184	Ref. PLCB PLCC	97T 57T	Ref. MI	98 ••n	Ref.	.ov 26 13 27 27	8ef. C42 C41	.ov 12 14 14	Ref. G2 G2 G3



CIRCUIT DIAGRAM R.F. UNIT, PART 1 HS31A

(Refer to Master Components List T5553)

Cross Reference Lize (Fig. 10&11)

T•5553

Page l of 3 Issue 3

R.F. UNT

(Refer to Master Com, onents List T5553)

Cross Reference List for WZ.26509/D Sh.1&2 (Fig.10&11)

MISCELLANEOUS MECHANICAL ITEMS

Ref. 1	Insulator Ceramic	No.198
Ref. 2	Air Filter	No.119
Ref. 3		
Ref. 4	Mounting Board Mycalex	No.236
Ref. 5	Mounting Board Mycalex	No.237
Ref. 6	Insulator .	No.199
Ref. 7		
Ref. 8		
Ref. 9		
Ref.10		
Ref.11	Coil Mounting Plate Mycalex	No.238
Ref.12	Top Panel Mycalex	No.251
R∈f•13	Contact Mounting Mycalex	No.239
Ref.14	End Cheek Mycalex	No. 81
Ref.15	Contact Mounting Mycalex	No.240
Ref.16	Rctor Mounting Mycalex	No.241
Ref.17	Contact Assembly	No. 87
Ref.18	Contact Assembly	No. 88
Ref.19		
Ref.20	Spring Contact	No. 89
Ref.21	Stand-Off Insulator	No.200
Ref.22	Mounting Board Mycalex	No.242
Ref.23	Spring Contact	No. 90
Ref.24	Grid Contact Spring	No. 91
Ref.25	Stand-Off Insulator	No.201
Ref:26	Ball Contact Assembly	No. 88
Ref.27	Spring	No.419
Ref.28	Switch Blade Assembly	No.472
R∈f•29	Contact Panel Mycalex	No.252
Ref.30	Insulating Pillar	No.202
Ref.3l	Mounting Plate Mycalex	No.243
Ref.32	Ball Contact Assembly	No. 93
Ref.33	End Plate Mycalex	No.257
Ref.34	Bearing Plate Mycalex	No.254
Ref.35	Spring Contact Assembly	No. 94
Ref.36	End Plate Mycalex	No.255
Ref.37	Spring Contact Assembly	No. 95
Ref.38	Spring Contact Assembly	No. 96
Ref.39		
Ref.40	Spring Contact Assembly	No. 97
Ref.41	Spring Flat	No.420
Ref.42	Coupling Coil Mounting Plate Mycalex	No.244
Ref•43	Spring Contact Assembly	No. 98
Ref•44	Spring Contact Assembly	No. 99
Ref.45	Spring Contact	No.100

R.F. UNIT

(Refer to Master Components List T5553)

Cross Reference List

for WZ.26509/D Sh.1&2 (Fig.10&11)

MISCELLANEOUS MECHANICAL ITEMS CON LD:

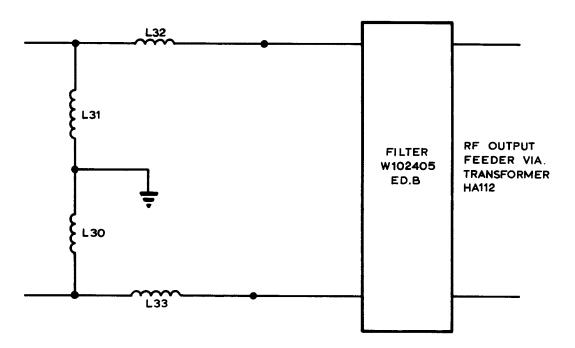
Ref.46	Spindle Assembly	No.424
Ref.47	Coil Support Mycalex	No.430
Ref.48	Coil Support Mycalex	No.431
Ref.49	Coil Support Mycalex	No.432
Ref.50	Coil Support Mycalex	No.433
Ref.51	Coil Support Mycalex	No.434
Ref.52	Coil Support Mycalex	No.435
Ref.53	Insulator Conical Porcelain	No.199
Ref. 54	Insulating Piece Mycalex	No.203
Ref.55	Mounting Board Mycalex	No.245
Ref.56	Support Plate Mycalex	Nc.256
Ref.57	Coupling Bar Mycalex	No.116
Ref.58	Mounting Plate Mycalex	No.246
Ref.59	Mounting Board Mycalex	No.247
Ref.60	Spring Assembly	No.421
Ref.61	Shaft Assembly	No.403
Ref.62	Former Mycalex	No.127
Ref.63	Former Mycalex	No.128
Ref.64	Former Mycalex	No.129
Ref.65	Former Mycalex	No.130
Ref.66	Former Mycalex	No.131
Ref.67	Former Mycalex	No.132
Ref.68	Contact Assembly	No.101
Ref.69	Insulating Rod	No.204
Ref.70	. Conical Insulator	No.205
Ref.71	Valveholder Ceramic 5 Pin	No.530
Ref.72	Insulator Stand-Off	No.201
Ref.73	Insulator Stand-Off	No.207
Ref.74	Base Mycalex	No. 1
Ref.75	Terminal Block Mycalex	No.487
Ref.76	Spring Contact	No.102
Ref.7.7	Spring Contact Plate Mycalex	No.259
Ref.78	Condenser Plate Mycalex	No.258
Ref.79	Flexible Drive Assembly	No.118
Ref.80	Manual Drive Assembly	No.119
Ref.81	Manual Drive Assembly	No.120
Ref.82	Manual Drive Assembly	No.121
Ref.83		
Ref.84	Spring Contact Assembly	No.103
Ref.85	Spring	No.422
Ref.86	Contact Mounting Mycalex	No.248
Ref.87	Contact Assembly	No. 88
Ref.88	End Cheek Mycalex	Nc. 82
Ref.89	Contact Assembly	No.105
Ref.90	Coupling Mycalex	No.115
		_

NOTE: The preceding Cross Reference List for T5553 identified 'for WZ.26509/D Sh.1 & 2 (Figs.10 & 11)' applies only to Fig.10B (WZ.26509/D Sh.1) following for identities of components in Fig.11 (WZ.17588/D Sh.2) refer to Components List No.1, R.F. Unit.

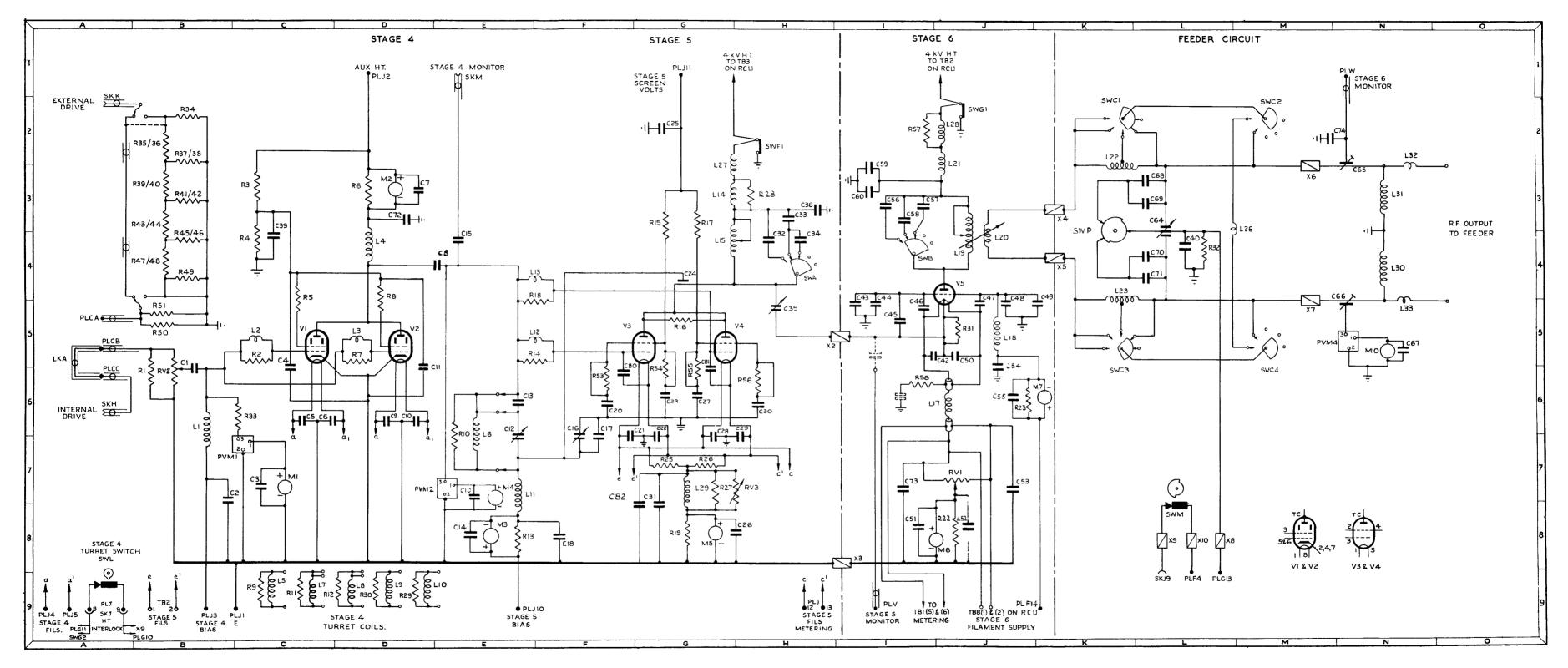
6**E-**02**31-1** n. 67 (To prec Fig.10B

R.F. Unit of Transmitter HS31/1 (WZ.26509/D Sh.1)

Modification No.1785



Modification No.1785 entails the provision of Filter Type W.10240! Ed.B at the output of HS31/l when 50 ohms output impedance is provided by Transformer Type HA112.



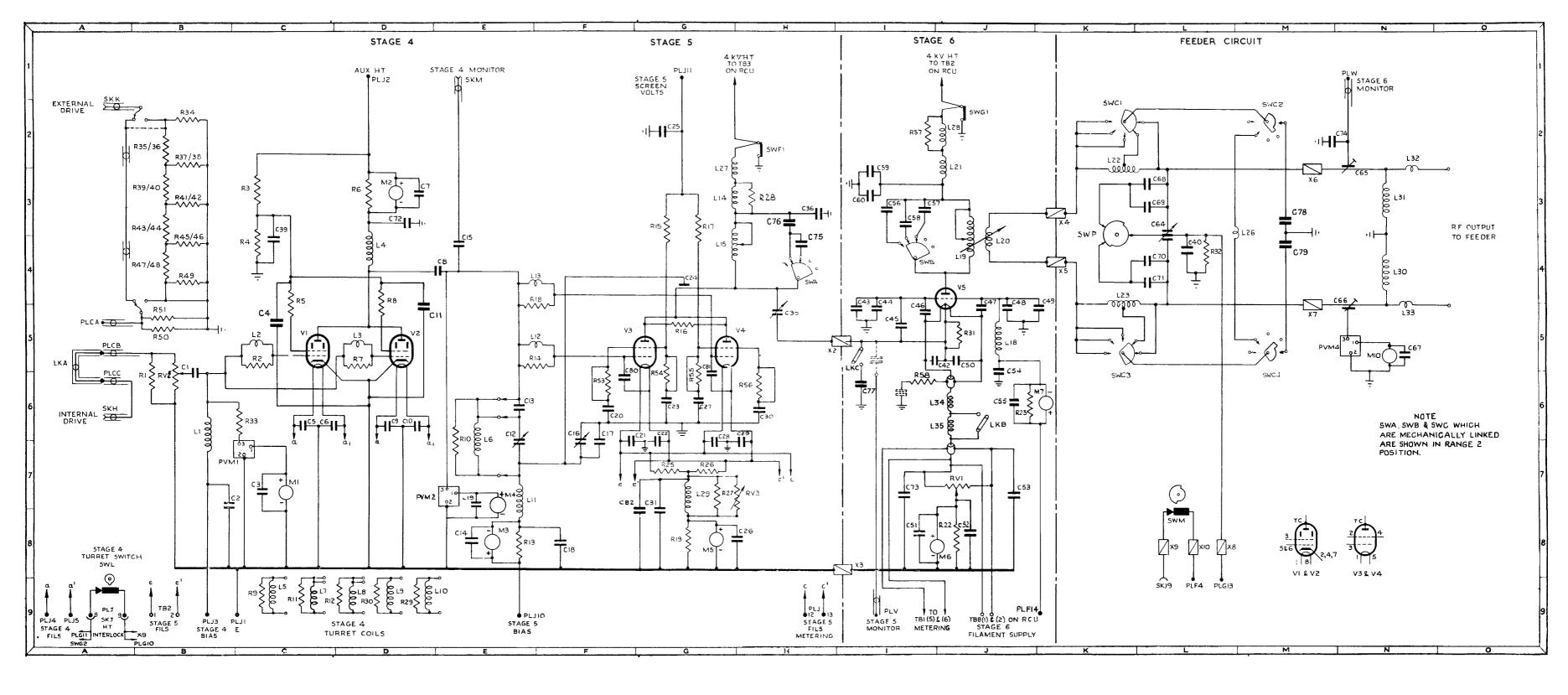
CIRCUIT DIAGRAM R.F. UNIT, PART 1 HS31A

R.F. Unit of Transmitter HS31A/1 (WZ.27279/D Sh.1)

Modification No.1784

L30, L31, L32 and L33 are replaced by R.F. Filter Type W.102405 Ed.C when 50 ohms output impedance is provided by the use of Wideband Transformer Type HAll2.

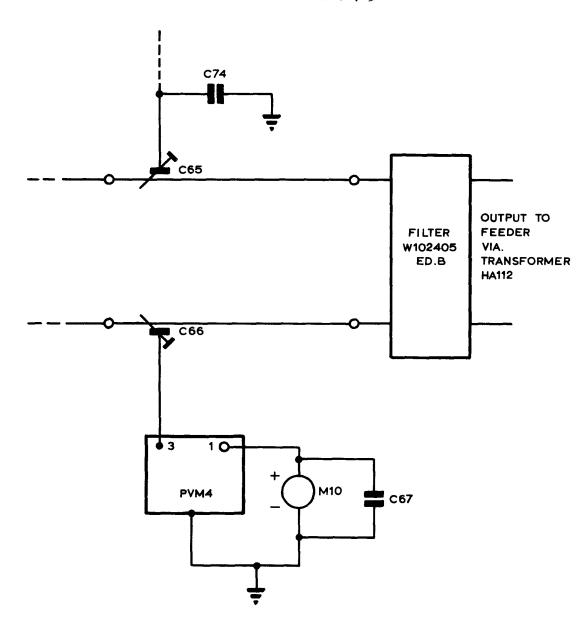
A.P.116E-0231-1 2nd Edition A.L.4, June 1970 Fig.10C(a)



CIRCUIT DIAGRAM
R.F. UNIT PART 1 (INCLUDING OUTPUT CIRCUIT)
HS 31A

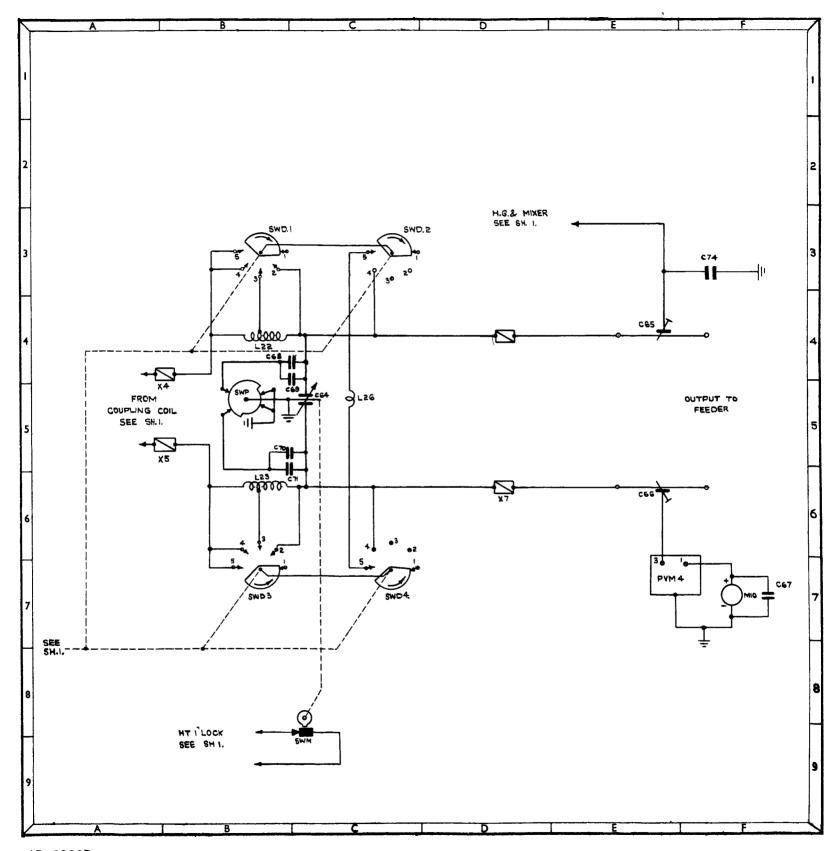
R.F. Unit of Transmitter HS31 (WZ.17588/D Sh.2)

Modification No.1785



Modification No.1785 entails the provision of Filter Type W.102405 Ed.B at the output of Transmitter HS31 when 50 ohms output impedance is provided by Transformer Type HA112.

A.P.116E-0231-1 2nd Edition A.L.4, June 1970 Fig.ll(a)



AP.2922D Vol.1 April 1965

CIRCUIT
RADIO FREQUENCY UNIT, SHEET 2
WZ.17588/D Sh.2 Iss.3

R.F. UNIT 3.5kW ISB TRANSMITTER TYPE HS.31A WQ.12610 Sh.1-6 Ed.A W.37907 Sh.9 Ed.C

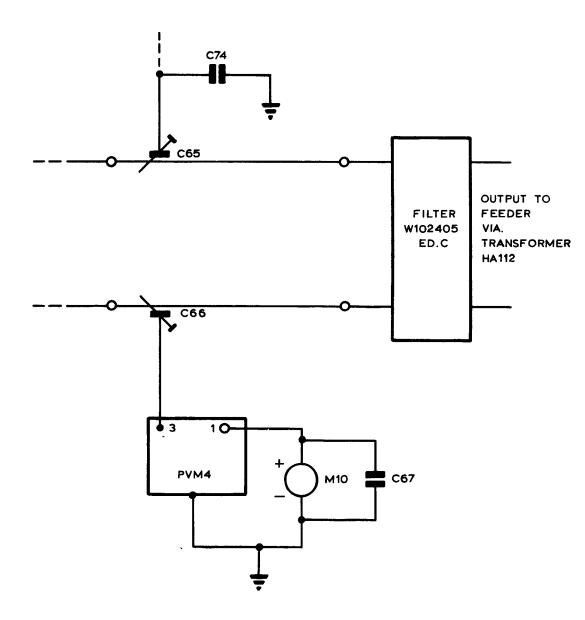
Cross Reference List for WZ.17364/D Sh.2

Ref.	No.	Ref.	No.	Ref.	No.	Ref.	No.	Ref.	No.	Ref.	No.	Ref.	No.	Ref.	No.
C64 C65	35 36	C69 C70	37 37	C 79	42	L23 L26	107	м10	154				100	Х7	409
C66 C67 C68	36 14 37	C71 C74 C78	37 39 42	L22	106	L32 L33		PVM4	157	SWID SWIP	329 331 35		408 408 409		
	-										37		707		
									:		l				

NOTE: SWP is part of C64. See Item 427

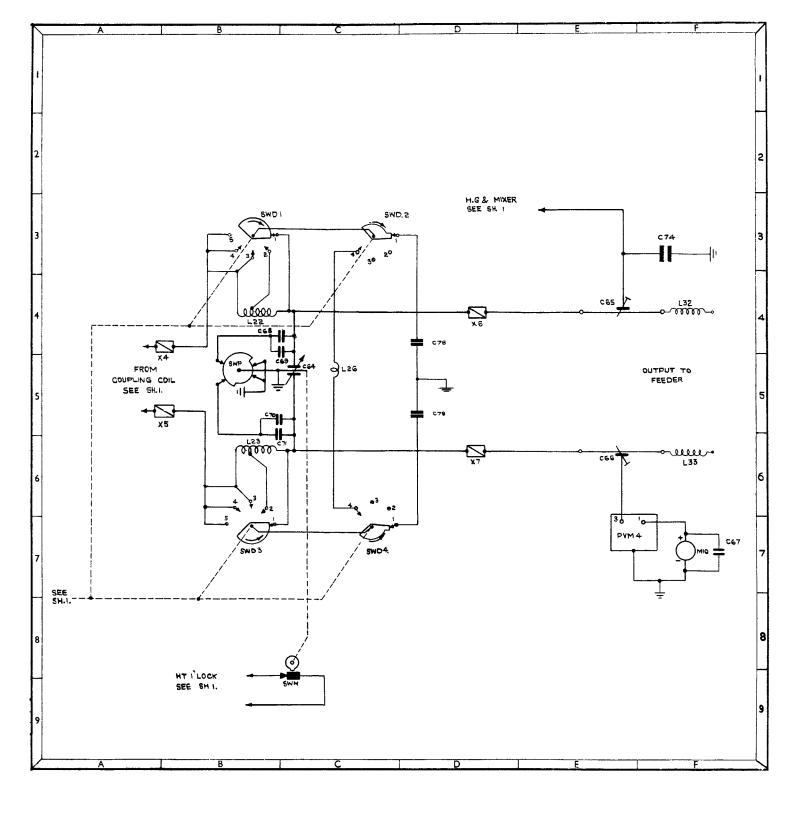
Circuit Diagram R.F. Unit HS31A (WZ.17364/D Sh.2)

Modification No.1784

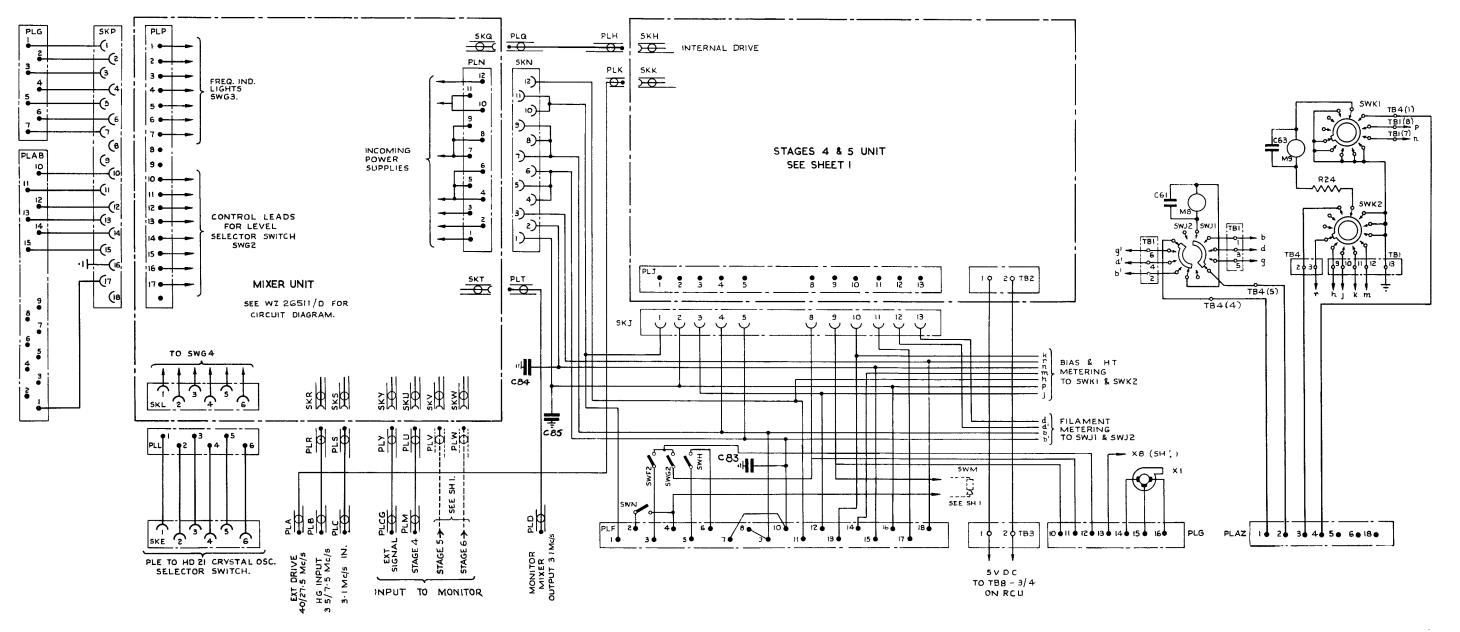


Filter W.102405 Ed.C replaces L32 and L33 when 50 ohms output impedance is provided in Transmitter HS31A using Transformer Type HA11:

Fig.llA(a)

