Tait Orca Handportable Radios

Service Manual

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Contents

Part A: Introduction

Part B: Radio specifications and circuit descriptions

Tait Electronics Ltd has made every effort to ensure the accuracy of the information in this manual. However, Tait Electronics Ltd reserves the right to update this manual and/or Tait Orca handportable radios and accessories without notice.

Part C: Diagnostics and fault finding

Part D: Servicing the radio

Part E: Battery packs and chargers

Part F: Interfacing non-Tait accessories

Part G: Additional information

PART A

Introduction

This part provides an introduction to servicing Tait Orca handportables. It includes an outline of the Tait Orca handportable range of products and precautions that should be taken before servicing Tait Orca handportables.

Detailed servicing instructions and information about spare parts are found in *Part D: Servicing the radio*.

Contents

Servicing Tait Orca handportables

The Tait Orca series of handportables is a range of high performance, microprocessor-controlled radios manufactured using an RF-shielded PCB and high-density SMD componentry.

The manufacturing process does not allow direct servicing access to components on the main PCB, although replacement PCBs are available on an exchange basis. Service repairs of Tait Orca handportables are therefore limited to key mechanical and ancillary devices associated with the main PCB. These include:

- the front panel assembly;
- the lens (Orca Excel and Orca Eclipse);
- the PTT keypad;
- the speaker;
- the keypad (Orca Excel and Orca Eclipse);
- the volume plate and keypad (Orca Eclipse);
- the LCD display (Orca Excel and Orca Eclipse);
- the shield, complete with user interface PCB assembly and polyester dome (Orca Excel and Orca Eclipse);
- the main PCB assembly;
- the antenna connector;
- the channel selector switch (Orca Elan and Orca Excel);
- the volume control switch (Orca Elan and Orca Excel);
- the microphone;
- the speaker contacts;
- the battery contacts;
- the PTT tact switch;
- the RF out assembly; and
- the auxiliary flexible PCB.

The repair of PCB-related faults is the responsibility of the Customer Services Division of Tait Mobile Radio. Detailed schematics and component location information for the main PCB may also be obtained from the Customer Services Division. Contact your Tait dealer for more information.

WWW technical support

Tait Electronics Ltd provides product support at the following address:

http://www.taitworld.com/support

At this site, you can send a request for support.

What does this manual contain?

This manual is supplied as part of the Tait Orca handportable service kit (TOPA-SV-001), and provides the following:

- general information and specifications on the Tait Orca series of handportables;
- basic circuit descriptions;
- information on finding and servicing of non-PCB-related faults;
- information on Tait Orca battery packs and chargers;
- information on interfacing accessories to Tait Orca handportables; and
- a glossary of key terms.

What is included in the calibration service kit?

The TOPA-SV-001 service kit contains:

- calibration test unit (TOPA-SV-004);
- radio calibration cable for connecting the radio to the calibration test unit (TOPA-SV-007);

- 25 pin RS232 to modular phone jack programming lead for connecting the calibration test unit to a PC (TOPA-SV-012);
- DC service adaptor (TOPA-SV-005);
- SMA to N-type RF test lead for connecting to the radio's antenna connector (TOPA-SV-006);
- T6 driver bit and 8 mm socket (TOPA-SV-011);
- this manual;
- *User's Manual: Calibration System for Tait Orca Radios* (IPN* 439-52000-xx, 'xx' refers to the manual version number); and
- a 3.5-inch high density 1.44 MB calibration system install disk.

Other items required for calibration but not included as part of the service kit are:

- RF communications test set (e.g. HP8920, MI2945/55, CMS52);
- digital current meter capable of measuring current up to 3 A, accurate to two decimal places.;
- DC power supply, 7.5 V, 3 A for handportables; and
- DC power supply, 13.8 V, 7 A for mobile radios.

Programming service kits

There are two service kits available for programming Tait Orca radios.

The TOPA-SV-002 service kit for programming conventional radios contains:

- *User's Manual: Programming System for Tait Orca Conventional Radios* (IPN 439-51100-xx); and
- accessory connector to modular phone socket programming cable for connecting the radio to the programming lead (TOPA-SV-003); and
- 25 pin RS232 to modular phone jack programming lead for connecting the programming cable to a PC (TOPA-SV-012); and
- a 3.5-inch high density 1.44 MB program install disk.

The TOPA-SV-015 service kit for programming trunked radios contains:

- *User's Manual: Programming System for Tait Orca Trunked Radios* (IPN 439-51200-xx); and
- accessory connector to modular phone socket programming cable for connecting the radio to the programming lead (TOPA-SV-003); and
- 25 pin RS232 to modular phone jack programming lead for connecting the programming cable to a PC (TOPA-SV-012); and
- a 3.5-inch high density 1.44 MB program install disk.

Conventions

Throughout this manual, the names of software screen, field and menu names are referred to in **bold sans serif font**. For example:

> Check that the information in the **Radio Model** fields (**Specifications** screen) is correct.

* An 'IPN' is the ten digit 'internal part number' which uniquely identifies any component used in a Tait product.

The Tait Orca series of handportables

There are three Tait Orca series handportables available:

- the Orca Elan;
- the Orca Excel; and
- the Orca Eclipse.

This manual includes information specific to all three handportables. As new features and enhancements occur, new revisions of this manual will be released.

The new text (without folder) is available as IPN 410-51000-xx, where 'xx' refers to the revision status of the new manual.

Product codes

The digits in the Tait Orca product code provide information about the radio's model number and various hardware options, according to the convention outlined in Figure A-1. The naming convention is not intended to imply that any particular combination of radio features is at present available or planned for later release. For more information on what features and variants are available, contact your nearest Tait dealer.

Operating Instructions

A user's manual is available for each radio. Figure A-2 shows the naming convention for Tait Orca radio user's manuals.

Accessories

Table A-1 shows the accessories available for Tait Orca handportables. Of these accessories, only the chargers are serviceable.

For more information on chargers, see *Part E: Battery packs and chargers*. The three battery packs available for Tait Orca handportables are also described in Part E.

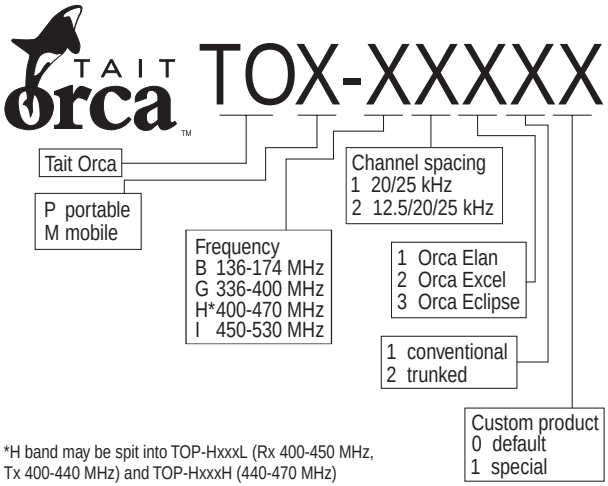


Figure A-1: The Tait Orca naming convention

Note that the naming convention is not intended to imply that any particular combination of radio features is at present available or planned for later release.

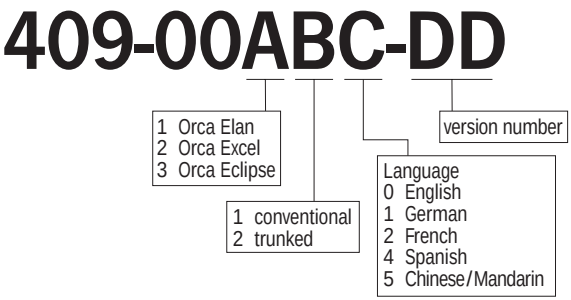


Figure A-2: Naming convention for Tait Orca handportable user's manuals

Fitting an accessory

To fit some accessories to the radio, you will need to remove the rear accessory cover. Remove the battery, then insert the end of a key underneath the bottom edge of the accessory cover. Lift to remove the cover.

When attaching or removing an accessory, ensure that the lever is in the upright position. Once the accessory is in position, rotate the lever 90 degrees counterclockwise to lock it in place.

Fitting a non-Tait accessory

See *Part F: Interfacing non-Tait accessories* for information on using non-Tait accessories with Tait Orca handportables.

Table A-1: Tait Orca handportable accessories

Type of accessory	Product code	Description
Antennas	TOPA-AN-101	136-230 MHz 3" helical
	TOPA-AN-102	336-530 MHz 3" helical
	TOPA-AN-201	136-330 MHz 6" helical
	TOPA-AN-202	400-530 MHz 6" 1/4 wave whip
Audio accessories	TOPA-AA-001	Speaker microphone -10 °C, two function buttons
	TOPA-AA-002	Speaker microphone -30 °C heavy duty, two function buttons
	TOPA-AA-003	Speaker microphone -30 °C MIL spec
	TOPA-AA-004	Speaker microphone -30 °C MIL spec RF
	TOPA-AA-005	7.5 mm accessory adaptor
	TOPA-AA-006	Tait Orca accessory connector kit
	TOPA-AA-007	Tait Orca RF accessory connector kit
	TOPA-AA-008	Speaker microphone, -30 °C MIL spec, no function buttons, high/* low volume
	TOPA-AA-009	2-wire palm microphone and earphone*
	TOPA-AA-010	3-wire lapel microphone and earphone*
	TOPA-AA-011	Light weight single speaker headset with in-line PTT*
	TOPA-AA-012	Over-the-head headset with noise cancelling boom microphone*
	TOPA-AA-013	Behind-the-head headset with noise cancelling boom microphone*
	T952-051	Earphone kit with coil corn and 2.5 mm plug†
Batteries	TOPB100	1100 mAh NiCd battery pack
	TOPB200	1500 mAh NiCd battery pack
	TOPB300	1850 mAh NiMH battery pack
Battery chargers	TOPA-CH-100	Desktop trickle charger
	TOPA-CH-200	Desktop fast charger
	TOPA-CH-300	Six-way multi-charger
Plug packs (for TOPA-CH-200)	T952-012	Australia, New Zealand and China (230 V 50 Hz input; plug configuration: )
	T952-022	Singapore and Middle East (230 V 50 Hz input; plug configuration: )
	T952-032	Mainland Europe (230 V 50 Hz input; plug configuration: )
	T952-042	USA and Canada (115 V 60 Hz input; plug configuration: )
	T952-052	UK and Hong Kong (230 V 50 Hz input; plug configuration: )
Carrying accessories	TOPA-CA-001	Heavy duty carry case
	TOPA-CA-002	Heavy duty holster
	TOPA-CA-003	38 mm belt clip x 10
	TOPA-CA-004	Accessory port cover x 10
	TOPA-CA-005	55 mm belt clip
	TOPA-CA-006	55 mm belt clip x 10

* For use with TOPA-AA-005
† For use with TOPA-AA-003, TOPA-AA-004 and TOPA-AA-008

Important information

Basic servicing precautions

Tait Orca handportables require specialised servicing techniques and should only be serviced at an approved Tait service centre equipped with the necessary facilities.

Standard anti-static procedures should be followed; a typical setup is shown in Figure A-1.

If in doubt, contact Tait Electronics Ltd or your nearest Tait dealer.

Warning!!!

Repairs attempted with incorrect equipment or by untrained personnel may result in permanent damage.

Caution: CMOS devices

This equipment contains CMOS devices, which are susceptible to damage from static charges. Care when handling these devices is essential. For correct handling procedures, refer to manufacturers' data books covering CMOS devices, such as *Philips Data Handbook Covering CMOS Devices* or *Motorola CMOS Data Book Section 5 (Handling Procedures)*.

Screw head types

Torx recess head screws and Pozidriv recess head screws require the correct sized driver to achieve best performance. Most of the screws in Tait Orca handportables are Torx head screws, and so a Torx T6 driver bit is supplied as part of the service kit. Some earlier radios have Pozidriv screws.

Torx head 1.8*5 mm screws should be removed using the supplied Torx T6 driver. When replacing these screws, set the driver to 2 inch pounds.

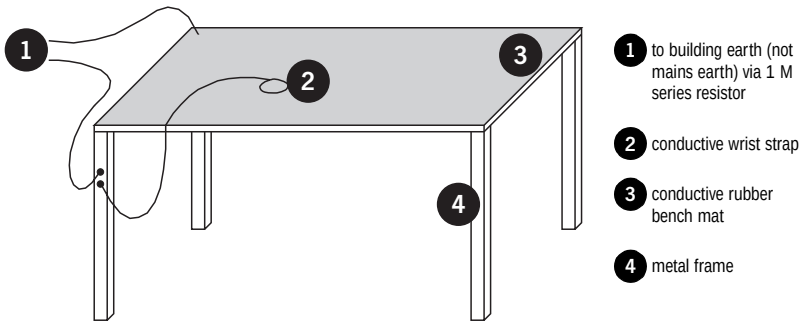
Pan Pozi M2*8 mm and M2*5 mm screws should be removed using a Pozi 1 driver. When replacing these screws, set the driver to 2 inch pounds.

Programming

For information on programming Tait Orca handportables, refer to:

- the *User's Manual: Programming System for Tait Orca Conventional Radios* (IPN 439-51100-xx), supplied as part of the TOPA-SV-002 service kit; or
- the *User's Manual: Programming System for Tait Orca Trunked Radios* (IPN 439-51200-xx), supplied as part of the TOPA-SV-015 service kit.

Figure A-1: Typical anti-static bench setup



Calibrating

For information on calibrating Tait Orca handportables, refer to the *User's Manual: Calibration System for Tait Orca Radios*. The calibration system is supplied as part of the TOPA-SV-001 service kit.

Test facilities

Standard test facilities provide a way of testing the radio's functions independently of normal radio operation. See *Part C: Diagnostics and fault finding* for a description of the test facilities available for Tait Orca handportables.

PART B

Radio specifications and circuit descriptions

This part outlines the radio specifications and circuit descriptions for Tait Orca handportables.

Contents

Radio specifications

The performance figures outlined in Tables B-1 to B-3 are typical figures, unless otherwise stated, for equipment operating at standard room temperature.

The test methods used to obtain these figures are those described in the European Telecommunication Standard ETS 300-086. Where applicable, the EIA figure is also given.

Details of test methods and the conditions that apply for type approval testing in all countries can be obtained from Tait Electronics Ltd.

Table B-1: General specifications

Size W x H x D (including 1100 mAh NiCd battery)	62 mm x 153 mm x 44 mm (2.4 in x 6.0 in x 1.7 in)
Weight (including 1100 mAh NiCd battery)	
Orca Elan	495 g (17.5 oz)
Orca Excel	520 g (18.3 oz)
Orca Eclipse	520 g (18.2 oz)
Switching band	B 136-174 MHz G 336-400 MHz H* 400-470 MHz I 450-530 MHz
Frequency increments	5, 6.25 kHz
IF bandwidth	
narrowband	9 kHz
medium/wideband	20 kHz
Channel spacing	
narrowband	12.5/20/25 kHz
medium/wideband	20/25 kHz

* Note that H band may be split into TOP-HxxxL (Rx 400-450 MHz, Tx 400-440 MHz) and TOP-HxxxH (440-470 MHz).

Supply voltage	6.0-9.0 V
Standard test voltage	7.5 V
Battery capacity	
NiCd	1100 mAh
NiCd	1500 mAh
NiMH	1850 mAh
Current consumption*	
Transmitting (1 W)	1.0 A
Transmitting (4/5 W)	1.8 A
Receive (rated audio)	270mA
Standby (conventional)	80mA (no economy mode) 40 mA (economy mode high)
Standby (trunked)	100 mA
Scanning (conventional)	75 mA (economy mode on)

* Note that the figures for current are dependent upon the functions active in the radio and the operating frequency.

