Shure Model PSM400
Personal Stereo Monitor Transmitter Specification
Project # 17174

Outline

General Product Description

The Shure PSM400T is a wireless transmitter designed for stereo transmission from a line level input. The signal is transmitted to a wireless body-pack receiver within the frequency ranges of (722-865) MHz into three different groups. Each transmitter/receiver combination has Eight available frequencies. The transmitter features a half-rack metal enclosure. This product was designed to be use by stage musicians and broadcast personnel.

I Special Features

1. Each transmitter/receiver combination has sixteen available transmission frequencies that must match on both units for proper reception.
2. Balanced 1/4 in. line level inputs.
3. 1/4 in. loop through.
4. Internal limmiter to protect the user from extremely high level signals and to limit the occupied bandwidth based on FCC standards.
5. Two rows of input level metering. Each row (left and right channel) has 4 LED’s with the last red LED indicating the point where the limiter is activated.
6. Headphone monitoring jacks(1/8in.) with volume control on front panel.
7. Half-rack steel chassis.
8. Phantom power protection.
14. Dynamic 2:1 Audio Companding.

15. Stereo pilot used as tone-key.
16. Timing circuitry for quiet operation.

II Circuit Description

Audio Section

The PSM transmitter requires a line level input source, balanced or unbalanced entering via (1 /4)" plugs. If only one connector is plugged in the signal is applied to both left and right input sections. The input signal (left and/or right) is converted from a balanced to an unbalanced signal through an active network (U201, U301). The unbalanced signal then gets sent to the headphone amp as well it goes through a 15kHz brick wall low pass filter (FL201, FL301). So that any 19kHz information from the input does not confuse the receiver pilot-detection circuitry.

The signal is then buffered, pre-emphasized (R219, C211), (R319, C311) and AC coupled into the compressor/limiter (NE571 U502A,B). The NE571 utilizes external amplifiers (U501A, B). The compander performs 2:1 logarithmic compression of the audio signal, which then feeds into U601, the stereo modulator. These two signals are "window" compared by U401 against fixed levels. If either signal exceeds these levels current is fed into the rectifying capacitors (C505, C515) thus lowering the gain on the compressor.

The stereo modulator outputs both the stereo modulated signal, and a 19kHz tone to be used as a pilot. The pilot tone is filtered and adjusted for proper phase (L601). The pilot tone is then mixed with the modulated audio (U602A). The level of pilot relative to audio is adjusted with trimmer pot R608. The mixed signal passes through a switch (SW601) controlled by the microprocessor, which is used to eliminate "popping" when frequencies are changed.

The LED ballistics are somewhere between peak and VU, with the intention of giving peak indication that is slow enough for the user to visually catch short transients.

RF section

Processed audio and pilot tone enter R35, an internal potentiometer that is adjusted for 35kHz deviation (100% modulation). The audio is then fed to the tuning voltage pin of the voltage Controlled oscillator (VCO), and modulates the carrier directly. The VCO is shielded to prevent external Rf fields from affecting its operation. Regulated 5vdc power is provided to ensure frequency stability.

The VCO is capable of tuning from 722 to 746 MHz (UA- Model) and 800 to 863 MHz (M and K - Models) with a 1 to 9 volt tuning voltage range. At the output of the VCO the RF signal splits into two paths. The output of the VCO is coupled by C36 the frequency control pin of the synthesizer U29. The synthesizers internal circuitry divides the signal as necessary to the desired reference frequency. The synthesizer contains a quartz-controlled reference oscillator circuit operating

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222 HARTREY AVENUE
EVANSTON, IL 60202
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from a 4.0 MHz crystal Y30, which is adjusted by means of trimmer C41. The output of the synthesizer is a series of current pulses, which are integrated by a passive loop filter to produce a control voltage signal. The control voltage signal is then connected to the VCO through amplifier U30A, which is used to isolate the PLL filter from the audio modulation signals the transmitter operates on eight selectable frequencies. Frequency selection is made via microprocessor U5 which interfaces with the user by means of switch SW20A. The VCO output is also coupled to a RF MMIC Q100 amplifier through a resistive pad. The RF signal is then applied to the RF power amplifier Q102.The PA is configured as a common emitter amplifier with active bias elements Q110 and D112. The power amplifier (Q102) contains fixed tuned low pass matching networks, and low pass filter FL101, providing a high degree of spectral purity.
During transmitter power up. Bringing the gates of Q101 and Q103 low mutes the RF power. This provides approximately 45dB RF attenuation until the PLL has locked. Bringing the gates of Q101 and Q103 high does then not mute the transmitter RF. During transmitter power off conditions, voltage is first removed from the VCO by bringing the base of Q90 high. In this manner the carrier signal of the transmitter is not allowed to drift off frequency during power on and power off conditions.

