MMDS VDL ENGINEERING ALIGNMENT PROCEDURE

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REVISION HISTORY

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-	0270373	Initial Release (MKS version 1.27)	11/25/2015
A	0288601	Updated with test equipment setup and TX section alignment.	05/26/2016
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Revision	ECO NO.	DESCRIPTION	DATE

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1 *INTRODUCTION*

1.1 *Purpose*

This procedure describes the alignment for the MMDS VDL 205-30997-xxxx.

1.2 *Definitions and abbreviations*

1.2.1 Definitions

Standard VOR test signal: RF carrier, amplitude modulated simultaneously a) 30±1% by a “reference phase signal,” composed of a 9960 Hz subcarrier, which is, in turn, frequency modulated at a deviation ratio of 16 by a 30 ±0.1% Hz signal, and b) 30 ±1% by a 30±0.1% Hz “variable phase signal” which can be varied in phase with respect to the 30 Hz FM of the reference phase signal.

Standard LOC centering signal: RF carrier modulated simultaneously by a 20 ± 1% 90 Hz ±0.3% and a 20 ± 1% 150 Hz ±0.3%. The difference in depth of modulation is less than 0.002.

Standard Glide Slope centering signal: RF carrier modulated simultaneously by a 40 ± 1% 90 Hz ±0.3% and a 40 ± 1% 150 Hz ±0.3%. The difference in depth of modulation between the 90 and 150 Hz signals is less than 0.002.

Standard Glide Slope deviation signal: RF carrier modulated simultaneously by a 40 ± 1% 90 Hz ±0.3% and a 40 ± 1% 150 Hz ±0.3%. The difference in depth of modulation is .091 ±0.002.

1.2.2 Abbreviations

Abbreviation	Description
Ω	Ohm
μA	Microampere
μF	Microfarad
μV	Microvolt
μW	Microwatt
°C	degrees Celsius
A	Ampere
ADF	automatic direction finder
AGC	automatic gain control
ALC	Automatic level control
ATE	Automated Test Equipment
CDI	course deviation indicator
COM or comm	Communication
CW	continuous wave (unmodulated)
dB	decibel
dBm	decibels relative to 1 mW
DDM	difference in depth of modulation
DMM	Digital Multi Meter
DSP	digital signal processor

CAGM	Com, ADF, Glide Slope Module
GS	Glide Slope
Hz	Hertz
IDENT	Identifier
IF	intermediate frequency
in.	Inch
KΩ	kilo-ohm
KHz	Kilohertz
LO	Local Oscillator
LOC	Localizer
MΩ	Mega ohm
mA	Milli ampere
MHz	Megahertz
mic	Microphone
min	Minute
MMDR	Multi Mode Digital Radio
MMDS	Multi Mode Digital Sensor
MPS	Minimum Performance Specification
mV	Milli volt
mW	Milli watt
NAV	Navigation
pF	Pico farad
PLL	phase locked loop
pW	Pico watt
RSSI	received signal strength indicator
reqd	Required
RF	radio frequency
rms	root mean square
sec	Second
TCXO	Temperature Controlled Crystal Oscillator
TP	Test Point
UUT	unit under test
TX	Transmitter or transmit
V	Volt
VDL	VHF data link
VHF	very high frequency (30 – 300MHz)
VOR	very high frequency omnidirectional radio range
VSWR	voltage standing wave ratio
W	Watt

1.3 *Assumptions and dependencies*

It is assumed that the MMDS VDL module has its parameter table of non-volatile memory set to default levels before alignment begins. If this is in doubt then the MMDS VDL module parameter non-volatile memory must be erased and power cycled to restore default values.
The MMDS VDL must be connected to a suitable host to supply DC power and I/O interfaces. The host, for example the KTR2280A host, requires 28V DC, and supplies the necessary DC power and I/O to the MMDS VDL.
The procedure is written around an operator typing commands into the Read/Write window in the TE2 User Interface. It is also acceptable to use the TE2 built in automated Tuning User Interface as well.
In many sections of this document, guidance is given to the alignment technician as to what range of alignment values are to be expected. For example … "Vary the TCXO tuning voltage by adjusting **MAIN_TUNE** (typical 1.5)". These values should not interpreted as required settings but only as starting points. Note also that software, firmware, and hardware changes over time will shift the typical values from what has been documented in this alignment procedure. In all cases the alignment procedure instructions only shall be used to determine if an alignment has been accomplished properly.

The Alignment Procedure references various Test Points. Refer to Appendix A for the location of these test points.

1.4 *Parameter Names and Addresses*

Addresses and parameter names can be found in "KTR 2280A MMDR Transceiver Minimum Performance Specification" MPS57000251-001. This alignment document will use parameter names in the description of the alignment. These are the names that will be recognized by the Tuning User Interface (all parameter names begin with a "P_").

1.5 *Required Test Equipment*

Before beginning this alignment procedure, verify that all the test equipment is currently in calibration.
TE2 test panel (071-05561-0000 MOD 1)

Te2Aui (Control Head Simulator Tool 731-01264-000x), see VDD57000610-000 for latest revision.

KTR2280 Test Panel UUT Cable (200-10594-0000)
190 KHz to 335 MHz AM/FM RF Signal generator with avionics waveform generation capability
DMM
Oscilloscope
PC computer
Frequency counter
Power Supply +28V
Audio Generator
Audio Distortion Analyzer
Modulation analyzer
Watt meter
30 dB power attenuator, 50W minimum
Network Analyzer

1.6 *Test equipment Setup/Initial Setting*

1.6.1 TE2 Test Panel

Download	OFF
MIC Key	OFF (Center)
TX INTERLOCK	OFF
TEST MODE	ON (RS422)
UNIT POS PGM1	0 (DOWN)
UNIT POS PGM2	0 (DOWN)
UNIT POS PARITY	1 (UP)
INLK	OFF
EMERGENCY FREQUENCY	NORMAL
AUDIO IN	BNC
AUDIO IN LO	0 ohms load
AUDIO OUT	BNC
AUDIO OUT LO	0 ohms load
DC POWER	OFF

1.6.2 Power Supply

Voltage	27.5 V
Current	7A
Output	ON

2 *Functional Alignment Section*

2.1 *Initial Radio Setup*

1. Open the Te2Aui shortcut on the desktop
2. Turn on power supply
3. Make sure power supply voltage is 27.5 V
4. Turn on DC power on test panel
5. Make sure the current drawn is 0.6 ± 0.2A

NOTE: If the unit has been aligned/partially aligned before and needs complete realignment after rework or unit software update , run the NVM Reset Procedure at APPENDIX D

2.2 *DSP*

2.2.1 100.8 MHz Sample Clock

Figure 1 MAIN_START_ALIGN

1) Type P_**MAIN_START_ALIGN**. In the Address box and "1" in the input/output value box and click "WRITE" to set parameter P_MAIN_START_ALIGN value to 1
2) Allow radio to operate a minimum of 1 minute.
3) Monitor TP106 on the DSP/NAV board with an frequency counter. Refer to Appendix A for the location of TP106.

4) Vary the TCXO tuning voltage by adjusting P_**MAIN_TUNE** (typical 1.5) by typing "**P_MAIN_TUNE"** on the Address box of General TMCP Lite Command and typing the value in Input/output Value box and clicking "WRITE" (Figure 2), Adjust the value until a frequency of 100.800000 MHz +/- 101Hz is measured. ."WRITE" must be clicked for every time the parameter value is changed.

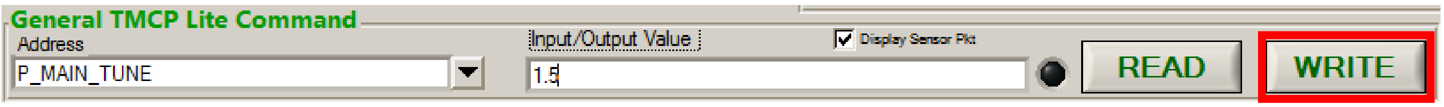


Figure 2 Adjusting MAIN_TUNE

2.3 *Navigation Receiver*

This section describes the alignment of all the parameters related to the VOR and Localizer functions.

2.3.1 Front End Alignment

1) Disable the NAV RF AGC by setting P_**NAV_RF_AGC_ENABLE** to 0 as picture shown below and click "WRITE".

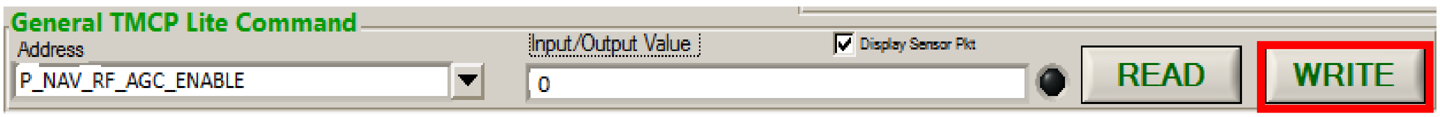


Figure 3 Disabling NAV RF AGC

2) Tune the receiver to 111 MHz (This will select the Low Band of the RF Preselector)

