

FM 3 Stereo Tuner Service Manual

QUAD FM 3 TUNER

service supplement

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500-3-78

ALIGNMENT PROCEDURE – 1

General

To achieve the specified performance this alignment procedure should be followed closely. Alignment should not be attempted without the equipment listed below.

Equipment required

- 1 10.7 MHz wobbulator with a maximum output of 100mV rms.
- 2 Oscilloscope with a maximum Y sensitivity of 10mV/cm and D.C. coupled Y amplifier.
- 3 VHF signal generator covering the range 88-108MHz, with AM and FM modulation facilities and an attenuator accurate at signal levels of $2\mu\text{V}$. (e.g. the Radiometer MS27).
- 4 Stereo signal generator with both multiplexed audio and multiplex RF outputs (e.g. the Radiometer SMG1).
- 5 Harmonic distortion meter or 19KHz notch filter.
- 6 Detector probe (a suitable circuit is shown in fig. 1).

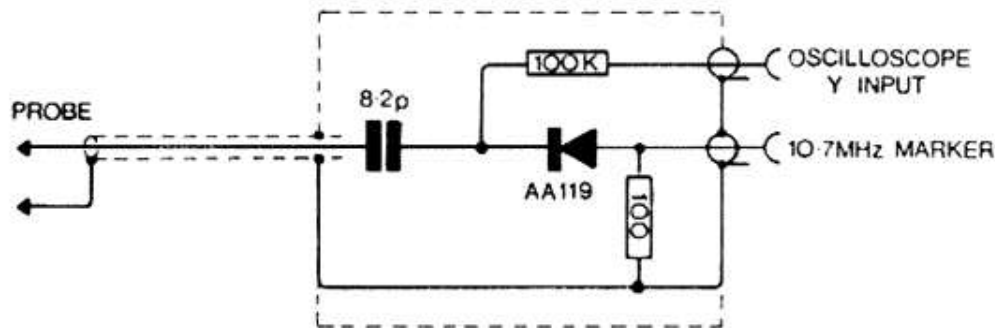


Fig. 1 Suggested Circuit of Detector Probe

Filter coding

Two versions of the ceramic filter have been used and can be interchanged providing the necessary alignment adjustments are made. The original type CFP10.7MA has a black body and is colour coded to indicate centre frequencies as follows:

Green	$10.62 \pm .03\text{MHz}$	White	$10.74 \pm .03\text{MHz}$
Blue	$10.66 \pm .03\text{MHz}$	Yellow	$10.78 \pm .03\text{MHz}$
Red	$10.70 \pm .03\text{MHz}$		

The later types SFG10.7MA (chromium plated body) and SFJ10.7MA2 (plastic coated body) are colour coded:

Black	$10.64 \pm .035\text{MHz}$	Blue	$10.67 \pm .035\text{MHz}$
Red	$10.70 \pm .035\text{MHz}$	Orange	$10.73 \pm .035\text{MHz}$
White	$10.76 \pm .035\text{MHz}$		

Note that types CFP and SFG carry the colour code spot at their input end but type SFJ carries it at its output end. The lead-out wires of SFJ are in line but may be bent to fit without redrilling board for service replacement.

HT Voltage adjustment

From serial number 5885 onwards no HT voltage adjustment is provided. On earlier models positive and negative supplies were adjusted to 14 volts by means of RV102 and RV104 respectively.

IF Alignment—before serial no. 10,000

Connect the detector probe to test point D, inject a wobbled 10.7MHz signal at test point C, and observe the probe output on the oscilloscope. Throughout the following procedure progressively reduce the wobbulator output as necessary to maintain an oscilloscope display amplitude of approximately 50mV peak to peak.

If a 10.7MHz crystal oscillator is available it may be injected at the appropriate probe terminals to provide a marker. Adjust both cores of IFT1 simultaneously for a maximum response.

Adjust the core of L5 for maximum response.

Make small adjustments to IFT1 and L5 cores as necessary to obtain the response shown in fig. 2.

Remove detector probe from test point D and transfer oscilloscope input lead to point B (Pink interconnecting lead). Adjust core of discriminator coil L6 for maximum slope of the centre portion of the discriminator characteristic.

Transfer probe to test point A and unsolder the filter input pin (pin 1). This is necessary since the response at this point (fig. 5) is dominated by the filter input impedance. It should be noted that the peak response at this point does not correspond with the filter centre frequency.

The response at test point A with filter removed is shown in fig. 4 and should show no signs of double humping. If it does it will be necessary to replace IFT1.

IFT 1

L5

L6

IFT 1

IF responses: As a rough check of performance after completing the IF alignment, increase the input signal to obtain the amplitude shown in fig 4, when the amplitudes shown in figs 2, 3, and 5 should also be obtained.

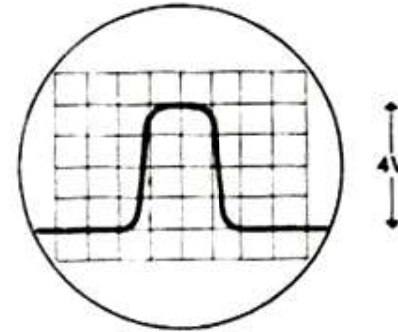


Fig. 2 Response at output of IC1 (Test point D)

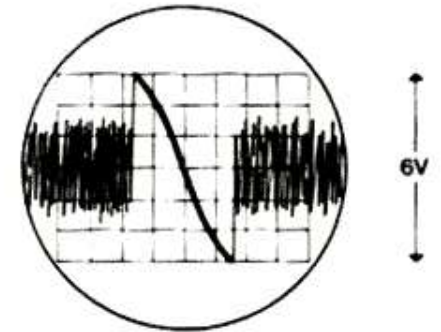


Fig. 3 Discriminator response (Test point B)

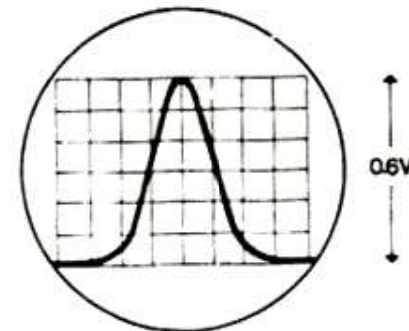


Fig. 4 Response at test point A, with filter removed

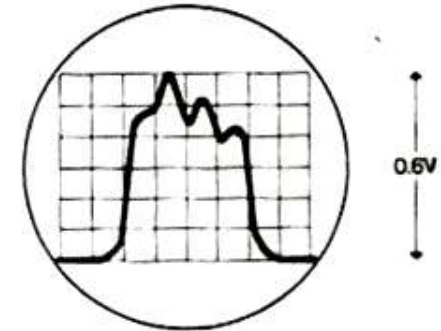


Fig. 5 Response at test point A, with filter present

IF Alignment—serial no. 10,000 onwards

Connect an oscilloscope to Test Point Q (pin 13 of CA3089), and inject a wobbled 10.7MHz signal at test point P. Adjust the core of IFT1 for maximum amplitude at test point Q. Fine adjustment of the core will then enable the maximum width of the flat top to be obtained as shown in fig. 2, with a minimum of generator output.

Transfer oscilloscope lead to test point R and adjust core of L6 for maximum slope of the linear centre portion of the discriminator characteristic.

RF Circuit Alignment—before serial no. 10,000

After completing IF alignment remove wobblator input but leave detector probe at test point A.

