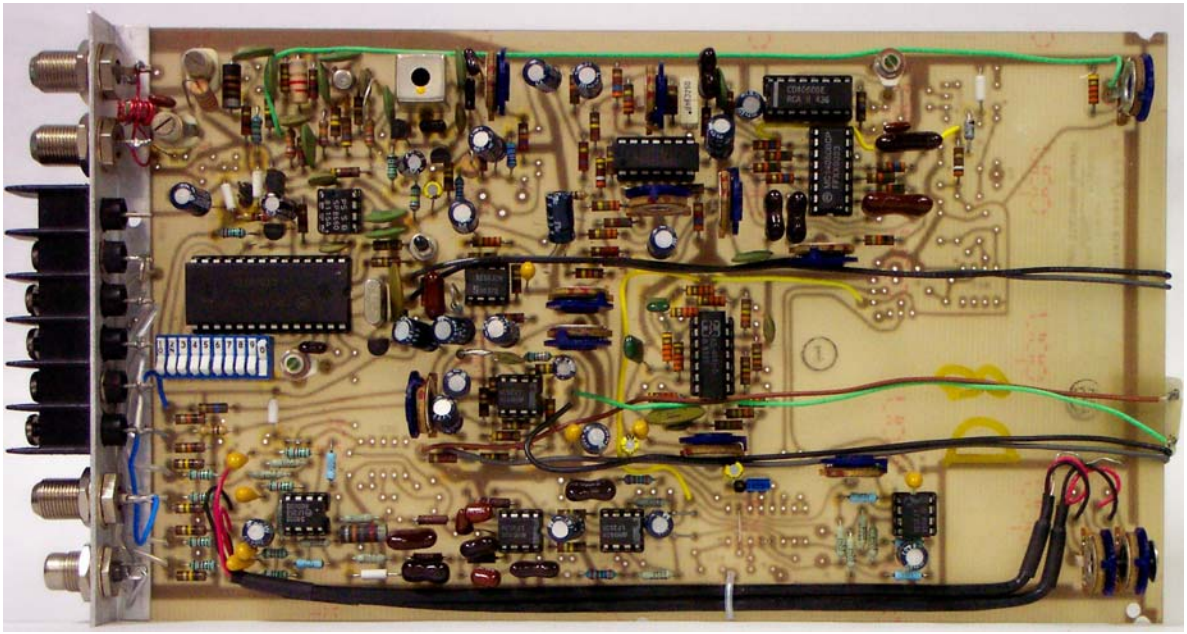
FMT615C



FREQUENCY AGILE FM MODULATOR

INSTRUCTION BOOK
IB1215-02

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 GENERAL DESCRIPTON

The FMT615C mounts in 1/3 of a PMS610 mainframe and power supply, the remaining 2/3 of the mainframe is available to mount any compatible 600 series products.

1.2 The unit is equipped to accept audio and modulate that program to the 88-108 MHz FM stereo broadcast band. The audio may be true stereo (separate Left and Right channels), mono, or synthesized (within the FMT615C) to stereo as selected by a field-programmable jumper jack under the top cover. In addition to the FM band output, there is a composite stereo audio output to feed an additional microwave modulator to deliver audio stereo programming to a remote cable system. There is also a mono output to feed audio to the TV audio modulator.

1.3 The RF output frequency of these units, like other FM SYSTEMS INC products, is adjustable in the field without changing crystals. This state-of-the-art design uses a master crystal oscillator and a programmable phase-lock-loop (PLL) system to precisely set the output to any standard frequency in the FM Broadcast Band. Other frequencies outside the 88-108 MHz Band are available upon special request.

2.0 INSTALLATION AND OPERATING INSTRUCTIONS

2.1 Remove the shipping container and inspect for shipping damage. The FMT615C is to be mounted in a PMS610 mainframe and power supply. If you have purchased a separate FMT615C module to be installed in an existing PMS610, refer to the mounting instructions supplied with the PMS610 mainframe.

2.2 When power is applied, observe that the red “OFF FREQUENCY” LED illuminates and flickers off, indication that the RF output is locked on frequency.

Note: This section assumes that the FMT615C is tuned to the desired FM channel output frequency. If not proceed to Section 6.0 Tuning Procedures.

2.3 Connect an RG59U cable between the “FM CHAN OUTPUT-OUT” and the cable head-end combiner input. Terminate the “FM CHAN OUTPUT-IN” with 75 OHM, or loop-thru from another unit with 75 Ohms resistive termination.

2.4 Adjust the RF output level control (at the front panel on the right hand side) to match the FM band levels in your cable system. Note that reversal of the FM output “IN” and “OUT” connections will reduce the output 20 dB due to the directional coupler.

2.5 MONO AUDIO OUTPUT Connect the mono output to any load of 600 Ohms or higher. This mono output is isolated from the stereo input and will not affect stereo separation. The standard output level is +10dBm into a 600 Ohm load at 100% modulation.

