



**Tait Orca 5000 Portable Radios  
Service Manual**

**June 2003**

**IPN: M5000-00-105**

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# Preface

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## Contacting Tait Electronics Ltd

The contact details for your nearest Tait Electronics regional office, can be found on the Tait Website: <http://www.taitworld.com/>

## Enquiries and comments

If you have any enquiries regarding this manual, or any comments, suggestions and notifications of errors, please contact Customer Support, Tait Electronics Ltd, Christchurch, New Zealand, or refer to the Tait Website.

## Conventions

Throughout this manual, the following conventions are used:

- 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.

- The **x**-character is used as a wildcard in product codes and part numbers, to indicate unspecified characters.

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## Updating equipment and manuals

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## Publication history

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May 2001	M5000-00-100
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# PART A Introduction

This part provides an introduction to servicing Tait Orca 5000 portable radios. It includes an outline of the Tait Orca 5000 range of products and precautions that should be taken before servicing Tait Orca 5000 portable radios.

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

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# Servicing Tait Orca 5000 portable radios

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The Tait Orca 5000 series is a range of portable high performance, microprocessor-controlled radios manufactured using an RF-shielded PCB and high-density SMD components.

Servicing of Tait Orca 5000 portable radios is limited to key mechanical and ancillary devices. These include:

- the front panel assembly;
- the lens (Orca 5015/2x/35/40);
- the PTT keypad;
- the speaker;
- the keypad;
- the LCD display (Orca 5015/2x/35/40);
- the shield, complete with user interface PCB assembly and polyester dome (Orca 5015/2x/35/40);
- the main PCB assembly;
- the antenna connector;
- the channel selector switch;
- the volume control switch;
- the microphone;
- the speaker contacts;
- the battery contacts;
- the PTT tact switch;
- the RF out assembly
- the auxiliary flexible PCB
- the rear panel; and
- the chassis.

The repair of PCB-related faults is the responsibility of Technical Support at Tait Electronics Ltd. Detailed schematics and component location information for the main PCB may also be obtained from Technical Support. 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>

## What does this manual contain?

This manual is supplied as part of the Tait Orca 5000 service kit (TOPA-SV-117G), and provides the following:

- general information and specifications on the Tait Orca 5000 series of portable radios;
- basic circuit descriptions;
- information on finding and servicing non-PCB-related faults;
- information on Tait Orca 5000 battery packs and chargers;
- information on interfacing accessories to Tait Orca 5000 portable radios; and
- a glossary of key terms.

## Calibration service kit

The TOPA-SV-117G service kit contains:

- calibration test unit (TOPA-SV-004);
- radio calibration cable for connecting the radio to the calibration test unit (TOPA-SV-007G);
- 9 pin RS232 to modular phone jack programming lead for connecting the calibration test unit to a PC (TOPA-SV-019);
- 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; and
- TOP Programming Utilities (TPU) CD-ROM (IPN 406-00003-xx).

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 portable radios; and
- TOPA-SV-A07 if calibrating TOP-Axxxx-xx 66-88MHz product.

## **Programming kit**

The TOPA-SV-116 kit for programming Tait Orca 5000 radios contains:

- accessory connector to modular phone socket programming cable for connecting the radio to the programming lead (TOPA-SV-003G); and
- 9 pin RS232 to modular phone jack programming lead for connecting the programming cable to a PC (TOPA-SV-019); and
- TOP Programming Utilities (TPU) CD-ROM (IPN 406-00003-xx).

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# The Tait Orca 5000 series of portable radios

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There are eight Tait Orca 5000 series portable radio products:

- Orca 5010/11 - low tier conventional
- Orca 5015 - mid tier conventional
- Orca 5020/21 - high tier conventional
- Orca 5030 - low tier trunked
- Orca 5035 - mid tier trunked
- Orca 5040 - high tier trunked

This manual includes information specific to all the Orca 5000 portable radios. As new features and enhancements occur, new revisions of this manual will be released.

## The Tait Orca product code

The characters in the Tait Orca 5000 product code provide information about the radio's functional parameters and various hardware options, according to the scheme outlined in Figure A-1. For more information on available products, contact your nearest Tait dealer.

Figure A-1: Tait Orca 5000 Product Code Scheme

The Tait Orca Product Code has the following structure:

### TOP-abcde-mn

where:

- TOP - Family designator
- a - Frequency band
- b - Channel spacing/IFBW
- c - User interface
- d - Air interface
- e - Compliance-relevant changes
- m - Badging
- n - Custom variations not affecting radio/EMC compliance

## Notes:

1. The complete Tait Orca product code standard can be downloaded from the

technical support Website:

<http://www.taitworld.com/support>

2. In this manual, when the term TOP x is used (e.g. TOP A or TOP B), it indicates the specific frequency band. TOP A will therefore refer to an A band Orca, and TOP B to a B band Orca.

## Operating instructions

A user's guide is available for each radio. Copies can be obtained through Technical Support.

## Accessories

Table A-1 shows the accessories available for Tait Orca 5000 portable radios. Of these accessories, only the chargers are serviceable.

For more information on chargers, see *Part E: Battery packs and chargers*. The battery packs available for Tait Orca 5000 portable radios are also described in Part E.

## New chassis

A new chassis and accessory connector have been introduced in September 2002. This provides greater strength to the accessory connector. Old accessories are however no longer compatible with the new chassis, nor will the new accessories fit the old chassis. See "Accessory connector compatibility" on page G-8. Information specific to the old chassis or accessories can be found in version M5000-00-103 of the Tait Orca 5000 service manual.

The new accessory connectors have a different shape quarter turn tip, no hooks on the locating posts and a green dot on the outside at the lower left corner

The new chassis has a different shape hole for the connector's quarter turn tip, and a green

seal behind. Figure A-2 illustrates the difference. Radios factory fitted with the new chassis also have a product code with the format TOP-xxxx-Bx.

Figure A-2: Changed chassis hole



### 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. Keeping the accessory connector parallel to the radio, engage the two posts at the base of the connector with the rear panel. Once the accessory is in position, rotate the lever 90 degrees counterclockwise to lock it in place. See Figure A-3.

### Removing an accessory

When removing an accessory, press the lock spring tab before rotating the clip clockwise. See Figure A-4.

### Fitting a non-Tait accessory

See *Part F: Accessories* for information on using non-Tait accessories with Tait Orca 5000 portable radios.

Figure A-3: Fitting an accessory with a D-Clip

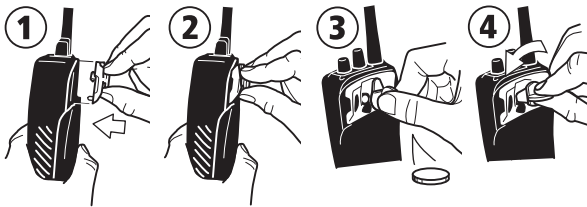


Figure A-4: Removing an accessory with a D-Clip

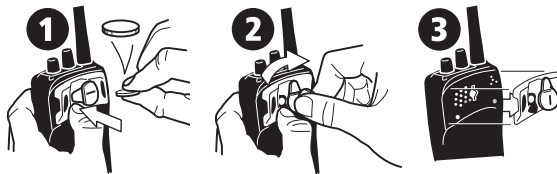







Table A-1: Tait Orca 5000 accessories

Type of accessory	Product code	Description
Antennas	TOPA-AN-101	130-230 MHz 3" helical
	TOPA-AN-102	336-540 MHz 3" helical
	TOPA-AN-201	136-340 MHz 6" helical
	TOPA-AN-212	400-940 MHz 6" wave whip
	TOPA-AN-203	896-941MHz 7" gain
	TOPA-AN-204	806-870M 1/2 wave gain
	TOPA-AN-205	896-941M 1/2 wave gain
	TOPA-AN-301	66-88MHz 10" helical
Audio accessories	TOPA-AA-001G	Speaker microphone, -10 to 60 °C, two function buttons
	TOPA-AA-002G	Speaker microphone, -30 to 60 °C, heavy duty, two function buttons
	TOPA-AA-003G	Speaker microphone, -30 to 60 °C, MIL spec
	TOPA-AA-004G	Speaker microphone, -30 to 60 °C, MIL spec, with antenna socket
	TOPA-AA-005G	7.5 mm accessory adaptor
	TOPA-AA-006G	Tait Orca accessory connector kit
	TOPA-AA-007G	Tait Orca RF accessory connector kit
	TOPA-AA-008	Speaker microphone, -30 to 60 °C, MIL spec, no function buttons, high/low volume*
	TOPA-AA-009	2-wire palm microphone and earphone, -30 to 75 °C*
	TOPA-AA-010	3-wire lapel microphone and earphone, -30 to 75 °C*
	TOPA-AA-011	Light weight single speaker headset with in-line PTT, -30 to 75 °C*
	TOPA-AA-012	Over-the-head headset with noise cancelling boom microphone, -30 to 75 °C*
	TOPA-AA-013	Behind-the-head headset with noise cancelling boom microphone, -30 to 75 °C*
	TOPA-AA-101G	Speaker microphone, -10 to 60 °C, two function buttons (with D-Clip)
	TOPA-AA-102G	Speaker microphone, -10 to 60 °C, heavy duty, two function buttons (with D-Clip)
	TOPA-AA-103G	Speaker microphone, -10 to 60 °C, MIL spec (with D-Clip)
	TOPA-AA-104G	Speaker microphone, -30 to 60 °C, MIL spec, with antenna socket (with D-Clip)
TOPA-AA-106G	Tait Orca 5000 accessory connector kit (with D-Clip)	
TOPA-AA-107G	Tait Orca 5000 RF accessory connector kit (with D-Clip)	
* For use with TOPA-AA-005G	T952-051	Earphone kit with coil cord and 2.5 mm plug, -30 to 75 °C (for use with TOPA-AA-003G, TOPA-AA-004G, TOPA-AA-008, TOPA-AA-103G & TOPA-AA-104G)
Batteries	TOPB100	1100 mAh NiCd battery pack
	TOPB200	1500 mAh NiCd battery pack
	TOPB200-IF	1500 mAh NiCd battery pack (intrinsically safe)
	TOPB400	1500 mAh NiMH battery pack
	TOPB500	2000 mAh NiMH battery pack
	TOPB600	1100 mAh NiCd battery pack (slim)
	TOPB700	1500 mAh NiMH battery pack (slim)

Type of accessory	Product code	Description
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
	TOPA-CA-101	Heavy duty carry case (with D-Clip)
	TOPA-CA-102	Holster carry case (with D-Clip)
	TOPA-CA-103	Belt loop
	TOPA-CA-104G	D-Clip
	TOPA-CA-105	Handstrap

### Warning!

The following accessories have the old accessory connector and are still available for purchase. These accessories only fit the older

Tait Orca series portable radios. **Do not attempt to fit to the new chassis.**

Table A-2: Tait Orca 5000 portable radio accessories with the old connector

Type of accessory	Product code	Description
Audio accessories	TOPA-AA-001	Speaker microphone, -10 to 60 °C, two function buttons
	TOPA-AA-002	Speaker microphone, -30 to 60 °C, heavy duty, two function buttons
	TOPA-AA-003	Speaker microphone, -30 to 60 °C, MIL spec
	TOPA-AA-004	Speaker microphone, -30 to 60 °C, MIL spec, with antenna socket
	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



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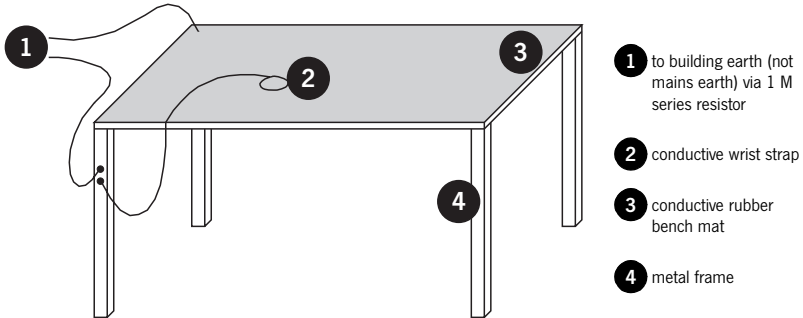
# Important information

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## Basic servicing precautions

Tait Orca 5000 portable radios require specialised servicing techniques and should only be serviced at an approved Tait service centre equipped with the necessary facilities.

Figure A-5: Typical anti-static bench setup



## 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 5000 portable radios 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.

Standard anti-static procedures should be followed; a typical setup is shown in Figure A-5.

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

Torx head 1.8x5 mm screws should be removed using the supplied Torx T6 driver. When replacing these screws, set the driver to 2in.lb (0.23Nm).

Pan head Pozidriv M2x8 mm and M2x5 mm screws should be removed using a number 1 Pozidriver. When replacing these screws, set the driver to 2in.lb (0.23Nm).

## Programming

For information on programming Tait Orca 5000 portable radios, refer to:

- the *Tait Orca Trunked Programming Application User's Manual* or the online help;
- the *Tait Orca Conventional Programming Application User's Manual* or the online help.

The User's Manuals are on the TOP Programming Utilities (TPU) CD-ROM, which is included, together with this manual, as part of the calibration service kit.

## Calibrating

For information on calibrating Tait Orca 5000 portable radios, refer to:

- the *Tait Orca Calibration Application User's Manual* or the online help.

The User's Manual is on the TOP Programming Utilities (TPU) CD-ROM, which is included, together with this manual, as part of the calibration 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 5000 portable radios.

## Basic maintenance

Your Tait Orca portable radio requires no regular maintenance other than ensuring that the battery has sufficient charge and that no damage has occurred to the antenna or the battery pack.

### General care

- Wipe the battery contacts, accessory connector contacts and radio display with a dry lint-free cloth to remove any dirt, oil or grease.
- Use a cloth dampened with clean water to clean the radio's case and display lens, but do not immerse the radio in fluids.
- Do not allow the radio to come into contact with detergents, alcohol, aerosol sprays or petroleum-based products as they may permanently damage the case.
- Avoid high temperatures. If the radio overheats, it will cease to function. You will hear two short high-pitched beeps.

## Troubleshooting

If you are experiencing difficulty operating your Tait Orca portable radio check the following items:

- Is the battery firmly attached to the radio?
- Is the battery sufficiently charged?
- Is the battery charger working properly?
- Is the antenna damaged?

If all appears to be in order but your radio still fails to operate properly, consult your local Tait dealer for assistance.

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# Servicing Intrinsically Safe radios

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## Intrinsically Safe radios

Intrinsically Safe (IS) radios are certified by a third party to be safe to use in particular hazardous locations.

Tait Orca 5000 IS portable radios can be identified by one or more of the following:

■ Yellow labels

■ IS circle logo



■ FM diamond logo

A radio with any of these features must only be serviced by an agency certified by both the approval authority and Tait Electronics Ltd. Any unauthorised repair or substitution of parts invalidates the intrinsic safety rating and the third party IS approval.

## IS PCB servicing requirements

Tait Orca 5000 IS portable radios must be returned to an authorised Tait branch or subsidiary for servicing. Any unauthorised repair or substitution of parts invalidates the intrinsic safety rating.

## FM approval

Tait Orca 5000 IS portable radios and accessories are approved by Factory Mutual Corporation (FM) to the following ratings:

■ IS/I/1/CD/T3C Ta=40°C

■ NI/I/2/ABCD/T3C Ta=40°C

See Table A-3 on page A-12 for more detail on these ratings.

## FM approved products

Radios with the following product code have FM IS approval:

■ TOP-x24x0-B2

■ TOP-x24x0-T2

■ TOP-x25x0-B2

■ TOP-x25x0-T2

■ TOP-x26x0-B2

■ TOP-x26x0-T2

For more information about the Tait Orca product code, refer to page page A-5.

## FM approved accessories

The following accessories are approved for use with the Tait Orca 5000 IS portable radios.

■ TOPB200-IF NiCd IS battery pack

■ TOPA-AA-003G rugged speaker-microphone

■ TOPA-AA-004G RF speaker-microphone

■ TOPA-AA-005 adapter (required for use with TOPA-AA-012/013)

■ TOPA-AA-012 heavy duty headset with noise cancelling microphone (over the head)

■ TOPA-AA-013 heavy duty headset with noise cancelling microphone (behind neck)

■ T952-051 rugged earphone kit (optional for use with TOPA-AA-003/004)

## TOPB200-IF IS battery pack

The shift life of the TOPB200-IF IS battery pack may be reduced by up to 10 percent when compared to its non-IS equivalent.

The battery pack should not be charged in a hazardous location.

Table A-3: FM ratings

<b>Approval</b>	<b>Class</b>	<b>Division</b>	<b>Group</b>	<b>Temperature Rating</b>
Intrinsically Safe: The unit is unable to cause ignition under normal or abnormal operating conditions.	Class I: Gas or petroleum type environment.	Division 1: Hazardous mixtures are normally present.	Groups C & D: Ethylene and propane gases.	T3C: 160°C
Incentive: The unit is unable to cause ignition under normal operating conditions.	Class I: Gas or petroleum type environment.	Division 2: Hazardous mixtures are present abnormally.	Groups A, B, C & D: Acetylene, hydrogen, ethylene and propane gases.	T3C: 160°C

# PART **B** Radio specifications and circuit descriptions

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

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# Radio specifications

Tables B-1, B-2 and B-3 show information common to all the radios. For detailed information on each band, refer to the performance figures outlined in Tables B-4 to B-11.

The performance figures 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.

## Important notes for Tables B-4 to B-11

With regard to the typical performance figures, specifications are subject to change without notice and shall not form part of any contract. They are issued for guidance purposes only. For further information please check with your nearest Tait office or authorised dealer who can confirm that the radio meets applicable regulatory requirements.

\* Tait Orca products have an intermediate (universal) IF bandwidth and can be programmed per channel for 2.5, 4.0 or 5.0 kHz deviation to cover any channel spacing. See “Universal band versus wideband IF filtering” on page B-15.

† TOPB600 batteries are recommended for use with conventional radios (Orca 501x/2x) only.

Table B-1: General specifications

Parameter	Performance
Supply voltage	6.0 to 9.0 V
Standard test voltage	7.5 V

Table B-2: Receiver performance

Parameter	Performance
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 (relative to 1 kHz), 300-2550 Hz (narrowband) 300-3000 Hz (wideband)
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
RSSI	
range	-120 to -40 dBm
slope	29 mV/dB (typical)

Table B-3: Transmitter performance

Parameter	Performance
Duty cycle	20% (1 minute Tx, 4 minutes Rx at maximum temperature and voltage)
Group delay variation bandwidth	$\pm 50 \mu\text{s}$ (at mod audio output) 300-3000 Hz
Trunking data deviation (as per MPT1327)	
narrowband	1.5 kHz
mediumband	2.4 kHz
wideband	3 kHz
Audio response	
below limiting	6 dB/oct +1, -3 dB (relative to 1 kHz) 300-3000 Hz
in limiting	0 dB +0, -4 dB (relative to maximum system deviation) 450-2550 Hz
above 3 kHz	-35 dB/oct min
input for 60% deviation	5 mV <sub>rms</sub>
distortion	<5% at 1 kHz
Ruggedness	2 minutes (into infinite VSWR)
Stability	5:1 VSWR (all phase angles, <60 dBc)



Table B-4: TOP-Axxxx 66-88MHz radio specifications

<b>General</b>	<b>Orca 501x/2x</b>	<b>Orca 503x/40</b>	
Frequency Range	66-88MHz		
Channel Spacing	12.5 / 20 / 25 kHz		
Frequency Increments	5 or 6.25kHz		
IF Bandwidth	Universal Bandwidth (UB) 10kHz*		
Frequency Stability	+/-15ppm (-20 to -10°C); +/-10ppm (-10 to +60°C)		
Current Consumption (Receiver Squelched)	80mA	100mA	
Current Consumption (Standby with high economy duty cycle)	40mA	N/A	
Current Consumption (Receiver Rated Audio)	300mA		
Transmitter current (Low/High power)	800mA/ 1.6A		
Size, incl. 1500mAh NiMH battery (WxHxD)	66 x 154 x 41mm		
<b>Weight</b>	<b>Orca 5010/11/30</b>	<b>Orca 5035</b>	<b>Orca 5015/2x/40</b>
With TOPB600 1100mAh NiCd†	490g	510g	515g
With TOPB200 1500mAh NiCd	525g	545g	550g
With TOPB700 1500mAh NiMH	510g	530g	535g
With TOPB500 2000mAh NiMH	550g	570g	575g
<b>Receiver</b>			
Measurements as per:	ETS 300-086		
Intermediate frequencies	21.4MHz and 455kHz		
Sensitivity 12dB SINAD	< -119dBm		
Sensitivity 20dB SINAD	< -114dBm		
Fixed Squelch Sensitivity	12dB SINAD or 16dB SINAD Nominal		
Selectivity	70dB (NB), 75dB (WB)*		
Spurious Response	70dB		
Intermodulation	65dB		
Blocking	94dB		
Ultimate Signal to Noise Ratio (EIA)	39dB (NB), 44dB (WB)*		
Audio Response (300 Hz - 2.55 kHz)	Within +1 / -3dB of 6dB / Octave De-emphasis		
Distortion (EIA)	<5% @ 1kHz, 60% Deviation		
Rated Audio Output	> 500mW nominal		
<b>Transmitter</b>			
Measurements as per:	ETS 300-086		
Power Output (Low/Mid/High)	1 / 2.5 / 5W		
Spurious Emissions (Cond. & Rad.)	< -36dBm (0-1GHz), < -30dBm (1-4GHz)		
Hum and Noise (EIA)	38dB (NB), 43dB (WB)*		
Modulation Type* narrowband	10K0F3E		
wideband	16K0F3E		
Deviation Limiting	Adjustable up to +/- 5kHz		
Audio Response (300 Hz - 2.55 kHz)	Within +1 / -3dB of 6dB / Octave Pre-emphasis		
Distortion (EIA)	<5% @ 1kHz, 60% Deviation		

\*, † See "Important notes for Tables B-4 to B-11" on page B-3.

