

Digital Scrambler
Type 9003B
Handbook

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Codan Pty Ltd
ACN 007 590 605
81 Graves Street
Newton
South Australia

PO Box 96
Campbelltown
South Australia
5074

Telephone
National (08) 8305-0311
Internat'l +61 8 8305 0311
Facsimilie (08) 8305 0411

9003B Digital Scrambler

The 9003B Digital Scrambler can be used with all Codan HF-SSB transceivers and Remote Control equipment.

The front panel of the 9003B is fitted with two different microphone connectors to cater for various equipment models; a smaller diameter microphone connector and a larger diameter microphone connector. The rear panel of the 9003B has two corresponding transceiver adaptor connectors.

The 9003B is internally configured so that only one corresponding pair of front and rear panel connectors is active at any time. The active pair is identified on the rear panel as "ENABLED", while the inactive pair is identified as "DISABLED".

The 9003B will be supplied from the factory pre-configured for your transceiver. However, if it should be necessary to alter the configuration, remove the top cover of the unit (by removing the four screws on the sides of the top cover) and follow the instructions contained inside.

Digital Scrambler circuit diagram 04-02727, (Issue 3) and VPD interface assembly 08-04132 (Issue 2) refer to the changes.

Using the 9003B Digital Scrambler with a 9323/9360/9390 Transceiver

- (a) Ensure that the small connector on the rear of the 9003B is "ENABLED".
- (b) Unplug the transceiver microphone.
- (c) Connect the Interface Cable (Part No. 08-05242) between the small plug at the rear of the 9003B and the transceiver microphone input.
- (d) Fit the microphone, removed in (b) above, to the small plug mounted on the front panel of the 9003B.
- (e) Refer to the Digital Scrambler Type 9003 Handbook for further instruction on operation of the unit.

NOTE: The 9323/9360 Transceiver supplies DC power to the 9003B through the interface cable; there is no need to provide a separate DC supply to the 9003B.

Using the 9003B Digital Scrambler with other Codan transceivers

- (a) Ensure that the large connector on the rear of the 9003B is "ENABLED".
- (b) Refer to the Digital Scrambler Type 9003 Handbook for further instruction on the installation and operation of the unit.

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1 THEORY OF OPERATION

1.1 Introduction

The 9003 Digital Scrambler is a voice security device designed for use with standard radio equipment. Digital processing of the audio speech signals almost eliminates the possibility of an unauthorised listener understanding your radio communications. The Scrambler operates within the standard audio bandwidth and does not degrade the transceiver's performance.

1.2 Operation

The speech from the microphone is connected via the Interface PCB to the Voice Privacy Device (VPD) module. Here it is digitised and stored in RAM prior to encryption.

Each half second of digitised audio is divided into 8, 16, or 32 segments and scrambled according to the programmed key code.

Synchronising information is added to the out of order segments prior to conversion back to an audio signal. The resulting scrambled speech is passed to the transceiver for transmission.

The received audio is again digitised stored in RAM and divided into 8, 16, or 32 segments using the synchronising information as a timing reference.

If the VPD module has the same key code, the segments are sorted into their original sequence. The digital information is converted to audio and passed to the loudspeaker via the audio amplifier.

Installation

2 INSTALLATION

2.1 Location

- (a) The 9003 should be located where the **Clear/Secure** switch is easily accessible and near the transceiver associated with it.
- (b) If the unit is to be fitted to a vehicle, avoid areas where the equipment may be subjected to constant direct sunlight or high temperatures.
- (c) For marine installations, locate the 9003 away from areas that may be subjected to water or sea spray. It may be necessary to insulate the mounting bracket from the vessel structure.

NOTE: On some vessels, the DC supply is isolated from the antenna's earth to prevent corrosion (electrolysis effect).

Caution should be taken that the DC isolation is maintained when installing the 9003 Digital Scrambler.

2.2 Power Supply

- (a) The 3 core cable fitted with a 4 way connector is used to supply the DC power to the unit.
- (b) As a precaution, isolate the battery supply during the installation of the equipment.
- (c) Plug the cable into the connector marked **Power** located on the rear panel of the 9003.
- (d) The unterminated wires should be connected to the nearest convenient DC Supply and wired as follows:

Black wire	negative supply	Connect to -ve ground See Note 1
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Red wire	Use for 12 V operation	Connect to +ve 12 V Supply - See note 2
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Orange Wire	Use for 24 V operation	Connect to +ve 24 V Supply - See note 2
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- NOTE:**
- 1. The case of the 9003 is internally connected to the negative rail. Installation is not recommended for vehicles with positive chassis/ground connection.
 - 2. Warning: Connect only one +ve wire (red or orange). Insulate or cut off unused wire.

- (e) In the Clear mode, the current consumption of the 9003 is extremely low (≈ 20 mA). Therefore, when not in use, it is not necessary to switch or disconnect from the battery supply, unless the battery is not charged for long periods.