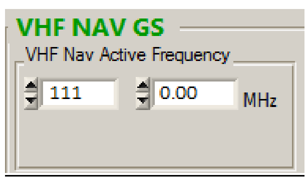
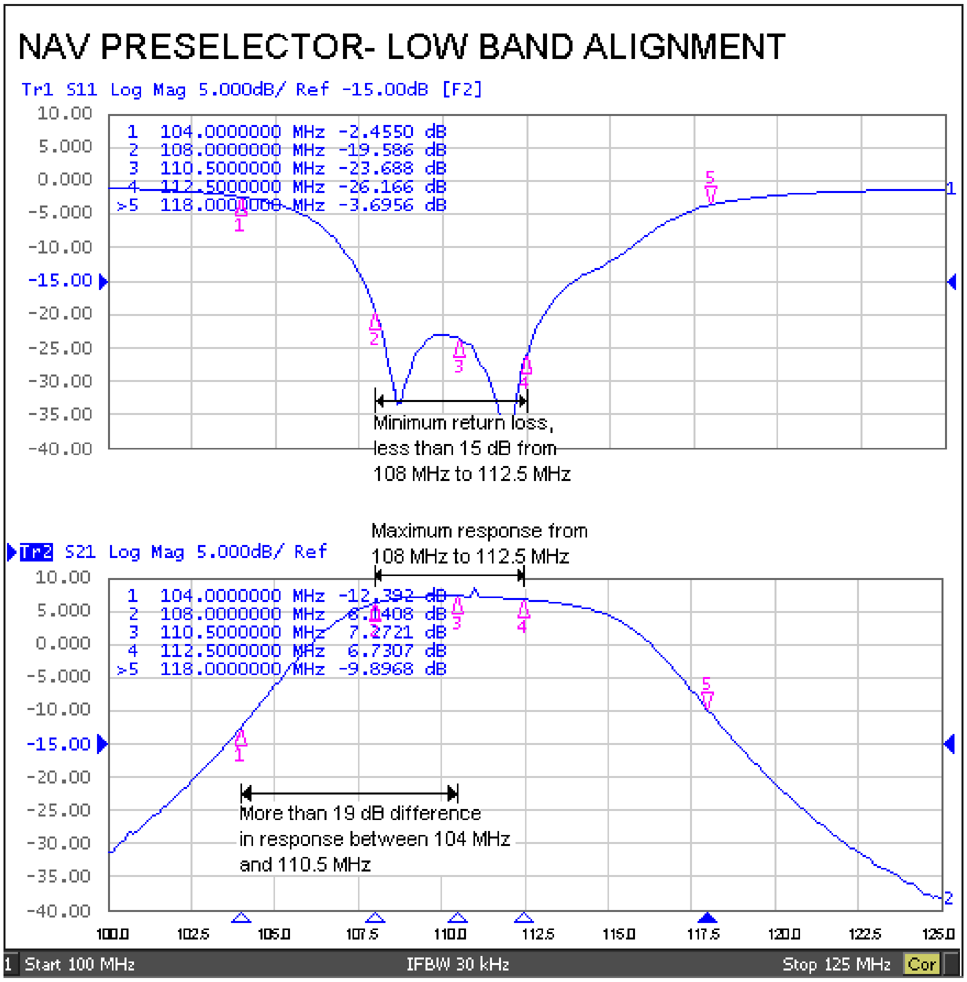


Figure 4 Tuning NAV Receiver to 111 MHz

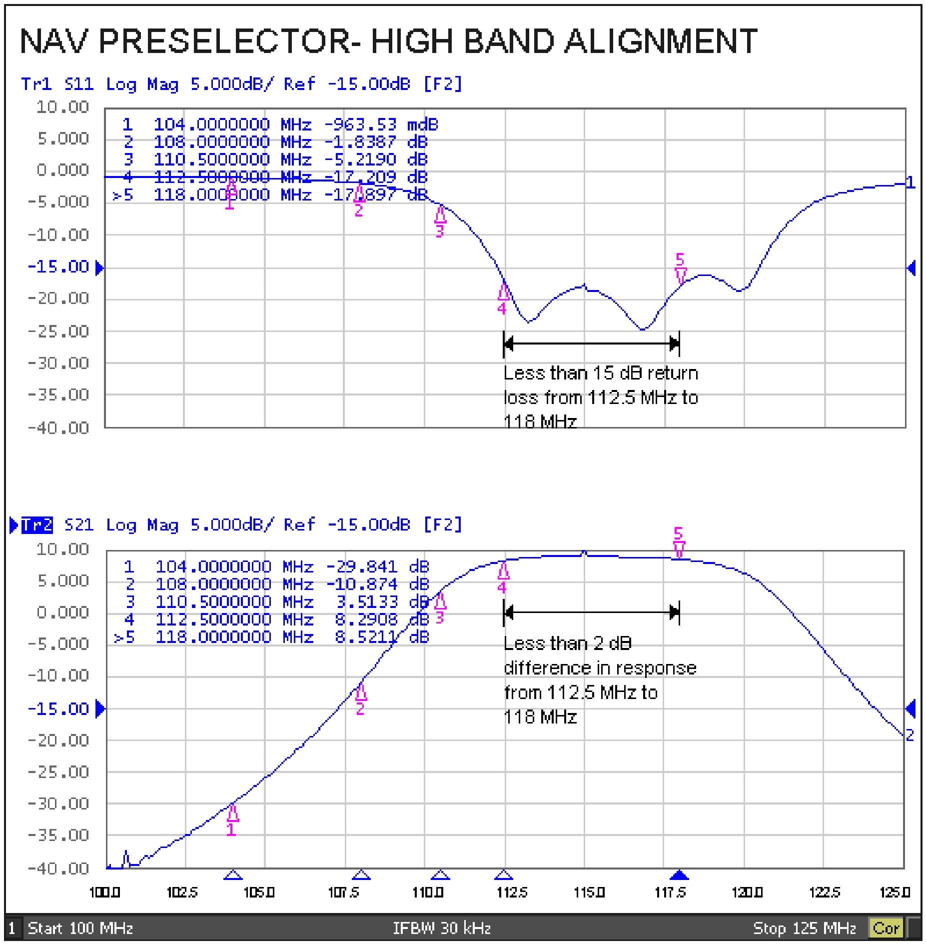
3) With a Network Analyzer Output Test Port 1 connected to the MMDS NAV antenna port, at a test level of –20 dBm, and a high impedance probe at TP105 and the Network Analyzer test port 1connected to the NAV Antenna Connector, sweep from 100MHz to 125 MHz. Refer to Appendix A for the location of TP 105.
4) Adjust Capacitors C5, C89, and C98 for a minimum insertion loss (S21) at 110.5 MHz and an insertion loss (S21) at 104 that is at least 9 dB below the insertion loss (S21) at 110.5 MHz.
5) Move the high impedance probe to the output of second preselector (TP104). Refer to Appendix A for the location of TP104.
6) Adjust Capacitors C30, C56, and C57 for maximum insertion gain (S21) at 110.5 MHz and insertion loss (S21) at 104 that is at least 19 dB below the insertion gain (S21) at 110.5 MHz.
7) Verify that the return loss (S11) at the antenna input is less then –15 dB from 108 to 112.5MHz.
8) Repeat steps 3 through 7 optimizing for best return loss (S11) and maximum insertion gain (S21) from 108 MHz to 112.5MHz. Note: A typical tuned response will have 1 to 2 dB less insertion gain at 108 MHz than at 110.5MHz. The insertion loss (S21) at 104MHz will be between 19 and 20 dB below the insertion gain (S21) at 108MHz.
9) Tune the receiver to 115MHz.(This will select the High Band of the RF Preselector)
10) Verify that the return loss (S11) between 112.5 MHz and 118 MHz is less then –15 dB and the insertion gain (S21) is flat within 2dB from 112.5 to 118MHz. Note: A typical response will be centered with maximum insertion gain (S21) around 115MHz and the insertion gain (S21) at 112.5MHz and 118MHz is within 1 dB of each other.

The tuning process may require several passes through steps 2 and 10 to satisfy all of the filter requirements.



Note: A typical tuned response will have between 1 and 2 dB more loss at 108 MHz then at 110.5MHz and the loss at 104MHz will be between 19 and 20 dB below that at 108MHz.

Figure 5 NAV Preselector Low Band Alignment



Note: A typical response will be centered with maximum response around 115MHz and the responses at 112.5MHz and 118MHz within 1 dB of each other.

Figure 6 NAV Preselector High Band Alignment

2.3.2 LO1 VCO Adjustment

1) Tune the receiver to 117.95 MHz by entering the value into the VHF Nav Active Frequency box and pressing "Enter" on the keyboard.

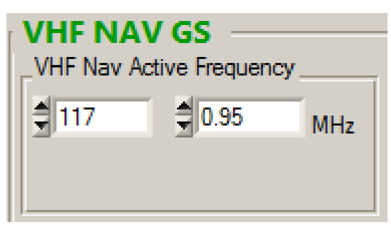


Figure 7 Tuning NAV Frequency

2) Adjust C114 for a DC voltage at TP99 to 7.1 ± 0.1 Vdc on the DSP/NAV board. Refer to Appendix A for the location of TP99.
3) Tune the receiver to 108 MHz.

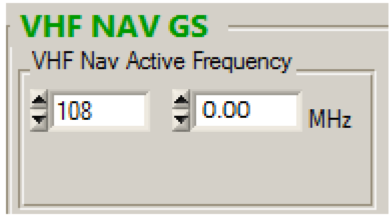


Figure 8 Tuning NAV Frequency

4) Verify that the voltage at TP99 is 3.0 ± 0.5 Vdc.
5) Readjust C114 as necessary to meet both steps 2 and 4 simultaneously.

2.3.3 LO2 VCO Adjustment

1) Adjust C25 on the DSP/NAV board for a voltage at TP102 to between 2.5 +/- 0.5 Vdc on the DSP/NAV board. Refer to Appendix A for location of TP102.

2.3.4 A/D Resonators Calibration

Note: Each Receiver AD9874 IC has two resonator circuits that need to be tuned for best Sigma Delta A/D operation. The AD9874 IC will calibrate itself if commanded to do so. Upon power up, valid calibration values must be loaded into the AD9874.

1) Within NAV RCVR Alignment Software with no signal applied to the NAV antenna input, command the AD9874 to tune its A/D resonators by setting typing P_**NAV_START_ALIGN** on the Address box of General TMCP Lite Command and typing “1” in the Input/output Value box and clicking “WRITE” (Figure 9).

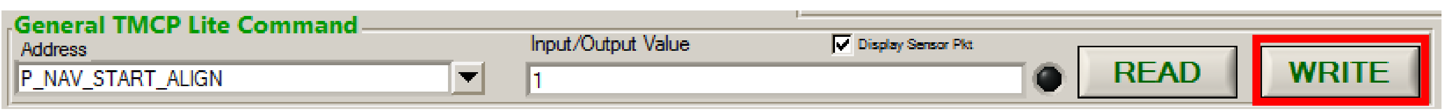


Figure 9 P_NAV_START_ALIGN

2) The software will automatically store the calibration values into Nonvolatile memory.