Power Supply Section

Tabletop AC Adapter class 2 power unit. (PS40, PS40E, PS40UK)
Domestic: (PS40), (Input: 120VAC 60Hz 14W, Output: 15VDC 600mA, 9W)
Export European: (PS40E), (Input: 230VAC 50/60 Hz, Output: 15VDC 600mA, 9W)
United Kingdom : (PS40UK),(Input: 230VAC 50/60 Hz ,Output: 15VDC 600mA, 9W)

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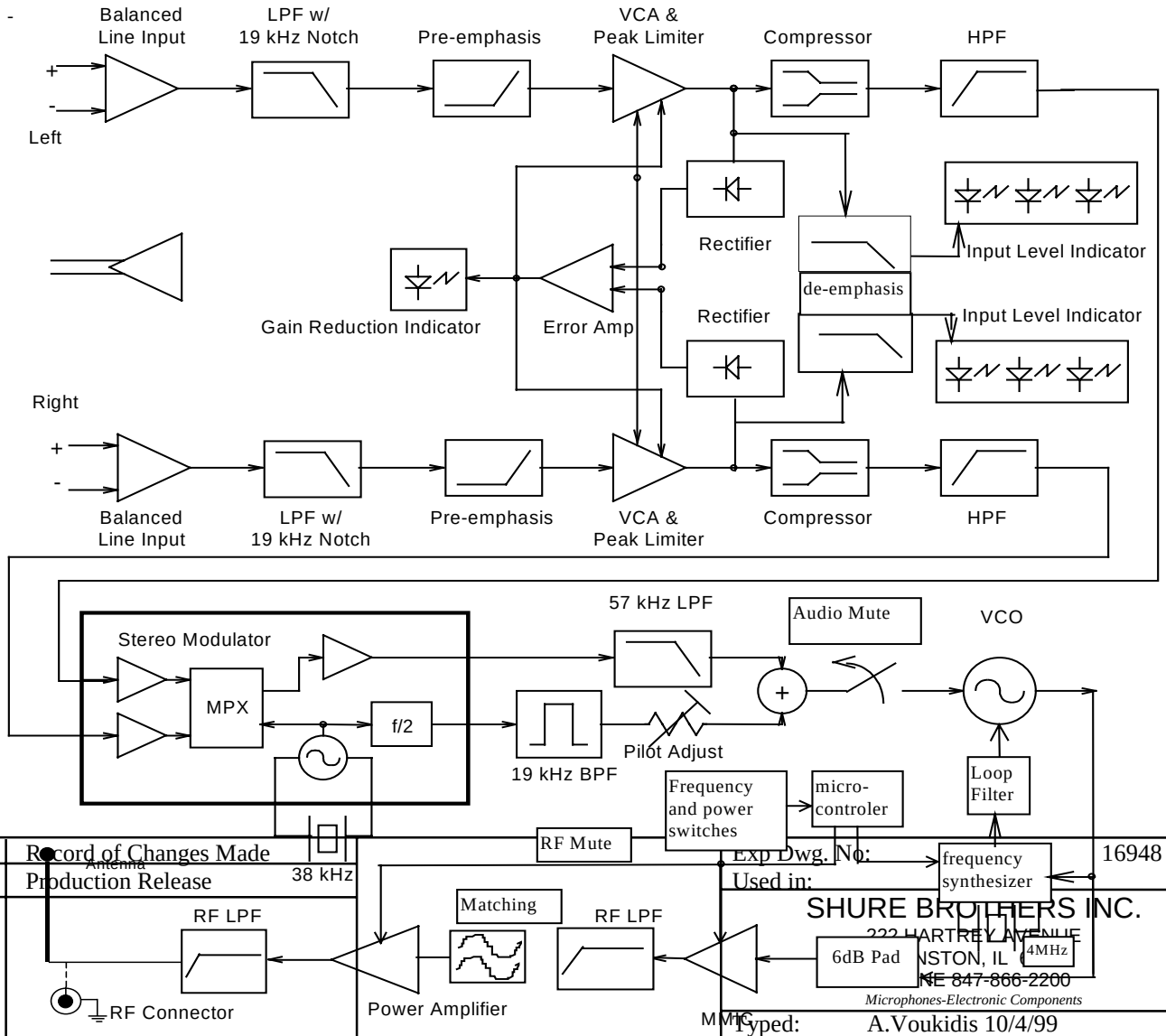
System Block Diagram