Frequency stability	±2.5 ppm from -30 °C to +60 °C

Table B-2: Receiver performance

Sensitivity	
12 dB SINAD	-117 dBm (minimum) -120 dBm (typical) .25 µV (EIA)
20 dB psophometric	-114 dBm (minimum) .40 µV (EIA)
Ultimate signal to noise ratio	
narrowband	40 dB
wideband	45 dB
Audio	
Minimum load impedance	13 Ω
Rated power	500 mW (1kHz, 60% deviation into 16 Ω
Distortion	<5% (1kHz, 60% deviation at rated power into 16 Ω)
Response	-6 dB/oct +1, -3 dB (cf 1 kHz), 300-2550 Hz (narrowband) 300-3000 Hz (wideband)
Selectivity	
to 225 MHz	70 dB (narrowband) 75 dB (mediumband) 75 dB (wideband)
UHF	66 dB (narrowband) 72 dB (mediumband) 72 dB (wideband)
Spurious responses	70 dB
Intermodulation	65 dB 70dB (EIA)
Blocking	-13 dBm
Spurious emissions	
to 1 GHz	-57 dBm (conducted and radiated)
1 to 4 GHz (136-470 MHz)	-47 dBm (conducted and radiated)
1 to 12.75 GHz (>470 MHz)	-47 dBm (conducted only)
Group delay variation	±50 µs (at detected audio output) bandwidth 300-3000 Hz
Hum and noise	40 dB
RSSI	
range	-120 to -40 dBm
slope	28.65 mV/dB (typical)
Squelch	
city	16 dB_{SINAD} fixed
country	12 dB_{SINAD} fixed

Table B-3: Transmitter performance

Power output	
136-174 MHz	1 W (low) 2.5 W (medium) 5 W (high)
174-530 MHz	1 W (low) 2.5 W (medium) 4 W (high)
Duty cycle	20% (1 minute Tx, 4 minutes Rx at maximum temperature and voltage)
Spurious emissions	
to 1 GHz	-36 dBm (conducted and radiated)
1 to 4 GHz (136-470 MHz)	-30 dBm (conducted and radiated)
1 to 12.75 GHz (470-870 MHz)	-30 dBm (conducted only)
Adjacent channel	
narrowband	60 dBc
mediumband	70 dBc
wideband	70 dBc
Group delay variation	±50 µs (at mod audio output)
bandwidth	300-3000 Hz
Modulation type	direct FM
Deviation limiting	±5 kHz (adjustable up to)
narrowband	±2.5 kHz
mediumband	±4.0 kHz
wideband	±5.0 kHz
Trunking data deviation (as per MPT1327)	
narrowband	1.5 kHz
mediumband	2.4 kHz
wideband	3 kHz
FM hum and noise	
narrowband	40 dB
wideband	45 dB
Audio response	
below limiting	6 dB/oct +1, -3 dB (cf 1 kHz) 300-3000 Hz
in limiting	0 dB +0, -4 dB (cf maximum system deviation) 450-2550 Hz
above 3 kHz	-35 dB/oct min
input for 60% deviation	5 mV_{rms}
distortion	<5% at 1 kHz
Ruggedness	2 minutes (into infinite SWR)
Stability	5:1 SWR (all phase angles, <-60 dBc)

Circuit descriptions

Figure B-1 shows the circuit interface diagram for the Tait Orca handportable.

The Tait Orca handportable has been designed to be totally electronically tuned using the *Calibration System for Tait Orca Radios*. The titles of tests referred to below are tests available in the calibration system, e.g. **Power Level** test refers to the **Power Level** screen in the calibration system. Consult the calibration system *User's Manual* for more information on specific calibration tests.

Transmitter

The RF power amplifier amplifies transmit RF from the VCO to the output power level (4W UHF/5W VHF). The PA output is fed to the PIN switch, which provides isolation between the transmit and receive paths.

An LPF follows the PIN switch and provides attenuation of unwanted high frequency signals.

Following the LPF, the signal is fed to the antenna.

The output power level is controlled by the microprocessor and associated circuitry, and is initially set by calibrating the radio (**Power Level** test).

Transmit (Tx) audio

Tx audio from the microphone is processed by the DSP and associated circuitry into two modulation signals, one required by the TCXO in the synthesiser and the other by the VCO.

A digital pot is used to set the overall deviation and modulation balance; these are controlled by calibration (**Maximum Deviation** and **Modulation Balance** tests).

Receiver

RF from the antenna is fed via the LPF and PIN switch into the receiver. The RF passes through the front end tuning circuit, which rejects unwanted frequencies. The front end is electronically tuned, and the front end tuning voltage that sets the centre of the bandpass filter is determined during calibration (**Front End Tuning** test).

The output of the front end tuning stage is fed to the first mixer, and the VCO provides the local oscillator input. The output of the mixer is at the first IF frequency (45.1 MHz UHF/ 21.4 MHz VHF).

The IF signal passes through two crystal filters, separated by the IF amplifier.

In the Demod IC, the signal passes through the second mixer, producing the second IF (455 kHz). The second IF passes through a ceramic band pass filter and IF amp, which are external to the IC. The second IF is then fed back into the Demod IC for another amplification stage, then through another ceramic band bass filter. The final stage is the phase lock loop (PLL) discriminator in the Demod IC, which produces detected audio.

A squelch detect circuit detects high frequency audio noise and compares it with a threshold, which is set up by the microprocessor and can be set during calibration (**Squelch Thresholds** test).

The RSSI output of the detector circuit provides an analogue indication of the received signal strength. RSSI thresholds are set during calibration (**RSSI Thresholds** test).

TOP-x2xxx radios have 9 kHz ceramic filters and can operate on wide/medium or narrow band, whereas TOP-x1xxx radios have 20 kHz ceramic filters and can operate on wide or medium band. This is programmable on a per channel basis.

Receive (Rx) audio

The detected audio is processed by the DSP, amplified and fed to an internal speaker, whose selection is controlled by a line from the microprocessor. The speaker output is always available on the accessory connector, to drive an external speaker.

The unprocessed audio from the output of the Demod IC (RX-DET-AF) is also available at the accessory connector.

All signalling, such as Selcall, CTCSS, DCS, DTMF and FFSK, and all confidence tones are generated by the DSP.

The DSP operates in half-duplex mode. That is, its CODEC input and output is switched between the Tx and Rx audio paths, according to whether the radio is transmitting or receiving.

Synthesiser and VCO

The synthesiser receives channel frequency information from the microprocessor. It then sets the VCO to the required frequency and maintains its stability using a phase-locked loop. There are one or two VCOs, depending on the radio type. Some bands have one VCO that covers the whole tuning range of the radio plus the IF offset, with its output switched to Tx or Rx. Other bands have a dedicated Tx and Rx VCO.

A lock detect output from the synthesiser (LCK-DET) indicates whether the VCO is producing the correct frequency (the radio is in lock). If the frequency is incorrect, the lock detect status prevents the transmitter from operating, and informs the control microprocessor.

The reference frequency for the synthesiser is provided by the TCXO (temperature compensated crystal oscillator), which is initially set on frequency using a DC voltage at calibration (**TCXO Calibration** test).

Power supplies

+5V-DIG

The +5V-DIG supply provides regulated 5 V to the microprocessor and its associated circuitry. It is controlled by the on/off switch and a line from the microprocessor.

It provides 5 V to all circuitry that requires power when the radio is in economy mode.

+5V-AN

The +5V-AN supply provides the power to all circuitry that requires 5 V when the radio is not in economy mode, mainly all analog circuitry in the receiver, synthesiser and audio modules. It is controlled by a line from the microprocessor and is a regulated supply.

+5V-TX

The +5V TX supply provides power for the exciter stage of the transmitter when the radio is in transmit mode. It is controlled by a line from the microprocessor and is a regulated supply.

+7V5-BATT

The +7V5-BATT supply is the unregulated voltage supplied to the radio from the battery.

+7V5-ACC

The +7V5-ACC supply is supplied to the accessory connector from the battery through a switch and with some current limiting.

+7V5-SW

The +7V5-SW switched supply is unregulated voltage supplied to the radio from the battery through a switch.

+14V

The +14V regulated supply provides the 14 V required by the loop filter in the synthesiser.

A switch mode regulator produces this voltage from the +7V5-SW and +5V-AN supplies.

+4V3-DEC

The +4V3V-DEC supply is derived from the +5V-AN voltage. It is used to power the transmit and receive VCOs in conjunction with the transmit control line from the processor. It also provides the loop filter reference in the synthesiser.

Accessory connector interface

The accessory connector interface is described in *Part F: Interfacing non-Tait accessories*.

Implications of narrowband versus wideband IF filtering

The two physical variants of bandwidth in the Tait Orca handportable series differ in the bandwidth of the second IF ceramic filtering, and in the squelch circuit design. TOP-x2xxx radios are narrowband and TOP-x1xxx radios are wideband.

The effect of the wider IF filtering is to allow a higher modulation depth and rate without causing either waveform or group delay distortion problems. This may be critical in high speed data reception applications, but it is recommended that this is confirmed for the actual application.

A different squelch circuit is required in each case because of the characteristics of the signal produced by the different IF filtering. At the same time, the squelch circuitry for the 20/25 kHz variant does not have to cope with a large range in the modulation depth, and hence can be optimised for ideal performance. The 12.5/20/25 kHz variant has the compromise that high deviation signals can 'desensitise' the receiver, in that they confuse the squelch circuitry and may cause occasional chopping of the audio in fringe areas.

PART C

Diagnostics and fault finding

This part provides information on diagnosing faults in Tait Orca handportables.

The information in the fault finding charts should be used in combination with the test facilities, and it may also be helpful to examine the radio programming software data using the programming system for Tait Orca conventional or trunked radios.

Contents

Test facilities

Standard test facilities provide a way of testing the radio's functions independently of normal radio operation. A series of test commands can be sent to a radio in two ways:

- using the calibration system; or
- using a terminal program.

See the *User's Manual: Calibration System for Tait Orca* Radios for information on using the calibration system to send test commands to a radio.

When using a terminal program, use the following settings:

- baud rate: 9600
- number of data bits: 8
- number of stop bits: 1
- parity: none
- flow control: none.

To put the radio into computer-controlled test mode, send **^** (**Shift-6**), wait for a return prompt (**v**), then immediately send **%** (**Shift-5**). You can then begin sending test commands to the radio.

A full list of test commands is given in Table C-1. Table C-1 shows how to calculate the parameters necessary for test command 101.

If using the calibration system to send test commands to a radio, the parameters for command 101 are automatically calculated from the frequency value entered.

Error codes

The errors you may receive while the radio is in test mode are outlined below. If the radio must be returned for repair (e.g. the DSP needs to be replaced), contact your Tait dealer for more information.

{C01}

An invalid command code has been received. Try sending the command again.

{C02}

A (valid) command code has been received but with invalid parameters. Check the parameters and try sending the command again.

{C03}

A (valid) command code has been received but it cannot be processed at this time. Try sending the command again.

If the error persists, turn the radio off, then on again and put the radio into test mode. If the error still persists, contact your Tait dealer.

{C04}

An error occurred during the initialisation of test mode. Turn the radio off, then on again and put the radio into test mode.

If the error persists, contact your Tait dealer.

{X01}

EPROM checksum error. The software code in the flash has been corrupted. Re-download the radio software.

If the error persists, the flash needs to be replaced. Contact your Tait dealer.

{X02}

Internal RAM failed. The RAM in the microprocessor is faulty and the microprocessor needs to be replaced. Contact your Tait dealer.

{X03}

External RAM failed. The RAM in the ASIC is faulty and the ASIC needs to be replaced. Contact your Tait dealer.

{X04}

The DSP is not responding. Check the DSP for pin connections.

If the error persists, the DSP needs to be replaced. Contact your Tait dealer.

{X05}

The DSP version number is incorrect. The radio software and DSP software are incompatible. The DSP needs to be replaced with a later version. Contact your Tait dealer.

{X06}

The MCU internal configuration is incorrect. Contact your Tait dealer.

{X09}

The prototype timer has expired. This error will only occur on prototype software releases when the radio usage time has expired.

New radio software must be downloaded into the radio and the new software must have a different software version number.

{X31}

Model configuration checksum error. This error indicates that the radio's model configuration checksum is incorrect. Contact your Tait dealer.

{X32}

Database checksum error. This error indicates that the radio's database checksum is incorrect. Contact your Tait dealer.

{X33}

ESN error. The radio's electronic serial number is incorrect. Contact your Tait dealer.

{X35}

Temperature is above the T1 threshold and turn down of transmit power is impending. All the radio to cool down before continuing.

{X36}

Temperature is above the T2 threshold and turn off of the transmitter is impending. Allow the radio to cool down before continuing.

{X37}

Voltage is less than the V1 threshold; the radio will give a low battery warning. Replace the battery or use a DC service adaptor.

{X38}

Voltage is less than the V2 threshold. The radio turns itself off after indicating this error and so will be unable to respond to the reset command character.

Replace the battery or use a DC service adaptor.

Table C-1: Test commands

Function	Description	CCTM code	Parameters
Signalling	Set modem to send zeros	10	None
	Set modem to send ones	11	None
	Set modem to send preamble	12	None
	Disable modem signalling	13	None
	Read modem receive string (continuous)	14	None
	Disable all signalling	15	None
	Enable subaudible signalling	16	None
	Read subaudible signalling decode status	17	Returns: 0 = signal not detected, 1 = signal detected
Mute	Force Rx audio muted	20	None
	Force Rx audio unmuted	21	None
	Mute DSP input	22	None
	Unmute DSP input	23	None
	Let squelch control Rx audio	24	None
	Read RX_BUSY status	25	Returns: 0 = busy inactive, 1 = busy active
	Relax Rx mute control	26	None
Rx/Tx	Inhibit PA (transmit mode)	30	None
	Enable PA (transmit mode)	31	None
	Set radio to Rx	32	None
	Set radio to Tx	33	None
	Set transmit to low power	34	None
	Set transmit to mid power	135	None
	Set transmit to high power	35	None
	Set transmit to max power	36	None
	Set transmit to no power	137	None
	Activate economy mode	42	None
	Deactivate economy mode	43	None
	Read battery level	46	Returns: 0 to 255
	Read temperature level	47	Returns: 0 to 255
	Set keypad test on	50	None
	Set keypad test off	51	None
	Set display test on	52	IN: 0, 1, 2 or 3
	Set display test off	53	None
	Read averaged RSSI level	63	Returns: 0 to 255
	Read L1 threshold	64	Returns: 0 to 255
	Read L2 threshold	65	Returns: 0 to 255
Miscellaneous	Select normal micro clock	70	None
	Select birdie micro clock	71	None
	Read synth lock status	72	Returns: 0 = not in lock, 1 = in lock
	Select external speaker/microphone	74	
	Select internal speaker/microphone	75	
	Stop the MCU clock	79	None
	Select wide band	84	None
	Select medium band	85	None
	Select narrow band	86	None
	Select city squelch	88	None
	Select country squelch	89	None

(continued on next page)

Table C-1: Test commands (continued)

Function	Description	CCTM code	Parameters
Radio info	Read radio serial number	94/131	Returns: 6 digit number (hex)
	Read DSP software version number	132	Returns: 4 digit number (hex)
	Read radio software version number	96	Returns: 4 digit number
	Read radio type	130	Returns: radio type (P or M), frequency band (B-J), channel spacing (1 or 2)
Synth	Load absolute synth frequency	101	tttttt T rrrrrr R F (see Table C-2)
	Load synth reference divider	102	8 to 16383
Config	Set volume pot	110	0 to 255
	Set transistor gate bias	111	0 to 255
	Set TCXO mod	112	0 to 255
	Set VCO mod	113	0 to 255
	Set Tx power level	114	0 to 255
	Set TCXO coarse frequency	115	0 to 255
	Set TCXO fine frequency	116	0 to 255
	Set Rx front end tuning	117	0 to 255
	Set squelch threshold	118	0 to 255
	Set CTCSS modulation	120	0 to 32767
	Set DCS modulation	121	0 to 32767
	Set FFSK modulation	122	0 to 32767
	Set Selcall modulation	123	0 to 32767
	Set DTMF modulation	124	0 to 32767
	Set voice modulation	125	0 to 32767
	Force DCS signalling (023 tone)	126	None
	Force CTCSS signalling (67.0 Hz)	127	None
	Force Selcall signalling (2000 Hz for 2 seconds)	128	None
	Force DTMF signalling (tone A)	129	IN: 1 = start encoding, 0 = stop encoding
	Read calibrated volume setting	136	Returns: 0 to 255

Table C-1: Calculating the parameters required for test command 101

Calculating parameters for test command 101

Enter the parameters in the format ttttt T rrrrrr R F

- ttttt represents the transmit frequency
  See Example 1
- T and R represent channel spacing
  0 = 5 kHz
  1 = 6.25 kHz
- rrrrrr represents the receive frequency
  See Example 2
- F indicates whether the test command changes the calibration values
  0 = do not change calibrated values
  1 = recalculate calibrated values based on new frequencies

Note: ttttt and rrrrrr may be up to 6 digits long.

Example 1: Calculating ttttt for an H band radio

$$\text{ttttt} = \frac{\text{transmit frequency (MHz)}}{\text{channel spacing (MHz)}}$$

$$= \frac{461.025 \text{ MHz}}{6.25 \text{ kHz}}$$

$$= \frac{461.025 \times 10^6 \text{ Hz}}{6.25 \times 10^3 \text{ Hz}}$$

$$= 73764$$

Example 2: Calculating rrrrrr for an H band radio

$$\text{rrrrrr} = \frac{\text{receive frequency (MHz) - IF (MHz)}}{\text{channel spacing (MHz)}}$$

$$= \frac{461.025 \text{ MHz - } 45.1 \text{ MHz}}{6.25 \text{ kHz}}$$

$$= \frac{415.925 \times 10^6 \text{ Hz}}{6.25 \times 10^3 \text{ Hz}}$$

$$= 66548$$

Note: IF depends on the radio's switching band.

- For B, C and D bands radios, the IF is 21.4 MHz.
- For E, F, G, H and I band radios, the IF is 45.1 MHz.

Fault finding charts

The fault finding charts in Figures C-1 to C-6 address the faults you are most likely to find.

They are:

- radio cannot be switched on;
- cannot change channel (Orca Elan and Orca Excel);
- no serial communications;
- receive faults;
- cannot transmit; and
- no transmit audio.

If you experience other faults that do not fall into these categories, contact your Tait dealer.