2.3.5 Reference TCXO Alignment

Note: For a new unit, the TCXO should be set on frequency with a tuning voltage of 1.5Vdc. This is a DAC setting of 1.403 Volts. If the alignment software defaults to this voltage, no alignment should be necessary.

1) Tune the NAV RCVR to 116 MHz by entering the value into the VHF Nav Active Frequency box.

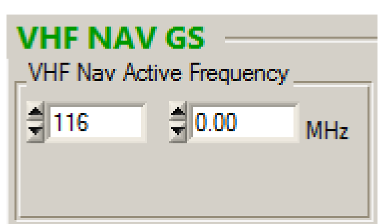


Figure 10 Tuning NAV Frequency

2) Monitor the 1st LO frequency with a frequency counter at TP100 on the DSP/NAV board. Refer to Appendix A for location of TP100.

3) Using alignment software vary the TCXO tuning voltage by typing "**P_NAV_TCXO_TUNE"** on the Address box of General TMCP Lite Command and typing the value in Input/output Value box and clicking "WRITE" (Figure 11), Adjust the value until a frequency of 161.0000MHz +/- 160Hz is measured.

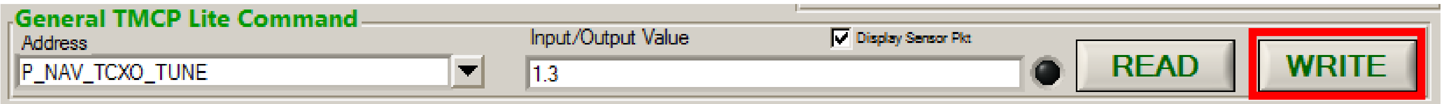


Figure 11 Adjusting NAV_TCXO_TUNE

2.3.6 Verification of NAV Sensitivity after Alignment

1) Power Cycle the 2280A radio by turning off and turning on the DC power on the test panel.
2) If error message pops up click "OK" then continue

Figure 12 Error Message

3) Connect a 108.100 MHz signal with 1 KHz 30% AM RF Level -108dBm from the signal generator to the NAV antenna port. Adjust the radio to Channel 108.100 MHz (Figure 13). Monitor SINAD of the NAV audio on the audio analyzer, reading should be more than 6dB.

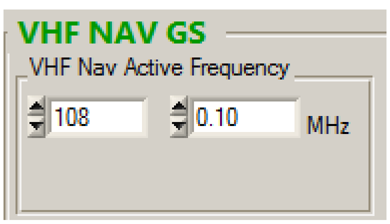


Figure 13 Tuning NAV Frequency

4) Connect a 117.950 MHz signal with 1 KHz 30% AM RF Level -109dBm from the signal generator to the NAV antenna port. Adjust the radio to Channel 117.950 MHz (Figure 14). Monitor SINAD of the NAV audio on the audio analyzer, reading should be more than 6dB.

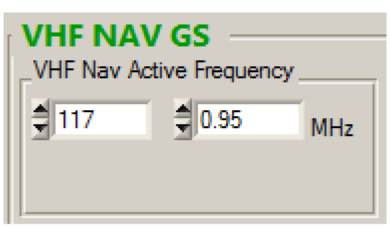


Figure 14 Tuning NAV Frequency

5) If the reading on step 3 or 4 is out of the specification then realign the radio according to section 2,3.1

2.4 *Glideslope*

Note: All alignment should be done at room temperature with the unit operated for periods of time sufficient for it internal temperature to stabilize, 5 minutes minimum.

The Glideslope receiver needs no alignment other than the gain calibration of the RF detector and the possible setting of the TCVCXO reference oscillator of an older unit. A TCVCXO of a new unit will be on frequency with 1.5Vdc applied to the Tuning voltage. This voltage may need to be adjusted with older units due to crystal aging.

2.4.1 Reference TCVCXO Alignment

Note: For a new unit, the TCVCXO should be set on frequency with a tuning voltage of 1.5Vdc. This is a DAC setting of 1.403 Volts. If alignment software defaults to this voltage, no alignment should be necessary. To set the TCVCXO, alignment software must remove the IF centering offsets for temperature that are used during normal operation.

1) Tune the GS RCVR to 332 MHz (NAV = 109.3 MHz).

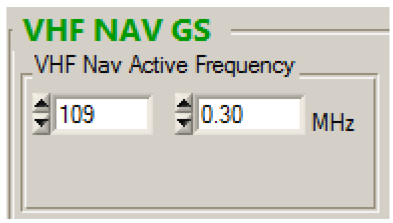


Figure 15 Tuning GS RCVR to 332MHz

2) Monitor the 1st LO frequency with a frequency counter at TP1. Refer to Appendix A for location of TP1.
3) Using alignment software set Address box to "P_**GS_ENABLE_TEMP_COMP"** and Input/output Value box **to 0** and click "WRITE".(Figure 16)

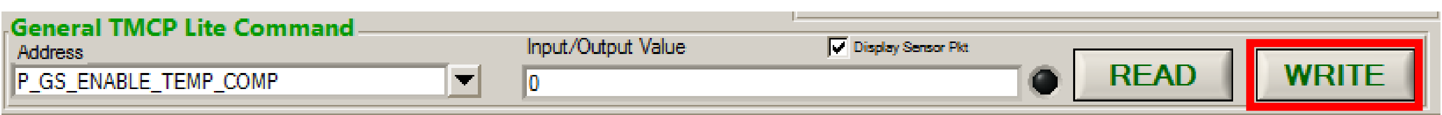


Figure 16 P_Setting P_GS_ENABLE_TEMP_COMP to 0

4) Using alignment software vary the TCXO tuning voltage by typing **P_GS_ALIGN_TUNE_VOLTAGE** on the Address box of General TMCP Lite Command and typing the value (typical xx) in Input/output Value box and clicking "WRITE", Vary the value until a frequency of 414.2000MHz +/- 420Hz is measured.

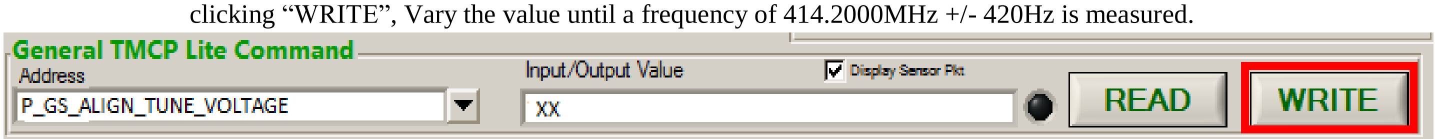


Figure 17 Adjusting P_GS_ALIGN_TUNE_VOLTAGE

Type **"P_GS_TUNE_VOLTAGE"** and Click "READ" to check the value in the Input/output box.

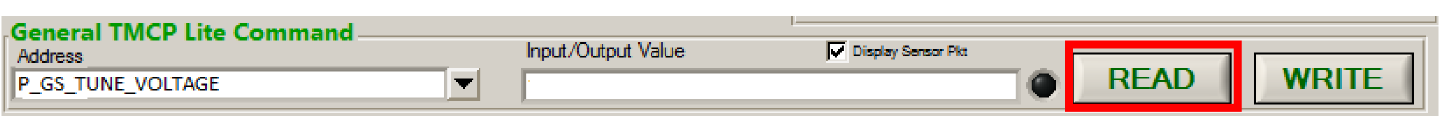


Figure 18 Reading P_GS_TUNE_VOLTAGE

5) Using alignment software set Address box to "P_**GS_ENABLE_TEMP_COMP"** and Input/output Value box **to 1** and click "WRITE" (Figure 19) and Type **"P_GS_TUNE_VOLTAGE"** and Click "READ" to verify that the value of changes from its previous value in step 4.

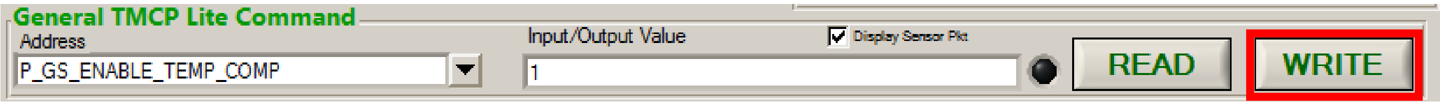


Figure 19 P_Setting P_GS_ENABLE_TEMP_COMP to 1

2.4.2 DDM adjustment (Receiver Gain)

Note: The Receiver Gain modifies the DDM measurement. The MMDS software automatically calibrates the DDM measurement when told to do so. This is done by applying a RF signal with a standard centering signal, measuring each of the two tones and calculating the gain factors for each tone. The DSP makes these measurements and stores in non-volatile memory the appropriate gain values.

1) Apply a standard 0.000 DDM signal, at frequency 332MHz and RF level of –53 dBm from signal generator.
2) Command the alignment software to calibrate the GS DDM by setting the Address box to "**P_GS_START_ALIGN**" and Input/output Value box **to 1** and click "WRITE".(Figure 20). The alignment software should measure and automatically store the gain values for the GS receiver 90 and 150 Hz tones (**P_GS_DDM_CALIBRATION_FACTOR_90HZ** and **P_GS_DDM_CALIBRATION_FACTOR_150HZ**), and the operating temperature measured during calibration (**P_GS_CALIB_TEMP**).

