Lectrosonics Standard Test & Alignment Procedure

Part number(s):	HH	**Hardware version(s):**	17424B (audio) & 17423B (radio)	**Firmware version(s):**	0.93
Part number(s):	HHAU	**Hardware version(s):**	17424B (audio) & 17423B (radio)	**Firmware version(s):**	?
Part number(s):	HH/E01	**Hardware version(s):**	17424B (audio) & 17423B (radio)	**Firmware version(s):**	?
Part number(s):	HH/E02	**Hardware version(s):**	17424B (audio) & 17423B (radio)	**Firmware version(s):**	?
Common name:	hand held transmitter	**Author(s):**	Rodney Wildhagen & Cruz Garcia	**Test procedure version:**	01.00
Date:	04 Oct 2011				

Initial setup: Audio Board only

- Audio board with PIC18F67J11 µC IC

Step	***Measurement name& description***	**Measurement result**	**(Typ)**
Test Segment 10 of 60			
	Program µC IC and Current draw Audio board only		
CAUTION	When reprograming already tested devices, be sure to set device programmer GUI to preserve all settings (block, limiter settings, etc.). In Microchip MPLAB this is done by selecting Programmer > Settings > Program > Preserve EEPROM on program > Apply > OK. Failure to do so will result in loss of all assigned variable values such as frequency block, limiter setting, indicator settings, etc.		
Note	This need only be performed at the factory the first time the DUT is powered up, when µC IC is replaced, or when a firmware update is desired and confirmed to be appropriate.		
	Apply +3.0VDC, 300mA current limit in at battery contact J8 (J9 is circuit common)		
Note	In order to program DUT, JU1 must be jumpered or the power button must be pressed during the entire programming process. Remove JU1 jumper after programming.		
	Program µC IC with programming cable connected at J6 (ICSP port)		
	Remove ICSP cable		
	Measure current draw	50 to 500 mA	(117)
Note	The goal here is only to ensure the audio board powers up and is not burning up with fever		

Remove DC voltage from Battery contacts and apply firmware version label to audio board

Test Segment 20 of 60

NOTE: This segment may be performed using one audio board to test multiple radio boards

Initial setup:

- Known good, pre-tested audio board with PIC18F67J11 µC IC running firmware version appropriate & current for part number connected to an untested radio board
- Test panel key pad or appropriate test rig connected to audio board J2
- Apply +3.0VDC, 300mA current limit in at battery contact J8 (J9 is circuit common).
- All voltage measurements referenced to circuit common
- All demodulated carrier and carrier deviation measurements taken with a Hewlett Packard 8901B modulation analyzer with no 8901B filters selected. Use of other instruments may yield different results particularly measurements pertaining to noise and phase and measurements where noise is a significant factor
- All audio stimulus signals applied to audio input rig defined at foot of this document
- All audio stimulus signals are single ended.
- Carrier power for various part numbers are as follows:
- HH=100mW, HHAU & HH/E01=50mW and HH/E02
- All audio measurements taken with a ≤ 10 Hz HPF and 80KHz LPF (use filter on audio signal analyzer, no modulation analyzer unless otherwise specified).
- `This font indicates use of the Alternate Method to manual testing. The Alternate Method uses the LectroLink apparatus and either the LecNet2 Command Terminal Utility or the O:\ATE\MTE\HH\HH_LectroLink_Control.exe program. Test steps bearing the same number indicates alternate method(s).`

Step	***Measurement name & description***	**Measurement result (Typ)**
	Power Up sequence and current draw	
Prerequisite(s):	FPGA IC programmed	
	Hold test power button on test panel key pad for 3 seconds until DUT powers up	
	Observe behavior of test key pad LED	-10 LED turns on red, then -20 LED turns on red then both off. both LED's flash red once then

		green once	
	Observe behavior of test audio board LCD	"HH"	
		"Vx.xx"	
		"block XX"	
		"Hybrid"	
		?	
		?	
		?	
		?	
		frequency "Main" screen	
Note	a flashing antenna icon inside a ∅ indicates the PLL is not locked		
	Measure current draw	50 to 500 mA	(145)
Note	The goal here is only to ensure the DUT powers up and is not burning up with fever		

Audio board frequency block assignment

Prerequisite(s): FPGA IC programmed

Note: This part has to be performed only on the first DUT to setup Test Audio Board for the Block.

Momentarily connect audio board TP5 to TP22 (enter Set-up mode)

Note **Entering Set-up mode is not necessary if the Alternate Method is exercised.**

Using the test key pad navigate to the "Block" screen.

Press UP or DWN button on the test panel key pad to change unit to desired Block

```
block= (set freq block 470,19-33, 944 standard 400-999 extended)
```

Turn DUT Off then back On and check to see if the Block set.

VCO adjustment & VCO start-up test

Prerequisite(s): FPGA IC programmed

Using the test key pad navigate to the "Freq." screen

Press MENU/SEL and UP button simultaneously to change frequency to highest frequency. (pressing MUNU/SEL

and UP simultaneously will step the frequency up in increments of 16 only pressing the UP or DOWN buttons will only increment by 1)

`channel=XX` `set channel (0(00) to 1020 (ff) in normal tuning mode, 80 is 512)`

Adjust radio board C1 for 2.5 VDC at radio board TP1 (VCO_CONT) +2.45 to +2.55 VDC (+2.5)

No DC power in at battery contacts

Wait until transmitter completely powers down (approx. 4 sec)

Apply +3.0VDC, 500mA current limit in at battery contact J8 (J9 is circuit common)

Hold Power button for 3 seconds (make sure unit come on).

