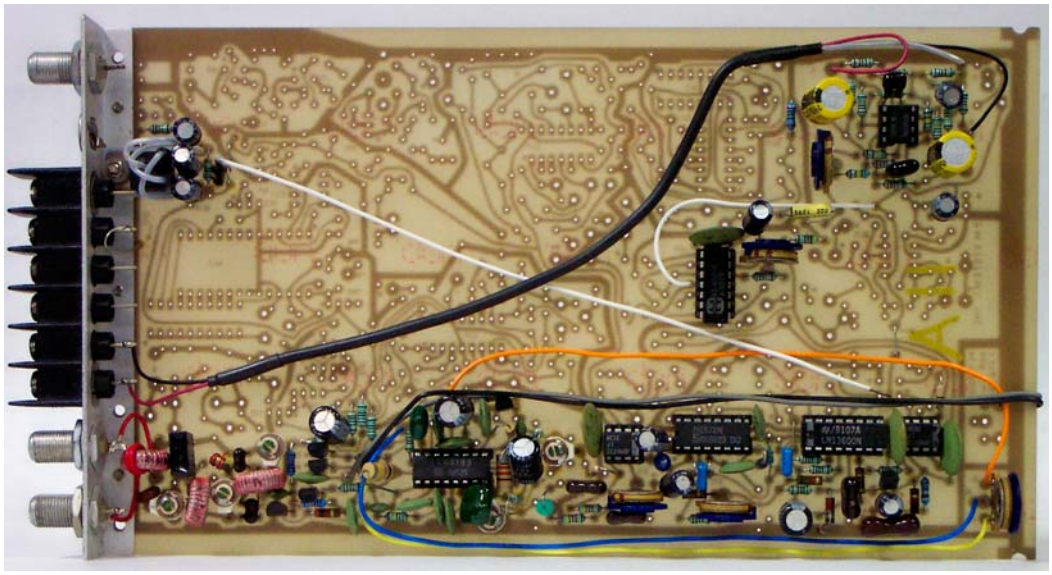
FMR611S



SUBCARRIER DEMODULATOR

INSTRUCTION BOOK
IB 2040-21

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TABLE OF CONTENTS

1.0 GENERAL DESCRIPTION

1.1.0 The FMR611S demodulates a signal which is frequency modulated upon a subcarrier in the 4.5-8.5 MHz band. The subcarrier may be transmitted by way of a microwave system or through a satellite transmission system. Ordinarily the subcarrier is carried along with a video signal. There may be several subcarriers above video, each carrying a monaural or stereo program. One FMR611S is required for each subcarrier to be demodulated.

1.2.0 Since microwave, and especially satellite transmission systems, inject significant levels of noise into the transmission path, certain operating parameters must differ from that used in standard FM broadcasting. The deviation ratio is increased from +/-75 KHz to +/-237 KHz for 100% modulation. This provides 10 dB greater signal-to -noise than possible +/-75 KHz deviation.

2.0 SPECIFICATIONS

S.C. INPUT FREQUENCY (SPECIFY)	IN 4.5-8.5 mhZ BAND
S.C. INPUT LEVEL	20-150 mV P-P
S.C. INPUT IMPEDANCE	HIGH Z BRIDGING
S.C. INPUT CONNECTORS	F (2)
S.C. INPUT DEVIATION	DEPENDS ON APPLICATION (USUALLY -+/237 KHz)
S.C. INPUT CHANNEL SPACING	600 KHz MINIMUM
AUDIO BASEBAND OUTPUT	0 dBm (APL), +10 dBm(PPL)
AUDIO OUTPUT IMPEDANCE	LOW Z, BALANCED
POWER REQUIREMENTS	-24V AT 65 MA

3.0 FUNCTIONAL DESCRIPTION

The FMR611S can be considered to be made up the following subsections:

3.1 Subcarrier band pass filter and input amplifier
3.2 Main amplifier squelch and A.L.C circuit
3.3 Limiter and discriminator
3.4 Low pass filter
3.5 Baseband audio processing and output stage
3.6 Voltage regulators

3.1.0 The subcarrier input band pass filter consists of L1-L8, C1-C7 which form a synchronously tuned band pass filter which may be tuned to any subcarrier frequency. Transistor Q1 couples the high impedance filter to the low impedance pre-amplifier IC-1. The gain of pre-amplifier IC-1 is controlled by Q11 so that the output of IC-1 remains in its linear range. This prevents amplitude-to-phase noise conversion, which improves the system's signal-to-noise ratio.