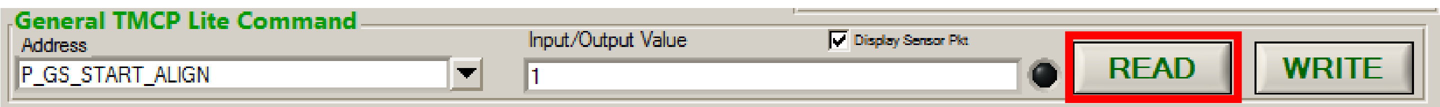


Figure 20 GS_START_ALIGN

3) Now confirm the alignment by reading the GS DDM output. The DDM reading should be 0.000 +/- 0.0001. (Figure 21)

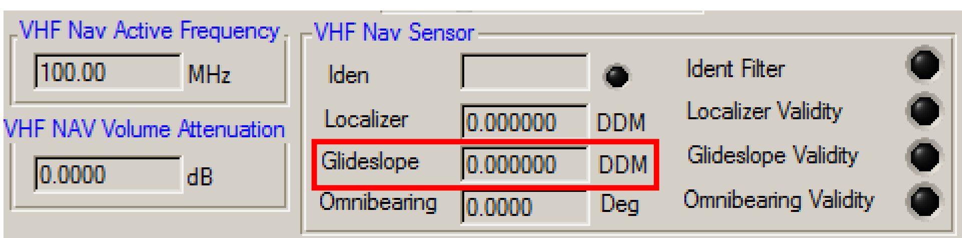


Figure 21 DDM reading

2.4.3 GS Receiver First Local Oscillator Tuning Check

1) Tune the GS receiver to 329.15 MHz (NAV = 108.95).

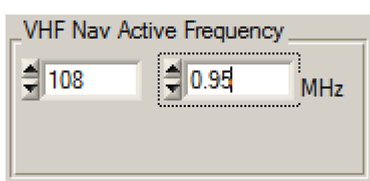


Figure 22 Setting Nav Active Frequency to 108.95 MHz

2) Check the voltage at TP3 at CAGM board and verify that the measured DC voltage is between 2.5 and 7 Vdc. Refer to Appendix A for location of TP3.
3) Tune the GS receiver to 335 MHz (NAV = 110.3).

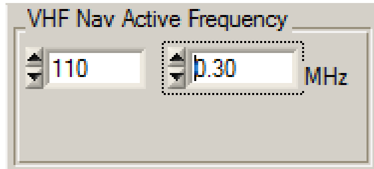


Figure 23 Setting Nav Active Frequency to 110.3 MHz

4) Check the voltage at TP3 and verify that the measured DC voltage is between 4 and 8.5 Vdc.

2.4.4 GS Receiver Second Local Oscillator Tuning Check

1) Check the voltage at TP2 at CAGM board and verify that the measured DC voltage is between 2.5 and 8.5 Vdc. Refer to Appendix A for location of TP2.

2.4.5 Verification of GS Sensitivity

1. Set the signal generator to GS Frequency 329.15 MHz (108.95 MHz on Te2Aui) and an up 0.045 DDM signal, at RF level of -87 dBm. Connect signal generator RF output to UUT GS antenna port. Click Channel Freq and set to 329.15 MHz.

2. Verify that the GS Dev is 0.045 ± 5 % and the "**Valid**" indicator lights up (green).

3. Verify for GS Frequency 335 MHz (110.3 MHz on Te2Aui) channel reading according to Step 1 and 2 above

2.4.6 Verification of ADF Sensitivity

1. Set ADF frequency to 190lHz, volume -20dB and ADF mode, set RF Signal Generator to an ADF Amplitude Modulation frequency of 190kHz with 30%, 400 Hz modulation , -98dBm RF output, and connect it to the ADF RF port on the KTR2280A. Select Audio switch to ADF on KTR2280 Test Panel, set Audio Analyzer Source frequency to 400Hz, verify the SINAD of ADF audio must be more than 6dB and "**Valid**" indicator must be green.

2. Verify ADF frequency channel 2189 kHz & 850 kHz according to step 1 above.

2.5 *COM Receiver*

2.5.1 Control of IFAGC and Notches

Variable Names	**Default Values**
P_WB_NOTCH1_VOLTAGE	4.095 (9v on Board)
P_WB_NOTCH2_VOLTAGE	4.095 (9v on Board)
P_WB_NOTCH3_VOLTAGE	4.095 (9v on Board)
P_COM_IF_AGC	13 (6.5 dB Attenuation)

P_WB_NOTCHx_VOLTAGE: This analog input moves the notch's resonant frequency to a desired location.

P_COM_IF AGC: This control sets the receiver gain. Its primary purpose is to fix the amount of receiver gain in the chain to a level that prevents the ADC from overloading due to large signal inputs.

Note: The following section up to **section 2.5.3** is for the automated COM Receiver Alignment, alternatively for the manual COM Receiver Alignment procedure, refer to **APPENDIX B** and **APPENDIX C**.

2.5.1.1 Procedure for Automated IF AGC Alignment

The IF AGC alignment procedure sets the correct gain for the receiver. For manual procedure refer to Appendix B.

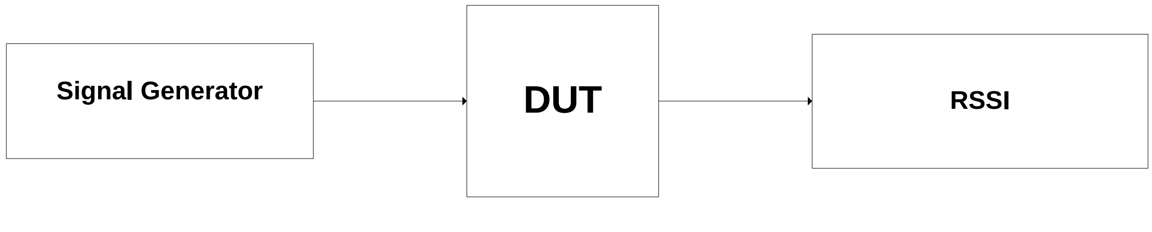


Figure 24 Test Setup

1) Test Setup as shown in figure 24.
2) Ensure that the "**COM Tx Interlock**" switch on the test panel/box is in the OFF position.
3) Select Alignment->Tune->Comm RX I the Te2Aui Window**.**
4) Set Signal Generator to 127 MHz , -25dBm with no modulation and connect RF output to UUT Com antenna

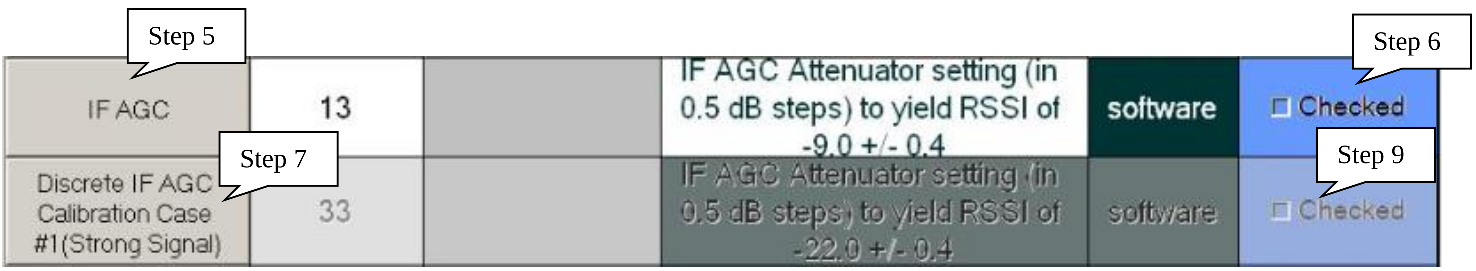


Figure 25 IF AGC Alignment

5) Click IF AGC to start the auto alignment.
   Note, the program may show IF AGC Fail, click OK to continue.

Figure 26 Failure Dialog Box

6) Tick Checked after completion.
7) Click "Discrete IF AGC Calibration Case #1 (Strong Signal)" in alignment page.
8) Power cycle the unit when the message window pops up
9) Tick Checked after completion
10) In row 3 Discrete IF AGC Calibration Case #2 (Com-2-Com) and row 4 Discrete IF AGC Calibration Case #3 (Com-2-VDL) do not need to be aligned. **Tick Checked** for these 2 steps, and proceed to notch alignment Step 2.4.1.2

Caution : Do not click on the Discrete IF AGC Calibration Case #2 (Com-2-Com) and Discrete IF AGC Calibration Case #3 (Com-2-VDL) button or it will set parameters to the wrong value and the automatic notch tuning will generate false alignment values.

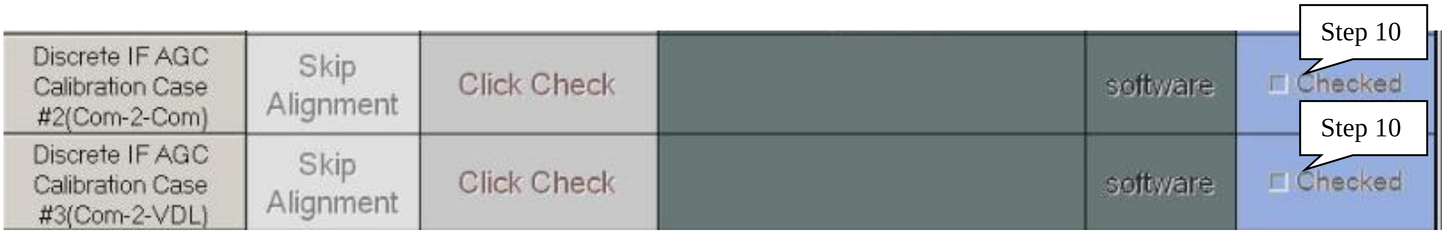


Figure 27 Skipped Alignments

2.5.1.2 Procedure for Automated Notch Control Alignment

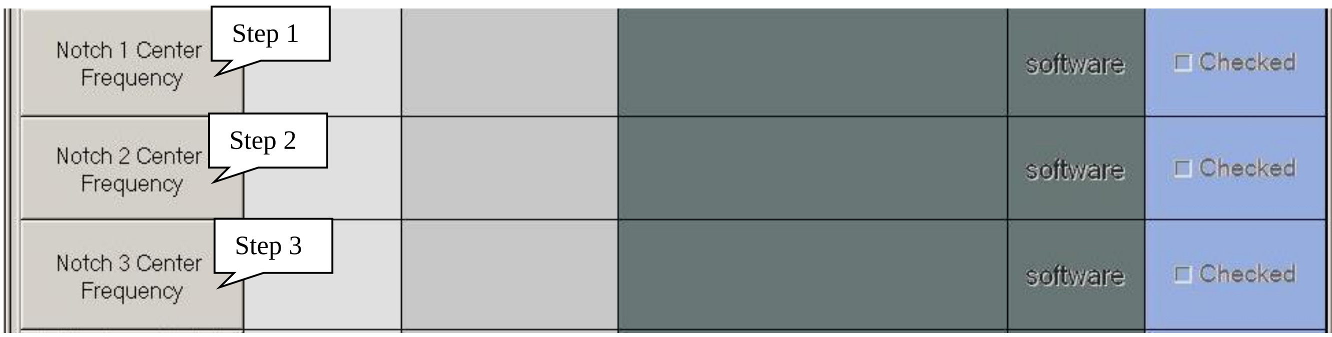


Figure 28 Notch Tuning

1) Click "Notch 1 Center Frequency" in alignment page. Follow the instruction to set the signal generator to 118MHz , 128MHz and 138MHz, -40dBm and then click "OK". Wait for auto alignment to complete. Tick "Checked" after completion.