Measure carrier signal power to be sure the VCO starts on power up at selected carrier frequency ≥ +10 dBm

Using the test key pad navigate to the "Freq." screen

Press MENU/SEL and UP button simultaneously to change frequency to lowest frequency. (pressing MUNU/SEL and UP simultaneously will step the frequency up in increments of 16 only pressing the UP or DOWN buttons will only increment by 1)

`channel=XX` `set channel (0(00) to 1020 (ff) in normal tuning mode, 80 is 512)`

Measure DC voltage at radio board TP1 (VCO_CONT) +0.6 to +1.2 VDC

No DC power in at battery contacts

Wait until transmitter completely powers down (approx. 4 sec)

Apply +3.0VDC, 500mA current limit in at battery contact J8 (J9 is circuit common)

Hold Power button for 3 seconds (make sure unit come on).

Measure carrier signal power to be sure the VCO starts on power up at selected carrier frequency ≥ +10 dBm

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Carrier signal power adjustments & spectral purity measurements

Prerequisite(s): FPGA IC programmed

Momentarily connect audio board TP22 to J5 pin 4 (enter Set-up mode)

Note **Entering Set-up mode is not necessary if the Alternate Method is exercised.**

Note

Power Measurement are made with the output of the DUT connected directly to the power measuring device to ensure measurement is as accurate as posable .

Using the test key pad navigate to the "PwrCal" screen

Note

This sets the DUT to "L" (50mW) carrier power at the Mid carrier frequency, from here pressing the UP or DWN buttons adjusts carrier power. Pressing MENU/SEL button once will move to the Low carrier freq. UP and DWN buttons adjusts carrier power. Press MENU/SEL again moves to the highest frequency, UP and DWN buttons adjusts carrier power. Pressing MENU/SEL once more moves to "H" (100mW) at the Mid freq and the pattern continues to set power for 100mW..

Measure current draw

Repeat this process until all 6 carrier signal power points have been adjusted and double checked after the last adjustment has been made

Current draw tolerances for test procedure segment #20

50mW	100mW
160 to 196 mA (178)	191 to 233 mA (212)

Carrier signal power tolerances for test procedure segment #20

	50mW	100mW
HH	+15 to +19dBm	+18 to +22dBm
HHAU	16 to 17.5dBm	
HH/E01	+14.8 to -18.8dBm	
HHB/E02	9.5 to 11.1dBm	

`powercal(p,s)=` set transmitter power calibration parameter, "p" selects the power level must be 50 or 100, "s" specifies the carrier frequency within the block and must be 0 for block bottom, 1 for block middle, or 2 for block top

Note `Carrier power may alternatively be adjusted by first querying the powercal value "powercal(50,0)?" and subsequently incrementing or decrementing carrier power using "p=+2" syntax.`

Test Segment 30 of 60

NOTE: This segment may be performed using one known good pre-tested audio board to test multiple radio boards

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Spectral purity measurements and RF Mute function

Prerequisite(s): FPGA IC programmed

Connect RF Board J3(J4 common) DUT output to a splitter that feeds to the SpecAn, Frequency Counter high frequency input and the ModAn.

Momentarily connect audio board TP22 to J5 pin 4 (enter Set-up mode)

Note **Entering Set-up mode is not necessary if the Alternate Method is exercised.**

Apply +3.0VDC, 500mA current limit in at battery contact J8 (J9 is circuit common)

Using the test key pad navigate to the "PwrCal" screen

Step thru all 6 PwrCal measurement while checking for spurs using both prescribed setting in the next steps. This will result in 12 different spur measurements.

Measure spurs 5 to 1495MHz RBW=30kHz, VBW=10kHz ≤ -65 dBc

Note Neither the 2nd nor the 3rd harmonic should be considered as a spur

Measure spurs carrier freq +/- 20MHz RBW=30kHz, VBW=10kHz ≤ -65 dBc

Using the test key pad navigate to the "Standby" menu and press the MENU/SEL to activate RF Mute

Measure RF carrier output at radio board J3 ≤ -60 dBc

Press MENU/SEL button again to get to the "Xmit" menu, Pressing MENU/SEL again take unit out of "Standby"

Measure carrier signal power to at radio board J3 ≥ +5 dBm

Using the test key pad navigate back to the frequency "Main" screen

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Modulation level and distortion adjust

Prerequisite(s): FPGA IC programmed

DUT at middle carrier frequency

`channel=XX` `set channel (0(00) to 1020 (ff) in normal tuning mode, 80 is 512)`

NOTE BL944 specimens are permitted to exhibit 150% of otherwise allowable distortion. Some products have required this additional margin, others have not. At the time of this writing it is unknown how this product will shake out.