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III Test Equipment (or approved equivalent)

1.	Digital Multimeter	Fluke 77 or 87
2.	Audio Oscillator	Krohn Hite 4300A or HP8903
3.	AC Meter	HP8903, HP400GL, or Tektronix AA501
4.	Distortion Analyzer	HP8903,Tektronix AA501(4) 50Ω loads
5.	Frequency Counter	Phillips PM6666 or HP5386A
6.	Spectrum Analyzer	HP8591A
7.	IF Receiver	Shure Modified P6R Design
9.	50 ohm cable(RG-58/U),	2ft or less,BNC to BNC connector
10.	1/4-to-1/4in. cable	Shure Part #:
11.	Non-metallic slot-type screw driver. (Toray yellow adjuster #A-1810)	
12.	Non-metallic slot-type screw driver. (Toray red adjuster #A-0910)	

IV Alignment Procedure

PREFACE: If any part of the following alignment cannot be achieved, see Section X, "Service Evaluation and Troubleshooting".

WARNING: Under no circumstances should FL301 and FL201 be adjusted. These parts come in preset form from the manufacturer and can not be retuned If they are accidentally adjusted, THEY MUST BE REPLACED!

Initial Transmitter Settings

1. Set headphone volume control (R136) full clockwise.
2. Set audio analyzer with a 30kHz low pass filter.
3. Remove antenna Of UUT and place capacitor C155 to the open pad of C154. (After all of the following test have been completed place back the antenna to the UUT and remove C154.)

Frequency / Channel Table

Channel	Model (HF)	IF (HF)	Model (HF-A)	IF (HF-A)	Model (MN)	IF (MN)	Model (KE)	IF (KE)
0	722.325	611.725			800.600	690.000	842.175	731.575
1	723.100	612.500			801.100	690.500	843.250	732.650
2	724.500	613.900			802.325	691.725	843.675	733.075
3	725.550	614.950			805.050	694.450	845.900	735.300
4	726.125	615.525			808.600	698.000	846.325	735.725
5	728.450	617.850			810.550	699.950	847.075	736.475
6	730.450	619.850			811.600	701.000	847.500	736.900
7	731.525	620.925			813.300	702.700	852.450	741.850
8	734.175	623.575			813.800	703.200	854.900	744.300
9	738.225	627.625			815.425	704.825	856.175	745.575
A	739.625	629.025			822.875	712.275	856.950	746.350
B	740.350	629.750			823.475	712.875	859.375	748.775
C	741.600	631.000			824.625	714.025	860.400	749.800

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D	**743.225**	632.625			**827.700**	717.100	**860.900**	750.300
E	**744.275**	633.675			**828.775**	718.175	**863.100**	752.500
F	**745.675**	635.075			**829.175**	718.575	**864.300**	753.700

4.0 **DC REGULATOR TESTS.**

Check TP901 for (12.4±.4)Vdc,TP13 for (6.0±.4)Vdc, Tp2 for (5.0±.4)Vdc, and TP1 for(4.8±.2)Vdc. On the production fixture only, check DC current drain of UUT, should be ……mA

4.1 **VCO TUNING VOLTAGE**

Set the Tx to the minimum frequency of the transmitter model. Attach a coaxial cable between the spectrum analyzer and J2, the antenna port. Set the spectrum analyzer center frequency to frequency of the transmitter model you are working (see table above) ,set the span at 200KHz and the amplitude at 17 dBm. At TP3 set:

a)A-Model 2.0VDC(+/-.25volts) at(Channel "1")
b)B-Model x0VDc(+/-.25volts) at (Channel"1") 801.100MHz.
c)C–Model x2VDc(+/-.25volts) at(Channel "1") 843.250MHz.

4.2 **RF POWER.**

Measure the output power of UUT, the power should be as follows:

HF - Models +15.0dBm (+/- 1.5dB)
MN - Models +13.0dBm (+/- 1.5dB)
KE - Models +10.0dBm (+/- 1.5dB)
HF(A) - Models +15.0dBm (+/- 1.5dB)

4.3 **PILOT TONE SETTING.**

Adjust R608 to set 19kHz sidebands to -14.75dBc ± 0.75dB.

