MICROWAVE MODULES LTD

MMT 144/28 MHz LINEAR TRANSVERTER

INTRODUCTION

This unit is a high performance solid state 144 MHz transverter for use in SSB, FW, AM and CW modes.

Please read this instruction book carefully to get the full benefit from your MMT144/28.

UNIT DESCRIPTION

This 144 MHz solid state linear transverter is intended for use with a 28 MHz transceiver to produce a high reliability transceive capability for satellite or terrestrial communication.

The inclusion of an RF vox network minimises the necessary connection to the drive source, and will automatically switch the transverter into the transmit mode when 28 MHz drive is applied. For further details refer to page 10.

The incorporation of a low noise receive converter and a low distortion transmit converter makes the unit ideal for all types of communication, particularly where a high degree of stability, sensitivity and linearity are of prime importance.

The unit is housed in a highly durable black diecast case and all circuitry is constructed on high quality glass-fibre printed circuit board. The high power linear amplifier stages are housed in a separate internal compartment, thus ensuring excellent electrical and thermal stability.

A wide range of applications is offered by this MMT 144/28 transverter, which by virtue of its linear mode of operation will enable 28 MHz, SSB, FM, AM or CW equipment to be used at 144 MHz.

SPECIFICATION

GENERAL

FREQUENCY COVERAGE	:	144 – 146 MHz
INPUT FREQUENCY RANGE	:	28 – 30 MHz
DC POWER REQUIREMENTS	:	11 – 13.8 VOLTS (12.5 VOLTS NOMINAL)
CURRENT CONSUMPTION	:	300 mA QUIESCENT 2.1 AMPS PEAK
RF CONNECTORS	:	50 ohm BNC SOCKETS
POWER CONNECTOR	:	5 PIN DIN SOCKET
SIZE	:	187 x 120 x 53 mm ($7\frac{3}{8} \times 4\frac{3}{4} \times 2\frac{1}{16}$)
WEIGHT	:	900 GRAMS (2 lb)

RECEIVE SECTION

OVERALL CONVERTER GAIN	:	30 dB TYPICAL
OVERALL CONVERTER NOISE FIGURE	:	2.5 dB MAXIMUM
INPUT IMPEDANCE	:	50 ohm
IF OUTPUT IMPEDANCE	:	50 ohm
QUIESCENT RECEIVE CURRENT	:	100 mA

SPECIFICATION

TRANSMIT SECTION

INPUT IMPEDANCE	:	50 ohm
INPUT MODES	:	SSB, FM, AM or CW
INPUT REQUIRED FOR FULL OUTPUT	:	1 mW TO 750 mW (SEE PAGE 10 FOR FURTHER DETAILS)
POWER OUTPUT	:	10 WATTS CONTINUOUS RATING
OUTPUT IMPEDANCE	:	50 ohm
RELATIVE 116 MHz OUTPUT	:	BETTER THAN – 65 dB
OTHER SPURIOUS OUTPUTS	:	BETTER THAN – 65 dB
QUIESCENT TRANSMIT CURRENT	:	300 mA

LOCAL OSCILLATOR

LOCAL OSCILLATOR FREQUENCY	:	116 MHz
MAXIMUM FREQUENCY ERROR AT 144 MHz	:	1 KHz
TYPICAL DRIFT AT 144 MHz	:	1 KHz/HOUR
FREQUENCY SENSITIVITY OVER VOLTAGE RANGE 11 – 13.8 V	:	50 Hz

SOCKET FUNCTIONS

144 MHz INPUT

This socket is not connected, since for transceive operation the receive input is routed through the socket marked "144 MHz output". However, should external changeover be required, see page 10.

PO

This socket carries all the DC functions of the transverter.

CARE SHOULD BE TAKEN TO AVOID REVERSE POLARITY, WHICH MAY RESULT IN SEVERE DAMAGE TO THE UNIT.

