OPERATING AND MAINTENANCE INSTRUCTIONS FOR K-156-B & B/1 F.S.K./A.M. CONVERTERS

OPERATING AND MAINTENANCE INSTRUCTIONS FOR K-156-B & B/1 F.S.K./A.M. CONVERTERS

Serial No.....

Please quote this number when ordering spares or requiring service

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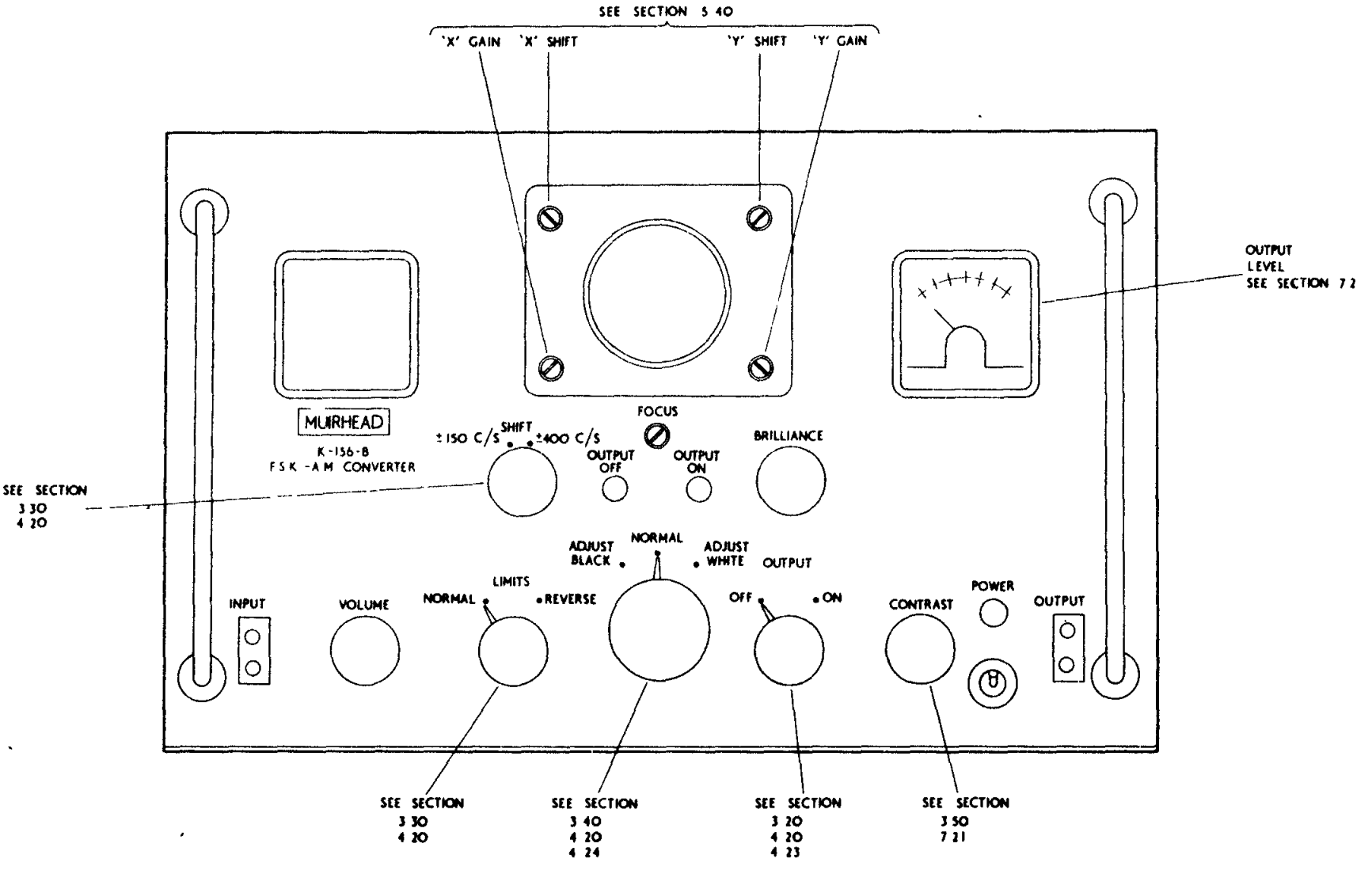
4525 7.63

MUIRHEAD & CO. LIMITED BECKENHAM KENT ENGLAND



GUIDE TO OPERATING CONTROLS K-156-B

1 00 SPECIFICATION

Input Signal	Centre Frequency 2550c/s
Frequency Shift	±400c/s or ±150c/s
Input Level	+10 to -50dB, ref 1mW into 600 ohm
Input Impedance	600 ohm balanced
Output Signal	Amplitude modulated carrier frequency of 1800c/s. (Can be supplied within the range 1500c/s - 2400c/s.)
Output Level	600 ohm
Contrast Ratio	12 to 30dB; continuously variable
Power Supplies	105 - 125 / 200 - 240 } 50/60c/s
Power Consumption	60VA approx
Dimensions	17-1/2in wide x 10-1/2in high x 13in deep (44·5cm x 26·7cm x 33cm)
Weight	46lb (21kg.)

2 00 GENERAL DESCRIPTION

The K-156-B and K-156-B/1 F S K /A.M. Converters have been introduced to enable certain Mufax Chart Recorders to operate unattended over radio circuits. Once the Converter and Radio Receiver have been set up to the required transmitting station no further adjustments are required, as each transmission phases and closes down the Recorder automatically.

The end limit frequencies are checked and adjusted with the aid of the internal cathode ray oscilloscope and check oscillator without interrupting the output signal to the Recorder.