Installation

2.3 Connecting to a 7 pin microphone socket

To interface the 9003 Digital Scrambler to a 7 pin microphone socket on a Transceiver or Remote Control:

- (a) Unplug the transceiver microphone.
- (b) Connect the Interface Cable (Pt No. 08-04292-001) between the 8 way plug at the rear of the 9003 and the transceiver or remote control microphone input.
- (c) Fit the microphone, removed in (a) above, to the 7 pin plug mounted on the front panel of the 9003.

2.4 Connecting to a 6 pin microphone socket

NOTE: To be used with code 656 accessory kit.
(Pt No. 15-00656 Interface Kit-6 pin, 9003).

To interface the 9003 Digital Scrambler to a 6 pin microphone socket on a Transceiver or Remote Control:

- (a) Unplug the transceiver microphone and discard.
- (b) Connect the Interface Cable (Pt No. 08-04291-001) between the 8 way plug at the rear of the 9003 and the transceiver or remote control microphone input.
- (c) Fit the new microphone (supplied with the 15-00656 Interface Kit) to the 7 pin plug mounted on the front panel of the 9003.

3 OPERATION

3.1 Clear Mode

- (a) With **Clear** selected on the 9003, the VPD unit is bypassed and the transceiver functions as normal.

NOTE: DC power to the 9003 is still required when operating in the **Clear** mode.

- (b) On reception of a scrambled message, it will remain scrambled and not understood as long as the **Clear** mode remains selected.

3.2 Secure Mode

In the **Secure** Mode the **Mute** function on your Transceiver (if fitted) must be disabled for satisfactory operation. The receiving station must be programmed with the same security key code, for your transmissions to be understood.

To operate in the **Secure** mode proceed as follows:

- (a) Switch **Mute** off
- (b) Select **Secure**
- (c) Operate PTT and pause for approximately half second before speaking. Check the **Lock** indicator is lit, indicating secured transmission.
- (d) At the end of the transmission, release the PTT to return to the receive mode.
- (e) At the beginning of a received scrambled message the **Lock** indicator will commence **flashing**, indicating the 9003 has synchronised with the 9003 at the transmitting end. Providing the same key code is used, the message will be received unscrambled and intelligible.

Operation

- (f) The Lock indicator will continue to flash for five seconds after the end of the received transmission. However, should communications be continued with breaks of less than five seconds between transmitting and receiving, synchronisation will be maintained resulting in no loss of speech content.
- (g) If the sender's speech is transmitted in the Clear mode (or without a Digital Scrambler fitted) and the receiver is still in Secure mode, the speech will be understood, but the Lock indicator will not flash, indicating normal unscrambled transmission (unsecured).
- (h) During a Secure transmission, any other person within the network, with the same key code, may monitor the transmission, simply by selecting the Secure mode & waiting for approximately one second for the scrambler to synchronise (Lock LED flashing). Once synchronised, the third party's transmission will also be understood by others within the operating network.

3.3 Transceiver Frequency/Clarifiers

The scrambler is sensitive to frequency differences between the Transmitter and the Receiver. When this difference is 30Hz, or greater, the scrambler may not lock. If your transceiver is fitted with a clarifier, it's use will introduce some frequency difference, and the following will apply:

- a) If your transceiver is equipped with a digital clarifier, such as the 8525/8528 transceiver, then

the clarifier should NOT be adjusted.
- b) If your transceiver is equipped with a clarifier knob it is recommended that:
 - 1) The clarifier knob is returned to the the central position for zero frequency off-set, or
 - 2) The clarifier is removed entirely.

4 TECHNICAL DESCRIPTION

4.1 Description

With the switch S1 in the Secure mode, contacts S1A complete the DC path to energise relay K1. With relay K1 energised, contacts K1/a connect the microphone to the VPD module pin 10 (mic. in). In transmit, the scrambled speech from the VPD module pin 12, is attenuated by R9/R10 and connected to the transceiver microphone input via relay contacts K1/b and isolating transformer T1.

When PTT is operated, the low that is applied to pin 8 of the VPD module results in a low appearing at pin 9. This switches off transistor V1 causing V3 to conduct and relay K2 to energise. Contacts K2/a operate the transceiver PTT and K2/b isolate the loudspeaker from the audio amplifier. When the PTT is released, a delay of approximately 0.25 seconds occurs in the VPD module before pin 9 goes high. A further delay is achieved by the time constant of R6/C1 (V2 conducting in the Secure mode) causing V3 to remain conducting for a further 0.25 seconds, before releasing relay K2. This overall delay of approximately half a second permits the remaining speech delayed by the VPD module to be transmitted before returning to the receive mode.

The receiver audio is applied to the VPD module pin 14 via attenuator R11/R12, normally in a scrambled format. The unscrambled output (if the key code is correct) from pin 15 is connected to an audio amplifier IC1 incorporating a low pass filter. The output of IC1 is connected to the loudspeaker via contacts K2/b, switch S1B and link (pins 5 to 7) fitted in the microphone plug.