Momentarily connect audio board TP22 to J5 pin 4 (enter Set-up mode)

Note **Entering Set-up mode is not necessary if the Alternate Method is exercised.**

`pilotbp=1`

Using the test key pad navigate to the "DevOff" screen (Mid carrier freq is highlighted)

`tone=1 (sets DSP 1kHz test tone mode ON)`

Adjust radio board R26 for minimum modulation distortion at demodulated carrier	≤ 1.0 % THD+N	(0.7)
Adjust radio board R47 for 100kHz peak deviation at radio board J3	99 to 101 kHz	(100)

Press MENU/SEL button on the test panel key pad (Lowest carrier freq is highlighted)

`channel=XX`	`set channel (0(00) to 1020 (ff) in normal tuning mode, 80 is 512)`	
Measure distortion at demodulated carrier, fine adjusting radio board R26 if required	≤ 1.2 % THD+N	(0.7)
Press UP or DWN button on the test panel key pad for 100 kHz peak carrier deviation at radio board J3	99 to 101 kHz	(100)
`devoff(0)? (Get deviation offset setting for the Low channel) (+10 to -10). devoff(0)=x (set deviation offset for 100KHz)(1KHz steps).`	99 to 101 kHz	(100)

Press MENU/SEL button on the test panel key pad (Highest carrier freq is highlighted)

`channel=XX`	`set channel (0(00) to 1020 (ff) in normal tuning mode, 80 is 512)`	
Measure distortion at demodulated carrier, fine adjusting radio board R26 if required	≤ 1.2 % THD+N	(0.7)
Press UP or DWN button on the test panel key pad for 100 kHz peak carrier deviation at radio board J3	99 to 101 kHz	(100)
`devoff(1)? (Get deviation offset setting for the high channel) (+10 to -10). devoff(1)=x (set deviation offset for 100KHz)(1KHz steps).`	99 to 101 kHz	(100)

Repeat this step until no further adjustment is necessary

Press BACK button on the test panel key pad to get back to the frequency "Main" screen

`tone=0 (turns off DSP 1kHz test tone)`

Test Segment 40 of 60

Install VCO shield cover

No DC power in at battery contacts

Disconnect radio board from audio board

Install VCO shield assembly Part number ?

Bend tabs at 45 degrees and Solder around the VCO shield

Allow to cool for a minimum of 10 minutes

Test Segment 50 of 60

NOTE: This segment must be performed using the audio/radio board pairs that will remain paired up

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Setup:

- Audio board with PIC18LF6J11 µC IC running firmware version appropriate & current for part number connected to an untested radio board, these boards will live together til death do they part.
- Test panel key pad connected to audio board J3
- Apply +3.0VDC, 500mA current limit in at battery contact J8 (J9 is circuit common)
- All voltage measurements referenced to circuit common
- All demodulated carrier and carrier deviation measurements taken with a Hewlett Packard 8901B modulation analyzer with no 8901B filters selected. Use of other instruments may yield different results particularly measurements pertaining to noise and phase and measurements where noise is a significant factor
- All audio stimulus signals applied to audio input rig
- All audio stimulus signals are single ended.
- Carrier power for the various part numbers are as follows:
- HM=100mW, HMAU & HM/E01=50mW and HM/E02
- All audio measurements taken with a ≤ 10Hz HPF and 80KHz LPF (use filter on audio signal analyzer, not modulation analyzer unless otherwise specified).
- `This font indicates use of the Alternate Method to manual testing. The alternate Method uses the LectroLink apparatus and either the LecNet2 Command Terminal Utility or the O:\ATE\MTE\HM\HM_LectroLink_Control.exe program. Test steps bearing the same number indicate alternate method(s).`
- Connect Power Meter Head to RF Board J3(MT4 is circuit

	defined at foot of this document, see below	common).	
	Power Up sequence and current draw		
Prerequisite(s):	FPGA IC programmed		
	Hold power button on test panel key pad for 3 seconds.		
	Observe behavior of test key pad LED	-10 LED turns on red, then -20 LED turns on red then both off.	
		both LED's flash red once then green once	
	Observe behavior of test key pad LCD	"000000"	
		"HH"	
		"Vx.xx"	
		"Hybrid"	
		?	
		?	
		?	
		?	
		frequency "Main" screen	
	a flashing antenna icon inside a Ø indicates the PLL is not locked		
	Measure current draw	50 to 500 mA	(170)
Note	The goal here is only to ensure the audio board powers up and is not burning up with fever		
20.20	*Control Panel switch test*		
Prerequisite(s):	FPGA IC programmed		
	Apply +3.0VDC, 500mA current limit in at battery contact J8 (J9 is circuit common)		
	LCD display and push button key pad installed		
	Observe LCD display and verify the frequency "Main"		

screen is displayed			
buttons?	realtime button status bitmap (menu/sel=128, back=64, up=1, down=2, "4=4", "3=8", "2=16", "1=32", no button=0)	ok 0 (no tolerance)	(0)
Press and release control board Menu/Sel button			
Observe change in menu on LCD to the Menu screen			
press and hold Menu/Sel	realtime button status bitmap (menu/sel=128, back=64, up=1, down=2, "4=4", "3=8", "2=16", "1=32", no button=0	ok 1 (no tolerance)	(1)
buttons?			
Release Menu/Sel button			
Press and hold control board Down button			
Observe change in highlighted menu on LCD			
buttons?	realtime button status bitmap (menu/sel=128, back=64, up=1, down=2, "4=4", "3=8", "2=16", "1=32", no button=0)	ok 16 (no tolerance)	(16)
Release Down button			
Press and hold control board Up button			
Observe change in highlighted menu on LCD			
buttons?	realtime button status bitmap (menu/sel=128, back=64, up=1, down=2, "4=4", "3=8", "2=16",	ok 32 (no tolerance)	(32)