2) Click "Notch 2 Center Frequency" in alignment page. Follow the instruction to set the signal generator to 118MHz , 128MHz and 138MHz, -40dBm and then click "OK". Wait for auto alignment to complete. Tick "Checked" after completion.

3) Click "Notch 3 Center Frequency" in alignment page. Follow the instruction to set the signal generator to 118MHz , 128MHz and 138MHz, -40dBm and then click "OK". Wait for auto alignment to complete. Tick "Checked" after completion.

2.5.2 COM Squelch Calibration

1) Verify (change if necessary) default settings for P**_CNR_SQUELCH_SETTING = 12** and **P_RSSI_SQUELCH_SETTING = 88** by pressing "Com Squelch Calibration".
2) Tick "Checked".

Figure 29 Com Squelch Calibration

Verification of COM Sensitivity after Alignment

1. Cycle unit power.
2. Set "Squelch Override" to Enable from TE2 tool.
3. Connect a 118.000 MHz signal generator with 1kHz 30% AM to the COM antenna port. Adjust the radio to Channel 118.000 MHz. While monitoring SINAD of the COM audio, adjust the signal generator's RF output power until 6dB is reached. The 6dB sensitivity of the radio should be better than -107dBm.

4. Connect a 136.975 MHz signal generator with 1kHz 30% AM to the COM antenna port. . Adjust the radio to Channel 136.975 MHz. While monitoring SINAD of the COM audio, adjust the signal generator's RF output power until 6dB is reached. The 6dB sensitivity of the radio should be -107dBm.
5. Tick "Checked" after completion

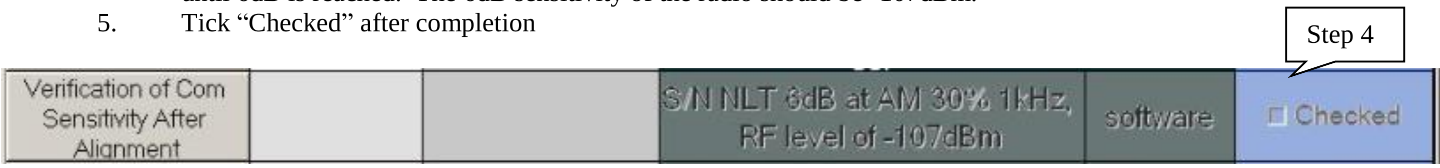


Figure 30 Verification of Com Sensitivity After Alignment

6. Set "Squelch Override" to disable from TE2 tool.

2.5.3 COM Receiver First Local Oscillator Tuning Check

1) Click "FIRST LO Tuning Check"
2) The output value should display 157MHz, if not power cycle the UUT, repeat from step 1 until 157MHz displayed.
3) Check the voltage at TP5 on the CAGM board and verify a DC voltage of between 3.5 and 6.5 Vdc. Refer to Appendix A for the location of TP5.
4) Tick Checked and close the TUI window

Figure 31 First LO Tuning Check

2.6 *Transmitter Synthesizer*

2.6.1 VCO Alignment

1) Tune Transceiver to 136.975 MHz (TX PLL to 273.95MHz) (Figure 32).

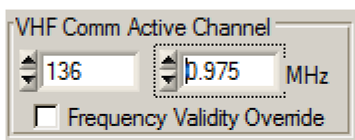


Figure 32 Tuning COM Channel to 136.975 MHz

2) Adjust C335 on CAGM board for a tuning voltage at TP6 of 7.5 +/-0.05 Vdc. Refer to Appendix A for the location of TP6.
3) Tune Transceiver to 118MHz

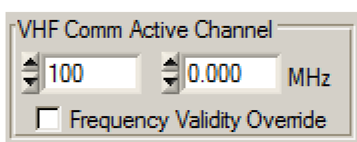


Figure 33 Tuning COM Channel to 118 MHz

4) Verify Tuning Voltage at TP6 is 3 +/- 1 Vdc

2.6.2 Reference TCVCXO Alignment

Note: For a new unit, the TCVCXO should be set on frequency with a tuning voltage of 1.5Vdc. This is a DAC setting of 1.403 Volts. If alignment software defaults to this voltage, no alignment should be necessary. For older equipment:

1) Tune the COM to 135 MHz. (Figure 34).

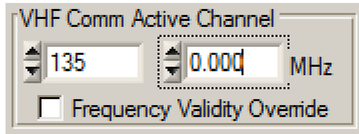


Figure 34 Tuning COM Channel to 135 MHz

2) Monitor the transmitter frequency with a frequency counter at TP7 on the CAGM board. Refer to Appendix A for location of TP7.
3) Using alignment software vary the TCXO tuning voltage via **P_COM_TCXO_TUNE** until a frequency of 270.000MHz +/- 270Hz is measured.

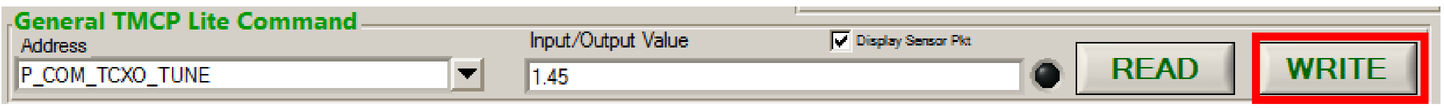


Figure 35 Example of setting P_COM_TCXO_TUNE

4) Using alignment software, store this value in P**_COM_TCXO_FACTORY_CALIB1** by reading **P_COM_TCXO_TUNE** and writing the value to **P_COM_TCXO_FACTORY_CALIB1.**

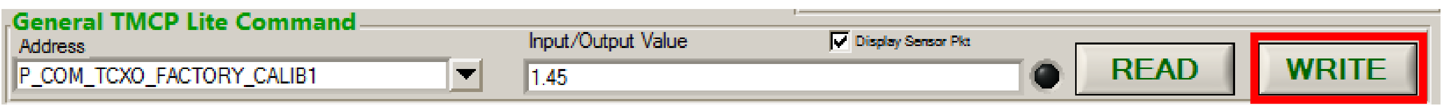


Figure 36 Storing value from P_COM_TCXO_TUNE to P_COM_TCXO_FACTORY_CALIB1

2.7 *Transmitter*

There are several controls that allow test and alignment of the KTR2280A transmitter. Several parameters will have to be set in each individual radio for correct operation.

The KTR2280A should be turned on and allowed to warm up for at least 3 minutes prior to aligning the transmitter.

Unless otherwise noted, when keying the MIC KEY to align biases or to align output power level, it is important to use the shortest duration needed for accurate measurement. Long transmissions can significantly increase the temperature of the transmitter, adding unwanted variation to the alignment. This applies to both M2 and COM transmitter alignments.

2.7.1 Audio COM Mode Alignments

2.7.2 Alignment Setup

1) Disable RF input to the transmitter by setting **P_TX_RF_SUPRESS** to 1 by entering “**P_TX_RF_SUPRESS**” in the address box , “1” in the Input/output Value box and clicking “WRITE”.

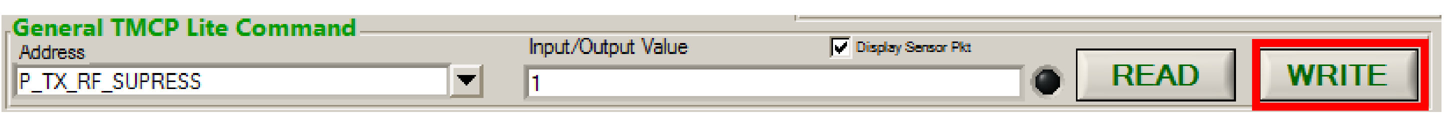


Figure 37 Setting P_TX_RF_SUPRESS to 1

2) Disconnect external mic audio or set external mic audio to 0V.

3) Disable Transmitter ALC (audio compressor) by setting **P_TX_ALC_ENABLE** to 0 . Setting the parameter value is done by entering “**P_TX_ALC_ENABLE**” in the address box , “0” in the Input/output Value box and clicking “WRITE”.

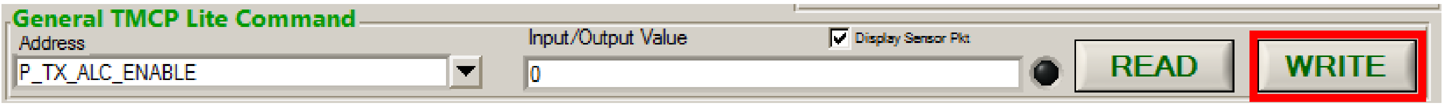


Figure 38 Setting P_TX_ALC_ENABLE to 0

2.7.2.1 Align COM Driver Bias Control

1) Set **P_TX_DRVR_BIAS_ADJUSTED** to 0 by typing "**P_TX _DRVR_BIAS_ADJUSTED**" in the Address box and the value "0" in the Input/output Value Box and clicking "Write".

