

# OWNERS MANUAL

# **RFCAST**

Model MT100 (-E & -U)  
100 WATT FM STEREO TRANSMITTER



## USER NOTICES

**IT IS VERY IMPORTANT TO READ THE FOLLOWING MANUAL SECTIONS PRIOR TO OPERATION OF THIS TRANSMITTER!**

### **Notice 1**

The transmitter main operating voltage setting is marked on the rear of the MT100 chassis. It may be necessary to change this setting for your operating condition.

**Please refer to AC Main Voltage Setting in section 6.0 Set Up Procedure.**

### Notice 2

The transmitter operating frequency from the factory may not be set for your authorized frequency as it is normally set for a mid band value such as 98.0 MHz.

**Please refer to Frequency Of Operation Change in section 6.0 Set Up Procedure.**

### Notice 3

For adjusting the RF output power setting a qualified technician should employ the use of an RF Wattmeter and a calibrated dummy load.

**Please refer to the section entitled RF Power Control in section 3.4 of this manual.**

### Notice 4

The factory settings of this manual for such this as Input Selection, preemphasis, and input sensitivity may not be correct for your application or installation requirements.

**Please refer to the other exciter settings in section 6.0 Set Up Procedure where you will be directed where else to reference in this manual.**

### GENERAL COMMENTS

THIS PRODUCT DOES NOT INCLUDE A DETAILED TECHNICAL MANUAL, RATHER AN ENHANCED OPERATORS MANUAL. WHAT THIS DOCUMENTATION IS INTENDED TO DO IS TO GIVE THE USER THE CORRECT INSTRUCTIONS AND INDICATIONS ABOUT HOW TO OPERATE AND PERFORM PERIODIC CHECKS AND DETERMINE IF THE TRANSMITTER IS FUNCTIONING PROPERLY.

WE ARE AWARE THAT THE TRANSMITTER DOCUMENTATION MAY PRESENT SOME SMALL AMBIGUITIES AND IMPERFECTIONS, MANY OF WHICH HAVE ALREADY BEEN NOTED AND RESOLVED IN THE NEXT RELEASE AND PRODUCTION. FOR THIS REASON, EVERY OBSERVATIONS/SUGGESTIONS OR PARTICULAR COMMENTS ARE WELCOME.

ELECTRONIC FILES OF THE SCHEMATIC DIAGRAMS IN THIS MANUAL ARE AVAILABLE. SHOULD A LARGER MORE VIEWABLE VERSION OF ANY DIAGRAM BE REQUIRED NOTIFY RICHARDSON ELECTRONICS, LTD.

TO CALL OUR TECHNICAL SUPPORT CENTER OR FOR OTHER CUSTOMER SERVICE ISSUES AT RICHARDSON ELECTRONICS IN LA FOX, ILLINOIS REFER TO THE FOLLOWING NUMBERS:

TECHNICAL SUPPORT: 630-208-2790

CUSTOMER SERVICE: 630-208-2304

## **Returns and Exchanges**

Equipment (Damaged or undamaged) should not be returned unless written approval and a Merchandise Return Authorization (MRA Number) is received from your Richardson Sales representative or **Richardson Customer Service**. Special shipping instruction will be provided which will assure proper handling. The circumstances and reasons for the return must be included in the request for return. Equipment that is special or "custom" ordered may be not returnable. In situations where return or exchange is at the request of the customer a restocking fee may be charged. All returns must be sent freight prepaid and properly insured by customer. When communicating with **Broadcast Richardson** please refer to your Order or Invoice Number.

## **Unpacking**

Use care when unpacking the equipment. First perform a visual inspection of the item(s) to determine if any damage occurred during shipment. Be sure to retain all the shipping materials (crates and boxes or cartons) until such time that it has been determined that the received equipment arrived undamaged. Find all PACKING LISTS and keep them to assist in locating and identifying any components or assemblies that may have been removed for shipping and might need to be reinstalled in the equipment. Make sure that all shipping straps, supports and packing materials are completely removed from the equipment prior to initialization and use.