Figure C-1: Fault finding – Radio cannot be switched on

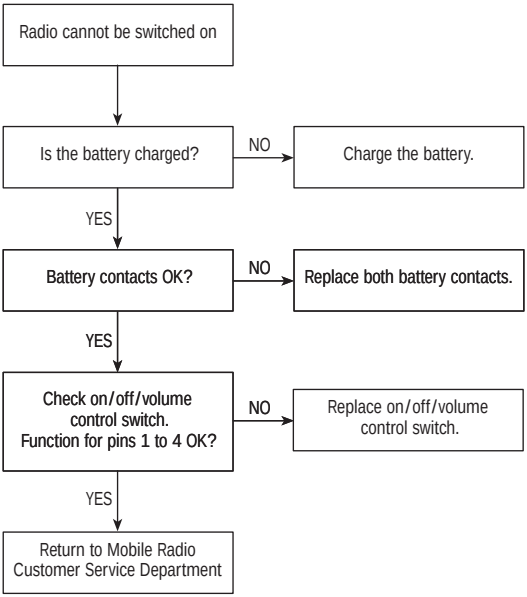


Figure C-2: Fault finding – Cannot change channel (Orca Elan and Orca Excel)

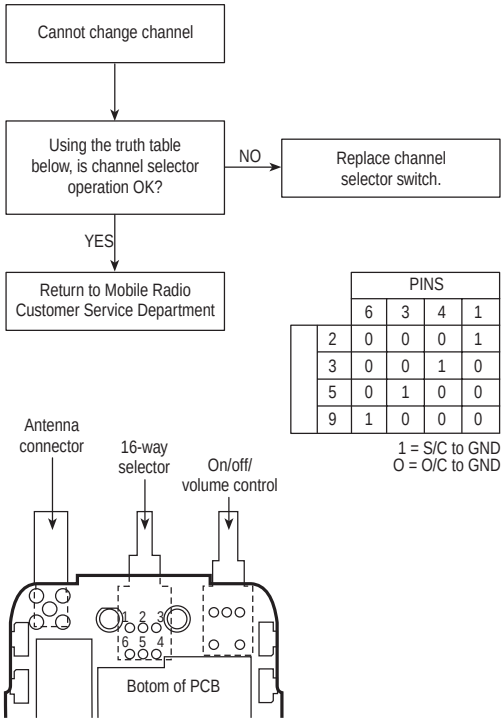


Figure C-3: Fault finding – No serial communication

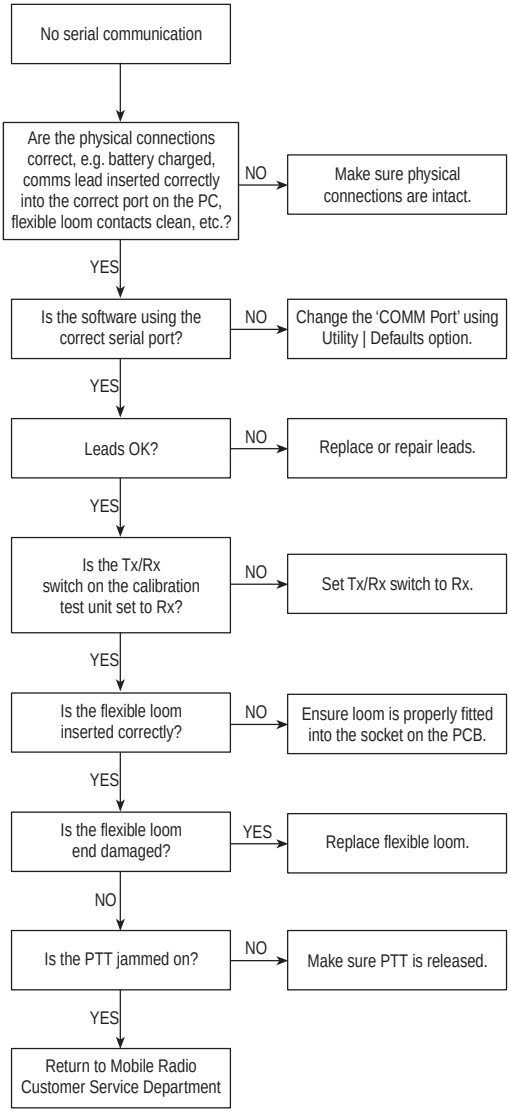


Figure C-4: Fault finding – Receive faults

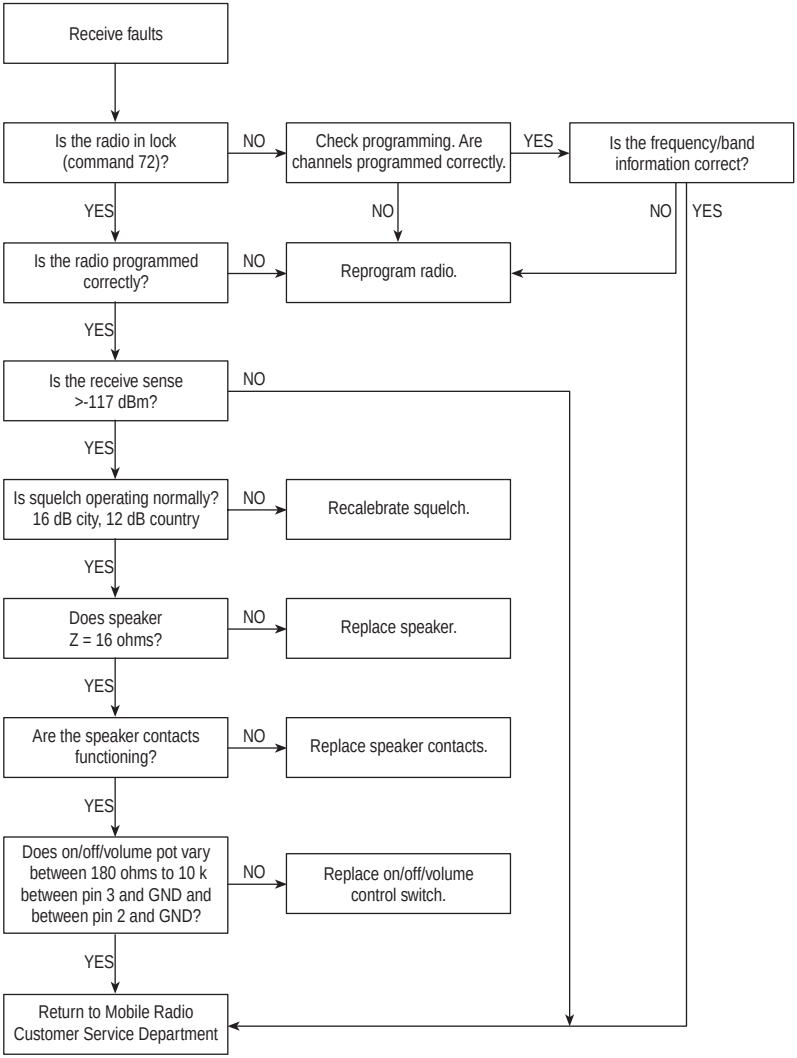


Figure C-5: Fault finding – Cannot transmit

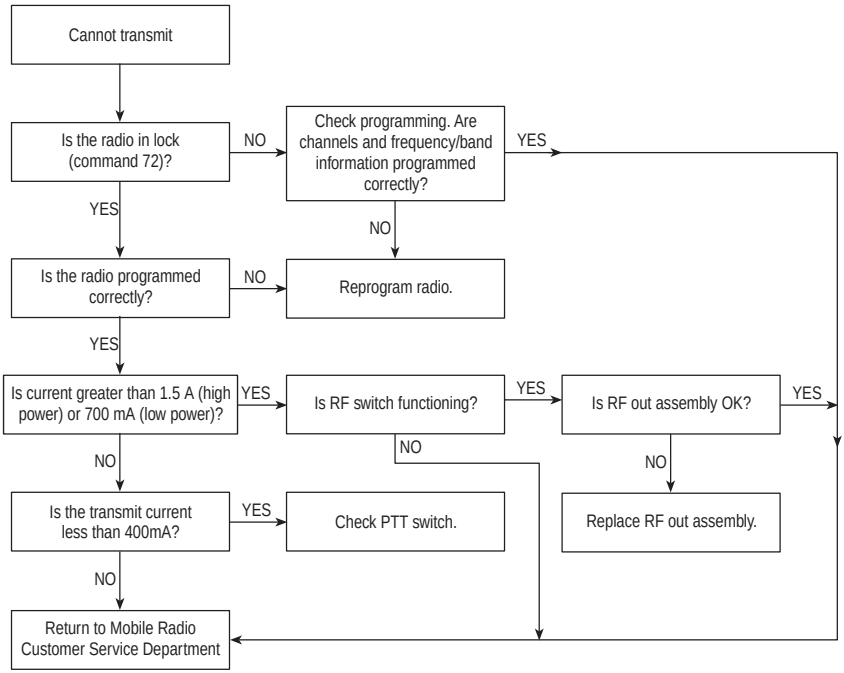
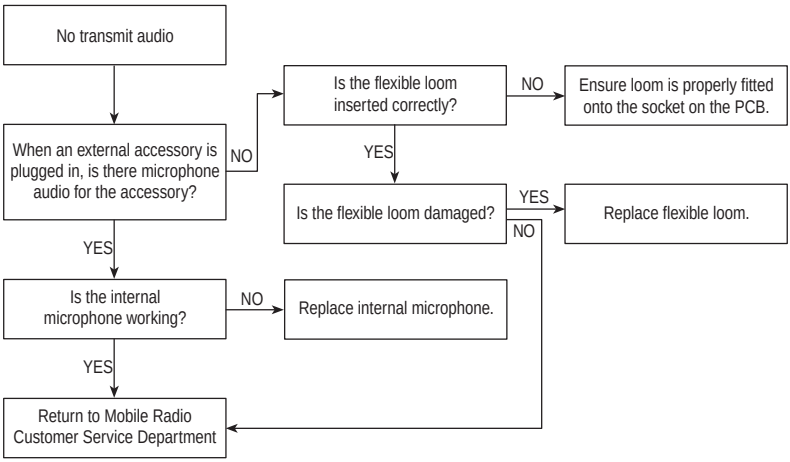


Figure C-6: Fault finding – No transmit audio



PART D

Servicing the radio

This part describes the disassembly and reassembly of Tait Orca handportables and the servicing of some key mechanical and ancillary devices.

Information is also provided on ordering spare parts for servicing handportables.

Contents

Servicing the radio

The manufacturing process does not allow direct servicing access to components on the main PCB. Service repairs of Tait Orca handportables are therefore limited to key mechanical and ancillary devices associated with the main PCB. These include:

- front panel assembly;
- lens (Orca Excel and Orca Eclipse);
- PTT keypad;
- speaker;
- keypad (Orca Excel and Orca Eclipse);
- volume plate and keypad (Orca Eclipse);
- LCD display (Orca Excel and Orca Eclipse);
- shield, complete with user interface PCB assembly and polyester dome (Orca Excel and Orca Eclipse);
- main PCB assembly;*
- antenna connector;
- channel selector switch (Orca Elan and Orca Excel);
- volume control switch (Orca Elan and Orca Excel);
- microphone;
- speaker contacts;
- battery contacts;
- PTT tact switch;
- RF out assembly; and
- auxiliary flexible PCB.

A list of spares kits available for servicing Tait Orca handportables is shown in Table D-1 on page D-16. These spares can be ordered from your local Tait dealer.

Screw head types

Most of the screws in Tait Orca handportables are Torx head screws, and so a Torx T6 driver bit is supplied as part of the service kit. Some earlier radios have Pozidriv screws. When removing screws be sure to use the correct driver.

Torx head 1.8*5 mm screws should be removed using the supplied Torx T6 driver. When replacing these screws, set the driver to 2 inch pounds.

Pan Pozi M2*8 mm and M2*5 mm screws should be removed using a Pozi 1 driver. When replacing these screws, set the driver to 2 inch pounds.

* Refer to Table D-2 on page D-16 for details.

Disassembling the radio

Removing the front panel from the chassis

Unscrew the antenna and detach the battery pack.

On Orca Elan and Orca Excel radios, the channel selector and on/off/volume control knobs need to removed before separating the front panel and the chassis.

To remove the knobs, insert a side cutter at the base of each knob, flat side down (Figure D-2), making sure not to damage the knob label and the switch shaft. Squeeze lightly; the knobs should pop off. Discard the knobs.

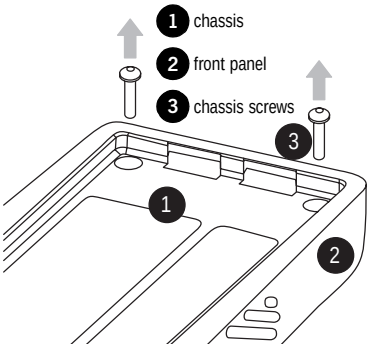
Some earlier Tait Orca radios have the knobs glued on. If so, the knob's metal insert will remain on the switch shaft. Remove the insert using a sharp scalpel blade.

Remove the two chassis screws at the base of the radio (Figure D-1), then reattach the battery and hold the base of the radio in one hand. With the other hand, pull the chassis from the front panel using the base of the battery as leverage (Figure D-3).

At this point you can replace the following:

- the front panel assembly;
- the PTT keypad (PTT key and function keys);
- the speaker;
- the lens (Orca Excel and Orca Eclipse);
- the keypad (Orca Excel and Orca Eclipse); and
- the volume plate and volume keypad (Orca Eclipse).

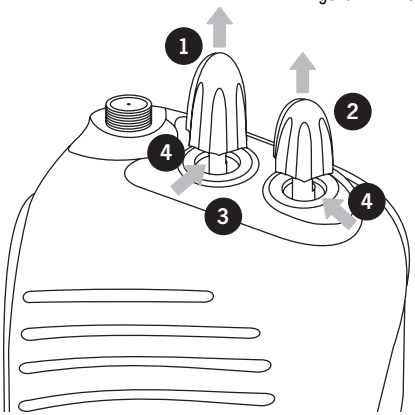
Figure D-1: Removing the chassis screws



Note that you should not attempt to remove the PTT keypad before removing the front panel from the chassis. See "Replacing the PTT keypad" on page D-8 for more information.

On Orca Eclipse radios, once the front panel has been removed from the chassis, the volume plate and keypad must be removed from the front panel before reassembly is attempted. Refer to Figure D-13 on page D-15.

Figure D-2: Removing the knobs (Orca Elan and Orca Eclipse)



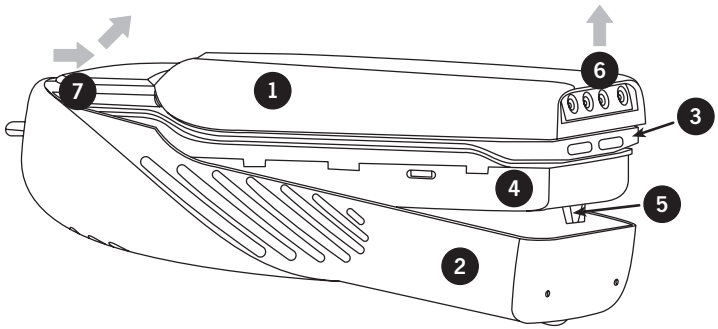
1 channel selector

2 on/off/volume control

3 knob label

4 insert guide cutters here

Figure D-3: Removing the front panel from the chassis, using the battery as leverage



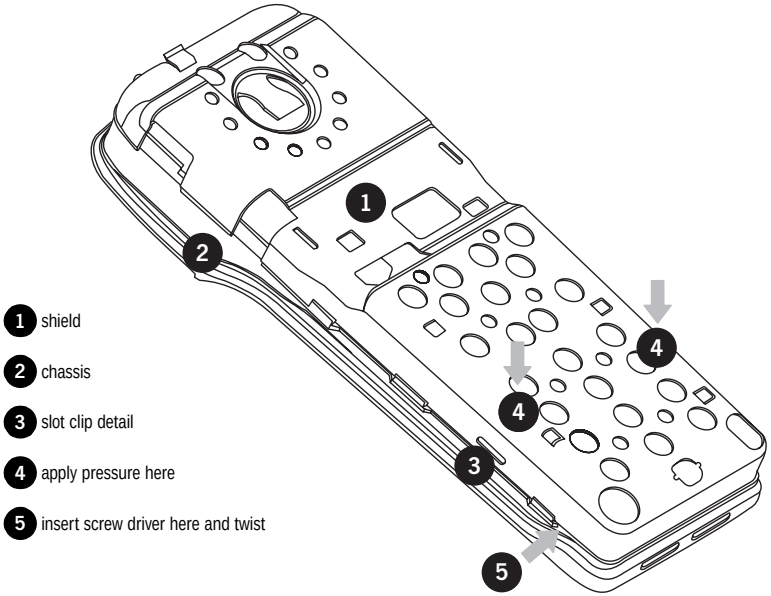
1. battery pack
2. front panel
3. chassis
4. shield
5. microphone grommet protruding from the shield
6. grip battery here, gently pull away from the front panel
7. pull radio out and away from the front panel at this point

Removing the shield from the chassis

To remove the shield, place the radio's internal assembly on a flat surface with the shield side facing up toward you. Press lightly down on the shield above the slot clip detail (shown in Figure D-4), which will slightly bow the shield away from the chassis.