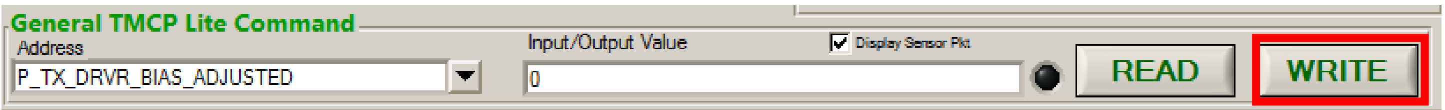


Figure 39 Setting P_TX_DRVR_BIAS_ADJUSTED to 0

2) Set **P_TX_FINAL_BIAS_ADJUSTED** to 0 by typing "**P_TX_FINAL_BIAS_ADJUSTED**" in the Address box and the value "0" in the Input/output Value Box and clicking "Write".

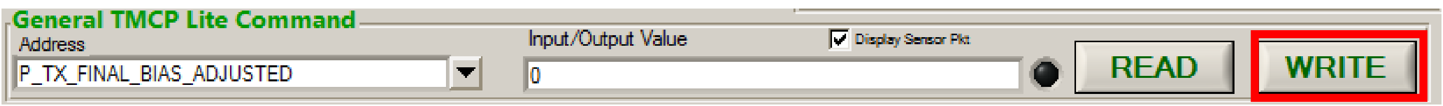


Figure 40 Setting P_TX_FINAL_BIAS_ADJUSTED to 0

3) Set **P_TX_PRE_DRVR_ADJUSTED** to 0 by typing "**P_TX_PRE_DRVR_ADJUSTED**" in the Address box and the value "0" in the Input/output Value Box and clicking "Write".

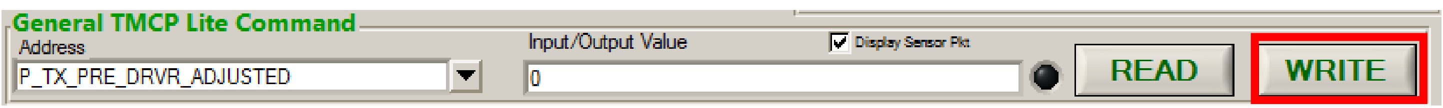


Figure 41 Setting P_TX_PRE_DRVR_ADJUSTED to 0

4) Activate MIC Key and note down the 28V current drawn on the power supply.
5) Adjust **P_TX_DRVR_BIAS_ADJUSTED** (typical 2.8) by typing "**P_TX_DRVR_BIAS_ADJUSTED**" in the Address box and the value in the Input/output Value Box and clicking "WRITE". With MIC Key active ,monitor the 28V Power supply current. Switch off MIC Key and vary the parameter value and activate the MIC Key again. Repeat until the 28V current on the power supply from step 4 increases by 300 ± 10 mA.

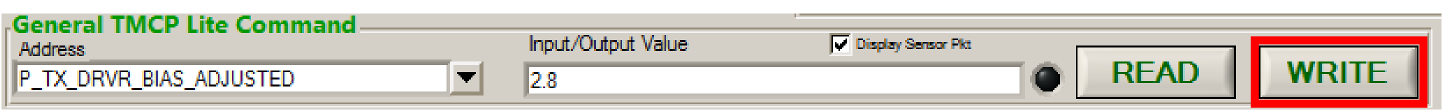


Figure 42 Example of setting P_TX_DRVR_BIAS_ADJUSTED

2.7.2.2 Align COM Final Bias Control

1) Set the **P_TX_DRVR_BIAS_ADJUSTED** to 0 after first recording the level after adjustment in the previous section (Section 2.7.2.1 step 5).
2) Activate MIC Key and note 28V current (should be same as noted in section 2.7.2.1 step 4).
3) Adjust **P_TX_FINAL_BIAS_ADJUSTED** (typical 2.7) by typing "**P_TX_FINAL_BIAS_ADJUSTED**" in the Address box and the value in the Input/output Value Box and clicking "WRITE". With MIC Key active monitor the 28V Power supply current. Switch off MIC Key and vary the parameter value and activate the MIC Key again. Repeat until the 28V current on the power supply increases by 300± 10 mA from the reference value in step 2.

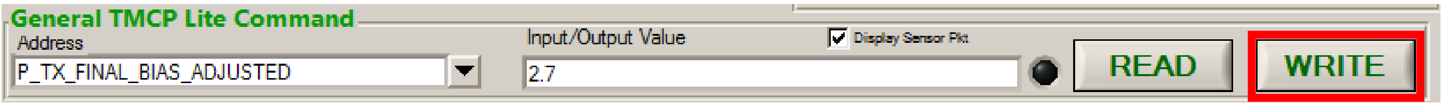


Figure 43 Example of setting P_TX_FINAL_BIAS_ADJUSTED

4) Set the **P_TX_DRVR_BIAS_ADJUSTED** back to previously aligned level recorded in step 1.

2.7.2.3 Align Pre-driver Current Limit

1) Set software COM modulation level to fully on by setting **P_TX_COM_MOD_NORMAL_118MHZ** to 32767.0 (Figure 44). The radio must be channeled to 119 MHz and then back to 118 MHz for change to take effect (Figure 45).

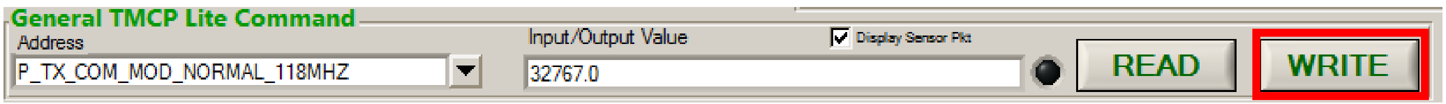


Figure 44 Setting P_TX_COM_MOD_NORMAL_118MHZ to 32767.0

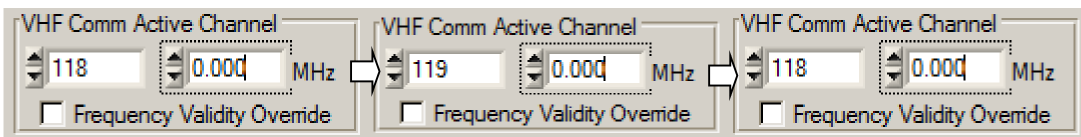


Figure 45 Channeling frequency to 119MHz and back

2) Measure the current using **P_TX_PRE_BIAS_MON** (when MIC Key is **inactive**) by typing "**P_TX_PRE_BIAS_MON**" in the address box and clicking "READ". Note this number as Pre-Driver Off Current.

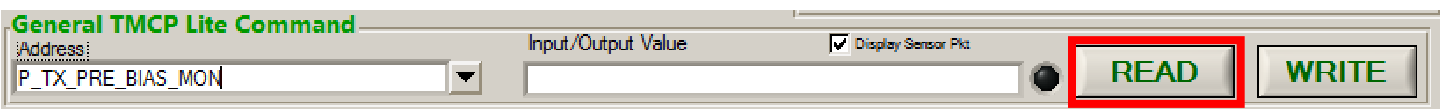


Figure 46 Reading P_TX_PRE_BIAS_MON

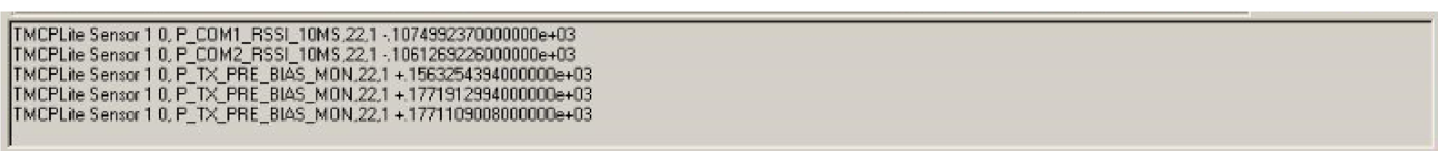


Figure 47 Example of P_TX_PRE_BIAS_MON reading

3) Adjust **P_TX_PRE_DRVR_ADJUSTED** (typical 1.8) by typing "**P_TX_PRE_DRVR_ADJUSTED**" in the Address box and the value in the Input/output Value Box and clicking "WRITE". With MIC Key active monitor **P_TX_PRE_BIAS_MON** until the current reaches Pre-Driver_Off_Current + 400 -+/-10 mA.

For example if Pre-Driver_Off_Current is 32 mA, adjust **P_TX_PRE_DRVR_ADJUSTED** until **P_TX_PRE_BIAS_MON** is 432 +/- 10mA. Read the **P_TX_PRE_BIAS_MON** value immediately after the Mic Key becomes active.

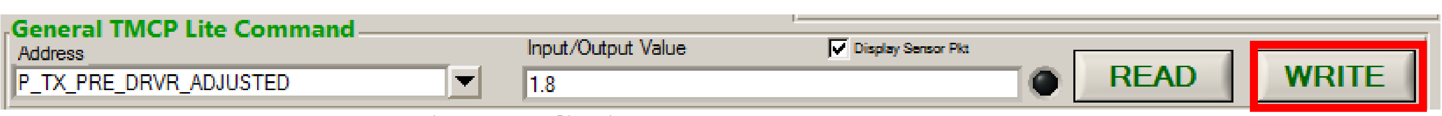


Figure 48 Adjusting P_TX_PRE_DRVR_ADJUSTED

2.7.2.4 Align COM Modulation DC Offset

1) Enable RF to the transmitter by setting **P_TX_RF_SUPRESS** to 0.
2) Set software COM modulation level to 0 by setting **P_TX_COM_MOD_NORMAL_118MHZ** to 0.0. The radio must be channeled to 119 MHz and then back to 118 MHz for change to take effect (Figure 45)
3) Adjust **P_TX_DC_SHIFT** (typical 1000 to 1900) until output power is 4W +/- 0.1W with MIC Key active. Record setting.
4) Adjust **P_TX_DC_SHIFT** (typical 3000 to 3600) output power is 16W +/- 0.1W with MIC Key active. Record setting.
5) Write to **P_TX_DC_SHIFT** (2 * 4W setting ins step 3) – (16W setting in step 4).