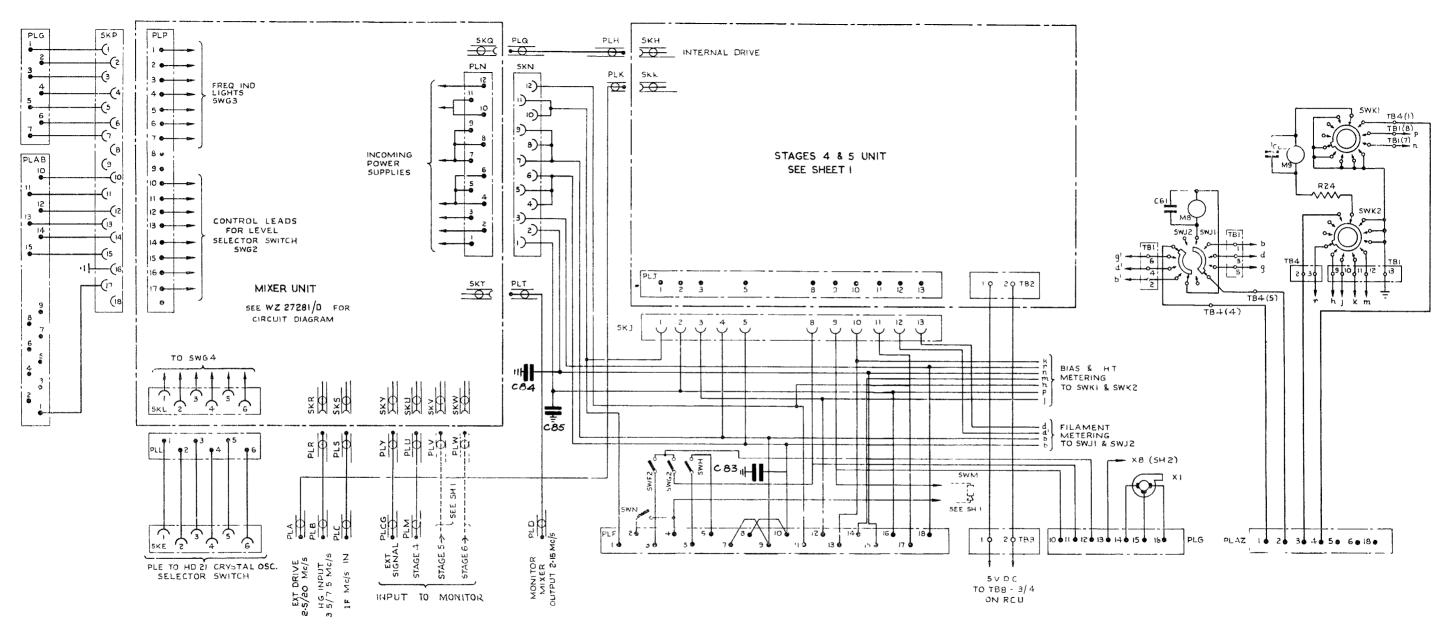


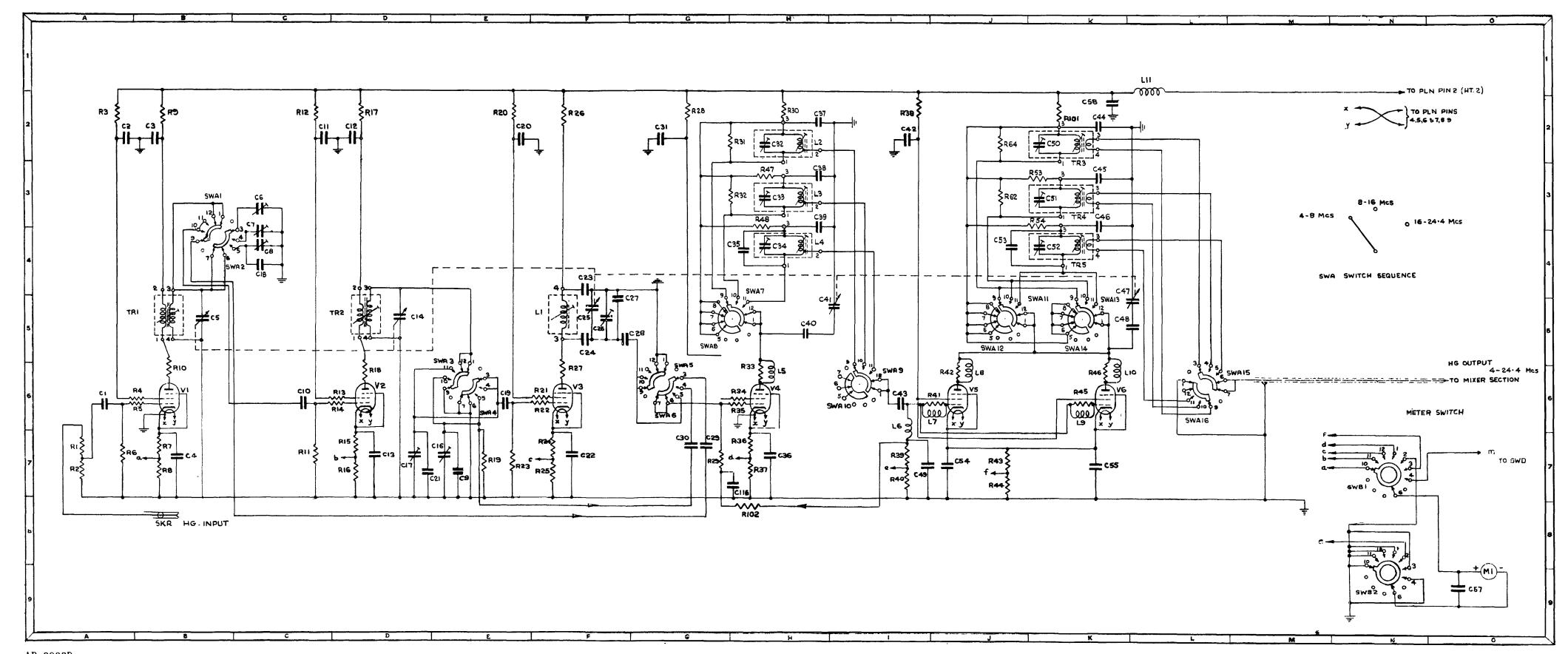
CIRCUIT DIAGRAM
R.F. UNIT, PART 2 (OUTPUT CIRCUIT)
HS31A



.P.116E-0231-1 d Edn. Oct. 167

INTER-UNIT CONNECTIONS
R.F. UNIT
HS31/1





AP.2922D Vol.1 April 1965

CIRCUIT MIXER UNIT, SHEET 1 WZ.17590/D Sh.1 Iss.1

MIXER UNIT HS.31A W.37920 Sh.7-9 Ed.D WQ.12610 Sh.7 Ed.A

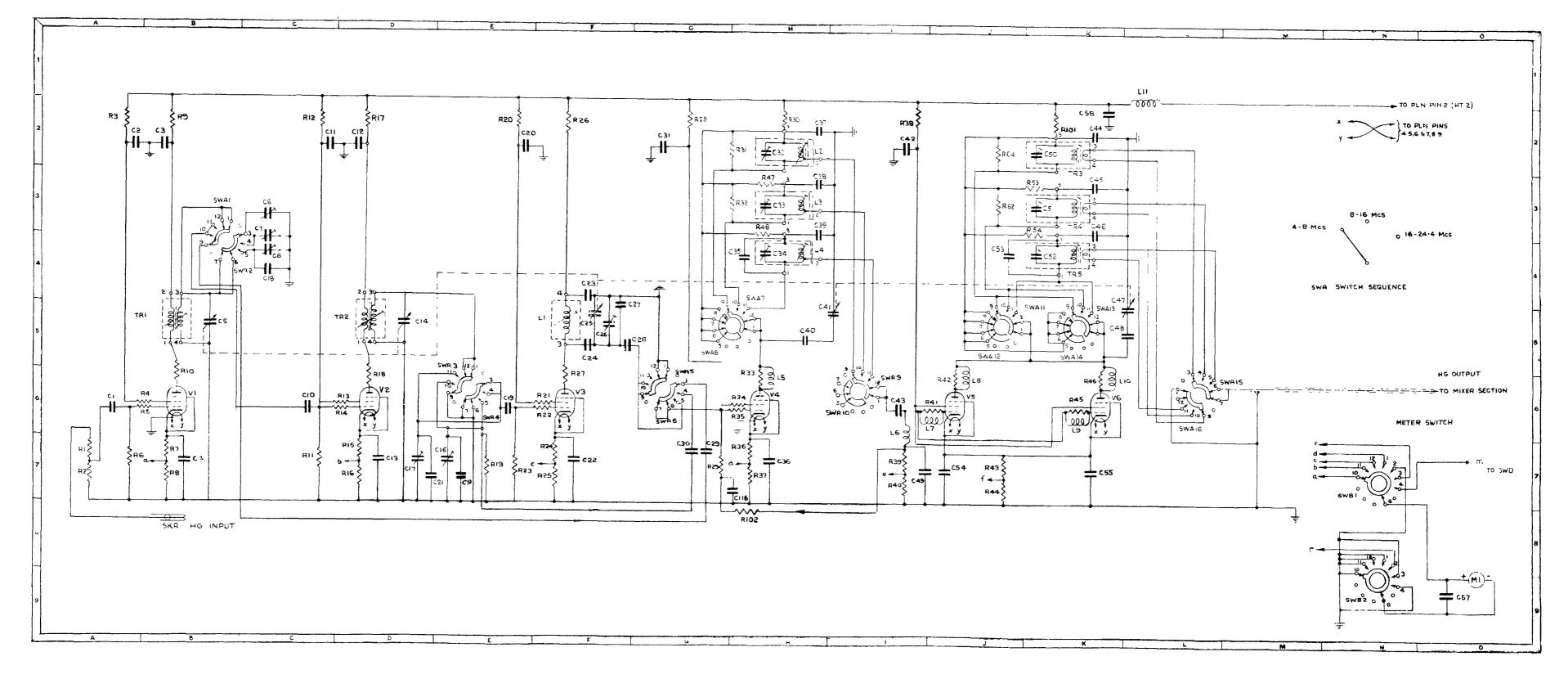
Cross Reference List for WZ.24354/D Sh.1

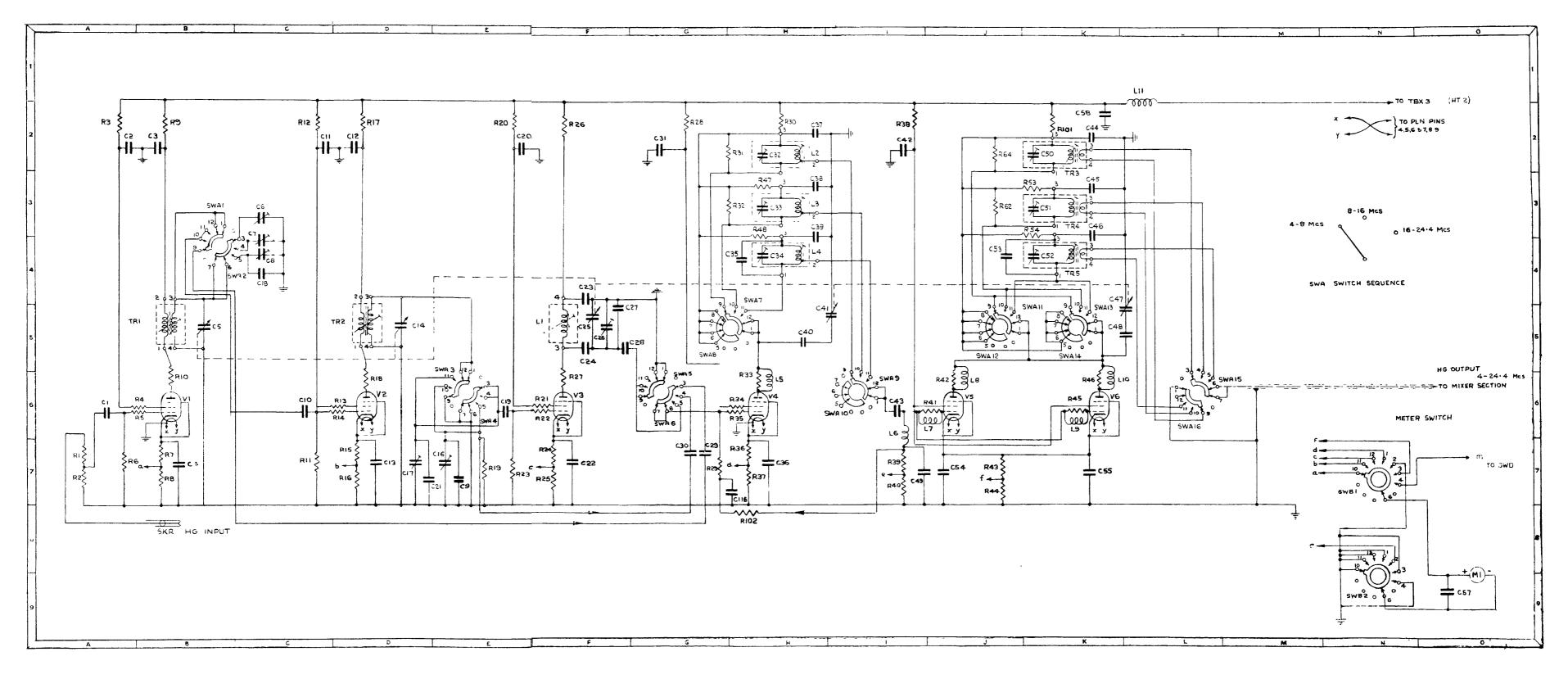
Ref.	No.	Ref.	No.	Ref.	No.	Ref.	No.	Ref.	No.	Ref.	No.	Ref.	No.	Ref.	No.
C1 C2 C3 C4 C5 C6 C7 C8 C9 C10 C12 C13 C14 C16 C17 C18 C20 C21 C22	44 45	C23 C24 C25 C26 C27 C28 C29 C30 C31 C32 C33 C34 C35 C36 C37 C38 C40 C41 C42 C43	<u>: </u>	C44 C45 C46 C47 C48 C50 C51 C52 C53 C54 C55 C116	51 51 51 51 51 51 51 51 51 51 51 51 51 5	L1 L2 L3 L4 L5 L6 L7	114 115 116 117 118 119 118 118 118 120 155 246 247 248	R4 R5 R6 R7 R8 R9 R10 R11 R12 R13 R14 R15 R16 R17 R18 R20 R21 R22 R23 R24	242 249 250 251 249 251 249 251 249 251 249 251 249 251 249 251 249 251 249 251 249 251 249 251 249 251 249 251 251 251 251 251 251 251 251 251 251	R25 R26 R27 R28 R29 R30 R31 R32 R33 R34 R35 R36 R37 R38 R40 R41 R42 R43 R44	251 252 254 2554 2554 2556 242 2551 2552 2551 2552 2552 2552 2552	R46 R47 R48 R53 R54 R62 R64 R101 R102	242 260 260 260 260 256 263 255	TR1 TR2 TR3 TR4 TR5 V1 V2 V3 V4 V5 V6	372 373 374 375 376 396 396 396 396

MISCELLANEOUS MECHANICAL ITEMS

Ref.1	Spring Contact	No.479
Ref.3	Valveholder for V1-V6	No.505
Ref.4	Insulator (Stand-Off)	No.448

T.4260 1736 CP





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		395	RISI	575	RIIS	295		TSE		TSE		098		555	ГТЯ
			8130 B130					TSE		362		TSE		798	BI6
			RI28					995		2 9 2		TSE		555	STA
			FIST					895		795		625	25.A	TSE	BIT BIS
			RI26				888			792		355		095	RIS
		252	BISS	TLE	B106	695	78 A		89A	595		855		252	EII
			RISt					355		362		252	82A	TSE	BT0
			RILS					698		362		555		555	6A
			RISI		B103			555		TSE		TSE		798	8A
			RISO					99£	१९३	TSE		999 799		2 5 2	Z.A.
185	85 LA	177	811A	155	RIOO	955		698		098		525	BS4		98 85
878	75 LA	225	RI18	SSI		298		598		TSE		252	RZZ		₽£ 18¢
			LITA			755	62 ਸ਼		B60	TSE	בלים		•	095	FF
TSE	RISS	555	PIT8			099		TSE		795		TSE		6475	ZÆ
[75	.ሌ ГЯ	698	SILA		968	295	77.7	TSE	82 <i>R</i>	555	65 ਸ਼	095	RZO	875	ТЯ
		27	כדלס	89	CISO	27	CTOO	59	080	25	090	55	C †0	27	0 Z0
		27	6£10		6110		660		640		695	23	650	τŚ	6T3
		27	8510		CII8		860		870		850	23	850	25	CT8
		TL	7510		LTTO	1	۷60	27	770	147	250	55	750		Žτο
			9510		9110	74	960	29	940		990	17	950	67	9T0
		27	92T0 92T0	129	פדד: סדדל	047	960	99	940		550	25	550		STO
		55	62 ES		STID	8.6	760 260	<u> </u>	570 570		790 290	99 99	750 250	27 27	CIT
		27	CISS	79	CIIS	53	260	ت بـ	272		250		250	27	CTO
		02	CTZT		CITI		T60	27	TZO		CET		TED	27	CII
		69	CTZO		CITO		060		020	95	090		020	τS	CIO
		27	CI29	99 -	6010		680	09	690			97	629	09	60
	:	<u>5</u> 5	CI28	(0	80T0	27	880	99	890		272	TS	820	67	80
		27 27	0725 2720		2010 9010	cc.	980 780	99	<u> </u>		270	25	720	67 C#2	70
		89	GZZS	55	SOLO		₹80 989	8† 8†	990 990	50	970 970	67 87	-	6†7 8†7	90 90
		<u> </u>	מזטנ		7010		785	27		53	כלל	ξ <u>ζ</u>		27 27	Ct
		,	CISS		CT03	27	ξ80	69		25		ξς		27	ξ0
<u> </u> _,	_,		CISS		CTOS	84	280	85	C6 S	۲۲	C75	247	CSS	۲۲	20
27	CITI	9	CISI	55	CTOT	53	C87	85	T90	87	מלד	55	CST	97	СТ
•on	.19A	•ON	Ref.	ON.	.1eA	•on	.19A	*ON	.19A	•on	.19A	•on	.19A	•oN	.19A

(Refer to Master Components List T5553) Cross Reference List T5553) for WZ.26511/D Sh.1&2 (Fig.12&13)

MIXER UNIT

(Refer to Master Components List T5553) Cross Reference List for WZ.26511/D Sh.1&2 (Fig.12&13)

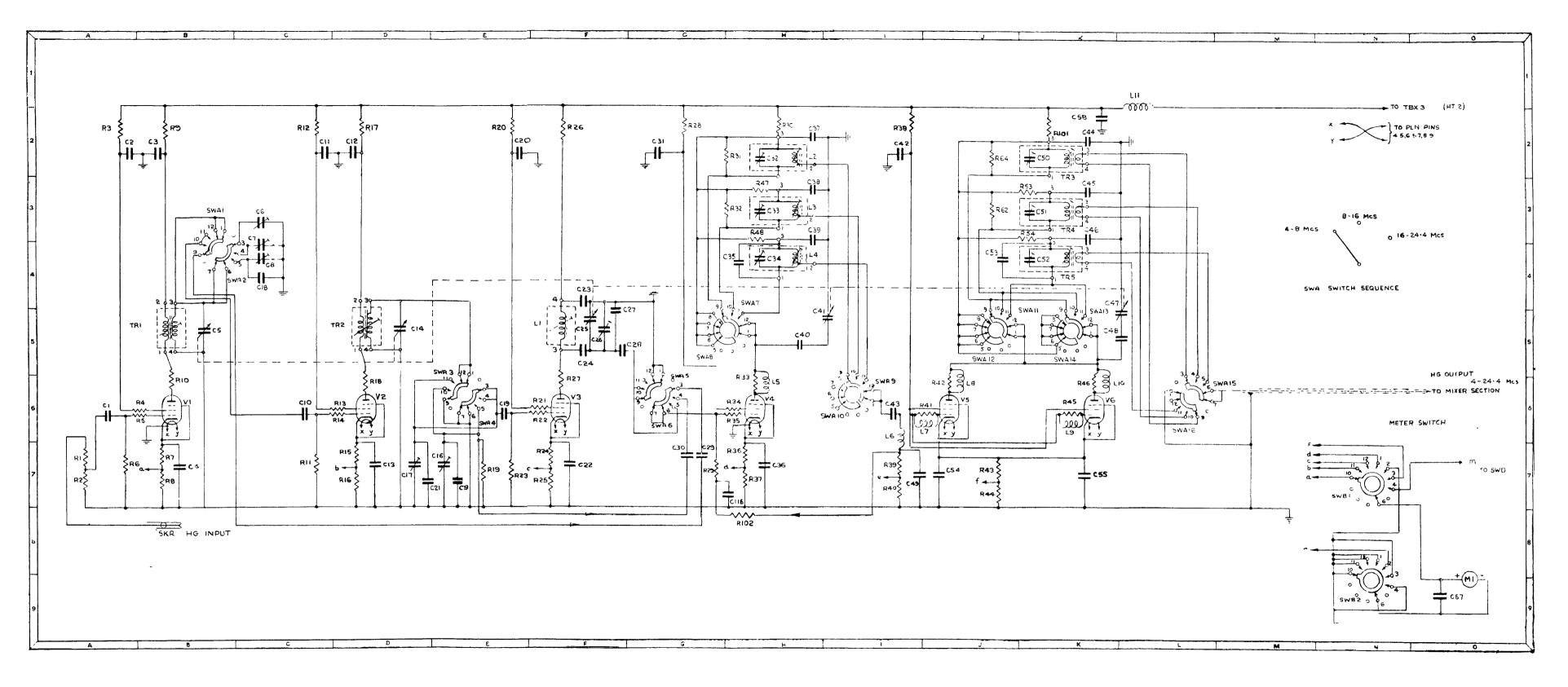
Ref.	No.	Ref.	No.	Ref.	No.	Ref.	No.	Ref.	No.	Ref.	No.	Ref.	No.	Ref.	No.
Ll	(177 (178	L15	182	L29	189	PLBB	263	RV6	397	SKX	405	TR3	502	V 3	520
L2	179		179	L30	190	PLBC	263	RV7	397	SKY	405	TR4	503	V4	520
L3	180	L17	180	L31	190	PLBD	263	RV8		SKZ	405	TR5	504		520
L4	181	L18	181	L32	190	PLBE	263	RV9	397			TR6	505	v 6	520
L5	182	L19	182	L33	190	PLBF	263	RV10	397	SWA	451	TR7	506	V 7	521
L 6	183	L20	183	L34	190	PLBG	263	RVll	397	SWB	452	TR 8	507	v 8	521
L7	182	L21				PLN				SWC	453	TR9	50 2	V 9	522
L8	182	L22				PLP	265	SKQ	405	SWD	454	TR10	503	VlO	522
L9	182	L23	182					SKR	405	SWE	455	TRll	508	Vll	523
LlO	182	L24	182	LKA	214	RVl	396	SKS	405	SWF	455	TR 12	509	V13	523
Lll	184	L25	182			RV2		SKT	405	SWG	456	TR13	510		
Ll2	185	L 26	188	Ml	230	RV3	397	SKU	405						
L13	18 6	L27				RV4	397	SKV	405	TRl	500	Vl	520	1	
L14	187	L28		PLBA	263	RV5	397	SKW	405	TR2	501	V 2	520		

MISCELLANEOUS MECHANICAL ITEMS

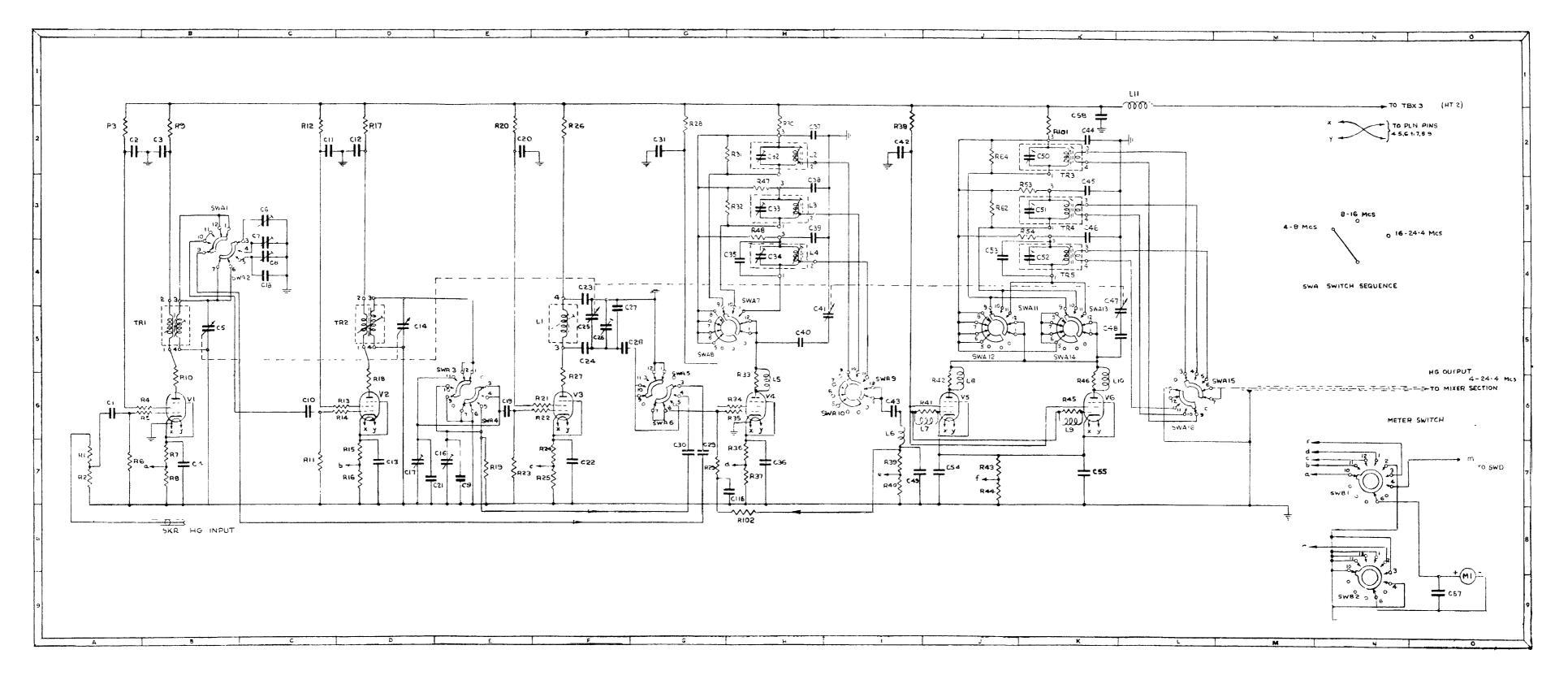
$\mathtt{Ref.l}$	Spring Contact	No. 86
Ref.2	Valveholder B8G for V10 & V11	No.526
Ref.3	Valveholder B7G with Skirt for	No.527
	V1 to V9, V12 & V13	
Ref.4	Insulator	No.208

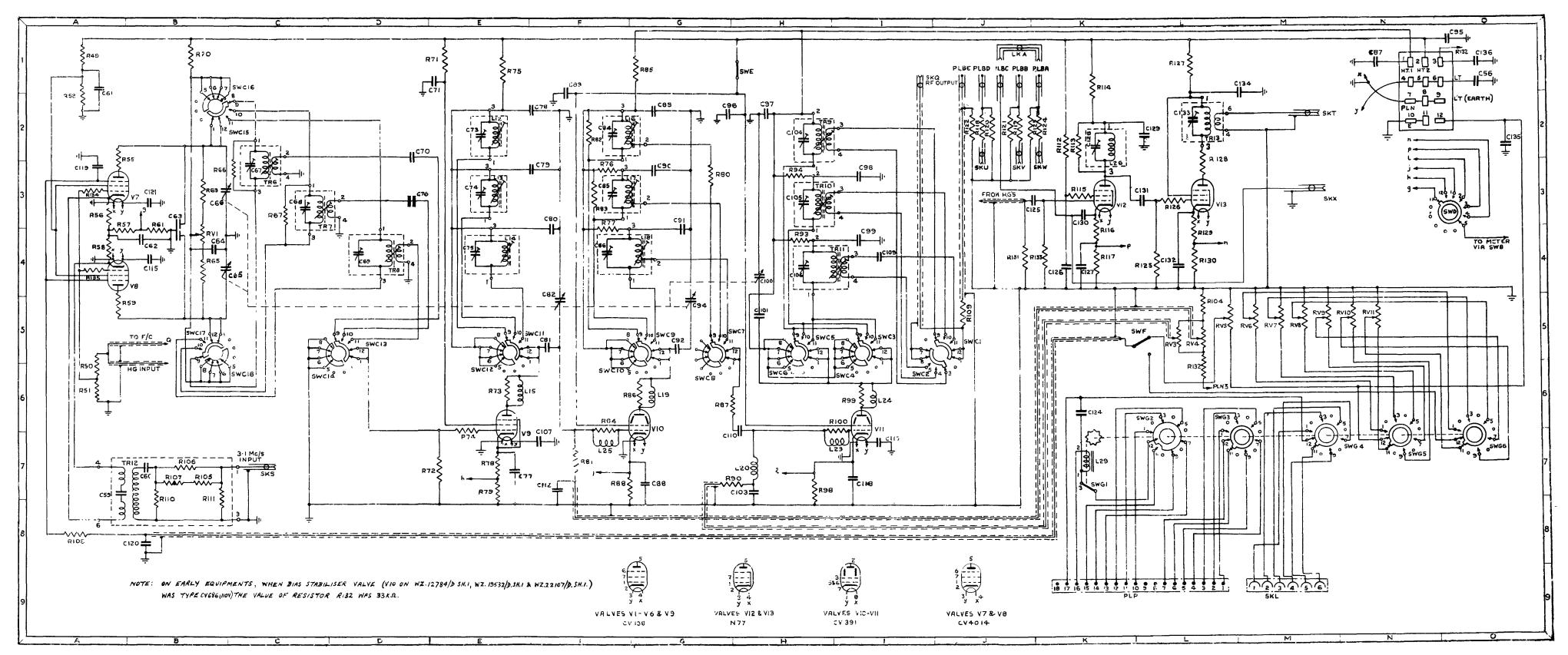
NOTE: The preceding Cross Reference List for T5553 identified 'for WZ.26511/D Sh.1 & 2 (Figs.12 & 13)' applies only to Fig.12B (WZ.26511/D Sh.1). For identities of components in Fig.13 (WZ.17590/D Sh.2), refer to Components List No.1, Mixer Unit.