3.2.0 The main amplifier, IC-2, contains three limiter stages as well as the ALC and squelch sensing circuits. The ALC signal is coupled through Q11 to cause the output of IC-1 to be constant over the normal 20-150 mV P-P subcarrier input level.

3.2.1 Pin 15 of IC-2 provides a D.C. signal proportional to the input subcarrier level. This D.C. signal is delivered to comparator IC-5. When the D.C. level indicates a loss of subcarrier, comparator IC-5 will turn off the D.C. Voltage to the limiter and discriminator, thus squelching the audio output to prevent noise modulation of the output. This will also turn off the green L.E.D. "subcarrier on " indicator on the front panel.

3.3.0 The high level limiter consists of IC-3 and associated circuitry which provides a constant amplitude 5V P-P signal to impedance converter Q2. Both IC-3 and Q2 are turned off when the input subcarrier is removed, thus squelching noise when the subcarrier is off.

3.3.1 The discriminator consists of impedance converter Q2 and L9, L10, L11, L12, C20, C21, C22, C23 and associated circuitry. This is an ultra-linear, very wide-band discriminator capable of linearly demodulating FM signals deviating up to +/-1 MHz. The audio output of this discriminator is also very high, which overcomes any noise present in the audio processing equipment.

3.4.0 The low pass filter, IC-9 (PINS 1,2,3) and associated circuitry, cuts off at 15 KHz and has an 18 dB per octave cut-off rate. This ensures that the high frequency noise and adjacent subcarrier frequencies will be blocked from the output.

3.4.1 The second half (PINS 5,6,7) of IC-9 is a level adjusting circuit with which the output level is controlled. Potentiometer R37 controls the output and is located just behind the front panel next to IC-9.

3.5.0 Baseband processing may vary according to the specific program service. Deviation control and shaping of the baseband frequency response are used to optimize the performance of an up-converter for a particular program service. The factory will set these parameters to match the needs of specific program services.

3.6.0 The baseband audio is processed through IC-11 (PINS 5,6,7) then de-emphasized as required (usually 75 microseconds) with R66 and C86.

3.6.1 IC-108 provides an balanced low impedance audio output with an average program level (APL) of 0 dBm.

3.7.0 Voltage regulator IC-4 reduces the -21 to -28 volt input voltage to a highly regulated value to isolate outside influences. A second regulator, Q10, produces the -5 volts necessary to run IC-7 and IC-6.

4.0 INSTALLATION AND OPERATING INSTRUCTIONS

This section assumes that the FMR611S is installed in the PMS 610 main frame. If not, proceed to Appendix B.

4.1.0 INSTALLATION

Turn on power and connect an RG59U cable with an "F" termination between the "composite" output of the satellite receiver and the "subcarrier input" connector on the rear of the FMR611S. When the satellite receiver is tuned to a channel that contains a subcarrier at the frequency the FMR611S is set for the green L.E.D. in the front panel should come on. This indicates that the subcarrier is being received.

4.1.1 Now connect the balanced audio output to the equipment that is to receive the signal. The audio level is pre-set to 0 dBm at average program level.

4.2.0 OPERATING INSTRUCTIONS

Once the unit is properly installed, the only operating instruction is to observe that the green L.E.D. Light is lit to ensure that the subcarrier is being received.

5.0 MAINTENANCE

No routine maintenance is required. It is recommended that the equipment not be re-adjusted in the field, except for changes of the output amplitude. All other adjustments require specialized test equipment. In order to avoid degrading the overall performance, do not adjust any control in the FMR611S "by ear". In the event of a malfunction of the FMR611S 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 procedure follow in section 6.