## **Technical Support**

Should you need technical assistance or trouble shooting guidance contact **Broadcast Richardson** in your local area or you can reach assistance from **Broadcast Richardson** in La Fox, Illinois at telephone +1 (630) 208-2782, Fax +1 (630) 208-2551 or Customer Service at +1 630-208-2304.

Throughout the world there are many Richardson Electronics, Ltd. offices that are also able to assist in contacting our technical support team.

## **WARNING!**

THE VOLTAGES AND CURRENTS IN THIS EQUIPMENT ARE DANGEROUS. PERSONEL MUST, AT ALL TIMES, OBSERVE SAFETY WARNINGS, INSTRUCTIONS, AND ANY REGULATIONS.

**This owner's manual is intended as a general guide for trained and qualified personnel who are aware of the dangers that are inherent in the handling and operation of potentially hazardous electrical and electronic circuits. It is not the intent of this manual to provide a complete set of safety instructions or precautions that should already be understood by trained or experienced personnel in using this or other types of electronic equipment.**

**The installation, operation, and maintenance of this equipment involves risks to personnel and also to the equipment. Broadcast Richardson or Richardson Electronics, Ltd. shall not be responsible for injury or damage that is the result of improper procedures or use by persons improperly trained or lacking the knowledge to perform associated tasks.**

**All local codes for building, safety, fire, or related standards must be observed. Consult local authorities for the standards for the area or region where the equipment will be installed and put in use.**

## **WARNING!**

AT ALL TIMES DISCONNECT AC/MAINS POWER BEFORE OPENING COVERS, DOORS, ENCLOSURES, PANELS, OR PROTECTIVE SHIELDS THAT EXPOSE LIVE CIRCUITS. USE ANY GROUNDING STICKS OR OTHER SHORTING PROBES TO DRAIN ENERGY FROM CIRCUITS BEFORE SERVICING. NEVER PERFORM MAINTENANCE, MAKE ADJUSTMENTS, OR SERVICE THE EQUIPMENT WHEN ALONE OR FATIGUED.

## **WARNING!**

IF ELECTROLYTIC OR OIL FILLED CAPACITORS ARE UTILIZED IN THE EQUIPMENT AND THE COMPONENT APPEARS LEAKY, OR IS BULGING, OR IF THE CASE OR COVERING OF THE COMPONENT APPEARS DAMAGED OR DISTRESSED ALLOW SUFFICIENT TIME FOR THE UNIT TO COOL OR FULLY DISCHARGE BEFORE SERVICING. SERVICING HOT OR LEAKY CAPACITORS CAN CAUSE A RUPTURE OF THE CASE AND POSSIBLE INJURY.

**Should accident or injury occur personnel engaged in the installation, operation, or service of the equipment should seek proper medical attention. It is advisable that such personnel have familiarity with first-aid practices.**

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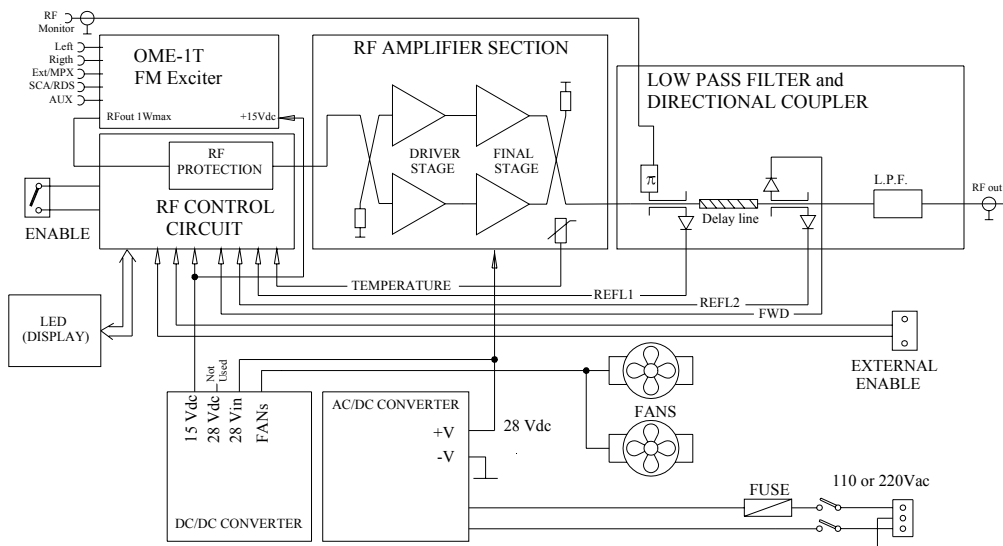
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# MT100 STEREO LOW POWER FM TRANSMITTER 100 WATT