	"1=32", no button=0)		
Release Up button			
Press and hold control board Back button			
Observe change in Menu on LCD return back to freq "main screen"			
buttons?	realtime button status bitmap (menu/sel=128, back=64, up=1, down=2, "4=4", "3=8", "2=16", "1=32", no button=0)	ok 2 (no tolerance)	(2)
Release Back button			
Press and hold control board Mute Ø button			
Observe change in Menu on LCD the Mute ØIcon appears			
buttons?	realtime button status bitmap (menu=1, back=2, mode=4, power=8, down=16, up=32, mute=64)	ok 4 (no tolerance)	(4)
Release Mute button			
Press and release Mute Ø until any icons are gone.			
Press and hold Audio board Mute button			
Observe change in Menu on LCD the<–Mute–> Icon appears and flashes			
buttons?	realtime button status bitmap (menu=1, back=2, mode=4, power=8, down=16, up=32,	ok 64 (no tolerance)	(64)

		mute=64)		
	Release Mute button			
	Press and hold control board Power button			
	buttons?	realtime button status bitmap (menu/sel=128, back=64, up=1, down=2, "4=4", "3=8", "2=16", "1=32", no button=0)	ok 0 (no tolerance)	(8)
	Release Power button			

DC voltage measurements

Apply +3.0VDC, 500mA current limit in at battery contact J8 (J9 is circuit common)

Hold Power button for 3 seconds (make sure unit come on).

Measure DC voltage at audio board:	TP16	+1.7 to +1.9VDC	(+1.8)
	TP9	+3.1 to +3.5VDC	(+3.3)
	D3/C37 junction	-3 to -3.6VDC	(-3.3)
	U16-pin5	+4.9 to +5.1VDC	(+5.0)
	C40/D4 junction	+6.9 to +7.1VDC	(+7.0)
	TP-3	+4.1 to +4.9VDC	(+4.0)
	TP1 (backlight)	+2.5 to +2.7VDC	+2.6
	TP6	+1.39 to +1.59VDC	(+1.49)
	TP15	TP6 value +/- 50mVDC	(+10mVDC)

Phantom power voltage measurements

Note: Current measurements are made with audio input rig (described at the foot of this document) attached to the audio input of the audio board with NO audio stimulus. Audio stimulus will light the audio LED's causing more current pull and the audio input rig can add as much as 10 mA. Connect input rig to DUT.

	Measure voltage at Audio	+2.0 to +3.0VDC	(+2.5V)

input Rig test point

Audio board frequency block assignment

Momentarily connect audio board TP5 to TP22 (enter Set-up mode)

Note **Entering Set-up mode is not necessary if the Alternate Method is exercised.**

Using the test key pad navigate to the "Block" screen.

Press UP or DWN button on the test panel key pad to change unit to desired Block

```
block= (set freq block 470,19-33, 944 standard 400-999 extended)
```

Turn DUT Off then back On and check to see if the Block set.

VCO adjustment & VCO start-up test

Using the test key pad navigate to the "Freq." screen

Press MENU/SEL and UP button simultaneously to change frequency to highest frequency. (pressing MUNU/SEL and UP simultaneously will step the frequency up in increments of 16 only pressing the UP or DOWN buttons will only increment by 1)

`channel=XX`	`set channel (0(00) to 1020 (ff) in normal tuning mode, 80 is 512)`

Adjust radio board C1 for +2.5 VDC at radio board TP1	+2.0 to +2.6 VDC	(+2.5)

No DC power in at battery contacts

Wait until transmitter completely powers down (approx. 4 sec)

Apply +3.0VDC, 500mA current limit in at battery contact J8 (J9 is circuit common)

Hold Power button for 3 seconds (make sure unit come on).

Measure carrier signal power to be sure the VCO starts on power up at selected carrier frequency	$\geq$ +10 dBm

Using the test key pad navigate to the "Freq." screen

Press MENU/SEL and UP button simultaneously to change frequency to lowest frequency. (pressing MUNU/SEL and UP simultaneously will step the frequency up in increments of 16 only pressing the UP or DOWN buttons will only increment by 1)

`channel=XX`	`set channel (0(00) to 1020 (ff) in normal tuning mode, 80 is 512)`

	Measure DC voltage at radio board TP1	+0.6 to +2 VDC	(+1.3)
	No DC power in at battery contacts		
	Wait until transmitter completely powers down (approx. 4 sec)		
	Apply +3.0VDC, 500mA current limit in at battery contact J8 (J9 is circuit common)		
	Hold Power button for 3 seconds (make sure unit come on).		
	Measure carrier signal power to be sure the VCO starts on power up at selected carrier frequency	≥ +10 dBm	

Carrier signal power adjustments & spectral purity measurements

Momentarily connect audio board TP22 to J5 pin 4 (enter Set-up mode)

Note **Entering Set-up mode is not necessary if the Alternate Method is exercised.**

Note Power Measurement are made with the output of the DUT connected directly to the power measuring device to ensure an accurate as possible measurement.

Using the test key pad navigate to the "PwrCal" screen

Note This sets the DUT to 50mW carrier power at the Mid carrier frequency, from here pressing the UP or DWN buttons adjusts carrier power. Pressing MENU/SEL button once will move to the lowest carrier freq. UP and DWN buttons adjusts carrier power. Press MENU/SEL again moves to the highest frequency, UP and DWN buttons adjusts carrier power. Pressing MENU/SEL once more moves to 100mW at the Mid carrier frequency and the pattern continues.