When the toggle switch S1 is in the Clear mode, the microphone is connected via T1 direct to the transceiver. PTT still operates via the VPD module but with no delay. Receiver output is connected direct to the loudspeaker via contacts S1B and link in the microphone plug.

The unit can be operated from either 12 or 24 volts DC supply.

The 12 volt input supply is protected against over voltage (>15 volts) and reverse polarity by a 1 Amp fuse F1 and a 15 volt zener diode V1.

The 24 volt input supply is protected against reverse polarity by series diode D3.

VPD Interface PCB

Ref	Description	Manufacturer	Manufacturer's P/N	Codan P/N	Remarks
A1	VPD	GSA	GSA1303	78-22001-001	
C1	10u 20% 25V	TA Cap AVX	TAP106M025CCS	47-11002-510	
C2	100n 10% 63V	PE Cap Philips	2222 370 11104	46-51000-521	
C3	5,6n 2% 63V	PS Cap Philips	2222 424 35602	46-35600-301	
C4	33n 10% 100V	PE Cap Philips	2222 370 21333	46-43300-524	
C5	2,2n 10% 100V	CE Cap Philips	2222 630 03222	46-32200-200	
C6	2,2u 20% 35V	TA Cap AVX	TAP225M035CCS	47-02203-510	
C7	2,2n 5% 160V	PS Cap Philips	2222 425 22202	46-32200-310	
C8	10n 2% 63V	PS Cap Philips	2222 424 31003	46-41000-301	
C9	2,7n 2% 160V	PS Cap Philips	2222 425 32702	46-32700-311	
C10	1u 20% 35V	TA Cap AVX	TAP105M035CCS	47-01003-510	
C11	33n 10% 100V	PE Cap Philips	2222 370 21333	46-43300-524	
C12	100n 20% 50V X7R	CE Cap Vitramon	VP41BY104MA	46-51000-261	
C13	100u 25V	EL Cap Elna	RB	48-21002-551	
C14	470u 16V	EL Cap Jamicon	SKR470T1CG18	48-24701-651	
C15	1n 10% 100V	CE Cap Philips	2222 630 03102	46-31000-200	
C16	1n 10% 100V	CE Cap Philips	2222 630 03102	46-31000-200	
C17	33n 20% 25V	CE Cap Murata	DD406SR333M25	46-43300-211	
C18	1n 10% 100V	CE Cap Philips	2222 630 03102	46-31000-200	
C19	Not Fitted				
C20	100n 50V Z5U	CE Cap Centralab	CZ20C104M244	46-51000-260	
C21	10u 63V	EL Cap Elna	RB	48-11006-351	
C22	1u 20% 35V	TA Cap AVX	TAP105M035CCS	47-01003-510	
C23	33n 20% 25V	CE Cap Murata	DD406SR333M25	46-43300-211	
C24	470u 16V	EL Cap Jamicon	SKR470T1CG18	48-24701-651	
C25	1n 10% 100V	CE Cap Philips	2222 630 03102	46-31000-200	
D1	Diode, Si small sig GP			23-10005	
D2	Diode, Si small sig GP			23-10005	
D3	Diode, Si 400V 1A			1N4004	
D4	Diode, Si 400V 1A			1N4004	
D5	Diode, Si small sig GP			23-10005	
D6	Diode, Si 400V 1A			1N4004	
IC1	Amplifier, Power 12W	IC Philips	TDA1020	TDA1020	
K1	Relay, 2C Bif 12V	720 Ohm Matsushita	DS2Y-S-DC12	64-21223-272	
K2	Relay, 2C Bif 12V	720 Ohm Matsushita	DS2Y-S-DC12	64-21223-272	
L1	Inductor, Toroid			44-80044	
L2	Inductor, 1mH	Taiyo Yuden	FL 5H 102K	43-83100-095	
L3	Inductor, 1mH	Taiyo Yuden	FL 5H 102K	43-83100-095	
L4	Inductor, Toroid			44-80044	
L5	Inductor, 100uH	Taiyo Yuden	FL 5H 101K	43-82100-095	
P1	Header (P) 15way 1Row 2mm Pitch	Molex	39-26-9156	60-00150-101	
P2	Header (P) 8way 1row	Molex	22-03-2081	60-00081-100	
P3	Header (P) 8way 1row	Molex	22-03-2081	60-00081-100	
P4	Header (P) 6way 1row	Molex	22-03-2061	60-00061-100	
P5	Header (P) 4way 1row	Molex	22-03-2041	60-00041-100	
R1	33 Ohm 5% 0,33W	CF Res Philips	2322 211 13339	40-13300-020	

VPD Interface PCB (cont'd)

