

CHAPTER 1

GENERAL DESCRIPTION

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CHAPTER 1

GENERAL DESCRIPTION

INTRODUCTION

1. The TR28B2 is a lightweight, channelised, battery powered transceiver designed primarily as a portable s.s.b. communications set operating in the 1,6MHz to 8MHz band. Up to 36 channels are available, the frequency of each channel being determined by the crystals installed. CW and compatible a.m. facilities are provided and a full range of accessories allow the set to be used under various conditions and environments including fixed and mobile operation.
2. Transmitter power output on s.s.b. is 25W between 2MHz and 8MHz and can be reduced to 5W, by a front panel control, for local operation.
3. Provision is made for various types of antenna to be used with the set: whip, slant wire, dipole etc., each antenna being tuned for the frequency in use by a front panel control. To tune under conditions of radio silence a tuning signal derived from an internal signal generator is fed to the antenna system. It is arranged that maximum sound in the headphones will correspond to the correct antenna coupling for the frequency selected. If radio silence is not required a 1kHz tone generator in the set may be used to tune the transmitter.
4. Two audio sockets, wired in parallel, are provided on the front panel. Audio input and output may be via hand-microphone-telephone (h.m.t.) to either of the sockets or a microphone with a press-to-talk (PTT) switch and separate headphones may be used.
5. The set incorporates an internal battery charging circuit which enables the internal battery to be charged in situ from any convenient 12V d.c. source. If the battery is removed from the set, then a.c. from a suitable source (the RACAL MSU 23 for example) or 12V d.c. may be used for charging.

TECHNICAL SPECIFICATION

6. The following specification is for normal conditions at room temperature and performance figures measured with a 12,6V d.c. supply. Worst case conditions can be supplied by the company on request.

General

- | | |
|--|---|
| 7. (a) Frequency Range | - 1,6MHz to 8MHz (36 channels) |
| (b) Temperature | - -10° to $+55^{\circ}\text{C}$ |
| (c) Supply Voltage | - 12V to 14V d.c. |
| (d) Power Supply | - 12V d.c., 5,0AH Nickel-cadmium rechargeable battery 10 cells |
| (e) Operating Modes | - SSB Telephony, A3J - USB and LSB
Compatible AM, A3
CW Telegraphy, A1 |
| (f) Frequency Stability | - Better than $\pm 100\text{Hz}$ at 1,6MHz rising linearly to $\pm 200\text{Hz}$ at 8MHz.
Internal trimmer range greater than 50ppm. |
| (g) Netting (TX and RX simultaneously) | - Range $\pm 100\text{Hz}$ minimum on channel frequency. Channel to be within $\pm 45^{\circ}$ of mechanical centre. |

Transmitter

8. (a) Power output (into 50 ohms)
- (i) SSB (High Power) for 26dB IP relative to PEP
 - 1,6MHz to 1,99MHz, 20W p.e.p. ± 1 dB
 - 2MHz to 8MHz, 25W p.e.p. ± 1 dB
 - (ii) AM (High Power)
 - 3W minimum
 - (iii) CW (High Power)
 - 1,6MHz to 1,99MHz, 10W r.m.s. ± 1 dB
 - 2MHz to 8MHz, 12W r.m.s. ± 1 dB
 - (iv) CW (Low Power)
 - 1,6MHz to 1,99MHz, 1W r.m.s. ± 1 dB
 - 2MHz to 8MHz, 2,5W r.m.s. ± 1 dB
- (b) Harmonic Emission (Using 2,4m to 3,6m Whip Antenna)
 - -40dB relative to the maximum available power out
- (c) Spurious Emission
 - spurious emissions separated from the carrier by more than 20kHz will be attenuated by at least 40dB relative to the maximum available power out.
- (d) Carrier Suppression
 - -40dB relative to the maximum available power output.
- (e) Unwanted Sideband Suppression
 - -40dB relative to 1kHz
- (f) Microphone Sensitivity (at 1kHz)
 - 1mV p.d. maximum for full output on SSB
- (g) Transmitter Current Consumption
 - 5,5A maximum