Table B-5: TOP-Bxxx 136-174MHz radio specifications

General	Orca 501x/2x	Orca 503x/40	
Frequency Range	136-174MHz		
Channel Spacing	12.5 / 20 / 25 kHz		
Frequency Increments	5 or 6.25kHz		
IF Bandwidth	Universal Bandwidth (UB) 10kHz*		
Frequency Stability	+/-2.5ppm (-30 to +60°C)		
Current Consumption (Receiver Squelched)	80mA	100mA	
Current Consumption (Standby with high economy duty cycle)	40mA	N/A	
Current Consumption (Receiver Rated Audio)	300mA		
Transmitter current (Low/High power)	810mA/1.6A		
Size, incl. 1500mAh NiMH battery (WxHxD)	66 x 154 x 41mm		
Weight	Orca 5010/11/30	Orca 5035	Orca 5015/2x/40
With TOPB600 1100mAh NiCd†	490g	510g	515g
With TOPB200 1500mAh NiCd	525g	545g	550g
With TOPB700 1500mAh NiMH	510g	530g	535g
With TOPB500 2000mAh NiMH	550g	570g	575g
Receiver			
Measurements as per:	ETS 300-086		
Intermediate frequencies	21.4MHz and 455kHz		
Sensitivity 12dB SINAD	< -119dBm		
Sensitivity 20dB SINAD	< -114dBm		
Fixed Squelch Sensitivity	12dB SINAD or 16dB SINAD Nominal		
Selectivity	70dB (NB), 75dB (WB)*		
Spurious Response	70dB		
Intermodulation	65dB		
Blocking	94dB		
Ultimate Signal to Noise Ratio (EIA)	37dB (NB), 42dB (WB)*		
Audio Response (300 Hz - 2.55 kHz)	Within +1 / -3dB of 6dB / Octave De-emphasis		
Distortion (EIA)	<5% @ 1kHz, 60% Deviation		
Rated Audio Output	> 500mW nominal		
Transmitter			
Measurements as per:	ETS 300-086		
Power Output (Low/Mid/High)	1 / 2.5 / 5W		
Spurious Emissions (Cond. & Rad.)	< -36dBm (0-1GHz), < -30dBm (1-4GHz)		
Hum and Noise (EIA)	36dB (NB), 42dB (WB)*		
Modulation Type* narrowband	10K0F3E		
wideband	16K0F3E		
Deviation Limiting	Adjustable up to +/- 5kHz		
Audio Response (300 Hz - 2.55 kHz)	Within +1 / -3dB of 6dB / Octave Pre-emphasis		
Distortion (EIA)	<5% @ 1kHz, 60% Deviation		

\*, † See "Important notes for Tables B-4 to B-11" on page B-3.

Table B-6: TOP-Cxxxx 174-225MHz radio specifications

<b>General</b>	<b>Orca 501x/2x</b>	<b>Orca 503x/40</b>	
Frequency Range	174-225MHz		
Channel Spacing	12.5 / 20 / 25 kHz		
Frequency Increments	5 or 6.25kHz		
IF Bandwidth	Universal Bandwidth (UB) 10kHz*		
Frequency Stability	+/-2.5ppm (-30 to +60°C)		
Current Consumption (Receiver Squelched)	80mA	100mA	
Current Consumption (Standby with high economy duty cycle)	40mA	N/A	
Current Consumption (Receiver Rated Audio)	300mA		
Transmitter current (Low/High power)	800mA/ 1.5A		
Size, incl. 1500mAh NiMH battery (WxHxD)	66 x 154 x 41mm		
<b>Weight</b>	<b>Orca 5010/11/30</b>	<b>Orca 5035</b>	<b>Orca 5015/2x/40</b>
With TOPB600 1100mAh NiCd†	490g	510g	515g
With TOPB200 1500mAh NiCd	525g	545g	550g
With TOPB700 1500mAh NiMH	510g	530g	535g
With TOPB500 2000mAh NiMH	550g	570g	575g
<b>Receiver</b>			
Measurements as per:	ETS 300-086		
Intermediate frequencies	21.4MHz and 455kHz		
Sensitivity 12dB SINAD	< -119dBm		
Sensitivity 20dB SINAD	< -114dBm		
Fixed Squelch Sensitivity	12dB SINAD or 16dB SINAD Nominal		
Selectivity	70dB (NB), 75dB (WB)*		
Spurious Response	70dB		
Intermodulation	65dB		
Blocking	94dB		
Ultimate Signal to Noise Ratio (EIA)	37dB (NB), 42dB (WB)*		
Audio Response (300 Hz - 2.55 kHz)	Within +1 / -3dB of 6dB / Octave De-emphasis		
Distortion (EIA)	<5% @ 1kHz, 60% Deviation		
Rated Audio Output	> 500mW nominal		
<b>Transmitter</b>			
Measurements as per:	ETS 300-086		
Power Output (Low/Mid/High)	1 / 2.5 / 4W		
Spurious Emissions (Cond. & Rad.)	< -36dBm (0-1GHz), < -30dBm (1-4GHz)		
Hum and Noise (EIA)	36dB (NB), 42dB (WB)*		
Modulation Type* narrowband	10K0F3E		
wideband	16K0F3E		
Deviation Limiting	Adjustable up to +/- 5kHz		
Audio Response (300 Hz - 2.55 kHz)	Within +1 / -3dB of 6dB / Octave Pre-emphasis		
Distortion (EIA)	<5% @ 1kHz, 60% Deviation		

\*, † See "Important notes for Tables B-4 to B-11" on page B-3.

Table B-7: TOP-Gxxx 336-400MHz radio specifications

General	Orca 501x/2x	Orca 503x/40	
Frequency Range	336-400MHz		
Channel Spacing	12.5 / 20 / 25 kHz		
Frequency Increments	5 or 6.25kHz		
IF Bandwidth	Universal Bandwidth (UB) 10kHz*		
Frequency Stability	+/-2.5ppm (-30 to +60°C)		
Current Consumption (Receiver Squelched)	85mA	100mA	
Current Consumption (Standby with high economy duty cycle)	40mA	N/A	
Current Consumption (Receiver Rated Audio)	300mA		
Transmitter current (Low/High power)	900mA/1.7A		
Size, incl. 1500mAh NiMH battery (WxHxD)	66 x 154 x 41mm		
Weight	Orca 5010/11/30	Orca 5035	Orca 5015/2x/40
With TOPB600 1100mAh NiCd†	490g	510g	515g
With TOPB200 1500mAh NiCd	525g	545g	550g
With TOPB700 1500mAh NiMH	510g	530g	535g
With TOPB500 2000mAh NiMH	550g	570g	575g
Receiver			
Measurements as per:	ETS 300-086		
Intermediate frequencies	45.1MHz and 455kHz		
Sensitivity 12dB SINAD	< -119dBm		
Sensitivity 20dB SINAD	< -114dBm		
Fixed Squelch Sensitivity	12dB SINAD or 16dB SINAD Nominal		
Selectivity	66dB (NB), 72dB (WB)*		
Spurious Response	70dB		
Intermodulation	65dB		
Blocking	94dB		
Ultimate Signal to Noise Ratio (EIA)	36dB (NB), 42dB (WB)*		
Audio Response (300 Hz - 2.55 kHz)	Within +1 / -3dB of 6dB / Octave De-emphasis		
Distortion (EIA)	<5% @ 1kHz, 60% Deviation		
Rated Audio Output	> 500mW nominal		
Transmitter			
Measurements as per:	ETS 300-086		
Power Output (Low/Mid/High)	1 / 2.5 / 4W		
Adjacent Channel Power	65dB (NB), 75dB (WB)*		
Spurious Emissions (Cond. & Rad.)	< -36dBm (0-1GHz), < -30dBm (1-4GHz)		
Hum and Noise (EIA)	37dB (NB), 43dB (WB)*		
Modulation Type* narrowband	10K0F3E		
wideband	16K0F3E		
Deviation Limiting	Adjustable up to +/- 5kHz		
Audio Response (300 Hz - 2.55 kHz)	Within +1 / -3dB of 6dB / Octave Pre-emphasis		
Distortion (EIA)	<5% @ 1kHz, 60% Deviation		

\*, † See "Important notes for Tables B-4 to B-11" on page B-3.

Table B-8: TOP-Hxxxx 400-470MHz radio specifications

<b>General</b>	<b>Orca 501x/2x</b>	<b>Orca 503x/40</b>	
Frequency Range	400-470MHz		
Channel Spacing	12.5 / 20 / 25 kHz		
Frequency Increments	5 or 6.25kHz		
IF Bandwidth	Universal Bandwidth (UB) 10kHz*		
Frequency Stability	+/-2.5ppm (-30 to +60°C)		
Current Consumption (Receiver Squelched)	80mA	100mA	
Current Consumption (Standby with high economy duty cycle)	40mA	N/A	
Current Consumption (Receiver Rated Audio)	300mA		
Transmitter current (Low/High power)	780mA/ 1.5A		
Size, incl. 1500mAh NiMH battery (WxHxD)	66 x 154 x 41mm		
<b>Weight</b>	<b>Orca 5010/11/30</b>	<b>Orca 5035</b>	<b>Orca 5015/2x/40</b>
With TOPB600 1100mAh NiCd†	490g	510g	515g
With TOPB200 1500mAh NiCd	525g	545g	550g
With TOPB700 1500mAh NiMH	510g	530g	535g
With TOPB500 2000mAh NiMH	550g	570g	575g
<b>Receiver</b>			
Measurements as per:	ETS 300-086		
Intermediate Frequencies	45.1MHz and 455kHz		
Sensitivity 12dB SINAD	< -119dBm		
Sensitivity 20dB SINAD	< -114dBm		
Fixed Squelch Sensitivity	12dB SINAD or 16dB SINAD Nominal		
Selectivity	66dB (NB), 72dB (WB)*		
Spurious Response	70dB		
Intermodulation	65dB		
Blocking	94dB		
Ultimate Signal to Noise Ratio (EIA)	34dB (NB), 40dB (WB)*		
Audio Response (300 Hz - 2.55 kHz)	Within +1 / -3dB of 6dB / Octave De-emphasis		
Distortion (EIA)	<5% @ 1kHz, 60% Deviation		
Rated Audio Output	> 500mW nominal		
<b>Transmitter</b>			
Measurements as per:	ETS 300-086		
Power Output (Low/Mid/High)	1 / 2.5 / 4W		
Spurious Emissions (Cond. & Rad.)	< -36dBm (0-1GHz), < -30dBm (1-4GHz)		
Hum and Noise (EIA)	35dB (NB), 41dB (WB)*		
Modulation Type* narrowband	10K0F3E		
wideband	16K0F3E		
Deviation Limiting	Adjustable up to +/- 5kHz		
Audio Response (300 Hz - 2.55 kHz)	Within +1 / -3dB of 6dB / Octave Pre-emphasis		
Distortion (EIA)	<5% @ 1kHz, 60% Deviation		

\*, † See "Important notes for Tables B-4 to B-11" on page B-3.

Table B-9: TOP-Ixxxx 450-530MHz radio specifications

General	Orca 501x/2x	Orca 503x/40	
Frequency Range	450-530MHz		
Channel Spacing	12.5 / 20 / 25 kHz		
Frequency Increments	5 or 6.25kHz		
IF Bandwidth	Universal Bandwidth (UB) 10kHz*		
Frequency Stability	+/-2.5ppm (-30 to +60°C)		
Current Consumption (Receiver Squelched)	80mA	100mA	
Current Consumption (Standby with high economy duty cycle)	40mA	N/A	
Current Consumption (Receiver Rated Audio)	300mA		
Transmitter current (Low/High power)	870mA/1.7A		
Size, incl. 1500mAh NiMH battery (WxHxD)	66 x 154 x 41mm		
Weight	Orca 5010/11/30	Orca 5035	Orca 5015/2x/40
With TOPB600 1100mAh NiCd†	490g	510g	515g
With TOPB200 1500mAh NiCd	525g	545g	550g
With TOPB700 1500mAh NiMH	510g	530g	535g
With TOPB500 2000mAh NiMH	550g	570g	575g
Receiver			
Measurements as per:	ETS 300-086		
Intermediate frequencies	45.1MHz and 455kHz		
Sensitivity 12dB SINAD	< -119dBm		
Sensitivity 20dB SINAD	< -114dBm		
Fixed Squelch Sensitivity	12dB SINAD or 16dB SINAD Nominal		
Selectivity	66dB (NB), 72dB (WB)*		
Spurious Response	70dB		
Intermodulation	65dB		
Blocking	94dB		
Ultimate Signal to Noise Ratio (EIA)	34dB (NB), 40dB (WB)*		
Audio Response (300 Hz - 2.55 kHz)	Within +1 / -3dB of 6dB / Octave De-emphasis		
Distortion (EIA)	<5% @ 1kHz, 60% Deviation		
Rated Audio Output	> 500mW nominal		
Transmitter			
Measurements as per:	ETS 300-086		
Power Output (Low/Mid/High)	1 / 2.5 / 4W		
Spurious Emissions (Cond. & Rad.)	< -36dBm (0-1GHz), < -30dBm (1-4GHz)		
Hum and Noise (EIA)	34dB (NB), 40dB (WB)*		
Modulation Type* narrowband	10K0F3E		
wideband	16K0F3E		
Deviation Limiting	Adjustable up to +/- 5kHz		
Audio Response (300 Hz - 2.55 kHz)	Within +1 / -3dB of 6dB / Octave Pre-emphasis		
Distortion	<5% @ 1kHz, 60% Deviation		

\*, † See "Important notes for Tables B-4 to B-11" on page B-3.

Table B-10: TOP-Jxxx 806-870MHz radio specifications

General	Orca 501x/2x	Orca 503x/40	
Frequency Range	806-870MHz Transmit 851-870MHz Receive		
Channel Spacing	12.5 / 20 / 25 kHz		
Frequency Increments	5 or 6.25kHz		
IF Bandwidth	Universal Bandwidth (UB) 10kHz*		
Frequency Stability	+/-1.5ppm (-30 to +60°C)		
Current Consumption (Receiver Squelched)	85 mA	100mA	
Current Consumption (Standby with high economy duty cycle)	40 mA	N/A	
Current Consumption (Receiver Rated Audio)	300mA		
Transmitter current (Low/High power)	780mA/1.3A		
Size, incl. 1500mAh NiMH battery (WxHxD)	66 x 154 x 41mm		
Weight	Orca 5010/11/30	Orca 5035	Orca 5015/2x/40
With TOPB600 1100mAh NiCd†	490g	510g	515g
With TOPB200 1500mAh NiCd	525g	545g	550g
With TOPB700 1500mAh NiMH	510g	530g	535g
With TOPB500 2000mAh NiMH	550g	570g	575g
Receiver			
Measurements as per:	EIA		
Intermediate frequencies	45.1MHz and 455kHz		
Sensitivity 12dB SINAD	< 0.25µV (-119dBm)		
Sensitivity 20dB SINAD	< 0.40 µV (-114dBm)		
Fixed Squelch Sensitivity	12dB SINAD or 16dB SINAD Nominal		
Selectivity	60dB (NB), 65dB (WB)*		
Spurious Response	65dB		
Intermodulation	65dB		
Hum and Noise	32dB (NB), 38dB (WB)*		
Audio Response (300 Hz - 2.55 kHz)	Within +1 / -3dB of 6dB / Octave De-emphasis		
Rated Audio Output	> 500mW nominal		
Transmitter			
Measurements as per:	EIA		
Power Output (Low/Mid/High)	1 / 2 / 3W		
Spurious Emissions (Cond. & Rad.)	- 65dB		
Hum and Noise	38dB (NB), 42dB (WB)*		
Modulation Type* narrowband	10K0F3E		
wideband	16K0F3E		
Deviation Limiting	Adjustable up to +/- 5kHz		
Audio Response (300 Hz - 2.55 kHz)	Within +1 / -3dB of 6dB / Octave Pre-emphasis		
Distortion	<5% @ 1kHz, 60% Deviation		

\* , † See "Important notes for Tables B-4 to B-11" on page B-3.

Table B-11: TOP-Kxxx 896-941MHz radio specifications

General	Orca 501x/2x	Orca 503x/40	
Frequency Range	896-941MHz Transmit 935-941MHz Receive		
Channel Spacing	12.5 / 20 / 25 kHz		
Frequency Increments	5 or 6.25kHz		
IF Bandwidth	Universal Bandwidth (UB) 10kHz*		
Frequency Stability	+/-1.5ppm (-30 to +60°C)		
Current Consumption (Receiver Squelched)	85 mA	100mA	
Current Consumption (Standby with high economy duty cycle)	40 mA	N/A	
Current Consumption (Receiver Rated Audio)	300mA		
Transmitter current (Low/High power)	750mA/1.3A		
Size, incl. 1500mAh NiMH battery (WxHxD)	66 x 154 x 41mm		
Weight	Orca 5010/11/30	Orca 5035	Orca 5015/2x/40
With TOPB600 1100mAh NiCd†	490g	510g	515g
With TOPB200 1500mAh NiCd	525g	545g	550g
With TOPB700 1500mAh NiMH	510g	530g	535g
With TOPB500 2000mAh NiMH	550g	570g	575g
Receiver			
Measurements as per:	EIA		
Intermediate frequencies	45.1MHz and 455kHz		
Sensitivity 12dB SINAD	<0.25µV (-119dBm)		
Sensitivity 20dB SINAD	<0.40µV (-114dBm)		
Fixed Squelch Sensitivity	12dB SINAD or 16dB SINAD Nominal		
Selectivity	60dB (NB), 65dB (WB)*		
Spurious Response	60dB		
Intermodulation	65dB		
Hum and Noise	32dB (NB), 38dB (WB)*		
Audio Response (300 Hz - 2.55 kHz)	Within +1 / -3dB of 6dB / Octave De-emphasis		
Rated Audio Output	> 500mW nominal		
Transmitter			
Measurements as per:	EIA		
Power Output (Low/Mid/High)	1 / 2 / 3W		
Spurious Emissions (Cond. & Rad.)	-65dB		
Hum and Noise	38dB (NB), 42dB (WB)*		
Modulation Type* narrowband	10K0F3E		
wideband	16K0F3E		
Deviation Limiting	Adjustable up to +/- 5kHz		
Audio Response (300 Hz - 2.55 kHz)	Within +1 / -3dB of 6dB / Octave Pre-emphasis		
Distortion	<5% @ 1kHz, 60% Deviation		

\*, † See "Important notes for Tables B-4 to B-11" on page B-3.



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# Circuit descriptions

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Circuit interface diagrams for the Tait Orca portable radios are shown in Figure A-1 (TOP B, C, G, H, I, J and K) and Figure A-2 (TOP A only).

The Tait Orca portable radio has been designed to be totally electronically tuned using the *Calibration Application*. 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 Application online help or 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 (3W 800/900 MHz, 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 pass 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 (programmable as **city** or **country** for each channel), which is set up by the microprocessor. The squelch level 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).

## 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 demodulator IC (RX-DET-AF) is also available at the accessory connector.

## DSP

All signalling, such as Selcall, CTCSS, DCS, G-STAR, DTMF and FFSK, and all confidence tones are generated by the DSP. However, only Selcall, CTCSS, FFSK and Two-tone are decoded 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 a 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 a current limiter.

### +7V5-SW

The +7V5-SW switched supply is an 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 +4V3-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: Accessories*.

### **Universal band versus wideband IF filtering**

The IF filtering for the universal band is designed in such a way that it functionally meets specifications for both narrowband and wideband systems.

The Deviation and Receive Audio Processing are selectable per channel, which enables the radio to inter-operate between narrowband and wideband channels.