Connect the RF generator to the aerial socket and inject a $300\mu\text{V}$, 75% amplitude modulated signal at 90MHz. Preset the cores of L1, L2, L3 level with the tops of the formers, and the trimming capacitors C1, C9, C20 approximately three threads out. Check that pointer travel is symmetrical about end scale markings, and that pointer is fixed to string. (If necessary secure with spot of Durofix or similar adhesive).

Set the tuner to 90MHz and adjust the cores of L3, L2, L1 in that order for maximum amplitude of oscilloscope display. If the front end of the tuner is badly misaligned it may be necessary temporarily

to increase the generator output slightly. Caution should be exercised since it is possible to align to a spurious response if too high an input level is used. It should be possible to obtain about 10mV peak to peak at the probe output for an RF input of $300\mu\text{V}$ or less. Necessity to apply an input signal greater than 1mV should be treated as a fault condition.

L6 Retune generator and tuner to 104MHz and adjust C20, C9 and C1 in that order for maximum response.

C1
C9
C20

Repeat adjustment of cores and trimmers until no further improvement is possible.

L1
L2
L3
C1
C9
C20 Remove probe, resolder filter pin 1 and connect oscilloscope to test point B, together with valve voltmeter. Inject $2\mu\text{V}$ 90MHz 30% FM at aerial socket.

Retune tuner to 90MHz observing the oscilloscope. The correct tuning point occurs with noise just showing in equal amounts on positive and negative peaks of the audio output.

Make small adjustments to the core of L6 to obtain maximum audio output level as observed on the voltmeter. Set RV2 for equal brilliance of the tuning lamps.

L6
RV2
LPI-
LP2

RF Circuit Alignment—serial no. 10,000 onwards

Since a demodulated output is available at test point Q, no detector probe is required with these sets unless a fault is suspected prior to the CA3089. RF circuit alignment then follows the procedures outlined above as for earlier models.

Adjustment of Noise sensing coil L4

Adjustment of this core should be unnecessary unless it is not possible to mute signals below $100\mu\text{V}$.

If alignment is necessary, connect a suitable amplifier to the audio output socket and the FM generator to the aerial socket. Unscrew the core of L4 until level with top of can.

Inject an FM signal of $10\mu\text{V}$ and advance the mute control to the point just prior to muting. Screw the core of L4 in until muting occurs. Increase the signal level until the tuner comes out of muting and re-adjust L4. Repeat adjustments of L4 progressively increasing signal level until no further improvements are possible.

This completes the RF board alignment with the exception of L7 which must be aligned in conjunction with the decoder.

Decoder—before serial no. 5885

Remove the pink inter-board lead from the decoder and inject a 19KHz pilot tone at a level of 30mV from the multiplex generator.

Connect the valve voltmeter by means of un-screened cable, to the tap on L101. Adjust the core of L101 for maximum output. L102 and L103 are aligned in a similar manner with the valve voltmeter connected to their respective taps.

L101
L102
L103

Connect the distortion meter input to the output socket Pin 5 and tune the distortion meter to 19KHz. Observe the distortion meter output on the oscilloscope which will show the residual 38KHz switching components together with smaller quantities of harmonics. Adjust the core of L104 for minimum display amplitude. Similarly connect the distortion meter to Pin 3 and adjust L105.

L104
L105

With the distortion meter still connected to Pin 3, apply a stereo signal modulated with 1KHz on right channel only and adjust RV101 for minimum crosstalk. Slight adjustments of L101 in conjunction with RV101 should now enable the crosstalk to be reduced to a small second harmonic component. Remove the multiplex input and reconnect the pink interconnecting lead. Inject at the aerial an FM stereo signal carrying right channel modulation at 1KHz.

Again observing the distortion meter output adjust the core of L7 for minimum crosstalk.

L7

As a check on these last three separation adjustments apply 10KHz right channel modulation and measure crosstalk which should be better than -30dB .

Decoder—serial no. 5885 onwards

The decoder now fitted uses a phase-locked loop integrated circuit providing improved stereo separation and lower distortion.

The only adjustment provided is RV100 which sets the free run frequency of the oscillator contained within IC100. For this adjustment either connect a digital frequency meter to test point S (pin 10 of IC100) where the 19KHz square waveform appears, or if an accurate 19KHz source is available, such as the pilot tone from a stereo generator, connect this to the X amplifier of an oscilloscope, test point S to the Y amplifier, and use the resultant Lissajous figure. It will be found advantageous to remove the audio input to the decoder by muting the set, for this adjustment only.

With a distortion meter connected to the output socket pin 3, apply an FM stereo signal carrying pilot tone only to the aerial socket. Tune the distortion meter to remove the 19KHz from the output signal so enabling crosstalk to be measured when applying a 1KHz signal on the Right channel only. The core of L7 is then adjusted for minimum crosstalk. Alternatively this adjustment may be performed with comparable accuracy by listening to the output.

ALIGNMENT PROCEDURE – 2 USING SOUND TECHNOLOGY 1000 TEST EQUIPMENT

Alignment is in three parts: RF, discriminator and decoder.

Part 1

Connections

Sound Technology 1000 HORIZ to X–Y1

Sound Technology 1000 RF out to tuner aerial input

Test Point Q to Y–Y2 via clip lead

Crystal marker generator loosely coupled to tuner aerial input via 47Ω Resistor

Mains to tuner

Controls

SCOPE TO XY

X—5v/cm DC coupled

Y—0.2v/cm DC coupled

Sound Technology 1000 FUNCTION—DUAL SWEEP

SWEEP WIDTH—700 to 800kHz

RF Level— $30\mu\text{V}$

L7 Input—Mono

(a) Tune tuner to 90MHz

Tune Sound Technology 1000 to 90MHz

(c) Signal to noise check

Controls

Sound Technology 1000 RF LEVEL $4\mu\text{V}$
FUNCTION—CW

Output level should drop by 40dB

Part 3

Connections

Sound Technology 1000 19kHz to Y1

Test point S to Y2 via clip lead

Right channel audio to voltmeter input

Controls

Sound Technology 1000 FUNCTION—STEREO
OSC LEVEL MINIMUM
RF LEVEL $1000\mu\text{V}$
PILOT LEVEL MINIMUM

Scope

Y1 2v/cm
Y2 2v/cm
TIMEBASE $10\mu\text{S/cm}$
TRIGGER Y1

(a) Adjust RV100 to obtain 19kHz signal on Y2

(b) Increase PILOT LEVEL on Sound Technology 1000 and confirm that 19kHz signals lock and stereo lamp illuminates at 3 to 5% pilot level.

(c) Set PILOT LEVEL to 9%

(d) Reconnect—Y2 to voltmeter output via clip lead
Y1 to left channel audio.

Controls

Sound Technology 1000 INPUT—Left
OSC LEVEL—100%

VOLTMETER 5mV, 10Hz to 10kHz

SCOPE Y1 0.2v/cm

Y2 0.2v/cm

TIMEBASE 0.2mS/cm

TRIGGER Y1

Adjust L7 for minimum crosstalk signal in right channel (less than 3mV)

Alignment is now complete but several checks still have to be made.

(1) Having checked left to right crosstalk, check right to left by connecting
left channel audio to voltmeter input
right channel audio to scope Y1
switching Sound Technology 1000 INPUT to RIGHT

- (2) Check the mono output
connect mono output to voltmeter input
switch Sound Technology 1000 INPUT to L + R
confirm that mono output level is approx 330mV at
100% modulation
switch Sound Technology 1000 INPUT to L - R
confirm that mono output level is less than 5mV
- (3) Check muting function
With the muting control on the tuner turned to
maximum, reduce RF level on Sound Technology
to 200 μ V and adjust L4 so that the tuner just mutes.