Receiver

9. (a) Sensitivity
- (i) SSB
 - A 3 μ V e.m.f. input from a 50 ohm source produces a minimum output of 320mV r.m.s. into 300 ohms.
 - (ii) AM
 - A 30 μ V, 30% modulated input from a 50 ohm source produces a minimum output of 60mV r.m.s. into 300 ohms.
- (b) Selectivity (relative to 1kHz)
- (i) SSB Bandwidth
 - Minimum 2kHz at -6dB
 - Maximum 5,5kHz at -40dB
 - (ii) AM Bandwidth
 - Minimum 6kHz at -6dB
- (c) Audio Frequency Response
- (i) Lower limit
 - 100Hz to 500Hz at -6dB relative to 1kHz
 - (ii) Upper limit
 - Determined by audio bandwidth
- (d) Audio Output
 - Factory set for 1mW maximum into 300 ohm headphones.
- (e) Signal to Noise Ratio (S+N/N)
- (f) AGC
 - 1 μ V e.m.f. input gives a minimum of 10dB
 - Threshold between 1 μ V and 3 μ V e.m.f.
 - The audio output will change by less than 3dB for 3 μ V to 1mV e.m.f. input.
- (g) Image Rejection
 - minimum 75dB
- (h) IF Rejection
 - minimum 60dB
- (j) Receiver Current Consumption
 - 90mA maximum

Figure 1.1

FUNCTIONAL DESCRIPTION

10. The transceiver circuits comprise the Receive path and Transmit path, each path using some common circuits, a TX/RX switch and an antenna tuning unit (ATU). Separate power supply regulators



provide the different voltages required. The following description is of the functional block diagram (Figure 1.1). It should be noted that the RX signal path is indicated by closed arrows and the TX signal path is indicated by open arrows.

Receive Path

11. The received signal from the ATU is routed via the TX/RX switch to a r.f. amplifier. The output is fed through the Image Suppression Filter which is a low pass filter suppressing all frequencies above 8MHz. The i.f. of 10,7015MHz is above the signal frequency and therefore the image frequency is very much higher than the signal frequency:
e.g. $f_{sig} = 5\text{MHz}$
 $f_{xtal} = 15,7015\text{MHz}$
 $f_{im} = 20,7015\text{MHz}$
12. The above technique allows the use of a simple filter to suppress all signals above 8MHz thus avoiding the use of switched coils when changing frequency.
13. The RX signal is mixed with the output of the 36 channel crystal oscillator, which is at $f_{sig} + 10,7015\text{MHz}$, and the resulting signal at 10,7015MHz is fed to a diode switch which routes the i.f. through the appropriate sideband filter (USB or LSB), amplifier. The i.f. signal is then mixed with the output of the carrier oscillator (10,7015MHz) in the demodulator.
14. The audio output from the demodulator is amplified and fed to an audio power amplifier the output of which drives a pair of headphones.
15. Part of the output of the audio amplifier is fed to the a.g.c. amplifier, its output providing an a.g.c. voltage for the i.f. stages of the receiver.

Transmit Path

16. The microphone input (or 1kHz from tone generator) is amplified and passed to the modulator where it is mixed with the output of the carrier oscillator (10,7015MHz) thus producing a double sideband i.f. This signal is amplified in the a.l.c. controlled TX IF amplifier and routed through the appropriate sideband filter as controlled by the sideband switch.
17. The SSB signal is mixed with the output of the channel oscillator to provide the signal frequency. The r.f. is amplified to 25W p.e.p. in the pre-amplifier, driver amplifier and power amplifier stages and is fed via the TX/RX switch and the ATU to the antenna.
18. Automatic level control (a.l.c.) signals derived from the PA stage are amplified in the a.l.c. amplifier, the output controlling the TX i.f. amplifiers. Overload protection of the PA stage is also provided by a current a.l.c. signal which controls the bias of the pre-amplifier stage.