6.1.0 SUBCARRIER TUNING

There is no requirement to "touch-up" the tuning of the subcarrier input circuitry and the factory strongly suggests that no adjustments be made except when there is a need to tune to a new subcarrier input channel frequency. In this case we recommend that the unit be returned to the factory for retuning. If circumstances require that the retuning be done in the field, the following procedure may be used:

6.1.1 **TEST EQUIPMENT REQUIRED**

A. Tuning tool "A" Micrometals (714-630-7420)
B. Deviation Meter
C. Sweep Generator
D. Oscilloscope
E. Distortion Analyzer
F. High Level Video Noise Generator

6.1.2.0 **TUNING OF PRESELECTOR**

Connect the sweep generator, set to the required operating frequency, to J1 (subcarrier input-in) and terminate J2 (subcarrier input-out) with 75 ohms. Adjust the sweep to +/- 1 MHz dispersion. Calibrate the scope to 100 KHz per horizontal division (horizontal deflection derived from sweep generator). Insulate the top of the scope probe with tape and tape to the wire lead of R1 that is connected to L1, then complete the following steps:

6.1.2.1 Adjust the sweep generator so that the desired subcarrier channel frequency aligns with the center line of the oscilloscope.

6.1.2.2 Short out the terminals of L3 with a screw driver or similar tool to make a very low inductance short. Tune L1 (using only tuning tool "A" to show maximum deflection on the scope at the center frequency of the subcarrier.)

6.1.2.3 Remove short from L3 and short L4 and tune L3 for minimum deflection at center frequency.

6.1.2.4 Remove short from L4 and short L6 and tune L4 for maximum deflection at center frequency.

6.1.2.5 Remove short from L6 and short L8 and tune L6 for minimum deflection at center frequency.

6.1.2.6 Remove short from L8 and tune L8 for maximum deflection at center frequency.

6.1.2.7 Remove the scope probe from R1 and place at the junction of R4 and C10 at Q1; observe shape of pass band. Minor adjustments may be made to the variable capactor to produce the flattest pass band. The band width should be 800 KHz between -3dB locations in the cut off region. The pass band should be flat, without tilt, to within +/-2.0 dB.

6.1.3.0 **TUNING OF DISCRIMINATOR**

Remove IC-2 (CA3189). Insert 1" of 24 gauge wire into pin 8 of IC-2. Connect the sweeper to the wire and ground. Calculate the following H and L frequencies:

H = Fc + 0.5 MHz
L = Fc - 0.5 MHz

Where Fc equals the subcarrier center frequency. Connect the scope probe to the junction of R21, R24 and C28.

6.1.3.1 Temporarily short out R22 with a clip cord adjust variable capacitor C23 (marked H on the circuit board). Tune to produce a minimum deflection on the scope at frequency H (operate scope on D.C. input mode and set undeflected trace exactly in the center).

6.1.3.2 Adjust L10 (marked L) to produce a maximum deflection on the scope at frequency that also produces the straightest line between frequency L and H.

6.1.3.3 Remove short from R22 and short R23. Adjust C22 (L) to produce a deflection minimum at frequency L.

6.1.3.4 Adjust L9 (marked H) to produce a maximum deflection on the scope at frequency H that also Produces the straightest line between frequency L and H.

6.1.3.5 Remove short from R23 and wire from pin 8 of IC-2 and disconnect sweeper.

6.1.4.0 **FINAL ALIGNMENT OF SUBCARRIER DEMODULATOR**

Section 6.1.2.---and 6.1.3. ---have provided an initial alignment of the subcarrier demodulator and the unit will now operate to relaxed specifications. This final alignment procedure is needed to fully meet specifications.

6.1.4.1 **SETTING LEVELS**

Connect a subcarrier signal tuned to center frequency to the subcarrier input. Set the level to 10 mV P-P. Connect the scope probe (10:1) across R7 at pin 8 of IC-1. Adjust R55 (marked ALC) for maximum deflection of the scope, then readjust to 60% of this maximum deflection.