The K-156-B is normally bench mounted, but extension pieces can be supplied for mounting in a standard 19inch rack frame.

The K-156-B/1 is designed specifically for mounting in a 19inch rack frame.

3 00 OPERATING CONTROLS

3.10 SHIFT SWITCH (S8)
This switch is set to the position which corresponds to the frequency shift of the required transmission. For transmission frequencies below 200kc/s the frequency shift will, in general, be ±150c/s, and for transmission frequencies above 1000kc/s it will be ±400c/s.

3.20 OUTPUT SWITCH (S4)
This switch controls the output to the recorder.

At OFF, the output to the Recorder is disconnected. The position is normally used while the initial setting up of the Radio Receiver is being carried out.

At ON, the output to the Recorder is continuous.

3.30 LIMIT SWITCH (S2)

This switch is usually set at NORMAL and the b.f.o. control of the Radio Receiver adjusted for either the black or the white limit frequency, depending on the transmission content. If, however, the b.f.o. has been adjusted to the wrong limit frequency, the input signal to the Converter will be inverted. This will cause the Converter, in turn, to send incorrect signals to the Recorder. To save readjustments of the b.f.o. and/or the main tuning controls, the LIMITS switch should be set to REVERSE, when the required inversion will take place.

3.40 ADJUST BLACK - NORMAL - ADJUST WHITE switch (S6)

This switch selects the presentation of the c.r.o. At ADJUST BLACK and ADJUST WHITE lissajous presentations are obtained, whereby the received signals are compared against the internal oscillator, the output of which corresponds to the appropriate limit frequency. When there is no transmission in progress, the received signal is usually 'whiter than white', i.e. the frequency of the Receiver's output is higher than the white limit frequency. Therefore, with the switch in the ADJUST WHITE position, the b.f.o. of the Radio Receiver can be approximately set before the transmission starts.

With the switch at NORMAL, the output signal from the Converter is displayed on the c.r.o. against the internally generated time base, thus allowing the contrast ratio and waveform shape of the output signal to be checked.

3.50 CONTRAST CONTROL (RV3)

If this control is set fully counter-clockwise, and the radio receiver has been correctly set up, the contrast ratio should be approximately 4 : 1. The contrast of the output signal may be adjusted by this control, but it should be used discriminately keeping the actual chart results in mind. An excessive increase in contrast will tend to intensify the darker grey tones and weaken the lighter ones, producing a thickening of some characters and the removal of others.

3.60 SERVICING SWITCH (S1)

The various positions of this switch enable certain checks to be made on the operation of the converter without the use of external equipment.

3.70 CHECK INPUT LEVEL SWITCH (S5)

This is a push button switch which, when depressed, connects the line input signal to the panel meter.

4.00 OPERATION

4.10 CONNEXIONS

Set the voltage selector, at the rear of the Converter, to the position which corresponds to the local power supply.

Connect the power supply to the Converter via the three pin plug (PL3) at the rear. The pin opposite the key-way should be connected to earth.

Connect the lines from the Radio Receiver to the terminal strip (TS1) at the rear of the Converter. (On earlier models, there is also a socket (INPUT) on the front panel, that is in parallel with TS1).

Connect the Converter to the Recorder with a line taken from the terminal strip (TS2) at the rear of the Converte (On earlier models there is also a socket (OUTPUT) on the front panel, that is in parallel with TS2).

4.20 OPERATION PROCEDURE

NOTE: This Converter is primarily intended to work with recorders that have Start/Stop signalling facilities, and for operation with these recorders, the procedure is as laid down below.

For those recorders which do not have these facilities, however, unattended operation can be achieved under the control of the OUTPUT ON/OFF switch. Thus with the Converter set up as laid down below, set the OUTPUT switch to ON, on receipt of the phasing signal. The recorder will operate automatically. Similarly, at the end of a transmission, set the OUTPUT switch to OFF. The recorder will close down.

Set the OUTPUT switch to OFF and turn the BRILLIANCE control counter-clockwise.

Set the power supply ON/OFF switch to ON and note that the amber and red lamps light.

Allow approximately five minutes for the Converter to warm up and stabilize.

Check that the SERVICING switch, at the rear of the Converter is at NORMAL.

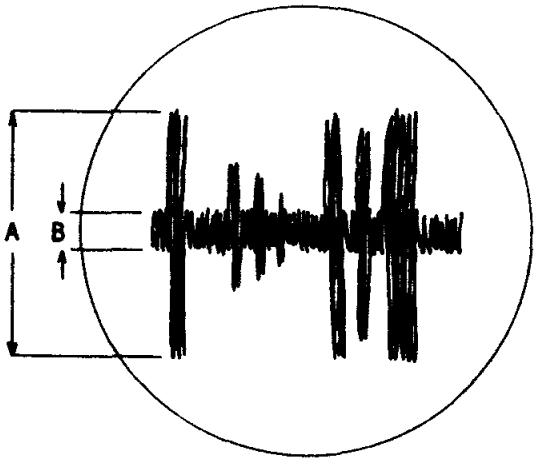
Determine, if possible, whether the transmission to be received contains the recognised Start/Stop signals and set up the recorder appropriately.

Tune the Radio Receiver to the required station; the input level to the Converter should be approximately 0dBm to enable it to function satisfactorily despite fading signals. Set the Controls on the Converter to the following positions:-

Set the SHIFT switch to either ±150c/s or ±400c/s depending upon the required transmission frequency shift.
Set the ADJUST BLACK-NORMAL-ADJUST WHITE switch to NORMAL.
Set the LIMITS switch to NORMAL.
Adjust the volume control until the received signal is clearly audible.