Ref	Description	Manufacturer	Manufacturer's P/N	Codan P/N	Remarks
R2	10k Ohm 5% 0,33W	CF Res Philips	2322 211 13103	40-41000-020	
R3	10k Ohm 5% 0,33W	CF Res Philips	2322 211 13103	40-41000-020	
R4	10k Ohm 5% 0,33W	CF Res Philips	2322 211 13103	40-41000-020	
R5	1k Ohm 5% 0,33W	CF Res Philips	2322 211 13102	40-31000-020	
R6	47k Ohm 5% 0,33W	CF Res Philips	2322 211 13473	40-44700-020	
R7	22k Ohm 5% 0,33W	CF Res Philips	2322 211 13223	40-42200-020	
R8	10k Ohm 5% 0,33W	CF Res Philips	2322 211 13103	40-41000-020	
R9	1k Ohm 5% 0,33W	CF Res Philips	2322 211 13102	40-31000-020	
R10	100 Ohm 5% 0,33W	CF Res Philips	2322 211 13101	40-21000-020	
R11	1k Ohm 5% 0,33W	CF Res Philips	2322 211 13102	40-31000-020	
R12	4,7k Ohm 5% 0,33W	CF Res Philips	2322 211 13472	40-34700-020	
R13	6,8k Ohm 5% 0,33W	CF Res Philips	2322 211 13682	40-36800-020	
R14	270 Ohm 5% 0,33W	CF Res Philips	2322 211 13271	40-22700-020	
R15	4,7k Ohm 5% 0,33W	CF Res Philips	2322 211 13472	40-34700-020	
R16	4,7k Ohm 5% 0,33W	CF Res Philips	2322 211 13472	40-34700-020	
R17	330k Ohm 5% 0,33W	CF Res Philips	2322 211 13334	40-53300-020	
R18	22k Ohm 5% 0,33W	CF Res Philips	2322 211 13223	40-42200-020	
R19	4,7 Ohm 5% 0,33W	CF Res Philips	2322 211 13478	40-04700-020	
R20	1k Ohm 5% 0,33W	CF Res Philips	2322 211 13102	40-31000-020	
T1	Transformer			44-30821	
V1	Transistor, NPN Si	Philips	BC548	BC548	
V2	Transistor, NPN Si	Philips	BC548	BC548	
V3	Transistor, NPN Si	Philips	BC548	BC548	
1	PCB, VPD Interface			07-01458	

Digital Scrambler, 9003B

Ref	Description	Manufacturer	Manufacturer's P/N	Codan P/N	Remarks
	VPD Interface	CIRCUIT DIAGRAM	FOR REFERENCE ONLY	04-02727	
B1	Loudspeaker, 105x70	8 Ohm Foster	C101K20S0050	65-21000-805	
F1	Fuse, STD	1 Amp Australux	3AG	63-00000-100	
H1	LED, Red HE T-1 3/4	Diffused Liton	LTL-4223	65-61110-207	
IC2	Regulator, Voltage +15V 1,5A IC	National	LM340T-15	XB-07815-400	
P6	Plug, 8way	Fixed Marushin	MI-753-8S	60-00083-320	
P7	Plug, 7way	Fixed Marushin	MI-752S	60-00073-320	
P8	Plug, 4way	Fixed Marushin	MI-721S	60-00040-320	
S1	Switch, Toggle DPDT on-on	C&K	7201-P3-Y-Z-Q-E	62-02220-000	
V1	Diode, Zener 15V 5% 5W			1N5352B	
9	Loom, Mic Input A			08-04294-001	
10	Loom, Power			08-04401-001	
11	Loom, Interface A			08-04293-001	
12	Loom, Switch			08-04402-001	
29	Loom, MIC I/P B			08-05234-001	
30	Loom, Interface B			08-05233-001	
	Cable, Interface 7pin A			08-04292-001	
	Cable, Power 12/24V			08-04404-001	
	Cable, Interface B			08-05242-001	