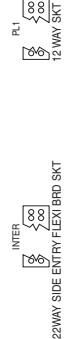
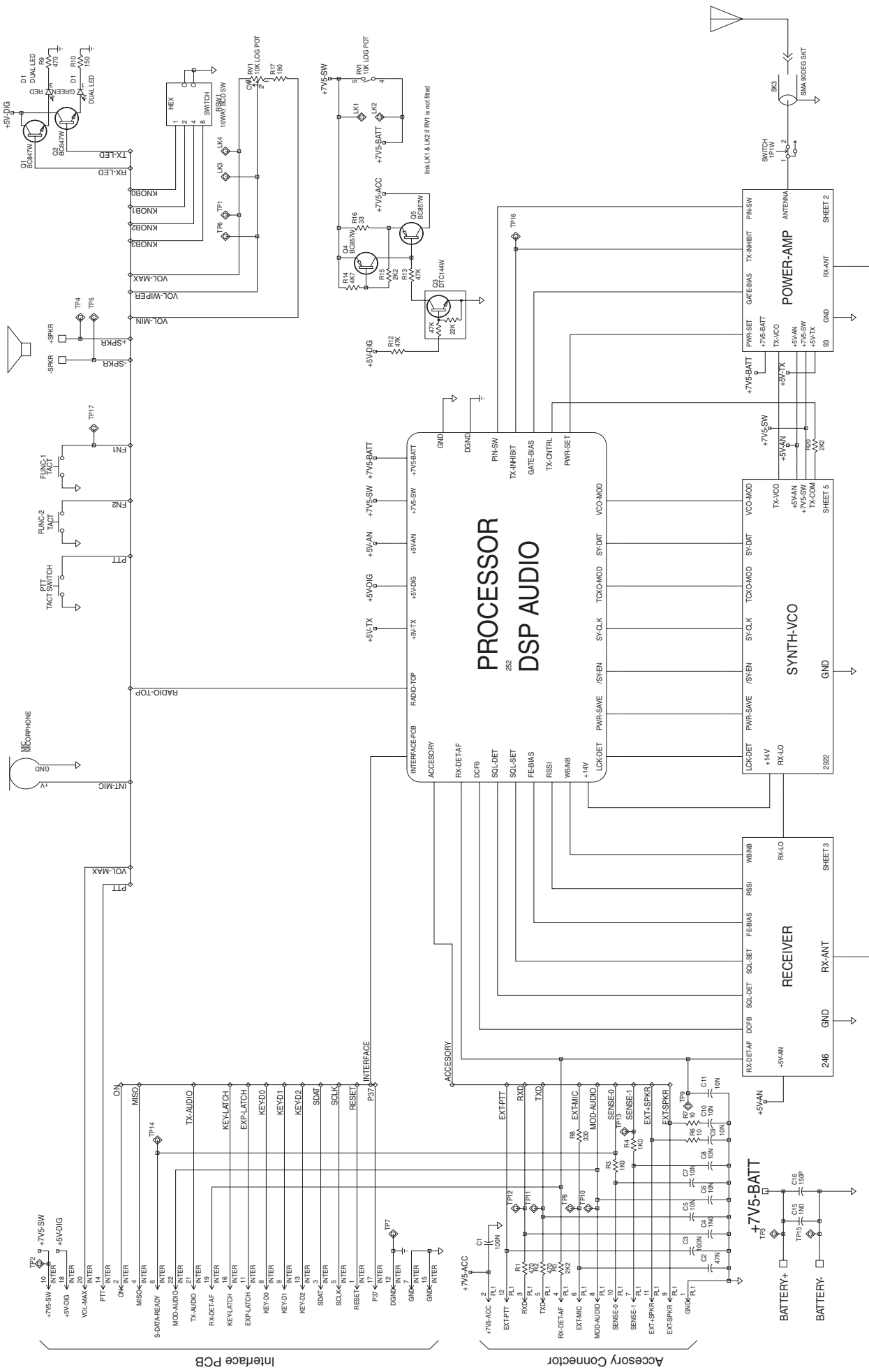


Figure B-1: Circuit interface diagram for Tait Orca portable radios (TOP B, C, G, H, I, J and K)



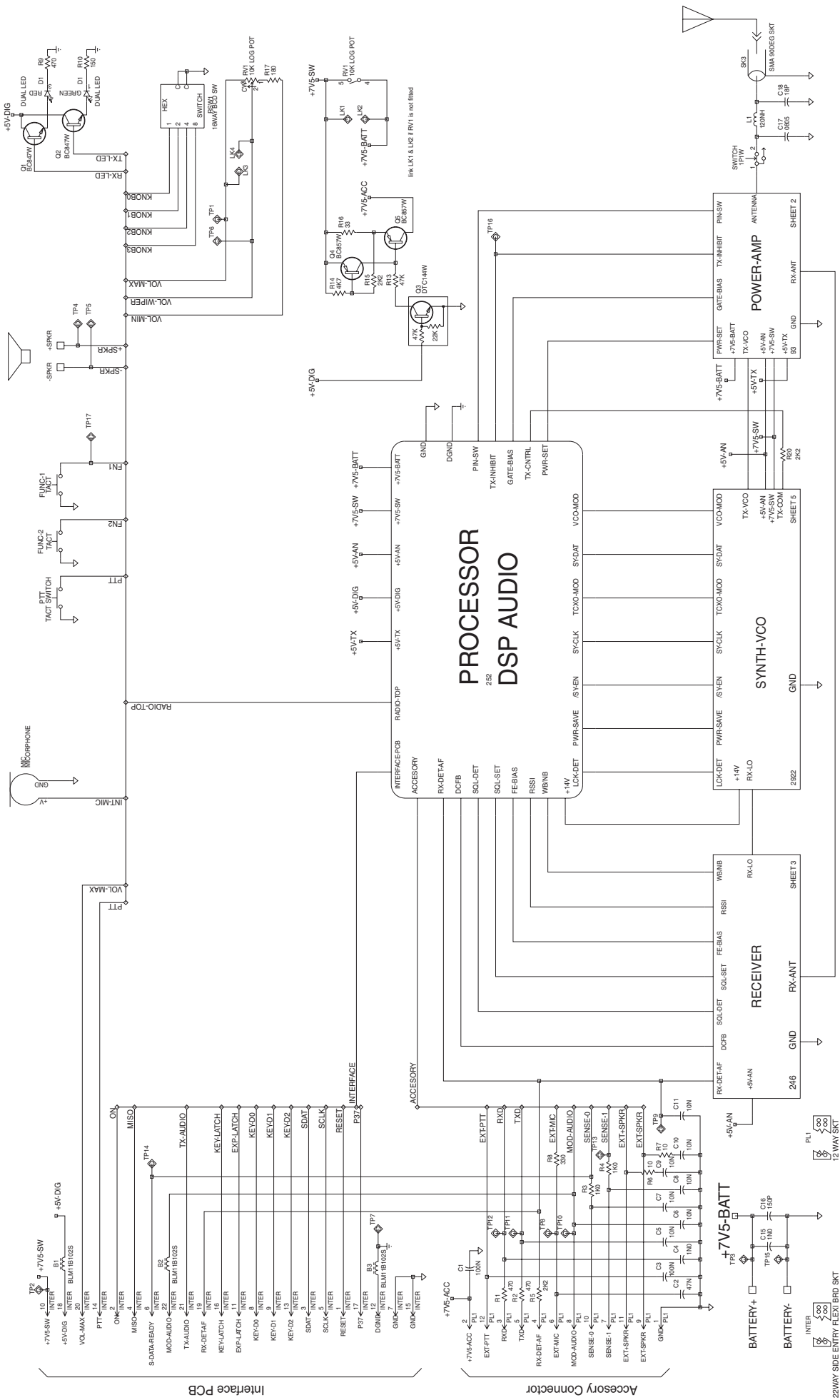


Figure B-2: Circuit interface diagram for Tait Orca portable radios (TOP A only)





# PART C Diagnostics and fault finding

This part provides information on diagnosing faults in Tait Orca 5000 portable radios.

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 5000 conventional or trunked radios.

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# Test facilities

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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 TOP calibration application; or
- using a terminal program.

See the *Tait Orca Calibration Application: User's Manual* or the program's online help 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**). A (-) appears. You can then begin sending test commands to the radio.

A full list of test commands is given in Table C-1. Table C-2 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. Allow 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
	Disable internal speaker	74	
	Enable internal speaker	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 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)
	Read DSP software version number	132	Returns: 4 digit number (hex)
	Read radio hardware version number	133	Returns: 4 digit number
	Read main database version	160	Returns: 4 digit number
	Read calibration database version	160	Returns: 4 digit number
	Read last system error	204	None
Synth	Load absolute synth frequency	101	ttttt T rrrrr R F (see Table C-2)
	Load synth reference divider	102	8 to 16383
	Load synth prescaler	103	0 = 64/65 1 = 128/129
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
	Select bottom microphone	138	None
	Select top microphone	139	None
	Disable both microphones	140	None
	Enable both microphones	141	None
	Set G-STAR modem to send zeros	150	None
	Set G-STAR modem to send ones	151	None
	Set G-STAR modem to send preamble	152	None
Send G-STAR message	153	None	
Set ANR on	170	None	
Set ANR off	171	None	
Set reciprocal gain	172	0 to 32767	

Table C-2: Calculating the parameters required for test command 101

**Calculating parameters for test command 101**

Enter the parameters in the format ttttt T rrrrr R F

- ttttt represents the transmit frequency  
See Example 1
- T and R represent channel spacing  
0 = 5 kHz  
1 = 6.25 kHz
- rrrrr 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 the calibrated values based on new frequencies

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

**Example 1: Calculating ttttt for an H band radio**

$$\begin{aligned}
 \text{ttttt} &= \frac{\text{transmit frequency (MHz)}}{\text{channel spacing (MHz)}} \\
 &= \frac{461.025 \text{ MHz}}{6.25 \text{ kHz}} \\
 &= \frac{461.025 \times 10^6 \text{ Hz}}{6.25 \times 10^3 \text{ Hz}} \\
 &= 73764
 \end{aligned}$$

**Example 2: Calculating rrrrr for an H band radio**

$$\begin{aligned}
 \text{rrrrr} &= \frac{\text{receive frequency (MHz)} - *IF \text{ (MHz)}}{\text{channel spacing (MHz)}} \\
 &= \frac{461.025 \text{ MHz} - 45.1 \text{ MHz}}{6.25 \text{ kHz}} \\
 &= \frac{415.925 \times 10^6 \text{ Hz}}{6.25 \times 10^3 \text{ Hz}} \\
 &= 66548
 \end{aligned}$$

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

- For A, B, C and D bands radios, the IF is 21.4 MHz.  
\*(For A band, add the IF (MHz) in the formula (radio uses high side injection).)
- For E, F, G, H, I, J and K band radios, the IF is 45.1 MHz.

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# Fault finding charts

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

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

They are:

- Radio cannot be switched on;
- Cannot change channel;
- No serial communication;
- Receive faults;
- Cannot transmit; and
- No transmit audio.



Figure C-1: Radio cannot be switched on

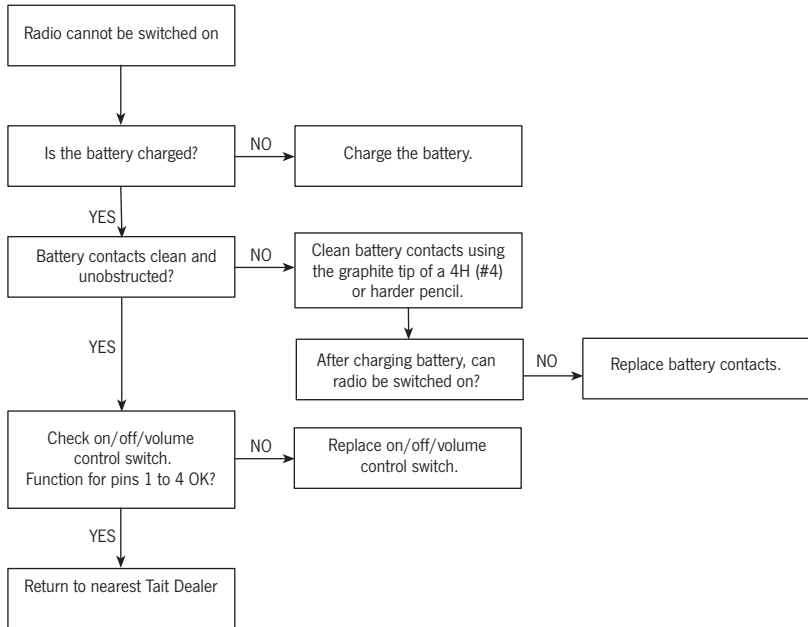


Figure C-2: Cannot change channel

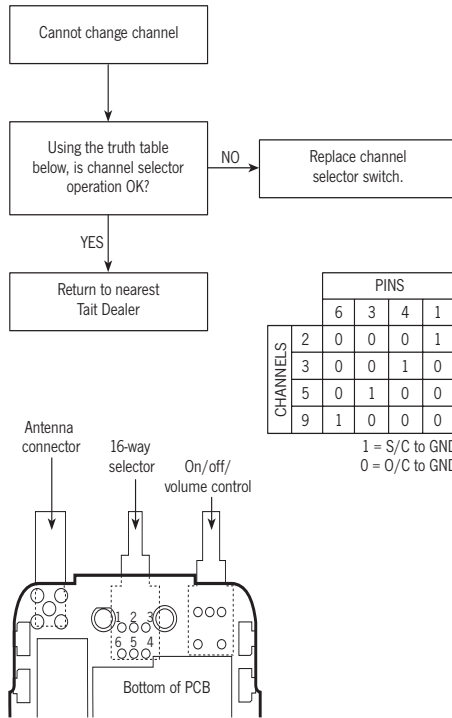


Figure C-3: No serial communication

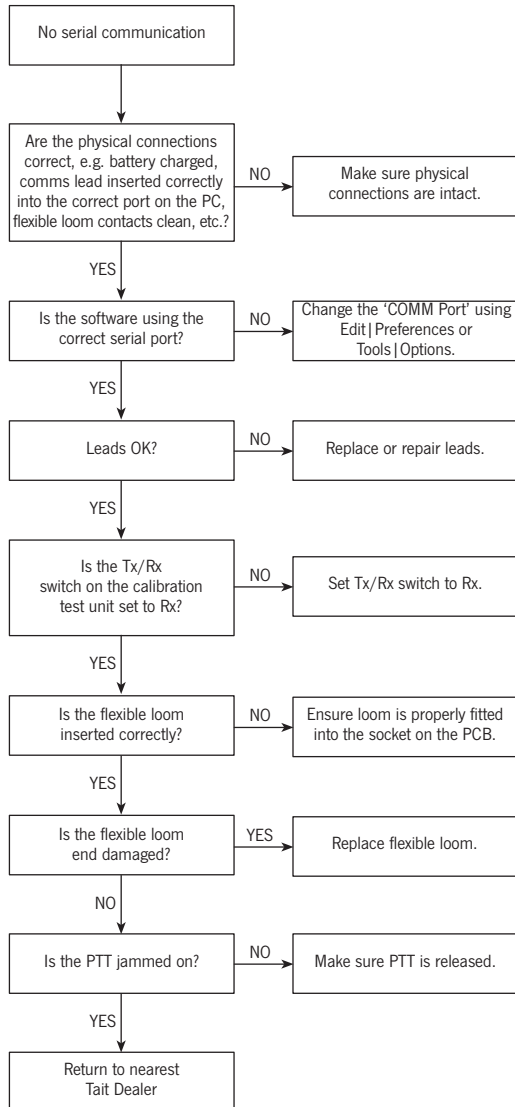


Figure C-4: Receive faults

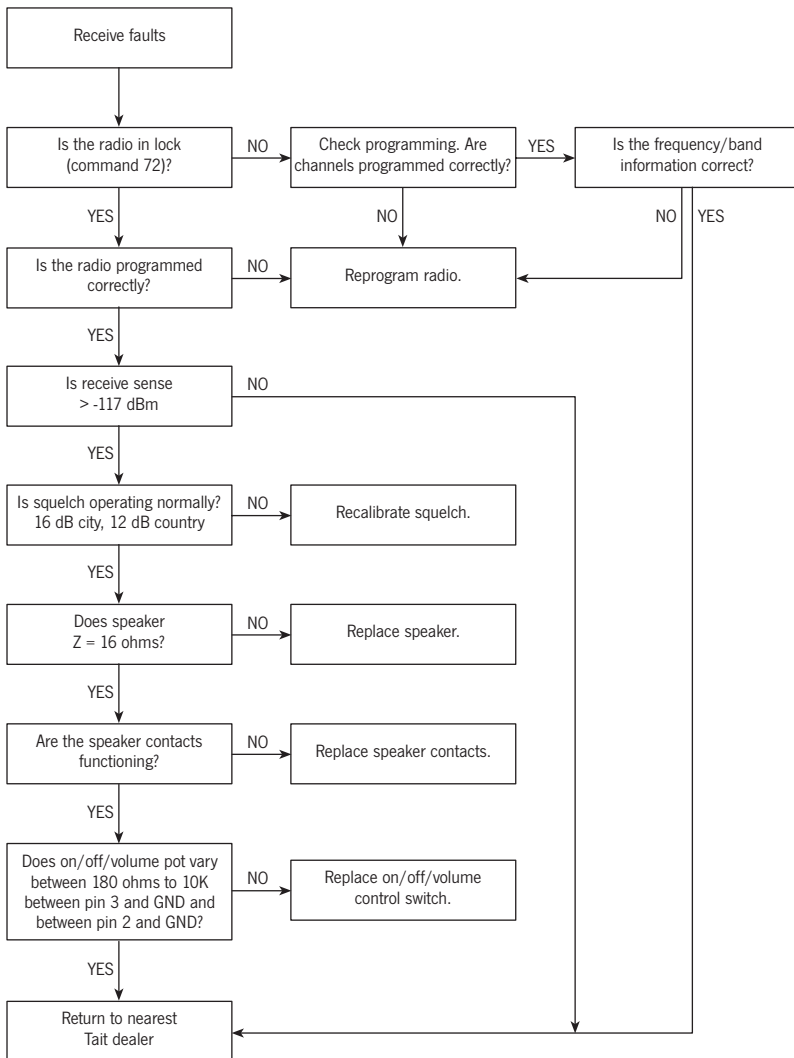


Figure C-5: Cannot transmit

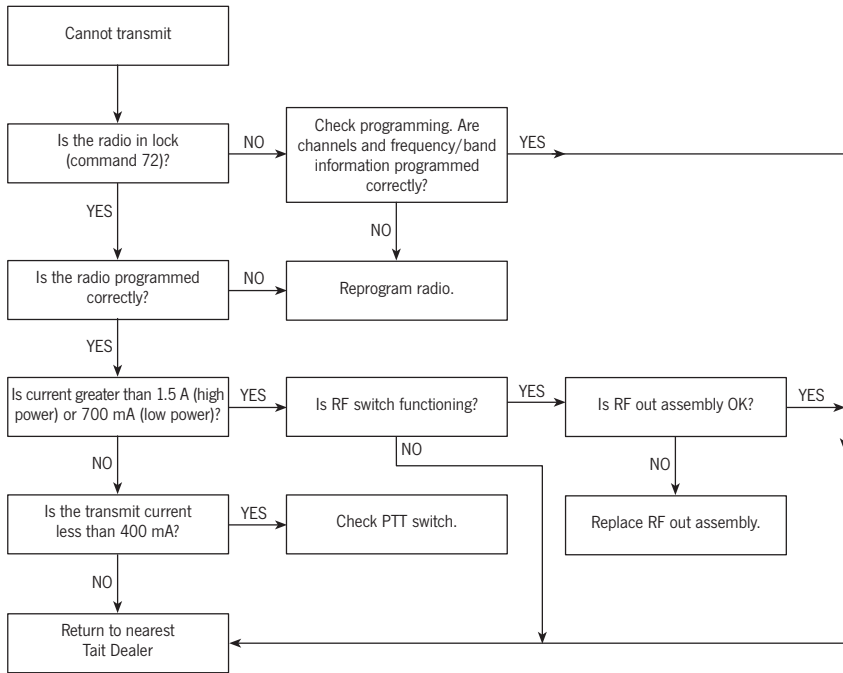
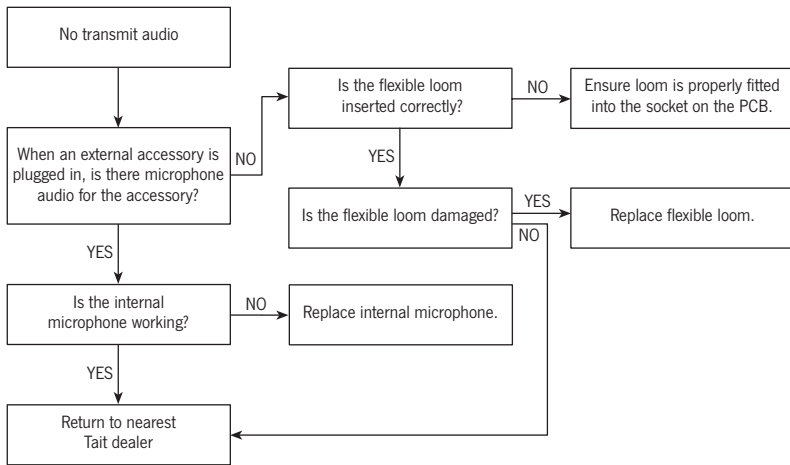


Figure C-6: No transmit audio



# PART **D** Servicing the radio

This part describes the disassembly and reassembly of Tait Orca 5000 portable radios and the servicing of some key mechanical and ancillary devices.

Information is also provided on ordering spare parts for servicing portable radios.

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Orca 5020/40 Re-skinning kit (TOPA-SP-406) ..... D-21

Orca 5015/2x/35/40 User Interface PCB and Shield (TOPA-SP-407) ..... D-22

Orca 5015/21 Re-skinning kit (TOPA-SP-408) ..... D-22



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# Servicing the radio

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Servicing of Tait Orca 5000 portable radios is limited to key mechanical and ancillary devices. These include:

- the front panel assembly;
- the lens (Orca 5015/2x/35/40);
- the PTT keypad;
- the speaker;
- the keypad (Orca 5015/2x/35/40);
- the LCD display (Orca 5015/2x/35/40);
- the shield, complete with user interface PCB assembly and polyester dome (Orca 5015/2x/35/40);
- the main PCB assembly;
- the antenna connector;
- the channel selector switch;
- the volume control switch;
- the microphone;
- the speaker contacts;
- the battery contacts;
- the PTT tact switch;
- the RF out assembly
- the auxiliary flexible PCB
- the rear panel; and
- the chassis.

A list of spares kits available for servicing Tait Orca 5000 portable radios is shown in Table D-1 on page D-17. These spares can be ordered from your local Tait dealer.

## Screw head types

Most of the screws in Tait Orca 5000 portable radios are Torx head screws, and so a Torx T6 driver bit is supplied as part of the service kit. When removing screws be sure to use the correct driver.

Torx head 1.8x5 mm screws should be removed using the supplied Torx T6 driver. When replacing these screws, set the driver to 2in.lb (0.23Nm).