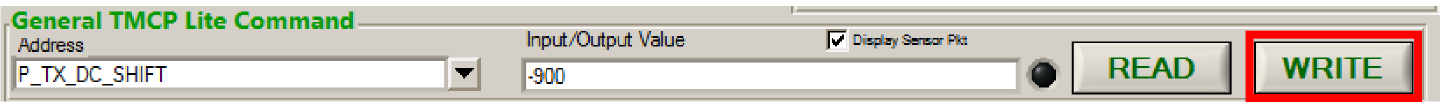


Figure 49 Example of setting P_TX_DC_SHIFT

2.7.2.5 Align Normal Carrier Power

1) Adjust **P_TX_COM_MOD_NORMAL_118MHZ** (typical 3300) by typing "**P_TX_COM_MOD_NORMAL_118MHZ**" in the Address box and the value in the Input/output Value box and clicking "WRITE". Repeat while varying the value until 18W+/- .5W output power is captured on external power meter when MIC Key is active. Must reset channel frequency after every adjustment for adjustment to take effect. (Figure 51)

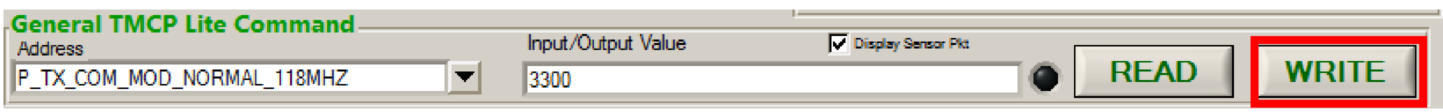


Figure 50 Adjusting P_TX_COM_MOD_NORMAL_118MHZ

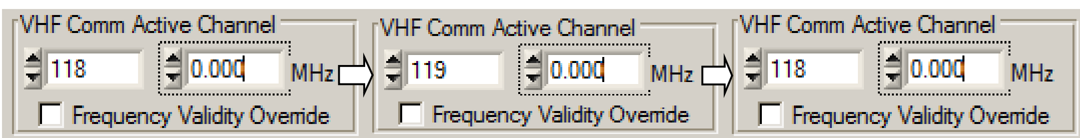


Figure 51 Resetting the channel frequency to 118MHz

2) Repeat previous step for:

- 123 MHz
- 127 MHz
- 132 MHz
- 136.975 MHz (**P_TX_COM_MOD_NORMAL_137MHZ)**

2.7.3 Manual Hardware Tuning Selection Test

1) Transmitter Tuning

The transmitter is tuned by changing the values of capacitors C68 and C73. These capacitors are on the output of transistor Q3 (the Final power transistor in the line-up). The characteristic that is being tuned is the power supply current increase for an 18W carrier-only transmission. The desired current increase is +3.3A over the receive-only current. The 18Wcarrier-only current increase is measured at five frequencies: 118, 123, 127, 132, and 136.975 MHz.

The requirement is that all five of these frequencies will have an increase over the receive-only current between +2.9A and +3.9A.

It is desired that all frequencies be +3.3A increase, but minimizing the maximum error is most important. Error is defined as the magnitude of the difference between the measured current and +3.3A.

Example:

With C68 = 100 pF and C73 = 100 pF the following data is taken:

118 MHz = +3.45 A Error = 0.15
123 MHz = +3.15 A Error = 0.15
127 MHz = +3.15 A Error = 0.15
132 MHz = +3.15 A Error = 0.15
136.975 MHz = +3.15 A Error = 0.15
Then C73 is changed to 91 pF and the following data is taken:

118 MHz = +3.6 A Error = 0.30
123 MHz = +3.3 A Error = 0.00
127 MHz = +3.3 A Error = 0.00
132 MHz = +3.3 A Error = 0.00
136.975 MHz = +3.3 A Error = 0.00

In this example the FIRST case is preferred to the second case. Even though the second case has four frequencies exactly nominal, it is more important to minimize the maximum error. It is better for all five frequencies to be in error by 0.15A than it is for one frequency to be in error by 0.3A.

This example shows another tuning guide. To make the 18W carrier-only current draw to go UP, the capacitance on the output of Q3 must go DOWN. The opposite is also true.

The following lists the combinations of capacitors that may be used in position C68 and C73 for tuning purposes. C73 is the capacitor nearest the final transistor.

C68	C73	Total Capacitance
91 pF	91 pF	182 pF
100 pF	91 pF	191 pF
100 pF	100 pF	200 pF
110 pF	100 pF	210 pF
110 pF	110 pF	220 pF

The part numbers for these parts are:
91 pF: 106-00074-0060
100 pF: 106-00044-0051
110 pF: 106-00044-0078

Summary:
- The desired nominal supply current increase for 18Wcarrier-only is +3.3A over receive-only supply current
- The requirement is that all of the five frequencies will have increases between +2.9A and +3.9A
- It is desired to minimize the maximum error when tuning.
- To cause the supply current increase to go UP the capacitance of C68 and C73 must go DOWN
- To cause the supply current increase to go DOWN the capacitance of C68 and C73 must go UP
- Verify the section 2.7.2.5 Align Normal Carrier Power

2.7.4 Align Mic Gain

1) Connect audio analyzer output to Test Panel Audio IN HI and also to the audio analyzer input.

2) Connect COM antenna port to Modulation Input, set modulation analyzer to **AM PEAK –**

3) Set audio analyzer frequency to 1kHz sine wave, vary amplitude until 100mVrms read on the audio analyzer input

4) Set channel frequency to 127 MHz. (Figure 52).

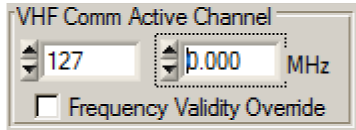


Figure 52 Setting channel frequency to 127MHz

5) Adjust **P_TX_CURRENT_MICGAIN** (typical 0.0018) until modulation analyzer reads 90% AM down mod (+/-1%) when MIC Key is engaged. (Figure 53)

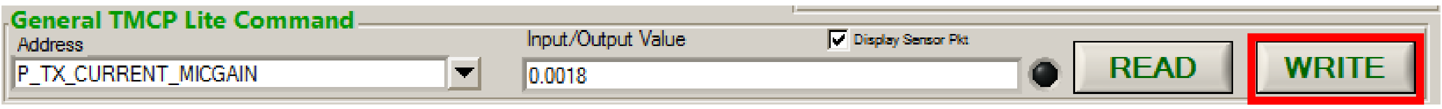


Figure 53 Adjusting P_TX_CURRENT_MICGAIN

6) Record value found in the previous step for **P_TX_MIC_GAIN** by setting **P_TX_MIC_GAIN** to the same value as **P_TX_CURRENT_MICGAIN** in step 3 (Figure 54)

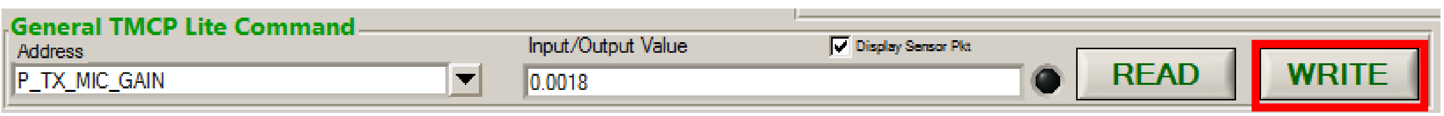


Figure 54 Setting P_TX_MIC_GAIN to P_TX_CURRENT _MIC_GAIN

2.7.5 Align the Transmitter Limiter and ALC thresholds

1) Adjust **P_TX_MODULATION_LIMIT** (typical 0.75) until modulation analyzer reads 85% AM down mod (+/-1%) on AM Peak - measurement when MIC Key is engaged. Adjustment is done by typing “**P_TX_MODULATION_LIMIT**” in the Address box , then typing the value in the Input/output box and clicking “WRITE”.

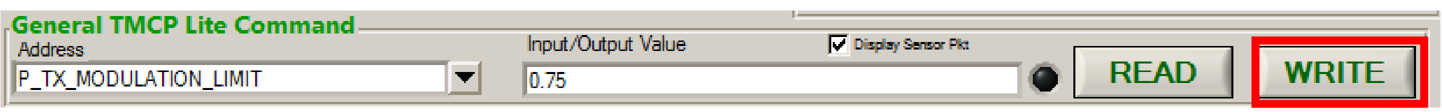


Figure 55 Adjusting P_TX_MODULATION_LIMIT

2) Set TX **audio compressor to enabled state (P_TX_ALC_ENABLE to 1)** by typing “**P_TX_ALC_ENABLE**” in the Address box and “1” in the Input/output Value box and clicking “WRITE”.

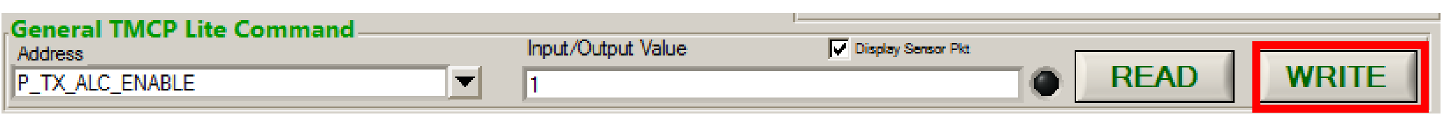


Figure 56 Setting P_TX_ALC_ENABLE to 1

3) Set Threshold for Transmitter ALC. Adjust **P_TX_RMS_UPPER_THRESHOLD** (typical 0.3) to capture 80% downmod (+/-1%) on the modulation analyzer AM Peak - measurement. Adjustment is done by typing “**P_TX_RMS_UPPER_THRESHOLD**” in the Address box , then typing the value in the Input/output box and clicking “WRITE”.