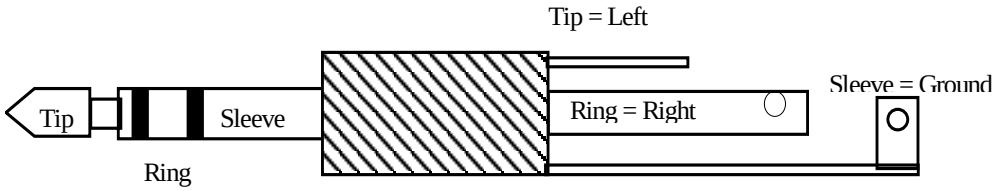
CARRIER FREQUENCY.

Attach the coaxial cable to the frequency counter. Adjust C41 for the proper carrier frequency **+/- 1kHz.**

4.4 **HEADPHONE OUTPUT TEST. (**Volume pot should set to the maximum)

Input a 1kHz audio at a level of **-20.0dBu** signal from audio generator to the Left IN (TP202) of UUT. Measure the headphone output at TPHPL1(left), TPHPR1(right) to be **+13.3dBu ± 2.5dB**. Verify that THD is less than **0.02%** with 400Hz and 30KHz filters activated . For this test a (1/8)"stereo plug can be used to access those test points, and (1/4)"mono plug to provide the audio at the UUT.

1/4" or 1/8" in. plug



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4.5 **COMPANDER SETTING.**

Increase audio generator output to get **-1.4dBu ± 0.1dB (660)mV** at TPLC1 or TPRC1. The audio generator output level should **be –7.6dBu ± 1.0dB.** Verify all green and yellow LEDs should be on.

4.6 **DEVIATION SETTING:**

NOTE: Verify that the receiver P4R, P4T_IF is: a) calibrated to 35KHz deviation, b)THD at headphone output audio Left and Right is less than 1.75%, c) Stereo separation is greater than 30dB between left and right.
Make sure the 400Hz highpass filter is OFF at the audio analyzer.
Set (P4T_IF or P4R) receiver's volume full clockwise.
Production test fixture only: ZAD Mixer **(**I = IF port, L= LO port, R= RF port)
Connect TPTRF1 (J3) to RF port of ZAD Mixer through 20dB RF attenuator.
Connect signal generator to LO Port of ZAD Mixer and set to +7dBm. IF port of ZAD Mixer should be connected to RF input of Shure P4T_IF receiver.
Monitor (P4T_IF or P4R) receiver at TP302 and adjust transmitter Deviation pot R151 for **-1.4dBu ± .1dB**
Verify the audio frequency response.
Audio output at 100Hz to be **-7.9dBu ± 1.0dB** at TP302.
Audio output at 10KHz to be **-3.8dBu ± 1.5dB** at TP302.
Reset Audio generator to 1kHz.

4.6 **LIMITER TEST.**

Input audio to left channel of UUT at a level of 2.0dBu at (TP202) and test the limiter by increasing audio level from audio generator by 0.2dB. Measure the audio at TPLC1 or TPRC1 of the receiver the audio level should be +2.8dBu ± 1dB. Verify that all left and right audio LED's (Green, yellow, Red) are on. Increase audio input to +10.2dBu and verify that the audio level remains at +2.8dBu ± 1dB.

4.7 **DISTORTION SETTINGS.**

Engage the 400Hz and 30kHz filters on the audio generator. Decrease audio level to **–7.6dBu**. Minimize distortion at the right receiver audio output(TP308) by trimming R508. Minimize distortion of the left receiver output(TP309) by trimming R518. Both channels should be less than **0.8%**

4.8 **STEREO SEPARATION.**

Feed left channel of transmitter input TP202 (a ¼"plug can be used) with a balanced audio 1kHz at +2.8dBu, insert a ¼"plug to the right channel input of UUT. Monitor receiver's right output (TP309) with audio analyzer. Tune L6 to minimize audio output and record this number. Measure the audio level at the receiver's left output. The resulting level should be at least **35dB** higher from the level measured at the receiver's right output.
(In the production fixture only feed the audio to the left channel of the UUT at the test point TP201).

4.9 **TALK OUT TEST.**

After final assembly into the chassis and case do the following talk out

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test. In production this consists of sending a 1kHz tone through left or right inputs of the P4T and listening to the demodulated tone coming via the ICOM through the L3 IF receiver, through a mixer, amp and speaker. In service this may be accomplished by sending a tone or voice through the P4T and listening to it either out of its corresponding receiver P4R.