MODIFICATIONS

RF Board

From Serial No. 540 onwards

- 1 New L6 coil coded yellow.
- 2 L5—modified* and mounted with colour spot to R16.
- 3 MR4, MR5 removed and replaced by 4K7 resistors.
- 4 C11 removed.
- 5 R32 removed.
- 6 C32 changed from 33pF to 18pF.
- 7 R12 changed from 680 Ω to 1K.
- 8 R21 changed to 2K2.
- 9 C34 changed to 47pF.
- 10 C47 .47 μ F added.

From Serial No. 1500 onwards

Issue 4 printed circuit board M12248

- 1 R37 added.
- 2 L5 unmodified* as pre 540.
- 3 R32 restored (see parts list re value).

* Modification to coil L5 comprised cutting off the unused centre legs to permit re-orientation.

The following modifications have been made at various stages in production from serial no. 3000 onwards.

- 1 Panel lamp series resistor changed from 10Ω to 68Ω to improve lamp life.
- 2 TR4 changed from 40244 to BFX44 or BF357K.
- 3 C13 and C15 changed to 100pF —a modification which results in improved background noise.
- 4 C26 changed from 3.3pF to 4.7pF consequent upon change of TR4 to BF357K.
- 5 TR1 may be 3N201.
- 6 TR2 may be 3N205.
- 7 TR10 and 11 may be MPSA12.

M12248 Issue 6 Printed Circuit Board

- 1 Tuning gang changed from Wingrove & Rogers CG80 to DAU 338/30.—N.B. These gangs are not inter-changeable and when ordering spares note should be made of the tuning scale fitted. With Wingrove & Rogers gangs the legend MHz appears centrally and with DAU gangs it is at the right end of the scale.
- 2 Chassis changed from Issue 6 to Issue 7.
- 3 Tuning drive changed.
- 4 Scale changed from B12233 to B12297 (see above).

10

- 5 Variable Resistor RV3 added.
- 6 R38 10K added.
- 7 Oscillator configuration altered resulting in:—
 - (a) L3 changed from 2 terminal to 3 terminal
 - (b) C25 changed from $.002$ to $.001\mu\text{F}$
 - (c) C18 changed from 20pF to 18pF .
- 8 Cores of L1, L2, L3, changed from 2 Neosid 900 and 1 Neosid 910 (L3) to 3 type 900.
- 9 L4 and L7 changed from G.B. Stock No. 750G to Toko type CAN 1980 BX. Stock No. 750Q.
- 10 C7 changed from 15pF to 13pF .

M12248 Issue 7 Printed Board

As issue 6 except tuning gang is Wingrove & Rogers CG80, Scale is B12233, C7 is 15pF and C18 is 20pF . Metalwork and tuning drive is as issue 4.

M12248 Issue 8 Printed Board

As issue 6 except TR10 and TR11 are each changed from 1 2N5306 to 2 BC109B or BC184K.

M12327 Issue 1 Printed Circuit Board, Serial No. 10,000 onwards

IC1, IC2, TR3 are removed and replaced by CA3089E as shown on relevant circuit diagram. If necessary the audio output from this board may be increased by modifying as issue 2 and setting RV3 for 100mV rms output at 22.5kHz deviation.

M12327 Issue 2 Printed Circuit Board

Link between pins 7 and 10 of CA3089E removed and pins 6 and 7 linked instead. R29 and R31 changed to 22k. This board was also redrilled to accommodate Jackson type C21 gang from serial no. 18900.

M12327 Issue 3 Printed Circuit Board

Drilling changed to accommodate Toko filter SFJ10.7 MA2.

Decoder

From Serial No. 540 onwards

R103 removed.

C105 changed to .015 μ F

L102 modified

R126 changed to 180 Ω

From Serial No. 900 onwards

R101 changed to 150 Ω

M12247 Issue 2 Printed Board

- 1 L101-5 changed from G.B. Stock No. 750G to Toko type CAN1980BX Stock No. 750Q—these are not interchangeable.

- 2 C105 changed from .015 to .01 μ F.
- 3 Diode type IS920 added between pin 2 of IC101 and Black interboard lead. (Anode of diode to pin 2). This reduces background noise when set is muted.
- 4 *Alternative Transistors*
TR103—BC143 changed to BC461 or BC303.
TR102—BC184K or BC109C.
TR103—BC154 or BC214C.
TR105—BC184K, BC109C or E5270.
IC101—MC1305P or SN76105.

M12307 Issue 2 Printed Board

From Serial No. 5885 onwards.

- 1 IC101 changed to MC1310P or SN76115.
- 2 No coils.
- 3 Power supply altered to eliminate HT setting pots.

Alternative transistors

Early tuners used type 40673 for both TR1 and TR2. For replacements use type 40822 for TR1 and 40823 or 3N205 for TR2.

INSTRUCTIONS FOR REPLACING DRIVE CORD

See Fig. 6A for tuners fitted with Wingrove & Rogers tuning capacitors or Fig. 6B for tuners with Dau or Jackson tuning capacitors.

Use nylon braided glass cored cord such as Finlayson size 20. Ensure that it does not come into contact with lubricant on pulley spindles.

Remove front panel (4 screws) and tuning drum (2 grub screws). For tuners with Wingrove and Rogers capacitors take 16 inches (40 cm) OR for those with Dau capacitors take 26 inches (66 cm) of cord, knot one end and trim, then thread through hole (2).

Take another length of cord, 30 inches (76 cm) long for Wingrove and Rogers OR 12 inches (30 cm) for Dau, knot one end and trim, then thread through hole (6) to outer edge of tuning drum (1) and through hole (7).

Turn tuning capacitor to fully closed position and replace tuning drum in position shown in Fig. 6. Lay the shorter length of cord around drum one turn in clockwise direction to pulley 3 for Wingrove and Rogers OR in anticlockwise direction for Dau, towards pulley (5). Attach free end of cord to spring (4), so that spring is approximately $\frac{1}{4}$ " from pulley (5). Remove surplus cord and loop free end of spring temporarily to pulley (5) spindle.

Take the other length of cord, and lay around tuning drum, $2\frac{1}{2}$ turns in anticlockwise direction for Wingrove and Rogers OR $1\frac{1}{2}$ turns in clockwise direction for Dau, to capstan (8), then 2 turns around capstan in clockwise direction to pulley (9), and around pulleys (10) and (5). Attach cord to free end of spring, extending spring about 25% and remove surplus cord.

Replace front panel, then with tuning capacitor fully closed, replace pointer (11) so that it lies at tuning knob end of scale line.