5 **TRANSCEIVER SPEAKER FACILITY**

5.1 Introduction

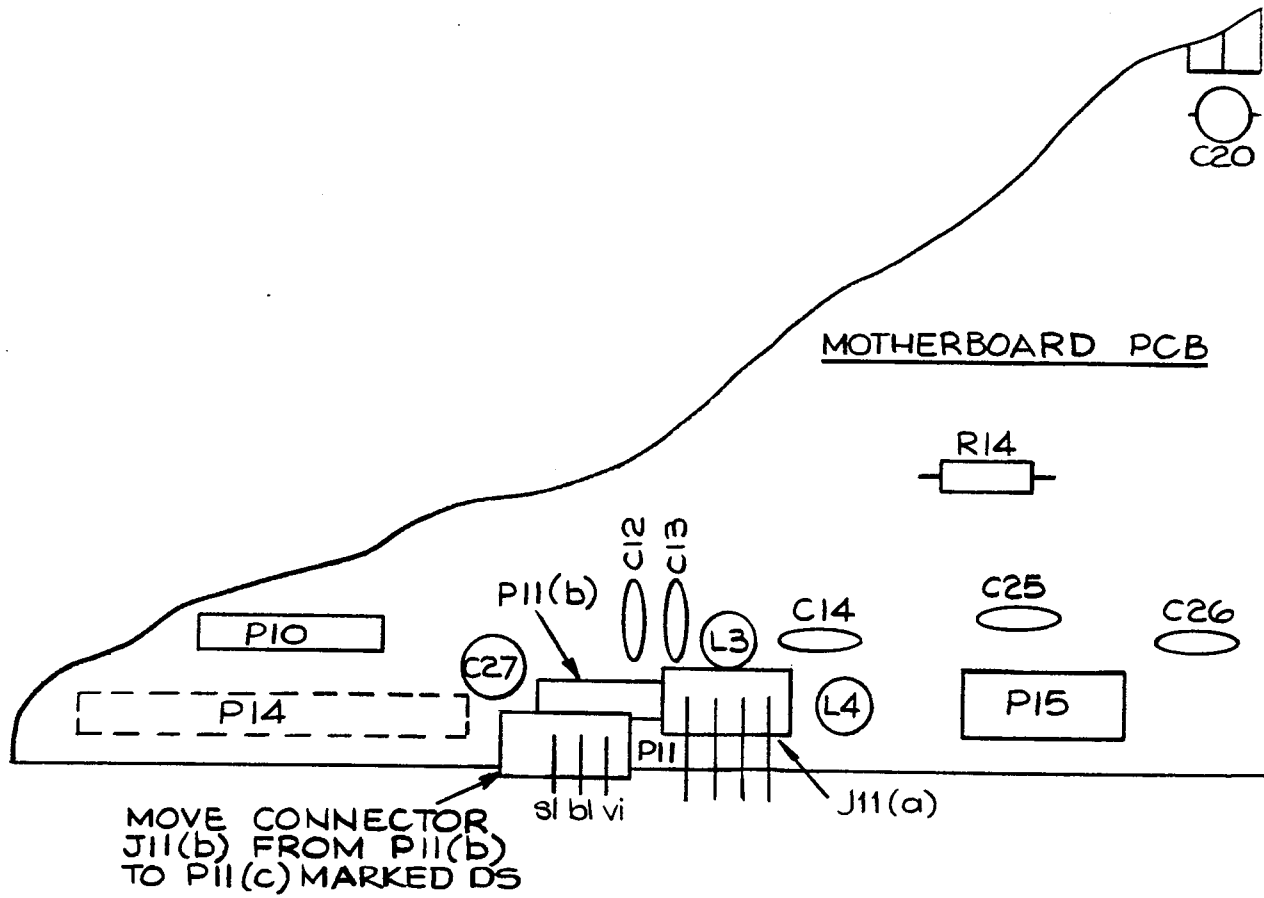
NOTE: The following modification should only be carried out by a Codan agent or qualified technician.

With minor modifications, it is possible to use the internally fitted speaker of the 8525/8528 Transceiver or the 8570 Remote Control Unit, when operating the 9003 digital scrambler. With these changes, the DC to power the 9003 is supplied via the interface cable, therefore eliminating the necessity of an external DC power cable.

The modifications to the transceiver and the rewiring of the interface cable are detailed in sections 5.2 to 5.4.

5.2 Modifications to Transceiver 8525/8528

- (a) Front Panel Control (PCB Issue 2)
(with Motherboard PCB issue 2 onwards)