# Disassembling the radio

## Removing the front panel from the chassis

Unscrew the antenna and detach the battery pack.

The channel selector and on/off/volume control knobs need to be 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.

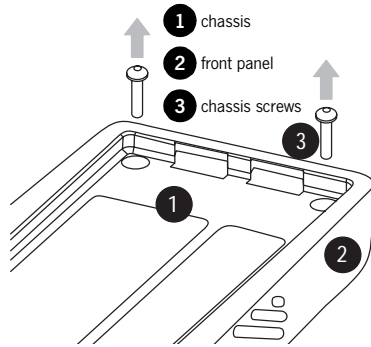
Some earlier Tait Orca 5000 portable radios have the knobs glued on. If so, the knob's metal insert will remain on the switch shaft. Remove the insert using a sharp scalpel blade.

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;
- the keypad; and
- the volume plate and volume keypad.

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.

Figure D-2: Removing the knobs

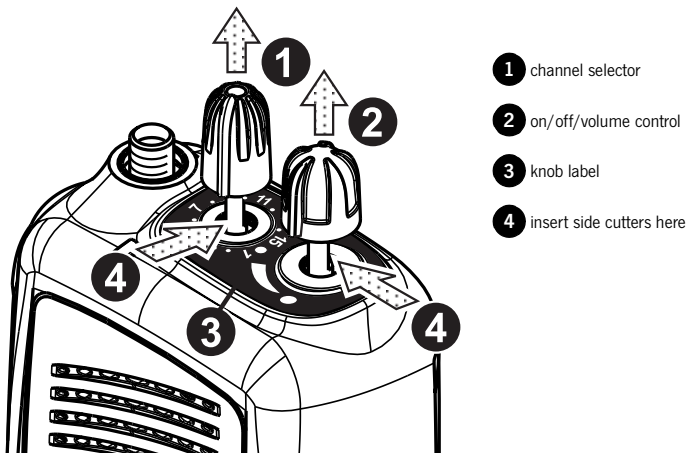
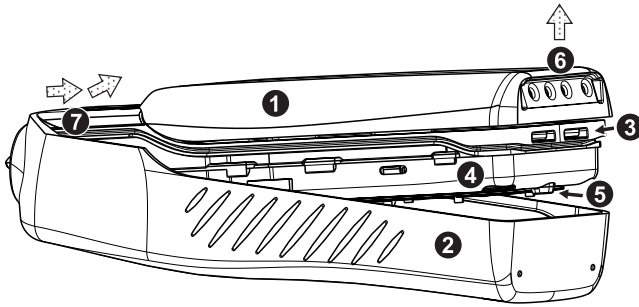


Figure D-3: Removing the front panel from the chassis, using the battery as leverage



- 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

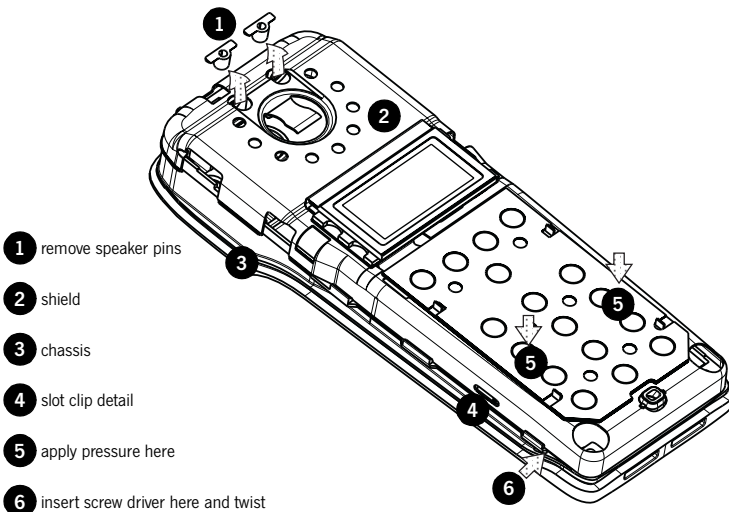
### Removing the shield sub-assembly from the chassis

Remove the plastic speaker pins. Place the radio's internal assembly on a flat surface with the shield side facing up toward you. Press lightly down on the shield sub-assembly 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 sub-assembly from the chassis



- 1 remove speaker pins
- 2 shield
- 3 chassis
- 4 slot clip detail
- 5 apply pressure here
- 6 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 5015, Orca 502x, Orca 5035 and Orca 5040 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 5015, Orca 502x, Orca 5035 and Orca 5040); and
- the shield, complete with user interface PCB assembly and polyester dome (Orca 5015, Orca 502x, Orca 5035 and Orca 5040).

At this point you can replace:

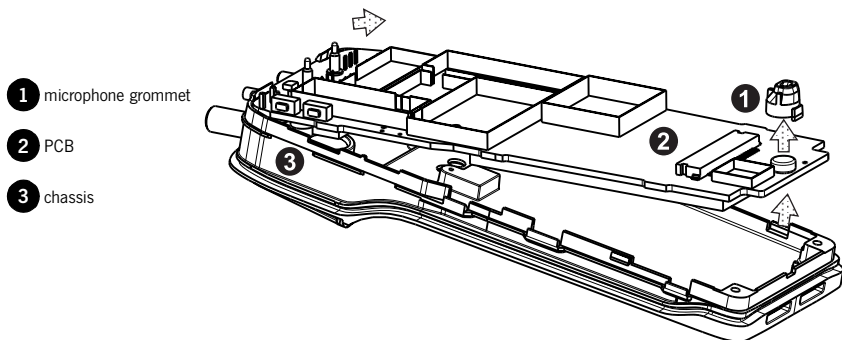
- the main PCB assembly;
- the antenna connector;
- the channel selector switch;
- the volume control switch;
- the microphone;
- the speaker contacts;
- the battery contacts;
- the PTT tact switch; and
- the RF out assembly.

## Removing the PCB from the chassis

Remove the knob seal, which covers the antenna connector, channel selector switch and volume control switch.

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.

Figure D-5: Removing the PCB from the chassis



## 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, 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.

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# Replacing key mechanical and ancillary devices

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This section describes the replacement of key mechanical and ancillary devices. These include:

- lens (Orca 5015/2x/35/40);
- PTT keypad;
- speaker;
- LCD display (Orca 5015/2x/35/40);
- shield, complete with user interface PCB and polyester dome;
- antenna connector;
- channel selector switch;
- volume control switch;
- microphone;
- speaker contacts;
- battery contacts;
- PTT tact switch; and
- chassis.

Note that instructions for replacing the RF out assembly and the auxiliary flexible PCB 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-14 to D-16.

## Replacing the lens (Orca 5015/2x/35/40)

You must disassemble the radio before gently prising 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.

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

Figure D-6: Replacing the lens



- 1 lens
- 2 front panel
- 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 central latch that holds the retaining plate in place. Discard the PTT retaining plate. Be careful not to lose the two pins that act as actuators for the function keys.

To install the new PTT retaining plate, insert the bottom tab into the hole at the bottom of the PTT recess. Bend the PTT retaining plate very slightly so that the top tab slots easily into

the hole at the top of the PTT recess. Be sure not to split or otherwise damage it.

## Replacing the speaker

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

Using a scalpel and a flat screw driver, carefully remove the speaker from the front panel. Clean with alcohol any remaining adhesive from the speaker seating. Replace the adhesive ring and secure a new speaker in place. Be sure to align the tabs.

## Replacing the LCD display (Orca 5015/2x/35/40)

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.

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-15 for detailed instructions).

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-16 for detailed instructions).

Figure D-7: Mounting the speaker in the front panel

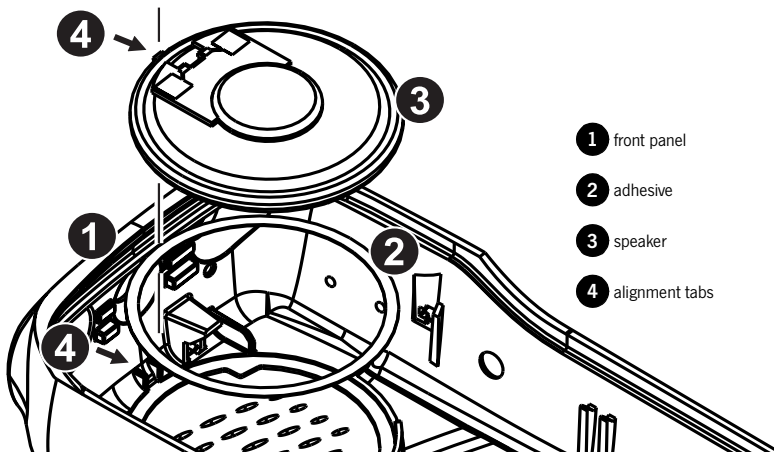
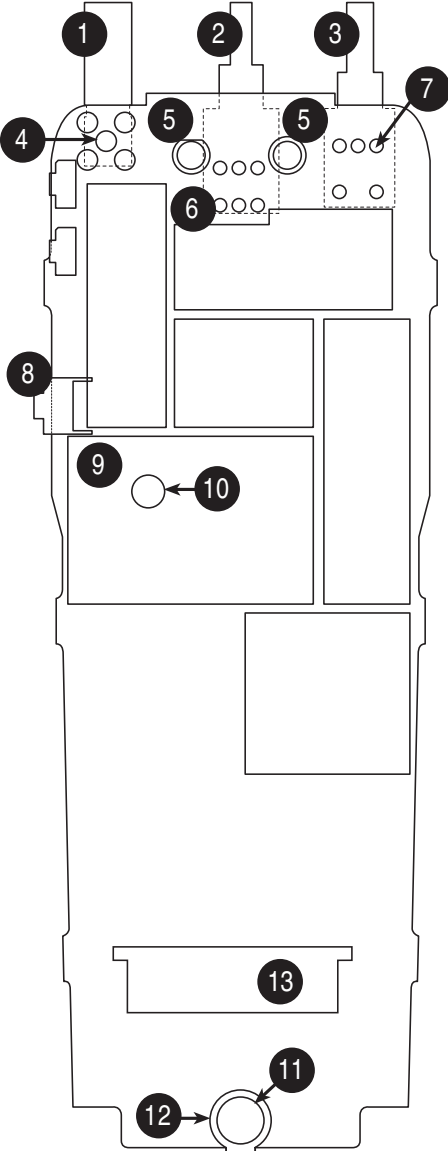


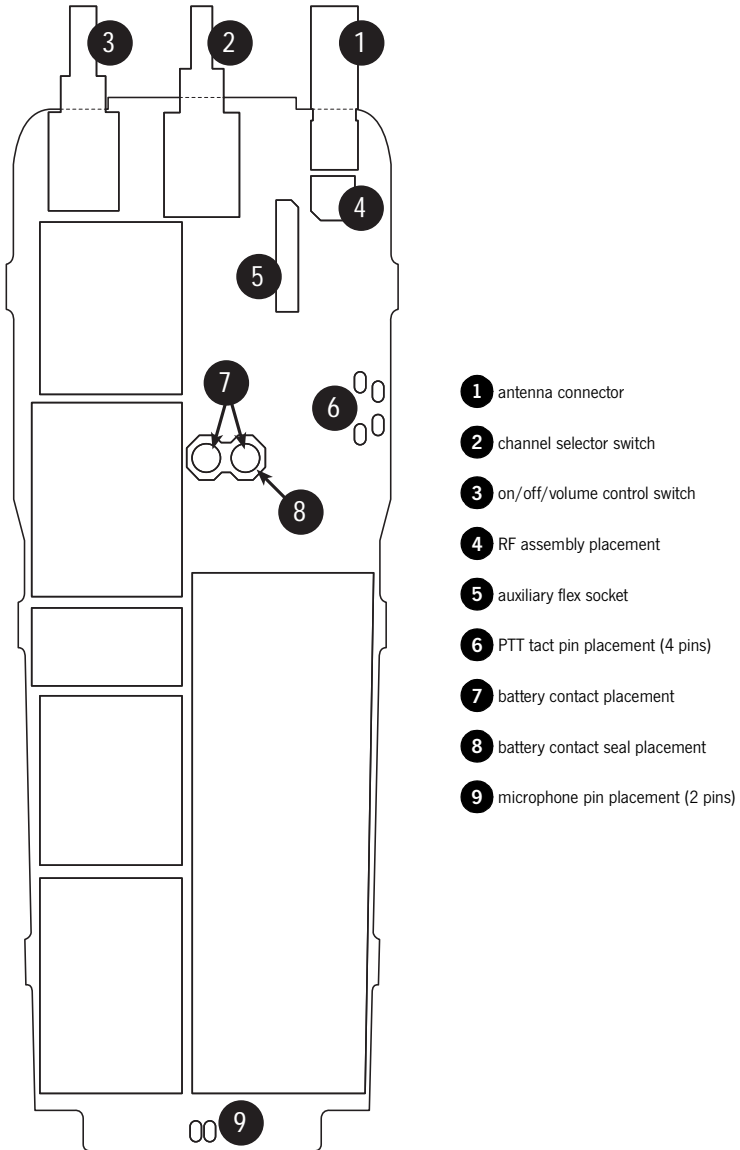
Figure D-8: Bottom surface of the PCB, which is visible when the shield has been removed from the chassis



- 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 (5 pins)
- 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



## **Replacing the shield, user interface PCB and polyester dome (Orca 5015/2x/35/40)**

On Orca 5015/2x/35/40 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-15.

## **Replacing the antenna connector, channel selector switch and volume control switch**

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-14 to D-17.

## **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).

## Replacing the chassis

Following the disassembly instructions, fully disassemble the radio. Discard both the chassis and main seal.

Inspect a new main seal to determine orientation and top/bottom surfaces. The tab is located at the top of the radio. Note that the seal is not flat. Ensure that the orientation is such that the bends follow the groove on the new chassis.

Locate the tab in the hole at the top of the chassis groove. Place top corners. Smooth seal into position across the top of the chassis.

Place the seal in the groove at the bottom of the radio and locate the corners.

Starting at the corners and moving towards the middle, work the seal into place along both sides of the chassis. Be careful not to stretch the seal.

Ensure that the seal is fully inserted in the groove all the way around the chassis. Ensure that it is not pinched when the radio is reassembled.

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# Reassembling the radio

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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;
- antenna connector;
- channel selector switch; and
- volume control switch.

## 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.

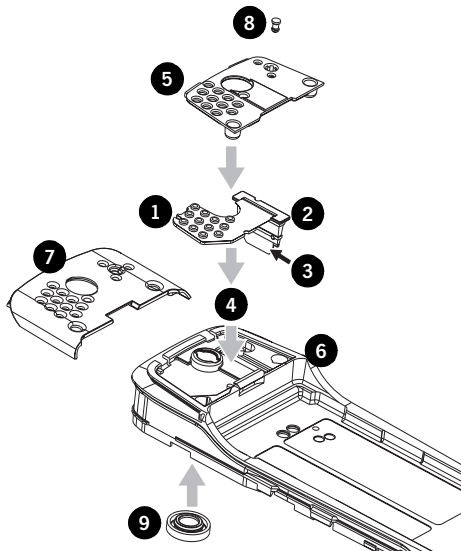
Fold the flexible PCB over and fit the contact area on the chassis; it should fit snugly in place.

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. Replace the chassis plug seal, pushing it onto the chassis boss.

Figure D-10: Rear panel assembly

- 1 auxiliary flexible PCB
- 2 auxiliary flex seal
- 3 end of auxiliary flex connector protruding through the seal
- 4 make sure the seal and auxiliary flex are firmly seated in the chassis here
- 5 rear panel seal
- 6 chassis
- 7 replace rear panel
- 8 RF contact pin
- 9 chassis plug seal



## 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, 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, 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 10in.lb (1.1Nm). Then tighten the PA screw to 2in.lb (0.23Nm).

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.

Replace the plastic speaker pins.

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) 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

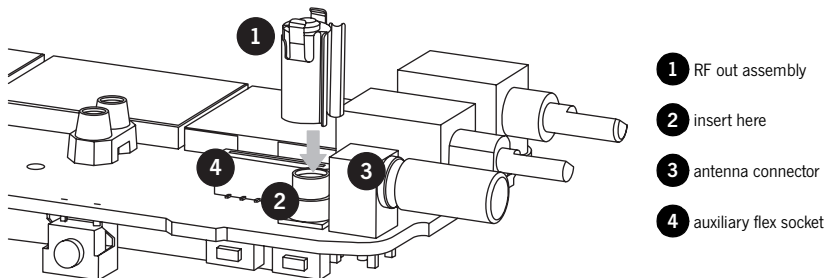
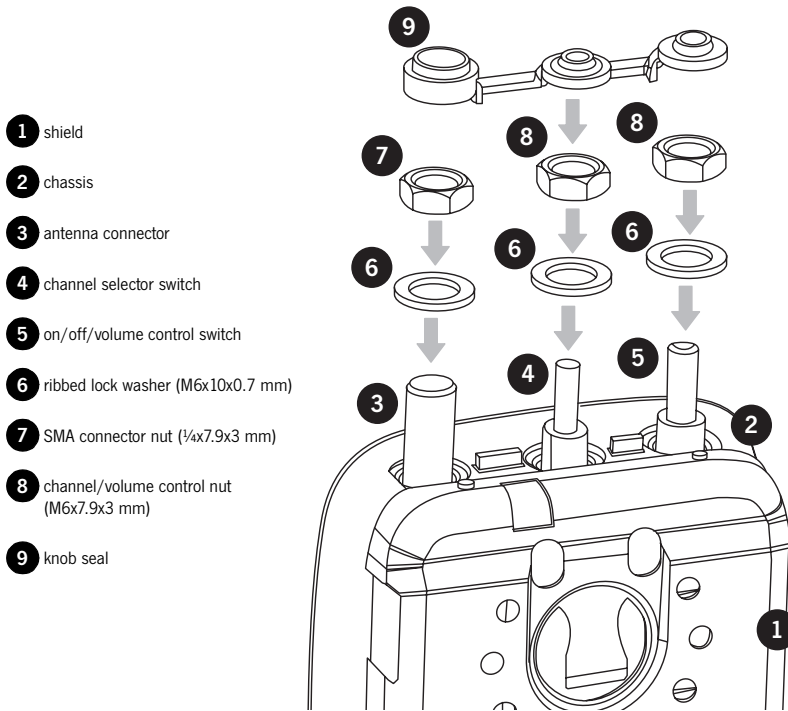


Figure D-12: Assembly of the switches



## 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 2in.lb (0.23Nm).

Replace the two knobs on the radio with new knobs. Press each knob on firmly. There should be a small gap between the knob label and the base of the knob.

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# Spares kits

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The following table shows a list of spares kits which are currently available for servicing Tait Orca 5000 portable radios. 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-401G	Orca 5010/11/30 spares kit
TOPA-SP-402G	Orca 5035 spares kit
TOPA-SP-403G	Orca 5015/2x/40 spares kit
TOPA-SP-404	Orca 5010/11/30 re-skinning kit
TOPA-SP-405	Orca 5035 re-skinning kit
TOPA-SP-406	Orca 5020/40 re-skinning kit
TOPA-SP-407	Orca 5015/2x/35/40 U/I PCB + shield
TOPA-SP-408	Orca 5015/21 re-skinning kit
TOPA-SP-504	Battery catch x 10
TOPA-SP-506	Orca 5000 series volume knobs x 10
TOPA-SP-507	Orca 5000 series channel knobs x 10

The contents of the Orca 5000 low, mid and high tier spares kits (TOPA-SP-401G, TOPA-SP-402G and TOPA-SP-403G) are shown in Tables D-2, D-3 and D-4. The contents of the Orca 5000 portable radio re-skinning kits are shown in Tables D-5, D-6 and D-7.

## Information contained in the tables

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.

## PCB Product Codes

Tait Orca 5000 main PCBs are available on an exchange basis from Technical Support at Tait Electronics Ltd. When ordering, use the following naming convention

TOP-XXXXX-KS.

For example, a replacement main PCB for a TOP-B2620-T0 is a TOP-B2620-KS.

The Tait Orca product code can be found on the chassis type approval label, which is visible when the battery is removed.