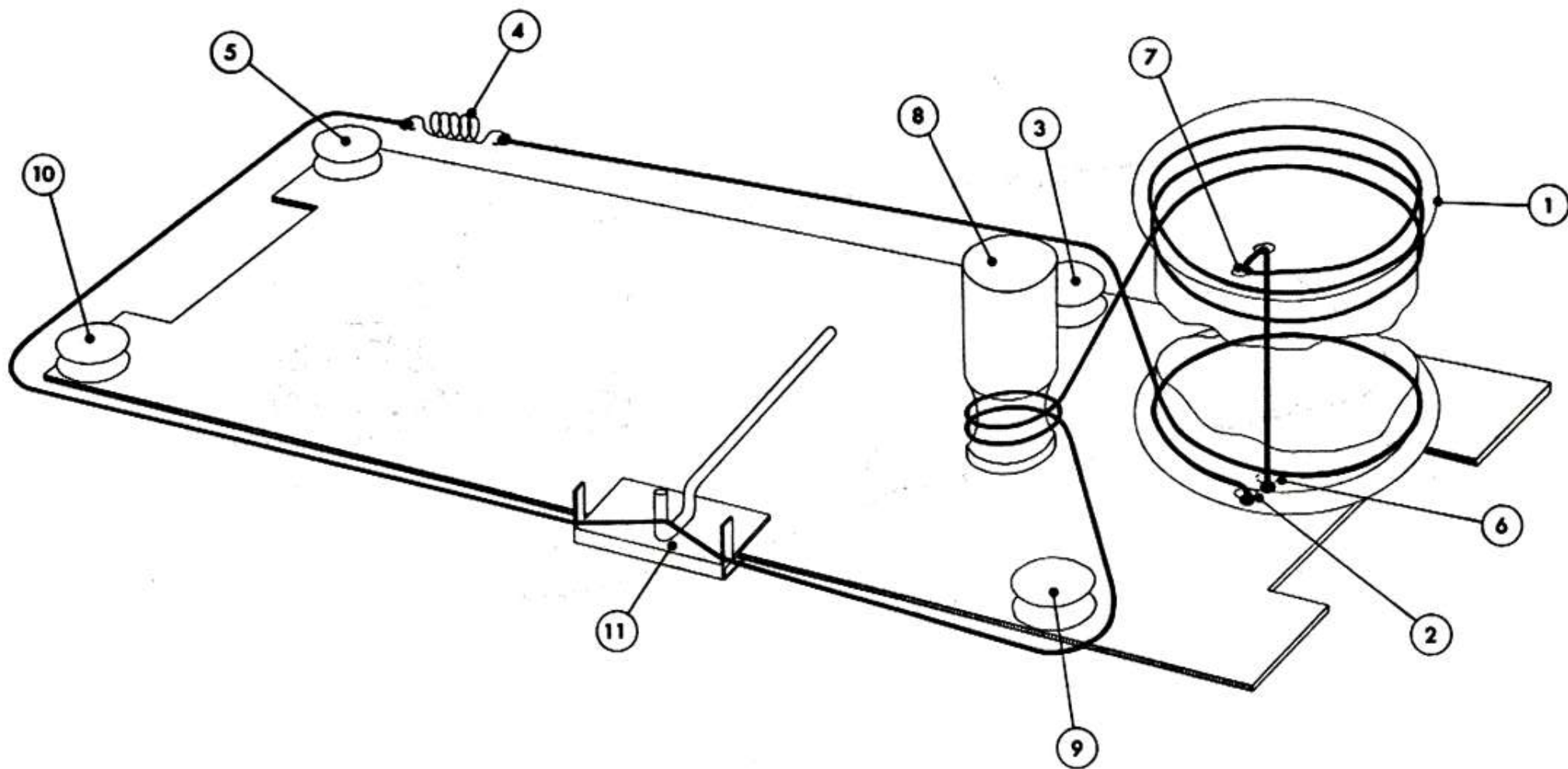


Fig. 6A

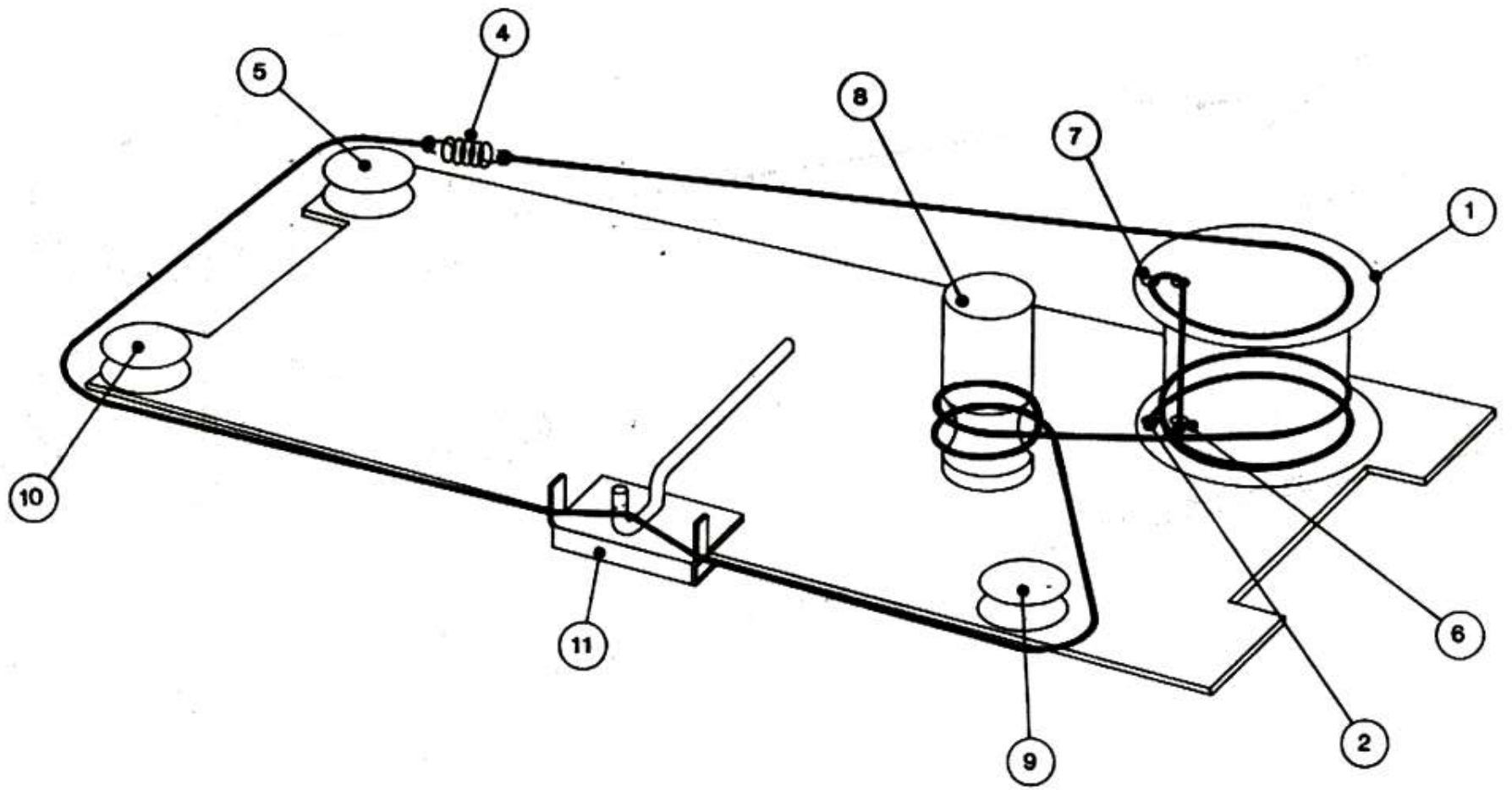


Fig. 6B

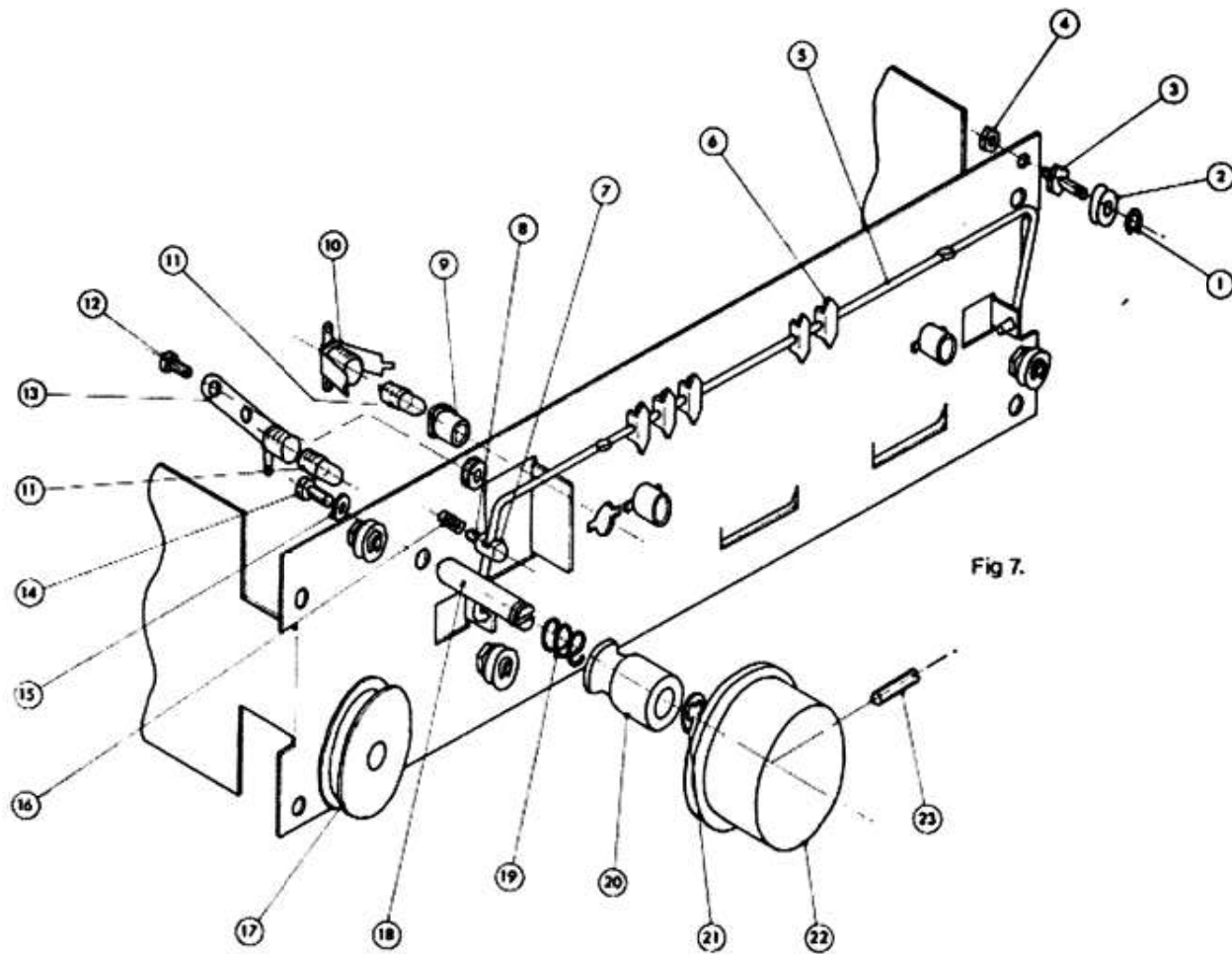
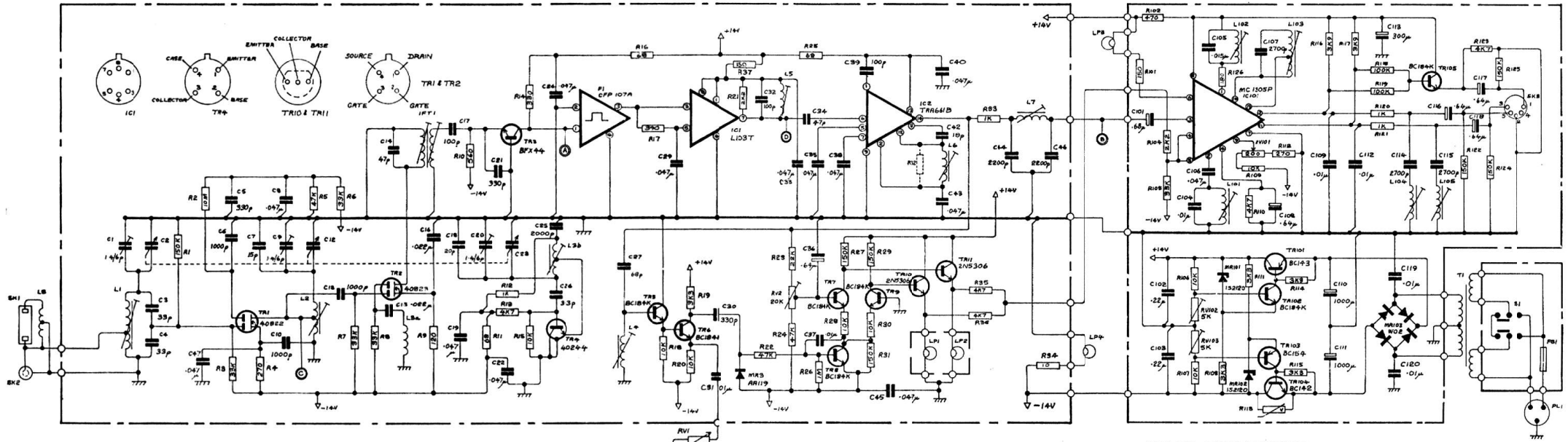


Fig 7.

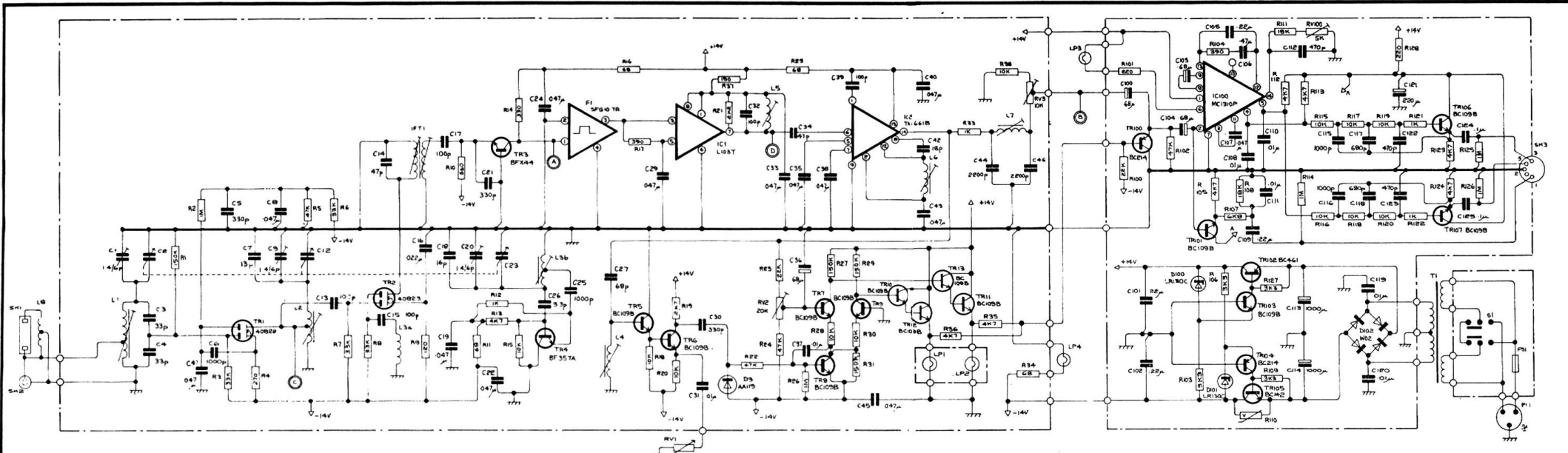
<i>No.</i>	<i>Description</i>	<i>Stock No.</i>
1	Circlip	752/K
2	Pulley	748/Q
3	Pulley Spindle	A12208
4	6BA Nut	16/B
5	Station Marker Support	A12193
6	Station Marker	A12199
7	Tappet	A12234
8	6BA Grub Screw	7/G
9	Bush	752/L
10	Lampholder	691/H
11	Bulb	690/M
12	6BA Screw	80/D
13	Lampholder	691/K
14	4BA Screw	63/D
15	Friction Washer	103/D
16	Tappet Spring	12833
17	Tuning Drum	A12198
18	Support	A12168/3
19	Capstan Spring	31275
20	Capstan	A12168/2
21	Circlip	748/N-A
22	Knob	A12168/1
23	4BA Grub Screw	7/D