2.6 A COMPOSTE STEREO AUDIO OUTPUT is located on the rear panel. It outputs (L+R) audio below 15KHz, the stereo pilot at 19KHz, and the stereo difference (L-R) in the 23KHz to 53KHz band as a 38KHz double sideband suppressed carrier (this is the US standard FM Broadcast Stereo Format). The composite stereo output is normally used to modulate a microwave transmitter to deliver stereo audio to a remote cable system head-end on a single subcarrier above video. The output level is 3.5 Vpp at 100% modulation.

2.7 Connect the source of audio capable of delivering -10 dBm or more at 100% modulation to the 50,000 Ohm balanced bridging inputs. The source impedance may be much lower than 50,000 Ohms, and need not be balanced. When unbalanced, connect to the “T” & “R” input terminals, just as if the source was balanced. Connect a separate ground lead (generally, the signal cable shield) between the two chassis. This quasi-balanced configuration produces results nearly as good as fully balanced operation. When the audio feed is mono, connect the Left & Right inputs in parallel, T to T & R to R, for optimum performance.

2.8 The built-in stereo synthesizer may be connected to generate (from a mono source) a very pleasing ambience, simulating true stereo. To switch from synthesized to true stereo, a jumper jack under the top cover is simply repositioned.

2.9 The modulation level of the local audio may be set by adjusting the control to the Left of the VU meter (use a small flat blade screwdriver) the VU meter should read 0 VU on loud average levels, only rarely entering the red zone on very loud peaks. NOTE the VU meter will read -10VU with no program input, this is the 19 KHz pilot at 10% modulation.

3.0 SPECIFICATIONS

OVERALL PERFORMANCE	SPECIFICATION
Deviation (100%)	75KHz peak, 10% (+/-7.5KHz)@ 19KHz
Frequency Response	20-15000 Hz +/-0.5dB
Pre-emphasis	75 microseconds
Total Harmonic Distortion	0.5% Maximum
Stereo Separation	40 dB @ 1KHz, 30 dB @ 15KHz
Signal to Noise Ratio	70 dB Minimum

AUDIO INPUT	
Format	True Stereo or Synthesized Stereo
Level (100%)	-10 dBm to +18 dBm, Adjustable
Impedance	Balanced Bridging (50K Ohms)
Indicator	Front Panel VU Meter
Connectors	6 Position Screw Terminal

STEREO GENERATOR	
Format	Standard Stereo Multiplex (19KHz pilot)
Synthesizer Type	Differential Phase Rotation

RF OUTPUT	
Frequency (FM Band or A1, A2)	88.1-107.9 MHz Other bands available
Stability	20 PPM, +/-1 KHz Typical
Level	+20 to +50 dBmV, Adjustable
Impedance	Directional coupler loop-through 75 Ohm
Connectors	F Type (female)
Harmonic Distortion	60 dB Below Carrier Level

AUDIO OUTPUTS	
Composite Stereo	3.5 Vpp (F female) Connector
Mono	+10 dBm 75 microseconds (RCA output)
MECHANICAL	
Power	-24 VDC 130mA (PMS610)
Mounting	Uses one space of three in the PMS610 Mainframe and power supply.

4.0 FUNCTIONAL DESCRIPTION:

The FMT615C contains the following subsections:

4.1 Dual local audio inputs, low-pass filters, & pre-emphasis.
4.2 Audio switching & stereo synthesis.
4.3 Stereo pilot and carrier generators.
4.4 Stereo matrix and multiplex modulator.
4.5 Mono audio output with de-emphasis.
4.6 Composite stereo audio output.
4.7 VU meter Driver.
4.8 88-108MHz frequency modulated oscillator and output coupler.
4.9 Programmable frequency phase lock control.
4.10 Voltage regulators.

4.1.1 LOCAL AUIDO INPUT, FILTERING & PRE-EMPHASIS

Local audio is applied to the balanced inputs of U21 through variable attenuation (R303, R304 & VR301) to accommodate a wide range of input signal levels without overloading. The signal then passes to U22, a three-pole low pass filter, which attenuates noise above the audible spectrum which could interfere with the stereo multiplexing later. Standard 75 microsecond pre-emphasis and approximately 10dB overall gain is provided by U23.

4.2.1 STEREO SYNTHESIS, U7

When the stereo synthesizer is selected, difference channel audio is developed from mono by a series of phase shifts as the signal passes thru U7. The synthesized difference level is controlled by VR331. The true stereo difference level is controlled by VR431, as selected by the jumper jack on P4, or by optional relay U24, and fed to the stereo modulator, U12.

4.3.1 STEREO PILOT& CARRIER, U9 & U10 & +8 GENERATOR, Q17

The stereo pilot and carrier frequencies (19 and 38 KHz) are digitally synthesized with U10, which is driven by U9, a crystal controlled oscillator with multiple frequency dividers. This provides stable frequency, amplitude, and phase relationships.