## 1.0 OVERVIEW

MT100 is a 100 Watt FM Low Power Transmitter. It is very simple and easy to use. It is composed of a mechanical frame (19 inches std., 3 RU high and 500mm depth), an exciter (OME-1T), a RF section, which comprises a RF control board and an amplifier section, a directional coupler and a low pass filter, a display, a power supply with a AC/DC converter and a DC/DC converter.

## 2.0 MT100 BASIC BLOCK DIAGRAM



## 3.0 SUBASSEMBLIES DESCRIPTION

### 3.1 MT100 AC/DC Power Supply

The AC/DC power supply is a vendor-supplied product. The input voltage is manually selectable for 220V or 110V, while the regulation range of the output voltage is 28V. The input voltage selector switch is located on the front of the power supply inside the MT100 chassis. The VADJ control is used to stabilize the output power. Below, are the power supply technical specifications:



Input	110 Vac or 220 +/- 15% (manually switched)
Output	28 to 30 Vdc
I max	10 A operating; 15 A short circuit
Efficiency	85% typ.
Isolation	4 KV (In/out or In/GND)
Weight (Typ.)	1500 g
Size (WxHxD)	120x80x200

### **3.2 MT100 DC/DC Power Supply**

The MT100 uses a DC/DC converter. It provides a voltage of 15V to the exciter and power to the fan circuits. Below, the technical specifications:

Vdc Input	20 up to 53 Vdc
Output 1	15 Vdc/1.5 A
Output 2	28 Vdc/3 A

### **3.3 FM Stereo Exciter**

The exciter is RFCast model OME-1T. The declared nominal RF output power is 1 Watt; this signal arrives to the RF final stage through the RF protection circuit. All the input connections are arranged on the front panel. Please refer to the annex datasheet at the back of this manual for more detailed specifications and for operational settings.

### **3.4 MT100 RF Control Circuit**

The RF input circuit has 3 main functions:

- 1) RF power control**
- 2) RF protection**
- 3) Measurement/status indication**

**RF Power Control.** A pin diode attenuator controls the RF input power coming from the exciter (OME-1T). RT3 trimmer may manually control this attenuator located on the internal control panel, in order to adjust for the output power requirement. The AGC control regulates the power, manually set, versus frequency and/or temperature changes. Moreover, the input attenuator includes a soft start, activated at the switching on or after any RF protection intervention. To access RT3 the operator engineer will need to remove the transmitter top cover.

When the MT100 works at a very high temperature and/or high reflected output power, a derating circuit is provided to decrease the output power in order to allow the equipment on function at a reduced power.

**RF Protection.** A fast comparator switches when the output detected reflected power exceeds a pre-set threshold. The regulation of this threshold is made by RT2 trimmer, adjusted in factory for a value of 20 Watts. When the protection is switched on, the protection circuitry removes the RF signal applied to the final stage amplifier very quickly, in about 1 microsecond.

**Measurement/status indication.** The two main measurements, FWD and REF power, are displayed by two BAR LEDs. The MT100 status is indicated with 3 LED's: RF nominal, RF fault, RF derating. The RF fault is on when the output power is lower than 3 dB related to the nominal output power. If the power decreases in derating conditions, the fault is off in all cases. The "enable" switch (SW1) is located on the front panel. It is possible to operate the enable switch by using the contacts on the rear chassis panel of MT100. The enable mode of the amplifier is realized when switch SW1 is on and the rear panel contacts (jumper) are closed.

WARNING: with enable off, there is no RF out but all the internal circuits are powered (stand by condition). Remember to switch off the main on / off switch on the transmitter rear panel and remove the power cord before opening the top cover or operating any inside circuits. Operating with the transmitter cover removed also affects the proper cooling of the RF amplifier.