Maintain pressure and insert a flat bladed screwdriver (approximately 4 mm) in the gap between the shield and the chassis. Twist the screwdriver and the shield should rise up over the clip.

Figure D-4: Removing the shield from the chassis



1. shield
2. chassis
3. slot clip detail
4. apply pressure here
5. insert screw driver here and twist

Repeat this on the other side. Remove the microphone grommet by pulling upward (Figure D-5).

You can now see the bottom surface of the PCB. The basic layout of the PCB is shown in Figures D-8 and D-9. Refer to these diagrams for the placement of parts.

Note that on Orca Excel and Orca Eclipse radios, the user interface loom must be detached from the main PCB before the shield can be separated from the main PCB and chassis.

At this point you can replace:

- the LCD display (Orca Excel and Orca Eclipse); and
- the shield, complete with user interface PCB assembly and polyester dome (Orca Excel and Orca Eclipse).

Removing the PCB from the chassis

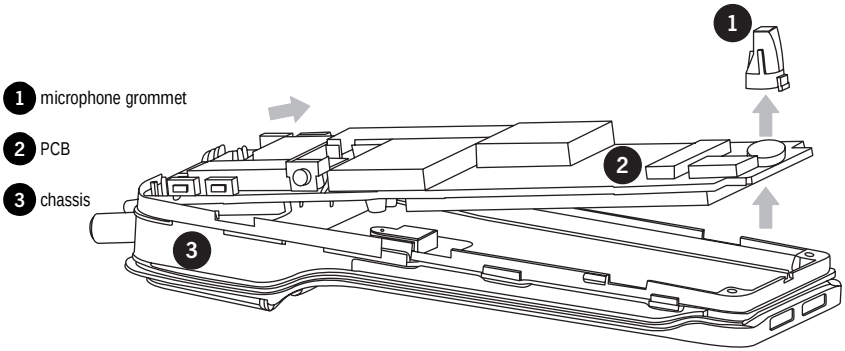
Remove the knob seal, which covers the antenna connector, channel selector switch (Orca Elan and Orca Excel) and volume control switch (Orca Elan and Orca Excel).

Remove the screw through the PA shield. Remove the three nuts for the antenna connector and knobs using the supplied 8 mm long reach socket driver, then remove the three ribbed lock washers. Gently lift the PCB up to the angle shown in Figure D-5, then pull it away from the chassis.

At this point you can replace:

- the main PCB assembly;
- the antenna connector;
- the channel selector switch (Orca Elan and Orca Excel);
- the volume control switch (Orca Elan and Orca Excel);
- the microphone;
- the speaker contacts;
- the battery contacts;
- the PTT tact switch; and
- the RF out assembly.

Figure D-5: Removing the PCB from the chassis (Orca Elan or Orca Excel shown)



Removing the rear panel

Follow the disassembly instructions and disassemble the radio to the PCB level. Refer to Figure D-10 for the details of the rear panel assembly.

Insert a small flat bladed screw driver under the auxiliary dummy rear cover and apply pressure to push the dummy rear cover lugs free of the holes in the rear panel. To remove the rear panel, either:

- slide the cover forward by pushing at the base with your thumbs; or
- insert a small flat-bladed screwdriver just under the notch in the base and twist.

Remove the rear panel seal. Note that the RF contact pin normally remains in the rear panel seal. Make sure that this is not lost during disassembly.

Using a calibration pin, lift the auxiliary flexible PCB contact area from the lower lefthand corner. Remove the flexible PCB with the seal from the chassis; they should come out as a unit.

You can now replace the auxiliary flexible PCB.

Replacing key mechanical and ancillary devices

This section describes the replacement of key mechanical and ancillary devices associated with the main PCB. These include:

- lens (Orca Excel and Orca Eclipse);
- PTT keypad;
- speaker;
- LCD display (Orca Excel and Orca Eclipse);
- shield, complete with user interface PCB assembly and polyester dome (Orca Excel and Orca Eclipse);
- antenna connector;
- channel selector switch (Orca Elan and Orca Excel);
- volume control switch (Orca Elan and Orca Excel);
- microphone;
- speaker contacts;
- battery contacts; and
- PTT tact switch.

Note that instructions for replacing the RF out assembly, the auxiliary flexible PCB and the Orca Eclipse volume key pad and plate are included as part of the reassembly instructions.

Refer to Figures D-8 and D-9 for the placement of parts. Once the required devices have been replaced, refer to the reassembly instructions on pages D-13 to D-15.

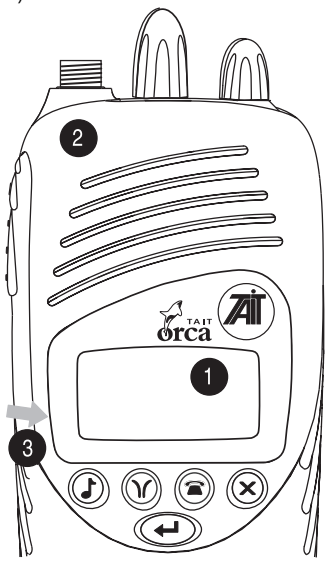
Replacing the lens (Orca Excel and Orca Eclipse)

Slide a thin bladed screw driver under one edge of the lens (Figure D-6), and gently prise the lens away from the front panel of the radio. Remove any adhesive remaining on the front panel.

Peel the paper from the back of the new lens, and place the lens in position on the front panel, so that the lugs on the back of the new lens fit into the holes in the front panel.

Press firmly into position, then remove the piece of clear plastic from the front of the lens.

Figure D-6: Replacing the lens (Orca Excel and Orca Eclipse)



1 lens

2 front panel (Orca Excel shown)

3 gently prise the lens away from the front panel

Replacing the PTT keypad

Following the disassembly instructions, remove the front panel from the chassis.

To remove the PTT retaining plate, from the inside of the front panel, gently push the five latches that hold the retaining plate in place. Be careful not to lose the two pins that act as actuators for the function keys.

To replace the PTT retaining plate, fit the keypad to the retaining plate, making sure not to split or otherwise damage it. Place the three clips on the long edge of the retaining plate into place, then make sure the actuators for the function keys and PTT key fit into the holes on the front panel. Clip the retaining plate into place.

Replacing the speaker

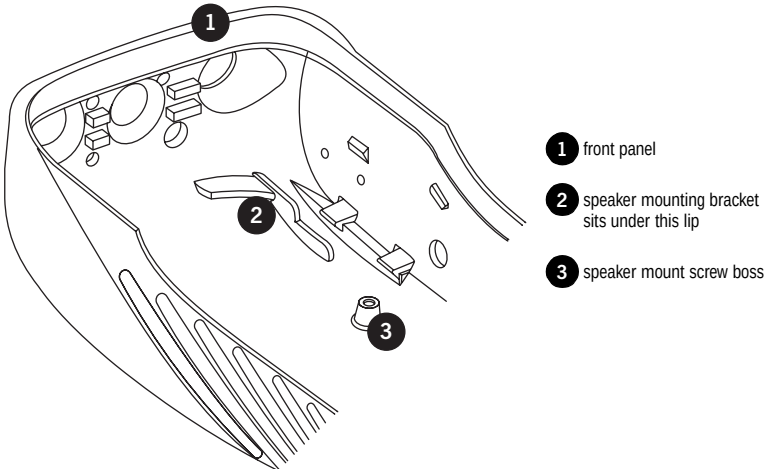
Following the disassembly instructions, remove the front panel from the chassis. The speakers sits in the mounting bracket on the inside of the front panel (see Figure D-7).

If the mounting bracket is damaged, remove the two screws at the base of the mounting bracket. Lift the speaker and mounting bracket out and discard.

Insert the new speaker and mounting bracket in the front panel, making sure the top edge of the mounting bracket goes under the lip in the front panel (Figure D-7). Replace the two screws to secure the speaker in place, gently tightening them to 1.5 inch pounds.

If the mounting bracket is not damaged, remove the speaker from the mounting bracket. Replace the adhesive ring and secure a new speaker in place.

Figure D-7: Mounting the speaker in the front panel (Orca Elan or Orca Excel shown)



Replacing the LCD display (Orca Excel and Orca Eclipse)

Following the disassembly instructions, remove the shield from the front panel and unplug the user interface loom from the main PCB.

Unplug the LCD display loom from the user interface PCB, remove the LCD display from the shield and discard the LCD display. Remove any adhesive remaining on the shield.

Position the new LCD display on the shield, pass the LCD loom through the gap in the shield and plug into the connector on the user interface PCB. Push down the two connector lugs to secure the loom.

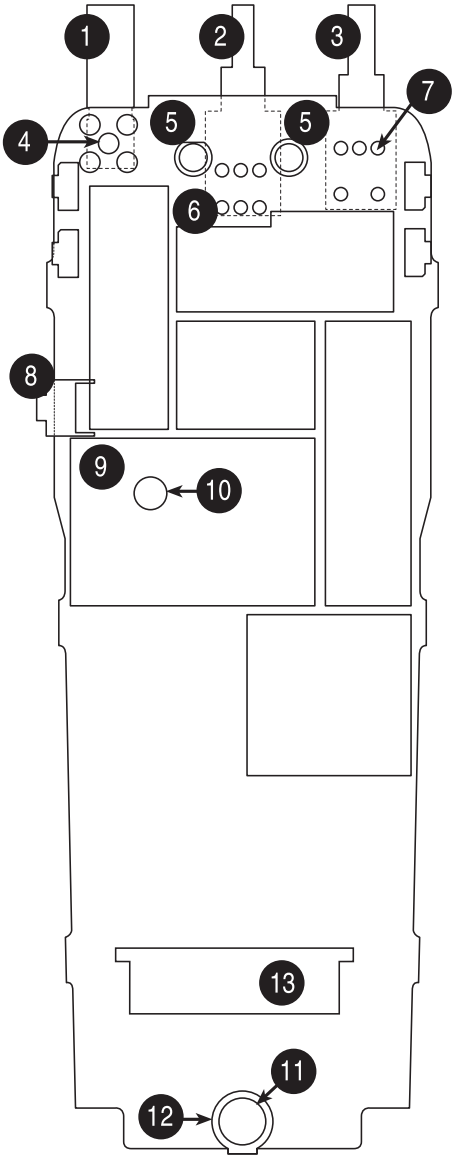
Plug the user interface PCB loom onto the connector on the main PCB and push down the connector lugs to secure.

Refit the shield onto the chassis (refer to page D-14 for detailed instructions).

Position a piece of foam tape on the shield, in the centre of the LCD area. Position the LCD display on the foam tape in such a way that the top left corner of the LCD does not interfere with the PTT switch. Place the LCD holder over the LCD, fitting the LCD holder locating blocks into the holes in the shield.

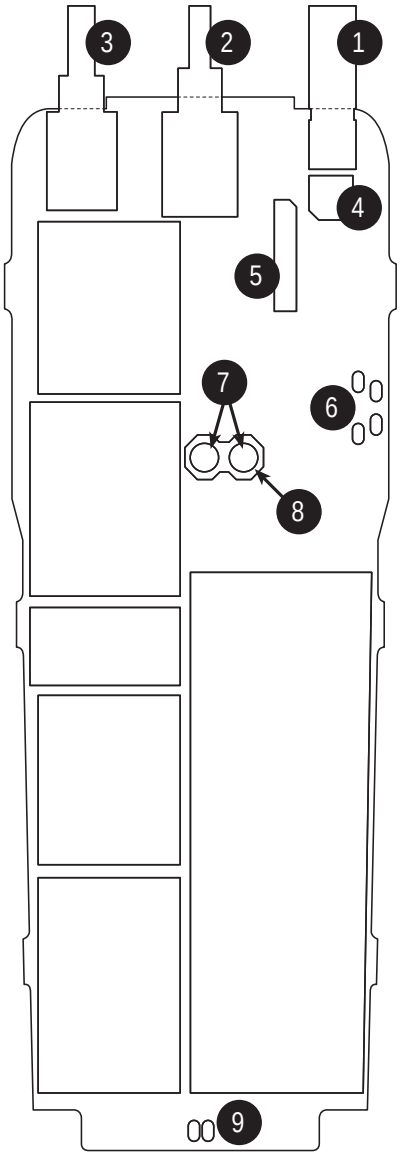
Refit the front panel to the chassis (refer to page D-15 for detailed instructions).

Figure D-8: Bottom surface of the PCB, which is visible when the shield has been removed from the chassis (Orca Elan or Orca Excel shown)



1. antenna connector
2. channel selector switch
3. on/off/volume control switch
4. antenna connector pin placement (5 pins)
5. speaker contact pin placement
6. channel selector pin placement (6 pins)
7. on/off/volume control pin placement (5 pins)
8. PTT tact switch
9. PA can
10. PA screw
11. microphone placement
12. microphone grommet placement
13. user interface loom connector

Figure D-9: Top surface of PCB, which is visible only when the PCB has been removed from the chassis (Orca Elan or Orca Excel shown)



1. antenna connector
2. channel selector switch
3. on/off/volume control switch
4. RF assembly placement
5. auxiliary flex socket
6. PTT tact pin placement (4 pins)
7. battery contact placement
8. battery contact seal placement
9. microphone pin placement (2 pins)

Replacing the shield, user interface PCB assembly and polyester dome (Orca Excel and Orca Eclipse)

On Orca Excel and Orca Eclipse radios the shield, user interface PCB and polyester dome are replaced as one complete assembly.

Following the disassembly instructions, remove the shield from the front panel and unplug the user interface loom from the user interface PCB.

Remove the LCD display assembly from the discarded shield, and fit to the replacement shield according to the instructions on page D-9.

Plug the user interface loom into the connector on the new user interface PCB, and reassemble the shield onto the chassis according to the instructions on page D-14.

Note that the light pipe in the discarded shield will need to be repositioned in the new shield.

Replacing the antenna connector, channel selector switch (Orca Elan and Orca Excel) and volume control switch (Orca Elan and Orca Excel)

Following the disassembly instructions, disassemble the radio to the PCB level. Remove the PCB from the chassis.

If any of the antenna connector, channel selector switch or volume control switch need to be replaced, remove them using a vacuum-operated solder station. Replace them according to the reassembly instructions on pages D-13 to D-15.

Replacing the microphone

Following the disassembly instructions, disassemble the radio to the PCB level. Remove the PCB from the chassis.

Use a desoldering station to remove the microphone. Discard the microphone.

When replacing the microphone, make sure it is aligned with the marks on the PCB, since it is polarised. Refer to Figures D-8 and D-9 for the placement of the microphone.

The microphone should not hang over the edge of the PCB. Solder it in place using a light-tip soldering iron (e.g. Weller PTR7 tip).

Replacing the battery and speaker contacts

Following the disassembly instructions, disassemble the radio to the PCB level. Remove the PCB from the chassis.

When replacing one of the battery or speaker contacts, replace the other contact, even if only one is faulty. If available, use solder paste to replace the contacts.

Note that the contacts are heat-sensitive and will fail if they are overheated.Low temperature solder must be used and the contacts must not be heated above 260°C.

Remove the contact with a soldering iron and discard. Refer to Figures D-7 and D-8 for the placement of the battery and speaker contacts.

Solder the replacement contact in place using a heavy-tip soldering iron (e.g. Weller 2PTCC8 tip). Hold onto the contact with a pair of pliers and apply large amounts of solder to the PCB, rather than to the contact, to avoid damaging the contact.

Replacing the tact switch

Following the disassembly instructions, disassemble the radio to the PCB level. Remove the PCB from the chassis.

Remove the PTT tact switch using a desoldering station or solderwick. Note that there is a lot of solder on both sides of the board, so be sure to remove it all.

Refer to Figures D-8 and D-9 for the placement of the PTT tact switch.

Place the new PTT on the board and solder it in place using a heavy-tip soldering iron (e.g. Weller 2PTCC8 tip).

Reassembling the radio

This section describes the reassembly of the radio once the required units have been serviced. Additional instructions for replacing the following mechanical and ancillary devices are also included:

- auxiliary flexible PCB;
- RF out assembly;
- volume plate and volume keypad (Orca Eclipse);
- antenna connector;
- channel selector switch (Orca Elan and Orca Excel); and
- volume control switch (Orca Elan and Orca Excel).

Rear panel reassembly and replacing the auxiliary flexible PCB

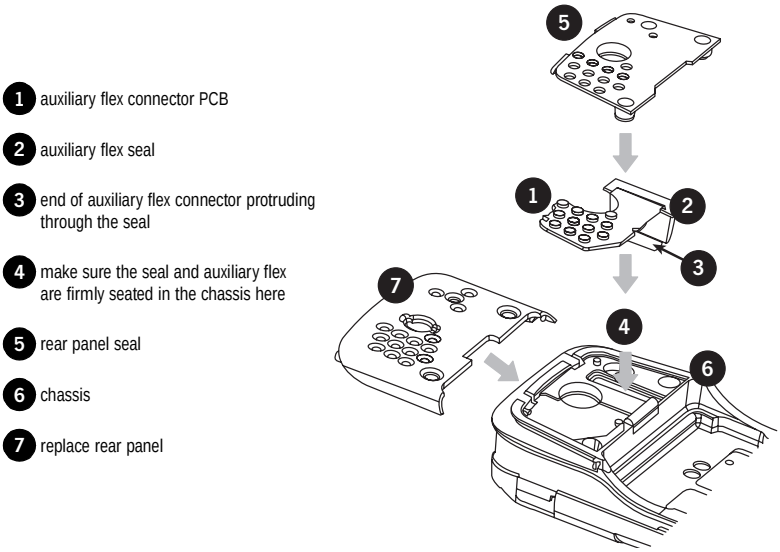
Follow the instructions on page D-7 to access the auxiliary flexible PCB, and replace. Push the flexible PCB with seal firmly into the chassis, aligning the notch in the seal with the locating pin on the chassis (see Figure D-10). The rubber must sit flush with the back of the chassis or the rear panel will not sit properly and the battery will not fit correctly.