5E-0231-1 n. (To prec Fig.12B

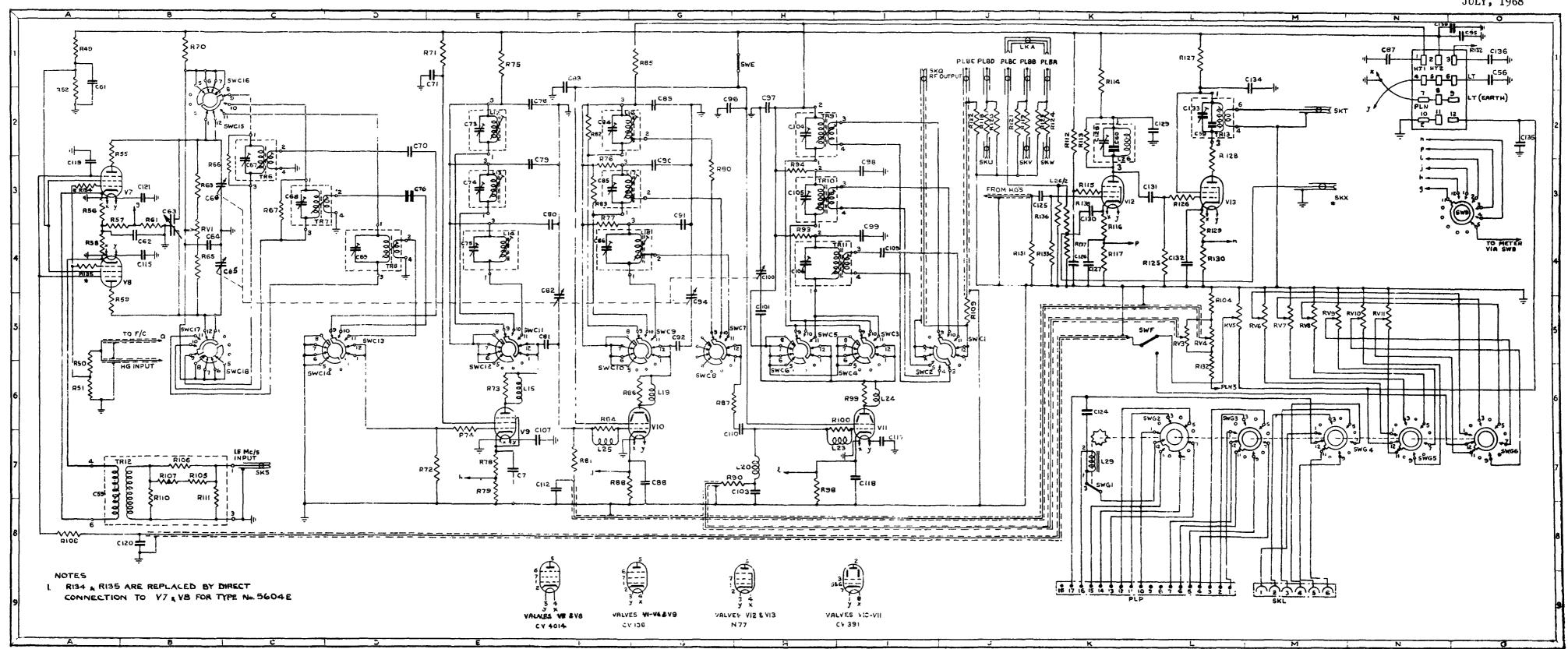


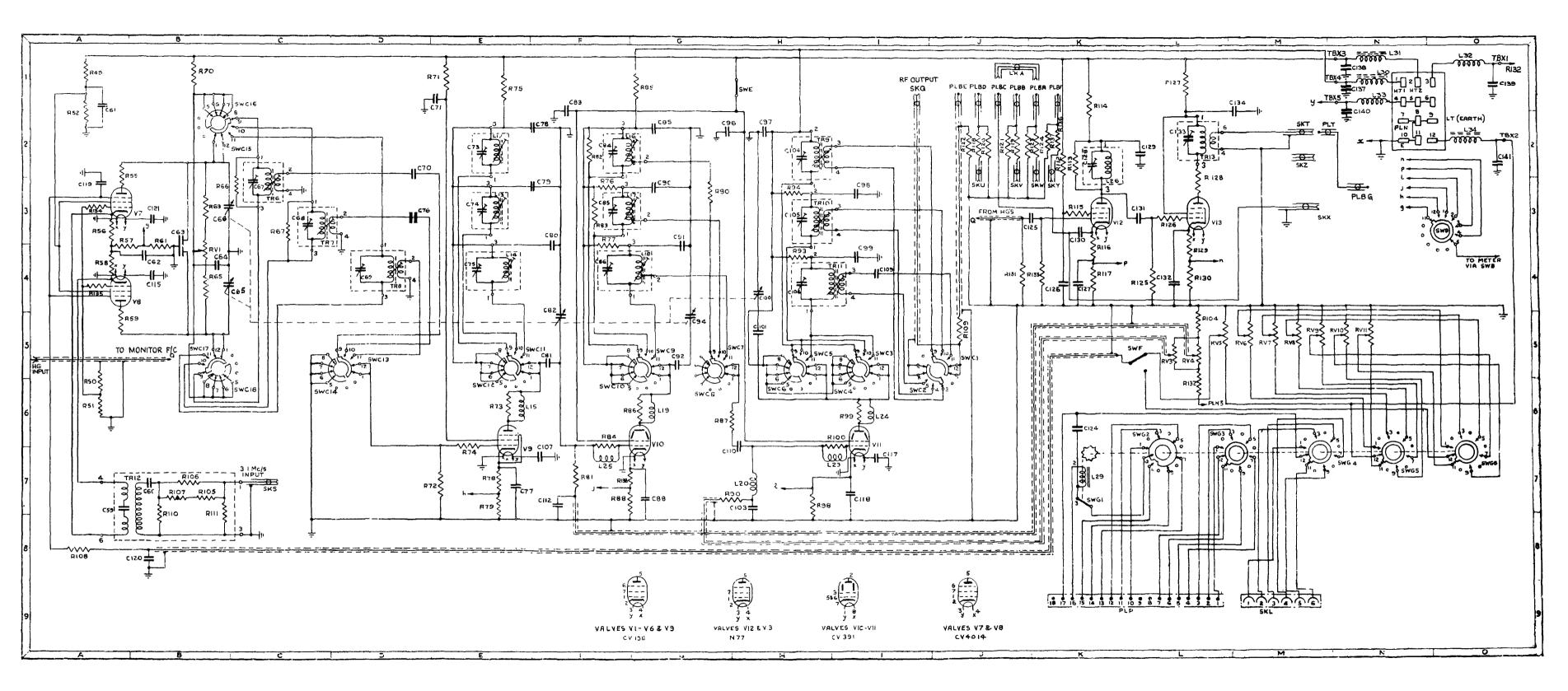
A.P.116E-0231-1 2nd Edn. Oct. '67 CIRCUIT DIAGRAM MIXER UNIT, PART 1 HS 31A/1



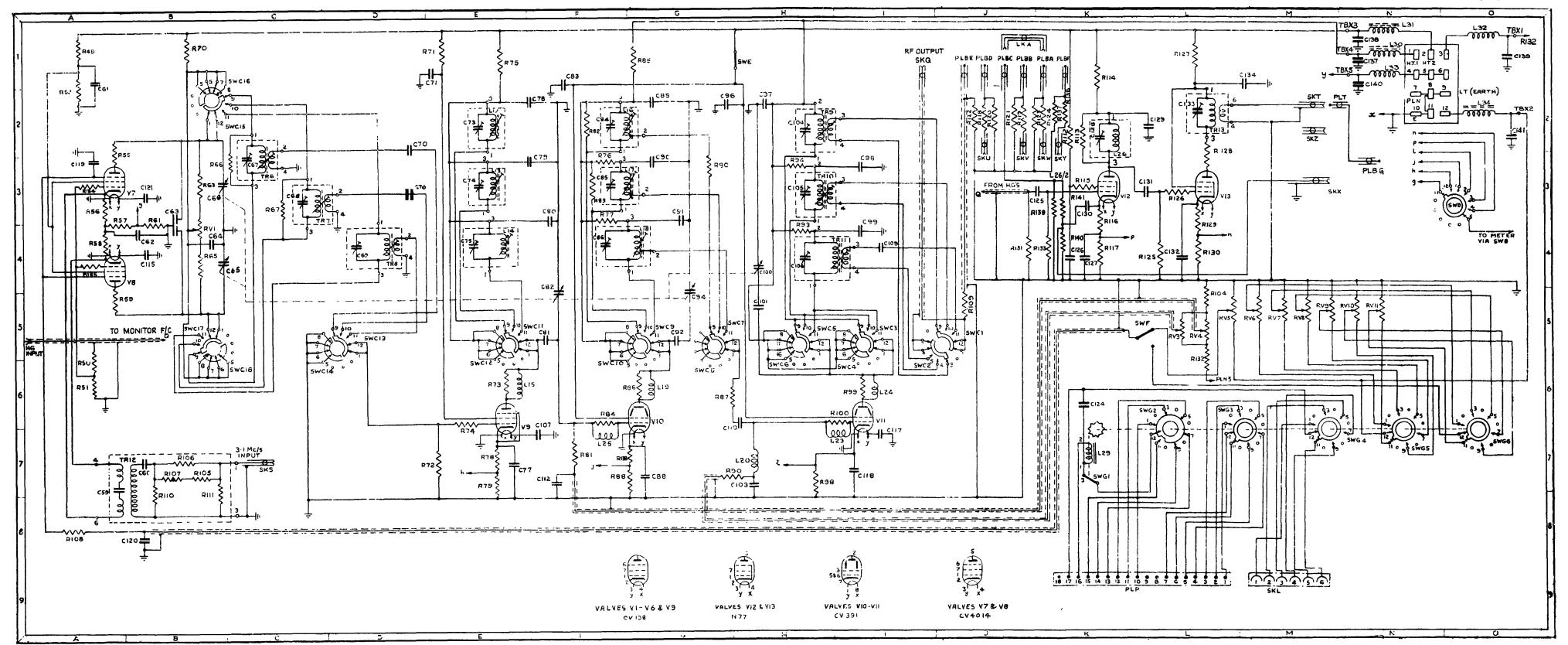


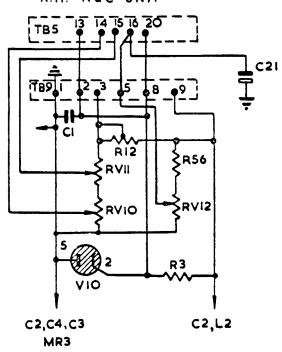
AP.2922D Vol.1 April 1965 CIRCUIT
MIXER UNIT, SHEET 2
WZ.17590/D Sh.2 Iss.4

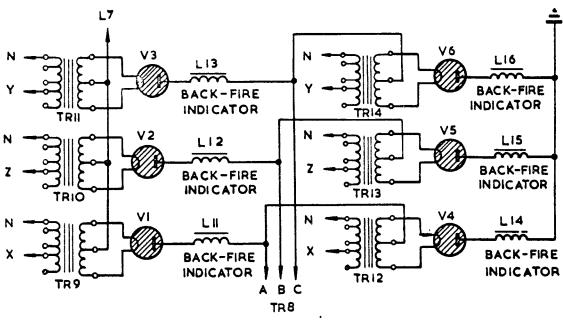




CIRCUIT DIAGRAM MIXER UNIT, PART 2 H831A/1 H831/1 (ANI) 13B F1G.1-3A WZ.26511/D SH.2 ISS.1

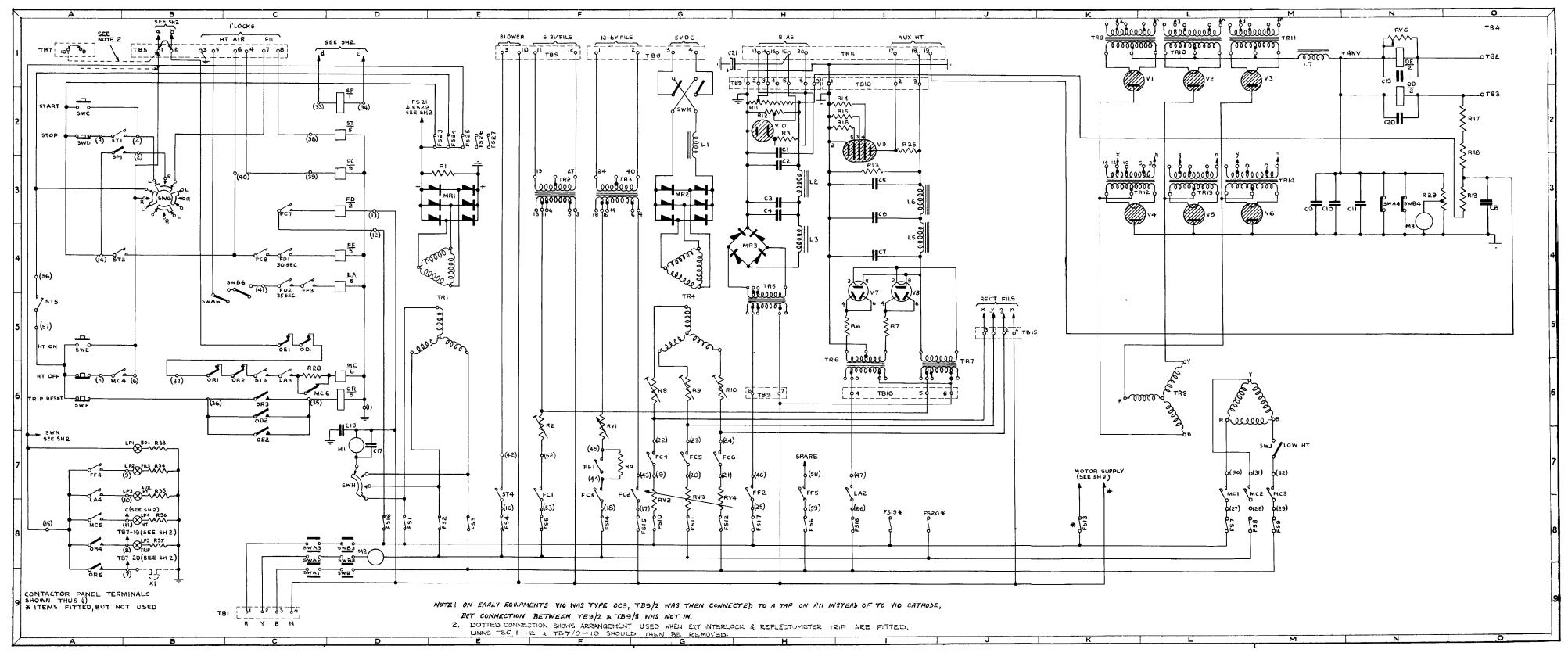






CIRCUIT CHANGES ARISING FROM
MODIFICATION NO.9785
(Fitting of Back-fire Indicators
and Remote Bias Control)

To face. Fig. 14) A.P.116E-0231-2nd. Edn, A.L. March, 1969.



AP.2922D Vol.1 April 1965 CIRCUIT
RECTIFIER AND CONTROL UNIT, PART 1
WZ.12784/D Sh.1 Iss.13

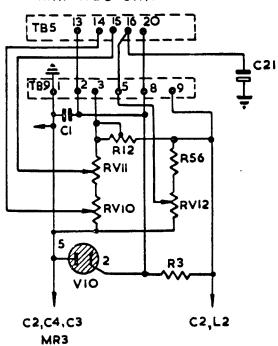
RECTIFIER & CONTROL UNIT W.37908 Sh.3 Ed.B

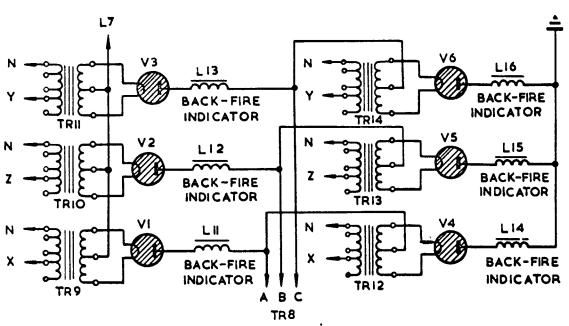
Cross Reference List for WZ.17361/D Sh.1 (Fig.14A)

•		-		,						-					
Ref.	No.	Ref.	No.	Ref.	No.	Ref.	No.	Ref.	No.	Ref.	No.	Ref.	No.	Ref.	No.
Cl	5	FS5	75	L5	89	ST	190	R13	206	RV6	289	TB8	352	Vl	389
C2	5	FS7	77	L6	89	FF	190	Rl4	207			TB9	353	V2	389
C3	5	FS8	77	L7	90	LA	190	R15	207			TBlO	354	V3	389
C4	5	FS9	77			MC *	189	R16	207	SWA	313	TB15	355	Λ7	389
C5	6	FS10	75			OR	192	Rl7	208	SWA-6	314			V5	389
c6	6	FS11	75	LPl	134	SP	193	Rl8	208	SWB	315		•	v 6	389
C7	6	FS12	75	LP2	134	FD	194	R19	209	SWB-6	316	TRL	363	V7	390
C8	7	FS14	78	LP3	134	OD	195	R25	210	SWC	317	TR2	364	v8	390
C9	. 8	FS15	78	LP4	134	OE	195	(Part	of	SWD	317	TR3	365	V 9	391
ClO	8	FS16	79	LP5	134			R28-18	39)	SWE	317	TR4	366	VlO	392
Cll	8	FS17	79					R29	211	SWF	318	TR5	367		
C17	9	FS18	80					R33	212	SWG	319	TR6	368	-	
C18	9	FS20	80	Ml	142	R1	198	R34	212	SWH	320	TR7	369		
C19	10	FS23	82	M2	143	R2	199	R35	212	SWJ	321	TR8	370	X1	403
C20	10	FS24	83	М3	144	R3	200	R36	212	SWK	322	TR9	371		
C21	11	FS25	81			R4	201	R37	212	SWL	323	TRIO	371	X3	411
						R6	202			SWM	324	TRll	371		
				MRl	164	R7	202		:	SWN	325	TR12	371		447
				MR2	161	R8	203			TBl	349	TR13	371		
FS1	75			MR3	162	R9	203	RVl	287	TB2	350	TR14	371		
FS2	75	Ll	87			R10	203	RV2	288	TB3	350				
FS3	75	L2	88			Rll	204	RV3	288	TB4	350				
FS4	76	L3	88	FC	191	R12	205	RV4	288	TB5	351				
		NOTE:				ses 2						el.			
				i		are co	:		one	assemī	ly.				
				Xl Fi	tted	exter	ially	·							
										1					
			*			placem			em l	89: ౮	C 270	0003			
				(Туре	UCA	7) (Mo	d.A.	4745).							
L		L	<u>:</u>			L	<u> </u>	L			<u> </u>	! <u>.</u>			

MISCELLANEOUS MECHANICAL ITEMS

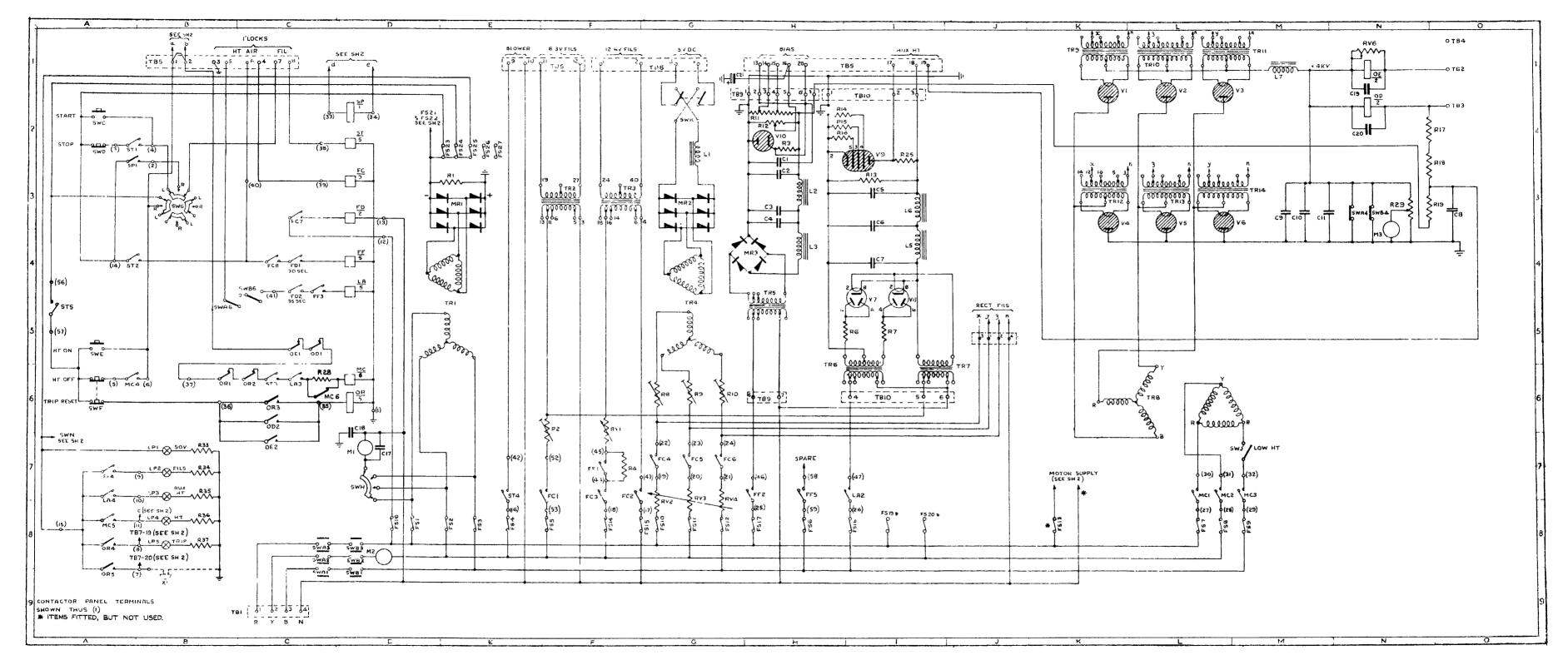
Ref. 1	Fuseholder (For FS7-9)	No.446
Ref. 2	Fuseholder (For FS1-5,10-12,14-15)	No.444
Ref. 3	Fuseholder (For FS16-18,20,22-25)	No.445
Ref. 4	Valveholder (For V7 & V8)	No.497
Ref. 5	Valveholder (For V9)	No.498
Ref. 6	Lamp Jack (For LP1-11)	No.455
Ref. 7	Resistor Mounting (For Rl & R2)	No.465
Ref. 8	Resistor Mounting (For R17-19)	No.466
Ref. 9	Anode Clip	No.414
Ref.10	Resistor for Mounting(For R13 & R25)	No.467
Ref.ll	Valve Retainer (For V9)	No.499
Ref.12	Valve Retainer (For V7 & V8)	No.500
Ref.15	Stand-Off Insulator	No.449
Ref.16	Valve Retainer (For V10)	No.501
	Socket for Relays OR & SP	No.503



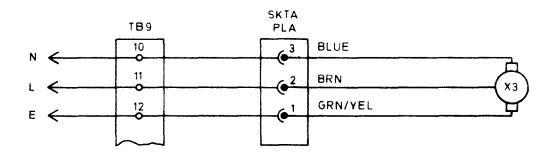


CIRCUIT CHANGES ARISING FROM
MODIFICATION NO.9785
(Fitting of Back-fire Indicators
and Remote Bias Control)

fo face. Fig. 14A) A.P.116E-0231-1 2nd. Edn, A.L. March, 1969.