Measure current draw

Repeat this process until all 6 carrier signal power points have been adjusted and double checked after the last adjustment has been made

Current draw tolerances for test procedure segment #20

	50mW	100mW
17423 ≤ B	333 to 407 mA (370)	414 to 506 mA (460)

Carrier signal power tolerances for test procedure segment #20

	50mW	100mW
HH	+16.3 to +17.7dBm	+19.3 to +20.7dBm
HHAU	+16.3 to +17.7dBm	
HH/E01	+14.8 to -	

	18.8dBm	
HH/E02	9.7 to 11.1dBm	

`powercal(p,s)=` `set transmitter power calibration parameter, "p" selects the power level must be 50 or 100, "s" specifies the position within the block and must be 0 for block bottom, 1 for block middle, or 2 for block top`

Note `Carrier power may alternatively be adjusted by first querying the powercal value "powercal(50,0)?" and subsequently incrementing or decrementing carrier power using "p=+2" syntax.`

Test Segment 60 of 60

Spectral purity measurements and RF Mute function

Prerequisite(s): FPGA IC programmed

Connect BNC cable with a 2 Prong Adaptor from RF Board J3(J4 common) to a splitter that feeds to the SpecAn, Frequency Counter high frequency input and the ModAn.

Step thru all 6 PwrCal measurement while checking for spurs using both prescribed setting in the next steps. This will result in 12 different spur measurements.

Measure spurs 5 to 1495MHz RBW=30kHz, VBW=10kHz ≤ -65 dBc

Note Neither the 2nd nor the 3rd harmonic should be considered as a spur

Measure spurs carrier freq +/- 20MHz RBW=30kHz, VBW=10kHz ≤ -65 dBc

Using the test key pad navigate to the "Standby" menu and press the SENU/SEL to active RF Mute

Measure RF carrier output at radio board J3 ≤ -60 dBc

Press MENU/SEL button again to get to the "Xmit" menu, Pressing MENU/SEL again take unit out of "Standby"

Measure carrier signal power to at radio board J3 ≥ +5 dBm

Using the test key pad navigate back to the frequency "Main" screen

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Modulation level and deviation adjustment

Prerequisite DUT at mid channel for the Block.

`channel=XX` `set channel (0(00) to 1020 (ff) in normal`

	tuning mode, 80 is 512)		
Note:	BL944 specimens are permitted to exhibit 150% of otherwise allowable distortion. Some products have required this additional margin. others have not. At the time of this writing, it is unknown how this product will shake out.		
	Momentarily connect Audio Board TP5 to TP22 (enter Set-up mode).		
	Entering Setup Mode is not necessary if the Alternate Method is used.		
	pilotbp=1		
	Using the test key pad navigate to the "DevOff" screen (Mid carrier frequency is highlighted)		
	tone=1 (sets DSP 1KHz test tone mode on)		
	Adjust RF Board R26 for minimum distortion at demodulated carrier at RF Board J3.	≤ 1.0% THD+N	(0.7)
	Adjust RF Board R47 for 100KHz peak deviation at RF Board J3.	99 to 101KHz	(100)
	Press MENU/SEL button on the test panel key pad (lowest carrier frequency is highlighted)		
	channel=XX set channel (0(00) to 1020 (ff) in normal tuning mode, 80 is 512)		
	Measure distortion at demodulated carrier at RF Board J3.	≤ 1.2% THD+N	(0.7)
	Press Up or Down button on test key pad for 100KHz peak deviation at RF Board J3.	99 to 101KHz	(100)
	devoff(0)? (Get deviation offset setting for the Low channel) (+10 to -10). devoff(0)=x (set deviation offset for 100KHz)(1KHz steps).	99 to 101KHz	(100)
	Press MENU/SEL button on the test panel key pad (Highest carrier frequency is highlighted)		
	channel=XX set channel (0(00) to 1020 (ff) in normal tuning mode, 80 is 512)		
	Measure distortion at demodulated carrier at RF Board J3	≤ 1.2% THD+N	(0.7)
	Press Up or Down button on test key pad for 100KHz peak deviation at RF Board J3.	99 to 101KHz	(100)
	devoff(1)? (Get deviation offset setting for the High channel) (+10 to -10). devoff(1)=x (set deviation offset for 100KHz)(1KHz steps).	99 to 101KHz	(100)

Repeat this Section until no further adjustment is necessary.

Press BACK button on the test key pad to get back to the main (frequency) screen.

`tone=0 (turns Off test tone)`

Low pass filter set / and Frequency adjust

Prerequisite(s) Unit in set-up mode

Unit at middle carrier frequency

Note **Entering Set-up mode is not necessary if the Alternate Method is exercised.**

Using the test panel key pad navigate to the "Rolloff" screen LCD reads "Rolloff 35Hz" If LCD reads anything other than "Rolloff 35Hz" press the DWN button on the test panel key pad to change it to "Rolloff 35Hz".