Antenna Tuning Unit

19. The ATU matches whip or 50 ohm antennas to the TX output and RX input.

Sidetone

20. In the transmit condition, the first RX audio amplifier operates as a diode which passes attenuated speech or keyed tone signals to the audio output stages.

Noise Generator

21. A simple multivibrator circuit generates a low frequency train of pulses with a high harmonic content when in the tune condition. This allows the transceiver to be tuned without using radiated power and therefore breaking radio silence.

PTT

22. Operation of the PTT switch (either microphone or CW key) energises relay RL1. The contacts of this relay perform two functions:-
- (a) connects the output of the TX PA stage to the ATU and earths the input to the receiver.
 - (b) activates the +9V supply to the transmit circuits and de-activates the +9V supply to the receive circuits.

POWER SUPPLIES

23. The primary power source of 12V is provided from nickel-cadmium cells contained in a separate battery box clipped to the base of the transceiver. The batteries are rechargeable in situ from an external 12V supply via d.c. to d.c. converter contained in the transceiver, or, from a 12V d.c. or suitable 13,6V a.c. charging source with the battery box removed.
24. The 12V supply provides inputs to the following:
- (a) 9V regulator - provides the main supply for all common TX/RX circuits, and via transistor switches the main supplies (9V TX and 9V RX) to the TX and RX circuits.
 - (b) DC/DC converter - provides the main supply (36/12V TX) for the PA stage, controlled by relay RL1.
25. The 12V supply also provides the main supply for the transmitter pre-amplifier and driver amplifier stages, also controlled by relay RL1.

Figure 1.2

MECHANICAL DESCRIPTION

General Construction

26. The TR28B2 comprises a cast aluminium front panel on which are mounted the operator controls and input and output connectors. Two carrying handles are integral parts of the casting. A chassis secured to the rear of the front panel contains the main p.c.b., crystal board and the DC converter. Mounted on the side of the chassis are the components comprising the Power Amplifier stage.
27. An antenna tuning unit, comprising a coil in which a ferrite rod is inserted by a lead-screw controlled by the front panel TUNE control, is also secured to the rear of the front panel.
28. A cast aluminium box cover is secured to the rear of the front panel by four screws.
29. A separate battery box containing ten nickel-cadmium cells and a charging circuit is clipped to the bottom of the transceiver by two quick release thumb catches. A socket in the battery box mates with a plug in the bottom of the transceiver when the battery box is clipped in position.

Figure 1.3

Front Panel Controls

30. A list of front panel controls and brief descriptions of their functions appear below. Full operating instructions are given in Chapter 2.
- (a) AUDIO sockets SK1 and SK2 - Identical 7 pin sockets connected in parallel. Used to connect h.m.t. or morse key and external charging source.
 - (b) 50 Ω Antenna socket SK3 - Used to connected 50 ohm antenna
 - (c) LSB/USB switch S1 - Selects required sideband and appropriate crystal bank A, B or C
 - (d) CHANNEL switch S2 - Selects required channel frequency on crystal bank selected
- by S1.
 - (e) BAND switch S3 - Selects one of three functions, TUNE, HP, LP, in each of the two following bands: 1,6 - 4MHz and 3,5 - 8MHz.

- (f) MODE switch S4
 - Selects the following modes of operation:
 - (i) OFF
 - (ii) REC - reception only
 - Internal batteries can be charged with S4 in either of the above positions.
 - (iii) SSB - reception and transmission in voice using PTT switch.
 - (iv) BK CW - CW transmission and reception
 - (v) CW - CW transmission only
 - (vi) AM - AM transmission and reception
- (g) GAIN control RV6
 - Controls IF gain of receiver
- (h) NET control RV12
 - Allows netting i.e. slight adjustment of transceiver frequency to cope with received frequencies slightly above or below the nominal channel frequency.
- (j) TUNE lamp LP1
 - TUNE control adjusted for maximum brilliance of LP1
- (k) METER M1
 - Indicates state of battery charge and received signal strength.

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