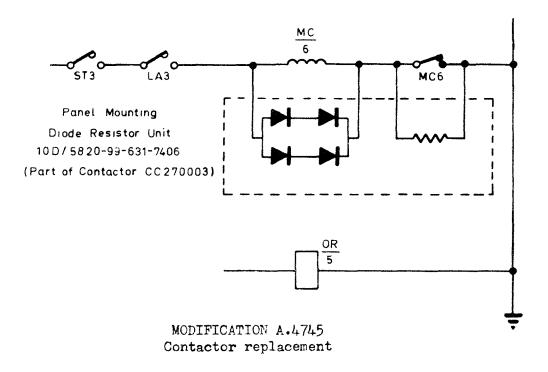


CIRCUIT DIAGRAM
RECTIFIER AND CONTROL UNIT, PART 1
HS31A



FAN

Fitted to all Rectifier and Control Units Refer to Figs. 14, 14A and 14B



Applicable to all Rectifier and Control Units Refer to Figs. 14, 14A and 14B

Fig.14C

RECTIFIER & CONTROL UNIT Refer to Master Components List T5553 Issue

Cross Reference List for WZ.26506/D Sh.1 & WZ.26506/B Sh.2 (Fig.14B & 15A)

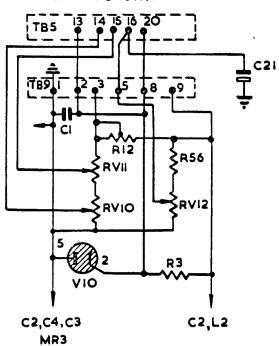
ſ	Ref.	No.	Ref.	No.	Ref.	No.	Ref.	No.	Ref.	No.	Ref.	No.	Ref.	No.	Ref.	No.
	FS2 FS3 FS4 FS5 FS6 FS7 FS8 FS9	77778839 100 1233445 43454 36664 1233445 445 133445 13344 13444 13	FS16 FS17 FS18 FS19 FS20 FS21 FS22 FS23 FS24 FS25 FS26 FS27 FS30 FS31 FS32 FS34 FS35 FS36 FS37 FS36 FS37 FS38 FS39 FS31	134 137 138 138 139 141 142 140 137	L1 L2 L3 L4 L5 L6 L7 L8 L90 LP1 LP2 LP3 LP4 LP5 LP10 LP10 LP10 LP10 LP10 LP10 LP10 LP10	150 150 151 151 152 153 213 217 218 219 280 281	R4 R5 R6 R7 R8 R9 R10	293 294 295 296 296 296 297 298 299 300 300 301 301 302	R40 R41 R42 R43 R44 R45 R46	306 306 306 306 306 306 307 307 307 308 310 311 312 313 314 315 316	RV4 RV5 RV6 RV7 RV8 RELAYS CONTAC FC) ST)		SWH SWJ SWK SWL SWM SWN SWP SWQ SWR TB1 TB2 TB3 TB4 TB5 TB6 TB7 TB8 TB10 TB11 TB12 TB13 TB14 TB15 TB16 TB17 TB12 TB13 TB14 TB15 TB17	44456789 44444	TR13 TR14 V1 V2 V3 V4 V5 V6 V7 V8 V9 V10 X1 X2 X3 X4	44444444444444444444444444444444444444
	* Wot	sac	replac	emen	t for	i item	Ref:	MC:	CC 27	0003	(Type	UCA) (Mo	d. A.	4745)	4 4 1 4 4 4 1 1 2 2 3 3 1 1 1 1 1 1 1 1 1 1 1 1 1 1

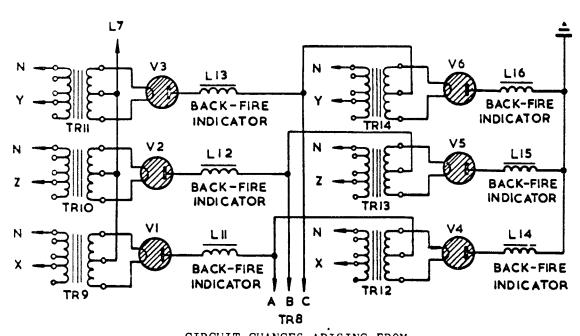
Refer to Master Components List T3 Issue Cross Reference List

for WZ.26506/D Sh.1 & WZ.26506/B Sh.2 (Fig.14B & 15A)

MISCELLANEOUS MECHANICAL ITEMS

Ref. 1	Fuseholder	No.144
Ref. 2	Fuseholder	No.145
Ref. 3	Fuseholder	No.146
Ref. 4	Valveholder I.O.	No.528
Ref. 5	Valveholder B5	No.529
Ref. 6	Lamp Jack	No.210
Ref. 7	Resistor Mounting	No.233
Ref. 8	Resistor Mounting	No.234
Ref. 9	Anode Clip	No. 84
Ref.10	Resistor Mounting	No.235
Ref.11	Valve Retainer	No.399
Ref.12	Valve Retainer	No.400
Ref.13		
Ref.14		
Ref.15	Stand-Off Insulator	No.207
Ref.16	Valve Retainer	No.401
	Contactor Panel WIS.9273-1-1	No.111

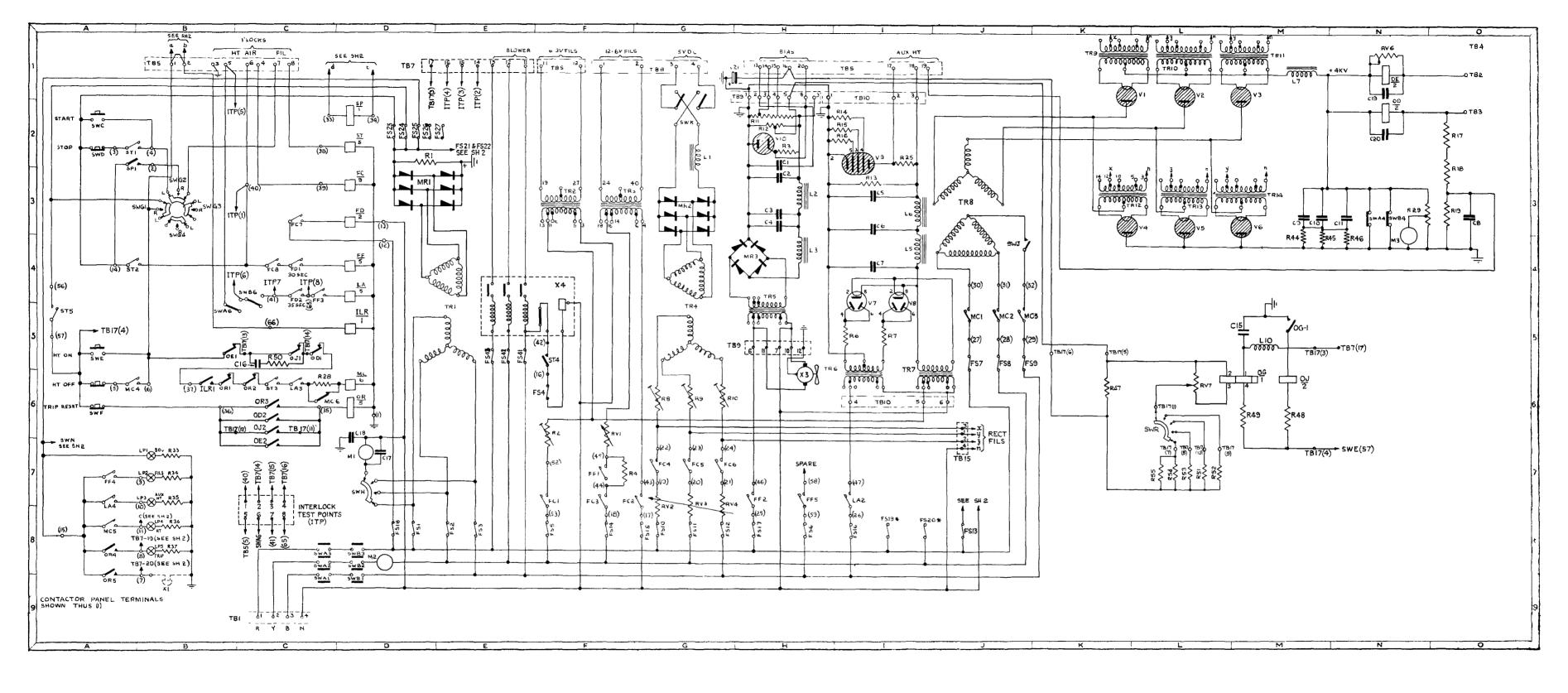




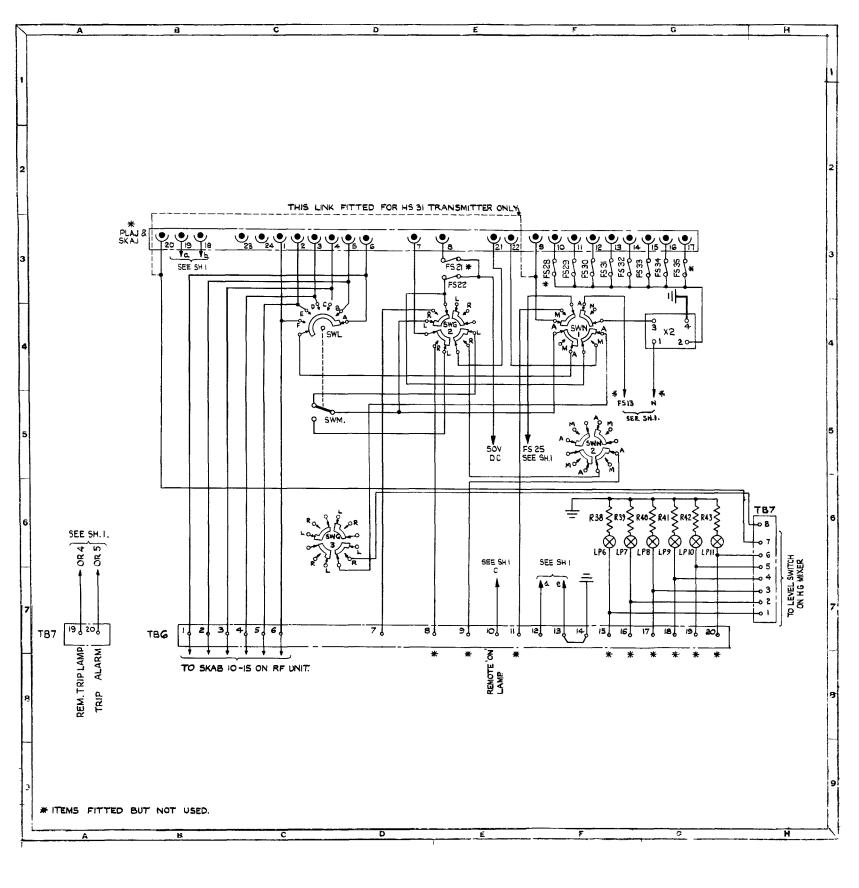
CIRCUIT CHANGES ARISING FROM
MODIFICATION NO.9785
(Fitting of Back-fire Indicators
and Remote Bias Control)

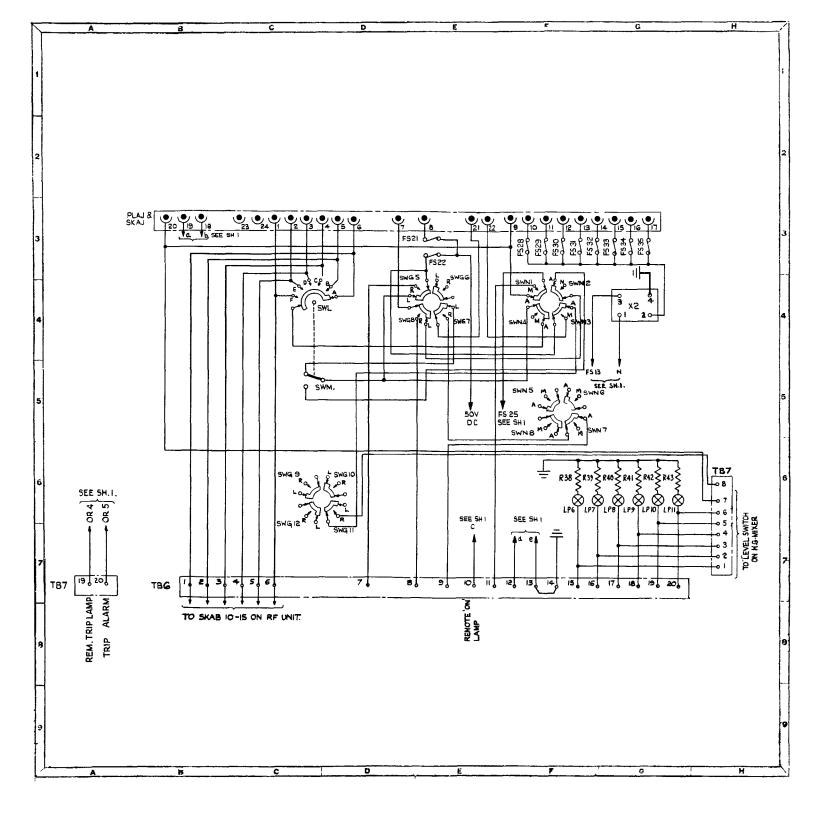
To face Fig. 14B)

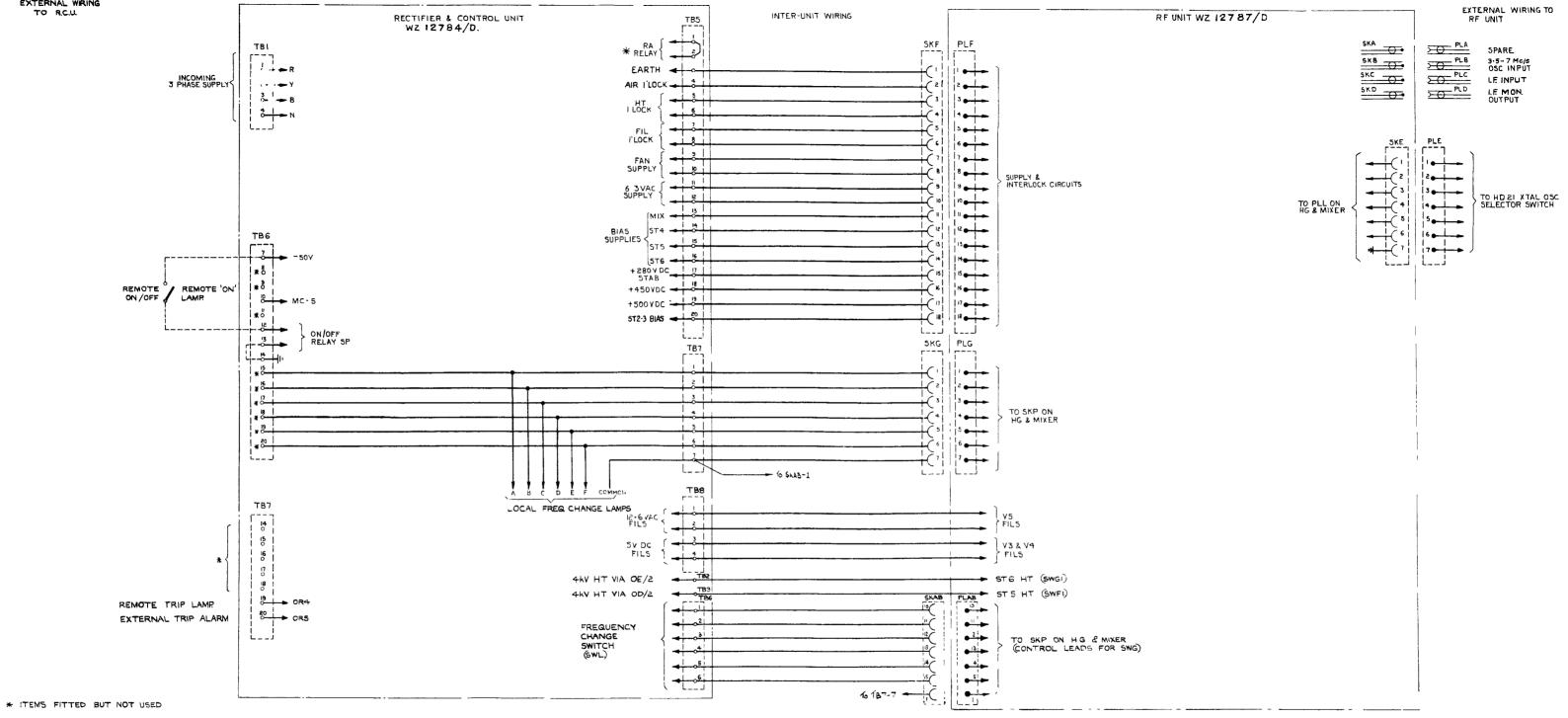
A.P.116E-0231-7 2nd. Edn, A.L. March, 1969.



CIRCUIT DIAGRAM
RECTIFIER AND CONTROL UNIT, PART 1
HS31/1 AND HS31A/1







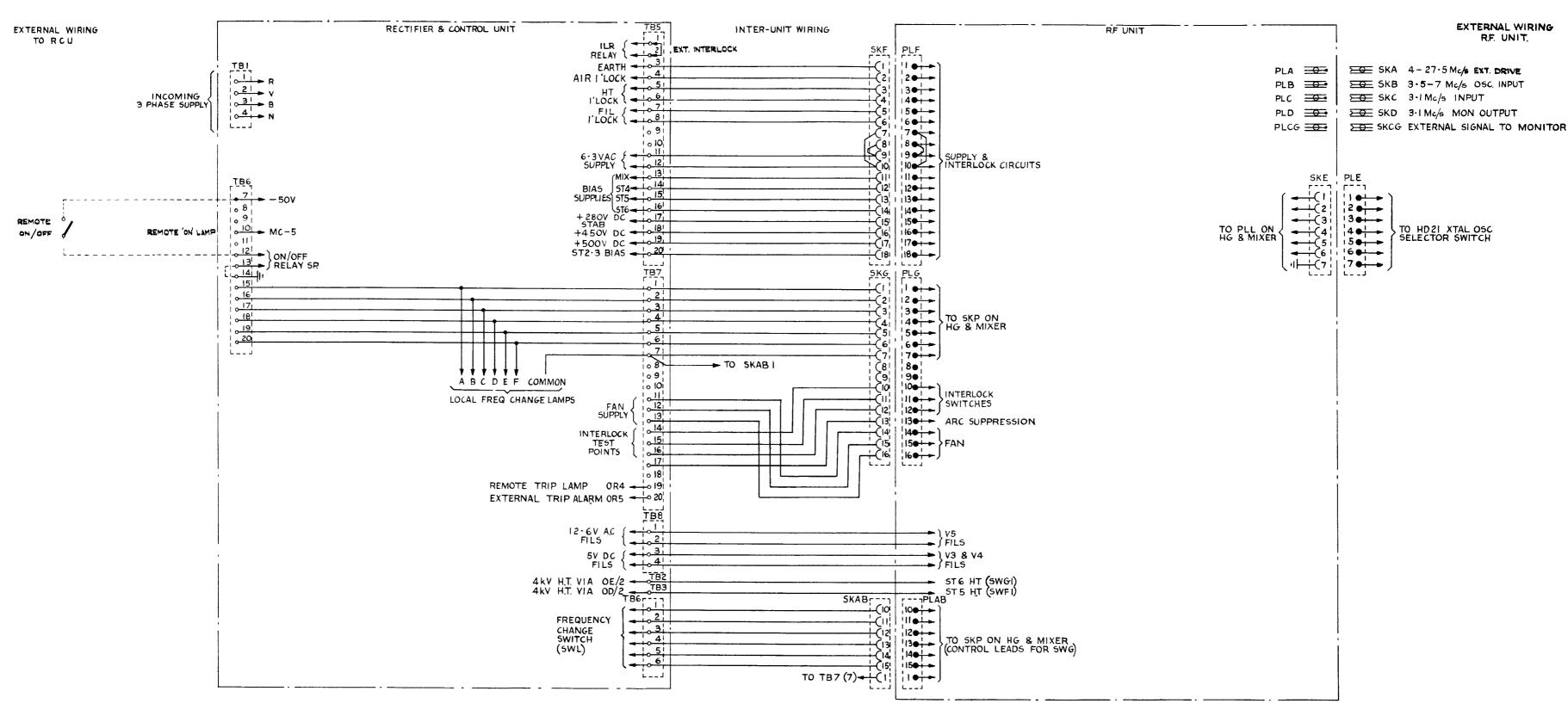
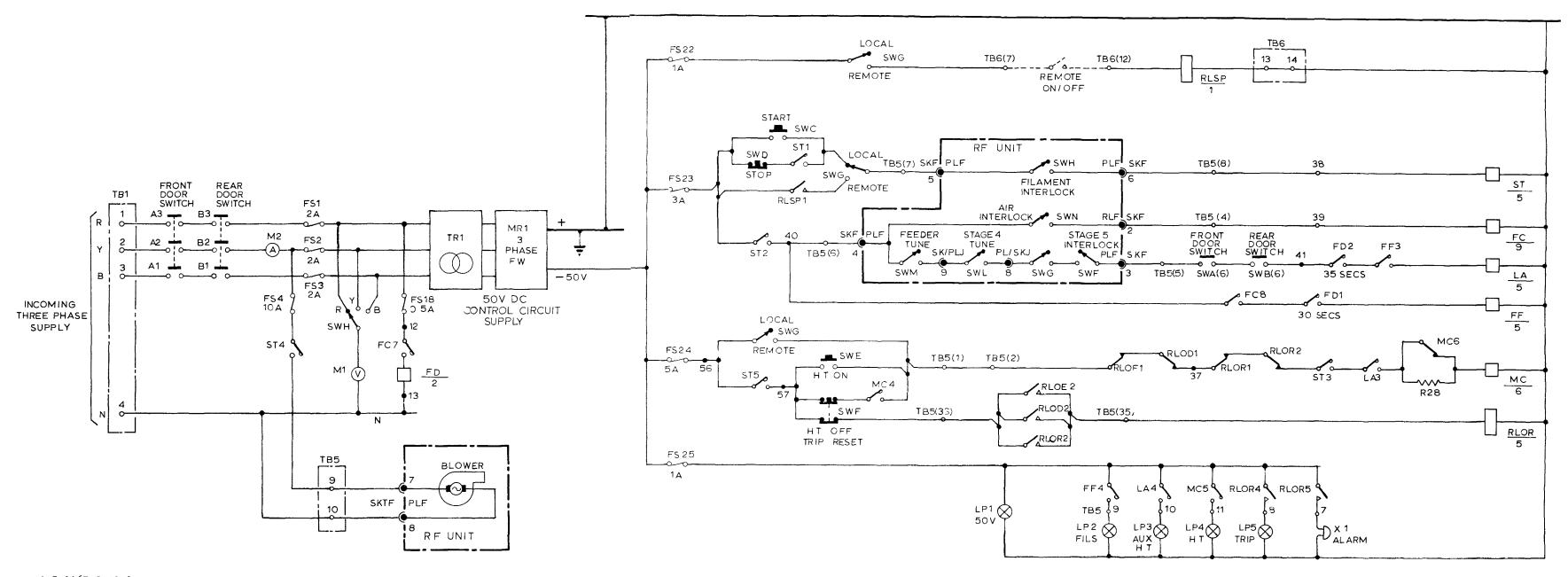
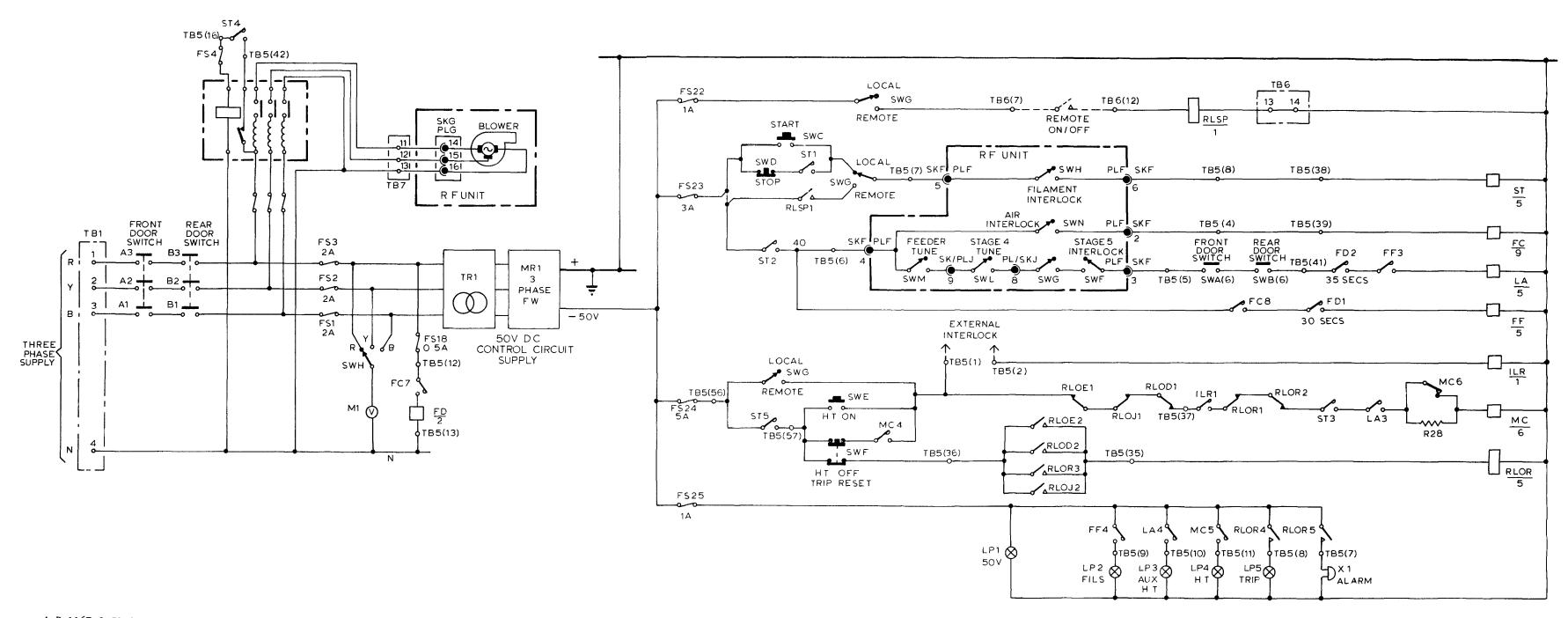


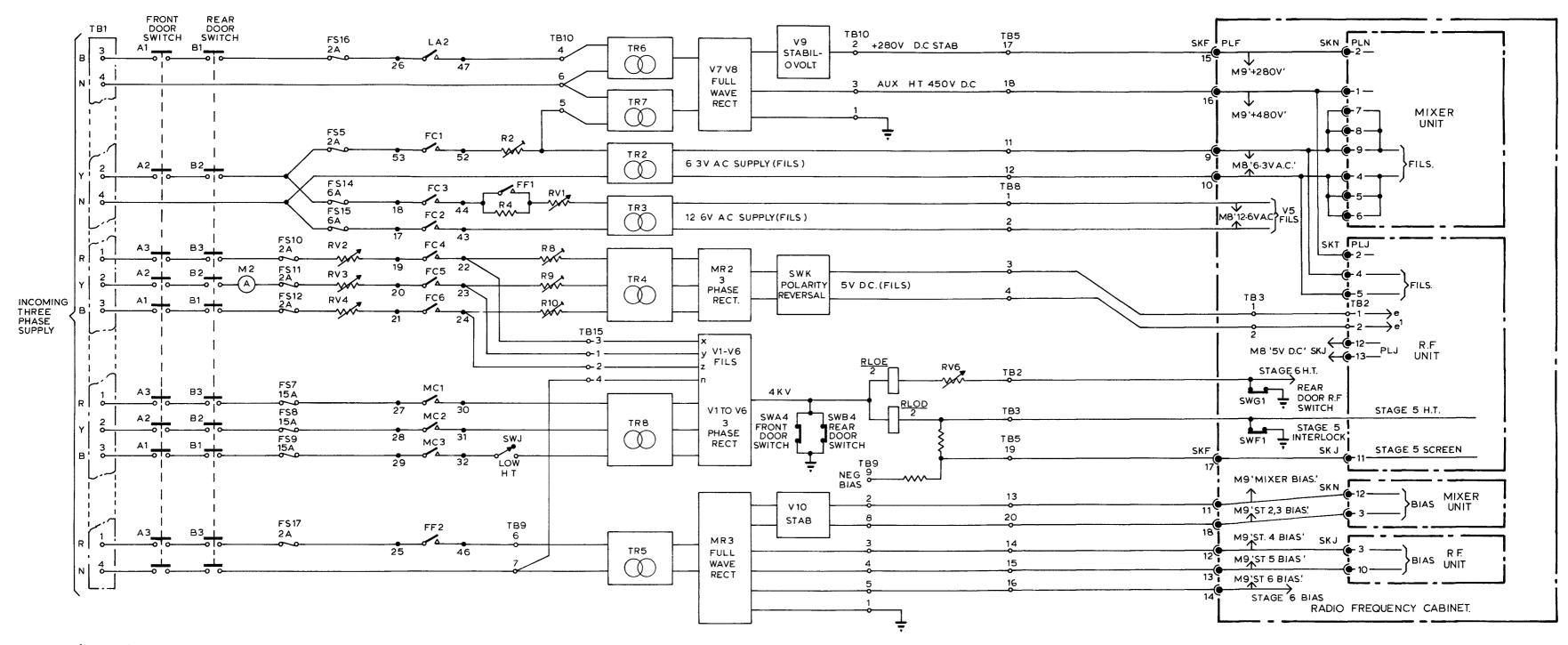
FIG.16A WZ.26508/D Sh.1



FUNCTIONAL DIAGRAM CONTROL CIRCUITS HS 31 AND HS 31A



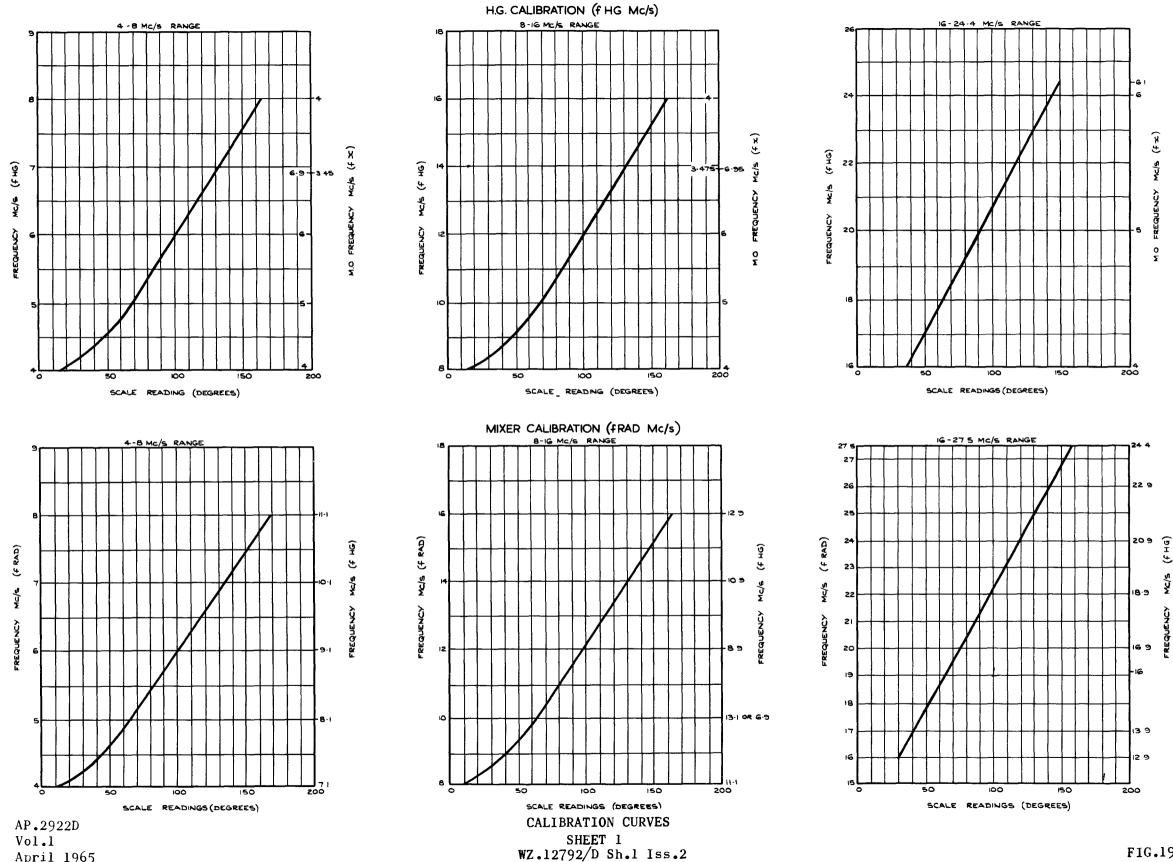
FUNCTIONAL DIAGRAM CONTROL CIRCUITS HS31A AND HS31A/1