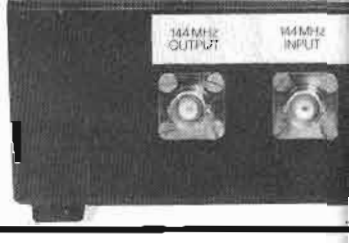
When looking at the socket as pictured below, connections are as follows:-

PIN 1 – SWITCHING (T/R)

This line should be grounded to select the transmit mode, which may be achieved by connection to your transceiver switching. The current drawn from this pin, relative to earth, is 1 mA.

144 MHz OUTPUT

As supplied, the transverter is wired for transceive operation, and this socket is used as the common 144 MHz input/output. Whilst the P.A. transistors are able to withstand a considerable degree of mismatch, it is recommended that the SWR **should not exceed 2 : 1**



SOCKET FUNCTIONS

ER

PIN 2 – NO CONNECTION

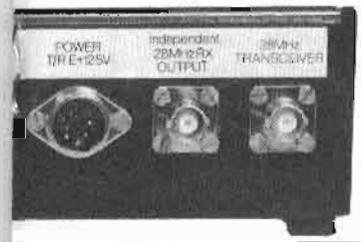
PIN 3 – NEGATIVE (E)

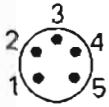
This line should be connected to the negative side of the supply, and earth.

PIN 4 – NO CONNECTION

PIN 5 – POSITIVE (+ 12.5V)

This line should be connected to +12.5 Volts in both receive and transmit modes.





INDEPENDENT 28 MHz RX OUTPUT

As supplied, the transverter is wired for transceive operation through the socket marked "28 MHz TRANSCEIVER". However, it is possible to use the internal receive converter independently with transceivers having separate input and output sockets at 28 MHz. This may be achieved by connecting the output from this socket to the aerial input of such a transceiver.

28 MHz TRANSCEIVER

For transceive operation at 144 MHz this socket should be connected to the low level socket of your 28 MHz transceiver. Incoming 28 MHz RF power is sampled by the RF VOX network, which enables appropriate connection to the receive or transmit section of the transverter to the existing 28 MHz transceiver. On receive this socket provides access to the receive converter, thus allowing incoming 144 MHz signals to be converted to 28 MHz. The input level is continuously variable in the range 0·1 mW to 750 mW. Fur further details, refer to page 10.

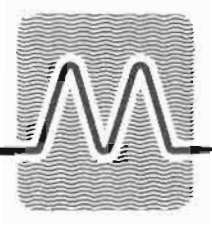
CIRCUIT DESCRIPTION

CRYSTAL OSCILLATOR AND BUFFER AMPLIFIER STAGES

A zener-controlled crystal oscillator using a high stability 5th overtone quartz crystal at 116 MHz provides a high degree of accuracy and frequency stability for the transverter. The output from the oscillator is fed into a grounded-gate J-FET buffer amplifier stage producing sufficient local oscillator drive for both receive and transmit mixers. The output from this buffer amplifier is fed into a bandpass filter which ensures that the oscillator chain is free of spurious outputs.

RECEIVE CONVERTER

Incoming 144 MHz signals are passed through the PIN diode aerial change-over relay to the RF amplifier stage, incorporating a protected dual-gate MOSFET. This stage then feeds a protected dual-gate MOSFET mixer coupled by a bandpass filter network, which ensures further image rejection. This mixer combines the 116 MHz local oscillator injection with the incoming 144 MHz signal to produce the intermediate frequency of 28 MHz. Conventional high Q inductances are used throughout which ensures excellent selectivity and image rejection performance.



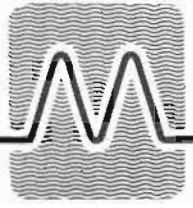
CIRCUIT DESCRIPTION

TRANSMIT CONVERTER

The incoming 28–30 MHz signal is fed into a continuously variable input attenuator, capable of handling input levels in the range 5 mW to 750 mW. In addition to this attenuator, provision has been made for input levels of less than 5 mW to be used. For further details see page 10. The required level is then fed into a balanced mixer, incorporating two protected dual-gate MOSFETS, and is mixed with the 116 MHz local oscillator injection to produce the 144 MHz required frequency. High Q circuitry is used in this area to filter out the local oscillator, and to ensure a spurious-free output signal. This low-level signal is then fed through two amplifier stages running in class AB and then into the power amplifier compartment for final amplification up to the required 10 watt power output level.