4.21 Switching on During a Transmission

If the note heard is a rhythmic tone, interrupted by regular pulses, then the chart transmission is in progress. Turn the BRILLIANCE control clockwise and view the presentation on the oscilloscope. Adjust the b.f.o. control of the Radio Receiver to obtain a presentation, the appearance of which is similar to that shown in the sketch. This is an approximate setting for the b.f.o. control.



$\frac{A}{B}$ = Contrast Ratio · A = Black Level
B = White Level

Set the ADJUST BLACK-NORMAL-ADJUST WHITE switch to ADJUST WHITE and adjust the b.f.o. control for a 1 : 1 lissajous on the oscilloscope. This is a final adjustment of the b.f.o. control and, provided that the approximate setting has been carried out correctly, no great alteration of its setting should be required. Reset the ADJUST BLACK-NORMAL-ADJUST WHITE switch to NORMAL and check that the presentation is clearly defined as shown in the sketch.

If this transmission is required, set the OUTPUT switch to ON and operate the recorder manually.

Set the CONTRAST control, as required, to achieve a satisfactory contrast ratio on the record.

If this transmission is not required, set the OUTPUT switch to OFF.

4.22 Switching On Prior to a Transmission

If the noise heard in the loudspeaker is the interval signal between transmissions - this may be a long white, a long black or even an inverted phasing pulse - only an approximate setting of the b.f.o. control can be made, the final adjustment being made during the actual chart transmission.

Adjust the b.f.o. control until a clearly defined presentation is obtained on the oscilloscope.

Set the ADJUST BLACK-NORMAL-ADJUST WHITE switch to either ADJUST BLACK or ADJUST WHITE, depending upon the interval signal being received, and adjust the b.f.o. control to obtain a 1 : 1 lissajous.

Set the OUTPUT switch to ON.

When the recorder operates, set the ADJUST BLACK-NORMAL-ADJUST WHITE switch to ADJUST WHITE and trim the b.f.o. control for a 1 : 1 lissajous.

Set the ADJUST BLACK-NORMAL-ADJUST WHITE switch to NORMAL and check that the oscilloscope presentation is clearly defined, as shown in the sketch.

Set the CONTRAST control, as required, to achieve a satisfactory contrast ratio on the record.

4.23 To Check Limits

During a transmission, the white limit of the received signal may be checked at any time, without interrupting the signal to the Recorder, by using the ADJUST BLACK-NORMAL-ADJUST WHITE switch.

5.00 CIRCUIT DESCRIPTION

5.10 LIMITER AND DISCRIMINATOR

The input to the limiter stage is derived from the input transformer T1 via the Band Pass Filter BPF1. The Band Pass Filter has a pass band of 1000c/s - 4000c/s to allow the sidebands of the centre frequency to be accepted without attenuation. The three stage limiter circuit comprising V1, V2, V3 and associated components, successively limits and amplifies the receiver's output signal to remove any variations in amplitude. The resultant constant-amplitude f.m. signal is then fed to the discriminator circuit, V4 and associated components.

The discriminator consists of an amplifier (V4) with two tuned transformers connected in series for an anode load, their tuning points being above and below the extremes of the frequency shift. Across the secondary winding of each transformer is a bridge rectifier and the resultant d.c. voltage outputs are added in opposition, one side of the output being earthed by the LIMITS switch S2. Thus, as the input to V4 varies in frequency,

so the output of the discriminator (at S2) varies in d.c amplitude and polarity; the output for black being positive, and the output for white negative

By means of the DISC BAL potentiometer RV1, the output for a black signal input is arranged to be equal and opposite in sign to the output for a white signal input The output of the discriminator for a centre frequency (2550c/s) input is, therefore, zero.

When the frequency shift is ±150c/s, a capacitor C45 is added across the cathode load of V4 to increase the stage gain, so that the output of the discriminator has an amplitude for ±150c/s shift similar to that for ±400c/s shift.

The Low Pass Filter LPF1 removes all frequencies above 1800c/s without influencing the modulation frequencies of the chart information.

5.20 REMODULATOR

This circuit consists of T2, V5 T3 and associated components. The output of the Low Pass Filter LPF1 is fed to the CONTRAST control RV3, the signal at the slider of which is fed to the centre-tapped secondary winding of transformer T2. The signal at this point is limited in positive amplitude by the clamping action of MR9 which is biased by the positive potential of the divider network R21 and RV4 (SET BLACK)

The carrier frequency for the modulator is derived from the anode tuned oscillator circuit, V11a and associated components The output signal from this circuit is fed via RV2 (MOD. INPUT) to the primary of transformer T2.

From the secondary winding of T2 both the carrier and modulation signals are applied to the grids of V5a and V5b.

The depth of modulation control, RV6 (MOD. CONTRAST) determines the grid bias of the valves and, therefore, the operating point. RV5 (MOD. BAL) enables the remodulator to be balanced for minimum modulation frequencies in the output.

The amplitude modulated output of V5 (a and b) is transformer coupled to the output pad R28, R29, R30 and R31, and the output to line is taken via the OUTPUT switch (S4), in the ON position.