Table D-2: Orca 5010/11/30 spares kit (TOPA-SP-401G)

IPN	Description	Quantity	Reference
040-05500-08	Volume Control Switch	10	D-8 (3), D-9 (3)
219-50029-00	RF out assembly	5	D-11 (1)
220-01414-03	Aux Flex Connector PCB	5	D-10 (1)
231-00010-45	Channel Selector Switch	10	D-8 (2), D-9 (2)
232-00010-42	Switch PTT (Low Profile)	5	D-8 (8), D-9 (6)
240-02156-01	Antenna SMA Connector	10	D-12 (4)
252-00010-77	Speaker 40mm 0.5W 16E FST	5	—
252-00010-56	Microphone	5	D-8 (11)
303-10053-00	Radio Chassis	5	D-4 (2), D-5 (3)
303-30072-00	Battery Catch	20	—
308-01015-00	Housing Accessory Dummy Cover	20	—
311-01049-xx	Channel Selector Knob	20	D-2 (1)
311-03108-00	PTT/Function Keypad	10	—
316-06763-00	Knob Label	5	D-2 (3)
316-06765-02	Rear Panel	10	D-10 (7)
316-85133-00	PTT/Function Key Retaining Plate	10	—
319-01026-00	Main RF Shield	5	D-4 (1)
345-00020-09	PA Screw M2x5mm Pan Torx	10	D-8 (10)
345-00020-11	Chassis Screw M2x8mm Pan Torx	10	D-1 (3)
352-00010-52	Channel/volume Control Nut (M6x7.9x3mm)	20	D-12 (9)
352-01053-00	Antenna SMA Connector Nut	10	D-12 (8)
353-00010-42	Ribbed Lock Washer M6x10x0.7mm	30	D-12 (7)
360-01060-00	PTT/Function Key Actuator	40	—
360-02019-00	Microphone Grommet/Seal	10	D-5 (1)
365-01673-00	Insert Front Panel Logo Label	1	—
362-01035-01	Chassis Plug Seal (green)	10	D-10 (9)
362-01106-00	Rear Panel Seal	10	D-10 (5)
362-01089-01	Aux Flex Seal	10	D-10 (2)
362-01091-01	Knob Seal	10	D-12 (10)
362-01092-02	Main Seal	20	—
369-01039-00	Adhesive Ring 40mm (speaker)	5	D-7 (2)
304-07044-00	Speaker pin frame	20	—
316-85027-00	Pin External RF out assembly	10	—
356-01070-00	Speaker Contact Probe Spring	10	—
339-00010-53	Plastic bag, 150x250mm	11	—
399-00010-69	Plastic bag, 75x100mm Mini grip	23	—
311-01153-00	Package carton, T2000 SII, unprinted	1	—
365-01663-00	Warning Labels for Green D-Clips	1	—
OPP401	Front Panel Assembly. This comprises the following parts:	5	—
252-00010-77	Speaker 40mm 0.5W 16E FST	1	—
307-01022-00	Speaker cloth	1	—
316-06760-xx	Front Panel	1	—
316-06763-00	Knob Label	1	D-2 (3)
354-01044-00	Bush M2 Threaded Brass	2	—
369-01039-00	Adhesive Ring 40mm (speaker)	1	D-7 (2)
316-85133-00	PTT/Function key retaining plate	1	—
311-03108-00	PTT/Function keypad	1	—
360-01060-00	PTT/Function key actuator	2	—
399-00010-91	Plastic bag, 96x225mm	1	—



Table D-3: Orca 5035 spares kit (TOPA-SP-402G)

IPN	Description	Quantity	Reference
040-05500-08	Volume Control Switch	10	D-8 (3), D-9 (3)
219-50029-xx	RF out assembly	5	D-11 (1)
220-01414-03	Aux Flex Connector PCB	5	D-10 (1)
231-00010-45	Channel Selector Switch	10	D-8 (2), D-9 (2)
232-00010-42	Switch PTT (Low Profile)	5	D-8 (8), D-9 (6)
240-02156-01	Antenna SMA Connector	10	D-12 (4)
252-00010-77	Speaker 40mm 0.5W 16E FST	5	—
252-00010-56	Microphone	5	D-8 (11)
303-10053-00	Radio Chassis	5	D-4 (2), D-5 (3)
303-30072-00	Battery Catch	20	—
308-01015-00	Housing Accessory Dummy Cover	20	—
311-01049-00	Channel Selector Knob	20	D-2 (1)
311-01050-00	Volume Knob	20	D-2 (2)
311-03108-00	PTT/Function Keypad	20	—
311-03110-00	Keypad	5	—
312-01087-00	Lens Coated	2	D-8(1)
303-23098-00	Protective Lens Cover	5	—
316-06763-00	Knob Label	5	D-2 (3)
316-06765-02	Rear Panel	5	D-10 (7)
316-85133-00	PTT/Function Key Retaining Plate	10	—
345-00020-09	Screw M2x5mm Pan Torx	10	D-8 (10)
345-00020-11	Chassis Screw M2x8mm Pan Torx	10	D-1 (3)
352-00010-52	Channel/volume Control Nut (M6x7.9x3mm)	20	D-12 (9)
352-01053-00	Antenna SMA Connector Nut	10	D-12 (8)
353-00010-42	Ribbed Lock Washer M6x10x0.7mm	30	D-12 (7)
360-01060-00	PTT/Function Key Actuator	40	—
360-02019-00	Microphone Grommet/Seal	10	D-5 (1)
362-01035-01	Chassis Plug Seal (green)	10	D-10 (9)
362-01087-00	Battery Contact Seal	10	D-9 (8)
362-01106-00	Rear Panel Seal	10	D-10 (5)
362-01089-01	Aux Flex Seal	10	D-10 (2)
362-01091-01	Knob Seal	10	D-12 (10)
362-01092-02	Main Seal	20	—
369-01039-00	Adhesive Ring 40mm (speaker)	5	D-7 (2)
316-85027-00	Pin External RF out assembly	5	—
304-07044-00	Speaker pin frame	20	—
356-01070-00	Speaker Contact Probe Spring	10	—
339-00010-53	Plastic bag, 150x250mm	16	—
399-00010-69	Plastic bag, 75x100mm Mini grip	25	—
311-01153-00	Package carton, T2000 SII, unprinted	1	—
365-01663-00	Warning Labels for Green D-Clips	1	—
TOPA-SP-407	User Interface Kit, 5020/21/35/40, with PCB & Shield	5	—
OPP501	Front Panel Assembly. This comprises the following parts:	5	—
252-00010-77	Speaker 40mm 0.5W 16E FST	1	—
307-01022-00	Speaker cloth	1	—
316-06761-00	Front Panel	1	—
316-06763-00	Knob Label	1	D-2 (3)
354-01044-00	Bush M2 Threaded Brass	2	—
369-01039-00	Adhesive Ring 40mm (speaker)	1	D-7 (2)
360-01060-00	Preselect Actuator	2	—
311-03108-00	PTT/Function keypad	1	—
316-85133-00	PTT/Function key retaining plate	1	—
312-01087-00	Lens, Coated	1	D-8(1)
303-23098-00	Protective Lens Cover	1	—
399-00010-91	Plastic bag, 96x225mm	1	—

Table D-4: Orca 5015/2x/40 spares kit (TOPA-SP-403G)

IPN	Description	Quantity	Reference
008-36671-80	LCD Display	1	—
040-05500-08	Volume Control Switch	10	D-8 (3), D-9 (3)
219-50029-00	RF out assembly	5	D-11 (1)
220-01414-03	Aux Flex Connector PCB	5	D-10 (1)
231-00010-45	Channel Selector Switch	10	D-8 (2), D-9 (2)
232-00010-41	Switch PTT (Low Profile)	5	D-8 (8), D-9 (6)
240-02156-01	Antenna SMA Connector	10	D-12 (4)
252-00010-77	Speaker 40mm 0.5W 16E FST	5	—
252-00010-56	Microphone	5	D-8 (11)
303-10053-00	Radio Chassis	5	D-4 (2), D-5 (3)
303-30072-00	Battery Catch	20	—
308-01015-00	Housing Accessory Dummy Cover	20	—
311-01049-00	Channel Selector Knob	20	D-2 (1)
311-01050-01	Volume Knob	20	D-2 (2)
311-03108-01	PTT/Function Keypad	20	—
311-03109-00	Keypad TOP5020/5040	5	—
311-03113-00	Keypad TOP5021	5	—
312-01087-00	Lens Coated	2	D-6 (1)
303-23098-00	Protective Lens Cover	5	—
316-06763-00	Knob Label	5	D-2 (3)
316-06765-02	Rear Panel	5	D-10 (7)
316-85133-00	PTT/Function Retaining Plate	10	—
345-00020-09	PA Screw M2x5mm Pan Torx	10	D-8 (10)
345-00020-11	Chassis Screw M2x8mm Pan Torx	10	D-1 (3)
349-00030-00	Speaker Screw 1.8x5mm Torx	10	D-7 (3)
352-00010-52	Channel/volume Control Nut (M6x7.9x3mm)	20	D-12 (9)
352-01053-00	Antenna SMA Connector Nut	10	D-12 (8)
353-00010-42	Ribbed Lock Washer M6x10x0.7mm	30	D-12 (7)
356-01070-00	Speaker Contact Probe Spring	10	—
360-01060-00	PTT/Function Key Actuator	40	—
360-02019-00	Microphone Grommet/Seal	10	D-5 (1)
362-01035-01	Chassis Plug Seal (green)	10	D-10 (9)
362-01087-00	Battery Contact Seal	10	D-9 (8)
362-01106-00	Rear Panel Seal	10	D-10 (5)
362-01089-01	Aux Flex Seal	10	D-10 (2)
362-01091-01	Knob Seal	10	D-12 (10)
362-01092-02	Main Seal	20	—
369-01039-00	Adhesive Ring 40mm (speaker)	5	D-7 (2)
304-07044-00	Speaker pin frame	20	—
316-85027-00	Pin External RF out assembly	20	—
311-01153-00	Package carton, T2000 SII, unprinted	1	—
339-00010-53	Plastic bag, 150x250mm	13	—
399-00010-69	Plastic bag, 75x100mm Mini grip	23	—
365-01663-00	Warning Labels for Green D-Clips	1	—
TOPA-SP-407	User Interface Kit, 5020/21/35/40, with PCB & Shield	5	—
OPP601	Front Panel Assembly. This comprises the following parts:	5	—
252-00010-77	Speaker 40mm 0.5W 16E FST	1	—
307-01022-00	Speaker cloth	1	—
316-06762-00	Front Panel	1	—
316-06763-00	Knob Label	1	D-2 (3)
369-01039-00	Adhesive Ring 40mm (speaker)	1	D-7 (2)
360-01060-00	Preselect Actuator	2	—
311-03108-00	PTT/Function keypad	1	—
316-85133-00	PTT/Function key retaining plate	1	—
312-01087-00	Lens, Coated	1	D-8(1)
303-23098-00	Protective Lens Cover	1	—
399-00010-91	Plastic bag, 96x225mm	1	—

Table D-5: Orca 5010/11/30 re-skinning kit (TOPA-SP-404)

IPN	Description	Quantity
311-01049-01	Channel Knob	1
311-01050-01	Volume Knob	1
316-06765-00	Rear Panel	1
345-00020-11	Screw M2x8mm SS Pan Torx Patch	2
362-01106-00	Rear Cover Seal	1
362-01091-01	Knob Seal	1
362-01092-02	Main Seal	1
OPP401	PHA Front Panel Assembly	1
399-00010-69	Plastic Bag 75x100mm Mini Grip	1
399-00010-53	Plastic Bag 150x250mm	1
410-01064-01	Packaging Header Card New Logo	1
316-06765-01	Rear Panel	1

Table D-6: Orca 5035 Re-skinning kit (TOPA-SP-405)

IPN	Description	Quantity
311-01049-01	Channel Knob	1
311-01050-01	Volume Knob	1
311-03110-00	Keypad	1
316-06765-00	Rear Panel	1
345-00020-11	Screw M2x8mm SS Pan Torx Patch	2
362-01106-00	Rear Cover Seal	1
362-01091-01	Knob Seal	1
362-01092-02	Main Seal	1
OPP501	PHA Front Panel Assembly	1
399-00010-69	Plastic Bag 75x100mm Mini Grip	1
399-00010-53	Plastic Bag 150x250mm	1
410-01064-01	Packaging Header Card New Logo	1
316-06765-01	Rear Panel	1

Table D-7: Orca 5020/40 Re-skinning kit (TOPA-SP-406)

IPN	Description	Quantity
311-01049-01	Channel Knob	1
311-01050-01	Volume Knob	1
311-03109-00	Keypad	1
316-06765-00	Rear Panel	1
345-00020-11	Screw M2x8mm SS Pan Torx Patch	2
362-01106-00	Rear Cover Seal	1
362-01091-01	Knob Seal	1
362-01092-02	Main Seal	1
OPP601	PHA Front Panel Assembly	1
399-00010-69	Plastic Bag 75x100mm Mini Grip	1
399-00010-53	Plastic Bag 150x250mm	1
410-01064-01	Packaging Header Card New Logo	1
316-06765-01	Rear Panel	1

Table D-8: Orca 5015/2x/35/40 User Interface PCB and Shield (TOPA-SP-407)

IPN	Description	Quantity
OPF200-B	UI PCB SMT Subassembly	1
311-04005-00	Ins Poly Dome for 5015/2x/40	1
319-01026-00	Main Shield RF	1
399-00010-86	Static Shielding Bag 127x203mm	1
008-36671-80	LCD Display 12x2 Lines Flex	1
304-07043-00	LCD Frame Holder	1
220-01501-00	PCB Flexi User Interface	1
369-01044-00	Conductive Adhesive/Mylar	
365-00011-38	Yellow Label Static Warning	

Table D-9: Orca 5015/21 Re-skinning kit (TOPA-SP-408)

IPN	Description	Quantity
311-01049-01	Channel Knob	1
311-01050-01	Volume Knob	1
311-03113-00	Keypad	1
316-06765-00	Rear Panel	1
345-00020-11	Screw M2x8mm SS Pan Torx Patch	2
362-01106-00	Rear Cover Seal	1
362-01091-01	Knob Seal	1
362-01092-02	Main Seal	1
OPP601	PHA Front Panel Assembly	1
399-00010-69	Plastic Bag 75x100mm Mini Grip	1
399-00010-53	Plastic Bag 150x250mm	1
410-01064-01	Packaging Header Card New Logo	1
316-06765-01	Rear Panel	1

# PART E

## Battery packs and chargers

This part provides information on the battery packs and chargers available for Tait Orca 5000 portable radios.

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.

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# Battery packs

Six battery packs are available for Tait Orca 5000 portable radios. These battery packs are not serviceable, but their construction and expected life are described below.

The battery packs available are:

- TOPB100 NiCD battery pack;
- TOPB600 NiCD battery pack (slim, no belt clip);
- TOPB200 NiCD battery pack;
- TOPB400 NiMH battery pack;
- TOPB700 NiMH battery pack (slim, no belt clip); and
- TOPB500 NiMH battery pack.

The battery casing is constructed using a rugged resin material, and includes two pieces that are ultrasonically welded together.

## Battery shift life

Battery shift life is outlined in Table E-1. Battery shift life for other models and circumstances can be calculated from the typical drain rates on page E-4.

For intrinsically safe batteries, see page A-11.

## Preserving battery shift life

It is important that you follow the steps below

to preserve the shift life of the battery:

- Charge or change the battery as soon as the radio gives the 'Low Battery' warning.
- Short condition the battery weekly.
- Long condition the battery only for the following reasons: on first use of new battery, if performance is poor, and after more than two weeks of storage.
- Avoid leaving charged batteries in the charger for more than a day.
- Clean electrical contacts of the battery using a fibre glass pencil, or the graphite tip of a type 4H (#4) or harder pencil.
- Always store the battery detached from the radio when storing for more than a few days.
- 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 shift life (in hours) based on a 5:5:90 duty cycle for a new conditioned battery pack\*.

Battery type	Radio type		
	Conventional - Medium Economy	Conventional - No Economy	Trunked
TOPB100/600 NiCD	8.5	7	6.5
TOPB400/700 NiMH	10.5	8.5	8
TOPB200 NiCD	11.5	9	8.5
TOPB500 NiMH	15	12	11

\* Users should aim to have one hour spare capacity at the end of their shift to allow for battery ageing.

## Extending battery shift life

Battery shift 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 optimises the radio's power use by reducing the transmit power in high signal strength areas.

Typical drain rates for a conventional UHF radio are:

- 1.5 A at high power transmit;
- 300 mA in receive at rated audio;
- 80 mA on standby (no audio);
- 55 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 *Tait Orca Portable Conventional Programming Application (TOPCPA)*. Dynamic power control in trunked radios is enabled in the **User Selectable Parameters** screen of the *Tait Orca Portable Trunked Programming Application (TOPTPA)*.

## 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. Contact your Tait dealer for recycling details.



# Battery chargers

**Note:** In order to charge TOPB700 NiMH batteries, the charger must have firmware version 2.07 or greater. TOPB500 NiMH batteries can be charged on chargers with firmware version 2.05 or greater.

Three battery chargers are available for Tait Orca portable radios:

- 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 conditioning 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.

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.

For details on charging intrinsically safe batteries, see page A-11.

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
240-02020-07	Skt DC jack	10	All
232-00010-28	Tact switch	10	Desktop fast charger Multi-charger
302-40054-01	Conditioning button	10	Desktop fast charger Multi-charger
262-00001-00	Charger light pipe	10	Desktop fast charger Multi-charger
312-01069-02	Charger top	10	All
312-01070-01	Charger base	10	All
365-01549-01	Charger logo label	10	All
365-01598-01	Charger labels	10	Desktop fast charger Multi-charger
365-01601-00			
365-01597-00	Charger labels	5	Desktop trickle charger
365-01601-02			
369-00010-11	Rubber charger foot	40	All
360-01059-00	Trickle charger blanking label	10	Desktop trickle charger
356-01079-00	Spring probe charger bias-ball	40	All

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# Desktop fast charger

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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.

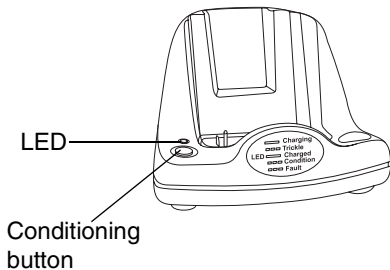
## Fast charger operation

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

Multiple protection methods are employed to ensure safe operation.

Figure E-1: Tait Orca fast charger



## 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,

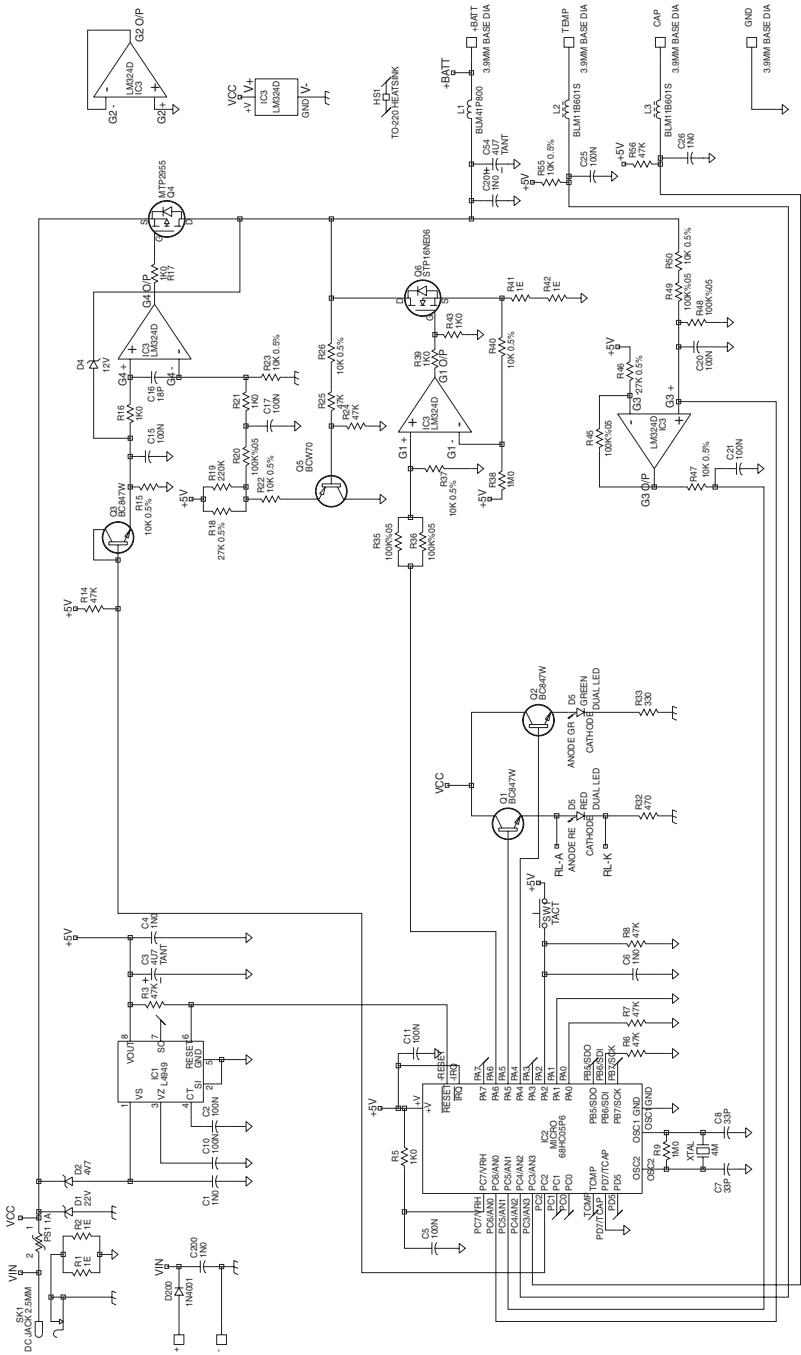
D1, in conjunction with PolySwitch™ PS1. Under reverse polarity conditions, D1 conducts, drawing the available short circuit current until PS1 trips. D1 also protects against any voltage spikes that may come through the AC to DC adaptor. The unit is designed for 10.5 - 14 V operation.

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 conditioning 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 charger 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 discharge (optional);
- Battery flat test;
- Battery type detection;
- Battery open circuit test;
- Battery short circuit test;
- Battery temperature test;
- Rapid charge, with multiple end-of-charge detection methods;
- Rest;
- Trickle charge (optional);
- Standby charge;
- Maintenance 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.

## Using the fast charger

Fast charger indicators are described in Table E-3.

Table E-3: Fast charger indicators

Indicator	Meaning
steady red	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 trickle charging
flashing amber	battery being long or short conditioned, or if flashing amber straight away, it may indicate a fault such as dirty contacts

### Charging the battery using the fast charger

Charging using the fast charger involves three stages.

- The fast charge stage quickly brings the battery up to near its full capacity. The charger LED will glow red.
- The trickle stage slowly tops up the battery until it is at its full capacity, which is typically 1½ hours. The charger LED will flash green.
- The standby charge stage keeps the battery at its full capacity, as long as the radio is turned off. The charger LED will glow green.