FUNCTIONAL DIAGRAM
POWER SUPPLY CIRCUITS
HS 31 SERIES

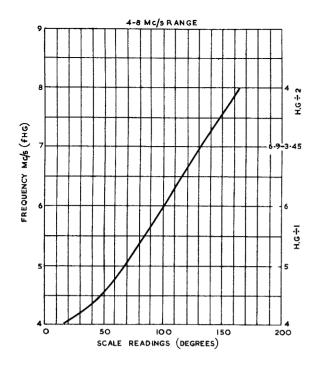
1	RADIATED		HGI (VI)	HG2 (V2)	HG 3 (V3)	AMP(V4)	AMP	(v5/6)		ITOR	MIXER (V7/8)	STI_(V9)	ST2 (VIO)	ST3 (VII)	ST4	574	ST5	ST5 Ic	ST6	ST6	н.т	A.C	MEAN	P.E.P.
OF EMISSION	FREQ. Mc/s	FREQ. Mc/s	Ic m A	Ic mA	Ic mA	Ic mA	IG A	Ic mA	VIZ . Ic m A	VI3. Ic	Ic mA,	Ic mA	Ic mA	Ic mA	Egy	Ia mA	Eg V	Ic mA	Ig mA	Ic A	k∨	CURRENT	P/O KW	KW.
2 T	4.0	3 · 55	2 · 8	5 . 0	1.75	4 · 7	1.0	18	8	19	12	8 · 6	4 1	2 5	4 · 5	9 2	6.5	149	80	1.06	4 · 1	13 . 0	1.8	3 · 6
c w	4.0	3.55	S · 8	2 · 0	1 · 8	4 · 7	1.0	18	8	19	12	8 · 5	4 1	2 7	10 · 5	9 0	110	210	240	1.6	4 · 05	15 · 7	3 · 6	
2 T	6.0	4.55	5 · 6	5 · 4	1 · 8	3 · 0	0.6	16	8	19	15	8 · 5	4 0	2 5	4 · 0	9.2	7 0	139	7 5	1.0	4 · 1	13.5	1.8	3 · 6
c w	6.0	4 · 5 5	2 · 6	5 · 5	1 · 8	3 · 1	0.6	15	8	19	1.5	8 · 5	4 0	2 5	9 · 5	91	109	500	220	1 · 5 5	4.05	15.1	3.6	
2 T	8 · 5	5.8	2 · 6	5 · 4	1 . 8	3.0	0 · 6	16	8	19	15	8 · 5	4 0	2 5	4 · 8	92	6 5	143	68	1-01	4 · 1	12.1	1 · 8	3 · 6
c w	8 · 5	5 · 8	2 · 6	5 · 5	1 . 8	3 · 1	0.6	15	8	19	15	8 · 5	4 0	2 5	8 . 0	92	100	220	2 1 5	1.21	4.05	15.0	3 · 6	
2 T	10.0	6-55	5 · 6	5 · 4	1.8	3 · 0	0.6	16	8	19	12	8 · 5	4 0	2 5	4 · 4	91	5 9	139	8 1	1 · 0 5	4 · 1	13 · 2	1.8	3 · 6
c w	10.0	6. 55	5 · 6	5 · 5	1 - 8	3 · 1	0.6	15	8	19	12	8 · 5	4 0	2 5	7 · 0	88	9 0	175	205	1.45	4 · 0	15.0	3.6	
2 T	15.0	5.95	2 · 6	5 · 4	1.8	3.0	0.6	16	8	19	15	8 · 5	40	2 5	4 - 0	94	5 5	141	70	1 . 0 5	4 · 1	13 · 3	1 - 8	3 · 6
C W	15.0	5.95	5 · 6	5 · 5	1.8	3 · 1	0.6	15	8	19	12	8 · 5	4 0	25	7 · 9	90	106	200	240	1 . 5 2	4.05	15 - 2	3 · 6	
2 T	18.0	3.725	5 · 6	5 · 4	1 . 8	3 · 0	0 · 6	16	8	19	15	8.5	4 0	2.5	3 · 9	9 2	5 9	130	60	0.98	4 · 05	13.0	1 . 8	3 · 6
C W	18 · 0	3.725	5 · 6	5 · 5	1 · 8	3 · 1	0.6	15	8	19	15	8 · 5	4 0	25	8.0	89	104	209	2 2 0	1.51	4.0	15 • 4	3 · 6	
2 T	22.0	4.725	2 · 4	5 · 6	4 · 9	4 · 7	1 · 2	18	9	19	15	8 · 5	4 1	24	3 · 6	90	50	133	31.	0.75	4.0	12 · 5	1 · 4	2 · 8
c w	55.0	4.725	5 · 3	5 · 6	4 · 9	4 · 7	1 · 2	18	8 · 5	19	12	8 · 4	4 0	2.5	6.6	88	88	2 0 5	110	1.52	3.95	14.9	5 · 8	
2 Т	27 · 5	6.1	2 · 4	5 · 6	4 · 9	4 · 7	1.5	18	9	19	12	8 · 5	4 1	24	3 · 8	94	4 9	130	50	0.78	4.05	12.4	1 · 4	2.8
c w	27.5	6.1	2· 3	5 · 6	4 · 9	4.7	1 · 5	18	8.5	19	12	8.4	40	2 5	7.6	91	92	550	150	1.52		14 · 3	5 . 8	

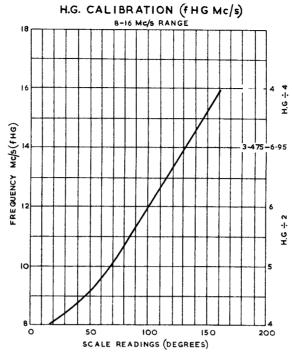
TYPE	RADIATED		HGI (VI)	HG2 (V2)	HG3(V3)	AMP (V4)	AMP	(V5/6)		ITOR	MIXER (V7/8)	STI (V9)	ST2 (VIO)	ST3 (VII)	ST 4	ST4	5T5	ST5	ST6	ST6	нт	A.C.	MEAN	P.E.P.
EMISSION	FREQ Mc/s		Ic mA	T _C mA	Ic m A	Ic mA	IG mA	Ic mA	VI2, Ic m A	VI3 Tc mA	Ic mA	Ic m A	Ic mA	Tc mA	Eg	Ia m A	Eg	Ic mA	Ig mA	Ic A	ΚV	CURRENT	P/O	KW
2 T	2⋅5		2·8	4.1	1.5	6.2	0.2	13	8	16	10	8.6	38	25	3⋅5	92	65	149	98	1.06	4.1	13 · 0	1.8	3.6
c w	2.5		2.8	4.1	1.5	6.2	0.5	13	8	16	10	8.5	37	24	6	90	100	210	255	1.6	4.05	15.7	3.6	
D. S. B (CARRIER)	2.5		2.8	4.9	1.6	3 · 8	0.5	17	8	18	13	8	40	28	2.2	94	61	129	65	0.85	4.05	11-6	1.5	
2 T	4.0		2.6	2 · 4	1.8	4.3	1.0	20	8	16	9	8.5	38	25	3.0	92	70	139	107	1-1	4.1	13 · 2	J·75	3.5
c w	4-0		2 · 6	2 · 4	1.8	4.3	1.0	20	8	16	9	8.5	38	25	4 · 8	85	100	185	260	1.55	4.05	15 · 1	3.5	
O.S.B (CARRIER)	4.0		2.6	2.8	1.9	3 · 7	1.0	22	8	17	μ	8.3	39	27	2.8	91	69	135	73	0.9	4.05	12.5	1.5	
2 T	4.9		2.6	2.6	1.8	8.4	0-1	12	8	16	9	g. 5	38	25	2.5	87	65	143	93	1.06	4.1	12.8	1.75	3-6
c w	4.9	_	2.6	2.6	1.8	8 · 4	0-1	12	8	16	9	8-5	38	25	4.2	82	100	200	265	1.57	4.05	15.0	3 · 5	
B.S.B. (CARRIER)	4.9		2.6	3.3	1.9	8-2	0.1	13	8	18	11	8-4	38	28	2.4	87	65	140	66	0.86	4.05	12	1.5	
21	8.0	1	2.6	3.2	1.4	8.6	0.1	12	8	16	8	8.5	40	25	2.5	88	50	115	91	1.05	4.1	12.0	1.75	3.6
c w	8.0		2.6	3.2	1 · 4	8 · 6	0.1	12	8	16	8	8-5	40	25	5 · 4	80	96	165	255	1.55	4.0	15.0	3 · 5	
D. S. B. (CARRIER)	8.0	1	2.6	3.5	1.5	8·4	·05	13	8	17	9	8.4	40	27	2.5	88	50	115	65	.9	4.05	12.0	1-5	
2.T	10 · 2		2.6	1.8	1.6	4· g	1 · 0	20	8	16	12	8.5	40	25	3. 5	90	65	130	105	1.05	4-1	13 · 3	1.75	3.6
cw	10- 2		2.6	1.8	1.6	4.8	1.0	20	8	16	12	8.5	40	25	7.9	81	115	170	250	1.52	4.05	15 · 2	3 · 5	
D.S.B. (CARRIER)	10.5		2.6	2.1	1 · 7	4 · 5	0.9	22	8	17	15	8.3	39	27	3.5	90	64	129	74	.9	4.05	12.5	1.5	
27	11-1		2.6	3. 2	1.5	8.7	0.1	- 11	8	16	8	8-5	40	25	3	86	59	120	90	1.02	4.05	12.5	1.75	3.6
cw	11:3		2.6	3 · 2	1.5	8.7	0-1	11	8	16	8	8.5	40	25	6.5	80	104	166	250	1. 5	4.0	14. 5	3.5	
D.S.B. (CARRIER)	11-1		2.6	3.5	1-6	8-4	0-1	12	8	17	9	8-4	39	27	2.9	86	59	118	61	.85	4.05	11.5	1.5	
2T	13-1		2.6	4.6	1.8	3.4	0.5	16	9	16	11	8⋅5	41	30	2.8	86	55	140	90	1-1	4.1	12.5	1.75	3.6
cw	13-1		2.6	4.6	1-8	3. 4	0.5	16	8.5	16	11	8·4	40	29	6 · 8	76	108	180	260	1.5	4.05	14.9	3.5	
D.S.B. (CARRIER)	13.1	_	2 · 6	5 · 1	1.9	3.1	0.4	18	8	18	13	8.4	40	33	2.8	85	55	138	60	0.92	4.05	11.5	1.5	
2T	20		2.8	5.0	4.9	7.3	0.3	18	7	16	12	8.5	38	24	3.3	91	68	155	105	1.05	4.05	12-4	1.75	3.6
cw	20		2.8	5.0	4.9	7.3	0-3	18	7	16	12	8:4	37	25	6· <i>B</i>	85	110	210	250	1.6	4.0	15 · 5	3.5	
D.SB. (CARRIER)	20		2.8	5 · 6	5	7.0	0.5	20	7	17	14	8.3	37	27	3 · 3	90	67	153	70	0· 87	4	11-4	1.5	

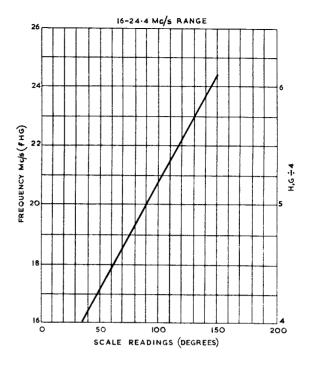


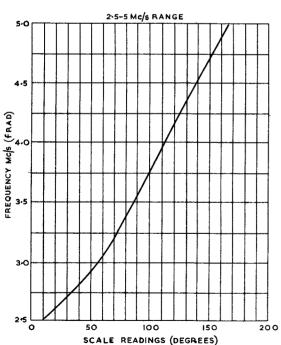
April 1965

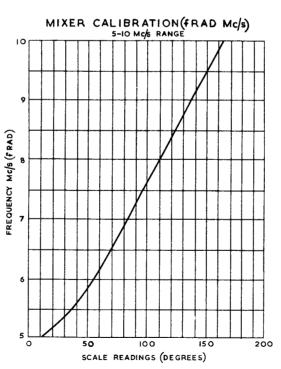
FIG.19

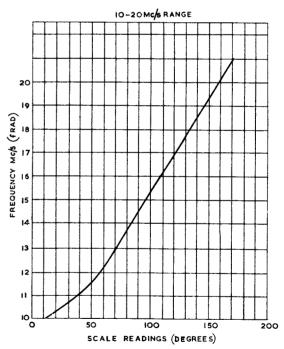


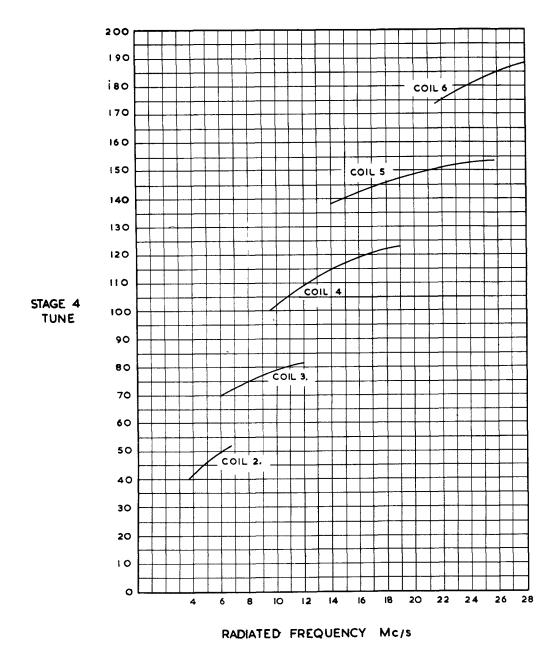


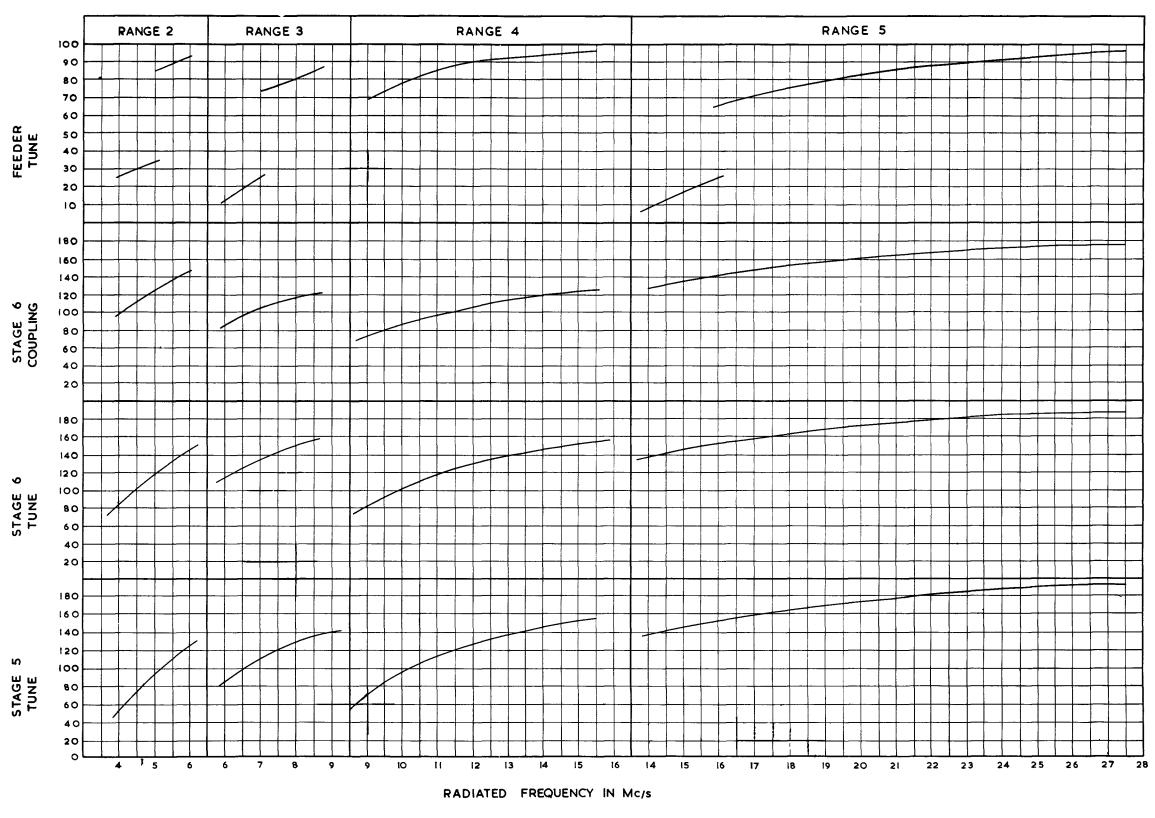




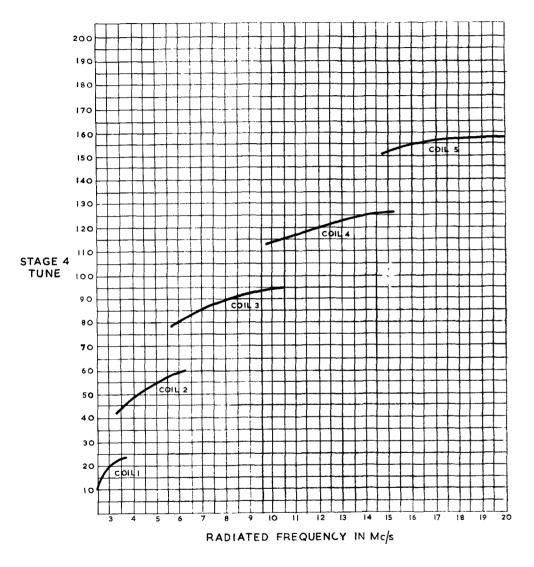


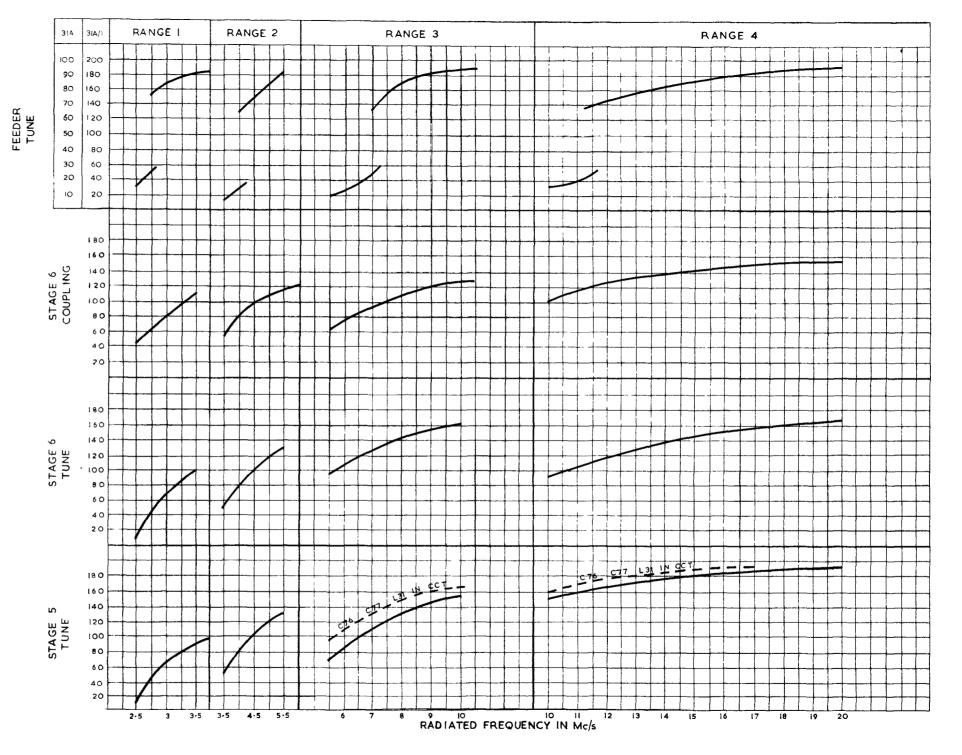




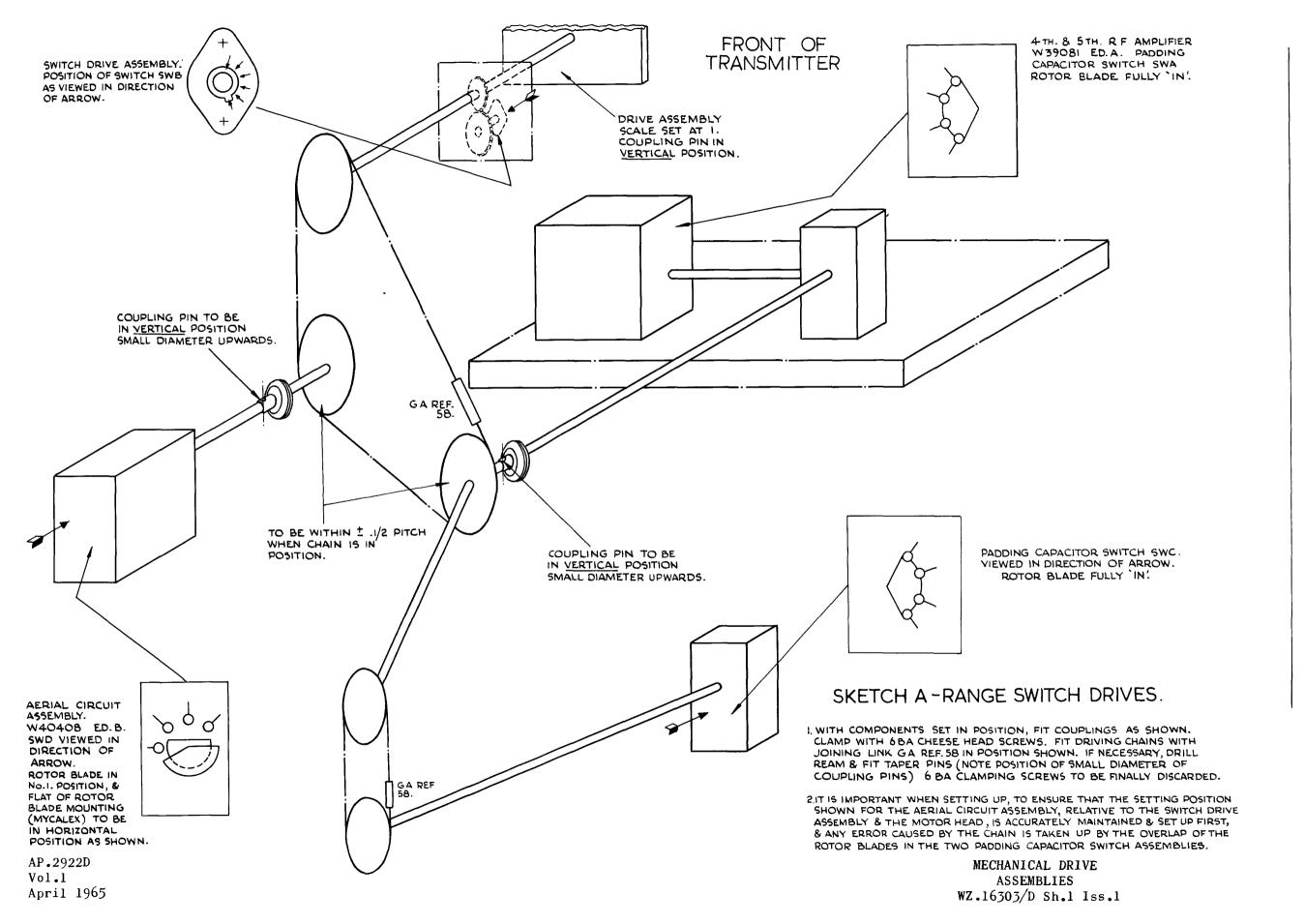


CALIBRATION CURVES
SHEET 2
WZ.12792/D Sh.2 Iss.2





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FRONT OF TRANSMITTER

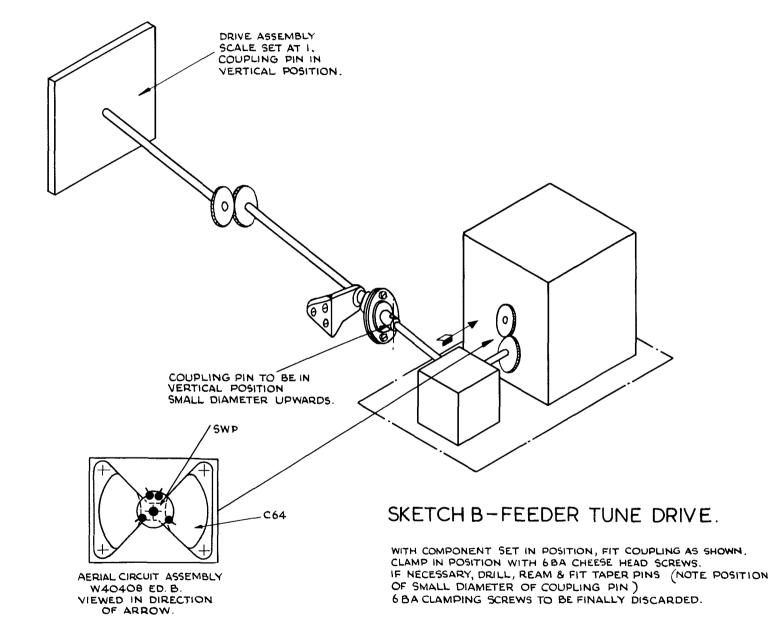
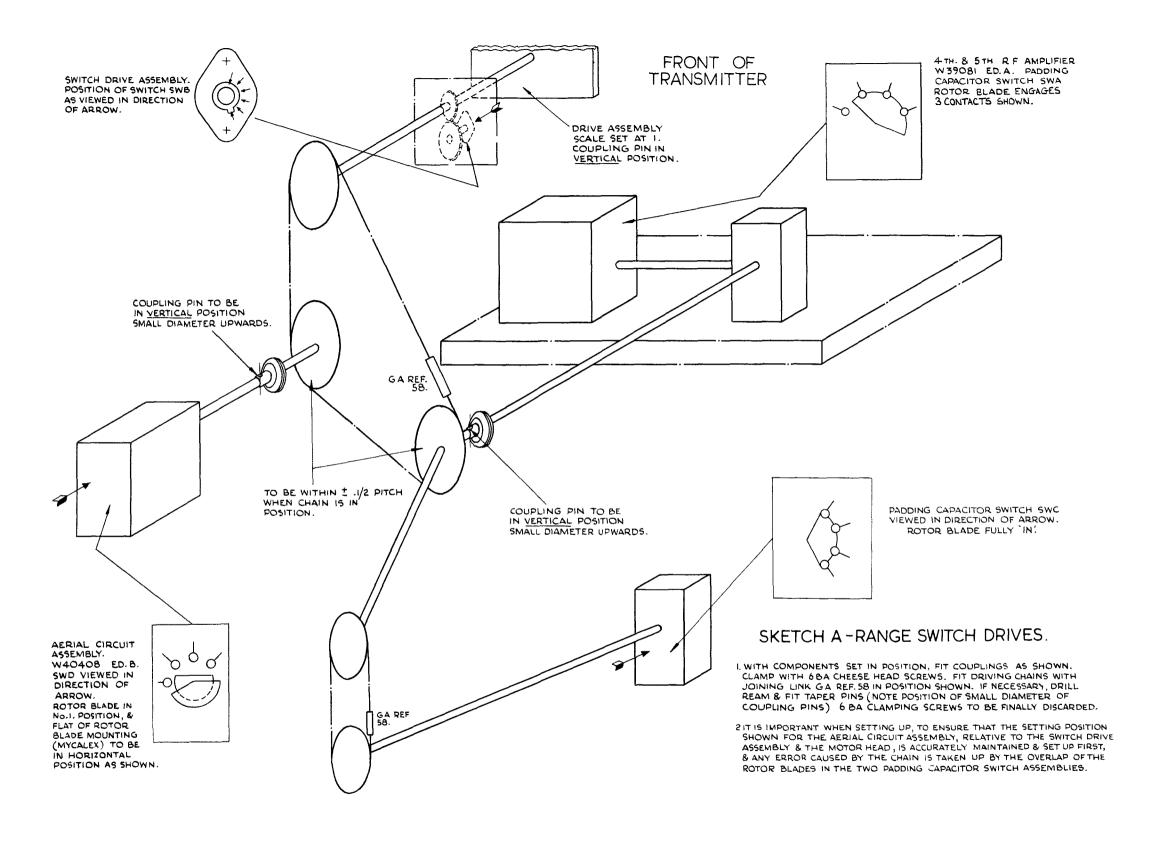