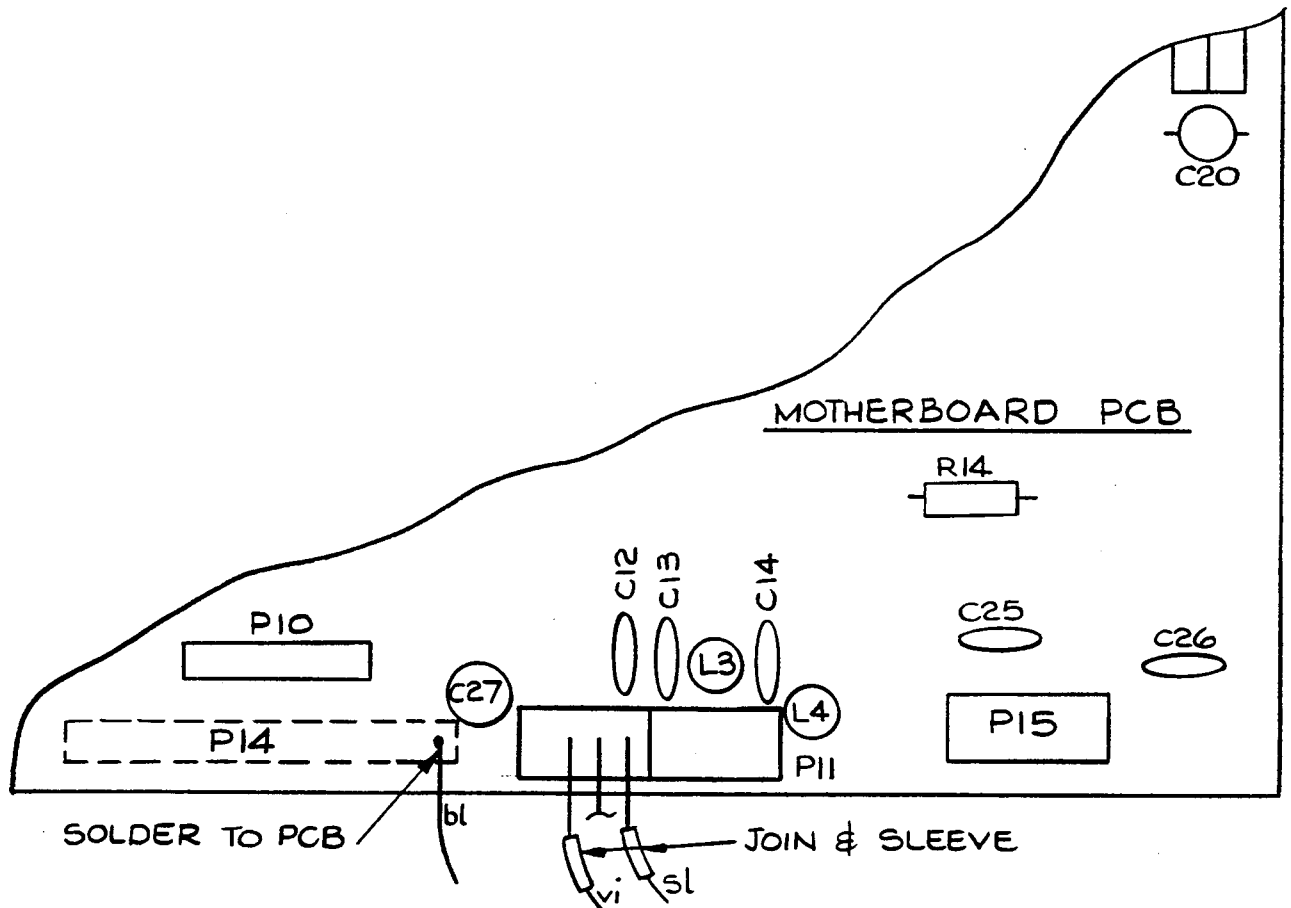


Wiring Details

- i. Reposition J11 (b) as shown

Transceiver Speaker Facility

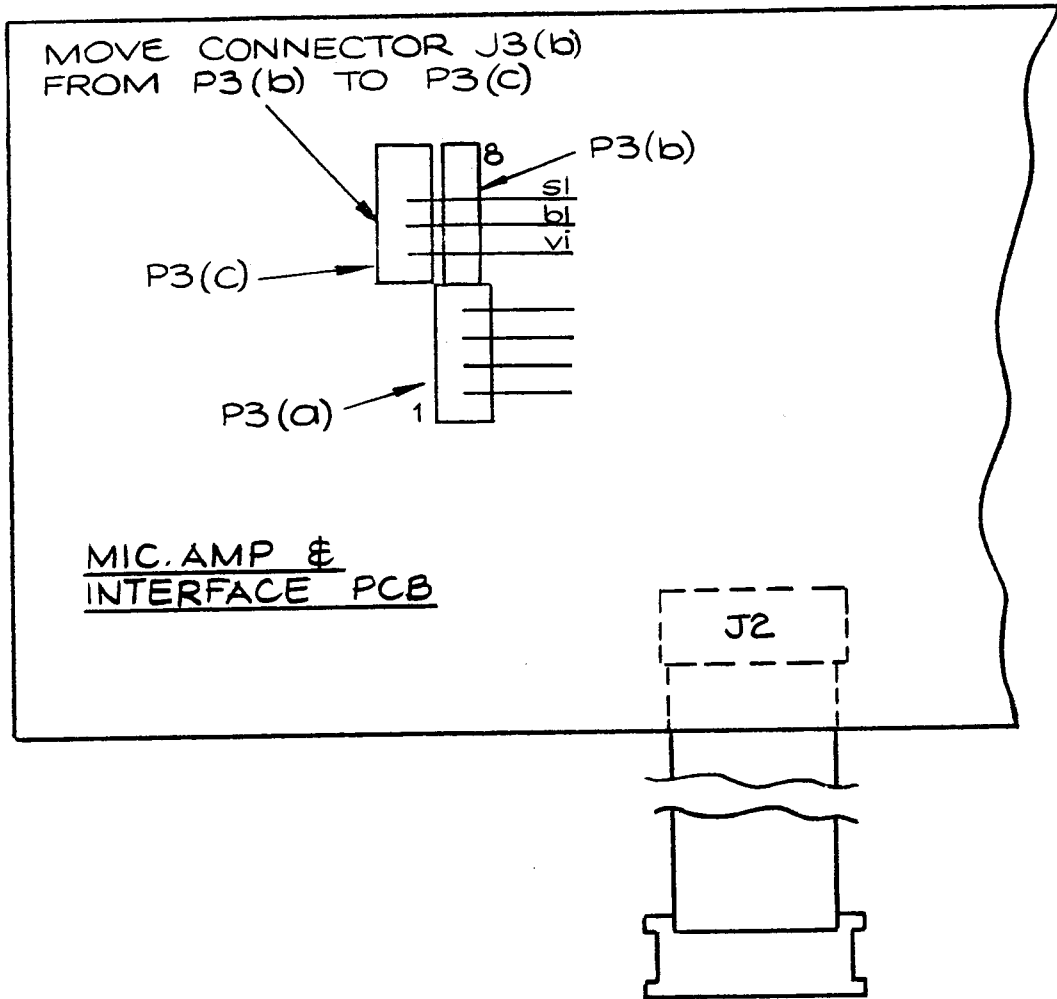
(b) Front Panel Control (PCB Issue 1)
(with Motherboard PCB issue 1)