The synthesized sine wave outputs are filtered to very low distortion by C473, C475, R475, & VR471 (19KHz) and C483, C486, R485 & R486. The pilot phase and injection level controls are VR471 and VR472. U9 also drives Q17 and rectifiers D471 & D472 to generate +8V for the optional Relay Actuate Terminal (T7) and driver (U28).

4.4.1 STEREO MATRIX & MODULATOR, U25 & U12

U25 is driven via relay U24 by U23 in a matrix to produce L+R and L-R channels. The L+R channel is applied to U26, via level control VR431, to one input of stereo multiplex modulator U12. The other input is driven by the 38 KHz carrier generator, U10. The output of U12 is a conventional double-sideband, suppressed carrier amplitude modulated signal centered on 38 KHz. This signal is added to the L+R signal at the input of U26, along with the 19KHz pilot signal, also from U10. MONO AUDIO OUTPUT WITH DE-EMPHASIS U26

The L+R channel is also applied to first half of U26 via VR561, which includes 75 microsecond de-emphasis to provide flat audio output to J5. This is normally used to feed a TV audio modulator.

4.6.1 COMPOSITE STEREO AUDIO OUTPUT, U26

The second half of U26 is a summing amplifier for the L+R (50 Hz to 15 KHz), Pilot (19 KHz), and L-R (23 KHz to 53 KHz). This composite stereo is delivered to the input of the FM oscillator, the composite output jack, and to the VU meter driver.

4.7.1 VU METER & LED DRIVER, U27

The composite stereo signal is amplified by U27 and rectified by D571 & D572 to drive the VU meter, which reads average modulation.

4.8.1 FREQUENCY MODULATED OSCILLATOR, Q6, Q7, & Q8

Q6, Q7, and Q8, with associated components, comprise a voltage controlled FM oscillator operating in the 88-108 MHz FM stereo band. The frequency deviation is set by VR501, The master modulation control, which varies the drive to D501, a voltage controlled capacitor. This with L501, controls the resonant frequency of the oscillator Q6. Q7 buffers the output of Q6 and drives Q8, the RF output transistor.

The RF output level is adjusted by VR503 accessible through a front panel hole with a small screwdriver. The output of Q8 is tuned to peak the desired frequency and reduce harmonics by C515, C517 and L502, L504. L504 is also the output directional coupler, in conjunction with R529.

4.9.1 PHASE LOCK LOOP, Q9, Q10, U13, & U14

The FM oscillator center frequency is set by comparing its output with a precision frequency derived from a crystal oscillator. Q9 taps a portion of theFM oscillator output from Q7 and applies it to U13, a frequency divide by ten circuit, then to U14, which divides by the number programmed on frequency set switch SW501. The total division is down to 10KHz, which is also the frequency generated by the reference crystal oscillator after it is separately divided. The two 10 KHz signals are applied to a phase comparator in U14.

The output of the phase comparator is a control voltage proportional to any phase and frequency difference between the reference and

the FM oscillators, this voltage is applied to voltage variable capacitor D504 which, with L501 corrects the FM oscillator center frequency. Whenever the FM oscillator free running frequency is outside the control range, the red unlock lamp on the front panel lights, indicating that RF output frequency is not controlled by the reference crystal. (See section: Tuning Procedures, FM Channel Frequency Change to correct this condition, which normally occurs only when switching to a new RF output frequency).

4.10 VOLTAGE REGULATORS, U15, Q2, Q12, Q16, & Q18

U15 is a three terminal voltage regulator, set to -18V. All power used in the FMT615C passes through U15, essentially eliminating any fluctuations due to variations of the -24V supply. Most of the unit operates directly from -18VDC, although U7, U9, U10, U21, U22, U23, U24 & U25 operate from -12VDC, regulated by a zener diode D542 and emitter follower Q128, and U13 & U14 operate from -5VDC, regulated by emitter follower Q16.

5.0 MAINTENANCE

No routine maintenance is required. However, you may wish to check the output frequency and amplitude periodically to verify that the FMT615C output is normal. It is recommended that the FMT615C not be internally re-adjusted in the field, except for system changes of the FM channel output frequency and amplitude, per Section 6.5, and stereo synthesizer mode, per Section 6.6.

All other adjustments require specialized test equipment. In order to avoid degrading the overall performance, do not adjust any control in the FMT615C a ”by ear”. In the event of a malfunction of the FMT615C, please contact the factory. We will generally recommend that the unit be sent to the factory for repair and recalibration. However if repair in the field must be accomplished, basic re-adjustment procedures follow in section 6.

6.0 TUNING PROCEDURES

To change the RF output frequency of FM SYSTEMS, 600 Series modulators, two quick steps are essential:

1. Set the new frequency for the PLL (Phase-Lock-Loop) with the DIP switches on the circuit board, SW501. (See the following Tuning T able for DIP switch settings).