6.1.4.2. **SETTING SQUELCH**

Connect subcarrier as in 6.1.4.1, but remove scope probe. Set subcarrier level to 10 mV P-P. Adjust R9 (marked SQ) to point where any further reduction of the input level will cause the green L.E.D. on the front panel to go out.

6.1.4.3 **MINIMIZE DISTORTION**

Modulate the subcarrier frequency from a know high quality modulator such as the FMT611S or TM-404. Set deviation to +/-300 KHz with a 1 KHz tone having a known distortion less than 0.05% THD. Connect to the deviation meter (AFM-2) to read deviation connect the distortion meter (HP334A) to the AF output of the AFM-2. Measure the distortion, which should be under 0.15%. Now connect the subcarrier modulator to the FMR611S under test and set the subcarrier level to 50 mV P-P. Connect the distortion meter to baseband output of the FMR611S. Measure distortion If higher than 0.3%, adjust L9 (H) and L8 (L) to reduce distortion to a minimum without causing the output level to drop more than 10%. This should not require more than one turn of the core in either direction.

FMR611S PARTS LIST
PL 2040-21 **RESISTORS**

PART NUMBER	DESCRIPTION			
R101	RESISTOR, FACTORY SELECT			
R103	RESISTOR, CARBON	10M OHM	5%	1/4W
R104	RESISTOR, CARBON	10M OHM	5%	1/4W
R105	RESISTOR, CARBON	3K	5%	1/4W
R106	RESISTOR, CARBON	1M OHM	5%	1/4W
R107	RESISTOR, CARBON	1M OHM	5%	1/4W
R108	RESISTOR, CARBON	10K	5%	1/4W
R112	RESISTOR, CARBON	100K	5%	1/4W
R113	POTENIOMETER	25K		
R114	RESISTOR, CARBON	10K	5%	1/4W
R116	RESISTOR, CARBON	1M OHM	5%	1/4W
R117	RESISTOR, CARBON	10K	5%	1/4W
R118	RESISTOR, CARBON	47 OHM	5%	1/4W
R121	RESISTOR, CARBON	2.4K	5%	1/4W
R122	RESISTOR, CARBON	100 OHM	5%	1/4W
R123	RESISTOR, CARBON	100 OHM	5%	1/4W
R125	RESISTOR, METAL FILM	10K	1%	
R126	RESISTOR, METAL FILM	43.2K	1%	
R127	RESISTOR, METAL FILM	43.2K	1%	
R143	RESISTOR, CARBON	100K	5%	1/4W
R144	RESISTOR, METAL	20.5K	1%	
R145	RESISTOR, METAL FILM	9.09K	1%	
R153	POTENTIOMETER	25K		
R154	RESISTOR, CARBON	100K	5%	1/4W
R155	RESISTOR, METAL FILM	4.22K	1%	
R156	POTENTIOMETER	10K		
R157	RESISTOR, METAL FILM	54.9	1%	
R158	RESISTOR, METAL FILM	60.4K	1%	
R161	RESISTOR, METAL FILM	200K	1%	
R162	RESISTOR, METAL FILM	200K	1%	
R163	RESISTOR, CARBON	51 OHM	5%	1/4W
R164	RESISTOR, CARBON	51 OHM	5%	1/4W

R165	RESISTOR, METAL FILM	221K	1%	
R166	RESISTOR, METAL FILM	221K	1%	
R167	RESISTOR, METAL FILM	60.4K	1%	
R168	RESISTOR, METAL FILM	60.4K	1%	
R169	RESISTOR, CARBON	10K	5%	1/4W
R170	RESISTOR, CARBON	10K	5%	1/4W
R171	RESISTOR, CARBON	10K	5%	1/4W
R172	RESISTOR, CARBON	10K	5%	1/4W
R541	RESISTOR, CARBON	240 OHM	5%	1/4W
R542	RESISTOR, CARBON	3.3K	5%	1/4W