QUAD FM3 TUNER

No	VALUE	TOL	VOL	MARKERS	REFERENCE	STOCK No.	No	VALUE	TOL	VOL	MARKERS	REFERENCE	STOCK No.	No	VALUE	TOL	VOL	MARKERS	REFERENCE	STOCK No.	No	VALUE	TOL	VOL	MARKERS	REFERENCE	STOCK No.
R1	20K	±10%	150V	RES	R1	20000	R107	10K	±10%	150V	RES	R107	10000	C120	0.1μ	±5%	50V	COND	120	50012	C101	100μ	±20%	50V	COND	C101	100000
R2	10K	±10%	150V	RES	R2	10000	R108	30K	±10%	150V	RES	R108	30000	C121	0.1μ	±5%	50V	COND	121	50012	C102	100μ	±20%	50V	COND	C102	100000
R3	50K	±10%	150V	RES	R3	50000	R109	10K	±10%	150V	RES	R109	10000	C122	0.1μ	±5%	50V	COND	122	50012	C103	100μ	±20%	50V	COND	C103	100000
R4	270	±10%	150V	RES	R4	27000	R110	4K7	±10%	150V	RES	R110	4700	C123	0.1μ	±5%	50V	COND	123	50012	C104	100μ	±20%	50V	COND	C104	100000
R5	47K	±10%	150V	RES	R5	47000	R111	5K8	±10%	150V	RES	R111	5800	C124	0.1μ	±5%	50V	COND	124	50012	C105	100μ	±20%	50V	COND	C105	100000
R6	50K	±10%	150V	RES	R6	50000	R112	50K	±10%	150V	RES	R112	50000	C125	0.1μ	±5%	50V	COND	125	50012	C106	100μ	±20%	50V	COND	C106	100000
R7	50K	±10%	150V	RES	R7	50000	R113	50K	±10%	150V	RES	R113	50000	C126	0.1μ	±5%	50V	COND	126	50012	C107	100μ	±20%	50V	COND	C107	100000
R8	50K	±10%	150V	RES	R8	50000	R114	50K	±10%	150V	RES	R114	50000	C127	0.1μ	±5%	50V	COND	127	50012	C108	100μ	±20%	50V	COND	C108	100000
R9	10K	±10%	150V	RES	R9	10000	R115	10K	±10%	150V	RES	R115	10000	C128	0.1μ	±5%	50V	COND	128	50012	C109	100μ	±20%	50V	COND	C109	100000
R10	50K	±10%	150V	RES	R10	50000	R116	50K	±10%	150V	RES	R116	50000	C129	0.1μ	±5%	50V	COND	129	50012	C110	100μ	±20%	50V	COND	C110	100000
R11	50K	±10%	150V	RES	R11	50000	R117	50K	±10%	150V	RES	R117	50000	C130	0.1μ	±5%	50V	COND	130	50012	C111	100μ	±20%	50V	COND	C111	100000
R12	1K	±10%	150V	RES	R12	1000	R118	10K	±10%	150V	RES	R118	10000	C131	0.1μ	±5%	50V	COND	131	50012	C112	100μ	±20%	50V	COND	C112	100000
R13	4K7	±10%	150V	RES	R13	4700	R119	100K	±10%	150V	RES	R119	100000	C132	0.1μ	±5%	50V	COND	132	50012	C113	100μ	±20%	50V	COND	C113	100000
R14	330	±10%	150V	RES	R14	33000	R120	1K	±10%	150V	RES	R120	1000	C133	0.1μ	±5%	50V	COND	133	50012	C114	100μ	±20%	50V	COND	C114	100000
R15	10K	±10%	150V	RES	R15	10000	R121	10K	±10%	150V	RES	R121	10000	C134	0.1μ	±5%	50V	COND	134	50012	C115	100μ	±20%	50V	COND	C115	100000
R16	50K	±10%	150V	RES	R16	50000	R122	50K	±10%	150V	RES	R122	50000	C135	0.1μ	±5%	50V	COND	135	50012	C116	100μ	±20%	50V	COND	C116	100000
R17	330	±10%	150V	RES	R17	33000	R123	330	±10%	150V	RES	R123	33000	C136	0.1μ	±5%	50V	COND	136	50012	C117	100μ	±20%	50V	COND	C117	100000
R18	10K	±10%	150V	RES	R18	10000	R124	10K	±10%	150V	RES	R124	10000	C137	0.1μ	±5%	50V	COND	137	50012	C118	100μ	±20%	50V	COND	C118	100000
R19	3K8	±10%	150V	RES	R19	3800	R125	3K8	±10%	150V	RES	R125	3800	C138	0.1μ	±5%	50V	COND	138	50012	C119	100μ	±20%	50V	COND	C119	100000
R20	10K	±10%	150V	RES	R20	10000	R126	10K	±10%	150V	RES	R126	10000	C139	0.1μ	±5%	50V	COND	139	50012	C120	100μ	±20%	50V	COND	C120	100000
R21	10K	±10%	150V	RES	R21	10000	R127	10K	±10%	150V	RES	R127	10000	C140	0.1μ	±5%	50V	COND	140	50012	C121	100μ	±20%	50V	COND	C121	100000
R22	4K7	±10%	150V	RES	R22	4700	R128	10K	±10%	150V	RES	R128	10000	C141	0.1μ	±5%	50V	COND	141	50012	C122	100μ	±20%	50V	COND	C122	100000
R23	47K	±10%	150V	RES	R23	47000	R129	10K	±10%	150V	RES	R129	10000	C142	0.1μ	±5%	50V	COND	142	50012	C123	100μ	±20%	50V	COND	C123	100000
R24	330	±10%	150V	RES	R24	33000	R130	10K	±10%	150V	RES	R130	10000	C143	0.1μ	±5%	50V	COND	143	50012	C124	100μ	±20%	50V	COND	C124	100000
R25	10K	±10%	150V	RES	R25	10000	R131	10K	±10%	150V	RES	R131	10000	C144	0.1μ	±5%	50V	COND	144	50012	C125	100μ	±20%	50V	COND	C125	100000
R26	50K	±10%	150V	RES	R26	50000	R132	50K	±10%	150V	RES	R132	50000	C145	0.1μ	±5%	50V	COND	145	50012	C126	100μ	±20%	50V	COND	C126	100000
R27	330	±10%	150V	RES	R27	33000	R133	330	±10%	150V	RES	R133	33000	C146	0.1μ	±5%	50V	COND	146	50012	C127	100μ	±20%	50V	COND	C127	100000
R28	10K	±10%	150V	RES	R28	10000	R134	10K	±10%	150V	RES	R134	10000	C147	0.1μ	±5%	50V	COND	147	50012	C128	100μ	±20%	50V	COND	C128	100000
R29	3K8	±10%	150V	RES	R29	3800	R135	3K8	±10%	150V	RES	R135	3800	C148	0.1μ	±5%	50V	COND	148	50012	C129	100μ	±20%	50V	COND	C129	100000
R30	10K	±10%	150V	RES	R30	10000	R136	10K	±10%	150V	RES	R136	10000	C149	0.1μ	±5%	50V	COND	149	50012	C130	100μ	±20%	50V	COND	C130	100000
R31	10K	±10%	150V	RES	R31	10000	R137	10K	±10%	150V	RES	R137	10000	C150	0.1μ	±5%	50V	COND	150	50012	C131	100μ	±20%	50V	COND	C131	100000
R32	47K	±10%	150V	RES	R32	47000	R138	47K	±10%	150V	RES	R138	47000	C151	0.1μ	±5%	50V	COND	151	50012	C132	100μ	±20%	50V	COND	C132	100000
R33	330	±10%	150V	RES	R33	33000	R139	330	±10%	150V	RES	R139	33000	C152	0.1μ	±5%	50V	COND	152	50012	C133	100μ	±20%	50V	COND	C133	100000
R34	10K	±10%	150V	RES	R34	10000	R140	10K	±10%	150V	RES	R140	10000	C153	0.1μ	±5%	50V	COND	153	50012	C134	100μ	±20%	50V	COND	C134	100000
R35	47K	±10%	150V	RES	R35	47000	R141	47K	±10%	150V	RES	R141	47000	C154	0.1μ	±5%	50V	COND	154	50012	C135	100μ	±20%	50V	COND	C135	100000
R36	4K7	±10%	150V	RES	R36	4700	R142	4K7	±10%	150V	RES	R142	4700	C155	0.1μ	±5%	50V	COND	155	50012	C136	100μ	±20%	50V	COND	C136	100000
R37	150	±10%	150V	RES	R37	15000	R143	150	±10%	150V	RES	R143	15000	C156	0.1μ	±5%	50V	COND	156	50012	C137	100μ	±20%	50V	COND	C137	100000
R38	470	±5%	150V	RES	R38	47000	R144	470	±5%	150V	RES	R144	47000	C157	0.1μ	±5%	50V	COND	157	50012	C138	100μ	±20%	50V	COND	C138	100000
R39	20K	±10%	150V	RES	R39	20000	R145	20K	±10%	150V	RES	R145	20000	C158	0.1μ	±5%	50V	COND	158	50012	C139	100μ	±20%	50V	COND	C139	100000
R40	20K	±10%	150V	RES	R40	20000	R146	20K	±10%	150V	RES	R146	20000	C159	0.1μ	±5%	50V	COND	159	50012	C140	100μ	±20%	50V	COND	C140	100000
R41	10K	±10%	150V	RES	R41	10000	R147	10K	±10%	150V	RES	R147	10000	C160	0.1μ	±5%	50V	COND	160	50012	C141	100μ	±20%	50V	COND	C141	100000
R42	10K	±10%	150V	RES	R42	10000	R148	10K	±10%	150V	RES	R148	10000	C161	0.1μ	±5%	50V	COND	161	50012	C142	100μ	±20%	50V	COND	C142	100000
R43	10K	±10%	150V	RES	R43	10000	R149	10K	±10%	150V	RES	R149	10000	C162	0.1μ	±5%	50V	COND	162	50012	C143	100μ	±20%	50V	COND	C143	100000
R44	10K	±10%	150V	RES	R44	10000	R150	10K	±10%	150V	RES	R150	10000	C163	0.1μ	±5%	50V	COND	163	50012	C144	100μ	±20%	50V	COND	C144	100000
R45	10K	±10%	150V	RES	R45	10000	R151	10K	±10%	150V	RES	R151	10000	C164	0.1μ	±5%	50V	COND	164	50012	C145	100μ	±20%	50V	COND	C145	100000
R46	10K	±10%	150V	RES	R46	10000	R152	10K	±10%	150V	RES	R152	10000														