V Test for Product Acceptance

<Basic tests needed to test operation of the unit. No detailed specs.>

1. **DC POWER:** Plug in unit and observe frequency LED to be on. Check TP234 for +12.4VDC ± 0.4VDC, TP226 for -12.3VDC ± 0.4VDC and TP106 for 5.1VDC ± 0.3VDC.
2. **RF POWER** Attach a coaxial cable between the spectrum analyzer and J2, the antenna port. Set the spectrum analyzer center frequency to the carrier frequency of the transmitter model you are working with, (see TABLE 1 above). The output power should be as follows:
   HF-Models +15.0dBm (+/- 1.5dB)
   MN- Models +13.0dBm (+/- 1.5dB)
   KE- Models +10.0dBm (+/- 1.5dB)
3. **19kHz PILOT:** With no audio input, 19kHz pilot tone sidebands should be -14.75dBc ± 0.75dB.
4. **AUDIO LEDs:**Input a 1 kHz sinewave at +12.2dBu to either left or right 1/4 jack. Turn input volume R202 full clockwise. All green, yellow, and red audio LEDs should be on.
5. **LIMITER:** Decrease audio level to 2.2dBu. Measure and record the level at TP55 (should be 2.6dBu ± 2dB). Increase the audio input by 10dBu. The level at TP55 should be the same ± 0.1dB and all audio level LEDs and L/R limiter LEDs should be on.
6. **DEVIATION SETTING:** Connect output of audio generator to the "Left/CH1 IN" of the P4T. Set audio generator output to get -1.4dBu ± 0.1dB at TP28. TP118 should measure -1.4dBu ± 0.3dB. The audio generator output should be -11.8dBu ± 2dB and all green and yellow LEDs should be on.
   Set receiver volume full clockwise. Monitor receiver at TP302. You should measure -1.4dBu ± 0.1dB.

Agency Approvals

VII Additional Product Specifications

Specification	Minimum	Typical	Maximum
Frequency Response (+0.5dB, -3dB, referenced to 1kHz)	**50Hz**	**-**	**15kHz**
Total Harmonic Distortion	**0%**	**0.5%**	**0.8%**
Input Impedance (input pad OUT/IN)	**-**	**20kΩ/14kΩ**	**-**
Headphone output impedance	**-**	**100Ω**	**-**
RF Power output: (MN-model)	**+11.0dBm**	**+13dBm**	**+15.0dBm**
(KE-model)	**+8.0dBm**	**+10dBm**	**+12.0dBm**
USA (HF-model)	**+13.0dBm**	**+15.0dBm**	**+17.0dBm**
Carrier frequency tolerance		**±5kHz**	
Spurious emissions dBm(up to 4GHz)	**-**	**-65dBm**	**-54dBm**
FM Deviation	-	**35kHz**	**-**
Stereo separation (Load dependent)	**35 dB**	**40dB**	**-**

VIII Mechanical Specification

1. **Overall Dimensions**
   1.718″(43.6mm) High x 8.630″(219.2mm)Wide x 5.375″(136.5mm)Deep.
   With rack mounting accessories available.
2. **Weight**
   2.0Lbs (907.2 grams)
3. **Housing**
   Chassis: Extruded Aluminum, Black paint.

Front / Rear Plate: Aluminum, Anodized Black, Polycarbonate name plate.

4. **Antenna**
PCB mount semi-ridgid 1/4 wavelength for all models.

IX Environmental Specifications

Temperature Storage (CQE 4)
7 days at +165F (+74C) degrees, unpacked.
7 days at -20F (-29C) degrees, unpacked.
After each 7 day storage, the units must be allowed to stabilize for 24 hours before testing. Units must operate per the -7 specification.

Temperature Cycling (CQE 5)
5 cycles from -20F (-29C) degrees, to +165F (+74C) degrees with a 1 / 2 hour. Allow 24 hours for stabilization before testing. Units must operate per -7 specifications Mechanically and Electrically.

Operational Temperature (CQE 17)
Operate units as described in the -7 at +20F at (-7C) and +120F (+49C) degrees. Allow three hours for stabilization of each temperature before testing. Units must operate per the -7 specifications.

Steady State Humidity (CQE 2)
Perform a 10 day test at 92% RH at +80 f (+27 C)temperature. At the end of the 10 day period allow the units to recover for 24 hours. Units must pass the -7 specification.

Moisture Resistance (CQE 1).
Perform a 7 day test at 90% to 98% RH with the temperature cycled between (-10 C) and +150 F (66 C) degrees. Allow the units to recover for 24 hours. Units must operate per the –7 specifications.

Unpacked Drop Test (CQE 65).
Class III product: One 6″drop to a small concrete surface on each corner Edge and face (26 drops total). Then five 20″ drops to a smooth concrete surface on the normal resting surface of the unit (bottom). Units must operate per the –7 specification after testing.