5.30 LIMITS OSCILLATOR

The limits oscillator consists of V11b and associated components. By means of the SERVICING switch (S1) and the SHIFT switch (S8) any of five test signals (2150c/s, 2400c/s, 2550c/s, 2700c/s and 2950c/s can be selected. These signals correspond to the limit and centre frequencies for both types of frequency shift normally employed, and are used for checking the operating of the Converter without using an external oscillator. These signals are applied to the input of the Band Pass Filter and Limiter, and enable the discriminator to be balanced, and the Remodulator to be adjusted for output and contrast. In normal use, the limit signals are selected by the ADJUST BLACK-NORMAL-ADJUST WHITE switch, (S6), in conjunction with the SHIFT switch (S8) and are used to set up the b.f.o. of the Radio Receiver

5.40 CATHODE RAY OSCILLOSCOPE AND ANCILLIARY CIRCUITS

When the ADJUST BLACK-NORMAL-ADJUST WHITE switch is at NORMAL, a presentation of the Remodulator output signal is displayed on the c.r.t. against a time base derived from V12, a cold cathode diode The time base circuit generates a saw-tooth wave form which is applied to the grid of V13 via the X GAIN potentiometer RV11. The signal on pin 2 of V13 is cathode coupled to Pin 7, and the outputs from the two anodes,

which are in anti-phase, are applied to the X plates of the c.r.t.

A signal from the remodulator output transformer T3 is applied to the grid of V14, via RV14 (Y GAIN control). V14 is a cathode coupled push-pull amplifier and the two anode outputs are applied to the 'Y' plates of the c.r.t. X & Y shift is provided by means of RV12 and RV13, which control the bias on the grids of V13 and V14.

When the ADJUST BLACK-NORMAL-ADJUST WHITE switch is in either the ADJUST BLACK or ADJUST WHITE position, the output of the discriminator circuit is applied to the Y amplifier V14 and the appropriate limit frequency from the limits oscillator is connected to the X amplifier V13. This enables the b.f.o. of the radio receiver to be checked and the position to which the ADJUST BLACK-NORMAL-ADJUST WHITE switch is set depends upon whether the received signal contains a majority of 'black' or 'white'. The presentation on the c.r.o. will be a lissajous of 1 : 1 if the b.f.o. control of the radio receiver has been correctly adjusted.

The controls of the c.r.t. are mounted on the display panel, the shift controls being in the top corners and the gain controls in the bottom corners. The two left hand controls are for the X amplifier and the two right hand controls are for the Y amplfier.

5.50 LOUDSPEAKER AMPLIFIER

This is a conventional two stage amplifier, with feedback from T4 to V6a cathode, used for audio monitoring of the input signals.

5.60 POWER SUPPLIES

All the power supplies required by the converter are derived from the power supply transformer T5. H.T.1, H.T.2 and H.T.3 are derived from the same winding, H.T.3 being stabilized by V16.

H.T.4 the -400V d.c. supply is derived from a separate winding and supplies the additional voltage required by the c.r.t. and the bias voltage for the detector stages.

6.00 TEST VOLTAGES

The following voltages are typical values only and a tolerance of ±10% is allowable. They should be measured with a 20 000 ohm/volt test meter, with the Converter working from a nominal power supply voltage and with the operating controls in the relevant positions. All voltages are with respect to earth.

6.10 POWER SUPPLY

TEST POINT	D.C. VOLTS	REMARKS
H.T.1 Junction of R99 & C42	320V	
H.T.2 Junction of R100 & R101	230V	
H.T.3 Junction of R101 & V16 pin 5	150V	
H.T.4 Negative terminal of C44	-400V	

6.20 LIMITER AND DISCRIMINATOR

Set S1 (SERVICING)to CHECK BLACK and S8 (SHIFT) to ±400c/s.

TEST POINT	D.C. VOLTS	REMARKS
V1 pin 1	125V	
pins 3 & 8	1·5V	
pin 6	95V	
V2 pin 1	125V	
pins 3 & 8	2·2V	
pin 6	95V	
V3 pin 1	125V	
pins 3 & 8	5·8V	
pin 6	120V	
V4 pins 1 & 6	125V	
pins 3 & 8	5V	

6.30 REMODULATOR

TEST POINT	D.C. VOLTS	REMARKS
T3 pin 2	115V	
RV5 Slider	1·1V approx.	Dependent upon the setting of RV5 & RV6

6.40 LOUDSPEAKER AMPLIFIER

TEST POINT	D.C. VOLTS	REMARKS
V6 pin 1	120V	
pin 3	1·8V	
pin 6	280V	
pin 8	3·7V	

6.50 CARRIER AND LIMITS OSCILLATOR

TEST POINT	D.C. VOLTS	REMARKS
V11 pin 1	135V	
pin 3	17V	
pin 6	63V	
pin 8	6·5V	

6.60 X AND Y AMPLIFIER

TEST POINT	D.C. VOLTS	REMARKS
V13 pin 1	220V	
pins 3 & 8	52V	
pin 6	220V	
V14 pin 1	220V	
pins 3 & 8	52V	
pin 6	220V	

TEST POINT	D.C. VOLTS	REMARKS
V15 pins 6, 7, 9, & 10	220V	
pin 8	230V	
pin 1	250V approx.	Dependent upon the setting of RV15

7.00 ADJUSTMENT

Should it be necessary to change a valve in any of the following stages of the Converter, the appropriate readjustment procedure should be carried out as laid down below.

7.10 DISCRIMINATOR (V4)
Set the SERVICING switch (S1) to CHECK NULL and connect an external d.c. voltmeter between pin 1 of the Low Pass Filter (LPF1) and earth.

Set the SHIFT switch (S8) to each position in turn, and adjust the DISC. BAL control RV1 so that the two readings obtained are symmetrical about zero.

7.20 REMODULATOR (V5)
Set the SERVICING switch (S1) to MOD. BAL and adjust the MOD. BAL control (RV5) to obtain a minimum signal on the oscilloscope.