FIG.21



FRONT OF TRANSMITTER

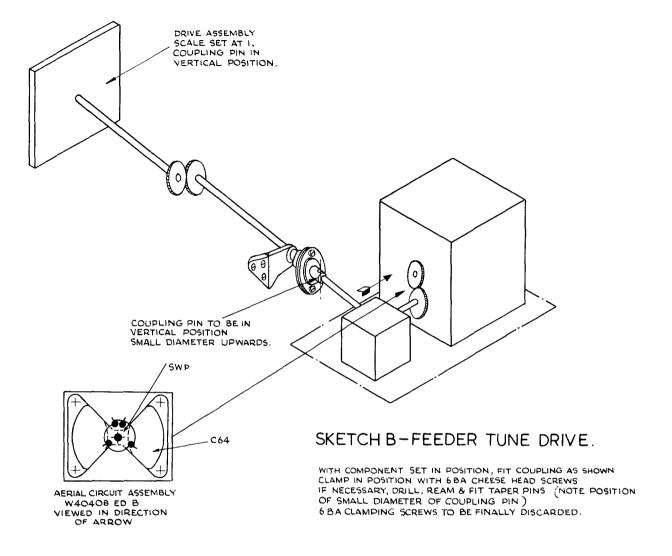
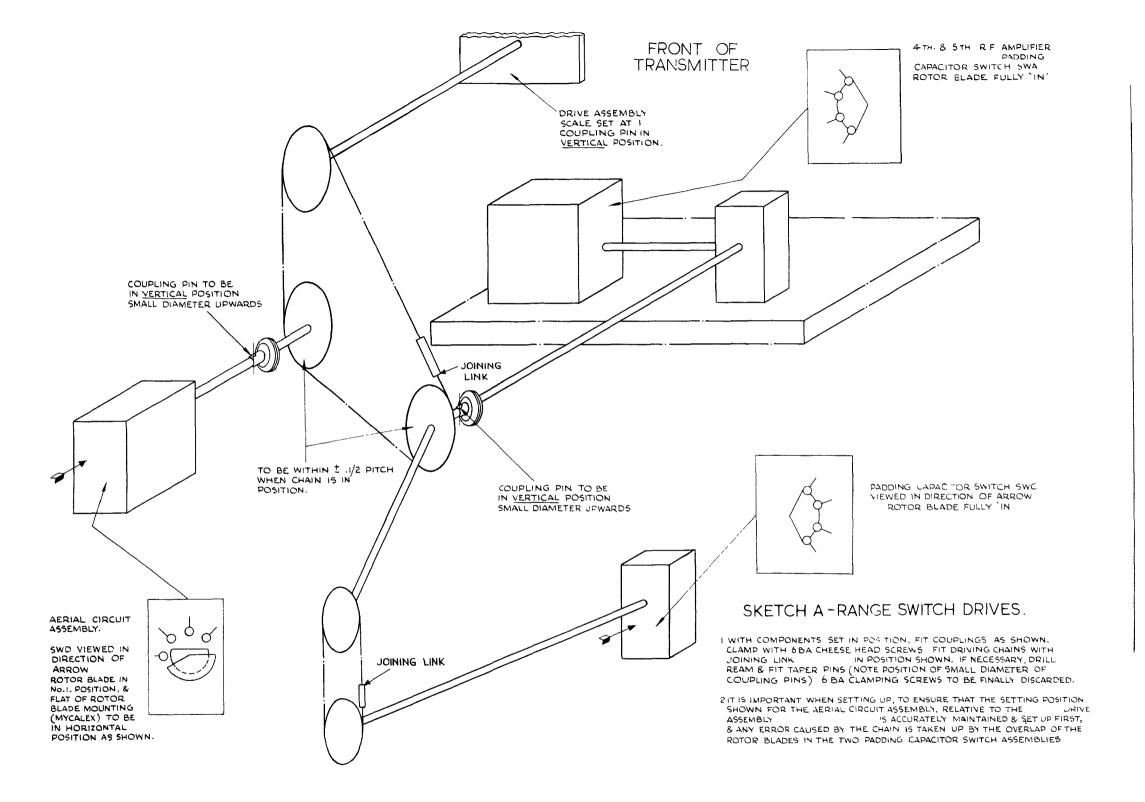
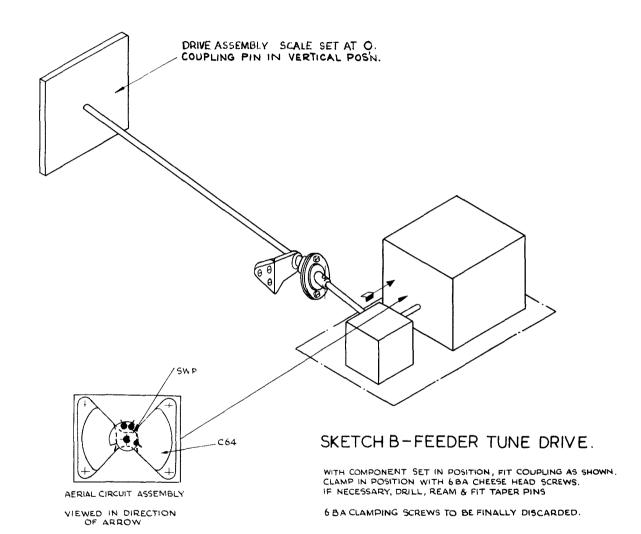


FIG.21A WZ.17369/D SH.1 ISS.1

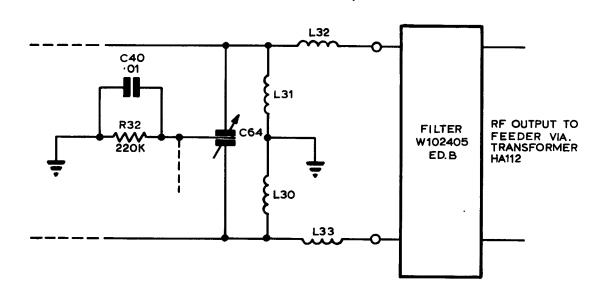


FRONT OF TRANSMITTER



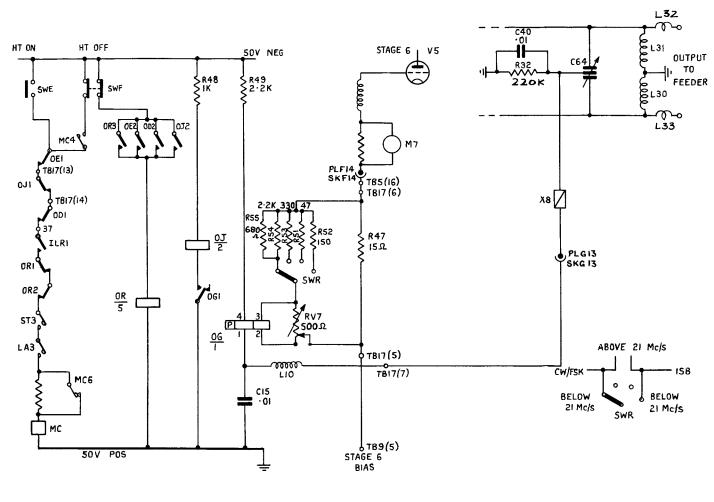
Feeder Capacitor Arc and Stage 6 Grid Current Trip Circuit, HS31/1 (WZ.26146/B Sh.1)

Modification No.1785



Modification No.1785 entails the provision of Filter W.102405 Ed.B at the output of HS31/1 when 50 ohms output impedance is provided by use of Transformer HAll2.

A.P.116E-0231-1 2nd Edition A.L.4, June 1970 Fig.22(a)



16E-0251-1 n. Oct. '67 FUNCTIONAL DIAGRAM
FEEDER CAPACITOR ARC AND STAGE 6
GRID CURRENT TRIP CIRCUIT HS31/1

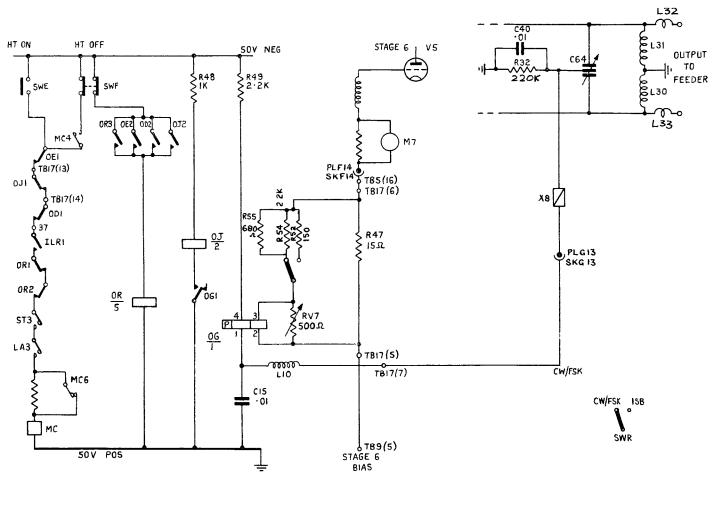
F1G.22 WZ.26146/B SH. 1SS.2

Feeder Capacitor Arc and Stage 6 Grid Current Trip Circuit of HS31A/1 (WZ.27283/B Sh.1)

Modification No.1784

L30, L31, L32 and L33 are replaced by Filter W.102405 Ed.C when 50 ohms output impedance is provided by use of Transformer Type HA112.

A.P.116E-0231-1 2nd Edition A.L.4, June 1970 Fig.22A(a)

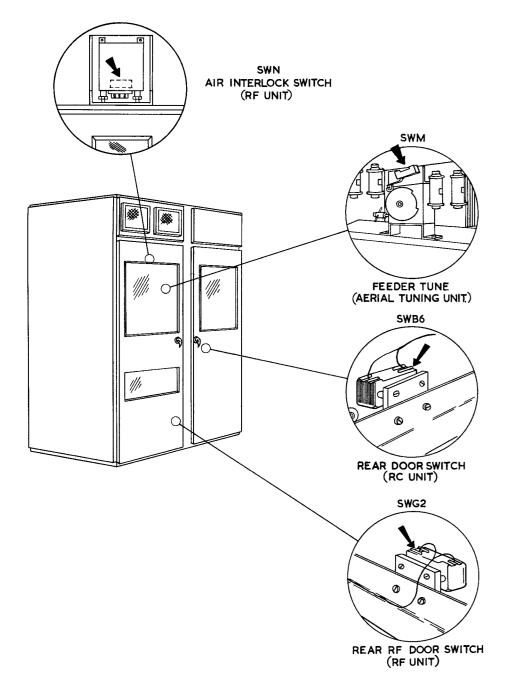


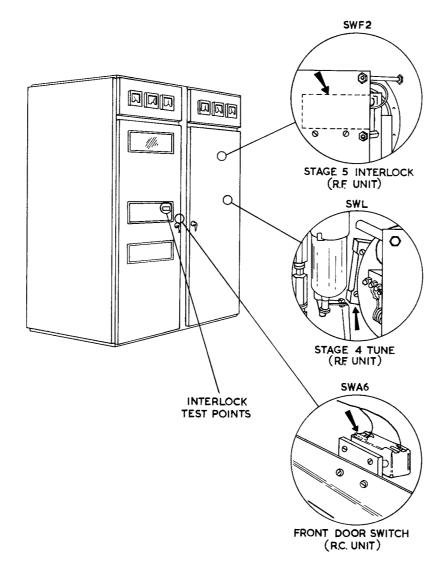
116E-0231-1

dn. Oct. '67

FEEDER CAPACITOR ARC & STAGE 6
GRID CURRENT TRIP CIRCUIT
HS31A/1

FIG.22A WZ.27283/B SH.1 ISS.2



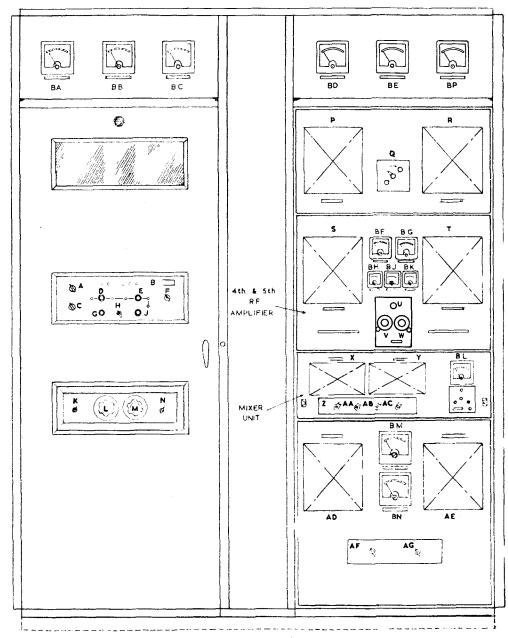


中等 INTERLOCK TEST POINTS RECTIFIER & CONTROL UNIT TB5(8) d FD2 (35 Sec.) d FDI 9(30 Sec.) TB5(4) SWB6 (REAR DOOR SWITCH) FC8 SWA6 (FRONT DOOR SWITCH) TB5(5) SKF6 PLF6 SKF3 PLF3 SWF2 (STAGE 5 INTERLOCK) SWH (FIL. INTERLOCK SWITCH) SWG2 · PLF5 SKF5 P(REAR RF DOOR SWITCH) RF UNIT SKJ8 PLJB ⁹ SWL γ(STAGE 4 TUNE) PLJ9 SWM

(FEEDER TUNE) PLF4 SKF4 TB5(7) TB5(6) ST2 STOP START O F523 ~50V

REAR VIEW FRONT VIEW

CIRCUIT DIAGRAM



RECTIFIER & CONTROL UNIT

RADIO FREQUENCY UNIT

A.P.116E-0231-1 2nd Edn. Oct. '67

S : : : : : : : : : : : : : : : : : : :	OUTPUT TUNE control ST. 5 TUNE control ST. 4 TUNE control ST. 6 TUNE control REUTRALISING FEEDBACK control HG TUNE control HG TUNE control HG Me/s range switch MIXER I MONITOR METERING switch RAD Mc/s range switch ST. 6 COUPLING control ST. 6 TUNE control FIL. VOLTMETER switch AUX. VOLTMETER switch	

CONTROLS

AUTO-MANUAL switch

LOCAL/REMOTE switch

AC. VOLTMETER switch

STAGE 6 FILS rheostat

STAGE 5, & RECT. FILS theosiat

ST.5 HT INTERLOCK switch
OUTPUT TUNE control

OFF & ON switch

HT VOLTS switch

RANGE control

START switch

STOP switch

HT ON switch
FREQUENCY switch

GRID CURRENT TRIP LEVEL CONTROL INTERLOCK TEST POINTS

REF

A

D

Ε

Q

METERS

STAGE 6 GRID CURRENT STAGE 6 CATHODE CURRENT ST 5 CATHODE CURRENT

ST. 4 ANODE CURRENT

ST. 5 GRID PEAK VOLTS ST. 5 GRID CURRENT

ST. 4 GRID PEAK VOLTS

MIXER METERING

FIL VOLTMETER

BP FEEDER INDICATOR

AUX VOLTMETER

REF

BA BB

BC

BD

BN

AC VOLTS

HT. VOLTS

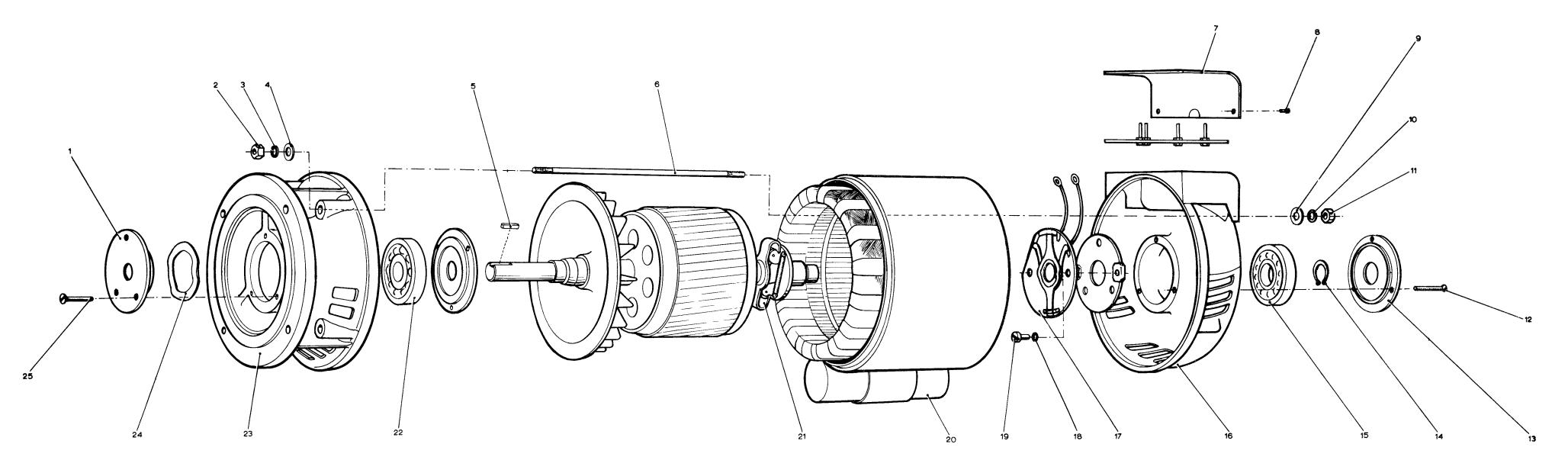
TITLE

SUCTION FAN ASSEMBLY 6105-99-622-3206

Cross Reference List for Fig.25

(Refer to Components List No.1 - page 100)

Dwg. Ref.	No.	Dwg. Ref.	No.	Dwg. Ref.	No.	Dwg. Ref.	No.
14 15	98 92	17 20	95 96	21 22	94 93	24	97



TRANSMITTERS, RADIO
TYPES T.10158, T.10158A, T.16719
T.10158A, T.16719A
(Marconi HS31, HS31 modified, HS31A
HS31/1 and HS31A/1

Supplement 1

to

A.P.116E-0231-1

2nd Edition

CONTENTS LIST

NOTE: The Section titles in this Contents List are the same as those bearing the same Section numbers in the main book (A.P.116E-0231-1).

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- 2. TRANSMITTER DIFFERENCES
- (4. DESCRIPTION OF EQUIPMENT)
 - 4.1 General
 - 4.2.5 Fuse Panel (Fuse List)
 - 4.2.8 4th and 5th R.F. Amplifier (Controls and meters)
 - (4.3 GENERAL DESCRIPTION)
 - 4.3.1 Rectifier and Control Unit
 - 4.3.2.1 Mixer Unit
 - 4.3.2.2 4th and 5th R.F. Amplifier
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 - 6.4.2 H.T. Off and Trip Re-set
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- (8. SETTING UP)
 - 8.7 SETTING UP THE OVERLOAD RELAYS
 - 8.7.1 Stage 6 Grid Current
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- (ll. MAINTENANCE)
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3.5 kW H.F. I.S.B. TRANSMITTERS Types HS31, HS31/1, HS31A and HS31A/1

1 INTRODUCTION

The Types HS31, HS31/1, HS31A, HS31A/1 are general purpose transmitters for use in the frequency range 2.5 to 27 Mc/s, HS31A and HS31A/1, covering the band 2.5 to 20 Mc/s, and the HS31 and HS31/1 the Band 4 to 27.5 Mc/s. The four transmitters are similar, but in the HS31 and HS31/1 the frequency range is covered without external changes of coils, whereas the HS31A and HS31A/1 have internal links which, set in one position, cover the band 2.5 - 17 Mc/s, and, in the other, the Band 6 - (a 20 Mc/s. External units are used to provide the drive and the type of service required. Drive frequencies are normally supplied by Type HD21 Crystal Drive Units. The type of service is supplied by various units at different intermediate frequencies depending on the service and type of transmitter. The i.f. may also be dependent on the required radiated frequency i.e. above or below 4 Mc/s.

2 TRANSMITTER DIFFERENCES

The variations in frequency range between the HS31 and HS31A and between HS31/1 and HS31A/1 transmitters cause three main differences:

- (a) in the unit identities,
- (b) in the intermediate frequencies,
- (c) in the r.f. tuning and loading circuit components.

The differences in the unit identities used in the four transmitters are clearly shown in List 2 at the front of the handbook and Table 1 following gives the differences in intermediate frequencies. The variations in r.f. tuning and loading components are covered in Section 4 (Description of Equipment).

Table 1
List of Ancillary Units and Intermediate Frequencies

HS31 ar	nd HS31/	L	HS31A and HS31A/1					
Type of Service	Aux. Unit	I.F. (Mc/s)	Aux. Unit	I.F. (Mc/s) (Above 4 Mc/s f RAD)	I.F. (Mc/s) (Below 4 Mc/s f RAD)			
FSK	HD22	3.1	HD22	3.1	6.2			
FSK Diplex	HD22	3.1	(Modified) HD22 (Modified)	3.1	6,2			
I.S.B.	HD61B HD51 SSD2	3.1 3.1	HD51 (Modified)	2.15	2.15			

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Table 1 (Contd.)

HS31 a	ind HS31/	L	HS31A and HS31A/1					
Type of Service	Aux. Unit	I.F. (Mc/s)	Aux. Unit	I.F. (Mc/s) (Above 4 Mc/s f RAD)	I.F. (Mc/s) (Below 4 Mc/s f RAD)			
D.S.B.	HD51	-	HD5l (Modified)	2.15	2,15			
C.W.	HD22		(Modified) (Modified)	3.1	6.2			

4.1 GENERAL

The information given in the main book (A.P.116E-0231-1), together with this Supplement, provides a complete manual on the Marconi Transmitter Types HS31, HS31/1, HS31A and HS31A/1. Where desirable, the main book has been amended, but where repeated references would cause complicated notes to be added this supplement has been referred to. For ease of comparison between the Supplement and A.P.116E-0231-1, the paragraph headings and numbers are the same in the Supplement as those in the main book in which the transmitter differences occur.

4.2.5 Fuse Panel

The change from a single phase r.f. unit blower in the HS31 and HS31A to a 3-phase blower in the HS31/1 and HS31A/1 causes FS4 to have a different function, and three additional fuses (FS41-43) to be needed. The table in A.P.116E-0231-1 covers the HS31 and HS31A, whilst the additional fuses for the HS31/1 and HS31A/1 are listed in Table 2, we take 2 amp. FS4 substituted for the 10 amp. fuse in HS31 and HS31A.

Table 2

Fuse	Location	Rating
FS4	Blower Starter Supply	2A
FS41	Blue Phase R.F. Unit Blower	6A
FS42	Yellow " " " "	6A
FS43	Red " " " "	6A

4.2.8 4th and 5th R.F. Amplifier

In the HS31/1 and HS31A/1 transmitters, the Stage 5 Feedback control RV3 is situated on the 4th and 5th R.F. Amplifier Panel, and provides, by means of a.f. feedback, adjustment of the envelope correction circuit in Stage 5, to minimize I.S.B. distortion.

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4.3.1 Rectifier and Control Unit

In the HS31/1 and HS31A/1 are two additional overload relays OG and OJ, mounted on a separate sub-unit at the top of the right-hand wall of the cubicle, viewed from the rear, near the rear door. These relays are operated by excess currents in the Stage 6 grid circuit or when an arc develops across the feeder capacitor (C64 in the r.f. unit).

The three-phase r.f. unit blower in the HS31/1 and HS31A/1 has a starter unit, and this, with its associated fuses FS41, 42 and 43, is mounted in front of the bias unit, immediately accessible inside the front door. This starter incorporates its own trip reset circuit operated by buttons on its front panel.

Standing on the floor of the HS31/1 and HS31A/1 cubicles are the main h.t. discharge surge limiting resistors R44-R46.

4.3.2.1 Mixer Unit

In the HS31/1 and HS31A/1 sub-units, above the Monitor Frequency Changer U-link selector sockets, is a single co-axial socket labelled MONITOR OUTPUT 3.1 Mc/s (HS31/1) 2.15 Mc/s (HS31A/1). This is an alternative outlet for the 3.1 Mc/s HS31/1 2.15 Mc/s (HS31A/1) monitoring signal for use when a Spectrum Analyser tuned to 3.1 Mc/s (HS31/1) 2.15 Mc/s (HS31A/1) is placed beside the transmitter. The roof outlet is for the cable which passes 3.1 Mc/s (HS31/1) 2.15 Mc/s (HS31A/1) to the monitoring rack in the Drive Room. To use this facility the socket must be connected to SKT on the mixer chassis when it is desired to monitor the 3.1 Mc/s (HS31/1) 2.15 Mc/s (HS31A/1) signal at the transmitter. A dummy socket SKZ is fixed to the chassis to anchor the unused plug PLT on either output.