The battery can be charged separately or attached to the radio. The radio must be turned off to ensure a full charge.

Turn off the radio and insert the battery/radio into the charger. 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).

Approximate charge times are:

- up to 1½ hours for TOPB100 and TOPB600;
- up to 2 hours for TOPB200, TOPB400 and TOPB700; and
- up to 2½ hours for TOPB500.

Once the battery has reached approximately 90% capacity, the indicator will flash green. At this point, it is recommended the battery be left in the charger for a further 1 to 2 hours, to ensure maximum battery charge. Once the battery is fully charged, the indicator will glow green. Avoid leaving charged batteries in the charger for more than a day.

### Conditioning the battery with the fast charger

Two conditioning functions are available on the fast charger, a short conditioning cycle and a long conditioning cycle. The short cycle discharges the battery then charges it. Regularly recharging a battery that has not been completely discharged will eventually affect its ability to hold a full charge.

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

**Note:** Do not use the short conditioning cycle on a new battery without first fully charging it using a long conditioning cycle.

The long conditioning cycle is necessary:

- before the battery is used for the first time;
- if the battery performance has deteriorated; or
- after the battery has been stored for longer than two weeks.

To short condition the battery

Turn off the radio and insert the battery/radio into the fast charger. When the charger LED glows red, press the conditioning button until the indicator flashes amber. Release the conditioning button. The LED will flash amber while the battery is being discharged. Once the battery is discharged, it will charge normally. The battery is ready to be used again when the charger LED glows green.

To long condition the battery

Long conditioning 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 long condition the battery, turn off the radio. Press and hold the conditioning button while inserting the battery/radio. Continue holding the conditioning button until the indicator flashes amber. When the indicator flashes amber, release the conditioning button.

The long condition cycle will take approximately 24 hours.

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

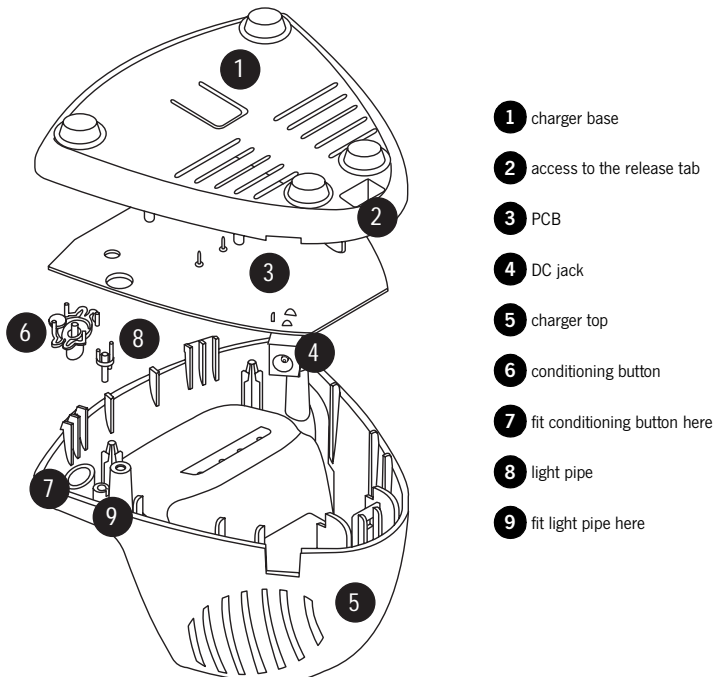
## Repairing the fast charger

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.

Figure E-3: Assembly of the desktop fast charger



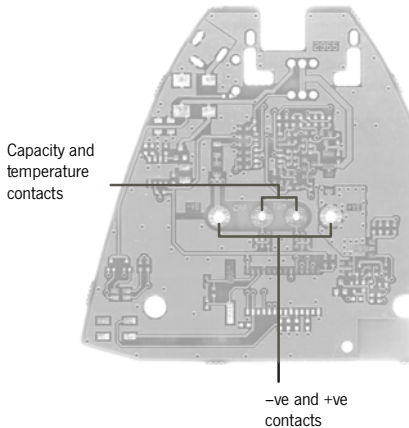
### Replacing the spring contacts

Remove the faulty contacts with a soldering iron and discard.

If the replacement spring contacts have a larger diameter and will not fit through the PCB, the holes should be drilled out to 2.2mm.

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.

Figure E-4: The fast charger PCB



### Reassembling the charger

Refer to Figure E-3.

Hold the body of the charger upside down and insert the conditioning 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.

Table E-4: Charger Spares and Upgrade Kits:

Product code	Description
TOPA-SP-202	Charger Spares Kit
TOPA-SP-203	Charger Upgrade Kit
TOPA-SP-205	Charger Software Upgrade Kit

### 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).

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# Desktop trickle charger

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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,  $V_{IN}$  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  $V_{IN}$  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

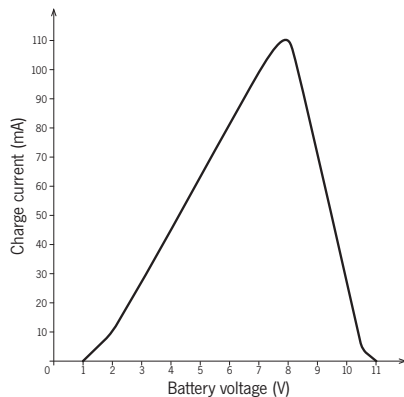
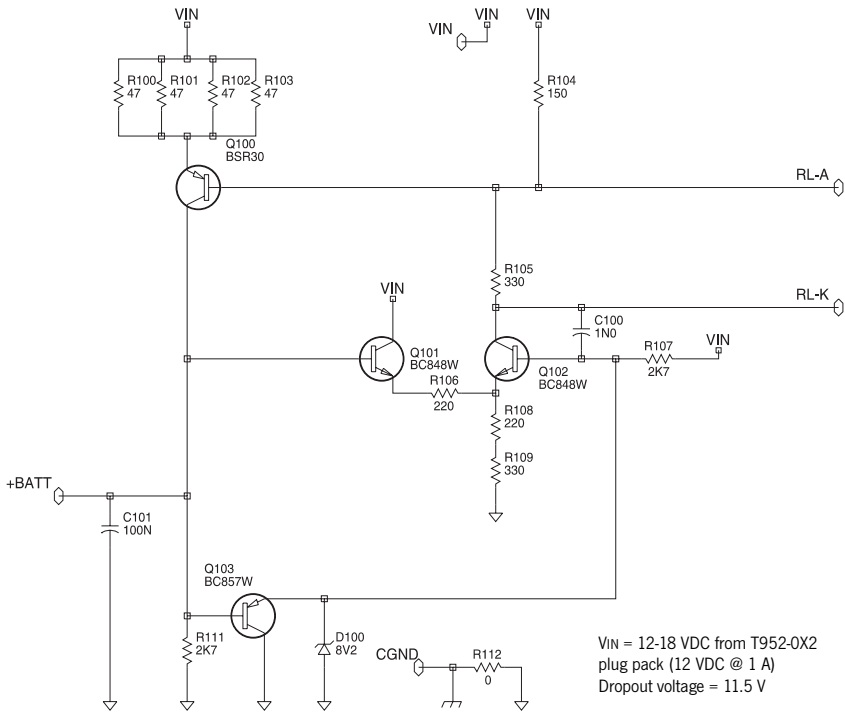




Figure E-6: Circuit diagram of the Tait Orca desktop trickle charger



## 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. You can leave the battery in the charger

until you next need to use the radio. 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.

## Troubleshooting

*When inserting the battery/radio in the charger, there is no indication on the charger LED.*

- Check that the battery/radio is seated properly in the charger.
- Check that the charger is properly plugged in and the correct plug pack is being used.
- Check that the battery and charger contacts are clean and not obstructed.

Clean the electrical contacts of the battery and charger using a fibre glass pencil, or the graphite tip of a type 4H (#4) or harder pencil.

- May indicate a faulty plug pack or cable. Contact your Tait dealer.

*The charger LED flashes amber as soon as the radio is seated in the charger.*

- Check that the battery and charger contacts are clean and not obstructed.

*The charger LED glows amber.*

- Safe range for charging is 5°C to 40°C, and optimum battery performance will be obtained between 15°C and 25°C. The charger will start charging when the battery temperature is within the range 5°C to 40°C.

*The charger LED flashes red.*

- Check that the battery and charger contacts are clean and not obstructed.
- May indicate a more serious fault such as a faulty battery. Contact your Tait dealer.

*The battery contacts show corrosion.*

- Contact corrosion may start to be noticed later in life, and will reduce battery cell capacity. If early signs of corrosion appear, then clean back and end contacts of the battery using a fibre glass pencil, or the graphite tip of a type 4H (#4) or harder pencil.

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# Multi-charger

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



## Repairing the multi-charger

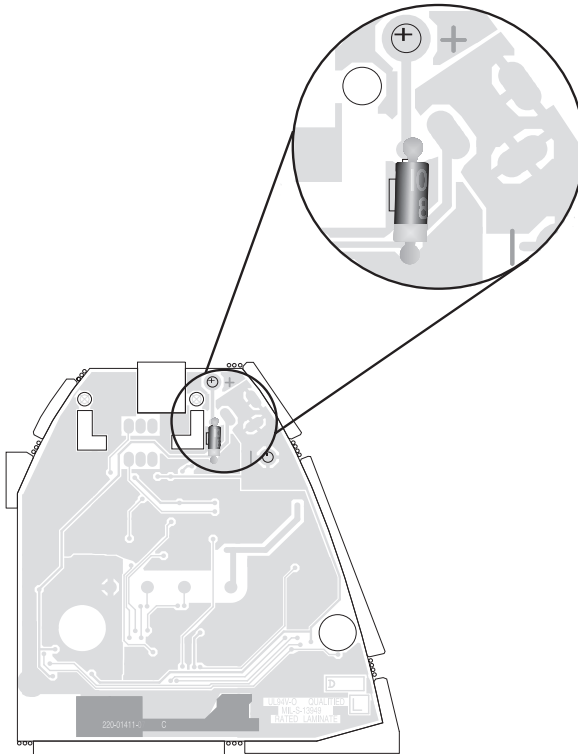
Should one of the charger units be faulty, you can repair it according to the instructions for the desktop fast charger, or replace the faulty PCB with a fast charger PCB to which the diode (1N4001 or similar) has been added (refer to Figure E-8).

To remove a faulty charger from the multi-charger:

- Unplug the power cord.
- Undo the 10 screws at the base of the radio using a Pozi 1 driver.
- **Do not** pull the top off the charger using the housing of the individual chargers. Instead, from the side of the charger, lift the top cover up and gently fold back.
- Unplug the red and black wires leading to the faulty charger.
- Remove the three screws holding the faulty charger to the top of the multi-charger.
- Gently pull the faulty charger away from the multi-charger top. Turn the charger upside down so that the release tab is at the top.
- Depress the release tab using the end of a flat-bladed screwdriver and gently pull the base away from the body.
- Desolder both wires.
- Repair the board or replace it with a new one to which the required diode has been added.
- Pass the wires through the charger base.
- Solder the red wire to the positive terminal on the PCB and the black wire to the negative terminal on the PCB.
- Place the charger upside down and make sure the conditioning button, the light pipe and the PCB are seated properly.
- Attach the base at the front edge, and clip it down at the back.

- Gently pull the wires through the multi-charger top while aligning the charger with the three screw holes.
- Fasten the charger to the multi-charger top using the three screws.
- Reconnect the red and black wire to the fuse connector. Ensure that the polarity is correct.
- Close up the multi-charger, replacing the 10 screws using a Pozi 1 driver.

Figure E-8: The Tait Orca Fast Charger PCB. The inset shows where to place the diode (1N4001 or similar) for using the PCB in a multi-charger



## Fuse replacement

Each charger is protected by a 3A fuse. To replace a fuse, open the multi-charger as described previously. The fuse must be replaced with a 12V 3A secondary fuse made from material with a Class V-2 flammability rating.

A suitable fuse can be ordered directly from

Technical Support, Tait Electronics (IPN 265-00010-64).

# PART **F** Accessories

This part describes how to interface accessories with Tait Orca 5000 portable radios, using the Tait Orca accessory connector and the 7.5 mm accessory adaptor.

Detailed servicing information about the Tait Orca vehicle kit is also provided on page F-10.

A list of audio accessories currently available for use with Tait Orca 5000 portable radios is found in Table A-1, on page A-7.

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# Tait Orca 5000 accessory connector

The Tait Orca 5000 portable radio has a versatile accessory interface on the rear of the radio for connecting external accessories, such as speaker microphones and headsets.

There are four Tait accessory connector kits available for Tait Orca 5000 portable radios:

- Accessory Connector Kit with green P-Clip (TOPA-AA-006G);
- RF Accessory Connector Kit with green P-Clip (TOPA-AA-007G).
- Accessory Connector Kit with D-Clip (TOPA-AA-106G); and
- RF Accessory Connector Kit with D-Clip (TOPA-AA-107G)

These kits are for use with the new chassis only. See “New chassis” on page A-5 and “Accessory connector compatibility” on page G-8. For accessory connectors compatible with the old chassis, refer to issue M5000-00-103 of this service manual.

Each kit contains the accessory connector PCB with the required spring probes soldered on. The board supplied with the RF accessory connector kit has four additional probes for RF applications.

Figure F-1 shows the bottom side of the accessory connector PCB and a circuit diagram of the accessory connector is shown in Figure F-3.

Table F-1 shows the signals available at the accessory connector, and the signals are described in more detail in “Accessory connector signal specifications” on page F-6.

## Screw head types

The Tait Orca 5000 Accessory connector requires a Pozi 1 driver for the green

P-Clip connector, and a Hex 2 driver for the D-Clip connector. Additionally a Torx T6 driver is required.

## Connecting an accessory

Check that your accessory is compatible with the accessory connector by referring to Table F-1 “Accessory connector signal specifications” on page F-5. If connecting a headset, refer to “Connecting a headset” on page F-5 for connection details.

## Accessory connector PCB link options

There are two optional links on the accessory connector PCB.

To turn off the radio’s internal speaker, short link 1 (‘LINK1’, shown in Figure F-1).

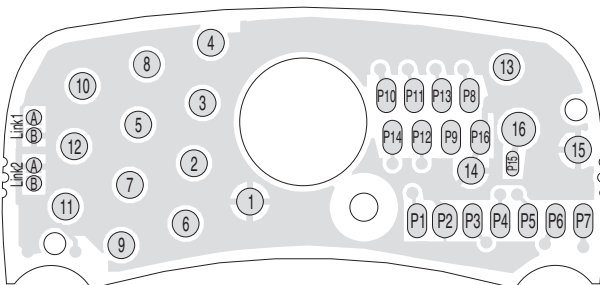
If an external switch is to be used to control the EXT-PTT line, for example in a hands-free vehicle kit, short link 2 (‘LINK2’, shown in Figure F-1).

## Accessory connector PCB connections

Solder pads P1 to P16 are provided on the bottom side of the accessory connector PCB for connection to external accessories. The location of these pads is shown in Figure F-1.

This diagram also shows the locations of the spring probes 1 to 16, and links 1 and 2.

Figure F-1: Tait Orca accessory connector PCB - bottom side



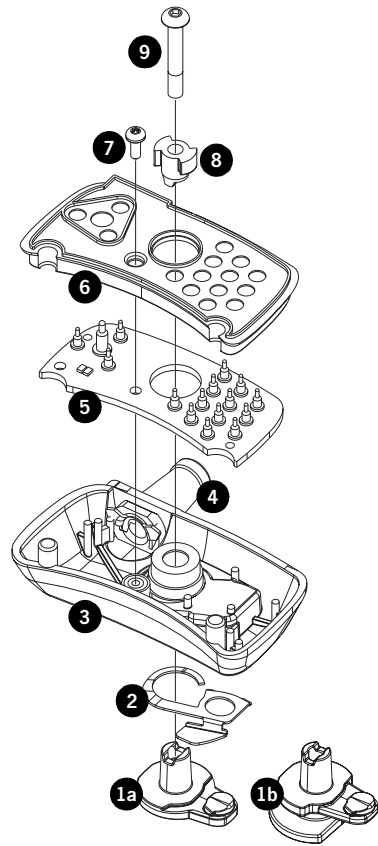
## Accessory connector assembly

Assemble the accessory connector as shown in Figure F-2.

The order of assembly is as follows.

- 1 Thread the cable from your accessory through the accessory housing, making sure it goes through in the proper direction.
- 2 Slide a grommet of appropriate size onto the cable and pull firmly so the cable and grommet fit in place.
- 3 Strip and tin the accessory signal wires.
- 4 Solder the accessory wires to the correct pads on the accessory connector PCB (refer to Table F-2 for headset connections).
- 5 Fit the accessory connector PCB links, if required.
- 6 Crimp the cable at an appropriate distance along the cable, approximately in line with the edge of the PCB.
- 7 Use narrow-nose pliers to pull out the appropriate plugs in the seal and fit it onto the PCB.
- 8 Fit the grommet and PCB/seal into the housing and secure it with the supplied screw. Torque the screw to 3in.lb (0.34Nm).
- 9 Fit the lock to the accessory connector housing.
- 10 Fit the quarter turn tip, and secure with supplied screw. Torque the screw to 3in.lb (0.34Nm).

Figure F-2: Accessory connector assembly diagram



- 1 Lock (a) green P-Clip or (b) D-Clip
- 2 Spring
- 3 accessory connector housing
- 4 grommet
- 5 accessory PCB, complete with pins
- 6 PCB seal
- 7 screw M2x5 Pan Torx
- 8 quarter turn tip (lugs)
- 9 screw M3x16 Pan Pozzi (green P-Clip)  
screw M3x20 Hex (with D-Clip)



Table F-1: Accessory connector signal specifications

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

\* Dependent on battery charge level.

## Connecting a headset

The headset must meet the following basic specifications:

- speaker impedance: 32  $\Omega$  (16  $\Omega$  min);
- speaker power: 1/4 W<sub>rms</sub> (min);
- microphone: electret, approximately 1 k $\Omega$ ; and
- PTT: switch not in line with microphone. Note that if your headset has a PTT in line with the microphone, it can be connected with the 7.5 mm accessory adaptor. See “7.5 mm Accessory adaptor” on page F-8 for more information.

Determine the compatibility/suitability of your headset by checking Table F-1. If it is compatible, follow the assembly procedure outlined previously, on page F-4.

Solder the headset wires onto the accessory connector PCB pads, as shown in Table F-2.

To turn the radio speaker off and only have the headset speaker on, short link 1 (LK1). This ties SENSE-0-ACC to GND, telling the radio to turn the speaker off.

Note that SPEAKER+ and SPEAKER- must not short to GND, or to any other signal.

Table F-2: Accessory connector headset connections

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

## Accessory connector signal descriptions

### RX-DET-AF-ACC

The RX-DET-AF-ACC 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 and 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.

### RXD-ACC

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

### TXD-ACC

The TXD-ACC 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.

### SENSE-0-ACC

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

### SENSE-1-ACC

On conventional radios, SENSE-1-ACC is an output which follows the squelch detect line.

On trunked radios, SENSE-1-ACC is a currently unused input.

### 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.

### GND

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

### BUTTON-1 and BUTTON-2

Two external accessory 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 k $\Omega$  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  $\Omega$ , voltage level on EXT-PTT is 0 V;
- BUTTON-1 function: resistor pull down 12 k $\Omega$ , voltage level on EXT-PTT is 1.5 V;
- BUTTON-2 function: resistor pull down 27 k $\Omega$ , voltage level on EXT-PTT is 2.5 V.

These resistors are already fitted to the accessory PCB.