7.21 To set up the Contrast and Output Levels
Set the SERVICING switch (S1) to CHECK BLACK, the SHIFT switch (S8) to ±400c/s and the ADJUST BLACK-NORMAL-ADJUST WHITE switch (S6) to NORMAL.

Turn the SET BLACK control (RV4) fully clockwise and the CONTRAST control (RV3) fully counter-clockwise.

(a) Adjust the MOD. INPUT control for a reading of 0dB on the panel meter. Note the amplitude of the signal on the oscilloscope.
(b) Set the SERVICING switch to CHECK WHITE, and adjust the MOD. CONTRAST control (RV6) for approximately 12dB down on the meter reading (or for 1/4 of the original oscilloscope reading).

Repeat (a) and (b) until the levels stated are obtained without further readjustment of RV2 and RV6. This gives the correct contrast ratio of 4 : 1 which corresponds to the 12dB change required from maximum signal (black) to minimum signal (white).

It is now necessary to reset the SET BLACK control (RV4). Set the SERVICING switch (S1) to CHECK BLACK and turn the CONTRAST control (RV3) fully counter-clockwise. Slowly rotate the SET BLACK control (RV4) counter-clockwise, until the panel meter reading just begins to decrease. If the CONTRAST control (RV3) is now rotated over its whole range, any change in the meter reading should be less than 0·5dB. If this condition is not obtained, make a further adjustment of the SET BLACK control RV4 and repeat the check

SPARES AND REPLACEMENT PARTS

To ensure speedy attention when ordering spares or replacement parts, please ensure that items are adequately described. The following details should be given when ordering electronic components:-

(a) The Type Number and description of the equipment.

(b) The location of the component. (If fitted on a printed-circuit board give the PC number printed on the board).

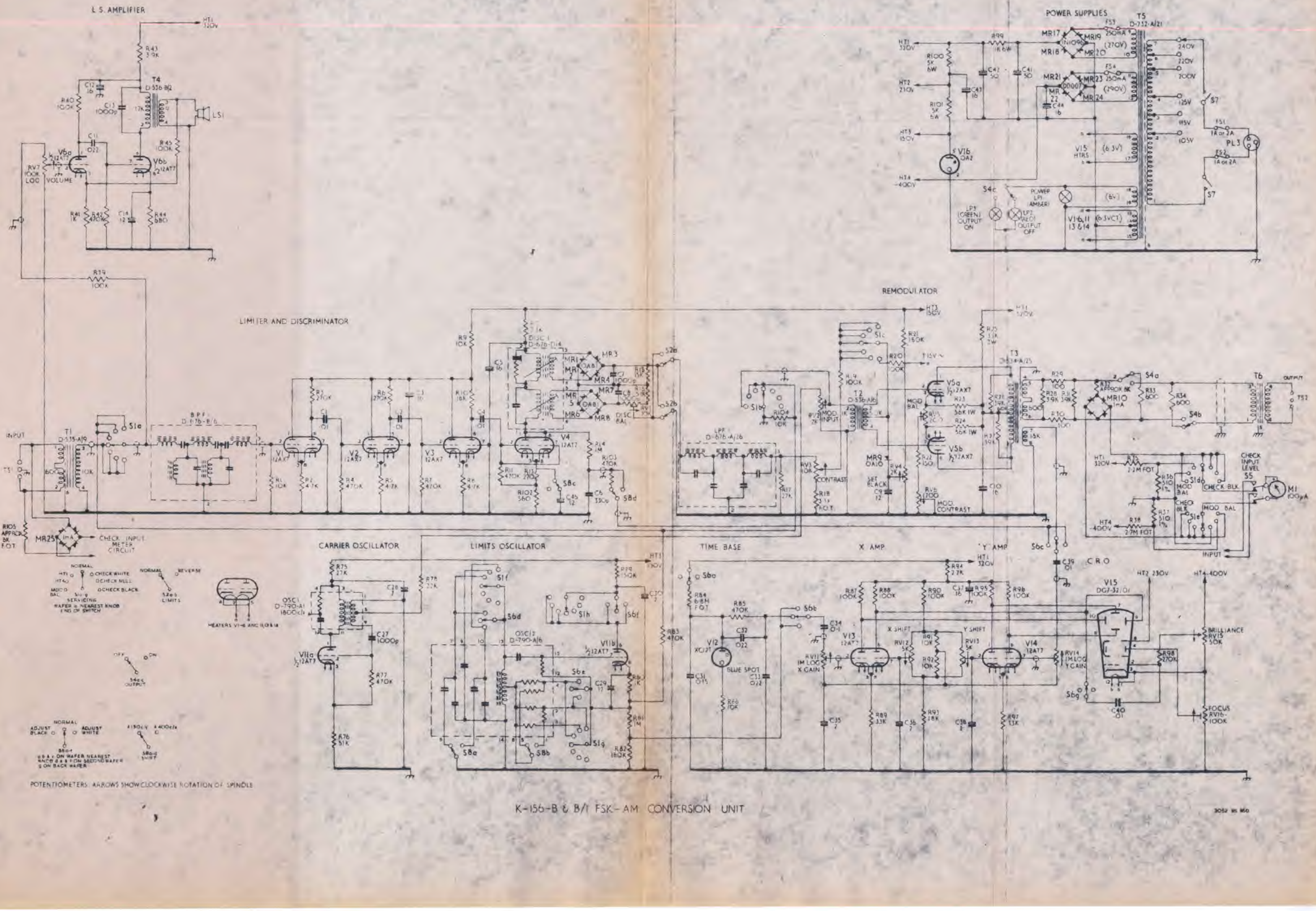
(c) The component reference as given on the circuit diagram or printed on the printed-circuit board.