4.3.2.2 4th and 5th R.F. Amplifier

In the HS31/1 and HS31A/1, the adjustment of an envelope correction circuit to minimize I.S.B. distortion is provided by a feedback potentiometer RV3, which is situated on the front panel.

The required tuning capacitance, which is switched into circuit with the anode tuning coil by SWA, differs in the HS31A and HS31A/1 from the HS31 and HS31/1.

In the HS31A, the tuning capacitors switched by SWA are C32 and C75, whilst in the HS31A/1 they are C75 and C76.

Storage clips are provided behind the front panel in the HS31A for storing the capacitor C76 when the transmitter is operating in the range 6.0 to 20.0 Mc/s (see Section 9.1 of this supplement).

4.3.2.3 Amplifier Stage 6

To cover the lower frequencies of the ${\tt HS31A}$ and ${\tt HS31A/1}$ the

.116E-0231-1 Edn. p.1 Oct. '67 Capacitors are switched across the anode tuning coil to cover the tuning range of the transmitter. In the HS31/1 and HS31A/1 the capacitors are on the switch assembly, SWB, which is mounted in the lower compartment of Stage 6 circuit in the top right-hand corner, and is ganged with SWA already mentioned in the description of Stage 5, Section 4.3.3.2, and with the output circuit range switch SWC, described below; SWC is shown in more detail in Sketch 'F' in Fig.4.

5.2 POWER SUPPLIES

The cooling fan in the HS31/1 and HS31A/1 differs from that in the HS31 and HS31A in that it is 3-phase and is supplied via a starter which incorporates phase failure and overload protection. Its operating coil is controlled via FS4 and ST4 relay contact.

5.2.1 Harmonic Generator

The HS31, HS31/1, HS31A and HS31A/1 transmitters have different intermediate frequencies, the HS31 and HS31/1 being 3.1 Mc/s and the HS31A and HS31A/1 2.15, 3.1 or 6.2 Mc/s. The use of 2.15 Mc/s is necessary to avoid the i.f. lying within the 2.5 - 4 Mc/s frequency band.

To allow the use of 3.1 Mc/s drive units (for economy reasons) with an HS31A or HS31A/1, the fundamental 3.1 Mc/s drive is used above 4 Mc/s radiated frequency, doubling to 6.2 Mc/s for radiated frequencies below 4 Mc/s. When this system is used monitoring exists only at radiated frequency, but equipment modified to RMC Mod. 1312, and using an I.F. of 3.1 Mc/s, will give an output at I.F. for external monitoring. Radiated frequencies between 2.9 and 3.3 Mc/s cannot, however, then be used. A crystal frequency table, to replace Table 3 below, faces Fig.9 in the main book.

The basic crystal formula of the transmitters is the same, but the primary crystal frequency range differs in each case. Table 3 shows the HS31A and HS31A/1 crystal frequency range (the range for HS31 and HS31/1 is given in Section 6.2.1 in the main book.

Table 3
Crystal Frequency Table

SWA Range	f xtal.	F	unction	f HG	Mult. Factor	
Mc/s	Mc/s	Vl	V 2	, V3	Mc/s	m
½ - 8	4.65 - 7.15 3.575 - 4	Ampl. Doubler	-	-	4.65-7.15 7.15 - 8	1 2
8 - 16	4 - 6.425 3.2125-4	Ampl. Doubler	Doubler Doubler	- -	8 - 12.85 12.85 - 16	2 4,
16 - 24.4	4-4.4625	Ampl.	Doubler	Doubler	16-17.85	4

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6.2.4 Stages 4 and 5

The Stage 5 anode tuned circuit differs in the various transmitter and Section 6.2.4 in the main book covers the HS31 and HS31/1. The following covers the HS31A and HS31A/1.

The anode tuned circuit consists of L15 and the two ceramic capacitors C32 (HS31A) C76 (HS31A/1) and C75, switched by the range switch SWA. On the lowest frequency range C32 (HS31A) C76 (HS31A/1) is connected in parallel with L15. On the next range C32 (HS31A) C76 (HS31A/1) in series with C75 is in circuit and on the other ranges, the self capacities of the valve and circuit tune the inductance.

To provide adjustment of the envelope correction circuit in the HS31/1 and HS31A/1, R27 is shunted by RV3.

In the HS31A, the output to Stage 6 is via C35 or C35 and C76 in parallel. In the HS31/1 and HS31A/1 the output to Stage 6 is via a variable vacuum capacitor (35) that is set to give the correct loading of V3 and V4; it is set up when the valves are first used and should not require resetting.

6.2.5 Stage 6

To cover the lower frequencies of the HS31A and HS31A/1, the filament chokes differ from those of the HS31 and HS31/1 already described in the main book. The following describes the HS31A and HS31A/1.

The filament chokes L30 and L31 (L34 and L35 in HS31A/1) are wound from concentric cable. One leg of V5 filament is connected to the inner conductor, the other leg to the outer conductor and the filament supply is applied to the other end. Thus the supply circuit is isolated from r.f. The cathode circuit is grounded via the centre tap of RV6 (RV1 in HS31A/1) connected between inner and outer of L31 (L35 in HS31A/1), and the meter shunt R22. Link LKB is used to short L31 (L35 in HS31A/1) out of circuit on the 6.0 to 20 Mc/s range.

In the HS31/1 and HS31A/1, the grid current flows through one winding of relay OG and excessive current will operate the trip circuits. Excessive grid current may result from feeder faults many of which cause the valve to unload with low anode current and consequently high grid current and grid dissipation.

6.2.6 Output Circuit

The HS31/1 and HS31A/1 transmitters have a suppressor circuit incorporated to suppress any arc which may occur across C64. This circuit comprises R32, C40 and relay OG in the RCU. An r.f. arc will produce a d.c. path to earth for the 50V d.c. via relay OG. OG will be energized and its contact OGl will cause OJ to be energized. The contacts of OJ de-energize the main contactor MC and lockout the transmitter via relay OR.

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In the HS31/1 and HS31A/1, feeder static leak chokes are situated in the roof of the cubicle. In the HS31A/1 these will be replaced by Filter W.102405 Ed.C when 50 ohms output impedance is provided.

6.2.7 Monitor Frequency Changer

The HS31/1 and HS31A/1 have an external monitoring point PLBF which is used when the transmitter is driving a power amplifier, thus allowing points in the power amplifier to be monitored in the same manner as described in Section 6.2.7 in the main book. Also incorporated in the HS31/1 and HS31A/1 is PLBG, which, in conjunction with PLT, SKT and SKZ, permits the use of a Spectrum Analyser tuned to 3.1 Mc/s (HS31/1) 2.15 Mc/s (HS31A/1) to be used in the transmitter hall.

6.3.1 Main H.T. Rectifier

In the HS31 and HS31A the smoothing capacitors are earthed direct whereas in the HS31/1 and HS31A/1 they are earthed via three resistors R44, 45 and 46.

6.3.5 Control Circuit Supplies

The HS31/1 and HS31A/1 cooling fans are supplied, via a starter which incorporates phase failure and overload protection, from the 3-phase a.c. input.

6.4.1 Switching-on Sequence

5(g) When, in the HS31/l and HS31A/l, the H.T. ON button SWE is pressed, the interlock pilot relay ILR will close and the main h.t. contactor MC, will 'make', energized via ODl, OEl and OJl, which are contacts of the overload relays and are normally closed, ORl and OR2, which are contacts of the overload reset relay and are normally closed, ST3 and LA3, which are contacts of the START relay and the auxiliary h.t. relay, and ILR1, which is a contact of the external circuit interlock pilot relay.

The remainder of the switching-on sequence is the same as that for the HS31 and HS31A described in Section 6.4.1 in the main book.

In the HS31/1 and HS31A/1 the external interlock circuit is incorporated in the control circuit, whereas in the HS31 and HS31A facilities exist for making it available as described in the main book.

6.4.2 H.T. OFF and Trip Reset

When SWF, the H.T. OFF and RESET button is pressed the interlock pilot relay ILR in the HS31/1 and HS31A/1 is released, with the main h.t. contactor, MC, switching off the high voltage rectifier only.

6.4.4 Overload Circuits

In the HS31/1 and HS31A/1 transmitters there are two additional overload circuits to those described in the main book, as follows:

1. Stage 6 Grid Circuit

To protect the Stage 6 valve from grid overloads a circuit, comprising SWR, R47, RV7, R51 - R55 and a coil of relay OG, is included in the grid supply line. In the HS31A/1 the grid current varies with the service and two trip settings, C.W./F.S.K. and I.S.B., are required; these are set by R52, R54 and R55 selected by SWR. In the HS31/1, the grid current varies with the service and frequency and so various trip settings are required; these are set by R51 - R55 selected by SWR.

When an overload occurs, excessive grid current through OG operates it, closing contact OGl which causes relay OJ to be energized. This relay has two contacts which are connected as the contacts of OD and OE are, and they function in a similar manner, see Section 6.4.4 in the main book.

2. Arc Protection Circuit

An arc across the Feeder Tune Capacitor completes the 50V d.c. circuit of relay 0J, which operates via relay 0G to remove the h.t., as described in Section 6.4.4 in the main book.

Reset nu STOP button.

8.7 SETTING-UP THE OVERLOAD RELAYS

The HS31/1 and HS31A/1 transmitters have additional overload relays to those described in the main book, and the following is the information necessary for the setting-up of these additional relays.

8.7.1 Stage 6 Grid Current

- (a) Set up the transmitter as described in Sections 9.1.1 9.1.4
- (b) Reduce the drive level and Stage 6 coupling, maintaining the stage 6 grid current at about 200 mA.
- (c) Turn the drive level to zero.
- (d) Turn the Stage 6 grid current trip switch to 'I.S.B. ABOVE 21 Mc/s' (HS31/1) 'I.S.B.' (HS31A/1). Increase the drive level to 100 mA (HS31/1), 150 mA (HS31A/1) Stage 6 grid current or until the trip operates, whichever is the lower.
- (e) Adjust the trip setting control RV7 until the relay operates with the grid current of 100 mA (HS31/1) 150 mA (HS31A/1).

This must be done in steps, the transmitter being switched off each time to gain access to RV7, situated at the rear of the R.F. Unit.

(f) In the HS31/1, check that the current at which the relay operates on the other switch position is as follows:

C.W. above 21 Mc/s - 200 - 250 mA I.S.B. below 21 Mc/s - 150 - 200 mA C.W. below 21 Mc/s - 280 - 350 mA

For the HS31A/1, the current at which the relay operates on the other switch position should be approximately 300 mA.

I.S.B. - 150 - 200 mA C.W. - 280 - 350 mA

8.7.2 Arc Suppression

To check the arc suppression circuits, connect a short circuit across one half of the Output Tuning Capacitor, press the START button and check that the AUX. H.T. is switched on.

Press the H.T. ON button - the OVERLOAD lamp should light immediately and it should be impossible to bring on the Main H.T. (supply path to MC open-circuit by relay contacts of OR).

8.7.3 Suction Unit and Starter

- (a) Remove the starter cover and set the overload pointer at 100% overload. The adjustment is made by a pointer situated at the left-hand side of the mechanism.
- (b) Remove all the fuses from the transmitter except FS1 4, FS23-25 and FS41-43 inclusive.
- (c) Close and lock the transmitter doors, close the main supply switch and press the START button. The suction unit should now start to run.
- (d) Press the STOP button and as the fan runs down check that the direction of rotation agrees with the arrow on the motor casing. If rotation is incorrect, reverse any two of the three motor connections; refer to the instructions on the motor terminal box.
- (e) Remove one of the three fuses FS41, 42 and 43, close the doors and press the START button. The motor should not start and will indicate overload by a clearly audible hum; within 12 seconds the starter overload should drop out, but do not keep the mains applied to

the suction unit for longer than 12 seconds under this condition otherwise damage due to overheating may occur.

If the trip out does not occur, check the wiring and, in the absence of fault, the starter should be returned to the factory. To reset the starter press the red button, after allowing approximately 5 minutes for the starter heater elements to cool down.

NOTE: Normal line current motor running 1.0 amp.

2 phases only - running, approximately 2.2 amp.

2 phases only - stalled on starting, approximately 7.0 amp.

8.11 STAGE 5-6 PRESET COUPLING CAPACITOR ADJUSTMENT

In the HS31/1 and HS31A/1, the output of Stage 5 enters Stage 6 via C35, a variable vacuum capacitor that is set to give the correct loading of V3 and V4.

The following describes the setting of C35.

- (a) Set the transmitter up for single tone operation at 21 Mc/s (HS31/1) 16 Mc/s (HS31A/1) as described in Sections 9.1.1 to 9.1.4 in the main book.
- (b) Reduce the drive level to zero and switch the I.F. Drive to 2 tone.
- (c) Increase the drive level until Stage 6 grid current reads approximately 130 mA. Check the tune of Stage 6 and then increase the Stage 6 coupling until the drive of 100 mA Stage 6 grid current corresponds to 1.1A Stage 6 cathode current. Check the tune of the feeder circuit (FEEDER TUNE) and if necessary readjust as described in Section 9.1.2 (p) in the main book.
- (d) Check and note the cathode current of Stage 5, it should be 160 mA. If not, it is necessary to adjust the variable coupling capacitor and retune to obtain the 160 mA with the Stage 6 drive at the level quoted in (c) above.
- (e) The setting of Stage 5-6 coupling achieved under the above conditions in the HS31/1 should be adequate to cover the rest of the band on all services, but will probably require adjustment if Stage 5 valves are changed.

In the HS31A/1, the setting of Stage 5-6 coupling achieved under the above conditions should be adequate to cover the range 6 - 20 Mc/s on all services. To cover the low frequency range, the above procedure is repeated at $5.6~\rm Mc/s$.

11.4 Manual Drive Assemblies

All the variable tuning controls are driven by manual drive assemblies mounted on the front panel. There are basically two types of drive assembly used, these are the single turn type and the multiturn type. The single turn types, the handles of which rotate less than 360°, are used for the RANGE switch and the FEEDER TUNE controls. The multi-turn types, the handles of which rotate a number of complete revolutions, are used for STAGE 4 TUNE, STAGE 5 TUNE, STAGE 6 TUNE and STAGE 6 COUPLING.

To set-up the manual drive assemblies it is necessary to check that:-

- (a) the dial stops are correctly set.
- (b) the components are set in the correct position.
- (c) the dials are correctly set.

The correct positions of (a), (b) and (c) for HS31/1 and HS31A/1 are listed below under the control names.

RANGE switch

- (a) Dial stops: 1, 2, 3, 4 and 5.
- (b) Components: (i) Stage 5: Switch blade making on all contacts.
 - (ii) Stage 6: Switch blade making on all contacts.
 - (iii) Feeder circuit: The switch blade should be clear of all contacts. The contacts of range 1 are not fitted.
- (c) Dial set to: 1.

FEEDER TUNE

- (a) Dial stops: 0 and 210
- (b) Components: Set the capacitor C64 to maximum capacity with padder capacitors C68-71 in circuit.
- (c) Dial set to: 0

Check that the interlock micro-switch SWM mounted on the tuning capacitor assembly opens when the capacitor reaches minimum with the fixed padders still in circuit and that the switch makes again at the maximum capacity following, in which position the fixed padders are now

out of circuit. If necessary adjust the position of the micro-switch. STAGE 4 TUNE

- (a) Dial stops: 0 and 210.
- (b) Components: Set the turret with the largest inductor (L5) connected across the capacitor Cl2. Set Cl2 to maximum capacity (ready to tune L5).
- (c) Dial set to: 0.

STAGE 5 TUNE

- (a) Dial stops: 0 and 210.
- (b) Components: Set the inductor (L15) wiper contacts to within approximately 1/8 turn (2") from the right-hand end of inductor.
- (c) Dial set to: 210.

STAGE 6 TUNE

- (a) Dial stops: 0 and 210.
- (b) Components: Set the inductor (L19) wiper contacts approximately 1/4 turn (3") from the top connection of the inductor.
- (c) Dial set to: 210.

STAGE 6 COUPLING

- (a) Dial stops: 0 and 210.
- (b) Components: Lower the inductor to the full extent of the extension rod steps, and set the inductor by rotating the front driving shaft approximately 1/2 turn.
- (c) Dial set to: 0.

STAGE 5-6 PRESET COUPLING

Adjust the variable capacitor 6 turns of the control from maximum capacity.

Slight adjustment may be required when fitting the assemblies to the couplings but the above settings allow for this. After fitting check the complete range coverage.

Supplement No.2

to

AP.116E-0231-1

2nd Edition

REMOTE (EXTENDED) CONTROL OF TRANSMITTER TYPE HS31 AT R.A.F. HITTADDU, GAN.

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REMOTE (EXTENDED) CONTROL OF TRANSMITTER TYPE HS31 AT R.A.F., HITTADDU, GAN.

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Master Components List

The Master Components List at the end of this supplement includes electrical components and selected mechanical components not covered in the mains manual AP 116E-0231-1, 2nd Edition.

INTRODUCTION

- 1. The Control Transmitter Unit provides remote operational switching of the HS31 transmitter when the transmitter is switched to remote control and lamp and meter indications of the state of the transmitter on both local and remote control.
- 2. As the HS31 is manually tuned, tuning must be completed on Local Control before switching to Remote Control.
- 3. This supplement outlines the changes incorporated by Modification Nos.A3785 and A4031 to the HS31 transmitter, and should be referred to in conjunction with the manual on Station Control, AP 116E-0244-1E, Supplement 1, Chapter 3.

REMOTE (EXTENDED) CONTROL OF TRANSMITTER

TRANSMITTER MODIFICATION

NOTE: The incorporation of this modification changes the reference identity numbers of the Transmitter HS31, and the Control Power Supply as follows:

OLD Nomenclature NEW

Ref.No.5820-99-933-2182 Transmitter Radio HS31 Ref.No.5820-99-622-8256 Ref.No.5820-99-933-2183 Control Power Supply Ref.No.5820-99-622-8255

- 4. To provide extended control facility to the Transmitter HS31 a tagstrip TB16 is added to the Control Power Supply and mounted beneath the existing tagstrip TB6, as shown in the Component Layout Change Diagram Fig.1.
- 5. Included in these changes is the addition of a Relay ILR to the Contactor Panel, and a 3-way terminal block fixed alongside the existing block TB2 in the Indicator Panel. The new terminals are numbered 13, 14 and 15.
- 6. Also included is the fitting of a Drive Muting Relay Unit H31-8827-01, Fig. 3. This unit is external to the HS31 Transmitter and is operated by the Aerial Interlock line breaking the r.f. drive to the transmitter.
- 7. Refer to the Remote Control Functional Diagram Fig.2. The HS31 Transmitter Ref.No.5820-99-622-8256 when modified, is linked to the Control Transmitter Ref.No.5820-99-972-5345 as shown. The changes to the existing wiring, and new connections, are described in detail in the Modification Leaflets A3785 and A4031 but their function is described as follows:
- TB16.1 Connects the 50V supply to energize RLA to light the AVAILABLE lamp and to be available for the START switch SA when the local/remote switch is at REMOTE.
- TB16.2 Connects the supply to the remote start pilot relay SP when the START switch is closed.
- TB16.3 & 4 Relays RLB and RLC are energized by the Auxiliary and Main H.T. contactors to light the READY and H.T. ON indicator lamps respectively.
- TB16.7 & 8 Connect the 50V supply when on REMOTE to the H.T. START switch and to the drive mute relay coil via the aerial interlock contacts.
- TB16.9 Connects the interlock relay ILR, fitted as part of the modification, which is energized via the H.T. START switch SC in the Control Transmitter, allowing the Main H.T. contactor MC to close.
- TB16.10 & 11 On REMOTE these complete the overload trip relay circuit via the reset part of SD.

REMOTE (EXTENDED) CONTROL OF TRANSMITTER

- TB16.12 Not used.
- TB16.13 Connects the transmitter trip relay RLF to light the TRANSMITTER TRIP lamp and initiate the alarm circuit.
- TB16.14 Connects the aerial trip relay RLG to light the AERIAL TRIP lamps and initiate the alarm circuit.

Drive Muting Relay Unit (H31-8827Z)

8. Refer to Fig.3. The relay socket terminals SKA3 and SKA1 are connected to the tagstrip TB16-8 and 15. R.F. sockets SKC and SKB supplied are fitted to the r.f. line which allows the unit to be connected in series; the line for the drive connected to the INPUT plug PLB, and the line to the transmitter is connected to the OUTPUT plug.

OPERATION SUMMARY

Local

9. When the transmitter is operated locally all the indicators light with the exception of the AVAILABLE lamp. This shows the central operator that the equipment is in use but not available for service by him. It should be noted that the alarm circuit is inoperative.

EXTENDED

- 10. When the transmitter has been set up and tuned locally into the required aerial, control is passed to the extended point by switching the transmitter back to Mains ON (50V d.c. lamp on) and setting the Remote/LOCAL switch to REMOTE.
- NOTE: The aerial selection which took place as part of the tuning procedure must not be changed at this time as it will affect the loading of the transmitter. If either the frequency or the aerial is changed the transmitter must be returned to Local Control and retuned.
- 11. At the control station the lamps AVAILABLE and AE INTERLOCK will show the station controller that the transmitter is under his control.
- 12. To switch on the transmitter press the START switch. Initially the START lamp will light and after approximately 35s will be extinguished and the READY lamp light.
- 13. Press the H.T. START switch:, the H.T. ON lamps will light and the transmitter is ready for use.
- 14. To switch off the transmitter press the STOP/TRIP RESET switch and all circuits will return to the state described in Para.10.

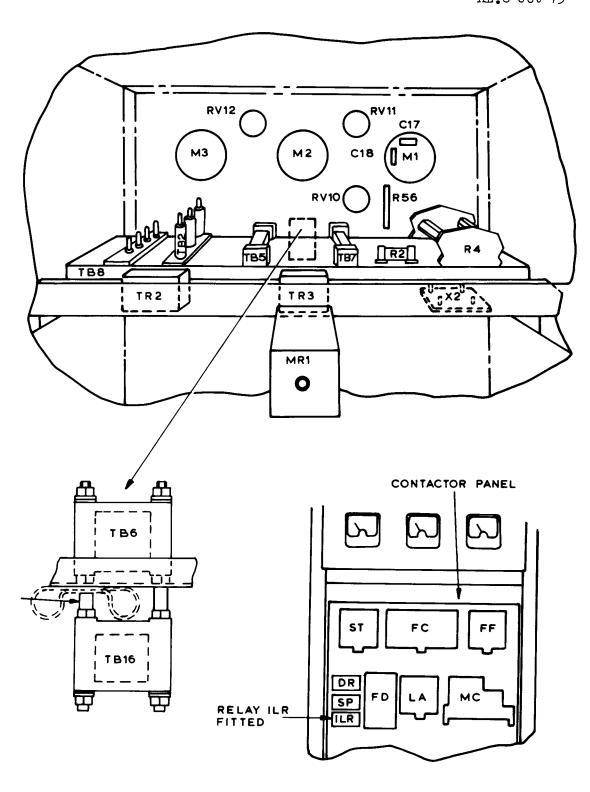
REMOTE (EXTENDED) CONTROL OF TRANSMITTER

MAINTENANCE

General

15. The Control Transmitter is fitted as an extension of the transmitter control circuits. Thus it can be proved to be faulty or not by returning to Local Control and switching on. If the transmitter becomes operative on Local Control and not on Extended Control the fault lies in the extension circuit, if it remains inoperative on both, the fault is in the transmitter.

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FUNCTIONAL DIAGRAM REMOTE CONTROL HS31 TRANSMITTER (Refer to Master Components List AP 116E-0231-1)

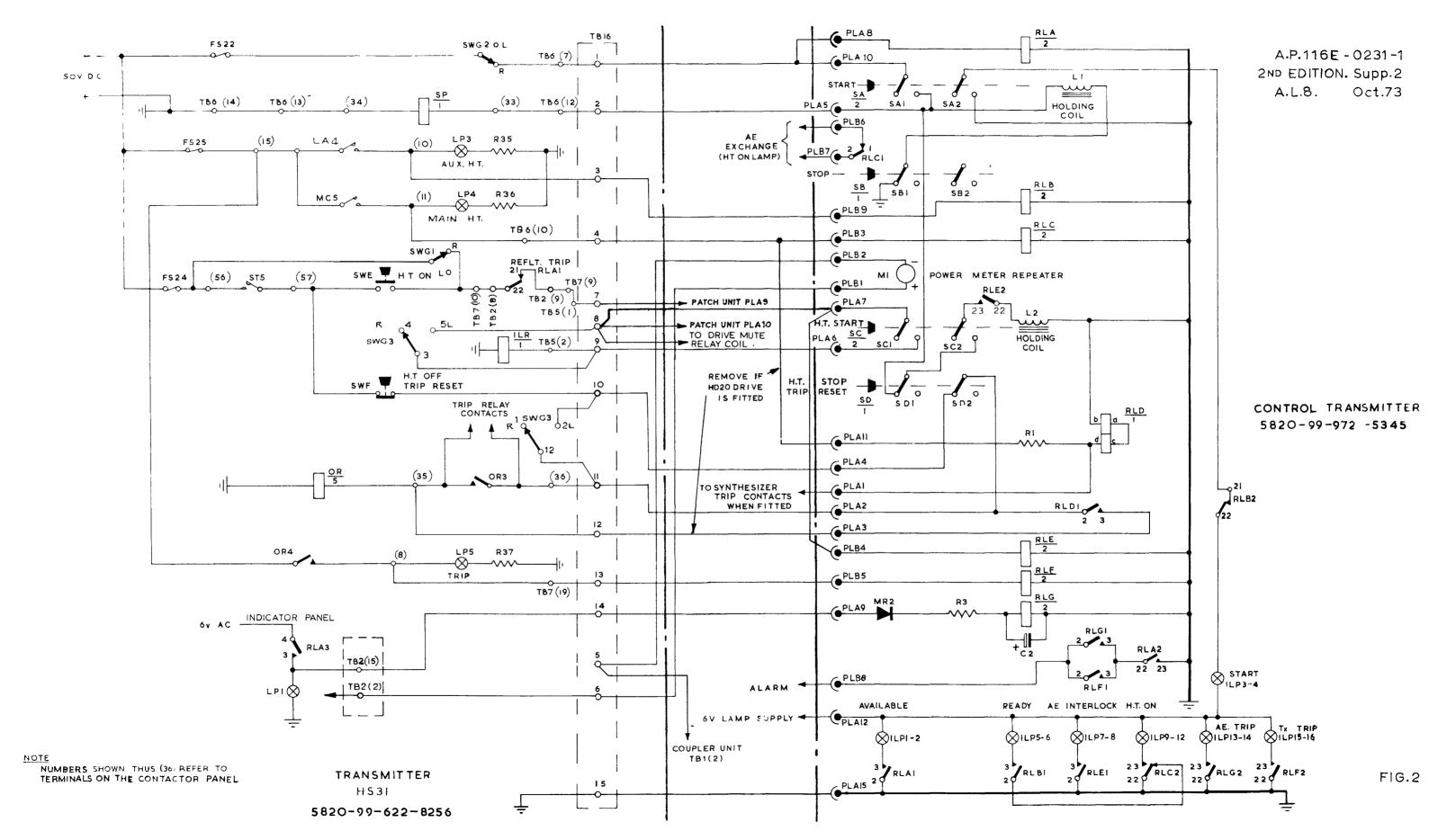
Supplement No.2

Cross Reference List for WZ.31065/D (Fig.2)

Ref.	No.	Ref.	No.	Ref.	No.	Ref.	No.	Ref.	No.	Ref.	No.	Ref.	No.	Ref.	No.
ILR	2	TB16	3												
	-	1220			: :		٠								
					:										
		-													

MISCELLANEOUS ITEMS

Socket for ILR	No. 9
End Moulding for TB16	No.13
STUD for TB16 assy.	No.18
3-way Terminal Block	No.12
(Part of TB2)	



DRIVE MUTING RELAY UNIT

(Refer to Master Components List AP 116E-0231-1)

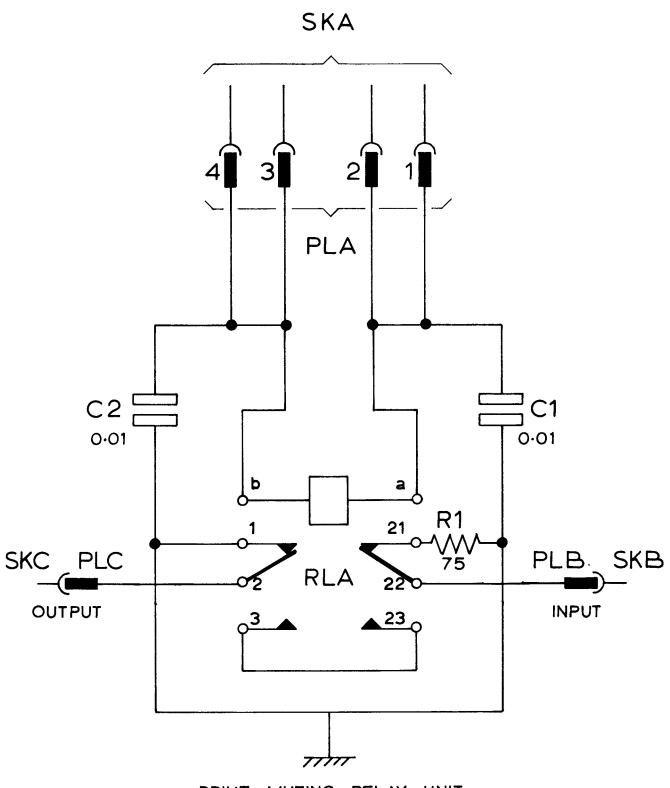
Supplement No.2

Cross Reference List for H31-8827Z (Fig. 3)

			No.	Ref.	No.	Ref.	No.	Ref.	No.	Ref.	No.	Ref.	No.	Ref.	No.
RLA	6	C1 C2	4 4	Rl	5	PLA PLB	7 8								
						PLC	8								

MISCELLANEOUS ITEMS

Socket for PLB No.10
Socket for PLC No.10



H-31-8827Z SH.1. ISSUE. 1.