### **3.5 MT100 RF Amplifier**

The RF amplifier section provides to amplify the RF signal coming from the RF control circuit.

It is composed by:

- 2 way 90 deg. hybrid splitter
- driver stage
- final stage
- 2 way 90 deg. hybrid combiner

The **2way splitter** is made by a 90 deg. Hybrid structure and provides to split in quadrature the input signal. Below, the technical specifications:

Frequency	87.5 – 108 MHz
Input power	50W Max
Return Loss (S11)	<-17 dB
Return Loss (S22 ed S33)	<-15 dB
Isolation (S32)	>15 dB
Insertion Loss (S21=S31)	<0.6 dB

The **driver stage** provides the first step of amplification of minimum 14dB gain in order to correctly drive the final stages. It is composed by a pair of SINGLE END stages operating in class AB. Below are the technical specifications:

VCC	28V
Idq	50 mA per section

Frequency range	FM ( 87.5-108 MHz )
Gain	> 16 dB typ.
Output Power	> 5 W

The **final stage** is an amplifier stage for FM signal operating in band II (87.5 – 108 MHz), with nominal output power of 100 Watts CW.

Normally, the amplifier operates up to 150 Watts in order to overcome the Insertion loss of the circuitry that follows the amplifiers, being the 2 Way Combiner, Directional couplers, and Low Pass Filter.

It is a balanced amplifier, including a pair of “push – pull” sections, each one using a medium power MOSFET with input / output matching network, and balancing to unbalancing transformer (balun). The RF MOSFET's bias are integrated on this printed circuit board. The polarization is in class B, with a 25 mA quiescent current per section.

VCC	28V
IDC (@ Full Power)	7 A typ.
Idq (total per 2 sections)	50 mA typ.
Frequency range	FM (87.5-108 MHz)
Power Gain	> 17 dB typ.
Output Power	> 100 W

The **2 way Combiner** is a 2 way in quadrature structure, and it provided to sum each two final stage sections to have 100 Watts power at the common port. One unbalancing 50 Ohm resistor guarantees the isolation between the input ports, in order to keep the Transmitter on, in case one of the final stages would be faulty (- 6dB derating).

Below, the technical specifications:

Frequency	87.5 – 108 MHz
Power handling	400 W Max
Return Loss (S11)	<18 dB
Return Loss (S22 ed S33)	<18 dB
Isolation (S32)	>18 dB
Insertion Loss (S21=S31)	< 0.4 dB

### **3.6 Low Pass Filter and Directional Coupler Unit**

The filter has a particular elliptic configuration; this configuration has been specifically chosen to guarantee the values of the harmonic components levels.

In-band Insertion Loss	<0.5 dB
Insertion Loss @ 175MHz	>55 dB
In-band Return Loss	<-20 dB

The directional coupler is a block composed by 2 directional couplers and a quarter wave delay line. Both ports of each directional coupler are used. Two of them detect the reflected power, one detects the FWD power and one is used as RF monitor. The function of the delay line is to have two reflected power signals detected at 90° of electrical angle. In this way, it is possible to have a quite constant reflected power level vs. the phase angle of that signal. The RF monitor is connected to the front panel (RF monitor port) to have +10 dB nominal signal.

#### 4.0 **MT100 Technical Specifications**

##### **Environmental**

Storage Temperature:	-20/+65 °C
Operating Temperature:	-5/+45 °C
Guarantee Performance Temperature:	0/+45 °C
Relative Humidity (Non Condensing):	< 90%
Guarantee Performance Altitude:	2000 m, (6560 ft)
Cooling:	> 100 cubic meters/hour