X Bench Checks / Service Evaluation: < *Trouble-Shooting Guide*>

Bench Checks

Dc Input

Plug in the transmitter unit.
Verify the appropriate setting of the voltage selector (SW4) to the correct line level voltage (115 Vac or 230 Vac).
Observe that the green or red frequency LED is illuminated.
Verify the following test points for their respective power levels:

TP222 for +20 Vdc
TP224 for -20 Vdc
+12.4Vdc .4 Vdc (labeled +12)
-12.3 Vdc 0.3 Vdc (labeled -12)
+5.1 Vdc 0.3 Vdc (labeled +5)

Audio LED

Input a 1 kHz sinewave at +10.2 dBu to either the left or right XLR jack.
Turn the input volume (R202) to a full clockwise position.
Verify that all green, yellow, and red LEDs are illuminated.
If the LEDs are not illuminated, confirm that there is audio at TP55 and TP25.
If there is audio at TP55 and TP25, check the LED drivers (U7, U15) and make sure they are soldered properly. Make sure all the LED leads are soldered properly.

Rf Power

Monitor conductively the antenna output (J3) for the power output. The rf power output should be:
18 dBm 1.5 dBm (HF)
13 dBm 1.5 dBm (MN)
10 dBm 1.5 dBm (KE)

Measure the carrier frequency. It should be within 5 kHz of the specified carrier frequency.

If any of the previous measurements are incorrect perform the bench checks that follow.

19 kHz Pilot Tone

Monitor the carrier on a spectrum analyzer and evaluate the appropriate 19 kHz pilot tone side bands. They should be -14.75 dBc 0.75 dB, with no audio input. If the results are low or high, or do not appear at all, follow the steps below.
If a 19 kHz pilot is visible, but is below -14 dBc, adjust R52 until the pilot side bands are -14.75 dBc 0.75 dB. If is still not high enough, there is a wrong value in the 57 kHz filter around U9A, or R50 and/or R126 are wrong values.
If a 19 kHz pilot is not visible, make sure all pins of R52, R126, C39, C40, L6, U6, and R126 are soldered correctly. If the 19 kHz pilot is still not visible, replace U4, Y4, and all of the above resistors, capacitors, and coils, until the pilot comes back.

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If a 19 kHz pilot is visible, but is high (above -14 dBc), set L6 to approximately the middle of its range and retune the 19 kHz pilot and stereo separation.

Audio Evaluation

Evaluate the audio or determine lack of a signal at the receiver:

Set up the equipment as follows:

Set the stereo/mono switch (SW1) to STEREO (down).

Input a 1 kHz tone to the left channel at -7.8 dBu.

Connect an XLR male to BNC (male) cable from left LOOP OUT to RIGHT/CH2 IN.

Check the rf output on a spectrum analyzer to see if it is being modulated. If the carrier is being modulated, this indicates a problem with the receiver. If the carrier is not being modulated, go on to the next step.

Verify that audio LEDs are illuminated. If none of the audio LEDs are lit, evaluate the generator output and make sure that is applied correctly. If only one string of LEDs is lit, check for a problem between the audio output and the limiter output (TP55 for the left channel, TP25 for the right channel).

If both strings of LEDs are lit, probe pin 2 of C89 and C45.

A 1 kHz sinewave with a 19 kHz pilot (on top) will be visible when the transmitter is working correctly. If there is a 1 kHz signal with no 19 kHz pilot, follow the Bench Check procedures given in “19 kHz Pilot Tone.” If there is no 1 kHz signal, follow the audio path toward the stereo modulator to reach the point where the signal ceases to determine which part in the path may be defective.

Audio Loss

If there is no audio at the receiver, verify that the PILOT/ON signal is switched ON (approximately 2.5 seconds). The 5 V PILOT/ON signal closes switch U17C, applying audio to the rf section.

Limiter

If the limiter is not operating correctly, set the equipment as follows:

Set the stereo/mono switch (SW1) to STEREO (down).

Input a 1 kHz tone to the left channel at 0 dBV (-2.2 dBu) to the left channel.

Measure and record the level at TP55. It should be 2.6 dBu 2dB.

Increase the audio input by 10 dB. The level at TP55 should remain the same, 0.1 dB.

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Verify all left channel audio LEDs and L/R limiter LEDs are illuminated.

Deviation Levels

If high or low deviation exists, a good carrier output and a correctly trimmed carrier frequency is necessary to check audio deviation. If some deviation is present, but not 35 kHz, then the problem is in the audio gain structure.