Wiring Details

- i. Cut wires blue, violet & slate on connector J11 (b)
- ii. Connect slate to pin 5 and sleeve join
- iii. Connect violet to pin 7 and sleeve join
- iv. Solder blue to track as detailed above

(c) Control Head 8530/8531 (PCB Issue 3)
(with Mic, Amp & Interface PCB issue 3 Onwards)

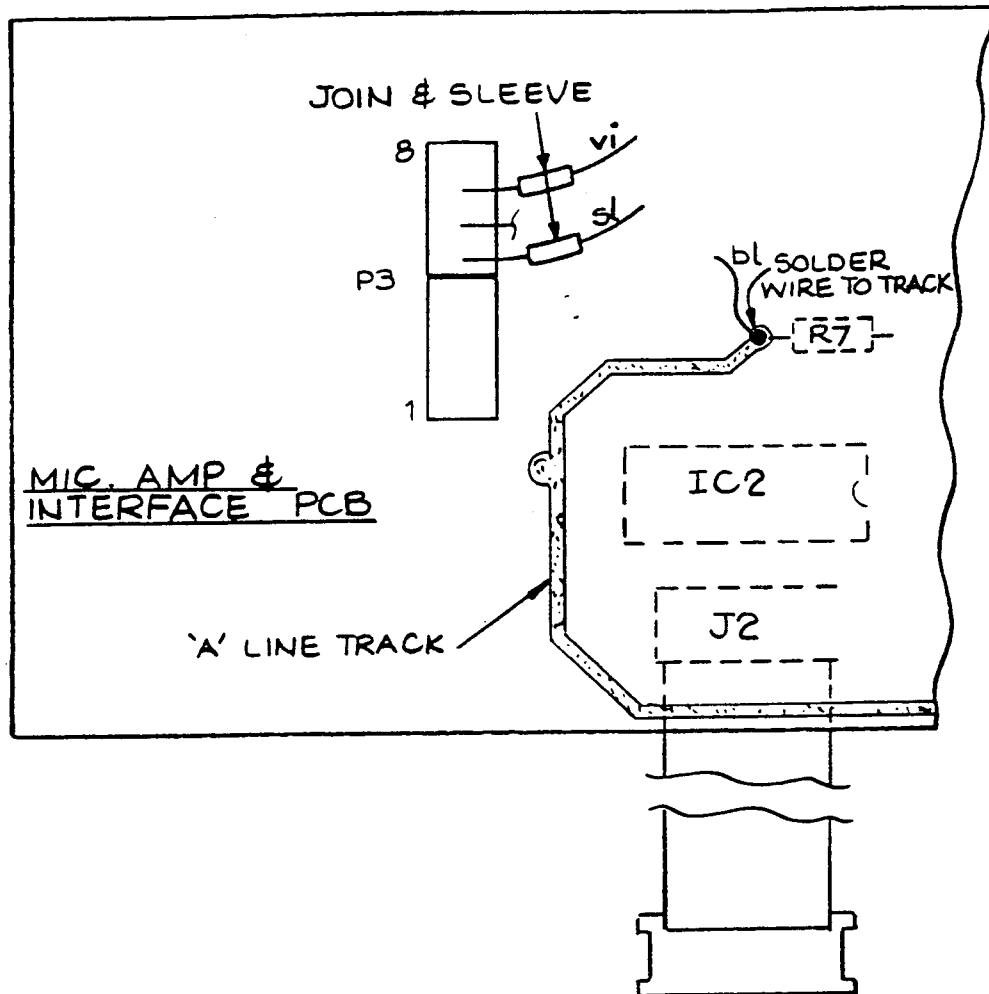


Wiring Details

- i. Reposition J3 (b) as shown

Transceiver Speaker Facility

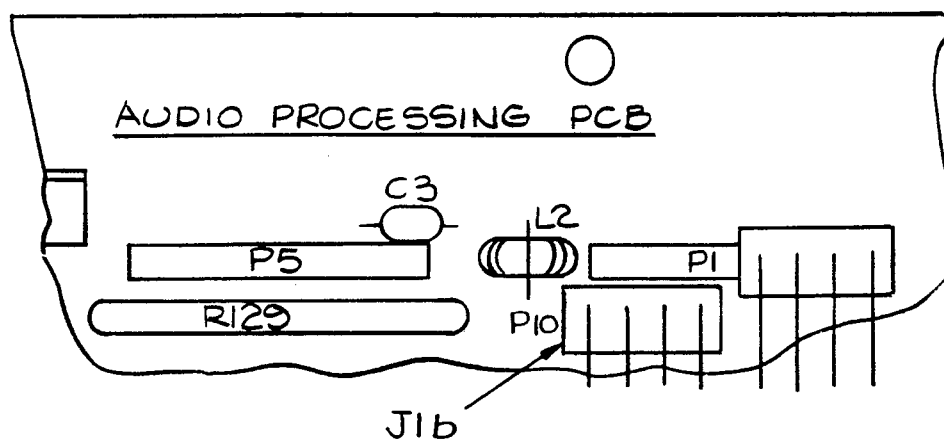
- (d) Control Head 8530/8531 (PCB Before Issue 3)
(with Mic Amp & Interface PCB before Issue 3)



Wiring Details

- i. Cut the Blue, Violet & Slate wires to connector P3 and rewire as shown.

5.3 Modifications to Remote Control type 8570



Wiring Details

- i. Move connector J1 (b) to P10 as detailed

Transceiver Speaker Facility

5.4 Modification to the Interface Cable 08-04292

- (a) Cut off the 7 way connector, remove existing wires and re-terminate as detailed in table 1 below.
- (b) Trim back to outer sheath all unused wires.
- (c) Ensure the connector's cable clamp securely clamps the outer sheath (including rubber sleeve).

Wire Colour	Connector Pin No.	Function
Brown	1	Ground (PTT)
Slate	1	Ground (Supply)
Red	2	PTT
Orange	3	Microphone
Yellow	4	Microphone
Green	5	Speaker
Blue	6	DC Supply +ve
Violet	7	Rx Audio

6 GENERAL

6.1 Specifications

Supply Volts	10 to 15 V DC Fuse protected for over voltage and reverse polarity
	15 to 30 V DC Protected against reverse polarity
Power Consumption (no audio)	Clear - 20 mA (nom) Secure - 90 mA (nom)
AF Power	2.5 W (nom) into 8 Ω
Extension Speaker	4 Ω to 16 Ω
Operating Temperature	-30° to +60°C
Receiver Input/Output Level	2 to 12 volts PP
Transmit Input/Output Level	20 mV PP (nom)