(d) A description of the item and the Ordering Reference as quoted in the relevant components code sheet.

Note: When ordering "Value as fitted" components, please give the above information where possible plus any details appearing on the component.

COMPONENTS LIST

The following lists give details of components to be used as replacements. Whilst every endeavour is made to supply spare and replacement parts of the same description as those given in the lists, Muirhead Limited reserve the right to supply alternative components when items listed are unobtainable.



K-156-B & B/1 FSK-AM CONVERSION UNIT

L.S. AMPLIFIER

POWER SUPPLIES

LIMITER AND DISCRIMINATOR

REMODULATOR

CARRIER OSCILLATOR

LIMITS OSCILLATOR

TIME BASE

X AMP

Y AMP

POTENTIOMETERS ARROWS SHOW CLOCKWISE ROTATION OF SPINDLE

K-156-B & B/1 FSK-AM CONVERSION UNIT

CODE	DESCRIPTION	ORDERING REFERENCE
	CAPACITORS	
C1	0·01µF 400V Mullard C296AC/A10K	22 294 156
C2	0·01µF 400V Mullard C296AC/A10K	22 294 156
C3	16µF 450V Plessey CE 883/1 (16+16+16 with C5 and C12)	22 820 010
C4	0·01µF 400V Mullard C296AC/A10K	22 294 156
C5	16µF 450V Plessey CE 883/1 (16+16+16 with C3 and C12)	22 820 010
C6	330pF Dubilier 635 Silver Mica	22 169 006
C7	1000pF Dubilier 635 Silver Mica	22 224 006
C8	1000pF Dubilier 635 Silver Mica	22 224 006
C9	12µF 25V Plessey CE 1375/1	22 483 010
C10	16µF 450V Plessey CE 883/1 (16+16+16 with C37 and C43)	22 820 010
C11	0·022µF 400V Mullard C296AC/A22K	22 308 046
C12	16µF 450V Plessey CE 883/1 (16+16+16 with C3 and C5)	22 820 010
C13	1000pF Dubilier 635 Silver Mica	22 224 006
C14	12µF 25V Plessey CE 1375/1	22 483 010
C27	1000pF Dubilier 635 Silver Mica	22 224 006
C28	2µF 150V Plessey CE 1283/1	22 441 040
C29	12µF 25V Plessey CE 1375/1	22 483 010
C30	2µF 150V Plessey CE 1283/1	22 441 040
C31	0·15µF 400V Mullard C296AC/A150K	22 378 096
C32	0·022µF 400V Mullard C296AC/A22K	22 308 046
C33	0·022µF 400V Mullard C296AC/A22K	22 308 046
C34	0·1µF 400V Mullard C296AC/A100K	22 371 243
C35	2µF 150V Plessey CE 1283/1	22 441 040
C36	2µF 150V Plessey CE 1283/1	22 441 040
C37	16µF 450V Plessey CE 883/1 (16+16+16 with C10 and C43)	22 820 010
C38	2µF 150V Plessey CE 1283/1	22 441 040
C39	0·01µF 400V Mullard C296AC/A10K	22 294 156
C40	0·01µF 400V Mullard C296AC/A10K	22 294 156
C41	50µF 500V Plessey CE8053/1 (50+50µF with C42)	22 780 030
C42	50µF 500V Plessey CE 8053/1 (50+50µF with C41)	22 780 03
C43	16µF 450V Plessey CE 883/1 (16+16+16 with C10 and C37)	22 820 01
C44	16µF 450V Plessey CE 809/1	22 497 1
C45	12µF 25V Plessey CE 1375/1	22 483 01
	RESISTORS	
R1	10kΩ ±5% 1/2W	20 403 1
R2	4·7kΩ ±5% 1/2W	20 402 5
R3	270kΩ ±5% 1/2W	20 404 4
R4	470kΩ ±5% 1/2W	20 404 5
R5	4·7kΩ ±5% 1/2W	20 402 5
R6	270kΩ ±5% 1/2W	20 404 4
R7	470kΩ ±5% 1/2W	20 404 5
R8	4·7kΩ ±5% 1/2W	20 402 5
R9	10kΩ ±5% 1/2W	20 403 1
R10	18kΩ ±5% 1/2W	20 403 3
R11	470kΩ ±5% 1/2W	20 404 5
R12	3·3kΩ ±5% 1/2W	20 402 3
R13	270Ω ±5% 1/2W	20 401 2
R14	1MΩ ±5% 1/2W	20 405 1
R15	15kΩ ±5% 1/2W	20 403 2
R16	1·2Ω ±5% 1/2W	20 403 0
R17	27kΩ ±5% 1/2W	20 403 4
R18	3·3kΩ ±5% 1/2W	20 402 3
R19	100kΩ ±5% 1/2W	20 404 2
R20	100kΩ ±5% 1/2W	20 404 2
R21	180Ω ±5% 1/2W	20 404 3
R22	150Ω ±5% 1/2W	20 401 0
R23	56kΩ ±5% 1W	20 424 0
R24	56kΩ ±5% 1W	20 424 0
R25	33kΩ ±5% 2W	20 363 4
R26	39kΩ ±5% 1/2W	20 403 4
R27	39kΩ ±5% 1/2W	20 403 4
R28	3·9kΩ ±5% 1/2W	20 402 4
R29	100Ω ±5% 1/2W	20 400 5
R30	100Ω ±5% 1/2W	20 400 5
R31	3·9kΩ ±5% 1/2W	20 402 4
R32	Value as fitted	
R33	700Ω ±1% 1/4W	20 751 42
R34	600Ω ±1% 1/4W	20 751 42
R35	Value as fitted	
R36	510Ω ±1% 1/4W	20 321 38
R37	510Ω ±1% 1/4W	20 321 38