Input a 1 kHz balanced or unbalanced -11.8 dBu level signal from the audio generator to LEFT/CH1 IN. The XLR male–to–13 mm (1/4–inch) cable should be attached from the left LOOP OUT to the RIGHT/CH2 IN.

Note: This is not equivalent to applying one signal with the transmitter in Mono, because there is a 6 dB loss in Mono.

Set the receiver volume to a full clockwise position.

Monitor the left expander input of the receiver (TP302).

Verify a deviation setting of -1.4 dBu 0.1 dB.

Continue to evaluate the audio frequency response by changing the audio generator output to 100 Hz. Measure the frequency response at TP302. It should be -7.3 dBu 1 dB.

Change the audio generator output to 10 kHz. Measure the frequency response at TP302. It should be -3.1 dBu 1 dB.

Distortion Level

Distortion is measured with L = R. If L is not equal to R when distortion is measured at the receiver, the distortion measurement will not be correct.

If the distortion measurement is not correct, retune the compander and deviation.

Rf Output

The transmitter must be powered from 220/110 Vac, 50/60 Hz input at J19 for proper operation. Microcontroller U10 uses a 5 V p–p control signal derived from the 50/60 Hz line voltage to initiate the power–up and power–down sequence of the transmitter rf section. When the transmitter is on, a 5 V p–p 50/60 Hz signal should be present at U10, pin 19. *There are no adjustable components relating to rf output power.*

Verify the following:

Rf MUTE changes from 0 Vdc to 5 Vdc shortly after the transmitter is switched on (approximately 1.5 seconds). Then the power amp (U29) and MMIC amp (Q5) will turn on, and the voltage across Q4 and Q7 will drop to 0 Vdc.

Check for correct dc voltages on U29, Q5, U32, U300, and U17.

Rf OFF changes from 0 Vdc to 4 Vdc when the transmitter is switched on, and changes from 4 Vdc to 5Vdc (momentarily) when the transmitter is switched off.

Check for correct rf power readings by probing the circuit with a 50 coaxial cable. The power readings shown include the loading effects of the 50 measurement device. Breaking the circuit at the point of measurement will increase the power readings by approximately 3 dB.

Low–pass filters U31 and U34 are soldered completely. Check for 0 continuity between pin 1 (IN) and pin 4 (OUT). An open circuit indicates that

the part may be cracked.
Check the continuity and value of all coils in the rf path.
Check the center pin of the antenna and J3 for signs of damage.

Carrier Frequency

Check for 4 MHz oscillations at U32, pins 1 and 2. If no oscillations are present, U31 may be defective.

If the frequency is off by less than 60 kHz, try retuning C259. If not correctable, replace C259, then U31, and, as a last resort, U32.

Verify the correct operation of the VCO by applying 1 Vdc to U300, pin 1, and adjusting this voltage to 4 Vdc. The carrier should move from a low frequency to a higher frequency, covering the full range of frequencies for this model transmitter.

NO POWER. These voltages feed the inputs to the +12V regulators. You should see about +12VDC at TP234.. Check TP106 for 5VDC. If this voltage is off by .5 volts or more check values of R194, 195,196 and U4C for correct biasing. Also look for foil, solder shorts, solder bridges, solder balls, unsoldered parts and backwards diodes and capacitors.

` **RF-OUTPUT POWER:**

NOTE: There are no adjustable components relating to RF output power.

Verify the following:
a) The amplifier Q100, Q102 have the proper dc voltages according to the schematic. Make sure there is presence of dc voltage at TP1(VCO dc Power).
Check for proper RF power readings by probing the circuit with a 50Ω coax cable. Note: The power reading shown include the loading affects of the 50Ω measurement device. Breaking the circuit at the point of measurement will increase the power readings by approximately 3dB.

RFMUTE changes from 0 VDC to 5 VDC shortly after the transmitter is switched on (approximately 1.5 seconds). At this time the power amp U29 and MMIC amp Q5 will turn on and the voltage across Q4 and Q7 will drop to 0 VDC.
Check for proper DC voltages on U29,Q5, U32,U33,U30 and U17.
RFOFF changes form 0 VDC to 4 VDC when the transmitter is switched on, and changes from 4 VDC to 5 VDC (momentarily) when the transmitter is switched off.

Low pass filters U31 and U34 are soldered completely. Check for 0Ω continuity between pin 1(in) and pin 4(out). An open circuit indicates that the part may be cracked.
Check for the proper model dependent resistor values R124 and R131. These values determine the proper RF pad value.
Check for proper model dependent VCO U32.
Check the continuity and value of all coils in the RF path.