`rolloff=0 (set LF roll-off to 35 Hz)`

Using the test panel key pad navigate to the "Fine" screen (menu function that allows offset of carrier frequency)

Press UP or DWN button on the test panel key pad to fine adjust middle carrier frequency +/- 2kHz

`finetune? (gets setting) finetune=xx (set fine frequency correction -16 to +15, 3.125 kHz steps)`

Pilot signal deviation & frequency measurements

Prerequisite(s) no audio in at audio input rig

Gain set to "0"

`level=0 (changes audio level to 0)`

Using the test panel key pad navigate to the "freq." screen

Press MENU/SEL and UP button simultaneously to change frequency to the lowest carrier frequency. (pressing MUNU/SEL and UP simultaneously will step the frequency up in increments of 16 only pressing the UP or DOWN buttons will only increment by 1) .

`channel=XX` `set channel (0(00) to 1020 (ff) in normal tuning mode, 80 is 512)`

Measure peak carrier deviation at radio board J3	4.5 to 6.5 KHz	(5.5)
	2.8 to 3.4KHz	(3.1)

		2.8 to 3.4 KHz	(3.1)
		1.5 to 1.9 KHz	(1.9)
Note	Pilot Tone signal frequency at demodulated carrier at radio board J3	31.999 to 32.001 KHz	(32)

Noise measurements (low gain branch)

Prerequisite(s) Unit in set-up mode

Gain set to "0"

Note **Entering Set-up mode is not necessary if the Alternate Method is exercised.**

Using the test panel key pad navigate to the "Compat" screen

Press UP button on the test panel key pad until LCD reads "Passthru"

```
compat=0 (changes compat mode to passthru)
```

Using the test panel key pad navigate to the "Freq." screen

Press MENU/SEL and UP button simultaneously to change frequency to highest frequency. (pressing MUNU/SEL and UP simultaneously will step the frequency up in increments of 16 only pressing the UP or DOWN buttons will only increment by 1)

```
channel=XX          set channel (0(00) to 1020 (ff) in normal
                    tuning mode, 80 is 512)
```

Using the test panel key pad navigate to the "Gainsw" screen — select low gain

```
gainsw=2
```

Measure Noise (noise signal amplitude) at radio board J3 — ≤ -55 dBu — (-58)

Noise & microphonics measurements (high gain branch)

Prerequisite(s) Unit in set-up mode

Note **Entering Set-up mode is not necessary if the Alternate Method is exercised.**

DUT in "Passthru"

No audio signal in at audio input rig

FREQ set to highest frequency

Gain set to "0"

Using the test panel key pad navigate to the "Gainsw" screen — select high gain

	`gainsw=1`		
	Measure Noise (noise signal amplitude) at radio board J3	≤ -55dBu	(-58)
	Tap edge of radio board repeatedly at corner opposite from power connections with ceramic screwdriver handle and measure noise at demodulated carrier at radio board J3 referenced to step #40.100.10 value	0 to 18dB(r)	(+5)
	Using the test panel key pad navigate to the Gain screen and change audio gain to "Gain 45"		
	`level=45 (changes audio level to 45)`		
	Measure Noise at radio board J3	≤ -53dBu	(-57)
	Using the test panel key pad navigate to the "Gainsw" screen	select "auto"	
	`gainsw=0`		

	Mic gain pot taper test		
Prerequisite(s)	Unit in set-up mode		
Note	**Entering Set-up mode is not necessary if the Alternate Method is exercised.**		
	DUT in "Passthru"		
	FREQ set to highest frequency		
	Audio Gain set to "Gain 45"		
	Gainsw set to "auto"		
	-55 dBu, 250Hz, low distortion, sinusoidal signal in at audio input rig		
Note	Neither audio board LED (D5 nor D6) are red (limiter not activated)		
Note	It is vital that the demodulation device (typically an FM modulation meter/analyzer) not be permitted to auto range while performing the remainder of test step #40.110		
	Measure audio signal level at demodulated carrier at radio board J3	0dB reference	(0)
Note	#40.110.20.10 carrier signal deviation varies a bit with different batches of digital pot IC's at the maximum gain setting		
	Change audio Gain setting to "Gain 22"		
	`level=22 (changes audio level to 22)`		
	Measure audio signal level at demodulated carrier at radio board J3	-24 to -22dB(r)	(-23)
	Change audio Gain setting to "Gain 22"		

	`level=0 (changes audio level to 0)`			
	Measure audio signal level at demodulated carrier at radio board J3		-43.5 to -41.5dB(r)	(-42.5)
	Mute unit by pressing S1			
	`mute=2`	`mute audio 1=unmuted 2=muted`		
	Measure audio signal level at demodulated carrier at radio board J3		≤ -45dB(r)	(-47)
	Un-mute unit by pressing S1			
	Measure audio signal level at demodulated carrier at radio board J3		-43.5 to -41.5dB(r)	(-42.5)

	Modulation distortion measurement			
Prerequisite(s)	Unit in set-up mode			
	DUT in "Passthru"			
	FREQ set to highest frequency			
	Audio Gain set to "Gain 0"			
	Gainsw set to "auto"			
Note	**Entering Set-up mode is not necessary if the Alternate Method is exercised.**			
	-10 dBu, 250Hz, low distortion, sinusoidal signal in at audio input rig			
	Verify neither audio board LED (D5 nor D6) are red (limiter not activated)			
	Measure audio signal distortion of the demodulated carrier radio board RF J3 at carrier frequency:	Highest freq	≤ 0.55% THD+N	(0.35)
	FREQ set to lowest frequency measure audio signal distortion.	Lowest freq	≤ 0.55% THD+N	(0.35)
	`channel=xx,`	`set channel (0(00) to 1020 (ff) in normal tuning mode, 80 is 512`	≤ 0.55% THD+N	(0.35)
	FREQ set to mid frequency measure audio signal distortion.	Middle freq	≤ 0.55% THD+N	(0.35)

channel=xx,	set channel (0(00) to 1020 (ff) in normal tuning mode, 80 is 512	≤ 0.55% THD+N	(0.35)

