

# **WIRELESS MEASUREMENT INSTRUMENT**

## **GMT20 TRANSMITTER USER'S MANUAL**

**Manual Part No. MNGMT20**

**Rev. A**

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# **PREFACE**

## **Certification**

Grayson Electronics Company certifies that this product met its published specification at time of shipment from the factory.

## **Warranty**

GEC warrants to the original purchaser (hereinafter called "Buyer") that Equipment manufactured by GEC shall be free, under normal use and service, from defects in material and workmanship for a period of twelve (12) months from the date of delivery to the Buyer (the Warranty Period), and shall conform to GEC's specifications. With respect to any equipment not manufactured by GEC (except for integral parts of GEC's Equipment to which the warranties set forth above shall apply), GEC gives no warranty, and only the warranty, if any, given by the manufacturer shall apply. Warranty is available upon request.

The preceding paragraph sets forth the exclusive remedies for claims (except as to title) based upon defects in or nonconformity of Equipment manufactured by GEC, whether the claim is in contract, warrant, tort (including negligence), strict liability or otherwise, and however instituted. Upon the expiration of the warranty period, all such liability shall terminate. The foregoing warranties are exclusive and in lieu of all other warranties, whether oral, written, expressed, implied or statutory. NO IMPLIED OR STATUTORY WARRANTIES OF MERCHANT ABILITY OR FITNESS FOR PARTICULAR PURPOSE SHALL APPLY. IN NO EVENT SHALL THE SELLER BE LIABLE FOR ANY INCIDENTAL, CONSEQUENTIAL, SPECIAL, INDIRECT OR EXEMPLARY DAMAGES.

## **In Case of Trouble**

In case problems arise that are not addressed adequately by this manual, further assistance may be obtained by calling Grayson Electronics, Measurements Systems Group at 1-800-800-7465.



# **1. Introduction**

## **1.1 About This Manual**

This manual provides an overview of the GMT20 PCS Transmitter. The transmitter is the propagation test configuration partner for the Spectrum-Tracker™ wireless measurement instrument.

Also included in this manual are procedures for unpacking, inspecting, and setting up the product for operation.

## **1.2 About the Measurement System Product**

### **1.2.1 Measurement System Operational Overview**

Personal Communications Services (PCS) represents the next wave in communications technology. As such, PCS carriers will require advanced test and analysis equipment to optimize network development and eventual construction. Grayson Electronics, a leader in wireless measurement technology offers a line of powerful diagnostic instruments including the wireless measurement mainframe, the GMR1000, and its matching PCS transmitter, the GMT20. The GMT20 is a rugged portable, and easy-to-use test transmitter created specifically for PCS.

The GMT20 is a full featured, 20-watt transmitter that can generate both CW and digitally modulated test signals in the PCS frequency band. The rugged GMT20 transmitter is housed in a durable, water resistant package ideal for the rigors of outdoor use in the field. The GMT20 enables carriers to test signal propagation from potential base station locations, and to validate and refine analytical propagation models. Information measured with Spectrum Tracker™ in these site surveys assists in system budget analysis, site selection, and evaluation of system architecture prior to hardware installation. The GMT20 is an essential site survey tool for network design engineers. Its rugged design will support temporary rooftop and other outdoor installations required for system site surveys.





## **2. Preparation For Use**

### **2.1 Introduction**

This section outlines precautions and preparations necessary before use of the measurement system. Also covered is unpacking and inspecting of the individual pieces and the requirements placed on the external power supply.

### **2.2 Precautions**

#### **2.2.1 Shock Hazard**

When replacing the AC fuse on the side panel, be sure to unplug the line cord and replace with a fuse of the correct rating and type.

When connecting the DC power cable, be sure to connect the red lead to the positive terminal and black lead to the negative terminal.

#### **2.2.2 Static Sensitive Components**

This unit includes integral static discharge protection devices. However, as with any electronic equipment, care should be taken not to touch connector pins directly.

There are no user serviceable components inside. Units must be returned to the factory for repairs.

### **2.3 Unpacking and Inspecting**

All equipment is packaged in a single shock and vibration protected enclosure.

Examine the carton for signs of damage. If carton appears to be damaged, contact the transportation agent immediately.

Open the carton and carefully remove each item. Check all items received against the packing slip and the following Parts List. Examine each item for physical damage, and make a note of any damages observed.