Fold the flexible PCB over and fit the contact area on the chassis; it should fit snugly in place.

Replace the rear panel seal by tucking the two tags at the top of the seal under the lip on the chassis and folding it over the flexible PCB. Check that the RF contact pin is positioned correctly in the rear panel seal, and that the seal is flush with the chassis.

Slide the rear panel on from the top of the radio (Figure D-10). Force it into place by pressing the top edge of the cover against the edge of a table; it will clip home. Make sure the gap between the cover and the chassis is as small as possible. Refit the auxiliary dummy cover by pushing the lugs into the holes on the rear panel.

Figure D-10: Rear panel assembly



Fitting the PCB to the chassis and replacing the RF out assembly

Put the battery contact seal over the battery contacts rather than into the chassis. If you put the seal on the chassis, the contacts will squash the seal.

Fit the replacement RF out assembly as shown in Figure D-11.

If you have removed the antenna connector or either of the switches (Orca Elan or Orca Excel radios only), fit them on the PCB (refer to Figures D-8 and D-9), but do not yet solder them in place. Align them with the holes in the chassis, and as you lower the PCB onto the chassis, make sure the accessory flex protruding from the chassis fits into the socket on the PCB. Lower the PCB onto the chassis, making sure it is firmly seated.

Fit the PA screw loosely in place. Align the switches so they are centred (Orca Elan or Orca Excel only), referring to Figures D-8 and D-9 for placement.

Figure D-12 shows the reassembly of the antenna and switches. Replace the washers, making sure the cone faces up. The nuts for the two switches are black.

Replace the nuts, making sure they are threaded correctly before using an 8 mm long reach socket driver set to 10 inch pounds. Then tighten the PA screw to 2 inch pounds.

Using a heavy-tip soldering iron (e.g. Weller 2PTCC8 tip), solder the antenna connector and two switches in place, if required, taking care not to damage the surrounding components.

Replace the knob seal over the antenna connector and the two switches (see Figure D-12).

Fitting the shield to the chassis

Replace the microphone grommet over the microphone.

Replace the shield from the top of the radio, ensuring that the two pins on the chassis go into the two holes at the top of the shield.

Should the main seal need replacing, place the new seal so that the notch at the top of the chassis (behind the channel selector switch on the Orca Elan and Orca Excel radios) matches that on the seal and the profile matches the chassis.

Run your finger around the seal to ensure that it fits properly into the seal retaining well.

Figure D-11: Placing the RF out assembly (Orca Elan or Orca Excel shown)

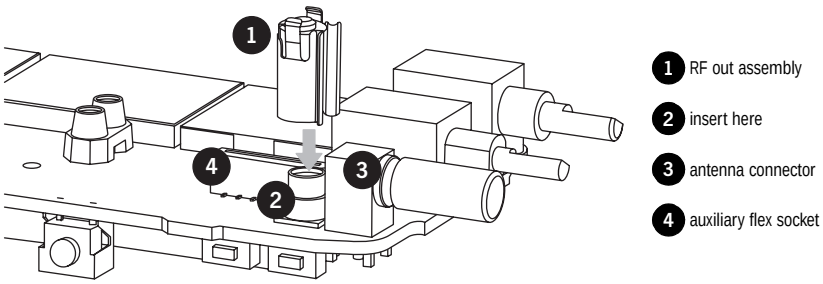
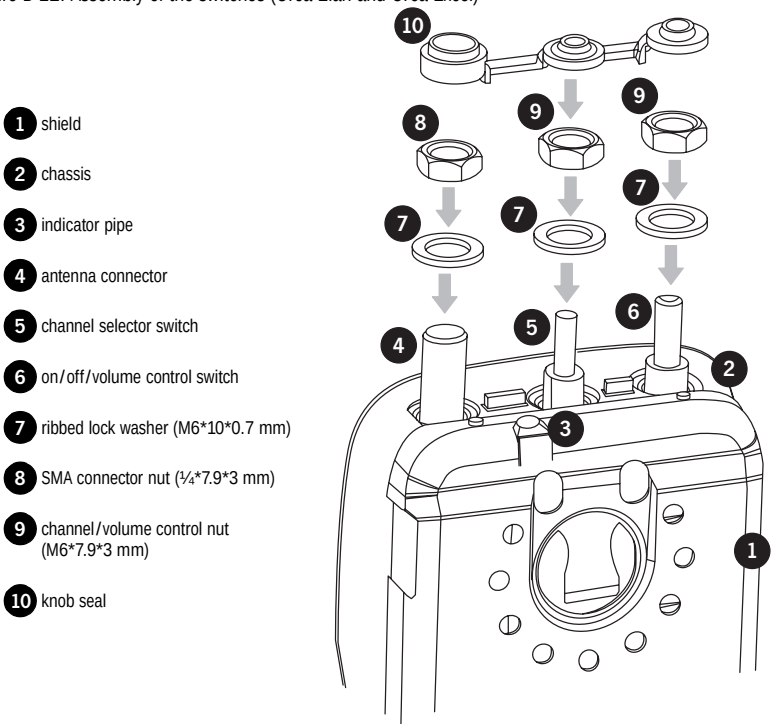


Figure D-12: Assembly of the switches (Orca Elan and Orca Excel)



Fitting the front panel to the chassis

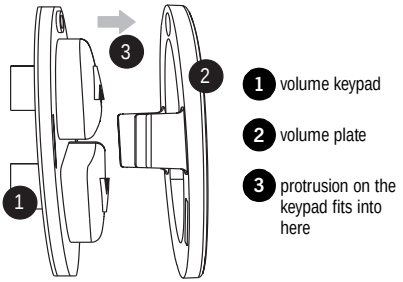
Place the radio into the front panel top first, inserting the antenna connector and knob switches through the holes. Gently ease the radio into the front panel until the edge of the chassis is flush with the edge of the front panel, while making sure that the seal is not pinched; using the battery as leverage as in radio disassembly may be helpful. Replace the two chassis screws at the base of the radio, tightening them to 2 inch pounds.

On Orca Elan and Orca Excel radios, replace the two knobs with new knobs, after placing a spot of Loctite™ 680 on each switch shaft. Make sure there is no gap between the base of each knob and the knob label by firmly pressing the top of each knob against a firm surface. Choose a surface that will not damage the top of the knob.

On Orca Eclipse radios, once the front panel has been fitted to the chassis, the volume keypad and volume plate can now be fitted in place. Figure D-13 shows the assembly of the volume keypad onto the volume plate.

Fit the keypad to the plate, aligning the round protrusion on the key pad with the hole in the plate. Clip the volume plate into position on the Orca Eclipse front panel, orientated so that the hole end is closest to the top of the radio.

Figure D-13: Assembly of the volume keypad and plate (Orca Eclipse)



Spares kits

The following table shows a list of spares kits which are currently available for servicing Tait Orca handportables. Spares kits are designed to service 100 radios, and can be ordered from your local Tait dealer.

Table D-1: Spares kits

Product code	Description
TOPA-SP-101	Orca Elan radio spares kit
TOPA-SP-102	Orca Elan front panel assembly kit
TOPA-SP-103	Orca Excel radio spares kit
TOPA-SP-104	Orca Excel front panel assembly kit
TOPA-SP-501	Volume knobs x 10
TOPA-SP-502	Channel knobs x 10
TOPA-SP-503	Accessory port cover x 10
TOPA-SP-504	Battery clip x 10

The contents of the Orca Elan, Orca Excel and Orca Eclipse spares kits (TOPA-SP-101, TOPA-SP-103 and TOPA-SP-105, respectively) are shown in Tables D-3 to D-5.

Note that the 'IPN' column is the ten digit 'internal part number' which uniquely identifies any component used in a Tait product.

The numbers in the 'Reference' column are Figure numbers in which the spares item is shown, and the number in brackets refers to the numbered legend within each figure.

Tait Orca main PCBs are available on an exchange basis from the Customer Services Division of Tait Mobile Radio. Quote the product code shown in Table D-2 when using this service.

Table D-2: Exchange PCBs

Product code	PCB Description
KSTOP-SP-B20	136-174 MHz – narrow band
KSTOP-SP-H1L	400-440 MHz – wide band
KSTOP-SP-H2L	400-440 MHz – narrow band
KSTOP-SP-H1H	440-470 MHz – wide band
KSTOP-SP-H2H	440-470 MHz – narrow band
KSTOP-SP-I10	450-530 MHz – wide band
KSTOP-SP-I20	450-530 MHz – narrow band

Table D-3: Orca Elan spares kit (TOPA-SP-101)

IPN	Description	Quantity supplied	Reference
345-00020-01	Chassis screw (M2*8 mm Pan Pozi)	10	D-1 (3)
311-01044-00	Channel selector knob	20	D-2 (1)
311-01043-00	Volume control knob	20	D-2 (2)
316-06633-00	Knob label	5	D-2 (3)
316-06629-00	Orca Elan front panel - bare	5	D-3 (2)
316-06634-00	Front panel logo plate	10	–
319-01203-01	Shield	5	D-4 (1)
362-01092-01	Main seal	20	–
303-11194-02	Handportable chassis	5	D-4 (2), D-5 (3)
360-02015-00	Microphone grommet/seal	10	D-5 (1)
311-03099-00	PTT keypad	20	–
316-85124-00	PTT retaining plate	10	–
360-01060-00	PTT/function key actuator	40	–
349-00030-00	Speaker screw (1.8*5 mm Torx)	10	D-7 (3)
252-00010-55	Speaker 0.5 W 16 Ω	5	–
302-05231-01	Speaker mounting bracket	5	–
369-01039-00	Speaker adhesive ring	5	–
231-00010-45	Channel selector switch	10	D-8 (2), D-9 (2)
040-05500-07	Volume control switch	10	D-8 (3), D-9 (3)
232-00010-37	PTT tact switch	5	D-8 (8), D-9 (6)
345-00020-00	PA screw (M2*5 mm Pan Pozi)	10	D-8 (10)
252-00010-56	Microphone	5	D-8 (11)
356-01077-00	Battery contact probe	10	D-9 (7)
362-01087-00	Battery contact seal	10	D-9 (8)
308-01057-01	Aux dummy rear cover	20	–
220-01414-03	Aux flex connector PCB	10	D-10 (1)
362-01089-00	Auxiliary flex seal	10	D-10 (2)
362-01088-00	Rear panel seal	10	D-10 (5)
316-06632-01	Rear panel	5	D-10 (7)
219-50029-00	RF out assembly	5	D-11 (1)
240-02100-55	Antenna SMA connector	10	D-12 (4)
353-00010-42	Ribbed lock washer (M6*10*0.7 mm)	30	D-12 (7)
352-01053-00	Antenna SMA connector nut	10	D-12 (8)
352-00010-52	Channel/volume control nut (M6*7.9*3 mm)	20	D-12 (9)
362-01091-01	Knob seal	10	D-12 (10)
303-30071-01	Battery catch	20	–
303-50087-00	Belt clip	20	–
OPP100:	Orca Elan front panel assembly. This comprises the following parts:	1	–
	252-00010-55 Speaker 0.5 W 16 Ω	1	
	302-05231-01 Speaker mounting bracket	1	
	307-01021-00 Speaker grill	1	
	316-06629-00 Orca Elan front panel	1	
	316-06633-00 Knob label	1	
	316-06634-00 Front panel logo plate	1	
	349-00030-00 Speaker screw (1.8*5 mm Torx)	2	
	354-01044-00 Bush M2 threaded brass	2	
	369-01039-00 Speaker adhesive ring	1	

Table D-4: Orca Excel spares kit (TOPA-SP-103)

IPN	Description		Quantity supplied	Reference
345-00020-01	Chassis screw (M2*8 mm Pan Pozi)		10	D-1 (3)
311-01044-00	Channel selector knob		20	D-2 (1)
311-01043-00	Volume control knob		20	D-2 (2)
316-06633-00	Knob label		5	D-2 (3)
362-01092-01	Main seal		20	–
303-11194-02	Handportable chassis		5	D-4 (2), D-5 (3)
360-02015-00	Microphone grommet/seal		10	D-5 (1)
311-03099-00	PTT keypad		20	–
316-85124-00	PTT retaining plate		10	–
360-01060-00	PTT/function key actuator		40	–
312-01071-00	Lens		10	D-6 (1)
349-00030-00	Speaker screw (1.8*5 mm Torx)		10	D-7 (3)
252-00010-55	Speaker 0.5 W 16 Ω		5	–
302-05231-01	Speaker mounting bracket		5	–
369-01039-00	Speaker adhesive ring		5	–
231-00010-45	Channel selector switch		10	D-8 (2), D-9 (2)
040-05500-07	Volume control switch		10	D-8 (3), D-9 (3)
232-00010-37	PTT tact switch		5	D-8 (8), D-9 (6)
345-00020-00	PA screw (M2*5 mm Pan Pozi)		10	D-8 (10)
252-00010-56	Microphone		5	D-8 (11)
356-01077-00	Battery contact probe		10	D-9 (7)
362-01087-00	Battery contact seal		10	D-9 (8)
308-01057-01	Aux dummy rear cover		20	–
220-01414-03	Aux flex connector PCB		10	D-10 (1)
362-01089-00	Auxiliary flex seal		10	D-10 (2)
362-01088-00	Rear panel seal		10	D-10 (5)
316-06632-01	Rear panel		5	D-10 (7)
219-50029-00	RF out assembly		5	D-11 (1)
240-02100-55	Antenna SMA connector		10	D-12 (4)
353-00010-42	Ribbed lock washer (M6*10*0.7 mm)		30	D-12 (7)
352-01053-00	Antenna SMA connector nut		10	D-12 (8)
352-00010-52	Channel/volume control nut (M6*7.9*3 mm)		20	D-12 (9)
362-01091-01	Knob seal		10	D-12 (10)
303-30071-01	Battery catch		20	–
303-50087-00	Belt clip		20	–
008-36671-70	LCD display		5	–
304-07041-02	LCD holder		5	–
311-03101-01	Orca Excel keypad		10	–
220-01501-00	User interface loom PCB		5	–
OPP200:	Orca Excel front panel assembly. This comprises the following parts:		1	–
	252-00010-55	Speaker 0.5 W 16 Ω	1	
	302-05231-01	Speaker mounting bracket	1	
	307-01021-00	Speaker grill	1	
	312-01071-00	Lens	1	
	316-06633-00	Knob label	1	
	316-06636-00	Orca Excel front panel	1	
	349-00030-00	Speaker screw (1.8*5 mm Torx)	2	
	354-01044-00	Bush M2 threaded brass	2	
	369-01039-00	Speaker adhesive ring	1	
OPF201:	Orca Excel user interface PCB and polyester dome, assembled on the shield. This comprises the following parts:		5	–
	OPF200	User interface PCB assembly	5	
	311-04004-00	Polyester dome	5	
	319-01203-01	Shield	5	

Table D-5: Orca Eclipse spares kit (TOPA-SP-105)

IPN	Description	Quantity supplied	Reference
345-00020-01	Chassis screw (M2*8 mm Pan Pozi)	10	D-1 (3)
362-01092-01	Main seal	20	–
303-11194-02	Handportable chassis	5	D-4 (2), D-5 (3)
360-02015-00	Microphone grommet/seal	10	D-5 (1)
311-03099-00	PTT keypad	20	–
316-85124-00	PTT retaining plate	10	–
360-01060-00	PTT/function key actuator	40	–
312-01071-00	Lens	10	D-6 (1)
349-00030-00	Speaker screw (1.8*5 mm Torx)	10	D-7 (3)
252-00010-55	Speaker 0.5 W 16 Ω	5	–
302-05231-01	Speaker mounting bracket	5	–
369-01039-00	Speaker adhesive ring	5	–
232-00010-37	PTT tact switch	5	D-8 (8), D-9 (6)
345-00020-00	PA screw (M2*5 mm Pan Pozi)	10	D-8 (10)
252-00010-56	Microphone	5	D-8 (11)
356-01077-00	Battery contact probe	10	D-9 (7)
362-01087-00	Battery contact seal	10	D-9 (8)
308-01057-01	Aux dummy rear cover	20	–
220-01414-03	Aux flex connector PCB	10	D-10 (1)
362-01089-00	Auxiliary flex seal	10	D-10 (2)
362-01088-00	Rear panel seal	10	D-10 (5)
316-06632-01	Rear panel	5	D-10 (7)
219-50029-00	RF out assembly	5	D-11 (1)
240-02100-55	Antenna SMA connector	10	D-12 (4)
353-00010-42	Ribbed lock washer (M6*10*0.7 mm)	10	D-12 (7)
352-01053-00	Antenna SMA connector nut	10	D-12 (8)
362-01091-01	Knob seal	10	D-12 (10)
311-03100-01	Volume key pad	5	D-13 (1)
316-85123-00	Volume plate	5	D-13 (2)
303-30071-01	Battery catch	20	–
303-50087-00	Belt clip	20	–
008-36671-70	LCD display	5	–
304-07041-02	LCD holder	5	–
311-03102-01	Orca Eclipse keypad	10	–
220-01501-00	User interface loom PCB	5	–
OPP300:	Orca Eclipse front panel assembly. This comprises the following parts:	1	–
	252-00010-55 Speaker 0.5 W 16 Ω	1	
	302-05231-01 Speaker mounting bracket	1	
	307-01021-00 Speaker grill	1	
	312-01071-00 Lens	1	
	316-06633-00 Knob label	1	
	316-06656-00 Orca Eclipse front panel	1	
	349-00030-00 Speaker screw (1.8*5 mm Torx)	2	
	354-01044-00 Bush M2 threaded brass	2	
	369-01039-00 Speaker adhesive ring	1	
OPF201:	Orca Eclipse user interface PCB and polyester dome, assembled on the shield. This comprises the following parts:	5	–
	OPF200 User interface PCB assembly	5	
	311-04004-00 Polyester dome	5	
	319-01203-01 Shield	5	

PART E

Battery packs and chargers

This part provides information on the battery packs and chargers available for Tait Orca handportables.