PART NUMBER	**CAPACITORS**
C101	CAPACITOR, CERAMIC VARIABLE 2-20 PF
C102	CAPACITOR, FACTORY SELECT
C103	CAPACITOR, MICA 18,000 PF
C104	CAPACITOR, CERAMIC VARIABLE 2-20 PF
C105	CAPACITOR, FACTORY SELECT
C106	CAPACITOR, CERAMIC VARIABLE 2-20 PF
C107	CAPACITOR, FACTORY SELECT
C108	CAPACITOR, CERAMIC .01 MF
C109	CAPACITOR, CERAMIC .01 MF
C111	CAPACITOR, CERAMIC .05 MF
C112	CAPACITOR, CERAMIC .05 MF
C113	CAPACITOR, CERAMIC .05 MF
C114	CAPACITOR, CERAMIC .1 MF
C115	CAPACITOR, CERAMIC VARIABLE 2-20 MF
C116	CAPACITOR, CERAMIC .05 MF
C117	CAPACITOR, CERAMIC .01 MF
C118	CAPACITOR, ELECTROLYTIC 100 MF
C121	CAPACITOR, CERAMIC .05 MF
C122	CAPACITOR, CERAMIC .05 MF
C123	CAPACITOR, CERAMIC .1 MF
C124	CAPACITOR, CERAMIC .05 MF
C125	CAPACITOR, CERAMIC .05 MF
C126	CAPACITOR, MICA 680 PF
C127	CAPACITOR, MICA 390 PF
C128	CAPACITOR, MICA 47 PF
C129	CAPACITOR, CERAMIC .1 MF
C131	CAPACITOR, ELECTROLYTIC 15 MF
C142	CAPACITOR, CERAMIC .1 MF
C143	CAPACITOR, ELECTROLYTIC 22 MF
C149	CAPACITOR, ELECTROLYTIC 22 MF
C150	CAPACITOR, ELECTROLYTIC 22 MF
C151	CAPACITOR, ELECTROLYTIC 22 MF
C152	CAPACITOR, MICA 18,000 PF
C153	CAPACITOR, MICA 5 PF
C154	CAPACITOR, ELECTROLYTIC 22 MF
C155	CAPACITOR, MICA 330 PF
C156	CAPACITOR, MICA 330 PF
C157	CAPACITOR, MICA 330 PF
C158	CAPACITOR, ELECTROLYTIC 220 MF
C159	CAPACITOR, ELECTROLYTIC 220 MF
C148	CAPACITOR, CERAMIC .1 MF

C541	CAPACITOR, ELECTROLYTIC	22 MF
C542	CAPACITOR, ELECTROLYTIC	22 MF
C543	CAPACITOR, ELECTROLYTIC	22 MF

PART NUMBERS

DIODES

D101	DIODE, 1N4742A MOT.
D102	DIODE, LED, GREEN
D103	DIODE, MVAM 115 MOT.

INDUCTORS

L101	5.1 MH	L105	47 MH
L102	5.1 MH	L106	22 MH
L103	.1 MH	L107	3.9 MH
L104	5.1 MH	L108	27,000 MH

TRANSISTORS

Q1	2N5485 (NAT'L)	Q3	2N4062 (NAT'L)
Q2	2N4062 (NAT'L)	Q4	2N3392 (G.E)

INTEGRATED CIRCUITS

U101	LM3189N (NAT'L/RCA)	U107	HA474-5 (NAT'L)
U103	LF353N (NAT'L)	U108	NE5532N (SIGN.)
U106	CA326OE (RCA)	U515	LM337T (MOT.)

Appendix B

F M SYSTEMS MAINFRAME/POWER SUPPLY INSTRUCTIONS AND SCHEMATIC

Includes PMS610X (Mainframe less power supply)

The PMS610 is a mainframe power supply for mounting F M Systems 600 series equipment. Up to three circuit board modules may be accommodated. These modules may be readily installed in the field with common hand tools; no soldering is required.