## 2. Preparation for Use

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### 2.3.1 PARTS LIST

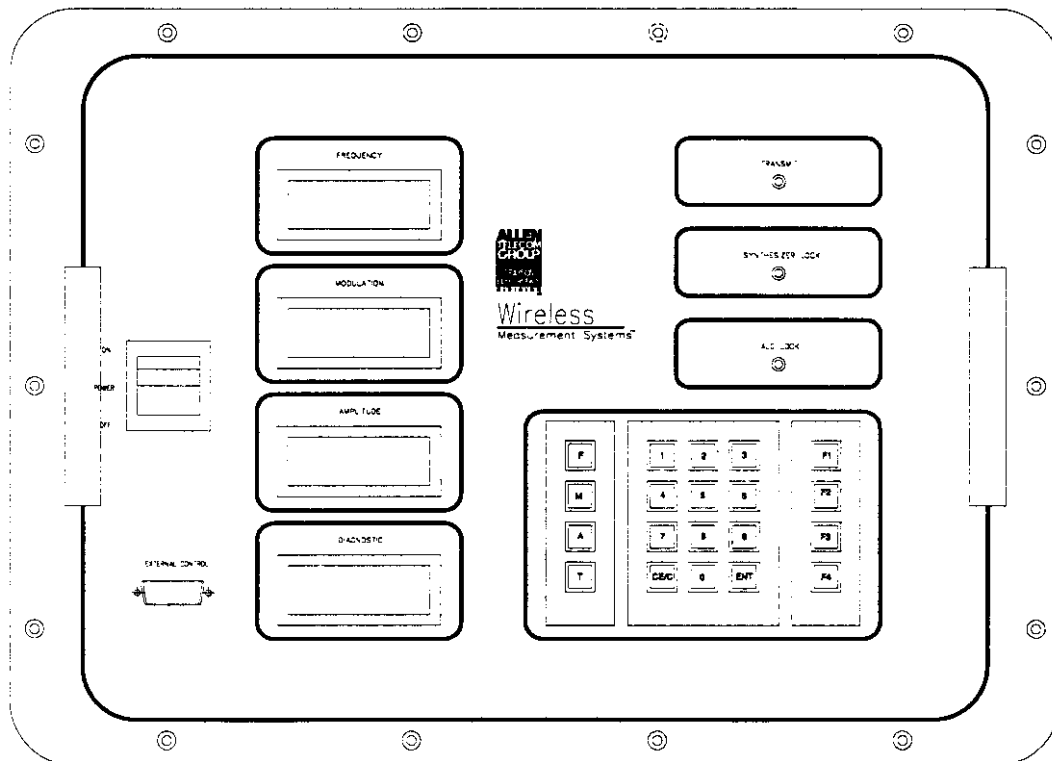
Item	P/N
AC Line Cord	G15A0075-1
DC Line Cord	G15A00076-1
AC Fuse	G52AF000-5 5 Amp
DC Fuse	G52AF013-30 30 Amp
Manual	MNGMT20

## 3. Interface Description

### 3.1 Introduction

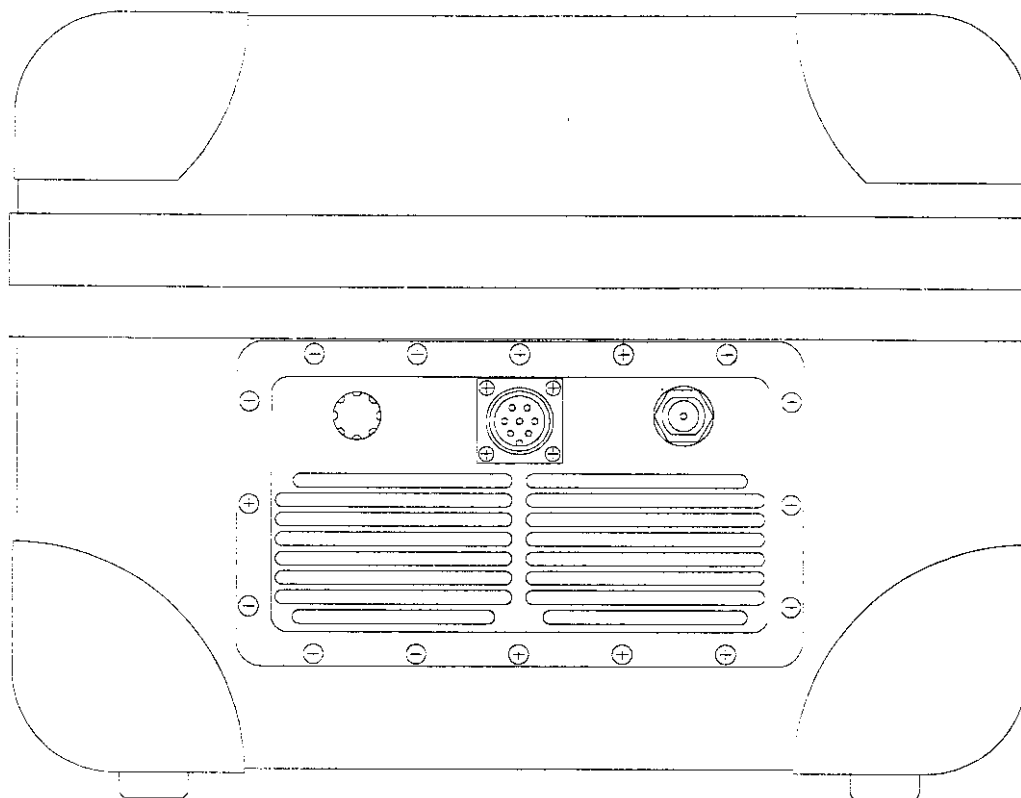
This section covers the front panel features and external interface ports. the first section gives a pictorial view of the front panel and a detailed description of the keypad and resultant indicators. The second part gives a detailed description of the side panel connectors and fuse holder.