Limiter range adjust / and -10 Limiter light adjust

Prerequisite(s) Unit in set-up mode

Note **Entering Set-up mode is not necessary if the Alternate Method is exercised.**

DUT in "Passthru"

FREQ set to middle

-30 dBu, 250Hz, low distortion, sinusoidal signal in at audio input rig

Using the test panel key pad navigate to the "Gain" screen

Press UP button to change audio level to "Gain 22 "

level=22 (changes audio level to 22)		(22)

Verify neither test key pad LED are red (limiter not activated)

Using the test panel key pad navigate to the "Limiter" screen (Ref is highlighted)

limitcal=1 (disables limiter calibration mode)		(0)
Measure and record audio signal amplitude at demodulated carrier RF J3	Reference for remainder of step	

Press MENU/SEL button on the test panel key pad until (-5 XX is highlighted)

limitcal=2 sets limiter calibration mode to "calibrated drop"		(2)
Press UP or DWN button for 5 dB below reference amplitude in step 40.130.60	Reference value - (3.5 to 6.5) dB	(-5)
Adjust lscale for 5 dB below reference amplitude in step 40.130.60 (lscale? gets setting) (lscale=xx sets limiter scale setting,-16 to +15)	Reference value - (3.5 to 6.5) dB	(-5)

Press MENU/SEL button on the test panel key pad (2R XXXX is highlighted)

limitcal=0 (sets limiter calibration mode to "normal")		

Increase stimulus signal amplitude in 1dB increments until D5 changes from green to red

ameter? (ameter? reading when D5 is green)	≤ 17000	
ameter? (ameter? reading when D5 changes to red)	≥ 18000	
ATS1 Audio Level	-29 to -26dBu	(-27)

Note:	D5 typically switches from green to red with about -28 dBu +/- 1 dB applied to audio input rig		
	Increase audio signal at DUT input amplitude by 10 dB		
	Press the UP button the test panel key pad to set -10 LED		
	`limit10=0 (sets +10db limit LED threshold)`		
	If audio board D6 is red decrease 250 Hz signal at input rig by 2 dB and verify that audio board D6 switches to green, if so skip to next step		
	If audio board D6 is green increase 250 Hz signal at input rig by 2 dB and verify that audio board D6 switches to red, if so skip to next step		
	`limit10?`	`24200 to 24700`	`(24320)`
	`ameter?`	`+/- 100 of Step 40.130.130.10`	`(24354`
	If neither sub-steps 40.130.130.10 nor 40.130.130.20 are true repeat this step (maximum or three times before succumbing to despair)		
	If neither sub-step 40.130.130.10 or 40.130.130.20are true repeat this step (maximum or three times before succumbing to despair)		
	Using the test panel key pad navigate to the frequency "Main" screen		

Frequency response measurement (low gain branch) & LF rolloff pot taper& Phase mesurement

Prerequisite(s)	Unit in set-up mode			
Note	**Entering Set-up mode is not necessary if the Alternate Method is exercised.**			
	DUT in "Passthru"			
	FREQ set to middle frequency			
	LF filter set to "LF 35"			
	Audio Gain level set to "Gain 22"			
	-35 dBu, 250 Hz, low distortion, sinusoidal signal in at audio input rig			
	Using the test panel key pad navigate to the "Gainsw"		select low gain	
	`gainsw=2 (sets codec gain swith setting to X1 branch)`			
	Neither audio board LED (D5 nor D6) are red (limiter not activated)			
	Measure frequency response	20 kHz	-2 to +3 dB(r)	(-0.5)

	of demodulated carrier (250Hz ref) at RF J3			
		10 kHz	-1 to +1 dB(r)	(-0.1)
		1 kHz	-1 to +1 dB(r)	(-0.1)
		50 Hz	-1.5 to +1.5 dB(r)	(+0.8)
		31.5 Hz	-5 to -1 db(r)	(-3.1)
	-35 dBu, 250 Hz, low distortion, sinusoidal signal in at audio input rig			
	Measure Phase responce of demodulated carrier at RF J3	20 kHz		(-54)
		10 kHz		(+152)
		400 Hz		(-160)
		50 Hz		(-168)