The battery packs are not serviceable, and repair of chargers is limited to replacement of the spring contacts, the discharge tact switch and the DC jack.

Contents

Battery packs

Three battery packs are available for Tait Orca handportables. These battery packs are not serviceable, but their construction and expected life are described below.

The battery packs available are:

- 1100 mAh NiCd battery pack;
- 1500 mAh NiCd battery pack; and
- 1850 mAh NiMH battery pack.

The battery casing is made of a rugged resin material and is ultrasonically welded. The casing is constructed with a planar, near field interference weld (<3 mm).

Battery life

Battery life is outlined in Table E-1. These are typical figures only, based on a conventional UHF radio using a 1100 mAh NiCd battery pack with medium economy cycling enabled. Battery life for other models can be calculated from the information in *Part B: Radio specifications and circuit descriptions*.

Preserving battery life

Before first use, the battery must be fully charged. It is highly recommended that the battery be put through a condition/analyse cycle before first use.

Other steps that can preserve battery life are as follows.

- Condition the battery weekly using the Tait Orca fast charger.
- Avoid storing the battery for extended periods without first fully recharging it. For best results, store the battery detached from the radio.
- Avoid repeatedly recharging the battery when it has only had a small amount of use.
- Turn the radio off when it is unattended for long periods.
- Use only a Tait-recommended charger.
- Maintain an ambient temperature of between 5°C and 40°C during recharging. Optimum battery performance will be obtained between 15°C and 25°C.
- Do not allow the battery pack contacts to become short-circuited.

Table E-1: Typical battery life for a conventional UHF radio* with medium economy cycling enabled

Duty cycle	RF power	Battery life (hours)		
		1100 mAh NiCd	1500 mAh NiCd	1850 mAh NiMH†
5/5/90	Low (1 W)	10.5	14	16
5/5/90	High (4 W)	8	10.5	13
10/10/80	Low (1 W)	7	9.5	11
10/10/80	High (4 W)	4.5	6.5	8

* Battery life for other models can be calculated from the information in *Part B: Radio specifications and circuit descriptions.*

† NiMH batteries are best suited for monitoring, low power applications where transmissions are infrequent.

Extending battery life

Battery life can be extended by activating economy mode (conventional radios) or by using dynamic power control (trunked radios).

During economy mode, the radio cycles between the normal receive state and a standby state in which some of the radio's circuitry is switched off or placed on standby mode. Dynamic power control optomises the radio's power use by reducing the transmit power in high signal strength areas.

Typical drain rates for a conventional UHF radio are:

- 80 mA on standby (no audio);
- 60 mA with low economy cycling enabled;
- 45 mA with medium economy cycling enabled; and
- 40 mA with high economy cycling enabled.

Economy cycling in conventional radios is programmed in the **Power Save Features** screen of the *Programming System for Tait Orca Conventional Radios*. Dynamic power control in trunked radios is enabled in the **User Selectable Parameters** screen of the *Programming System for Tait Orca Trunked Radios*.

Disposing of used nickel-cadmium batteries

NiCd batteries contain a small amount of the metal cadmium, which can produce potentially toxic waste if not disposed of properly. When no longer in use, contact your Tait dealer for recycling details.

Battery chargers

Three battery chargers are available for Tait Orca handportables:

- desktop fast charger;
- desktop trickle charger; and
- six-way multi-charger.

The fast charger charges, conditions and analyses the battery. The trickle charger only charges the battery, and does not have a discharge button but is otherwise identical in appearance to the fast charger. The multi-charger is made up of six fast chargers, and charging instructions for the fast charger also apply to the multi-charger.

Note that the trickle charger should not be used for NiMH battery packs as they can take up to 24 hours to charge fully and the overall lifetime of the battery may be reduced. NiMH battery packs should be charged using a fast charger.

Repair of chargers is limited to replacement of the spring contacts, the discharge tact switch and the DC jack.

The repair information provided for the fast charger also applies to repair of the trickle charger and multi-charger.

A spares kit is available for Tait Orca chargers (TOPA-SP-202). The contents of the spares kit is shown in Table E-2, and the assembly of these parts is shown in Figure E-3.

Table E-2: Contents of the Tait Orca chargers spares kit (TOPA-SP-202)

IPN	Description	Quantity	For charger
356-01073-00	Spring contacts C/T (inner contacts)	20	All
356-01075-00	Spring contacts +/- (outer contacts)	20	All
240-02020-07	Skt DC jack	10	All
232-00010-28	Tact switch	10	Desktop fast charger Multi-charger
302-40054-00	Charge/discharge button	10	Desktop fast charger Multi-charger
262-00001-00	Charger light pipe	10	Desktop fast charger Multi-charger
312-01069-01	Charger top	10	All
312-01070-01	Charger base	10	All
365-01549-01	Charger logo label	10	All
365-01598-00 365-01601-00	Charger labels	10	Desktop fast charger Multi-charger
365-01597-00 365-01600-00	Charger labels	5	Desktop trickle charger
369-00010-11	Rubber charger foot	40	All
360-01059-00	Trickle charger blanking label	10	Desktop trickle charger

Desktop fast charger

The Tait Orca desktop fast charger (Figure E-1) is an intelligent charger that can charge, condition and analyse both NiCd and NiMH batteries of varying capacities up to 2 Ah.

Fast charger operation

A circuit diagram of the fast charger is shown in Figure E-2. The fast charger operates using constant current charging and multiple criteria for end-of-charge detection. When a battery is inserted, the charger detects the type of battery, checks to see if it is working correctly, and then charges the battery.

If the discharge button is pressed after inserting the battery, the charger will discharge the battery before charging. If the discharge button is held down while the battery is being inserted, the charger will enter a condition/analyse cycle that will discharge and charge the battery a number of times and, on the last cycle, check its capacity.

Multiple protection methods are employed to ensure safe operation.

Figure E-1: Tait Orca fast charger charging an Orca Eclipse radio

Hardware operation

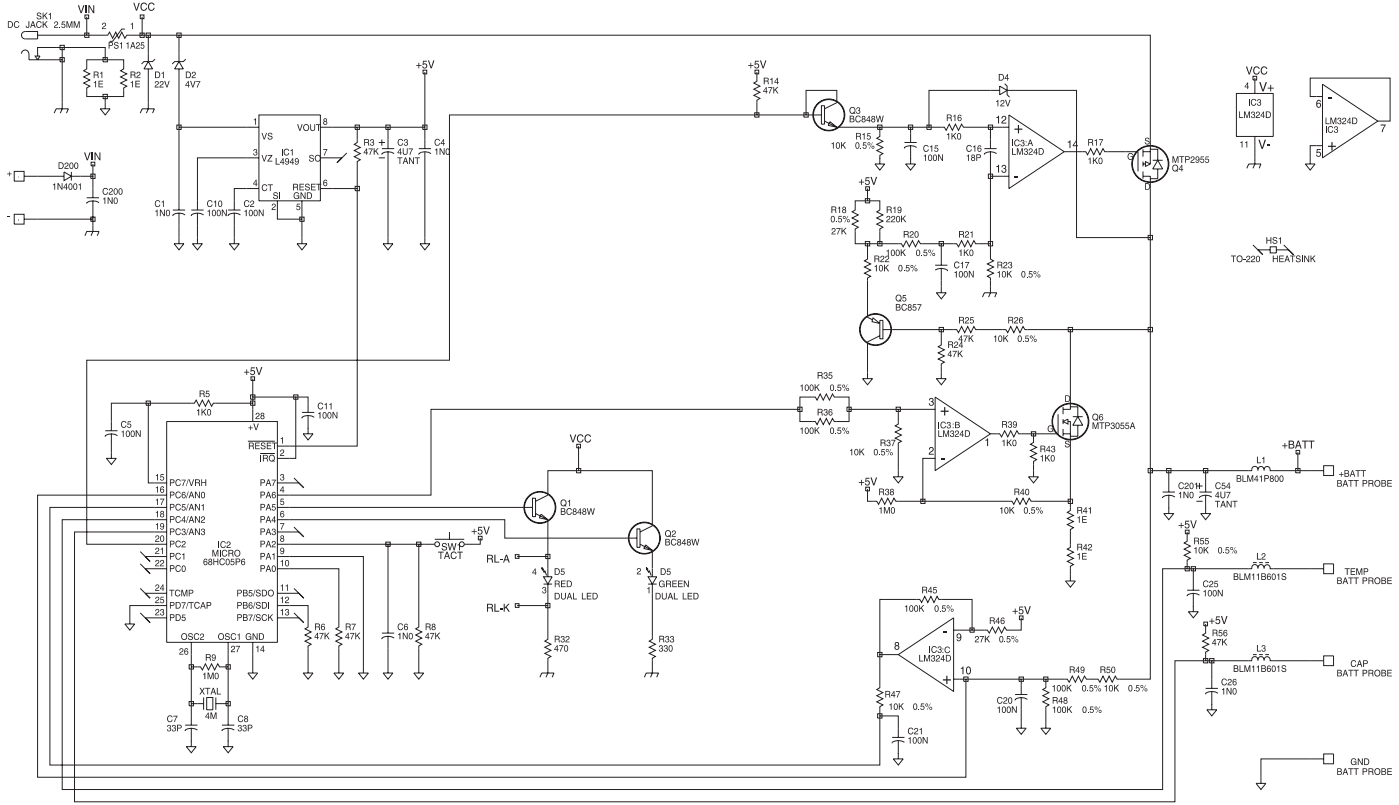
Power to the unit is provided from a 12 volt, 1 amp (nominal) wall-mounted AC to DC adaptor, through SK1. Reverse polarity protection is provided by the 22 V transient suppressor, D1, in conjunction with poly-switch PS1. Under reverse polarity conditions, D1 conducts, drawing the available short circuit current until PS1 trips. D1 also protects against any voltage spikes that may come through the AC to DC adaptor. The maximum safe input voltage range is 10.5 V to 17 V; however, the unit is designed for 10.5 - 14 V operation.

The +5V supply is produced by the regulator, IC1. A feature of this regulator is that it provides a RESET output to the microprocessor. This RESET output is used to delay startup of the microprocessor until the power supply has stabilised after turn-on. It also puts the microprocessor into reset if the input voltage falls too low. D2 sets this low voltage threshold to approximately 9.2 V.

The intelligence of the fast charger is provided by the microprocessor, IC2, which interfaces with the current source, the discharge circuit and the expanded battery voltage interface. The user can interact with the fast charger by pressing the discharge button, SW1, and can observe the operational state on the tri-colour LED, D5.

The current source is based on a ground-sensing linear topology. R1 and R2 are the current sense resistors. The power device is a P-channel MOSFET, Q4, which is controlled by an operational amplifier, IC3:A. The feedback path that controls the op amp, and hence the current, is through transistor Q5 and its resistor network. The grounding on R23 includes the ground sense resistors in the feedback path. The nominal output current is 800 mA.

Figure E-2: Circuit diagram of the Tait Orca desktop fast charger



The discharge circuit is based around a constant current sink. This uses an N-channel MOSFET, Q6, controlled by an operational amplifier, IC3:B. R41 and R42 are the current sense resistors that allow the op amp to set the current. The nominal discharge current is 400 mA.

The microprocessor needs to be able to monitor the battery voltage. A coarse voltage is provided by the voltage divider R48, R49 and R50. This voltage divider brings the range of battery voltage into the same range as the microprocessor A/D input (0-5 V). This enables the microprocessor to monitor the general battery voltage. An expanded battery voltage interface is based around operational amplifier IC3:C. It expands a small window of battery voltage over the range of the microprocessor A/D input. This enables the microprocessor to detect small changes in battery voltage and accurately pick when the battery voltage drops below peak.

The interface to the battery is through four contacts, positive (+BATT), temperature (TEMP), capacity (CAP) and ground (GND). The positive and ground contacts are the main connections for charging. In the battery pack, the temperature contact is connected to ground via a thermistor. This allows the charger to monitor the temperature of the battery and if the battery temperature is outside the range +5°C to +40°C, the charger will not charge the battery. The chargers also uses the temperature line for detecting the presence of a battery; for example, detecting whether the battery has been inserted or removed from the charger. In the battery pack, the capacity contact is connected to ground via a resistor. If there is a capacitor in parallel with the capacity resistor, then the resulting time constant indicates to the charger that the battery pack is NiMH. Consequently, battery packs that do not have a capacitor in parallel with the capacity resistor are considered to be NiCd.

Software operation

The charging sequence is as follows.

- battery flat check;
- battery type detection;
- battery open circuit test;
- battery dead short circuit test;
- battery short circuit test;
- battery temperature test;
- battery discharge (optional);
- fast charge;
- trickle charge;
- standby charge.

When the presence of a battery has been detected, the charger conducts a battery flat check to determine the flatness of the battery.

Battery type detection is used to determine if the battery pack is NiCd or NiMH. The charger then executes the battery fault tests to check for defects in the battery. Failure of any test results in a battery fault indication and terminates the charge sequence.

The battery open circuit test applies charge current for 1 second and checks to see if the battery pack is open circuit (the battery voltage is below an upper limit).

The battery dead short circuit test applies charge current for 3 seconds to check that the battery is not a direct short between its positive terminal and ground.

The battery short circuit test applies charge current for 19 seconds and checks to see if the battery voltage is sufficiently high to start charging.

The battery temperature test checks to see whether the internal battery temperature is within the required limits of +5°C to +40°C.

Once the battery fault tests have been successfully passed, the charger can enter either the fast charge or discharge. If the user has pressed the discharge button, then the charger will

enter a discharge cycle; otherwise, it will enter the fast charge cycle. The discharge cycle drains the battery to a lower limit, then the fast charge cycle is initiated. By discharging the battery prior to charging, the health of the battery can be maintained at its optimum level.

During the fast charge cycle, the battery is charged with a constant current until one of the end-of-charge (EOC) conditions is met. This requires the monitoring of battery temperature and voltage, and charge time.

If the end of the fast charge timeout period is reached and the battery voltage is not above a minimum threshold, then fast charge is terminated and a faulty battery indication is given.

During fast charge, the expanded battery voltage interface is monitored for transients. If a transient is detected, then all EOC conditions, except timeout, are disabled for 60 seconds.

When an EOC condition is successfully met, the charger enters trickle charge, which pulses the charge current to give a low average current. NiCd batteries are trickle charged with a current of 115 mA for 60 minutes, and NiMH batteries are trickle charged with a current of 50 mA for 120 minutes. After trickle charge, the charger enters standby charge, which pulses the charge current at a reduced rate until the battery is removed. If the total charge time was less than 10 minutes, the charger skips trickle charge and goes straight into standby charge. If during trickle or standby charge the battery voltage falls to the discharged battery threshold, the charger restarts the charge cycle as if the battery has just been inserted.

An analyse/condition mode is available to check the health of a battery. If the user inserts a battery while holding down the discharge button, the charger will enter the analyse/condition mode. In this mode, the battery will be discharged and charged a number of times. NiCd batteries go through three discharge/charge cycles, while NiMH batteries go through two discharge/charge cycles. The last discharge stage is timed and if the discharge time is less then 120 minutes for NiCd batteries or 180 minutes for NiMH batteries, a capacity fault will be indicated, and the battery will remain discharged. If the capacity is satisfactory, the battery will charge as normal.

Using the fast charger

Fast charger indicators are described in Table E-3.