2. Center the AFC (Automatic Frequency Control) range with the variable inductor (can coil) after setting the switches. Note: If either of these steps are skipped, the frequency will be incorrect and or will drift.

6.0.1 SET FREQUENCY SWITCHES

6.0.2 Look up the setting for the Frequency Switches (SW501 in the table below and carefully set each of the ten or fourteen switches.

6.0.3 If the new frequency is outside the range of this table, it may be set as detailed in a later section

6.0.4 CENTER AFC RANGE

6.0.5 After the switches are set to the new frequency, press the pushbutton SW516 "AFC TEST" and with a non-metallic screwdriver adjust L501, "AFC CENTER" (the variable inductor in the metal can with the color dot on it) to center the oscillator range on the new output frequency. The OFF FREQ light will flicker off. Release the push button, the OFF FREQ LED will remain off. The output frequency will be stable, Phase locked to the crystal reference oscillator.

6.0.6 OUTPUT FILTER TUNING

6.0.7 If the frequency was changed considerable, retune the output filter by adjusting C516 & C515, the two variable capacitors nearest the output connectors for peak output level.

6.0.9 SWITCH SETTING FOR ANY FREQUENCY

6.2.0 Use if desired frequency is not listed in the accompanying table.

6.2.1Note: Although the frequency setting switches may be programmed over a very wide range, the oscillator will only work within the range of frequencies originally specified, attempts to operate far outside the specified range will be without success unless other components are changed.

6.2.2 The sum of the open switch frequency increments is the output frequency. Refer to Table A-2 to determine the increments applicable.

6.2.3 Begin with all switches = to 0 (closed, rocker depressed). Starting with the most significant (largest) number, check to see if adding that frequency increment (see Table A-2) to the total will exceed the desired frequency. If so, leave that switch closed. If not, open that switch and add its frequency to the total.

EXAMPLE: (Assume the increment for highest switch is 102.4 MHz).

If 88.5 is the desired (target) frequency:
SW10, 102.4 MHz, is over target: leave it closed. The total is still 0.
SW9, 51.2 MHz, is under target: open it. The total is now 51.2.
SW 8, 25.6 MHz, added to 51.2 is under target: open it. The total: 76.8.
SW7, 12.8 MHz, if added to 76.8, it is over target: leave it closed.
The Total is still 76.8.
SW6, 6.4 MHz, added to 76.8, is under target: open it. Total 83.2.
Continue through until the total is equal to the desired frequency: remaining switches, if any, remain closed.

TUNING TABLE
10.240/8192/.0125
88-108 MHz BAND

AN X INDICATES NUMBER SIDE OF ROCKER SWITCH IS UP. SET SWITCHES TO THE DISIRED FREQUENCY AND FOLLOW THE DIRECTIONS IN THE INSTRUCTION BOOK.

FREQUENCY MHz	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**4**	**3**	**2**	**1**
88.0	-	X	X	-	X	X	X	-	-	-	-	-	-	-
88.1	-	X	X	-	X	X	X	-	-	-	X	-	-	-
88.2	-	X	X	-	X	X	X	-	-	X	-	-	-	-
88.3	-	X	X	-	X	X	X	-	-	X	X	-	-	-
88.4	-	X	X	-	X	X	X	-	X	-	-	-	-	-
88.5	-	X	X	-	X	X	X	-	X	-	X	-	-	-
88.6	-	X	X	-	X	X	X	-	X	X	-	-	-	-
88.7	-	X	X	-	X	X	X	-	X	X	X	-	-	-
88.8	-	X	X	-	X	X	X	X	-	-	-	-	-	-
88.9	-	X	X	-	X	X	X	X	-	-	X	-	-	-
89.0	-	X	X	-	X	X	X	X	-	X	-	-	-	-
89.1	-	X	X	-	X	X	X	X	-	X	X	-	-	-
89.2	-	X	X	-	X	X	X	X	X	-	-	-	-	-
89.3	-	X	X	-	X	X	X	X	X	-	X	-	-	-
89.4	-	X	X	-	X	X	X	X	X	X	-	-	-	-
89.5	-	X	X	-	X	X	X	X	X	X	X	-	-	-
89.6	-	X	X	X	-	-	-	-	-	-	-	-	-	-
89.7	-	X	X	X	-	-	-	-	-	-	X	-	-	-
89.8	-	X	X	X	-	-	-	-	-	X	-	-	-	-
89.9	-	X	X	X	-	-	-	-	-	X	X	-	-	-
90.0	-	X	X	X	-	-	-	-	X	-	-	-	-	-
90.1	-	X	X	X	-	-	-	-	X	-	X	-	-	-
90.2	-	X	X	X	-	-	-	-	X	X	-	-	-	-
90.3	-	X	X	X	-	-	-	-	X	X	X	-	-	-
90.4	-	X	X	X	-	-	-	X	-	-	-	-	-	-
90.5	-	X	X	X	-	-	-	X	-	-	X	-	-	-
90.6	-	X	X	X	-	-	-	X	-	X	-	-	-	-
90.7	-	X	X	X	-	-	-	X	-	X	X	-	-	-
90.8	-	X	X	X	-	-	-	X	X	-	-	-	-	-
90.9	-	X	X	X	-	-	-	X	X	-	X	-	-	-
91.0	-	X	X	X	-	-	-	X	X	X	-	-	-	-
91.1	-	X	X	X	-	-	-	X	X	X	X	-	-	-
91.2	-	X	X	X	-	-	X	-	-	-	-	-	-	-
91.3	-	X	X	X	-	-	X	-	-	-	X	-	-	-
91.4	-	X	X	X	-	-	X	-	-	X	-	-	-	-
91.5	-	X	X	X	-	-	X	-	-	X	X	-	-	-
91.6	-	X	X	X	-	-	X	-	X	-	-	-	-	-
91.7	-	X	X	X	-	-	X	-	X	-	X	-	-	-
91.8	-	X	X	X	-	-	X	-	X	X	-	-	-	-
91.9	-	X	X	X	-	-	X	-	X	X	X	-	-	-