MOUNTING AND SIZE: Fits Std. 19" wide rack. 1 3/4" High x 10 1/4" deep.

CAPACITY: Up to three F M Systems-standard circuit board modules, each 5.3" wide x 9.35" deep, or one 10.7" double-wide modules and an additional single module.

POWER (PMS610): 105-125 V., 50-60 Hz., 0.4 A max input; -24 V +/-5%., 0.5 A max. Output available internally. 5' 3-wire U.S.A. standard cord and plug.

POWER (PMS610X): -24VDC input and output.

CONNECTORS: Accessible on rear panel, provided as integral part of circuit board modules; see individual specification sheets for particulars.

WEIGHT (PMS610): 4 lbs. net +2/3 lb./avg. module, add 2 lbs. for shipping carton. (6 lbs. shipping less modules; 8 lbs. shipping w/3 modules).

WEIGHT (PMS610X): 2 lbs. net (4 lbs. shipping w/o modules; 6 lbs. shipping w/3 modules).

TO INSTALL AN ADDITIONAL MODULE, FOLLOWING THESE STEPS:

1. Select which of the three positions will be occupied by the new circuit board module.
2. Remove the mainframe from the rack; disconnect power.
3. Remove the bottom cover, and the #4-40 x 1/4" mounting studs adjacent to the new module's location from the mainframe.
4. Remove the appropriate rear-panel connector (blank) from the mainframe.
5. Remove the appropriate front-panel "nameplate" blank from the mainframe.
   A. Remove the old "nameplate" by carefully lifting one corner, then slowly peel the nameplate from the aluminum panel. The old nameplate may be destroyed, but the aluminum panel should be essentially as-new.

6. Install the new circuit board module with the components toward top cover. Take care to avoid moving any of pre-set controls (just a "slight" change can cause the unit to malfunction). Slip the connectors through the holes in the rear panel and drop the front edge of the circuit board onto the brackets attached to the front panel.

7. Install two 3/8" lockwasher and two 3/8" -32 nuts on the outermost "F" connecter barrels. Gently tighten the nuts while holding the circuit board to the mounting brackets.

8. Install two #4-40 x 1/4" studs and lockwasher to secure the front of the board to the mounting brackets.

9. Remove the top cover from the mainframe.

10. Connect the negative D.C. supply to the new circuit board from the PMS 610 power distribution wire. 0.025" square connector pins are used, usually connected to a multiple jumper (provided) with mating female connectors which connect from one circuit board to the to the next. Power supply return is through chassis.

11. Push any L.E.D.'s (Lighting Emitting Diodes) straight into the appropriate mounting holes. (see instructions for the particular module being installed). Insert only until the dark collar around the colored L.E.D. is flush with the front panel; the collar must not protrude, in order to ovoid interfering with the new nameplate.

12. Mount the new front-panel nameplate (Furnished with the circuit board module being installed)
    A. Temporarily set the new nameplate in place and check that all necessary cutouts are clear.
    B. Remove the paper peel coat from the adhesive backing of the nameplate, then slide the nameplate down around the L.E.D.'s onto the panel. Press gently to set the adhesive.
    C. Mount any additional panel components (Switches, meters, potentiometers, etc.) with the hardware supplied. Gently tighten the fasteners to secure the components; do not overtighten.

13. Mount the new rear-panel connector identification strips as illustrated in the instruction book for the particular module being installed.

14. Connect input, output and power cables. The green "POWER-ON" indicator should be illuminated. Set any internal controls as required.

CAUTION: Most circuit board modules have several adjustments which are carefully factory-set with precision instruments for optimum performance. Change only those which must be adjusted; some controls when mis-adjusted produce little change under "normal" operating conditions, but can seriously reduce the ability of the unit to function correctly under other conditions which may be encountered. Therefore, if you must adjust a control, place a mark on it before moving it, so that it may be returned to its original setting with reasonable accuracy.

15. Disconnect power. Replace top and bottom covers and mount mainframe to rack. Reconnect power and check for normal operations of each module.