##### **RF Characteristics**

Frequency Range:	87.5 – 108 MHz, 50Khz step, synthesized.
Output Power:	100 Watt nominal, (VSWR < 1.8:1).
RF Power Devices Technology:	MOSFET
Off lock Attenuation:	> 60 dBc
RF Output connector:	N Female
RF Output Impedance:	50 Ω
RF Output monitor level:	0 dBm nominal (BNC connector on the front panel)
RF Spurious:	< -95dBc @ +/-1MHz (Exceed .EBU/CCIR/FCC)
Harmonic:	< -90dBc
Frequency stability:	< 500 Hz / 6 months @ Center Frequency
Inputs:	Mono, Stereo, MPX, AUX, SCA/RDS
Input Impedance:	600Ω or 5KΩ unbalanced
Modulation Type:	F3E/F8E Direct FM at the carrier frequency
Frequency deviation:	+/-75KHz=100%
Variation of sensitivity for 75 KHz Deviation:	+/-1dB from 87.5 to 108 MHz
AF Limiter:	+1dB
Center Frequency Shift:	< +/-500Hz, (Due to +/-75KHz Mod)
Stereo Operation:	CCIR 450/S2 "Pilot Tone System"
Asynchronous AM SNR: (REF=100% AM Mod, @400Hz, BW=30Hz to 20KHz, FM Mod OFF)	- 56dB
Synchronous AM SNR: (REF=100% AM Mod, @400Hz, BW=30Hz to 20KHz, FM Mod +/-75KHz @400Hz)	-50dB

##### **Electrical**

Power Supply:	96/130 or 200/268 V, Single Phase AC, 48 to 62Hz.
Power Consumption:	< 250 VA

Power Factor:	> 0.9
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### R & Mono Input

Input connectors:	BNC female (front panel)
Input Impedance:	1.0 M ohm resistive, unbalanced, source impedance <10kOhm
Input level (For +/-75KHz deviation):	3 to 9 dBm/600Ω
Frequency response (30Hz to 15KHz):	+/- 0.15dB
Pre-emphasis:	Flat/50μSec/75μSec +/-3%
THD (30Hz to 15KHZ):	0.1%
FM S/N Ratio (REF= +/-75KHz):	
Weighted CCIR 468-2; BW= 30Hz to 20KHz	
flat	-68dBc
with de-emphasis 50μsec	-73dBc
with de-emphasis 75μsec	-76dBc
No-weighted; BW= 30Hz to 20KHz	
flat	-73dBc
with de-emphasis 50μsec	-76dBc
with de-emphasis 75μsec	- 78dBc
Audio Filter rejection: (19KHz to 100KHz)	>30 dB
19KHz suppression:	> 46dB

### External MPX Input

Input connectors:	BNC female (front panel)
Input Impedance:	10KΩ
Input level (For +/-75KHz deviation):	3 to 9 dBm/600Ω
Composite amplitude response (30Hz to 100KHz):	+/- 0.5dB
Composite phase response (30Hz to 53KHz):	+/- 0.5°
SNR: (30Hz to 200KHz; with de-emphasis 50μsec)	> 75dB

### Stereo Operation (L & R Channels)

Input connectors:	BNC female (front panel)
Input Impedance:	1.0 M ohm resistive, unbalanced, source impedance <10kOhm
Input level:	3 to 9 dBm/600Ω
Audio Filter Attenuation:	> 68 dB @ 19 KHz
Crosstalk Attenuation (From 30 Hz to 15 KHz):	> 50 dB
Pre-emphasis:	Flat/50μSec/75μSec +/-3%
38 KHz Suppression:	> 50 dB
Sub-Carrier Frequency:	38 KHz +/- 2Hz
Pilot Frequency:	19 KHz +/- 1Hz
Phase Difference 19/38 KHz:	0° +/- 2°

THD on Encoded Channels (30Hz to 15KHz):	< 0.1%
Audio Response (30Hz to 15KHz):	+/- 0.25dB
Nominal Pilot Deviation:	+/- 7KHz
Pilot Output level:	1 Vpp, square wave

### **SCA/RDS & AUX input**

Input connectors:	BNC type female (front panel)
Input Impedance:	5K $\Omega$
Input level (for +/-7.5KHz deviation @97.5MHz):	2.2Vpp/5K $\Omega$
Amplitude Response (10KHz to 100KHz):	+/- 0.15dB

## **6.0 Set up procedure**

The MT100 is shipped in a wooden box. It should be removed carefully removing the foam packing material and the clear protective film. This equipment can be operated independently, or, by its standard mechanical frame (19 inches), it may be mounted in an equipment rack.