FM BAND
TUNING TABLE
10.240/8192/.0125

88-108 MHz BAND

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FREQUENCY MHz	10	9	8	7	6	5	4	3	2	1	4	3	2	1
92.0	-	X	X	X	-	-	X	X	-	-	-	-	-	-
92.1	-	X	X	X	-	-	X	X	-	-	X	-	-	-
92.2	-	X	X	X	-	-	X	X	-	X	-	-	-	-
92.3	-	X	X	X	-	-	X	X	-	X	X	-	-	-
92.4	-	X	X	X	-	-	X	X	X	-	-	-	-	-
92.5	-	X	X	X	-	-	X	X	X	-	X	-	-	-
92.6	-	X	X	X	-	-	X	X	X	X	-	-	-	-
92.7	-	X	X	X	-	-	X	X	X	X	X	-	-	-
92.8	-	X	X	X	-	X	-	-	-	-	-	-	-	-
92.9	-	X	X	X	-	X	-	-	-	-	X	-	-	-
93.0	-	X	X	X	-	X	-	-	-	X	-	-	-	-
93.1	-	X	X	X	-	X	-	-	-	X	X	-	-	-
93.2	-	X	X	X	-	X	-	-	X	-	-	-	-	-
93.3	-	X	X	X	-	X	-	-	X	-	X	-	-	-
93.4	-	X	X	X	-	X	-	-	X	X	-	-	-	-
93.5	-	X	X	X	-	X	-	-	X	X	X	-	-	-
93.6	-	X	X	X	-	X	-	X	-	-	-	-	-	-
93.7	-	X	X	X	-	X	-	X	-	-	X	-	-	-
93.8	-	X	X	X	-	X	-	X	-	X	-	-	-	-
93.9	-	X	X	X	-	X	-	X	-	X	X	-	-	-
94.0	-	X	X	X	-	X	-	X	X	-	-	-	-	-
94.1	-	X	X	X	-	X	-	X	X	-	X	-	-	-
94.2	-	X	X	X	-	X	-	X	X	X	-	-	-	-
94.3	-	X	X	X	-	X	-	X	X	X	X	-	-	-
94.4	-	X	X	X	-	X	X	-	-	-	-	-	-	-
94.5	-	X	X	X	-	X	X	-	-	-	X	-	-	-
94.6	-	X	X	X	-	X	X	-	-	X	-	-	-	-
94.7	-	X	X	X	-	X	X	-	-	X	X	-	-	-
94.8	-	X	X	X	-	X	X	-	X	-	-	-	-	-
94.9	-	X	X	X	-	X	X	-	X	-	X	-	-	-
95.0	-	X	X	X	-	X	X	-	X	X	-	-	-	-
95.1	-	X	X	X	-	X	X	-	X	X	X	-	-	-
95.2	-	X	X	X	-	X	X	X	-	-	-	-	-	-
95.3	-	X	X	X	-	X	X	X	-	-	X	-	-	-
95.4	-	X	X	X	-	X	X	X	-	X	-	-	-	-
95.5	-	X	X	X	-	X	X	X	-	X	X	-	-	-
95.6	-	X	X	X	-	X	X	X	X	-	-	-	-	-
95.7	-	X	X	X	-	X	X	X	X	-	X	-	-	-
95.8	-	X	X	X	-	X	X	X	X	X	-	-	-	-
95.9	-	X	X	X	-	X	X	X	X	X	X	-	-	-