Check the center pin of the antenna and J3 for signs of damage.

CARRIER FREQUENCY. Check for 4MHz oscillations at U29 pins 1 and 2. If no oscillations are present Y30 may be bad. If the frequency is off by +/- 60KHz try to tune C41. If not correctable, replace C41, then Y30, and as a last resort U29.

NO AUDIO AT THE IF RECEIVER.
Set Stereo/Mono switch to Stereo and input a 1kHz tone to the left channel at 2.2dBu. Look at the RF output on the spectrum analyzer. If the carrier, is being modulated, your problem is in the IF receiver. If the carrier is not being modulated, continue to step 2.
Check to see if the transmitter left audio LEDs are lit. If they are, go to step 5.
If you still see no audio LEDs lit, check your generator output.
If your generator output is good, measure the audio level at TP55. If you still have audio at TP55, either the LED driver pins are not soldered down properly or one of the LED pins is not soldered down properly. If you do not have audio at TP55, follow the audio path from the input to see where the signal is lost and replace the corresponding parts.
Repeat steps 1-4 for the right channel, measuring TP25 instead of TP55 in step 4.
At this point, audio is getting to TP55 and audio LEDs are functioning for both the left and right channels. Set the Stereo/Mono switch to Mono and input a 1kHz tone to the left channel at -7.8dBu. Probe C89.2 and C45.2. If you see a 1kHz sine-wave with a 19kHz pilot riding on top of it, you need to fix your IF receiver. If you see a 1kHz signal and no 19kHz pilot, go to the troubleshooting section *No (or Low) 19kHz Pilot.* If you do not see a 1kHz signal, follow the audio path back toward the stereo modulator until you come to the point where the signal is getting lost and replace the corresponding part.
Verify the PILOT_ON signal changes form 0 VDC to 5 VDC shortly after transmitter power is switched on (approximately 2.5 seconds). The 5V PILOT_ON signal closes switch U17c applying audio to the RF section.

LOW OR HIGH DEVIATION: You need good carrier output power and a properly trimmed carrier frequency to check audio deviation. If you are getting no deviation, go to the troubleshooting section above, *No Audio at the IF Receiver.* If you can not get 35kHz deviation but you are getting something, the problem is in the audio gain structure:
Make sure the input pad is OUT and try setting deviation as in section 4.7 of the *Alignment Procedure*.
2. Input -6.8dBu at 1kHz into one channel with the system in “Mono”. All green and yellow audio LED’s should be on. If not, check the audio gain structure before TP55 and TP25. If the correct LED’s are on, check the audio gain structure after TP55 and TP25.

SHURE BROTHERS INC.
222 HARTREY AVENUE
EVANSTON, IL 60202
PHONE 847-866-2200
Microphones-Electronic Components

Typed: A.Voukidis 10/4/99

Checked: A.Voukidis

Approved:

Approved:

NO (OR LOW) 19KHZ PILOT: You should be monitoring the carrier on a spectrum analyzer. If you can not modulate the carrier with an audio signal, go to the troubleshooting section above, *No Audio at the IF Receiver.*
If you see a 19kHz pilot but it is below -14dBc:
Adjust R52 until the pilot side-bands are -14dBc ± 1dB. If it does
If you see no 19kHz pilot:
Make not get high enough, there is a wrong value in the 57kHz filter around U9A or, R50 and/or R126 are wrong values. Sure all pins of R52, R126, C39, C40, L6, U6, and R126 are soldered down properly. If that does not help, replace U4, Y6, and all of the above resistors, capacitors, and coils until the pilot comes back.

HIGH 19kHz PILOT: Set L6 to approximately the middle of its range and retune the 19kHz pilot and stereo separation.

NO STEREO SEPARATION: Make sure the transmitter is in stereo. Follow the procedure above for *No (or Low) 19kHz Pilot*. If you still have a problem, you need to fix your IF receiver.

DISTORTION: Remember that distortion is measured with L=R. If L is not equal to R when you measure distortion at the IF receiver, the distortion measurement will not be correct. Align the compander and set the deviation (Sections 4.6 and 4.7). If there are still distortion problems, they are too complicated to troubleshoot in this document.

AUDIO LED DISPLAYS. If you get audio at TP55 and TP25 but the LED displays are not working, check to make sure the LED drivers (U7,U15) are soldered properly and all of the LED leads are soldered properly.

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