The MT100 can set up for 220Vac or 110Vac, +/- 15%, single phase at 50Hz or 60Hz operation. The input main voltage is set at the factory or it may be changed by the switch located on the AC/DC converter. A label on the transmitter chassis rear indicates the factory set AC voltage. The normal current draw is approximately 1.2 amps for 220Vac operation, but, if supplied at 110Vac, the normal current is around 2.4 amps. It is installer's responsibility to correctly connect the three wires (line, N, GND) to the mains line or use the power cord supplied. It is also recommended that a transient or surge protector be properly grounded and the MT100 connected through the protector. Before switching the transmitter on, it is necessary to connect the RF output power type "N" connector to either a dummy load or an FM antenna.

### **AC Main Voltage Setting**

Sometimes the MT100 transmitter main operating voltage setting marked on the rear of the chassis may be necessary to change this setting for your operating condition.

In order to change the AC operating voltage it is necessary to change the switch inside the transmitter on the front of the power supply. Sliding this switch right or left makes the selection for 110 or 220 VAC operation. To access the power supply switch you will need to remove the top cover of the MT100 or the switch may also be accessed through the transmitter front panel by removing the four (4) corner screws on the front of the OME-1T stereo exciter then sliding it forward out of the way. Look into the slot where the exciter was mounted using a battery operated light and locate the power supply selector switch (approximately 9 to 10 inches from the front panel) and make the proper selection. Replace the OME-1T or the transmitter top cover and replace all screws and hardware unless a change of operating frequency is necessary before operating the transmitter.

### **Frequency Of Operation Change**

The MT100 transmitter operating frequency at time of shipment from the factory may not be set for your authorized frequency. In order to change the frequency of operation, locate, the OME-1T exciter section of this manual and review the information on page 4 of 4. After review the frequency setting examples in this section, substitute your values for the switch settings through the OME-1T chassis top. You should make sure that the transmitter is unplugged and that no power present.

To access the frequency change selector switches may be necessary to remove the four (4) screws on the front of the OME-1T and slide it forward far enough to allow a small screw driver blade to adjust the three (3) rotary frequency selector switches.

### **Output Power Setting**

Please refer to the earlier section entitled RF Power Control in section 3.4 of this manual.

### **Other Exciter Settings**

Please refer to the OME-1T exciter section of this manual, page 4 of 4, for jumper settings for left and right channel preemphasis selection (75 microseconds un-preemphasized, or 50 microseconds), left and right input sensitivity selection (6..9dBm, 3..6dBm or 0..3dBm), modulation limiter selection (On or Off), and input selection (Mono, Multiplex Internal, or Multiplex External). This page of the manual shows the various positions for the jumpers and their location on the OME-1T printed circuit board.

## **Turning On the transmitter**

After the above procedures, it is possible to turn the transmitter on. On the front panel, the mains LED indicates the status of the MT100. If it is on, the equipment has been correctly supplied. By activating the "enable" switch on the front panel, the transmitter will energize to the maximum power that has been set. Other LEDs provide further information on the MT100

- RF nominal (green): on if some RF output power appears
- Derating (yellow): on in two situations
  - when the reflected power is higher than 10dB (the transmitter power output is maintained until VSWR 2:1. If the VSWR is higher, the derating protection intervenes. It stabilizes the output power at a non-dangerous value for the amplifier)
  - when the operating temperature is too high (the temperature protection intervenes when the room temperature is  $\geq 45^{\circ}$ . In this case, the output power is reduced of about 6dB)
- Fault (red): on if the transmitter has other faults (for example, input power without output power, such as a fault in the RF amplifier or RF control circuit).

## **Balanced Amplifier Advantages**

The choice to use two RF devices was decided in order to improve the ruggedness of the amplifier in event of mismatched dummy load. Thanks to the 90 deg. hybrid isolation circuit the amplifier stages are not influenced by the operating condition changes of the load (antenna, filter, and so on...). Moreover, the amplifier is more immune to oscillation than one designed with only one RF device.

The two hybrid RF devices allow the amplifier to produce output power (-6 dB) even if one of them fails or is damaged. In the case of a single device, its failure forces the amplifier to go off and the complete loss of RF output power.