### 3.2 Front Panel Features



3.2 Figure-1 Front Panel

#### 3.3 Side Panel Features



3.3 Figure-1 Side Panel

#### 3.4 Keypad Operation

##### 3.4.1 Mode Keys

F = Frequency Mode  
M = Modulation Mode  
A = Amplitude Mode  
T = Transmit Mode

##### 3.4.2 Numeric Keypad

0 - 9      Numeric  
CE/C = Clear Entry  
ENT = Enter Key

##### 3.4.3 Function Keys

F1 - F4 = Undefined function keys

#### 3.5 Status LEDs

Transmit LED - ON when unit is transmitting  
Synthesizer LED - ON when synthesizer is locked  
ALC lock LED - ON when ALC loop is locked

#### 3.6 Display LEDs

Frequency	Indicates transmit frequency in MHz
Modulation	Indicates toggle function "OFF" or "EXTERNAL"
Amplitude	Indicates output power in 1 db increments
Diagnostic	Alternately displays internal DC voltage and internal operating temperature in degrees C.

#### 3.7 ON-OFF Switch

Controls primary power source, AC or DC

#### 3.8 External Control

DB 15 Connector for I-Q Modulation input

#### 3.9 Side Panel Features

AC Fuse  
Power Connector - AC or DC Power Cable  
RF Connector - Type N Female



## **4. Installation and Operation**

### **4.1 Introduction**

This section covers the installation, set up and operational features of the GMT20 transmitter.

### **4.2 Installation Procedure**

Remove transmitter from shipping container and install in a location with an ambient temperature range between -20 and 55°C. With the cabinet lid closed the transmitter will operate in a rainy environment as long as the drain holes on the bottom remain clear of obstructions and the transmitter is on a level surface.

### **4.3 Operation**

#### **4.3.1 Power Source**

Connect either the AC power cord to a source of 115 vac 60 Hz or the DC power cable to 11.2-15 Vdc capable of 15A. The AC input is fused on the side panel and the DC power cable contains an in line 30A fuse and reverse polarity protection. The front panel ON-OFF switch controls the primary power that is connected to the side panel.

#### **4.3.2 Battery Operation**

Connect the DC cable to the GMT20 and either a 12 volt battery or a 12 volt power supply capable of 18 amps. An internal voltage monitoring circuit will disable the transmitter when the internal voltage drops to approximately 11 volts. The front panel will then display "LOW BATT." To restore operation recharge or replace the battery and then resume testing. Note that long cables or poor connections will create a voltage drop which will cause the transmitter to shut down prematurely.

### 4.3.3 Frequency Control

The keypad sequence is as follows:

- Push “F” button
- Enter desired frequency in 20 KHz steps
- EX 1850.020
- Note that the initial “1” is preloaded. The “ENT” key is not required at the end of the frequency entry.
- Some 30 KHz frequency increments are available. The desired frequency must be divisible by 30 KHz exactly to be valid.

Example:  $\frac{1850.03}{.03} = 61,667.6$  is not a valid channel

$\frac{1920.03}{.03} = 64,001$  is a valid channel

- Read the transmit frequency on the frequency display.
- An invalid frequency entry will result in the display returning to the previous valid entry.

### 4.3.4 Amplitude Control

The keypad sequence is as follows:

- Push “A” button
- Enter desired amplitude from 03 to 43 in 1 db steps. The “ENT” key is not required. All single digit amplitudes must be preceded by a 0. Example: 03, 04 etc.
- Amplitude display indicates the transmit output power in dBm.
- An invalid keypad entry will result in the display returning to the previous valid entry.