FM BAND
TUNING TABLE
10.240/8192/.0125

88-108 MHz BAND

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FREQUENCY MHz	10	9	8	7	6	5	4	3	2	1	4	3	2	1
96.0	-	X	X	X	X	-	-	-	-	-	-	-	-	-
96.1	-	X	X	X	X	-	-	-	-	-	X	-	-	-
96.2	-	X	X	X	X	-	-	-	-	X	-	-	-	-
96.3	-	X	X	X	X	-	-	-	-	X	X	-	-	-
96.4	-	X	X	X	X	-	-	-	X	-	-	-	-	-
96.5	-	X	X	X	X	-	-	-	X	-	X	-	-	-
96.6	-	X	X	X	X	-	-	-	X	X	-	-	-	-
96.7	-	X	X	X	X	-	-	-	X	X	X	-	-	-
96.8	-	X	X	X	X	-	-	X	-	-	-	-	-	-
96.9	-	X	X	X	X	-	-	X	-	-	X	-	-	-
97.0	-	X	X	X	X	-	-	X	-	X	-	-	-	-
97.1	-	X	X	X	X	-	-	X	-	X	X	-	-	-
97.2	-	X	X	X	X	-	-	X	X	-	-	-	-	-
97.3	-	X	X	X	X	-	-	X	X	-	X	-	-	-
97.4	-	X	X	X	X	-	-	X	X	X	-	-	-	-
97.5	-	X	X	X	X	-	-	X	X	X	X	-	-	-
97.6	-	X	X	X	X	-	X	-	-	-	-	-	-	-
97.7	-	X	X	X	X	-	X	-	-	-	X	-	-	-
97.8	-	X	X	X	X	-	X	-	-	X	-	-	-	-
97.9	-	X	X	X	X	-	X	-	-	X	X	-	-	-
98.0	-	X	X	X	X	-	X	-	X	-	-	-	-	-
98.1	-	X	X	X	X	-	X	-	X	-	X	-	-	-
98.2	-	X	X	X	X	-	X	-	X	X	-	-	-	-
98.3	-	X	X	X	X	-	X	-	X	X	X	-	-	-
98.4	-	X	X	X	X	-	X	X	-	-	-	-	-	-
98.5	-	X	X	X	X	-	X	X	-	-	X	-	-	-
98.6	-	X	X	X	X	-	X	X	-	X	-	-	-	-
98.7	-	X	X	X	X	-	X	X	-	X	X	-	-	-
98.8	-	X	X	X	X	-	X	X	X	-	-	-	-	-
98.9	-	X	X	X	X	-	X	X	X	-	X	-	-	-
99.0	-	X	X	X	X	-	X	X	X	X	-	-	-	-
99.1	-	X	X	X	X	-	X	X	X	X	X	-	-	-
99.2	-	X	X	X	X	X	-	-	-	-	-	-	-	-
99.3	-	X	X	X	X	X	-	-	-	-	X	-	-	-
99.4	-	X	X	X	X	X	-	-	-	X	-	-	-	-
99.5	-	X	X	X	X	X	-	-	-	X	X	-	-	-
99.6	-	X	X	X	X	X	-	-	X	-	-	-	-	-
99.7	-	X	X	X	X	X	-	-	X	-	X	-	-	-
99.8	-	X	X	X	X	X	-	-	X	X	-	-	-	-
99.9	-	X	X	X	X	X	-	-	X	X	X	-	-	-

FM BAND
TUNING TABLE
10.240/8192/.0125

88-108 MHz BAND

AN X INDICATES NUMBER SIDE OF ROCKER SWITCH IS UP. SET SWITCHES TO THE DISIRED FREQUENCY AND FOLLOW THE DIRECTIONS IN THE INSTRUCTION BOOK.