Table E-3: Fast charger indicators

Indicator	Meaning
steady green	battery charging
steady green	battery charged
steady amber	charge suspended until battery temperature is within correct range
flashing red	battery not seated properly in the charger, contacts dirty or battery faulty
flashing green	battery being discharged
flashing amber	battery below optimum capacity

Charging the battery using the fast charger

The fast charger will charge the battery when the radio is on, but the battery will charge faster if the radio is turned off. The battery can be recharged attached to the radio or as a separate unit.

Insert the battery/radio into the charger. The indicator will glow amber for three seconds, then red. If the indicator does not glow red, make sure the battery/radio is seated properly and the charger is plugged in correctly. If the battery is too hot or too cold, the indicator will remain amber until the battery temperature is within the safe range for recharging (5°C to 40°C).

Charge times are:

- up to 1½ hours for the 1100 mAh NiCd battery;
- up to 2 hours for the 1500 mAh NiCd battery; and
- up to 2 ½ hours for the NiMH battery.

Once the battery is fully charged, the indicator will change from red to green. At this point, it is recommended that the battery be left in the charger for a further 1 to 2 hours, to ensure maximum battery charge. Leaving the battery in the charger once it is fully charged does not damage the battery.

Conditioning the battery with the fast charger

For best performance, the battery should be conditioned weekly using the fast charger. Conditioning the battery takes about eight hours, depending on how much use it has had.

To condition the battery, turn off the radio. Insert the battery/radio into the fast charger then press the discharge button until the indicator flashes green. The indicator will flash green while the battery is being discharged. Once the battery is discharged, it will charge normally.

Conditioning/analysing the battery with the fast charger

Conditioning/analysing the battery with the fast charger will put the battery through a number of conditioning cycles and will check the battery's capacity on the last cycle.

To condition/analyse the battery, turn off the radio. Press and hold the discharge button while inserting the battery/radio. Continue holding the discharge button; the indicator will glow amber for three seconds, and then will flash green. When the indicator flashes green, release the discharge button.

The condition/analyse cycle will take approximately 16 hours.

Once charged, the charger's indicator will glow green if the battery is in good condition. The indicator will flash amber if the battery is below its optimum capacity; consult your Tait dealer.

Repairing the fast charger

The assembly of the fast charger is shown in Figure E-3.

Depress the release tab in the base of the charger using the end of a flat-bladed screwdriver. Holding the lever in, gently pull the body away from the base. Lift out the PCB.

Replace the battery contacts, the tact switch and the DC jack, if necessary.

Replacing the spring contacts

Note that in some earlier chargers, the two outer contacts are the same type as the two inner contacts. If this is the case, the two outer holes must be drilled out to 2.2 mm to accommodate the larger new positive and negative spring contacts. Figure E-4 shows the charger PCB with the location of the different spring contacts indicated.

Remove the faulty contacts with a soldering iron and discard. When placing the replacement contact, it must not be bent or otherwise damaged. Solder the replacement contact in place using a heavy-tip soldering iron (e.g. Weller 2PTCC8 tip). Hold onto the contact with a pair of pliers and apply solder to the PCB, rather than to the contact, to avoid contact damage.

Replacing the discharge tact switch

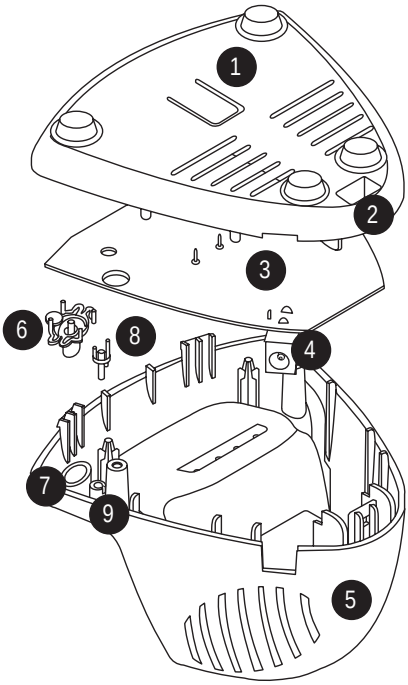
Remove the tact switch using a desoldering station or solderwick. Place the new part on the board and solder it in place using a medium-tip soldering iron (e.g. Weller PTA7 tip).

Replacing the DC jack

Remove the DC jack using a desoldering station or solderwick. There is a lot of solder on both sides of the board, so be sure to remove it all.

Place the new part on the board and solder it in place using a heavy-tip soldering iron (e.g. Weller 2PTCC8 tip).

Figure E-3: Assembly of the desktop fast charger



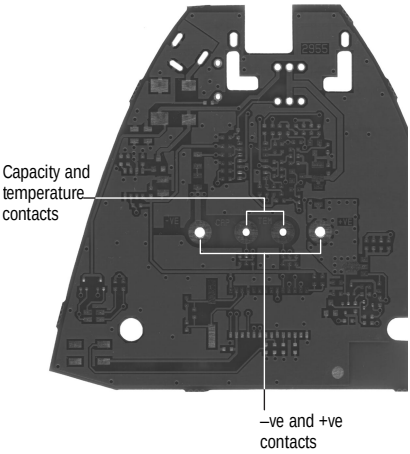
1. charger base
2. access to the release tab
3. PCB
4. DC jack
5. charger top
6. discharge button
7. fit discharge button here
8. light pipe
9. fit light pipe here

Reassembling the charger

Refer to Figure E-3.

Hold the body of the charger upside down and insert the discharge button and the light pipe; both parts self-orient. Place the PCB so it rests on the location pins. Attach the base at the front edge, and clip it down at the back.

Figure E-4: The fast charger PCB, showing the location of the different spring contacts



Desktop trickle charger

The Tait Orca desktop trickle charger can charge a 1100 mAh or 1500 mAh NiCd battery overnight. It is designed to provide approximately 1450 mAh of charge in a 16 hour period. Thus both 1100 mAh or 1500 mAh NiCd batteries can be charged. Simple protection of the radio is provided in the form of an open circuit voltage limit as well as short circuit protection.

Figure E-5 shows the charger current profile. Figure E-6 shows the circuit diagram for the trickle charger.

Trickle charger operation

When the battery voltage is above approximately 8 V, the charge current is inversely proportional to the battery voltage. This characteristic is produced by Q100, Q101 and Q102. The charge current is determined by the current through R104, which is set by Q102, its emitter resistors and the reference voltage. The slope of the curve is determined by Q101 and R106. The reference voltage is provided by an 8.2 V Zener diode (D100).

When the battery voltage is below approximately 8 V, the charge current is proportional to the battery voltage. This is accomplished by using Q103 to change the reference voltage in proportion to the battery voltage. This changes the current through R104, which changes the charge current, as desired.

The maximum voltage available from the trickle charger is limited to less than 10.5 V by R111, in conjunction with Q101, so that the radio can not be damaged if the battery goes open circuit. If the battery goes short circuit, then Q102 is held off by Q103 and thus Q100 is off, and there is negligible charge current.

On startup, the state of the charger is similar to that when the charger output is shorted. When power is applied, VIN starts to rise and the emitter voltage of Q103 rises. However, the base of Q103 is still at zero volts, so Q103 starts to turn on. When Q103 is on, it will maintain Q102 off and hence Q100 will also stay off. Thus when VIN has risen to its final value, the circuit is in an off state, giving negligible output voltage and charge current.

In order to activate the circuit, a minimum voltage of approximately 2.6 V (a battery) must be connected to the circuit to charge C101 and turn Q103 off, thus turning on the charger.

The LED is on whenever there is sufficient charge current. Its brightness is proportional to the charge current profile, and its turn-on and turn-off thresholds are determined by R105. Thus the LED is on under normal charging, dims when the battery approaches full charge and is off under fault/no charge conditions.

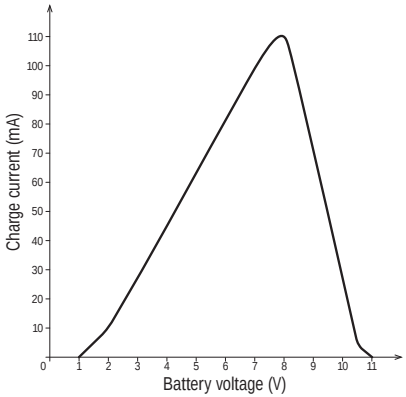
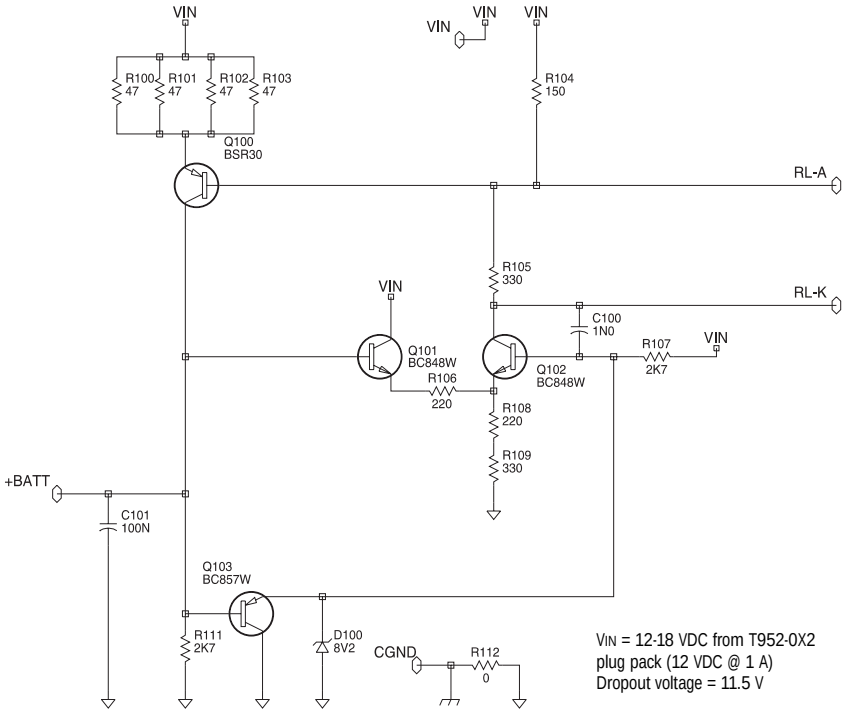


Figure E-5: Tait Orca desktop trickle charger current charge profile

Figure E-6: Circuit diagram of the Tait Orca desktop trickle charger



Using the trickle charger

The trickle charger is not recommended for NiMH battery packs, as they can take up to 24 hours to charge fully and the overall lifetime of your battery may be reduced. Use a fast charger instead.

The battery can be recharged attached to the radio or as a separate unit. To charge the battery pack using the trickle charger, make sure the radio is turned off. Insert the battery/radio into the charger. Make sure the indicator on the charger glows red. If the indicator does not glow red, check that the battery/radio is seated properly and the charger is plugged in correctly. The indicator will remain red until the radio is removed from the charger.

The battery will be fully charged in about 16 hours. Leave the battery in the charger until it is next needed; however, leaving the battery in the charger for longer than 24 hours is not recommended.

Repairing the trickle charger

For instructions on repairing the trickle charger, refer to those for repairing the desktop fast charger.

Multi-charger

The multi-charger (TOPA-CH-300) is made up of six desktop fast chargers that operate independently of one another. Each multicharger PCB has an additional diode.

Multi-charger operation

The operation of the multi-charger is the same as that of the desktop fast charger.

Figure E-7: The Tait Orca six-way multi-charger

PART F

Interfacing non-Tait accessories

This part describes how to interface non-Tait accessories.

Two types of accessory connectors are available for Tait Orca handportables, the Tait Orca accessory connector and the 7.5 mm accessory adaptor.

Instructions are provided for connecting non-Tait acessories using the Tait Orca accessory connector. A brief description of the 7.5 mm accessory adaptor is also provided.

A list of audio accessories currently available for use with Tait Orca handportables is found in Table A-1, on page A-7.

Contents

Tait Orca accessory connector

The Tait Orca handportable has a versatile accessory interface on the rear of the radio for connecting external accessories, such as speaker microphones and headsets.

The Tait Orca accessory connector PCB is shown in Figure F-1.

There are two Tait accessory connector kits available for Tait Orca handportables:

- Accessory Connector Kit (TOPA-AA-006); and
- RF Accessory Connector Kit (TOPA-AA-007).

Each kit contains the accessory connector PCB with the required pins soldered on. The board supplied with RF Accessory Connector Kit has four additional pins for RF applications.

Table F-1 shows the signals available at the accessory connector. A circuit diagram of the accessory connector is shown in Figure F-2, and the signals are described in the following paragraphs.

Signals

RX-DET-AF

The RX-DET-AF line carries unprocessed receive audio from the output of the detector IC.

MOD-AUDIO

The MOD-AUDIO line is used during calibration to set up the modulation balance and by some accessories, such as modems.

+7V5-ACC

The +7V5-ACC line supplies +7.5 V to accessories.

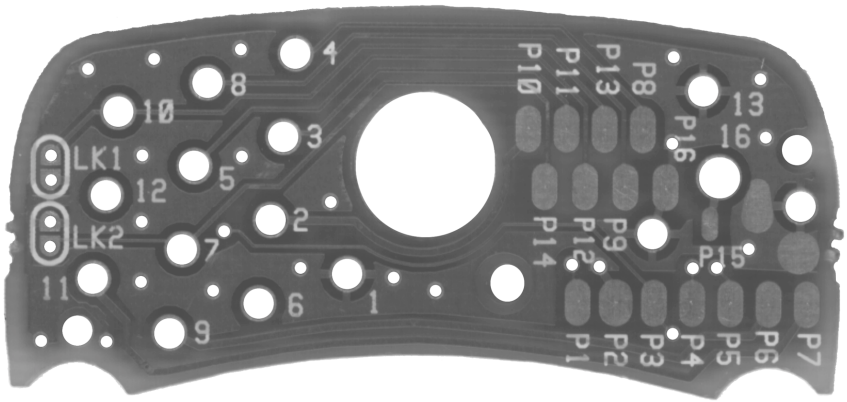
RXD

The RXD line carries data from the accessory connector to the controller during tasks such as radio programming and calibration.

TXD

The TXD line is a digital data line from the microprocessor and carries synchronous data from the controller to the accessory connector during tasks such as radio programming and calibration.

Figure F-1: Tait Orca accessory connector PCB, showing I/O pads P1 to P16 and the location of spring probes 1 to 16



SENSE-0/SENSE-1

SENSE-0 and SENSE-1 lines are used to detect accessories.

SENSE-0 is used to turn off the radio's internal speaker. To turn off the internal speaker, tie SENSE-0 to GND by shorting link 1 (LK1). The external speaker outputs are always active.

SENSE-1 is used to put the radio in VOX mode when an external voice-operated switch is used to control EXT-PTT (e.g. in a handsfree vehicle kit). To do this, tie SENSE-1 to GND by shorting link 2 (LK2). If the radio is being used in VOX mode on a conventional channel, then EXT-PTT will only be sensed when it is not busy. If the radio is being used on a trunking network, then EXT-PTT will only be sensed when it is on a valid traffic channel. A trunking call must be initiated by an internal key on the radio.

EXT-MIC

The EXT-MIC signal is an analogue input from the microphone of an accessory.

Connecting a microphone to EXT-MIC automatically turns off the radio's internal microphone.

EXT-PTT

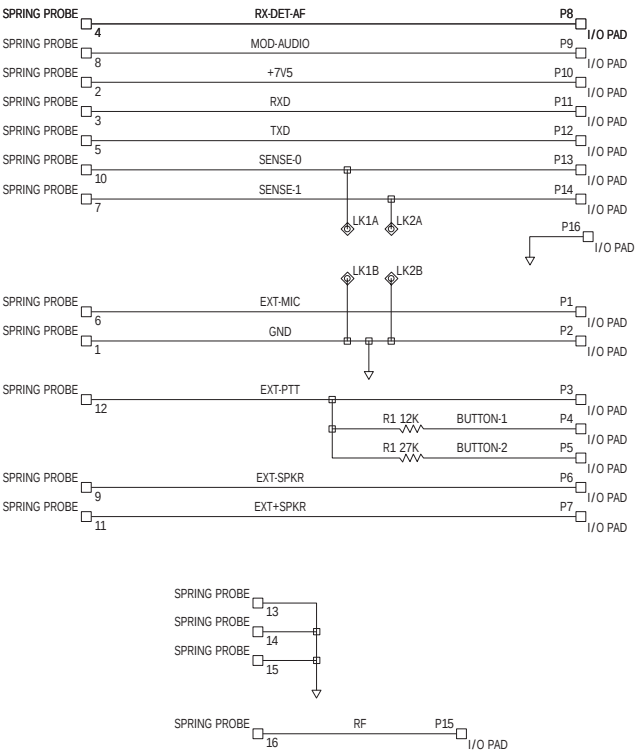
The EXT-PTT is an analogue signal from the accessory interface to the control area and indicates an external request for PTT and external function buttons.