Code	Description	Ordering Reference
R38	Value as Fitted	
R39	100kΩ ±5% 1/2W	20 404 215
R40	100kΩ ±5% 1/2W	20 404 215
R41	1kΩ ±5% 1/2W	20 401 545
R42	470kΩ ±5% 1/2W	20 404 565
R43	3·9kΩ ±5% 1/2W	20 402 445
R44	680Ω ±5% 1/2W	20 401 455
R45	100kΩ ±5% 1/2W	20 404 215
R75	27kΩ ±5% 1/2W	20 403 405
R76	51kΩ ±5% 1/2W	20 404 005
R77	470kΩ ±5% 1/2W	20 404 565
R78	22kΩ ±5% 1/2W	20 403 375
R79	150kΩ ±5% 1/2W	20 404 285
R80	1kΩ ±5% 1/2W	20 401 545
R81	1MΩ ±5% 1/2W	20 405 155
R82	180kΩ ±5% 1/2W	20 404 335
R83	470kΩ ±5% 1/2W	20 404 565
R84	6·8MΩ ±5% 1/2W	20 405 395
R85	470kΩ ±5% 1/2W	20 404 565
R86	10kΩ ±5% 1W	20 423 195
R87	100kΩ ±5% 1/2W	20 404 215
R88	110kΩ ±5% 1/2W	20 404 215
R89	33kΩ ±5% 1/2W	20 403 435
R90	100kΩ ±5% 1W	20 424 215
R91	10kΩ ±5% 1/2W	20 403 195
R92	10kΩ ±5% 1/2W	20 403 195
R93	18kΩ ±5% 1/2W	20 403 325
R94	2·2kΩ ±5% 1/2W	20 402 205
R95	100kΩ ±5% 1/2W	20 404 215
R96	100kΩ ±5% 1/2W	20 404 215
R97	33kΩ ±5% 1/2W	20 403 435
R98	270kΩ ±5% 1/2W	20 404 435
R99	1kΩ ±5% 6W	20 841 545
R100	5kΩ ±5% 6W	20 842 525
R101	5kΩ ±5% 6W	20 842 525
R102	560Ω ±5% 1/2W	20 401 405
R103	470kΩ ±5% 1/2W	20 404 565
R104	10kΩ ±5% 1/2W	20 403 195
R105	Value as Fitted	
* R106	600Ω ±1% 1W	20 351 421
* R107	600Ω ±1% 1W	20 351 421