FREQUENCY MHz	10	9	8	7	6	5	4	3	2	1	4	3	2	1
100.0	-	X	X	X	X	X	-	X	-	-	-	-	-	-
100.1	-	X	X	X	X	X	-	X	-	-	X	-	-	-
100.2	-	X	X	X	X	X	-	X	-	X	-	-	-	-
100.3	-	X	X	X	X	X	-	X	-	X	X	-	-	-
100.4	-	X	X	X	X	X	-	X	X	-	-	-	-	-
100.5	-	X	X	X	X	X	-	X	X	-	X	-	-	-
100.6	-	X	X	X	X	X	-	X	X	X	-	-	-	-
100.7	-	X	X	X	X	X	-	X	X	X	X	-	-	-
100.8	-	X	X	X	X	X	X	-	-	-	-	-	-	-
100.9	-	X	X	X	X	X	X	-	-	-	X	-	-	-
101.0	-	X	X	X	X	X	X	-	-	X	-	-	-	-
101.1	-	X	X	X	X	X	X	-	-	X	X	-	-	-
101.2	-	X	X	X	X	X	X	-	X	-	-	-	-	-
101.3	-	X	X	X	X	X	X	-	X	-	X	-	-	-
101.4	-	X	X	X	X	X	X	-	X	X	-	-	-	-
101.5	-	X	X	X	X	X	X	-	X	X	X	-	-	-
101.6	-	X	X	X	X	X	X	X	-	-	-	-	-	-
101.7	-	X	X	X	X	X	X	X	-	-	X	-	-	-
101.8	-	X	X	X	X	X	X	X	-	X	-	-	-	-
101.9	-	X	X	X	X	X	X	X	-	X	X	-	-	-
102.0	-	X	X	X	X	X	X	X	X	-	-	-	-	-
102.1	-	X	X	X	X	X	X	X	X	-	X	-	-	-
102.2	-	X	X	X	X	X	X	X	X	X	-	-	-	-
102.3	-	X	X	X	X	X	X	X	X	X	X	-	-	-
102.4	X	-	-	-	-	-	-	-	-	-	-	-	-	-
102.5	X	-	-	-	-	-	-	-	-	-	X	-	-	-
102.6	X	-	-	-	-	-	-	-	-	X	-	-	-	-
102.7	X	-	-	-	-	-	-	-	-	X	X	-	-	-
102.8	X	-	-	-	-	-	-	-	X	-	-	-	-	-
102.9	X	-	-	-	-	-	-	-	X	-	X	-	-	-
103.0	X	-	-	-	-	-	-	-	X	X	-	-	-	-
103.1	X	-	-	-	-	-	-	-	X	X	X	-	-	-
103.2	X	-	-	-	-	-	-	X	-	-	-	-	-	-
103.3	X	-	-	-	-	-	-	X	-	-	X	-	-	-
103.4	X	-	-	-	-	-	-	X	-	X	-	-	-	-
103.5	X	-	-	-	-	-	-	X	-	X	X	-	-	-
103.6	X	-	-	-	-	-	-	X	X	-	-	-	-	-
103.7	X	-	-	-	-	-	-	X	X	-	X	-	-	-
103.8	X	-	-	-	-	-	-	X	X	X	-	-	-	-
103.9	X	-	-	-	-	-	-	X	X	X	X	-	-	-

FM BAND
TUNING TABLE
10.240/8192/.0125

88-108 MHz BAND

AN X INDICATES NUMBER SIDE OF ROCKER SWITCH IS UP. SET SWITCHES TO THE DISIRED FREQUENCY AND FOLLOW THE DIRECTIONS IN THE INSTRUCTION BOOK.

FREQUENCY MHz	10	9	8	7	6	5	4	3	2	1	4	3	2	1
104.0	X	-	-	-	-	-	X	-	-	-	-	-	-	-
104.1	X	-	-	-	-	-	X	-	-	-	X	-	-	-
104.2	X	-	-	-	-	-	X	-	-	X	-	-	-	-
104.3	X	-	-	-	-	-	X	-	-	X	X	-	-	-
104.4	X	-	-	-	-	-	X	-	X	-	-	-	-	-
104.5	X	-	-	-	-	-	X	-	X	-	X	-	-	-
104.6	X	-	-	-	-	-	X	-	X	X	-	-	-	-
104.7	X	-	-	-	-	-	X	-	X	X	X	-	-	-
104.8	X	-	-	-	-	-	X	X	-	-	-	-	-	-
104.9	X	-	-	-	-	-	X	X	-	-	X	-	-	-
105.0	X	-	-	-	-	-	X	X	-	X	-	-	-	-
105.1	X	-	-	-	-	-	X	X	-	X	X	-	-	-
105.2	X	-	-	-	-	-	X	X	X	-	-	-	-	-
105.3	X	-	-	-	-	-	X	X	X	-	X	-	-	-
105.4	X	-	-	-	-	-	X	X	X	X	-	-	-	-
105.5	X	-	-	-	-	-	X	X	X	X	X	-	-	-
105.6	X	-	-	-	-	X	-	-	-	-	-	-	-	-
105.7	X	-	-	-	-	X	-	-	-	-	X	-	-	-
105.8	X	-	-	-	-	X	-	-	-	X	-	-	-	-
105.9	X	-	-	-	-	X	-	-	-	X	X	-	-	-
106.0	X	-	-	-	-	X	-	-	X	-	-	-	-	-
106.1	X	-	-	-	-	X	-	-	X	-	X	-	-	-
106.2	X	-	-	-	-	X	-	-	X	X	-	-	-	-
106.3	X	-	-	-	-	X	-	-	X	X	X	-	-	-
106.4	X	-	-	-	-	X	-	X	-	-	-	-	-	-
106.5	X	-	-	-	-	X	-	X	-	-	X	-	-	-
106.6	X	-	-	-	-	X	-	X	-	X	-	-	-	-
106.7	X	-	-	-	-	X	-	X	-	X	X	-	-	-
106.8	X	-	-	-	-	X	-	X	X	-	-	-	-	-
106.9	X	-	-	-	-	X	-	X	X	-	X	-	-	-
107.0	X	-	-	-	-	X	-	X	X	X	-	-	-	-
107.1	X	-	-	-	-	X	-	X	X	X	X	-	-	-
107.2	X	-	-	-	-	X	X	-	-	-	-	-	-	-
107.3	X	-	-	-	-	X	X	-	-	-	X	-	-	-
107.4	X	-	-	-	-	X	X	-	-	X	-	-	-	-
107.5	X	-	-	-	-	X	X	-	-	X	X	-	-	-
107.6	X	-	-	-	-	X	X	-	X	-	-	-	-	-
107.7	X	-	-	-	-	X	X	-	X	-	X	-	-	-
107.8	X	-	-	-	-	X	X	-	X	X	-	-	-	-
107.9	X	-	-	-	-	X	X	-	X	X	X	-	-	-
108.0	X	-	-	-	-	X	X	X	-	-	-	-	-	-