8 Element Scrambler	
Scrambling technique:	Disjoint frame, sliding window 8 time element scrambling of 64 ms speech segments with reverse read out
Permutation Space:	40,320
16 Element Scrambler	
Scrambling technique:	Disjoint frame, sliding window 16 time element scrambling of 32 ms speech segments with reverse read out
Permutation Space:	2.09×10^{13}
32 Element Scrambler	
Scrambling technique:	Disjoint frame, sliding window 32 time element scrambling of 16 ms speech segments with reverse read out
Permutation Space:	2.63×10^{35}

General

Total Allowable System Propagation Delay	10 ms
Voice Processing	A/D, D/A. Internally fully digital
Key Format	10 decimal digits
Key Entry	Cryptofil hand held programmer
Key to Permutation	Via pseudo-random sequence mapping generates algorithm
System delay	512 ms total end to end delay
Synchronisation	Fully automatic continuous re-sync every 0.5 seconds
Late Entry	approx 1 second
Size and Weight	165 mm W x 58 mm H x 200 mm D; 800 g (less mounting bracket. Depth includes rear connectors)

6.2 Connectors

(a) Interface to transceiver - 8 pin (rear panel)

Pin No.	Function
1) PTT
2) "
3) Mic.
4) "
5	Speaker Connection*
6	+12 V I/P
7	Receiver Audio
8	Ground

* Audio return to transceiver speaker when modified - see section 6

(b) External DC Supply Input - 4 pin (rear panel)

Pin No.	Function
1	+12 V Input
2	+24 V Input
3	No Connection
4	Ground

(c) Microphone Input - 7 pin (front panel)

Pin No.	Function
1	PTT Ground
2	PTT
3	Mic. Ground
4	Mic.
5	Speaker Connection*
6	Audio Ground
7	Audio Output

* Linked to pin 7 for internal speaker operation

6.3 Accessories

Code

656

Interface cable, 6 pin and microphone
P/N 15-00656 Interface Cable, 6 pin & Mic.