FM3
Serial numbers 5885 to 10,000



No	VALUE	TOL	VOL	REFERENCE	STOCK No	No	VALUE	TOL	VOL	REFERENCE	STOCK No	No	VALUE	TOL	VOL	REFERENCE	STOCK No	No	VALUE	TOL	VOL	REFERENCE	STOCK No	
R1	150K	±0.5%		ISKRA UPM 050	150K	R104	10K	±0.5%		ISKRA UPM 050	10K	C100	68K	±5%	35V	UNION CARBIDE HR68BWS	409B	TR15	6X4					
R2	1M	±0.5%		ISKRA UPM 050	1M	R105	4K7	±5%		ISKRA UPM 050	4K7	C101	20K	±5%	100V	SIEMENS MWM B38E-1	409D	TR16	BC109B					
R3	33K	±0.5%		ISKRA UPM 050	33K	R106	3K5	±0.5%		ISKRA UPM 050	3K5	C102	20K	±5%	100V	SIEMENS MWM B38E-1	409E	TR17	BC109B					
R4	270	±0.5%		ISKRA UPM 050	270	R107	68K	±5%		ISKRA UPM 050	68K	C103	40K	±5%	35V	UNION CARBIDE HR40BWS	409F	TR18	BC109B					
R5	470	±0.5%		ISKRA UPM 050	470	R108	18K	±5%		ISKRA UPM 050	18K	C104	40K	±5%	35V	UNION CARBIDE HR40BWS	409G	TR19	BC109B					
R6	33K	±0.5%		ISKRA UPM 050	33K	R109	300	±0.5%		ISKRA UPM 050	300	C105	40K	±5%	35V	UNION CARBIDE HR40BWS	409H	TR20	BC109B					
R7	33K	±0.5%		ISKRA UPM 050	33K	R110	300	±0.5%		ISKRA UPM 050	300	C106	40K	±5%	35V	UNION CARBIDE HR40BWS	409I	TR21	BC109B					
R8	33K	±0.5%		ISKRA UPM 050	33K	R111	18K	±5%		ISKRA UPM 050	18K	C107	40K	±5%	35V	UNION CARBIDE HR40BWS	409J	TR22	BC109B					
R9	120	±0.5%		ISKRA UPM 050	120	R112	4K7	±5%		ISKRA UPM 050	4K7	C108	40K	±5%	35V	UNION CARBIDE HR40BWS	409K	TR23	BC109B					
R10	500	±0.5%		ISKRA UPM 050	500	R113	4K7	±5%		ISKRA UPM 050	4K7	C109	40K	±5%	35V	UNION CARBIDE HR40BWS	409L	TR24	BC109B					
R11	68	±0.5%		ISKRA UPM 050	68	R114	4K7	±5%		ISKRA UPM 050	4K7	C110	40K	±5%	35V	UNION CARBIDE HR40BWS	409M	TR25	BC109B					
R12	1K	±0.5%		ISKRA UPM 050	1K	R115	10K	±0.5%		ISKRA UPM 050	10K	C111	40K	±5%	35V	UNION CARBIDE HR40BWS	409N	TR26	BC109B					
R13	4K7	±0.5%		ISKRA UPM 050	4K7	R116	10K	±0.5%		ISKRA UPM 050	10K	C112	40K	±5%	35V	UNION CARBIDE HR40BWS	409O	TR27	BC109B					
R14	330	±0.5%		ISKRA UPM 050	330	R117	10K	±0.5%		ISKRA UPM 050	10K	C113	40K	±5%	35V	UNION CARBIDE HR40BWS	409P	TR28	BC109B					
R15	10K	±0.5%		ISKRA UPM 050	10K	R118	10K	±0.5%		ISKRA UPM 050	10K	C114	40K	±5%	35V	UNION CARBIDE HR40BWS	409Q	TR29	BC109B					
R16	48	±0.5%		ISKRA UPM 050	48	R119	10K	±0.5%		ISKRA UPM 050	10K	C115	40K	±5%	35V	UNION CARBIDE HR40BWS	409R	TR30	BC109B					
R17	390	±0.5%		ISKRA UPM 050	390	R120	10K	±0.5%		ISKRA UPM 050	10K	C116	40K	±5%	35V	UNION CARBIDE HR40BWS	409S	TR31	BC109B					
R18	10K	±0.5%		ISKRA UPM 050	10K	R121	10K	±0.5%		ISKRA UPM 050	10K	C117	40K	±5%	35V	UNION CARBIDE HR40BWS	409T	TR32	BC109B					
R19	2.2K	±0.5%		ISKRA UPM 050	2.2K	R122	1K	±0.5%		ISKRA UPM 050	1K	C118	40K	±5%	35V	UNION CARBIDE HR40BWS	409U	TR33	BC109B					
R20	10K	±0.5%		ISKRA UPM 050	10K	R123	4K7	±5%		ISKRA UPM 050	4K7	C119	40K	±5%	35V	UNION CARBIDE HR40BWS	409V	TR34	BC109B					
R21	25K	±0.5%		ISKRA UPM 050	25K	R124	4K7	±5%		ISKRA UPM 050	4K7	C120	40K	±5%	35V	UNION CARBIDE HR40BWS	409W	TR35	BC109B					
R22	47K	±0.5%		ISKRA UPM 050	47K	R125	1M	±0.5%		ISKRA UPM 050	1M	C121	40K	±5%	35V	UNION CARBIDE HR40BWS	409X	TR36	BC109B					
R23	22K	±0.5%		ISKRA UPM 050	22K	R126	1M	±0.5%		ISKRA UPM 050	1M	C122	40K	±5%	35V	UNION CARBIDE HR40BWS	409Y	TR37	BC109B					