DRIVE MUTING RELAY UNIT H-31-8827-01

MASTER COMPONENTS LIST FOR

TRANSMITTER (HS31) REMOTE (EXTENDED) CONTROL

No.	Description and identity	Qty.	١
1 2 3	Drive Muting Relay Unit Relay Assembly WQ.8740 Sh.1 Ed.Px Terminal Block Assembly WZ.2489/B Ed.U x	1 1 1	
4	Capacitors Ceramic, 0.01 µF +80-20% 500V d.c. PC.18207/7 5910-99-580-7490	2	
5	Resistors Fixed Metal Oxide 75\Omega \pmu 2\% \frac{1}{2}\W PC.666641/96 Relays	1	
6	2 Changeover PC.65408/5 5945-99-011-9882 Plugs	1	
7 8	4-pole 5A PC.57014/1 5935-99-580-2867 R.F. Coaxial PC.60207/1 5935-99-054-0201	1 2	
9 10 11	Sockets Heavy Duty Relay WIS.4048/B Sh.1 Ref.13 R.F. Coaxial PC.68208/1 5935-99-580-6609 4-pole 5A PC.57016/1	1 2 1	
12 13 14	Terminal Blocks 3-way WIS.1631 Sh.1 Ref.3 5820-99-900-9915 End Moulding WIS.4412/C Ref.1 Clamp Strip 97/W379087C	1 2 1	
15 16 17 18 19	Labels Mod. Record H31-8808-50 Plate Marking Blank 10AM/9905-99-913-6858 10AM/9905-99-942-9495 STUD 4\frac{1}{3} in 1g W7415/C Sh.1 Ed.28BH STUD 2BA x 2 in 1g W7415/C Sh.1 Ed.11AC	1 1 4 1	

AP 116E-0231-1 2nd Edn. Supp.2 AL.8 Oct 73 FEEDER MONITORING EQUIPMENT
FOR
TRANSMITTER
TYPE T.10158
(Marconi Type HS 31)

Technical Appendix No.1 to A.P.2922D Vol.1

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Feeder Monitoring Equipment for Transmitter Type HS31

1 INTRODUCTION

The feeder monitoring system described herein provides visual indication of transmitted power and standing wave ratio (s.w.r.) in output feeder systems and is intended for use with a transmitter fitted with coaxial output feeders of 50 ohms characteristic impedance.

Forward and reflected waves in the feeder are sampled by directional couplers inserted at a convenient point near the feeder outlet on the transmitter roof and the coupler outputs are connected to a P.O. jack socket for use with a portable plug-in reflectometer panel. The coupler outputs can also be switched to provide duplicate readings at a common meter panel located in a central position.

In the event of the s.w.r. in any output feeder exceeding a predetermined level, the h.t. of the transmitter concerned is tripped and cannot be reinstated until the cause of the abnormal level is removed.

2 EQUIPMENT LIST

2.1 Coupler Assembly

Feeder Type Type No. Drg. No.
Telecon HM9 * 2865N W.53928 Sh.6 Ed.N

* Requires 2 in/HM9 adaptors, Drg. No. T80-0249 Sh.1

2.2 Portable Reflectometer Panel (Type Sl/1 Ref. No. 6625-99-993-1343)

Type No. Drg. No. 2959G W.55604 Sh.1 Ed.G

2.3 Indicator Panel Assembly

Type No. Drg. No. 4768A W.68874 Sh.1 Ed.A

2.4 Remote Metering Equipment

Drg. No.

Meter, Power WIS.9288/B Sh.1 Ref.1
Meter, SWR WIS.4235 Sh.16 Ref.252

Relays K.300 2C, ±10%, 100V PC.64901/12

3.1 General

The forward and reflected waves on the aerial feeders are sampled at convenient points by directional couplers. Each coupler consists of a small coil supported in the space between the inner and outer conductor of a rigid coaxial feeder. One end of the coil is earthed via a resistive load and the other is brought out via an insulated bush to the external circuits. The coil is coupled both inductively and capacitively to the transmission line and the mutual inductance between the line and the coil can be varied both in magnitude and sign by rotation of the coil but the capacity is not altered to the same extent. This makes it possible to adjust the coil so that the inductive and capacitive pick-up voltages cancel, and there is no output from a wave travelling in one direction in the transmission line. For a wave in the opposite direction in which the phase relationship is reversed, the inductive and capacitive voltages will be additive and there will be a voltage output. couplers therefore are employed, one set to respond to the forward wave and the other to the reflected wave. The two couplers are arranged close together in a short length of transmission line, referred to as a coupler assembly, and their outputs are fed to circuits mounted on a platform forming part of the assembly, and enclosed by a metal cover. For brevity the directional coupler responding to the forward wave and that to the reflected wave are referred to as forward and backward couplers respectively, and their outputs are called forward and backward signals, the last designations bearing no relation to the direction of flow of these outputs in subsequent rectifying and indicating circuits.

The outputs from both couplers after passing through equalising networks which provide frequency compensation, are then rectified. The resulting currents are then fed via output terminals TB1(1) and TB1(3) to the Indicator Panel Assembly which is mounted on the transmitter front near the feeder outlet. Inside the unit the backward line current is connected to one pole (SWA1) of a TEST TRIP key switch SWA, the forward line current is similarly connected to another pole SWA2. Pole SWA3 is connected to a d.c. supply for testing and setting the h.t. trip circuit. With switch SWA in the normal position, both forward and backward line currents are fed back to the coupler via terminals TB1(4) and TB1(2) respectively, where they pass through variable resistors providing a fine sensitivity control and then through the coils of a sensitive dual wound trip relay. The latter is thereby operated at a predetermined current difference giving a trip level reasonable independent of power. The relay contacts RLA1 when closed cause relay RLA3 to operate and break the transmitter interlock circuit and trip the transmitter off.

The monitoring circuit is terminated on the frame of the coupler unit via the frame and two auxiliary contacts on a P.O. type jack. Inserting the plug attached to a portable reflectometer panel breaks the two auxiliary contacts and the circuits to earth is then completed via the portable unit and the plug sleeve.

Remote indication of transmitted power and s.w.r. is provided by a metering panel mounted in the Test Equipment Rack. A two pair cable is fed from each transmitter monitoring point to the banks of a uniselector contained in the Power and Frequency Monitor Rack. When a transmitter is selected by a key switch on the control desk the lines from the selected transmitter are connected via the uniselector to the power and s.w.r. meters located in the Test Equipment Rack.

In order to maintain the local metering and trip levels independent of the remote meters when they are switched out of circuit, an equivalent resistance is inserted in each line by means of a relay fitted with two sets of changeover contacts. One relay is provided for each transmitter to be monitored.

To cater for the different power output levels of the types of transmitter to be monitored a special triple scale power meter is used on both the portable and remote metering panels.

3.2 Coupler Assembly

3.2.1 Mechanical

The unit consists of a short cylindrical aluminium casting machined internally and fitted with a concentric inner conductor terminated in the appropriate coaxial connectors. The casting is extended to form a platform through which two directional couplers are let into holes in the platform and project into the space between inner and outer conductors. Depth of penetration is determined by a collar held by grub screws: after setting to the correct depth and rotating to the correct position the two couplers are locked in position by grub screws in bosses on the casting. On no account should their position be altered. potentiometers are supported by a bracket at one side: their spindles are locked and RV2 and RV3 which affect the meter calibration should not be disturbed. A P.O. type jack is mounted at one end of the platform and a dual wound trip relay at the other. Connections are made to a terminal block and are taken out through a hole in the platform. A rectangular cover fits over the assembly and is held in position by a single screw at the front. A hole is provided in the cover to enable the portable meter unit to be plugged into the P.O. type jack. end of the cylindrical casting is split and provided with a nut and bolt for clamping in position on the feeder.

NOTE: The arrow on the coupler body must agree with the direction of transmission.

3.2.2 Electrical

Circuit Diagrams Fig.1

In the coupler unit the forward signal is picked up by coil X2 and rectified by the germanium crystal rectifier MR2 and smoothed by the resistance-capacity network R4, C5 and C6. An identical coil X1 picks

up the backward signal which is rectified and doubled by MR1, MR4, C2 and C8. The rectified output is smoothed by R3. C2 and C3. The identical coils X1 and X2 have a rising frequency output characteristic and to compensate for this the filters C1, R1 and C4, R2 have been inserted to give a substantially flat response. The components MR3, C7 and R5 are also compensating elements to counteract the effect of nonlinear rectification at low levels.

The rectified outputs of X1 and X2 representing the backward and forward line voltages respectively, are taken to the output terminals TB1(1) and TB1(3) respectively and thence to terminals TB2(1) and TB2(3) on the Indicator Panel Assembly. Inside this unit the backward line voltage (TB2(1)) is connected to a pole of the TEST TRIP switch SWA and then via the moving contact to terminal TB2(4). The forward line voltage (TB2(3)) is connected to another pole of SWA and then via the moving contact to terminal TB2(2). Both TB2(4) and TB2(2) are connected back to the coupler assembly via terminals TB1(4) and TB1(2) respectively These terminals are connected to variable resistors RV3 and RV2 which are the fine sensitivity controls for the backward and forward currents. Coarse control is afforded by the penetration of the couplers as previously described. RV3 and RV2 are connected to a dual wound moving coil trip relay RLA. The polarities of the coils are such that the currents work in opposition, the backward current seeking to close contact RLA1 and thereby furnish a trip, and the forward current tending to hold this contact open. The forward coil of RLA is shunted by a variable resistor RVl which is used to set the trip level at which the relay will operate. The backward and forward lines from the relay coils are terminated to earth via the auxiliary contacts of jack JKA and the remote meters or via the jack ring when the portable meter is plugged in.

3.3 Indicator Panel Assembly

Circuit Diagram Fig. 2

3.3.1 Mechanical

The unit consists of a chassis on which various components are mounted and a rectangular metal cover secured by four screws. The unit is fixed in position by four screws through the rear panel. An indicator lamp and key switch project through the front face of the cover and two holes are provided for adjusting two preset potentiometers mounted on the chassis. The two position key switch is non-locking in the test position.

3.3.2 Electrical

The Indicator Panel has the following functions:-

- (a) To lock out the transmitter on a fault condition and to indicate that tripping has occurred.
- (b) To generate and apply test signals for checking the trip operation.

When the s.w.r. on the lines rises above the predetermined limit, RLA in the Coupler Unit operates and contact RLA1 connects a 50V negative control voltage to relay RLA in the Indicator Panel, causing it to operate, with rectifier MR1 acting as a spark quench. Contact RLA1 in the Indicator Panel breaks the transmitter interlock circuit, tripping the transmitter off. This results in the release of the trip relay RLA in the Coupler Unit and the breaking of contact RLA1 but contact RLA2 holds on relay RLA and prevents the transmitter being restarted. Contact RLA3 completes the circuit of the fault indicator lamp LP1.

A 6.3V a.c. supply, derived from the transmitter, enters the unit via terminals TB2(10) and (11), is rectified by MR2, smoothed by Cl and connected to potentiometers RVl and RV2, the circuit being completed through one pole of the TEST TRIP switch SWA when switched to the test position. The potentiometers RVl and RV2 are adjusted to simulate the d.c. voltages obtained from couplers Xl and X2 and are used to check visually the response of the trip circuit in the Coupler Unit. The TEST TRIP switch normally passes signals from Xl and X2 to the monitoring circuits via poles SWAl and SWA2. Potentiometer RVl and RV2 can be adjusted with a screwdriver through the two holes provided in the front panel, and in conjunction with the portable meter unit, the response of the trip circuit over the power range may be observed.

3.4 Portable Reflectometer Unit

Circuit Diagram Fig. 3

3.4.1 Mechanical

The portable reflectometer is built into a small metal box with a sloping front. It can be stood on a convenient support or may be hung on the feeder near a coupler assembly, two hooks at the back being provided for this purpose. A carrying handle is also fitted.

On the front panel are two large square faced meters, one calibrated to read power and the other to read standing wave ratio. The power meter is provided with a triple scale to cater for the different power outputs of the transmitters on the station. The scale ranges are as follows:-

Scale	Transmitter	Range kW
Top	HS.51	0-42
Middle	HS.71	0-14
Bottom	HS.31	0-4.2

The power output from each type of transmitter is read directly on the scale without switching at the panel, the outputs from the various couplers being adjusted by the maker to suit the type of transmitter to which they are to be fitted.

All components are mounted behind the front panel and the cable which is connected to the coupler assemblies by means of a jack plug, leaves the instrument through a bushed hole in the side.

3.4.2 Electrical

Circuit Diagram Fig. 3

The forward signal is applied firstly to a power indicator Ml the scale being calibrated to read outgoing power in the feeder. The scale used is determined by the response of the directional coupler circuits. The signal is then passed to the control coil of ratiometer M2 and then to earth via the case of the unit and the sleeve of plug PL. The backward signal is applied to the deflection coil of M2 and then to earth. The meter M2 indicates the ratio between the current flowing in the control coil and the current flowing in the deflector coil. The movement has no restoring spring, but any current (above a certain minimum) in the control coil will bring that coil into a neutral plane and the pointer to the zero mark. Deflection is then caused by current in the deflection coil and, by virtue of the specially shaped permanent magnet pole pieces, the deflection bears the required relationship to the current ratio. Full scale deflection is given when control and deflection currents are equal. The values of the components in the coupler circuits are so chosen that equal currents are produced when the s.w.r. in the feeder is infinite, the ratiometer scale is therefore calibrated 1 to infinity. All meter coils are bypassed by fairly large value mica capacitors Cl, C2 and C3 to prevent erroneous readings due to stray r.f. fields.

3.5 Remote Reflectometer Panel

Circuit Diagram Fig.5

This comprises a panel on which are mounted two meters, one reading power and the other s.w.r. The Power meter is identical with that fitted on the Portable Reflectometer Unit but there is an extra scale added to the s.w.r. meter to read 'Power Factor'. This gives the ratio of transmitted power to the power indicated on the power meter.

To find the power transmitted to the load the power meter reading must be multiplied by the P.F. reading since the power meter indicates the power of the forward wave, a proportion of which is reflected at the load terminals.

The power and s.w.r. for any transmitter on the station will be indicated on this panel after selecting the desired transmitter by switching at the control desk. All lines not connected through to the meter panel via the uniselector are terminated with equivalent resistances switched into circuit by relays, one relay with two sets of changeover contacts is required for each transmitter to be monitored.

4 SETTING UP

4.1 General

The Coupler Assemblies and Indicator Panels are permanently connected in the feeders at points where monitoring facilities are required. The portable reflectometer panel is intended to be carried around from one coupler to another as required. Duplicate readings are given at the remote metering panel by switching at the control desk.

4.2 Trip Levels

Proceed as follows:-

- (a) Switch on the filament and control supplies of the transmitter.
- (b) Set the POWER LEVEL and S.W.R. LEVEL controls RVl and RV2 respectively, on the Indicator Panel Assembly to minimum output.
- (c) Plug the portable reflectometer panel into the jack located in the Coupler Unit.
- (d) Depress the TEST TRIP swatch SWA in the Indicator Unit.
- (e) Adjust the POWER LEVEL control until the reading on the portable meter corresponds to 3.5 kW.
- (f) Increase S.W.R. LEVEL control slowly until the fault lamp on the Indicator Panel shows a trip, then turn the control back to minimum.
- (g) On the Rectifier and Control Unit press the H.T. OFF and RESET button: the indicator lamp should be extinguished.
- (h) Undo the locking device on potentiometer RVl in the Coupler Unit and by successively increasing the S.W.R. LEVEL, adjusting RVl and resetting the trip after each trial; continue until the trip occurs with a s.w.r. of 2 shown on the meter. Release the TEST TRIP switch and lock RVl at this setting.

5 MAINTENANCE

5.1 Coupler Units

The setting of the directional couplers should in no circumstances be altered. They are locked in position, and cannot be reset without special equipment. They should be returned to The Marconi Company Limited for recalibration if they are disturbed or damaged.

5.2 Portable Reflectometer Panel

The panel should require little attention apart from the removal of the Cable Connections if these become worn from use.

5.3 Indicator Panel Assembly

This unit should require no attention apart from the replacement of an indicator lamp in the event of a failure.

COMPONENT LIST No.2 FOR INDICATOR PANEL TYPE 4768A (Drg. No. W.68874 Sh.1 Ed.A)

NOTES 1. When ordering spares quote identity only.

- 2. References in column 1 are normally shown on the circuit and component location diagram Fig. 2.
- 3. For identical items the total quantity is given at the first entry.

Ref.	Description	Value	Tol % ±	Rating	Identity	Qty
CAPACITORS						
Cl	Electrolytic, Plain Foil, Tub.	50 μF	+100 -20	12V Peak Working	PC.18402/16	
RESIS	STORS (FIXED)					
R2	Composite Grade 2 Insulated	560Ω	±10	<u>3</u> ₩	PC.66612/16	
R3	Composite Grade 2 Insulated	8.2 kΩ	±10	<u>3</u> ₩	PC.66612/30	
R4	Composite Grade 2 Insulated	470k	±10	<u>1</u> ₩	PC.66610/57	
RESISTORS (VARIABLE)						
RVl	Wirewound Linear	5 kΩ	±10	<u>1</u> ₩	PC.67401/29	
RV2	Wirewound	5 kΩ	±10	<u>1</u> ₩	PC.67401/29	

COMPONENT LIST No.2 (contd.)

Ref.	Description	Value	Tol % ±	Rating	Identity	Qty
MISCELLANEOUS ELECTRICAL ITEMS						
LPl	Lamp ElO Clear 6.5V 2.3W				PC.48701/2	1
MRl	Rectifier Westinghouse T5D/19					1
MR 2	Rectifier CG64H					1
SWA	Switch Lever 2 Position				PC.71202/2	1
RLA	Relay 2B 2M				PC.65406/15	1
TBl	Terminal Block 12 Way				WIS.1631/1/12	1

COMPONENT LIST No.3

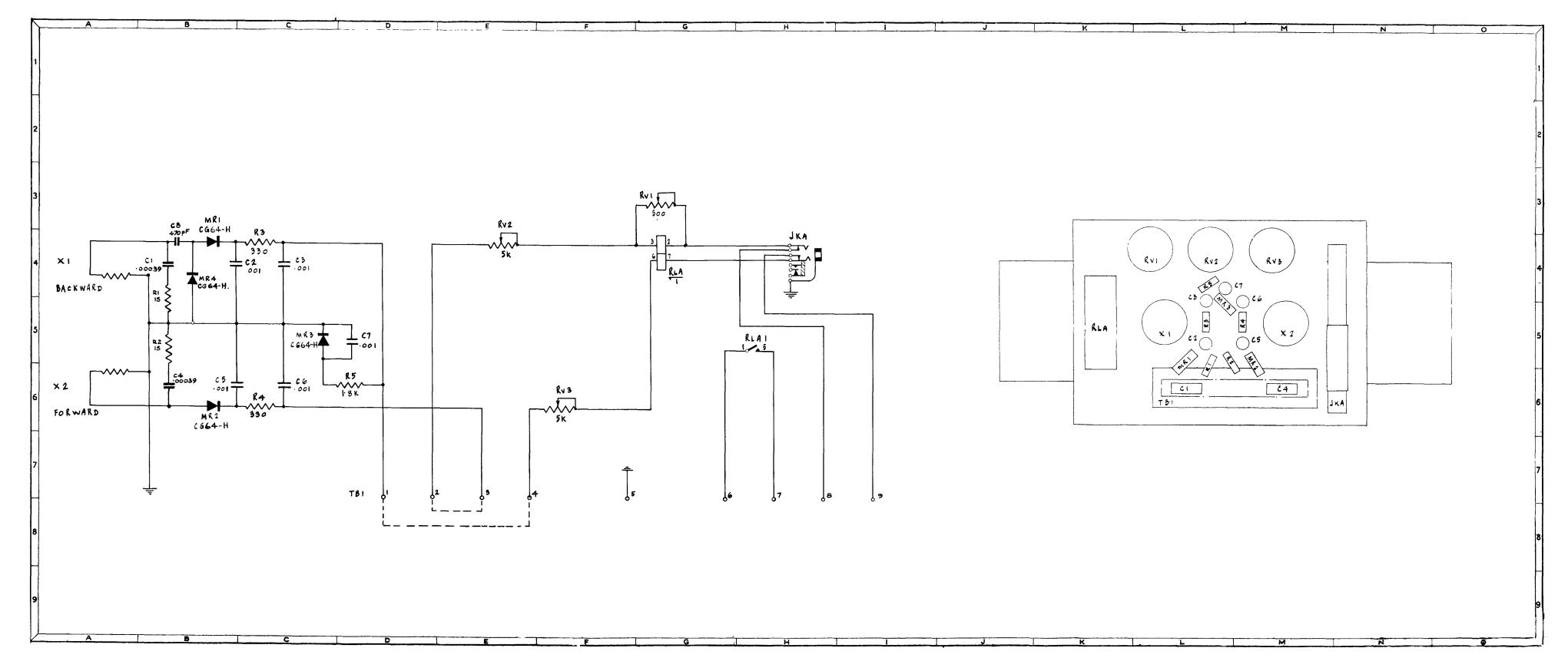
FOR

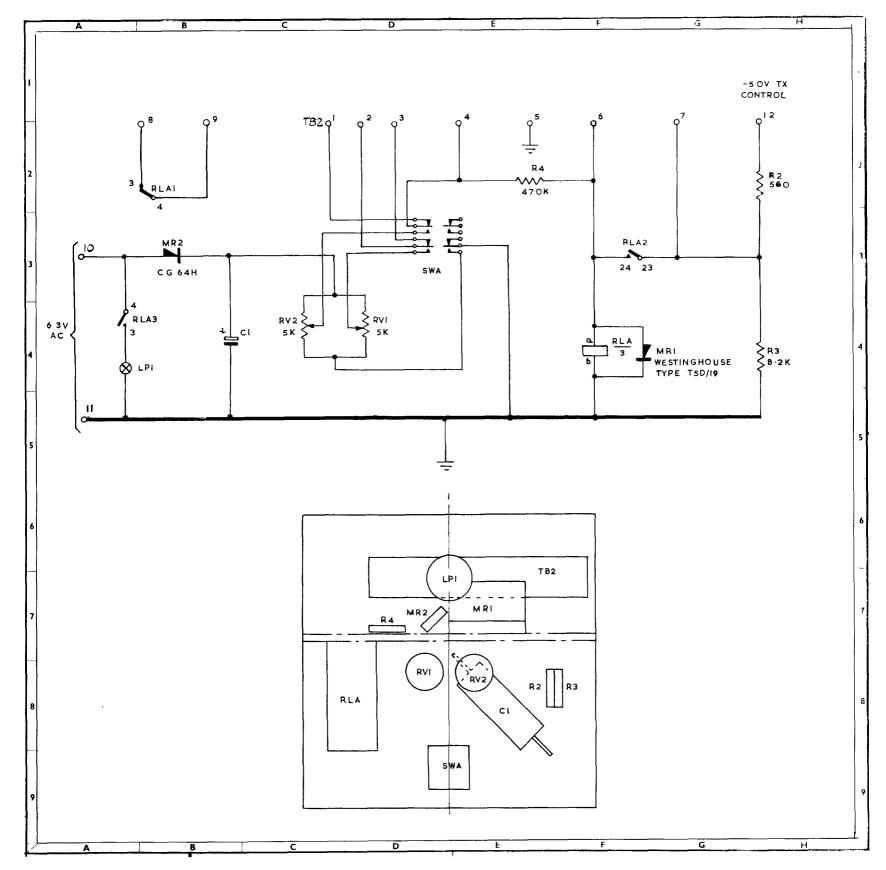
PORTABLE REFLECTOMETER PANEL TYPE 2959G (Drg. No. W.55604 Ed.G)

NOTES 1. When ordering spares quote identity only.

- 2. References in column 1 are normally shown on the circuit and component location diagram Fig. 3.
- 3. For identical items the total quantity is given at the first entry.

Ref.	Description	Value	Tol % ±	Rating	Identity	Qty
CAPACITORS						
Cl	Mica	0.01 μF	± 20	350 v	PC.18701/5	3
C2	Mica	0.01 μF	± 20	350V	PC.18701/5	
C3	Mica	0.01 μF	± 20	350V	PC.18701/5	
MISCELLANEOUS ELECTRICAL ITEMS						
PLA	Plug G.P.O. Type 316				WIS.2499/1	1
TBl	Terminal Block				W.21523/C/1/M	1
Ml	Power Indicator Meter				WIS.9288/B/1/1	1
M2	Ratiometer				WIS.4235/16/253	1





A.L.3 to A.P.2922D Feb. 1964 INDICATOR PANEL ASSEMBLY
CIRCUIT DIAGRAM AND COMPONENT LAYOUT
WZ.31015/B Sh.1 Iss.3