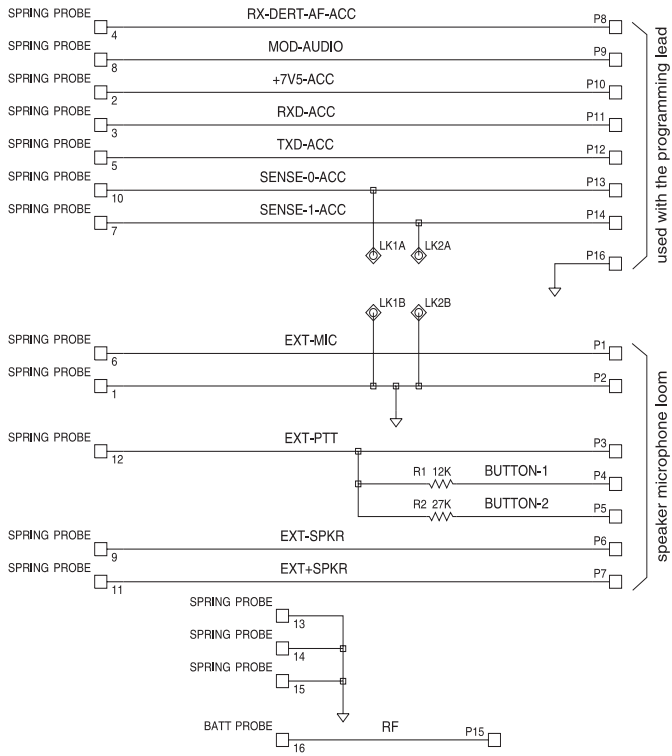
### EXT SPKR +/-

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

### 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.

Figure F-3: Tait Orca accessory connector circuit diagram



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# 7.5 mm Accessory adaptor

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

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 portable radio 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 portable radio. 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

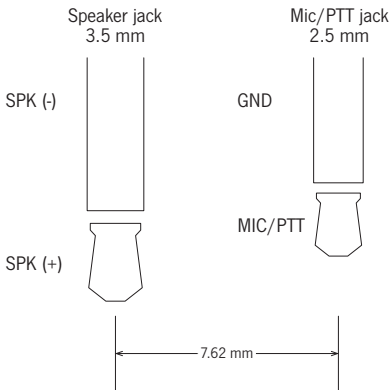
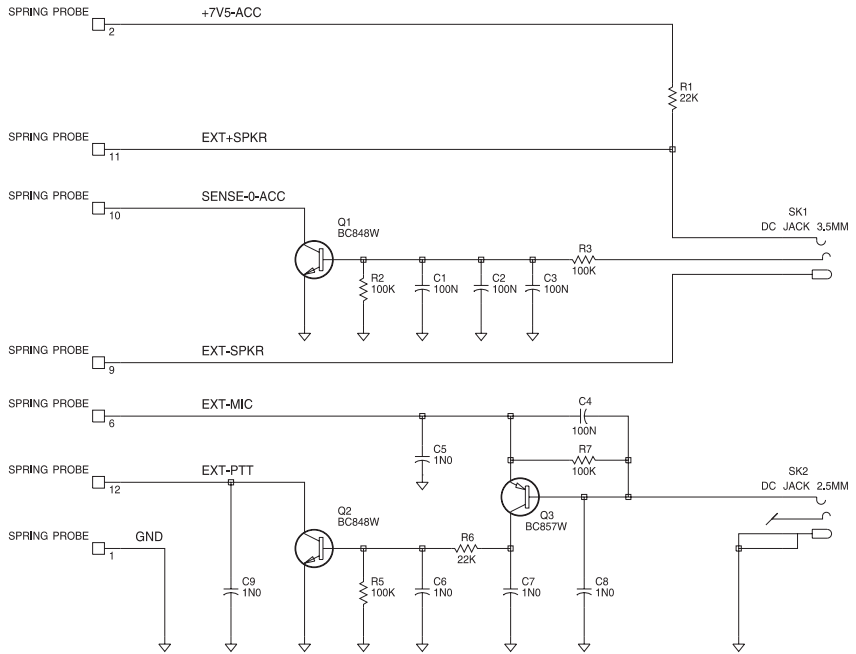


Figure F-5: Tait Orca 7.5 mm accessory adaptor circuit diagram



# Tait Orca vehicle kit

The Tait Orca vehicle kit provides a secure environment for a Tait Orca portable radio used in a vehicle. The vehicle kit allows the radio to be connected to the vehicle's external antenna and also acts as a fast charger for the radio's NiCd battery.

Note that NiMH batteries are not charged by the vehicle kit, and that the desktop fast charger should still be used to short condition NiCd batteries each week.

This section outlines the vehicle kit operation, specifications and servicing. A detailed circuit and interface description is also provided, to allow customised modification of the vehicle kit.

## Product codes

Table F-3 gives the product codes of available vehicle kit options and accessories.

The vehicle kits in Group A include selected mounting options and accessories. These accessories and other installation options are available separately as items in Group B.

Table F-3: Vehicle kit product codes

Product code	Description
TOPA-VK-002A	Vehicle kit, no installation accessories
TOPA-VK-006A	Vehicle kit with mobile microphone & mounting hardware
TOPA-VK-007A	Vehicle kit with mobile microphone, speaker & mounting hardware
TOPA-VK-008A	Vehicle kit with heavy duty mobile microphone & mounting hardware
TOPA-VK-009A	Vehicle kit with heavy duty mobile microphone, speaker & mounting hardware
TOPA-VK-011A	Vehicle kit with heavy duty microphone & speaker (no additional mounting hardware)

Group A

Product code	Description
TOPA-VK-010	Vehicle kit mounting adaptor
TOPA-VK-020	Vehicle kit single height U bracket
TOPA-VK-030	Vehicle kit double height U bracket
TOPA-VK-040	Vehicle kit triple height U bracket
TOPA-VK-050	Vehicle kit mounting plate
TOPA-VK-060	Vehicle kit charger disable kit
TOPA-VK-100	Vehicle kit mobile microphone
TOPA-VK-200	Vehicle kit external speaker
TOPA-VK-300	Vehicle kit visor microphone
TOPA-VK-400	Vehicle kit remote PTT
TOPA-VK-500	Vehicle kit heavy duty mobile mic

Group B

## Update to the vehicle kit

In order to allow the vehicle kit to be compatible with the new chassis, a new quarter turn moulding has been made. This new part is coloured green so that it can be easily identified. It can be fitted to all existing vehicle kits and will allow radios with both old and new chassis to be located in the vehicle kit. For instructions on replacing the quarter turn moulding, see "Trigger reassembly" on page F-14

## Installing a vehicle kit

Detailed installation instructions are provided in the *Tait Orca vehicle kit installation guide* (IPN 429-40000-xx). This guide is included with each vehicle kit.

## Vehicle kit operation

### Inserting the radio

Remove the accessory connector cover from the radio.

Ensure the vehicle kit release button is down and insert the radio into the radio cavity.

Push the radio firmly into place against the locating pegs and radio interface. You should hear the radio snap into place and the release button will pop up.

### Locking a radio in the vehicle kit

You can use the supplied key to lock the radio into the vehicle kit when you leave the vehicle unattended.

To lock the radio in the vehicle kit, insert the supplied key in the lock and turn it clockwise. To unlock the radio from the vehicle kit, turn the key counterclockwise.

### Removing the radio

To remove the radio from the vehicle kit, push the release button down. The radio can now be removed from the radio cavity.

### Charging the battery

Once the radio is inserted into the radio cavity, the charger status LED will glow amber for three seconds, then red. When the LED glows green, the battery is charged to a minimum of 70% capacity.

If the battery is too hot or too cold, the LED will glow amber until the battery temperature is within the safe range for recharging (0°C to 50°C). If the indicator remains amber, consider turning on your air conditioning. Optimum battery charging performance is obtained between 15°C and 25°C.

Charge times when the radio is turned off are:

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

You can still use the radio while the battery is being charged, but the charge times will vary, depending on how much the radio is being used.

The vehicle charger functional indicators are summarised in Table F-4.

Table F-4: Charger status LED indicators

Indicator	Meaning
steady green	battery charging
steady green	battery charged to a minimum of 70% capacity
steady amber	charge suspended until battery temperature is within correct range
flashing red	battery not seated properly in the charger, contacts dirty, battery faulty or NiMH battery inserted

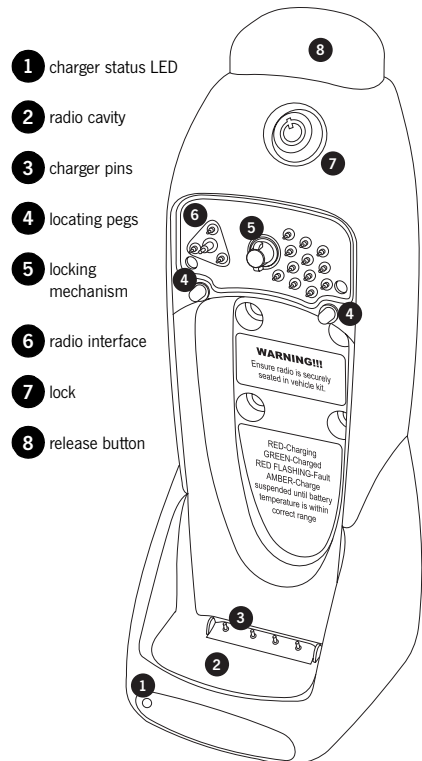


Figure F-6: Vehicle kit assembly

### Using the radio while in the vehicle kit

While the radio is seated in the vehicle kit, operation remains the same, except:

- the radio's microphone will be inoperative and an external microphone such as a

mobile microphone must be used; and

- the radio's speaker will be inoperative when an external speaker has been installed. Volume can be adjusted from the radio's volume control.

The standard installation results in the charger and external speaker being turned off when the ignition is off.

If the vehicle kit determines that the vehicle's battery is too low (less than 11 V), the vehicle kit will turn off.

**WARNING:** The vehicle kit uses less than 30 mA from the vehicle's battery when the ignition is off. For this reason, if you are leaving your vehicle unattended for an extended period of time (for example, more than one month), the positive fuse should be removed.

### Basic care and safety

- It is essential to condition your battery weekly using the desktop fast charger.
- Wipe the radio contacts and accessory interface with a dry, lint-free cloth to remove any dirt, oil or grease.
- Do not allow the vehicle kit to come into contact with detergents, alcohols, aerosol sprays or petroleum-based products, as they may permanently damage the case.

## Vehicle kit specifications

The following table outlines the vehicle kit specifications. Details of test methods can be obtained from Tait Electronics Ltd.

Table F-5: General specifications

Parameter	Specification
Supply voltage	13.8 VDC (nominal)
range	11 to 16 V range
protection	3 A fuses in power lead
Ambient temperature range	-10 to +60°C
Battery charger temperature range	0 to +50°C
Weight	375 g
Size W x H x D	80 mm x 230 mm x 95 mm (2 in x 5.8 in x 2.4 in)
Product supported	<ul style="list-style-type: none"><li>• all Tait Orca portable radios (frequency bands up to 530 MHz supported)</li><li>• all Tait Orca belt clips</li><li>• all Tait Orca NiCd batteries</li></ul>
Note that NiMH batteries are not charged.	
Technical compliance	complies with FCC part 15, CISPR 14 and CISPR 14-2
Fast charger charge current	0.8 A
Charger control	the charger uses voltage, temperature and temperature change to safely charge and maintain battery capacity



## Servicing the vehicle kit

The vehicle kit contains four PCBs, and the following servicing instructions outline the disassembly of the vehicle kit to allow replacement of these PCBs.

### Warning: Screw head types

There are four different types of Torx screws used in the vehicle kit: KC22x6, KC25x6, KC30x8 and KC30x10. All these screws require a Torx head screwdriver. When tightening any screws, be careful not to strip the threads in the plastic mouldings by exerting too much force.

The following table explains the torque settings required for the different Torx screw types.

Figure F-7: Vehicle kit torque specifications

Screw Type	IPN	Quantity	Torque (in.lb)
KC22x6	346-10022-06	2	2
KC25x6	346-10025-06	3	2
KC30x8	346-10030-08	2	6
KC30x10	346-10030-10	4	6

### Removing the vehicle kit back cover

The back cover is held to the front moulding by two plastic clips at the base of the unit. Insert the tip of a round screwdriver into the two holes at the bottom of the rear panel. Lever the tip upwards towards the top of the unit.

Hold the unit in such a way that your forefinger and thumb exert a slight pressure to separate the rear panel away from the front moulding, while you lever the clips with the screwdriver.

### Replacing the accessory probe PCB

Remove the back cover and unplug the accessory loom at the top of the options PCB. Unscrew the two KC30x10 screws holding the trigger assembly together. The trigger assembly can now be lifted out.

Note that the trigger assembly must be pressed

**downwards** while undoing these screws, as there are springs underneath.

Unplug the loom from the accessory probe PCB. Carefully use narrow nose pliers to unplug the MCX connector from the accessory probe PCB. Now remove the two KC22x6 screws on the front of the vehicle kit holding the accessory probe PCB into the front moulding. The accessory probe PCB can now be tilted upwards and removed from the moulding.

Fit the seal onto the new accessory probe PCB and reassemble the vehicle kit. Read the assembly instructions for more information.

### Replacing the charger probe PCB

Remove the back cover and unplug the accessory loom at the top of the options PCB. Lift the options/charger PCB assembly out of the front moulding, until the charger loom is accessible.

Unplug the charger loom and remove both PCBs from the front moulding. Note that these PCBs are still attached via the RF cable.

Unscrew the two KC30x8 screws holding the charger probe moulding into the front moulding, and slide out the probe moulding.

Unscrew the three KC25x6 screws holding the probe PCB to the probe moulding. Fit the seal onto the new charger probe PCB and reassemble the vehicle kit.

### Removing the options or charger PCBs

Remove the two DB25 fasteners holding the back panel to the accessory/options connector. Remove the two KC30x10 screws holding the back plate to the audio PA. Unclip the backplate from the options PCB. The PCBs can now be unplugged and replaced.

When putting the options/charger assembly back into the front moulding, make sure that the charger PCB is running in its tracks. Be careful that you do not bump the LED at the bottom of the charger PCB; the PCB does not require any force to insert.

## Reassembling the vehicle kit

To assemble the vehicle kit, reverse the disassembly process.

Note that when doing up the KC30x10 screws the threads in the plastic PA moulding must **not** be stripped. It is important that the audio PA is held firmly against the backplate, as the backplate serves as a heatsink.

## Trigger reassembly

When reassembling the trigger assembly, insert the peg moulding into the front panel. Insert the quarter turn moulding and rotate it until the peg moulding prevents it from turning. Drop the two springs into the peg moulding. While pressing in the trigger cap, replace the trigger assembly.

While holding the trigger assembly cover together (before doing up the screws) check that the locking mechanism works correctly. To do this, press in the locating pegs and check that the trigger cap pops up. Press the trigger cap down and check that the locating pegs pop out. If the trigger assembly does not work correctly, check that the quarter turn moulding is in the correct position and repeat the assembly process.

Tighten the two KC30x10 trigger assembly screws, while holding the trigger assembly in place.

## Rear cover reassembly

Locate the top of the rear cover into the back of the trigger assembly. Press the bottom of the rear cover to click/lock the cover into the front moulding.

## Spares kits

The following table shows a list of spares kits which are currently available for servicing Tait Orca vehicle kits. These can be ordered from your local Tait dealer.

Table F-6: Vehicle kit spares kits

Product code	Description
TOPA-SP-301	Vehicle kit spares kit
TOPA-SP-302	Vehicle kit reskinning kit

The contents of these kits are shown in Tables F-6 and F-7.

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 'Legend' column refer to Figure numbers in which the spares item is shown. The numbers in brackets refer to the numbered legend within the figure, where appropriate.

Table F-7: Vehicle kit spares kit (TOPA-SP-301)

IPN	Description	Quantity supplied	Legend
OPA-VK-010	TOP vehicle kit charger PCB	1	F-12
OPA-VK-020	TOP vehicle kit options PCB	1	F-13
OPA-VK-030	TOP vehicle kit accessory probe PCB	5	F-10
OPA-VK-040	TOP vehicle kit charger probe PCB	10	F-11
219-02665-00	Cable - RF (MCX to BNC connectors)	5	F-9
219-02666-00	Cable - charger to charger probe PCBs	5	F-9
219-02667-00	Cable - options to accessory PCBs	5	F-9
240-04021-74	Mobile microphone socket (6-way vertical phone jack)	5	F-8 (3)
240-04021-82	External speaker & remote PTT sockets (3. 5 mm DC jack)	10	F-8 (4), F-8 (5)
240-04021-83	Visor microphone socket (2.5 mm DC jack)	5	F-8 (6)
240-04021-85	Power/ignition sense socket (4-way right angle PCB mounting)	5	F-8 (7)
303-11204-00	Chassis moulding	10	—
305-00007-00	Trigger moulding	10	—
305-00008-01	Quarter turn moulding (green)*	10	F-6 (5)
305-00009-00	Peg moulding	10	F-6 (4)
305-00010-00	Trigger cap moulding	10	F-6 (8)
305-00021-00	Trigger spring	10	—
305-00022-00	Peg spring	20	—
305-00023-00	Lock	5	F-6 (7)
353-05006-00	Washer 7/16 beryllium	1	—
365-00011-54	Label R1556/2 90 x 24mm	19	—
399-00010-69	Plastic bag 75 x 100mm	6	—
399-00010-53	Plastic bag 150 x 250mm	8	—
399-00010-86	Static shielding bag 127 x 203mm	2	—
365-00011-38	Yellow static warning label	2	—
937-00000-79	Label 60 x 25.4mm	0	—
410-01153-00	Packaging - unprinted carton	1	—

\* The green quarter turn moulding is compatible with both the old and new radio chassis. See "Update to the vehicle kit" on page F-10.

Table F-8: Vehicle kit reskinning kit (TOPA-SP-302)

IPN	Description	Quantity supplied	Legend
305-00003-00	Lens	4	—
305-00004-00	Front moulding	4	—
305-00005-00	Rear moulding	4	—
305-00006-00	Probe moulding	4	—
305-00012-00	Auxiliary seal	4	—
305-00013-00	Probe seal moulding	4	—
305-00015-00	Back plate	4	—
305-00023-00	Lock	4	F-6 (7)
353-05006-00	Washer 7/16 beryllium	1	—
365-01610-00	Front warning label	5	—
365-01611-00	Front operation label	5	—
365-01612-00	Rear type approval label	5	—
365-00011-54	White label R1556/2 90 x 24mm	11	—
399-00010-53	Plastic bag 150 x 250mm	1	—
399-00010-69	Mini grip plastic bag 75 x 100mm	10	—
410-01153-00	Pkg Carton SII unprinted	1	—
937-00000-79	Blazer label 60 x 25.4mm	0	—

## Custom modifications

The following information is provided to enable modifications to be made to the standard vehicle kit installation:

- signal descriptions and specifications for the vehicle kit external connectors;
- block diagrams of the vehicle kit PCBs; and
- circuit descriptions for each vehicle kit PCB.

Detailed circuit diagrams and component location information for the vehicle kit PCBs may be obtained from Technical Support. Contact your Tait dealer for more information.

### Using external function buttons

It is possible to interface to the radio's external function buttons through any of the vehicle kit's external PTT connections:

- the accessory data connector (SK3);
- the mobile microphone socket (SKT1); or
- the remote PTT socket (EXT-PTT).

A resistor and a switch is needed for each external function button. See "BUTTON-1 and BUTTON-2" on page F-6 for more details.

For example, it is possible to modify a standard TOP speaker microphone (e.g. TOPA-AA-001G) to allow the use of external function buttons. To do this, add two resistors inside the microphone, disconnect the speaker, and crimp a 6-way phone plug onto the cable.

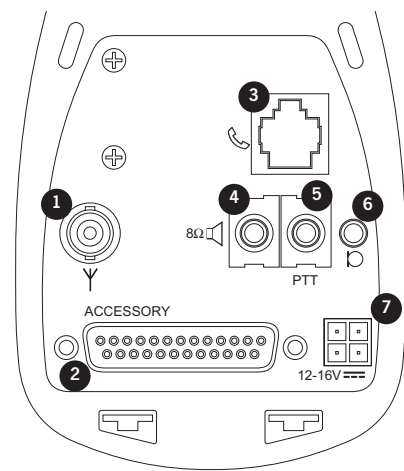
### Setting up 'hookswitch' functionality for a trunked radio

'Hook switch' functionality can be achieved by programming external function BUTTON-1 to **Clear**. As long as the microphone clip is grounded, then whenever the mobile microphone is on-hook, the call will be cleared down. You must unclip the microphone before a call can be initiated.

Note that you do not need to add any resistors, as the mobile microphone already has an inter-

nal 12 k $\Omega$  resistor wired correctly.

Figure F-8: Vehicle kit - rear view showing external connectors



- 1 Antenna BNC connector
- 2 Accessory/data connector
- 3 Mobile microphone socket
- 4 External speaker connector
- 5 Remote PTT connector
- 6 Visor microphone connector
- 7 Power/ignition sense connector

### Vehicle kit external connectors

The tables on page F-18 document the signals available on all of the vehicle kit's external connectors.

Note that the 25-way accessory/data connector provides access to all of the radio's accessory signals, as well as a few vehicle kit specific signals.

See "Tait Orca 5000 accessory connector" on page F-3 for further details about accessory signals.

Table F-9: Vehicle kit power connector  
(SK1 on the charger PCB)

Pin	Signal	Description
1	N/C	–
2	GND	Main ground connection
3	IGN	Switched accessory power - connect to permanent power to disable ignition sense
4	+13V8	Main connection to +13.8 V (vehicle battery). Use 3 A fuses.

Table F-10: Vehicle kit mobile microphone connector  
(SKT1 on the options PCB)

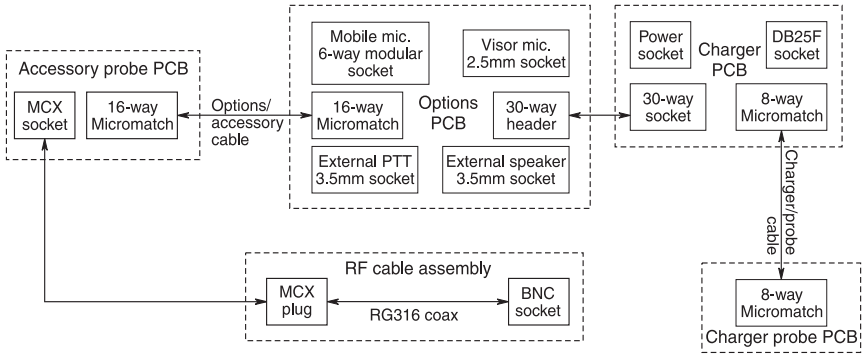
Pin	Signal	Description
1	+13V8LIM	Power out Zout = 10 $\Omega$ ; 100 mA maximum
2	N/C	–
3	EXT-PTT	External PTT and function buttons*
4	MOB-MIC	Dynamic microphone input impedance = 600 $\Omega$
5	GND	Ground
6	N/C	–

\* EXT-PTT is pulled high inside the radio by 27 k $\Omega$ . Function buttons are implemented by pull-downs to ground. For BUTTON-1, R = 12 k $\Omega$ ; for BUTTON-2, R = 27 k $\Omega$ .