### **4.3.5 Modulation Control**

The keypad sequence is as follows:

- Push “M” button
- Modulation display will toggle between “EXT” and “OFF” with each “M” key closure.
- “OFF” indicates a CW carrier
- “EXT” indicates that the external I-Q Modulation input on the front panel DB-15 connector is now active. The “EXT” configuration should not be selected unless an external I-Q input is connected or the amplitude display will not be accurate.
- The external modulation inputs are located on the front panel DB-15 connector. There are three inputs: I, Q, and Ref. These are located on pins 7, 6, and 5 respectively. Pins 12, 13, 14, and 15 are all grounds. The Ref input must be a fixed 3 Volt dc level. The I and Q input levels are both the same and consist of 2 Vp-p data riding on 3 Volts dc. Hence the maximum instantaneous I or Q voltage is 4 Volts and the minimum instantaneous I or Q voltage is 2 Volts. The input impedance of the I, Q, and Ref inputs is 1 K ohm. The I and Q inputs have a modulation bandwidth of 5 Mhz.
- NOTE: The transmitter will not function in the External Modulation mode without an input to the DB15 connector. Error 11 may also appear.

### **4.3.6 Transmit control**

The keypad sequence is as follows:

- Push the “T” button
- An illumination of the Transmit, Synthesizer Lock, and ALC lock LED’s indicates proper transmitter operation.
- Each contact closure of the “T” button toggles between transmitter ON and OFF.
- Any key that is pressed while the unit is transmitting will result in the transmit function being disabled.

### 4.3.7 Error Codes

Error 10	Synthesizer has lost phase lock.
Error 11	Power amplifier is not under leveling loop control.
Error 14	EEPROM data is invalid
Error 15	Last state configuration data is invalid
PA Temp	Internal temperature above limit
Low Batt	Internal DC supply voltage below limit.

— NOTE: Consult factory if error codes appear.

## 5. Performance Specifications

### 5.1 Frequency Range

1850-1990 MHz, 20 or 30 KHz steps.

### 5.2 Output Power

43 dBm to 3 dBm in 1 dB steps.

### 5.3 Output Power Level Accuracy

-20 to 0° C	- 1.25 dB + 0 dB
0 to +40° C	± 0.75 dB
+40 to +55° C	- 0 dB + 1.5 dB

### 5.4 Frequency Stability

+/-0.5 PPM	Typical -20 to +55° C
+/- 1.0 PPM	Worst Case -20 to +55° C

### 5.5 Output Power Spurious/Harmonics

≥ 60 dBc relative to 43 dBm

### 5.6 Duty Cycle/Operating Temperature Range

Continuous, -20° to +55° C

## **5. Performance Specifications**

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### **5.7 Load VSWR**

Safe operation into Open/Short at all phase angles.

### **5.8 Output VSWR**

1.5:1 (14 dB Return Loss)

### **5.9 Modulation**

CW or externally supplied I/Q source.  
Bandwidth 5 MHz

### **5.10 Power Consumption**

AC    115 volts (85 min, 264 max)  
      60 Hz (47 min, 63 max)  
      2.0 A nominal (2.25 A max)

DC    12.0 volts (11 min, 13.8 max)  
      18 A nominal (20 A max)

### **5.11 Dimensions and Weight**

Height -    11.0 inches  
Width -    19.0 inches  
Depth -    14.0 inches  
Weight -    40 lb.

## 6. Brief Technical Description

### 6.1 Introduction

This section includes information on how the transmitter hardware functions. This information is presented so that the user may have a better understanding of how the unit works.

NOTE: There are no field repairable assemblies in the transmitter.

### 6.2 Overview

The GMT20 is a self contained 20 watt linear transmitter for Personal Communications Services (PCS) frequencies. It is made up of many individual modules which will be each discussed in the text to follow. A block diagram is shown in Figure 6.2.1.