6.0.1 TEST EQUIPMENT REQUIRED

A. Deviation meter.
B. Oscilloscope.
C. Distortion analyzer.
D. Audio sine-wave generator.

6.1 FM DEVIATION & STEREO MULTIPLEX ALIGNMENT

Note: Audio mode must be set for true stereo, not synthesized, for this section.

6.1.1 Connect the scope probe to the junction of R463 and U12. With no audio signal input, adjust VR451 for best 38KHxz carrier null.

6.1.2 Continue as above, but also remove U10 and connect the audio signal generator, set the 1000 Hz at 0dBm to the Left Audio input only, do not connect the Right input yet. Adjust the Audio In level control (on the front panel at the Left) with a small screwdriver to set the internal meter to approximately 0VU. Adjust VR452 for best 1000 Hz null at the same point as above, U12.

6.1.3 Disconnect the audio input and the oscilloscope, and replace U10. Check that the Master Modulation Control, VR501 is near mid-position. Adjust VR472 for a pilot deviation of +/-7.5KHz as measured on the modulation meter connected to the FM channel output.

6.1.4 Connect the audio input, still set to 1000 Hz at 0dBm, to both the Left and Right input terminals, be sure to observe polarity, connecting Left and Right T (tip) terminals together, and Left and Right (ring) terminals together to produce an in-phase mono signal. Adjust the Audio In level control to produce +10 dBm at U25 (7)/C324.

6.1.5 Continue signal input as above. Adjust CR551 (L+R/Mono) for a deviation of +/-75 KHz on the modulation meter at the FM channel output. Adjust VR561 (Mono Out level) for +10 dBm into 600 Ohms at the Mono Audio output jack. VR561 may be set for any lower level if required for system compatibility, it has no effect on other levels within the FMT615C.

6.1.6 Disconnect the right channel audio input. Adjust VR431 (L-R) for a deviation of +/-75KHz on the modulation meter (be sure bandwidth

filter on the modulation meter is set to pass at least 50 KHz modulation).

6.1.7 Observe wave shape from Composite Output jack. The signal should be approximately 3.5 Vpp into 600 Ohms, and should have good stereo separation, as indicated by a relatively straight baseline within the modulated envelope. The 19KHz pilot should be visible within the baseline at approximately 0.35 Vpp. The demodulated output wave shape from the modulation meter should appear identical, although the amplitude will differ.

6.1.8 Attenuate the signal from the audio generator by 10dB (to -10dBm). Set VR570 so the internal meter reads “0” VU.

6.1.9 The stereo carrier (and pilot) frequencies are crystal controlled to better than +/- 1KHz accuracy. The crystal frequency may be trimmed over a narrow range by adjusting C472. As this is an extremely stable circuit, re-adjustment is unnecessary unless the crystal is replaced by one not tuned for a 30 pf load.

6.1.10 In order to provide optimum stereo separation, the 19KHz pilot phase zero crossing must coincide in time with the 38KHz carrier zero crossings.

Connect one probe of a dual-trace scope to 19 KHz at the junction of C476 and CR472. Trigger the scope on this signal only. Adjust the vertical for precisely center scale with the input shorted and for full scale deflection with the signal AC coupled.

Adjust the 19KHz phase, VR471, relative to the 38KHz phase, to align the negative to positive zero crossings. The horizontal scale may be expanded (with the time base multiplier) to facilitate accuracy.

6.3.0 AUDIO MODE

The FMT615C can operate in a true stereo mode, or by changing an internal programming connector, the audio can be synthesized to stereo within the FMT615C.

6.3.1 TRUE STEREO: On P4, the jumper jack must connected from the center post to the front post.

6.3.2 The degree of apparent stereo synthesized may be changed internally with VR331, from none to excessive. Lower settings produce sound which is nearly all monophonic, and higher settings produce sound which is un-natural.

7.0.0 COMPONENT LOCATOR