Table F-11: Vehicle kit accessory/data connector  
(SK3 on the charger PCB)

Pin	Signal	Description
1	GND	Signal ground
2	RX-IN	RS-232 Receive data to radio
3	TX-OUT	RS-232 Transmit data from radio
4	N/C	–
5	BUSY	Radio receiving low = busy (including beeps)
6	AUDIO-D25	Single ended audio. Zout = 3 k $\Omega$ ; AC coupled
7	GND	Signal ground
8	EXT-MIC-D25	Microphone input Zin = 1 k $\Omega$
9	MOD-AUDIO	To modulator
10	EXT-PTT	PTT and function buttons low = PTT
11	SPKR-OFF	Turns radio and external speaker off low = off
12	RX-DET-AF	Detected receive audio (unmuted)
13	GND	Signal ground
14	+5V	5 V power 25 mA maximum
15	+7V5-ACC	7.5 V from radio 25 mA maximum
16	SENSE-0-ACC	Radio internal speaker control low = off
17	SENSE-1-ACC	–
18	SPKR+	Balanced output from audio PA
19	SPKR-	Balanced output from audio PA
20	N/C	–
21	N/C	–
22	N/C	–
23	N/C	–
24	LVSD	Low voltage shut down - turns off vehicle kit
25	+13V8FILT	13.8V power 500 mA maximum

Figure F-9: Vehicle kit interconnection diagram



## Vehicle kit circuit descriptions

This section provides an outline of the design and describes the modular assembly of the vehicle kit. The vehicle kit contains four PCBs:

- the accessory probe and charger probe PCBs, interfacing to the radio and battery; and
- the charger and options PCBs, containing the electronic circuitry.

A block diagram showing how the four PCBs interconnect and naming the connectors on each PCB is shown in Figure F-9.

The following subsections and their associated diagrams expand on the functionality of each vehicle kit PCB.

## Vehicle kit accessory probe PCB (IPN 220-01506-xx)

This PCB provides the interface to the radio's accessory connector. The audio/control signals connect to the options PCB via a 16-way MicroMatch ribbon cable. The RF signal is routed via an MCX connector and coaxial cable to a BNC connector on the rear of the vehicle kit. A block diagram of this PCB is shown in Figure F-10.

Figure F-10: Vehicle kit accessory probe PCB block diagram

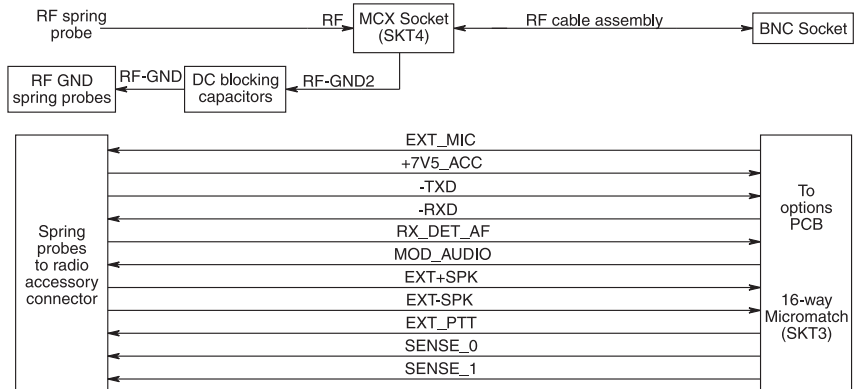
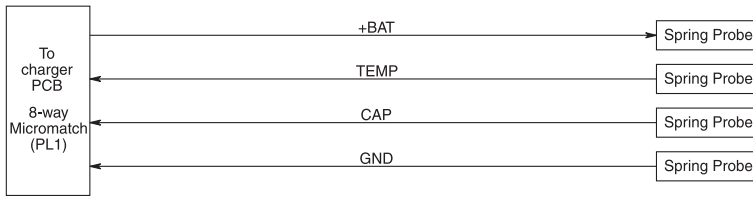


Figure F-11: Vehicle kit charger probe PCB block diagram



**Vehicle kit charger probe PCB (IPN 220-01564-xx)**

This PCB provides the interface to the radio battery for charging and is connected to the charger PCB via an 8-way MicroMatch ribbon cable. A block diagram of this PCB is shown in Figure F-11.

**Vehicle kit charger PCB (IPN 220-01504-xx)**

This PCB contains the fast charger circuit module, the majority of the power supply module and about half of the power save module. A block diagram of this board is shown in Figure F-12.

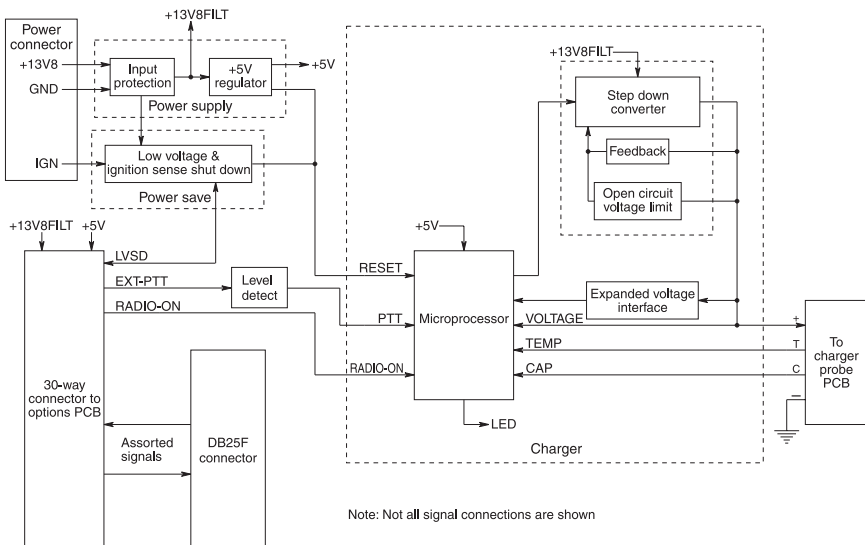
**Current source**

The switch mode current source is based around a Maxim MAX1627 100% duty cycle,

high efficiency, step down DC-DC controller (IC4). The core of the current source is a Buck converter consisting of Q9, L2, C46, C47 and D5. The feedback for the controller (IC4) is via current sense resistors (R58, R59) and a differential amplifier (IC5:B).

In steady state, approximately 0.8 A flows through R58 and R59, generating a voltage which is amplified by the differential amplifier, IC5:B. The output of this is fed into pin 2 of IC4 (FB). The threshold of the feedback input (IC4 pin 2) is 1.3 V, relative to VGND. When the feedback signal on pin 2 is above 1.3 V, the controller (IC4) turns off Q9. Similarly, when the feedback signal is below 1.3 V, the controller turns on Q9.

Figure F-12: Vehicle kit charger PCB block diagram





D4 and R46 create a virtual ground (VGND) and protect the MAX1627 from over voltages. Conducted noise is filtered by C42, C43 and L5. The blocking diode, D6, stops the radio battery from powering the vehicle kit when the current source is off.

The radio is protected from over voltages at the battery terminal by IC5:C, IC5:D and their associated circuitry. If the voltage at the output (BAT1) reaches approximately 10.3 V, then Q3 is turned on by the Schmitt trigger IC5:D. This changes the feedback from current controlled (via IC5:B) to voltage controlled (via IC5:C). The non inverting amplifier of IC5:C is configured such that it overrides the output of IC5:B and sets the output voltage to approximately 10.6 V.

The current source is normally controlled by the micro controller (IC3). When pin 20 goes low, the current source is turned on.

#### Fast charger micro controller

IC3 is a 68HC05 based micro controller, which runs custom charger software to control the current source and intelligently monitor the charge state of the battery. Note that this software behaves differently from the desktop fast charger software. When working correctly the microcontroller will always make the LED glow orange for 3 seconds whenever power is reapplied.

The line into IC3 pin 1 (RESET) is used by the 5 V regulator (IC1) to control the startup of IC3. RESET is only released by IC1, once power has stabilised and the circuits are powered up. The RESET line is also controlled by the power save circuitry, so that the fast charger can be turned off.

The control line for the current source is IC3 pin 20, with low being on and high impedance being off. This line controls the current source, via Q7.

The coarse voltage input used for general voltage measurements is IC3 pin 16. The expanded voltage input used for fine voltage

measurements is IC3 pin 17. Battery temperature is measured via IC3 pin 18. This pin is pulled to ground via a 10 k $\Omega$  (nominal) thermistor inside the battery case. The battery capacity input used to tell the charger whether the battery is NiCd or NiMH is IC3 pin 19.

The line to IC3 pin 7 is an input which tells the micro controller when the vehicle kit PTT is activated. The line to IC3 pin 9 is an input which tells the micro controller when the radio is on.

#### Vehicle kit power supply input protection

Power to the circuit (13.8 V nominal) is provided through a Mini Fit Molex connector. Protection circuitry consists of a 22 V transient suppressor (D1) and a 2.5 A PolySwitch™ (PS1). C11 and C12 provide some filtering of the input power.

Over voltage protection is also provided by D1. Short transient over voltage (>22 V) pulses will be clamped by D1, preventing harm to the circuit. Longer sustained over voltage conditions, such as incorrect connection to a 24 V vehicle supply, will cause D1 to conduct and eventually fail to a short circuit state. This will result in a power lead fuse blowing or PS1 tripping, if the fuses are of the incorrect rating (> 3A) or not fitted (i.e. the line is shorted).

#### Vehicle kit power supply 5 volt regulator

IC1, an L4949, is the 5 V regulator for the vehicle kit and produces the +5 V rail. It also controls the RESET line of the micro controller under startup and will reset the micro controller if there are any voltage dips. C13 is fitted to improve output noise and transient response. C14 sets the reset delay time. The tantalum capacitor C15 maintains the stability of the output voltage. The maximum current available from the +5 V rail is 100mA.

#### Vehicle kit power supply power save

The low voltage shut down (LVSD) circuitry on the charger PCB is used to power down sections of the vehicle kit under various condi-

tions. If the vehicle battery gets below 11 V, the Schmitt trigger built around IC2:A will go high, turning on Q1 and pulling the RESET line low. This will turn off the fast charger to conserve the vehicle battery. The output of IC2:A is also fed to the options PCB and the base of Q6. This puts the audio power amplifier (IC4) into standby to conserve the vehicle battery.

The ignition sense input to the charger PCB (IGN on pin 3 of the power connector) can be used to turn off the vehicle kit when the vehicle ignition is off. If IGN is wired to permanent power, then this feature is disabled. If IGN is wired to switched accessory power, then when the ignition is off the fast charger and the audio power amplifier are turned off via IC2:A.

LK4 is not fitted. It can be used to disable ignition sense for bench testing.

The diode (D2) in the feedback path of IC2:A is used to increase the hysteresis of the Schmitt trigger. Thus when low vehicle battery voltage triggers IC2:A, the vehicle battery must recover by approximately 1 V above the threshold before the vehicle kit will be powered up.

Note that to adjust the LVSD threshold, voltage

divider R22, R24, R25 and R26 must be changed.

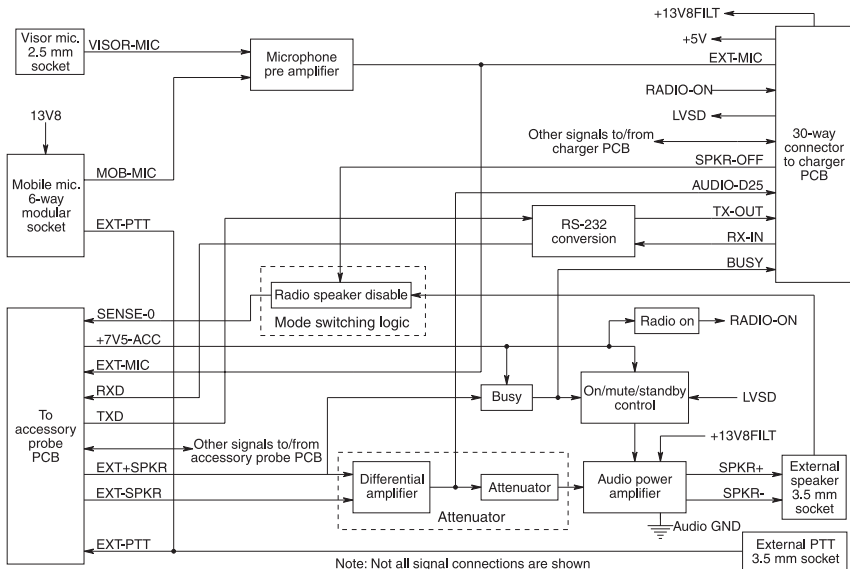
### Vehicle kit options PCB (IPN 220-01505-xx)

This PCB contains the mode switching logic, the microphone pre-amp, the RS-232 conversion module, the audio power amplifier with its associated input circuitry and the mute/standby module. A block diagram of this board is shown in Figure F-13.

#### Audio Power Amplifier and Associated Circuitry

The audio power amplifier takes the differential audio available at the radio accessory pins and amplifies it to drive an external speaker. The first stage is a differential amplifier (IC2:B) with a gain of -6 dB (0.5). This produces a single ended audio signal at pin 7 which is tapped off along two paths. The first path is via the voltage divider R69 and R68 which attenuate the signal by a factor of 100 (-40 dB). This signal is then AC coupled into IC4 which is configured for Bridge Tied Load (BTL) operation and has a fixed gain of 46 dB (200). IC4 is a Philips TDA1519A car audio power amplifier chip.

Figure F-13: Vehicle kit options PCB block diagram



Note that the recommended method for changing the gain of the audio power amplifier is to adjust the ratio of the voltage divider formed by R69 and R68.

The second path for the single ended audio signal present at pin 7 of IC2:B is via R78 and C52, to become the AUDIO-D25 signal. This signal has its output at pin 6 on the D25 connector on the charger PCB. The minimum input impedance of a circuit that connects to AUDIO-D25 is 6kΩ. The recommended input impedance would be 47kΩ.

The audio PA has three modes of operation (standby, mute and on) which are set by the voltage at pin 8. A pull-up for the on mode is provided by R75, while Q3 controls the mute mode, by switching in R73 to form a voltage divider with R75. Q4 pulls IC4 pin 8 low to control the standby mode. The following table summarises the PA operation.

Table F-12: Vehicle kit option PCB - audio PA operation

Mode	Voltage Level	Controlled By
On	> 8.5 V	Q3: off Q4: off R75: Pull up
Mute	3.3 V - 6.4 V	Q3: on Q4: off R75/R73: divider
Standby	< 2 V	Q4: on

When the audio PA is in either the mute or on mode, its outputs (pins 4 & 6) are biased with a DC level of approximately 6.5 V.

A BUSY signal is created by looking at the DC bias on the EXT+SPKR signal. IC2:A is configured as a Schmitt trigger and is used to produce the BUSY signal (pin 1). R67 and C27 provide filtering of the audio signal so that IC2:A is not falsely triggered by large audio peaks. The reference signal is produced from +7V5-ACC via the voltage divider of R65 and R66.

The 7V5-ACC signal is accessory power from the radio and indicates if the radio is switched

on. If there is no 7V5-ACC signal then the audio PA is held in its standby mode via Q7 and Q4. When the DC bias is absent from EXT+SPKR, BUSY is high and the audio PA is held in its mute mode via Q3. The audio PA can also be put into standby mode via the SPK-CUT control signal being high. Q4 will always override Q3.

Putting the audio PA into standby is part of the power save feature of the vehicle kit. LVSD is a control line from the charger PCB which goes high when the vehicle battery is too low (<11V). If LVSD is high then the audio PA is put into standby mode via Q6, Q7 and Q4.

A 3.5mm stereo phono socket is used to connect the external speaker. When the mono plug of an external speaker is attached, the middle connection of the stereo socket (SPKSENSE) is shorted to one of the audio PA output signals. When the audio PA is operating there is a DC bias of approximately 6.5 V (half rail) on both of its outputs. This bias is used to turn on Q5, which pulls SENSE-0-ACC low, disabling the radio's internal speaker.

The D25 connector has a control line called SPKR-OFF on pin 2. If the accessory connected to the D25 connector has a speaker, then by pulling SPKR-OFF low all other speakers can be disabled. The SPKR-OFF signal is inverted by Q9 to produce SPK-CUT. If SPK-CUT is high, then the audio PA will be placed in standby mode via Q4 (which turns off an external speaker if it is connected). SENSE-0-ACC is pulled low to disable the radio's internal speaker.

Microphone pre-amp

A capacitor multiplier formed by Q2, R2 and C19 is used to filter the +5 V supply producing +5V-FIL which is used to provide DC bias for the microphones via R3 and R22.

The internal microphone in the radio is disabled by an impedance to ground, which is typically the electret microphone of a speaker microphone. In the vehicle kit this is accomplished by R28, which is connected to the EXT-

MIC-D25 line. Thus whenever the radio is in the vehicle kit the internal microphone is disabled.

#### RS-232 Conversion

An RS-232 level 3 wire serial port is provided at the DB25 connector (TX-OUT, RX-IN, GND), for use by devices such as data terminals. The radio provides CMOS level serial communications via the RXD and TXD signals. These signals are converted to full RS-232 voltage levels (i.e. +10 V for a logic 0, and -10 V for a logic 1) by IC3.

PART

# G

## Additional information

This part provides a glossary of terms.

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# Glossary

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**Note:** Terms that appear in *italics* are also defined in this 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.

## **ANR**

Automatic Noise Reduction

## **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.

## **chassis, old/new**

See "New chassis" on page A-5 and "Accessory connector compatibility" on page G-8

## **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).

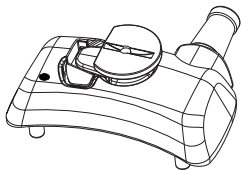
## **CTCSS**

Continuous Tone Controlled Squelch System. Continuous, subaudible coding on the channel for the purpose of segregating user groups.

## **D-Clip**

Accessory connector with protruding 'D' which allows the radio to be hung from a belt loop (TOPA-CA-103). The new and old D-Clips have different *quarter turn* tips. The old D-Clip has hooks on the locating posts. The

new D-Clip has a green dot on the outside at the bottom left corner. The D-Clip must be checked for compatibility with the *chassis* before use (see “Accessory connector compatibility” on page G-8).



### **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.

### **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 radios.

### **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.

### **green chassis/accessory**

‘Green’ chassis/accessory may be used in reference to the new *chassis* or associated accessories. This is due to the green seal used behind the quarter turn tip hole in the new *chassis* and a green dot on the lower left corner of the accessory connector.



## **G-STAR**

General Electric status and reporting system. Signaling is used to identify individual radio users by assigning a unique number to each radio. This is sent out each time the radio transmits, and is decoded by the dispatcher, giving a visual identification of the radio in use.

## **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 dialed string at radio programming time.

## **LCD**

Liquid crystal display.

## **LED**

Light emitting diode.

## **LPF**

Low pass filter.

## **MCU**

Micro control unit.

## **mute**

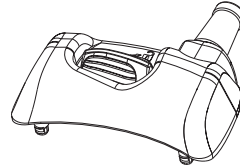
The receive audio gating element. When active, receive audio is passed to the speaker. The decision to activate/deactivate the audio signal path is based on an evaluation of signaling codes (*CTCSS*, *DCS*, *Selcall*) contained in the audio information (contrast with *squelch*).

## **number**

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

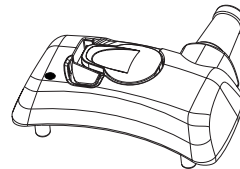
## **P-Clip**

Accessory connector (without protruding 'D' or lock spring tab), designed for use with the old *chassis*. There are small hooks on the locating posts.



## **P-Clip, Green**

Accessory connector (without protruding 'D'), designed for use with the new *chassis*. It has a green dot on the outside at the bottom left corner.



## **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.

**quarter turn**

This is the part of the accessory connector that rotates 90 degrees to lock the connector to the radio. The quarter turn tip is the end with the lugs.

**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*.

**Two-tone**

Also known as Type 99. In-band, two tone sequential signaling used to control the muting of a radio. Used for selective calling of individual units or groups of units. Tait Orca radios are able to decode Two-tone individual, group and super group calls.

**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 synthesis-

er (*PLL*) and the modulation signals TCXO-MOD and VCO-MOD.

**VOX**

Voice operated transmit.





# Accessory connector compatibility

Attempting to use an incompatible accessory connector with a particular chassis will result in damage to both the radio and connector. See “New chassis” on page 5.

The following table shows the compatibility of

the old and new accessory connectors with the various chassis.

How to identify a P-Clip, Green P-Clip or D-Clip accessory connector is explained in the Glossary.

Connector	Elan, Excel or Eclipse	TOP 5000 (01 Chassis)	TOP 5000 (02 Chassis)	TOP 5000 (current chassis)
				
Old P-Clip†	✓	✓	✓	✗
Old P-Clip† (Enhanced/Hardened)	✓	✓	✓	✗
New Green P-Clip (with green dot)	✗	✗	✗	✓
Old D-Clip‡	✗	✓	✓	✗
New D-Clip (with green dot)	✗	✗	✗	✓
Old Vehicle Kit	✓	✓	✓	✗
New Vehicle Kit (with green quarter turn tip)	✓	✓	✓	✓
Old Dummy Cover	✓	✓	✓	✗
New Dummy Cover	✗	✗	✗	✓

\* The graphic shows the shape of the hole for the accessory connector’s quarter turn tip on the back of the radio.

† There is a green seal inside the chassis.

‡ The old P-Clip and old D-Clip both have small hooks on the locating posts. This requires the accessory connector to be held at an angle of 15 degrees while the posts are inserted. See M5000-00-103 for details.

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# Notes

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