R24	47K	±0.5%		ISKRA UPM 050	47K	R127	3K5	±0.5%		ISKRA UPM 050	3K5	C123	40K	±5%	35V	UNION CARBIDE HR40BWS	409Z	TR38	BC109B					
R25	68	±0.5%		ISKRA UPM 050	68	R128	220	±0.5%		ISKRA UPM 050	220	C124	40K	±5%	35V	UNION CARBIDE HR40BWS	4100	TR39	BC109B					
R26	1K	±0.5%		ISKRA UPM 050	1K	R129	220	±0.5%		ISKRA UPM 050	220	C125	40K	±5%	35V	UNION CARBIDE HR40BWS	4101	TR40	BC109B					
R27	150K	±0.5%		ISKRA UPM 050	150K	C1	4.7p			CREATITE A-TRUD 12-02-80	8140	C126	40K	±5%	35V	UNION CARBIDE HR40BWS	4102	TR41	BC109B					
R28	10K	±0.5%		ISKRA UPM 050	10K	C2	4.7p			CREATITE A-TRUD 12-02-80	8140	C127	40K	±5%	35V	UNION CARBIDE HR40BWS	4103	TR42	BC109B					
R29	150K	±0.5%		ISKRA UPM 050	150K	C3	33p	±5%		ERIE RPD N330	537B	C128	40K	±5%	35V	UNION CARBIDE HR40BWS	4104	TR43	BC109B					
R30	10K	±0.5%		ISKRA UPM 050	10K	C4	33p	±5%		ERIE RPD N330	537B	C129	40K	±5%	35V	UNION CARBIDE HR40BWS	4105	TR44	BC109B					
R31	150K	±0.5%		ISKRA UPM 050	150K	C5	300p	±5%		ERIE RPD N330	537B	C130	40K	±5%	35V	UNION CARBIDE HR40BWS	4106	TR45	BC109B					
R32	1K	±0.5%		ISKRA UPM 050	1K	C6	18p	±5%		ERIE RPD N330	537B	C131	40K	±5%	35V	UNION CARBIDE HR40BWS	4107	TR46	BC109B					
R33	1K	±0.5%		ISKRA UPM 050	1K	C7	18p	±5%		ERIE RPD N330	537B	C132	40K	±5%	35V	UNION CARBIDE HR40BWS	4108	TR47	BC109B					
R34	68	±0.5%		ISKRA UPM 050	68	C8	18p	±5%		ERIE RPD N330	537B	C133	40K	±5%	35V	UNION CARBIDE HR40BWS	4109	TR48	BC109B					
R35	4K7	±0.5%		ISKRA UPM 050	4K7	C9	18p	±5%		ERIE RPD N330	537B	C134	40K	±5%	35V	UNION CARBIDE HR40BWS	4110	TR49	BC109B					
R36	47K	±0.5%		ISKRA UPM 050	47K	C10	47p	±5%		LEMO LEMPLAC IEP	551I	C135	40K	±5%	35V	UNION CARBIDE HR40BWS	4111	TR50	BC109B					
R37	150	±0.5%		ISKRA UPM 050	150	C11	47p	±5%		LEMO LEMPLAC IEP	551I	C136	40K	±5%	35V	UNION CARBIDE HR40BWS	4112	TR51	BC109B					
R38	10K	±0.5%		ISKRA UPM 050	10K	C12	47p	±5%		ERIE RPD N330	537B	C137	40K	±5%	35V	UNION CARBIDE HR40BWS	4113	TR52	BC109B					
R39	22K	±0.5%		ISKRA UPM 050	22K	C13	47p	±5%		ERIE RPD N330	537B	C138	40K	±5%	35V	UNION CARBIDE HR40BWS	4114	TR53	BC109B					
R40	22K	±0.5%		ISKRA UPM 050	22K	C14	47p	±5%		ERIE RPD N330	537B	C139	40K	±5%	35V	UNION CARBIDE HR40BWS	4115	TR54	BC109B					
R41	22K	±0.5%		ISKRA UPM 050	22K	C15	47p	±5%		ERIE RPD N330	537B	C140	40K	±5%	35V	UNION CARBIDE HR40BWS	4116	TR55	BC109B					
R42	47K	±0.5%		ISKRA UPM 050	47K	C16	0.022	±5%		DAU B38130	551B	C141	40K	±5%	35V	UNION CARBIDE HR40BWS	4117	TR56	BC109B					
R43	150	±0.5%		ISKRA UPM 050	150	C17	0.022	±5%		ERIE AD	504M	C142	40K	±5%	35V	UNION CARBIDE HR40BWS	4118	TR57	BC109B					
R44	10K	±0.5%		ISKRA UPM 050	10K	C18	0.022	±5%		LEMO LEMPLAC IEP	551J	C143	40K	±5%	35V	UNION CARBIDE HR40BWS	4119	TR58	BC109B					
R45	33K	±0.5%		ISKRA UPM 050	33K	C19	0.022	±5%		ERIE RPD N330	537B	C144	40K	±5%	35V	UNION CARBIDE HR40BWS	4120	TR59	BC109B					

Tuners between serial number 5885 and 10,000 have the phase locked loop decoder (Board type M12307) with the RF board M12248.

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