	Low gain High gain deviation. Audio signal distortion, Frequency response measurement, LF rolloff pot taper & Phase measurement (high gain branch)			
Prerequisite(s)	Unit in set-up mode			
Note	**Entering Set-up mode is not necessary if the Alternate Method is exercised.**			
	DUT in "Passthru"			
	FREQ set to middle frequency			
	LF filter set to "LF 35"			
	Using the test panel key pad navigate to the "Gain" screen			
	Press DWN button to change audio level to "Gain 15 "			
	`level=15 (changes audio level to 15)`			(15)
	Gainsw set to Low gain			
	`gainsw=2 (sets codec gain swith setting to X1 branch)`			
	-35 dBu, 250 Hz, low distortion, sinusoidal signal in at audio input rig			
Note	Neither audio board LED (D5 nor D6) are red (limiter not activated)			
	Measure deviation at the		10.0 to 12.0kHz of	(11)

demodulated carrier RF board J3		Deviation	
Using the test panel key pad navigate to the "Gainsw"		select high gain	
`gainsw=1 (sets codec gain swith setting to X8 branch)`			
Measure deviation at the demodulated carrier RF board J3		10.0 to 12.0kHz of Deviation	(11)
Measure distortion at the demodulated carrier RF board J3		≤ 1.5% THD+N	(1.3)
Measure frequency response of demodulated carrier (250Hz ref) at RF J3	20 kHz	-2 to +3 dB(r)	(-0.5)
	10 kHz	-1 to +1 dB(r)	(-0.1)
	1 kHz	-1 to +1 dB(r)	(-0.1)
	50 Hz	-1.5 to +1.5 dB(r)	(+0.8)
	31.5 Hz	-5 to -1 db(r)	(-3.1)
-35 dBu, 250 Hz, low distortion, sinusoidal signal in at audio input rig			
Measure Phase response of demodulated carrier at RF board J3	20 kHz		(-53)
	10 kHz		(+153)
	400 Hz		(-160)
	50 Hz		(-170)
Using the test panel key pad navigate to the "Gainsw"		select auto	
`gainsw=0 (sets codec gain swith setting to auto select)`			

Battery status telemetry adjustment, indicator & low voltage power up tests

Prerequisite(s) Unit in set-up mode

Note	**Entering Set-up mode is not necessary if the Alternate Method is exercised.**		
	DUT in "Passthru"		
	Frequency set to middle		
	Frequency set to middle frequency		
	Gainsw set to auto		
	`gainsw=0`		
	No audio signal at DUT input		
	Apply +2.0VDC, 500mA current limit in at battery contact J8 (J9 is circuit common)		
	Observe Battery Icon on LCD display	battery icon blinking ON/OFF	
	Using the test panel key pad navigate to the "BatMon" screen		
	`bscale? (query battery telemetry scale setting, 26 to 80)`		
	Press MENU/SEL button on the test panel key pad to shift from High to low Frequency on LCD screen		
	`batcal=1 Forces battery telemetry low, note frequency.`		
	`batcal=3 Forces battery telemetry high, check for frequency shift of 3.5KHZ`		
	Press UP or DWN button on the test panel key pad to adjust for 3.5 KHz freq. shift	3.5 KHz +/- 0.1	(3.5)
	`bscale=xx (set battery telemetry scale setting, 26 to 80) to adjust for 3.5KHz frequency shift`	`3.5 KHz +/- 0.1 (3.5)`	
	Repeat steps 40.180.40 to step 40.180.50 until no further adjustment is necessary to achieve 3.5 KHz freq. shift		
	Using the test panel key pad navigate to the frequency "Main" screen		
	`batcal=0 (sets battery telemetry to normal)`		
	Apply +2.25VDC, 500mA current limit in at battery contact J8 (J9 is circuit common)		
	Press Power button on the test panel key pad and hold for 3 to 4 second and watch LCD as unit powers down.		
	Measure current draw	0 to 4mA	(0)
	Press Power buttons and hold for 3 seconds as unit powers on ON.		
	Measure current draw	300 to 350 mA	(275) (?)

		?	?)
			(?)
	Carrier deviation and limiter distortion measurements (low gain)		
Prerequisite(s)	Unit in set-up mode		
Note	**Entering Set-up mode is not necessary if the Alternate Method is exercised.**		
	DUT in "Passthru"		
	Frequency set to middle frequency		
	LF filter set to "LF 35"		
	Using the test panel key pad navigate to the "Gain" screen		
	Press UP button to change audio level to "Gain 22 "		
	`level=22 (changes audio level to 22)`		`(22)`
	Apply +3.0VDC, 500mA current limit in at battery contact J8 (J9 is circuit common)		
	-20 dBu, 250 Hz, low distortion, sinusoidal signal in at audio input rig		
	Verify at least one audio LED red (both red is OK) (limiter activated)		
	Measure peak carrier deviation at RF J3	+73 to 77 kHz	(+75)
	Measure audio signal distortion at demodulated carrier at RF J3 output	1% THD+N max.	(+0.4)
	Power down and Carrier deviation measurement (with pilot and compressor on)		
Prerequisite(s)	Compressor enabled (power cycle enables compressor and pilot signal)		
	Pilot enabled (power cycle enables compressor and pilot signal)		
	Frequency set to middle frequency		
	Audio Gain set to "AUD 22"		
	LF filter set to "LF 35"		
	Adjust audio input at input Rig so -20 LED D5 just switches from GREEN to RED, -10 LED D6 is GREEN (-25 dBu in typically)		
	Measure peak carrier deviation at RF J3	37 to 41 kHz	(39)
		?	?)

	?	(?)
	?	(?)
Increase audio input level by 10 db		
Measure peak carrier deviation at RF J3 with:	41.5 to 45.5 kHz	(43.5)
No Audio Input Stimulas		
Measure current draw	170 to 190mA	(180)
Press the power button for 4 second while DUT powers down	?	(?)
Measure current draw	0 to 5mA	(0)

Audio input rig (single-ended audio signal source)