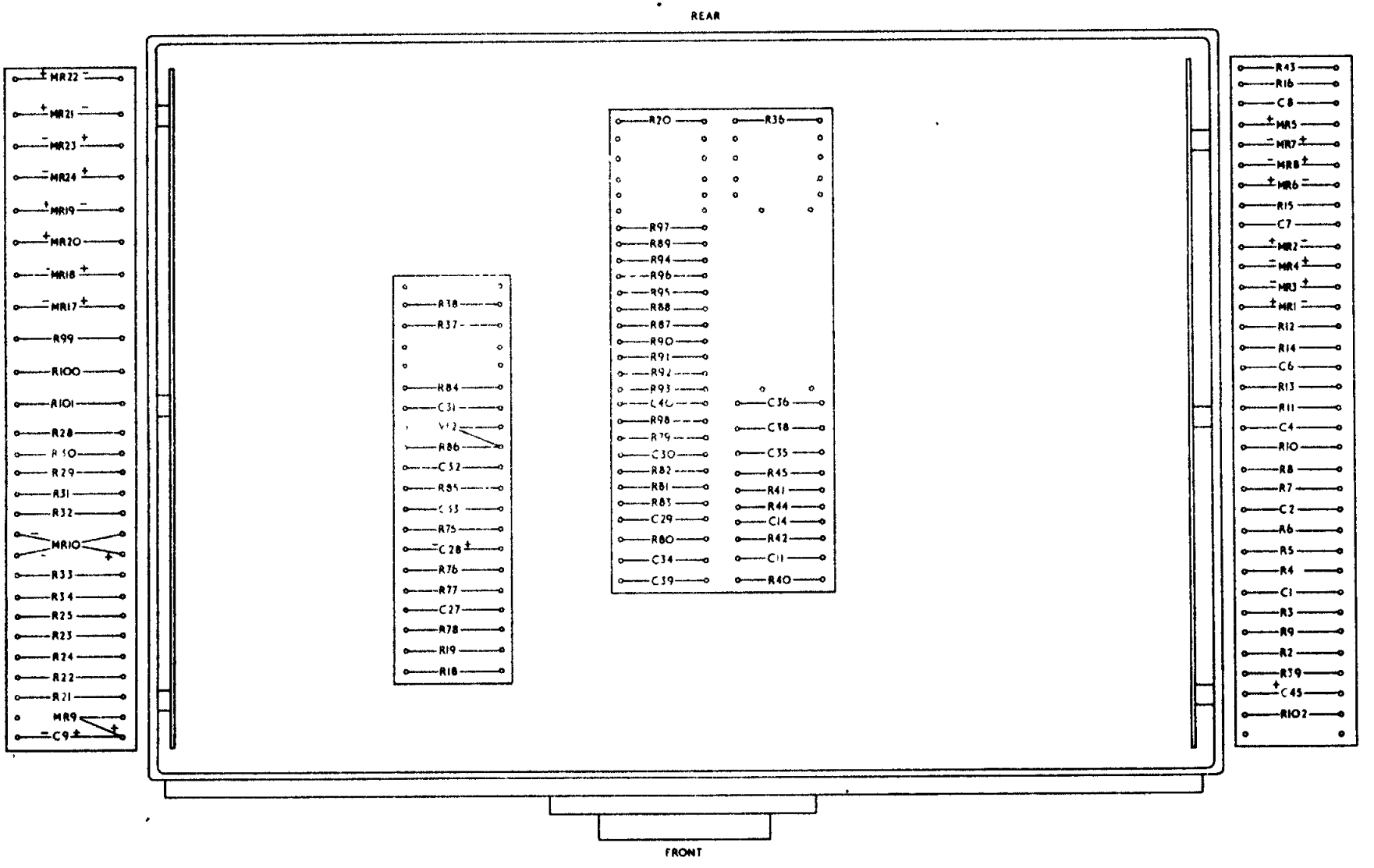
Code	Description	Orderin Referen
	POTENTIOMETERS	
RV1	10kΩ lin, Reliance MW	21 310 0(
RV2	2kΩ lin. Reliance MW	21 250 0(
RV3	10kΩ lin. Plessey EH2	21 310 0(
RV4	2kΩ lin, Reliance MW	21 250 0(
RV5	200Ω lin, Reliance MW	21 140 0(
RV6	200Ω lin, Reliance MW	21 140 0(
RV7	100kΩ log, Plessey EH2	21 410 1(
RV11	1MΩ log, Plessey EH2	21 470 1(
RV12	5kΩ lin, Reliance MW	21 280 0(
RV13	5kΩ lin, Reliance MW	21 280 0(
RV14	1MΩ log, Plessey EH2	21 470 1(
RV15	50kΩ lin, Plessey EH2	21 380 0(
RV16	100kΩ lin, Plessey EH2	21 410 0(
	VALVES	
V1	12AX7	23 070 02
V2	12AX7	23 070 02
V3	12AX7	23 070 02
V4	12AT7	23 070 01
V5	12AX7	23 070 02
V6	12AT7	23 070 01
V11	12AT7	23 070 01
V12	XC12T	23 070 11
V13	12AT7	23 070 01
V14	12AT7	23 070 01
V15	DG7-32/01	23 060 0(
V16	OA2	23 080 09
	TRANSFORMERS	
T1	Muirhead D-535-A/9	As Descrip
T2	Muirhead D-536-A/6	As Descrip
T3	Muirhead D-535-A/25	As Descrip
T4	Muirhead D-536-B/2	As Descrip
T5	Muirhead D-732-A/21	As Descrip
T6	Muirhead K-102-B/9	As Descrip
	RECTIFIERS	
MR1	Mullard OA81	23 111 00
MR2	Mullard OA81	23 111 00
MR3	Mullard OA81	23 111 00
MR4	Mullard OA81	23 111 00

* K-156-B/1A only

Code	Description	Ordering Reference
MR5	Mullard OA81	23 111 004
MR6	Mullard OA81	23 111 004
MR7	Mullard OA81	23 111 004
MR8	Mullard OA81	23 111 004
MR9	Mullard OA10	23 111 002
MR10	1mA Westinghouse(Supplied with meter)	
MR17	International Rectifier Co. IN1096	23 109 003
MR18	International Rectifier Co. IN 1096	23 109 003
MR19	International Rectifier Co. IN 1096	23 109 003
MR20	International Rectifier Co. IN1096	23 109 003
MR21	G & E Bradley DD007	23 103 001
MR22	G & E Bradley DD007	23 103 001
MR23	G& F Bradley DD007	23 103 001
MR24	G & E Bradley DD007	23 103 001
MR25	Westinghouse 1mA	23 119 000
	SWITCHES	
S1	N.S.F. DM 8 pole 7 position	23 033 084
S2	N.S.F. DM 2 pole 2 position	24 033 079
S4	N.S.F. DM 3 pole 2 position	24 033 141
S5	Burgess M1T1	24 018 008
S6	N.S.F. DM 9 pole 3 position	24 033 081
S7	Arrow 81058-BT-34	24 006 013
S8	N.S.F. DM 3 pole 2 position	24 033 091
	*K-156-B/1A only	

Code	Description	Ordering Reference
*S8	N.S.F. DM 8 pole 2 position	24 033 223
	LOW PASS FILTER	
LPF1	Muirhead D-676-A/26	As Description
	BAND PASS FILTER	
BPF1	Muirhead D-676-B/6	As Description
	DISCRIMINATOR	
DISC1	Muirhead D-676-D/4	As Description
	FUSES	
FS1	1A(200-240V)Belling Lee L1055	23 400 205
FS2	2A(105-125V)Belling Lee L1055	23 400 208
FS3	500mA Belling Lee L1055	23 400 211
FS4	250mA Belling Lee L1500	23 400 300
	LAMPS	
LP1	6V 0·1A Atlas 995-9119	23 500 501
LP2	6V 0·1A Atlas 995-9119	23 500 501
LP3	6V 0·1A Atlas 995-9119	23 500 501
	LOUDSPEAKER	
LS1	Rola-Celestion 30(8 ohm)	As Description
	METER	
M1	Ernest Turner 225	PE 50039
	SEALED UNITS	
OSC1	Muirhead D-790-A/1(1800c/s)	As Description
OSC2	Muirhead D-790-A/6	As Description

3052/85/86A. 87B,88C.89C,90B,91A,174A.175A.



K-156-B FSK-AM CONVERSION UNIT