POWER AMPLIFIER COMPARTMENT

This two stage linear amplifier uses the latest state of the art devices, which produce a highly reliable continuous power output of in excess of 10 watts. Biasing is provided for these stages from a thermally coupled diode network. High Q circuitry is used for all circuits on this board, including those associated with the PIN diode aerial changeover relay. This PIN diode switch has many advantages over a conventional relay, the most important being its low insertion loss, of lower than 0.2 dB.



SYSTEM CONSIDERATIONS

5mW - 750mW
7 - 29 dBm
0,1 - 15mW
-10 - 12dBm

INPUT ATTENUATOR

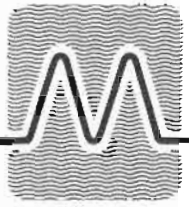
The input sensitivity potentiometer in the transverter exists to attenuate the 28 MHz input drive down to a suitable level to give a linear output power of 10 watts from the transverter. Adjustment can be made to this potentiometer to enable a drive level in the range 5 mW to 750 mW to be used for a linear output power of 10 watts. On removing the main lid, a small preset potentiometer can be seen, located on the main printed circuit board, half-way along the side remote from the PA compartment. To increase the sensitivity, which has been preset for 500 mW, rotate the slider of the potentiometer clockwise until the transverter just draws a maximum DC current when driven by a 28 MHz carrier wave. In addition to the range available from this attenuator, it is possible by linking the two pins near to the present potentiometer, to increase the sensitivity even further to allow operation with equipment having an output level of less than 5 mW. The range now available from the preset potentiometer is 0.1 mW to 15 mW. After these pins have been linked, the adjustment procedure described above should be carried out.

TRANSMIT/RECEIVE SWITCHING

Grounding pin 1 of the 5 pin DIN power socket will switch the transverter into the transmit mode. This may be achieved by connection to your transceiver switching circuitry. Alternatively, in the absence of this connection, the transverter will be switched into the transmit mode when 28 MHz drive is applied, by means of internal RF VOX circuitry. However, we would recommend that the RF VOX is used only in circumstances where the transverter is used remotely from the transceiver, or when the transceiver does not have a suitable switching facility.

SEPARATE 144 MHz RECEIVE INPUT

Reference is made on page 6 to this input, which can be connected to give permanent access to the receive converter input, independently of the internal PIN diode changeover relay. On the side of the screened PA compartment will be seen several coloured feedthroughs. The second feedthrough from the socket panel face (marked with a painted dot), carries the receive input. The wire from this feedthrough should be disconnected, and a length of wire should be connected between the existing terminal pin on the main printed circuit board and and the centre pin of the BNC socket marked "144 MHz INPUT".



WARNING

(a) **DO NOT** REVERSE THE POLARITY OF THE POWER SUPPLY – SEVERE DAMAGE WILL RESULT.

(b) **DO NOT** EXCEED AN SWR OF 2 : 1.

(c) **DO NOT UNDER ANY CIRCUMSTANCES** RUN THE TRANSVERTER WITHOUT A SUITABLE LOAD CONNECTED.

(d) **DO NOT** EXCEED 13.8 VOLTS DC SUPPLY TO THE TRANSVERTER, OTHERWISE OVERHEATING WILL ENSUE.

(e) **DO NOT** EXCEED AN INPUT DRIVE LEVEL OF 750mW TO THE TRANSVERTER OTHERWISE THE BALANCED MIXERS MAY BE DAMAGED.

(f) **DO NOT** ALLOW RF FROM YOUR TRANSCEIVER TO BE FED INTO THE SOCKET MARKED "INDEPENDENT 28 MHz RX OUTPUT".