Table F-1: Accessory connector signal descriptions

Signal	Description	Type	Signal level	Output impedance /current	Input impedance
RX-DET-AF	Unmuted receive audio	Analogue audio 1.15-1.6 VDC	53-225 mV_{rms}	2.2 kΩ	–
MOD-AUDIO	Modulator input	Analogue audio	0-4.8 V_{pp} 2.4 VDC	–	470 Ω
+7V5-ACC*	Accessory power	DC supply	7.0 V* nominal	20 mA (max)	–
RXD	Serial receive data	CMOS	high = 0 low = 1	–	–
TXD	Serial transmit data	CMOS	high = 0 low = 1	1 mA (max)	–
SENSE-0	Accessory sense (internal speaker disable)	CMOS	high = 1 low = 0	1 mA (max)	–
SENSE-1	Accessory sense (VOX mode)	CMOS	high = 1 low = 0	1 mA (max)	–
EXT-MIC	External microphone input (electret)	Analogue audio	11 mV_{pp} (typical) DC coupled	–	1 kΩ
EXT-PTT	External push-to-talk input	Analogue DC	0-5 V, PTT = 0 V	–	27 kΩ
EXT-SPKR	External speaker differential output	Analogue audio	±6.5 V_{pp} differential	To drive 16 Ω differentially	–
EXT+SPKR	External speaker differential output	Analogue audio	±6.5 V_{pp} differential	To drive 16 Ω differentially	–
RF	Accessory antenna connection	Radio frequency	Tx: 5 W_{rms} (max)	50 Ω	–

* Dependent on battery charge level.

Figure F-2: Circuit diagram of the Tait Orca accessory connector PCB for handportables



EXT-SPKR +/-

The EXT-SPKR +/- line can be used to drive an external speaker. Neither terminal should be grounded, as the output is differential.

GND

The GND pin is the ground point of the accessory connector.

RF

This pin provides a connection for accessories requiring RF, such as the RF speaker microphone. When an RF accessory is connected, the main antenna is switched out.

Accessory power

The 7V5-ACC supply is limited to 20 mA maximum. The output voltage itself will change depending on the battery voltage level, and there will be some voltage differential between the battery voltage and 7V5-ACC, depending on the current drawn by the accessory.

Accessory function buttons

Two external function buttons are available, BUTTON-1 and BUTTON-2.

The sensing of the external function buttons is determined by a voltage divider on EXT-PTT. This consists of a 27 kΩ pull up to 5 V inside the radio and a pull down resistor on the accessory PCB. The resistor pull downs for BUTTON-1 and BUTTON-2 are as follows:

- PTT function: resistor pull down 0 Ω, voltage level on EXT-PTT is 0 V;
- BUTTON-1 function: resistor pull down 12 kΩ, voltage level on EXT-PTT is 1.5 V;

- BUTTON-2 function: resistor pull down 27 kΩ, voltage level on EXT-PTT is 2.5 V.

These resistors are already fitted to the accessory PCB.

Connecting an accessory

First determine whether your accessory is compatible with the accessory connector by referring to Table F-1.

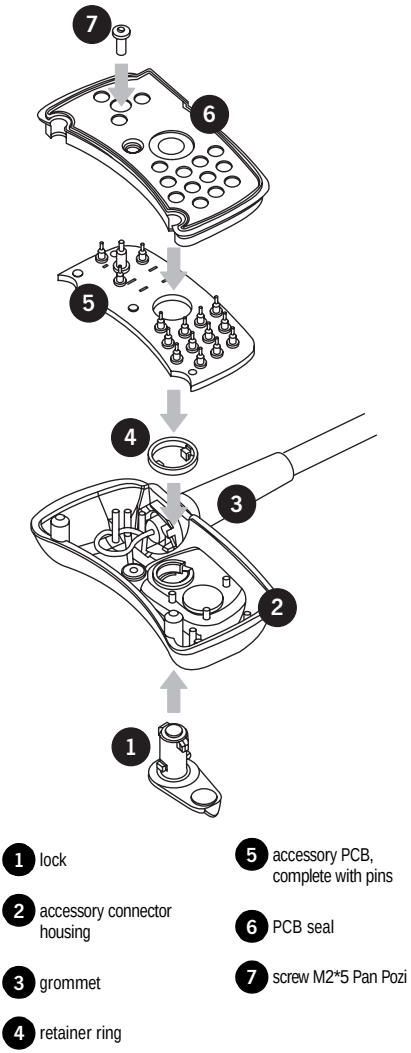
If it is compatible, short link 1 ('LK1', shown in Figure F-1 and Figure F-2) if it is necessary to turn off the radio's internal speaker. Then carefully follow the mechanical assembly procedure outlined below.

Mechanical assembly procedure

Figure F-3 shows an assembly drawing of the accessory connector. The order of assembly is as follows.

- Fit the lock to the accessory connector housing.
- Fit the retainer ring so that it holds the lock firmly to the housing.
- Thread the cable from your accessory through the accessory housing, making sure it goes through in the proper direction.
- Slide a grommet of appropriate size onto the cable and pull firmly so the cable and grommet fit in place.
- Strip and tin the accessory signal wires.
- Solder the accessory wires to the correct pads on the PCB (refer to Table F-2 for headset connections).
- Crimp the cable at an appropriate distance along the cable, approximately in line with the edge of the PCB.
- Use narrow-nose pliers to pull out the appropriate plugs in the seal and fit it onto the PCB.
- Fit the grommet and PCB/seal into the housing and secure it with the supplied screw.

Figure F-3: Assembly diagram of the accessory connector



Connecting a headset using the Tait Orca accessory connector

The headset must meet the following basic specifications:

- speaker impedance: 32 Ω (16 Ω min);
- speaker power: 1/4 W_{rms} (min);
- microphone: electret, approximately 1 kΩ; (and)
- PTT: switch not in line with microphone.*

To connect a headset to your Tait Orca handportable, the connections shown in Table F-2 must be made.

To turn the radio speaker off and only have the headset speaker on, short link 1 (LK1). This ties SENSE-0 to GND, telling the radio to turn the speaker off. SPEAKER+ and SPEAKER- must not short to GND, or to any other signal.

Procedure

Determine the compatibility/suitability of your headset. If it is compatible, follow the assembly procedure outlined previously, soldering the headset wires onto the correct pads on the accessory PCB.

Table F-2: Connections for connecting a headset

Solder to these pads	Signal from headset
P1	MIC
P2	GND
P3	PTT
P6	SPEAKER–
P7	SPEAKER+

* If your headset has a PTT in line with the microphone, it can be connected with the 7.5 mm accessory adaptor. See pages F-8 to F-9 for more information.

7.5 mm accessory adaptor

You can connect non-Tait accessories that require a 7.5 mm adaptor to the Tait Orca handportable using the 7.5 mm accessory adaptor (TOPA-AA-005).

Such accessories use 3.5 mm and 2.5 mm phono plugs with 7.62 mm spacing between them. The speaker and microphone/PTT jacks for the 7.5 mm adaptor are shown in Figure F-4.

To connect an accessory to the Tait Orca that uses PTT in series with the microphone, wire the accessory to a 3.5 mm plug and 2.5 plug according to Figure F-4.

The 7.5 mm accessory adaptor differs from the standard accessory connector in that with the 7.5 mm adaptor, the PTT signal is in series with the microphone signal. The standard accessory connector has separate PTT and microphone signals. If the accessory has function buttons, they will not work with the 7.5 mm adaptor.

The main function of the 7.5 mm adaptor is to demultiplex the accessory's MIC/PTT line into two separate lines for the Tait Orca handportable. The adaptor also detects the presence of the accessory speaker and turns off the radio's speaker.

Figure F-5 shows the circuit diagram for the 7.5 mm accessory adaptor.

When the accessory PTT switch is pressed, it connects the microphone to the adaptor between ground and the base of Q3 (see Figure F-5). This pulls Q3 low turning it on. Q3 in turn pulls the base of Q2 high which pulls the EXT-PTT line low, enabling the transmitter. Audio from the accessory microphone passes through C4 to the radio's EXT-MIC line.

When the accessory speaker is connected, the base of Q1 is pulled high via R3 and R1, turning it on. This pulls the SENSE-0-ACC line low, which tells the radio to turn off the internal speaker, and only the accessory speaker is operational. C1, C2 and C3 filter out the audio signal, so that the voltage swing of the signal will not turn off Q1.

Figure F-4: Plugs for the 7.5 mm accessory adaptor

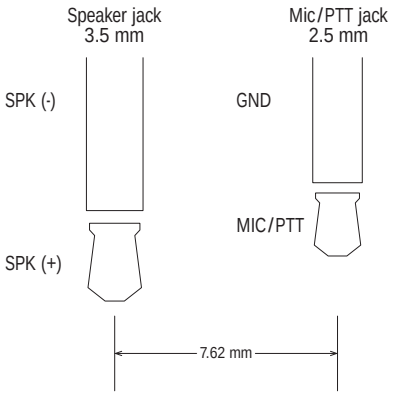
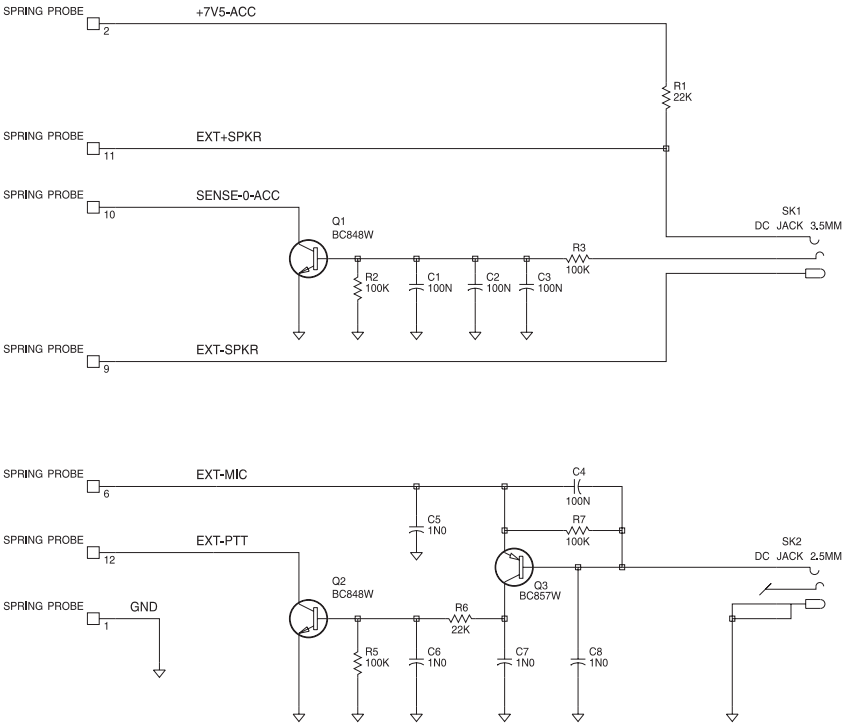


Figure F-5: Circuit diagram of the 7.5 mm accessory adaptor PCB for handportables



PART G

Additional information

This part provides reference information, including a glossary of terms.

Contents

Glossary

active

The 'on' (asserted) state of a signal or indicator.

ADC

Analog to digital converter. An electronic device that outputs binary data dependant upon the magnitude of voltage input.

brownout

A dip in the supply voltage sufficient to put the control section into hardware reset.

calibration

The process of determining the **calibration data** for a radio. Calibration is normally only carried out during product manufacture or major service.

calibration data

The set of coefficients for each of the electronic tuning variables, as a function of frequency, which allows the radio to calculate the **configuration data** for any frequency it operates on. The **calibration data** is unique for each radio.

call

A complete exchange of information between two or more parties. In **trunked mode**, this may occur on the **control channel** or on a **traffic channel**.

CCTM

Computer controlled test mode. The operating mode of the radio whereby computer equipment can control various radio functions by sending commands down a serial link to the radio.

channel

A receive/transmit frequency pair.

configuration

The determination and setup of the **configuration data** for a given frequency from the programmed **calibration data** (i.e. electronic tuning).

configuration data

The data set corresponding to the value of the electronic tuning variables on a given channel. This is calculated for each frequency from the **calibration data**.

control channel

The **channel** used by a **trunking system** to control the radio.

conventional mode

The mode of operation whereby the radio behaves as a conventional two-way radio (i.e. non-trunked operation).

CTCSS

Continuous tone controlled subaudible signalling. Continuous, subaudible coding on the channel for the purpose of segregating user groups.

DAC

Digital to analog converter. An electronic device that outputs a voltage dependent upon the value of binary data input.

database

The set of programmable data points that allows the product to be customised for a particular application or mode of operation.

Note: Terms that appear in **bold sans serif** font are also defined in this glossary.

DC

Direct current.

DCS

Digitally coded squelch. Continuous, subaudible coding (repeating digital code sequence) on the **channel** for the purpose of segregating user groups.

delayed

Key action. The input is not actioned until it has been stable for the duration of the debounce interval.

dialled string

A sequence of characters entered via the keypad. May contain **numbers**, **labels**, '*' or '#'. Used to initiate **calls** or invoke special functions.

dialling

The act of entering a number or label by typing in successive characters on the keyboard.

DSP

Digital signal processor.

DTMF

Dual tone multiple frequency. Method of encoding digits (0 to 9) and characters (A to F), each as a pair of eight standard tones.

economy mode

When the radio is cycling between the **receive mode** and **standby** state. Available on Tait Orca conventional handportables.

ECR

External call request.

EPROM

Erasable programmable read only memory.

EPTT

External press-to-talk.

ESN

The MPT1343 defined electronic serial number of the radio.

FFSK

Fast frequency shift keying. The signalling method employed in trunked radios. Data is represented by 1 cycle of 1200 Hz (logic 1) or 1.5 cycles of 1800 Hz (logic 0) and is transmitted at 1200 baud.

fixed (indicators)

Do not time out of their own accord. Generally indicate mode of operation or state.

idle

The state of the radio in **trunked mode** when it is not engaged in a call or call setup, or in **conventional mode** when the radio is not transmitting.

IF

Intermediate frequency.

inactive (indicator)

The 'off' (unasserted) state of a signal or indicator.

label

A plain language word (1 to 8 characters long) that is defined to represent a valid dialled string at radio programming time.

LCD

Liquid crystal display.

LED

Light emitting diode.

LPF

Low pass filter.

MCU

Micro control unit.

mute

The receive audio gating element. When active, receive audio is passed to the speaker. The decision to activate/deactivate the audio signal path is based on an evaluation of signalling codes (**CTCSS**, **DCS**, **Selcall**) contained in the audio information (contrast with **squelch**).

number

A simple **string** that corresponds to an MPT1343 defined called party identifier.

PA

Power amplifier.

PABX

Private automatic branch exchange.

PCB

Printed circuit board.

PLL

Phase locked loop.

PLCC

Plastic leaded chip carrier.

PMR

Private mobile radio.

programming mode

The mode of operation of the radio in which computer equipment can read from and write to the radio **database**.

PSTN

Public switched telephone network.

RAM

Random access memory.

receive mode

This is the state wherein the radio is producing a valid busy output, irrespective of whether any audio output is produced at the speaker terminals. The +5V-ECON supply is on, and sufficient time has elapsed for various circuit blocks to settle.

RF

Radio frequency.

RSN

The radio's unique serial number.

RSSI

Received signal strength indicator.

SCI

Serial communications interface. This is the serial interface from the radio to an external device, normally utilising transmit and receive data, signal and ground lines.

Selcall

Selective calling. Sequential tone burst coding on the channel for the purpose of selecting an individual or group with which to communicate.

selecting

The act of picking a **label** from a displayed list using the arrow keys.

signalling

Non-voice coding on the channel for the purpose of identifying parties and/or segregating user groups, e.g. **CTCSS**, **DCS**, **Selcall**.

SMD

Surface mount device.

SOIC

Small outline integrated circuit.

SOT

Small outline transistor.

squelch

The channel busy detection circuitry. The decision to activate/deactivate the audio signal path is based on a signal-to-noise measurement on the received **RF** signal (the squelch circuitry precedes the **mute** circuitry).

standby state

This is essentially when the +5V-ECON line is off. That is, when the radio is drawing the minimum current, while still being switched on.

string (simple)

A sequence of the characters 0 to 9, *, #, which instructs the radio to initiate a call or perform some other function.

successful (call)

A **call** for which a **traffic channel** is assigned.

system restart

The action taken by the radio (e.g. in response to the '^' character received on the **SCI**) where it immediately ceases current operation, then behaves as though it has just been switched on.

TCXO

Temperature compensated crystal oscillator (voltage controlled). The frequency reference for the **RF** part of the radio.

test mode

The operating mode of the radio whereby computer (computer equipment can control various radio functions by sending controlled) commands down a serial link to the radio.

traffic channel

The channel used by the radio for the duration of a **call**.

transmit mode

The radio has validated a request and commenced or completed the sequence of switching out of **receive mode**. This does not necessarily imply that **RF** is being generated.

trunked mode

The mode of operation of the radio whereby the radio obeys commands on the **control channel** and generally operates as proscribed in MPT1343.

trunking system

The infrastructure comprising repeaters and radios required to support a number of **control channels** and **traffic channels**.

VCO

Voltage controlled oscillator. The oscillator that generates either the on-channel signal to drive the transmitter, or the local oscillator to mix incoming **RF** signals to the **IF** of the radio. The instantaneous frequency of the VCO is determined by a combination of the synthesiser (**PLL**) and the modulation signals TCXO-MOD and VCO-MOD.

VOX

Voice operated transmit.

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