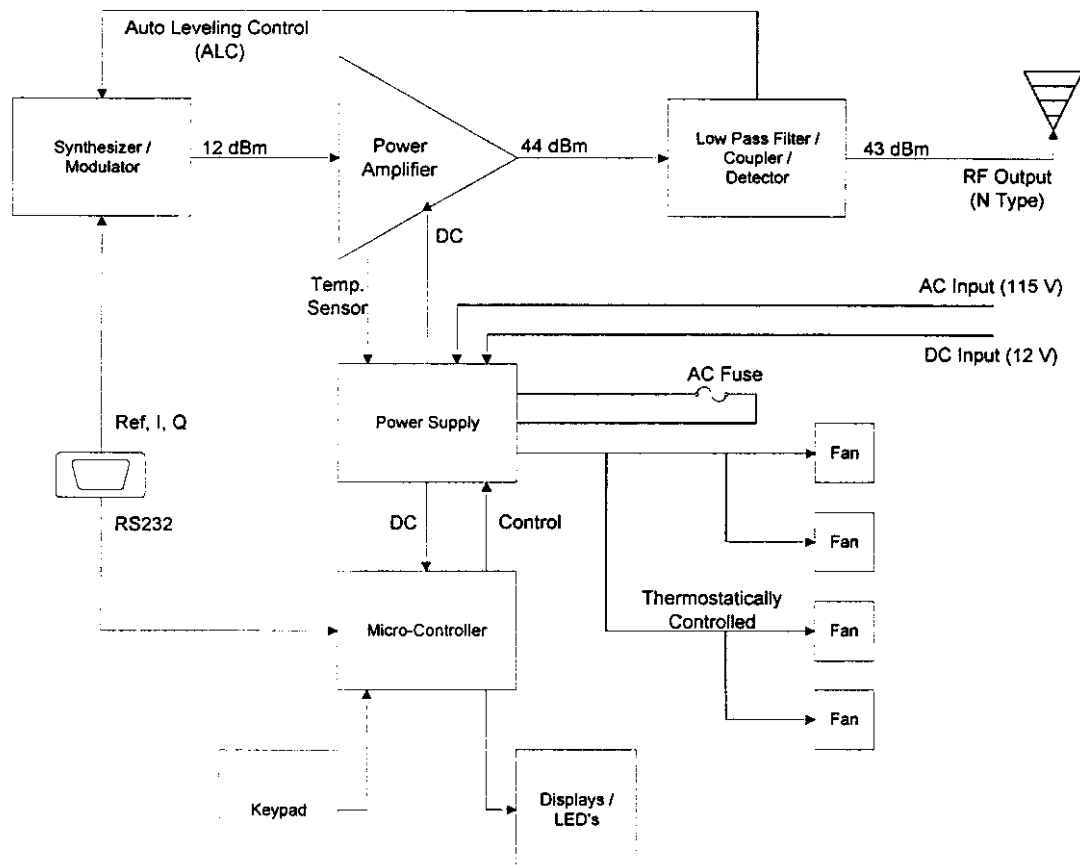


Figure 6.2.1 GMT20 Block Diagram

## 6. Brief Technical Description

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The synthesizer derives its frequency reference from an on board TCXO. It can tune in 20 or 30 KHz steps as shown in the examples in section 4.3.3. Following the signal source is an I / Q modulator. It has a modulation bandwidth of up to 5 MHz. External I / Q and DC Reference signals can be supplied to the modulator to produce any modulation format. Also the synthesizer/modulators output level is adjusted by the leveling control loop which is located in the filter-coupler.

The power amplifier is based on high power GaAs FET devices. There are three stages of amplification yielding at least 32 dB of gain. The stages are biased class-A to achieve high linearity and the ability to use any modulation type. The amplifier stages are followed by a dual isolator. The power amplifier has an internal temperature sensor that reports back to the micro-controller. There is also internal bias, regulation, and protection circuitry.

Following the power amplifier is the filter/coupler. It is basically a 5-pole low pass filter followed by a coupler. The output of the coupler is detected and compared to a stored reference voltage for a particular power level at a calibration frequency. The error signal from this comparison is used to adjust the output level of the synthesizer. There is a calibration point for every level at 5 different frequencies. These values are stored in the filter-coupler.

The power supply is designed to operate on either 115 VAC line voltage or 12 VDC battery voltage. The transmitters internal voltage is 12 volts and therefore for DC operation battery voltage is used directly. There are provisions to internally disconnect the supply should the battery voltage drop below approximately 11 volts. This is to protect the batteries and make sure that the transmitters performance stays within specification. For AC operation the supply uses a line of high performance switching regulator modules. The first of which is a Harmonic Attenuator Module (HAM) that maintains a good power factor regardless of load. This makes the power supply tolerant to operation with gas powered generators. The AC-DC and DC-DC switching modules are operated well below their capabilities to insure performance at high temperatures.

The GMT20 transmitter is controlled by a HC11 micro-controller. The controller reads keypads, sends messages to the displays, and controls each of the individual modules. There are feedback points built into the hardware to allow the controller to monitor the operation of the transmitter. The software contains built in diagnostics that watch for operation and performance problems.