PART B

Radio specifications and circuit descriptions

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

Contents

Radio specifications

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

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

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

Table B-1: General specifications

Size W x H x D (including 1100 mAh NiCd battery)	62 mm x 153 mm x 44 mm (2.4 in x 6.0 in x 1.7 in)
Weight (including 1100 mAh NiCd battery)	
Orca Elan	495 g (17.5 oz)
Orca Excel	520 g (18.3 oz)
Orca Eclipse	520 g (18.2 oz)
Switching band	A 66-88 MHz B 136-174 MHz C 174-225 MHz G 336-400 MHz H* 400-470 MHz I 450-530 MHz J 806-870 MHz Tx 851-870 MHz Rx K 896-941 MHz Tx 935-941 MHz Rx

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

Frequency increments	5, 6.25 kHz
IF bandwidth	
Narrowband	9 kHz
Medium/wideband	20 kHz
Universal bandwidth (UB)	10 kHz
Channel spacing	12.5/20/25 kHz
Supply voltage	6.0-9.0 V
Standard test voltage	7.5 V
Battery capacity	
NiCd (TOPB100, 600)	1100 mAh
NiCd (TOPB200)	1500 mAh
NiMH (TOPB400, 700)	1500 mAh
NiMH (TOPB500)	2000 mAh
Current consumption*	
Transmitting (1 W)	1.0 A
Transmitting (4/5 W)	1.8 A
Receive (rated audio)	270 mA
Standby (conventional)	80 mA (no economy mode) 40 mA (economy mode high)
Standby (trunked)	100 mA (hardware version 00.xx) 90 mA (hardware version 02.xx)
Scanning (conventional)	75 mA (economy mode on)

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

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

Table B-2: Receiver performance

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

Table B-3: Transmitter performance

Power output	
136-174 MHz	1 W (low) 2.5 W (medium) 5 W (high)
174-530 MHz	1 W (low) 2.5 W (medium) 4 W (high)
806-941MHz	1 W (low) 2 W (medium) 3 W (high)
Duty cycle	20% (1 minute Tx, 4 minutes Rx at maximum temperature and voltage)
Spurious emissions	
to 1 GHz	-36 dBm (conducted and radiated)
1 to 4 GHz (136-470 MHz)	-30 dBm (conducted and radiated)
1 to 12.75 GHz (470-870 MHz)	-30 dBm (conducted only)
Adjacent channel	
narrowband	60 dBc
mediumband	70 dBc
wideband	70 dBc
Group delay variation	±50 µs (at mod audio output)
bandwidth	300-3000 Hz
Modulation type	direct FM
Deviation limiting	±5 kHz (adjustable up to)
narrowband	±2.5 kHz
mediumband	±4.0 kHz
wideband	±5.0 kHz

Trunking data deviation (as per MPT1327)	
narrowband	1.5 kHz
mediumband	2.4 kHz
wideband	3 kHz
FM hum and noise	
narrowband	40 dB
wideband	45 dB
Audio response	
below limiting	6 dB/oct +1, -3 dB (cf 1 kHz) 300-3000 Hz
in limiting	0 dB +0, -4 dB (cf maximum system deviation) 450-2550 Hz
above 3 kHz	-35 dB/oct min
input for 60% deviation	5 mV_{rms}
distortion	<5% at 1 kHz
Ruggedness	2 minutes (into infinite SWR)
Stability	5:1 SWR (all phase angles, <-60 dBc)

Circuit descriptions

Figures B-1 and B-2 and show the circuit interface diagram for the Tait Orca handportable.

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

Transmitter

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

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

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

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

Transmit (Tx) audio

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

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

Receiver

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

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

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

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

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

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

Receive (Rx) audio

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

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

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

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

Synthesiser and VCO

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

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

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

Power supplies

+5V-DIG

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

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

+5V-AN

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

+5V-TX

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

+7V5-BATT

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

+7V5-ACC

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

+7V5-SW

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

+14V

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

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

+4V3-DEC

The +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: Interfacing non-Tait accessories*.

Universal band versus wideband IF filtering

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

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