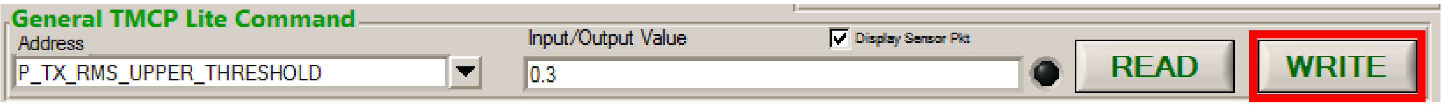


Figure 57 Adjusting P_TX_RMS_UPPER_THRESHOLD

2.7.6 Align the Transmitter MIC Sidetone Level

1) Reading the COM received audio output while MIC Key active, measure the audio level. Tune **P_SIDETONE** (typical 2400) until 1.4 Vrms is achieved on AC Level measurement on the audio analyzer. Tuning is done by typing "**P_SIDETONE**" in the Address box , then typing the value in the Input/output box and clicking "WRITE".

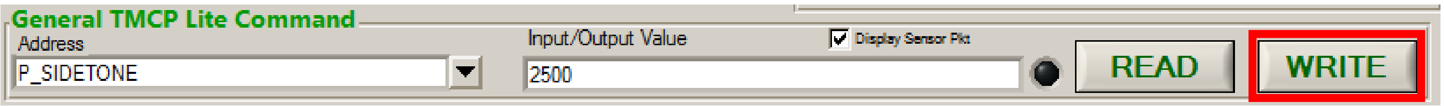


Figure 58 Tuning P_SIDETONE

2) Record value found in the previous step in the parameter table location for **P_SIDETONE_LEVEL**.

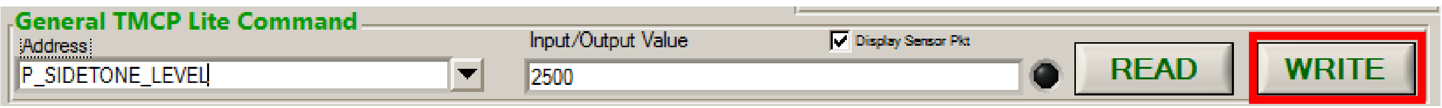


Figure 59 Recording the value to P_SIDETONE_LEVEL

2.7.7 Data Mode Alignments

2.7.8 Alignment Setup

Disable RF input to the transmitter by setting **P_TX_RF_SUPRESS** to 1. This is done typing "**P_TX_RF_SUPRESS**" in the Address box, and "1"in the Input/output Value box and clicking "WRITE"

2.7.8.1 Align Data Mode Driver Bias Control

1) Set **P_TX_M2_DRVR_BIAS_ADJUSTED** to 0 by typing "**P_TX_M2_DRVR_BIAS_ADJUSTED"** in the Address box and "0" in the Input/output Value box and clicking "WRITE".

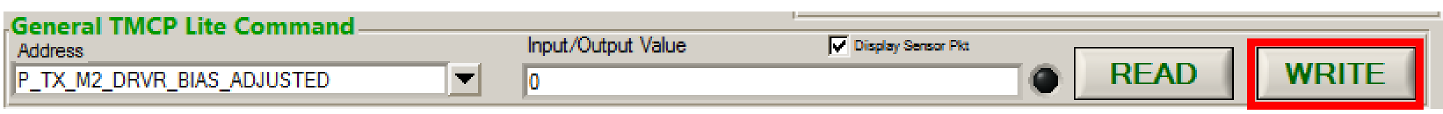


Figure 60 Setting P_TX_M2_DRVR_BIAS_ADJUSTED to 0

2) Set **P_TX_M2_FINAL_BIAS_ADJUSTED** to 0 by typing "**P_TX_M2_FINAL_BIAS_ADJUSTED**" in the Address box and "0" in the Input/output Value box and clicking "WRITE".

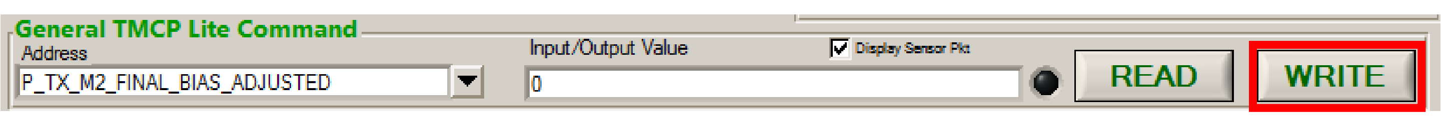


Figure 61 Setting P_TX_M2_FINAL_BIAS_ADJUSTED to 0

3) Set **P_TX_M2_PRE_DRVR_BIAS_ADJUSTED** to 0 by typing "**P_TX_M2_PRE_DRVR_BIAS_ADJUSTED**" in the Address box and "0 in the Input/output Value box and clicking "WRITE".

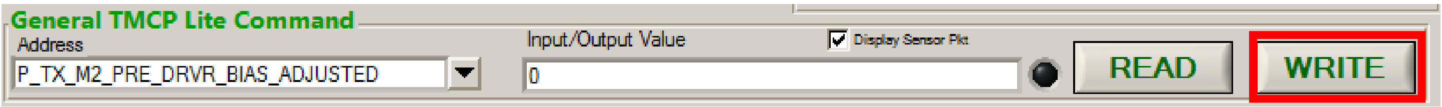


Figure 62 Setting P_TX_M2_PRE_DRVR_BIAS_ADJUSTED to 0

4) Click the **"Mode 2 Test"** button on the Te2uiA panel (opens the Mode 2 Bit Error Rate Testing and Transmit control window) (Figure 63)

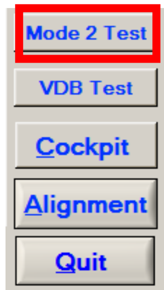


Figure 63 Mode 2 Test button

5) Set Mode 2 active channel frequency to 118.000 MHz, Click **"Tune". (Figure 64)**

Figure 64 Setting Active Channel frequency

6) Click the **"Start Test Sequence"** button, note 28V current, Click **"Stop". (Figure 65)**
7) If Warning Message pops up click "Continue" (Figure 66)

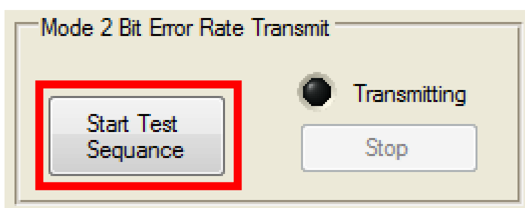


Figure 65 Mode 2 Transmit

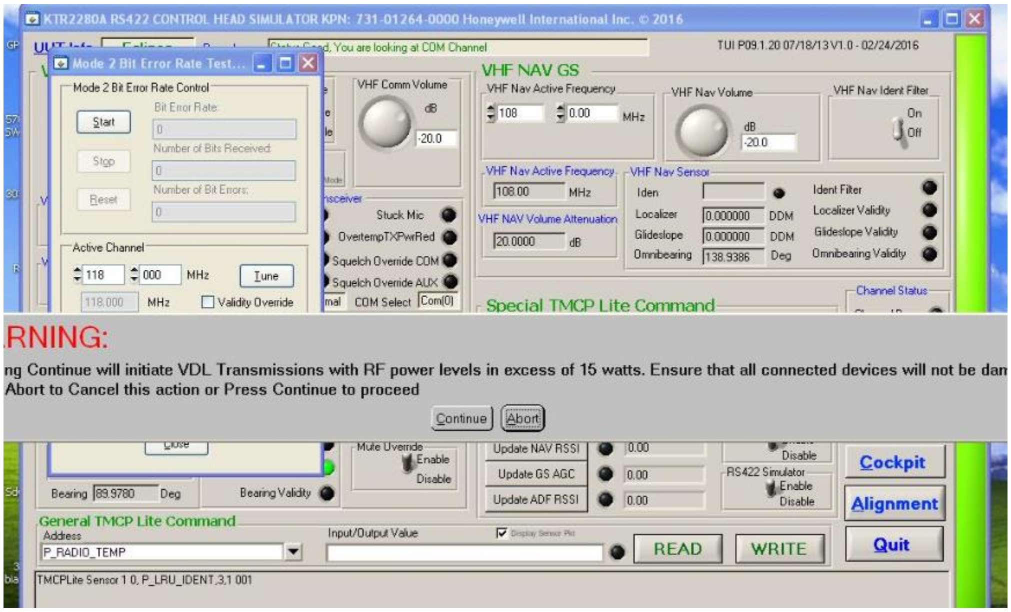


Figure 66 Warning Message

8) Adjust **P_TX_M2_DRVR_BIAS_ADJUSTED** (typical 2.9) until the 28V current noted in step 6 increases by 700 ± 10 mA and record this value __________________ .

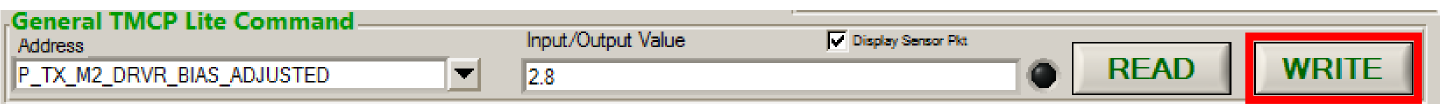


Figure 67 Adjusting P_TX_M2_DRVR_BIAS_ADJUSTED

CAUTION: Small changes in TX_M2_DRVR_ADJUSTED can make large changes in the Driver current. Start low in value and slowly adjust up until the desired current is reached. If Driver current is allowed to exceed 2 amps, the Driver FET (Q2 on the Transmitter board) may fail.

2.7.8.2 Align Data Mode Final Bias Control

1) Set **P_TX_M2_DRVR_BIAS_ADJUSTED to 0**.
2) Click the **"Start Test Sequence"** button, note 28V current, Click **"Stop". (Figure 69)**
3) Adjust **P_TX_M2_FINAL_BIAS_ADJUSTED** (typical 2.8) until the 28V current noted in step 2 increases by 3000 ± 50 mA and record this value __________________ .

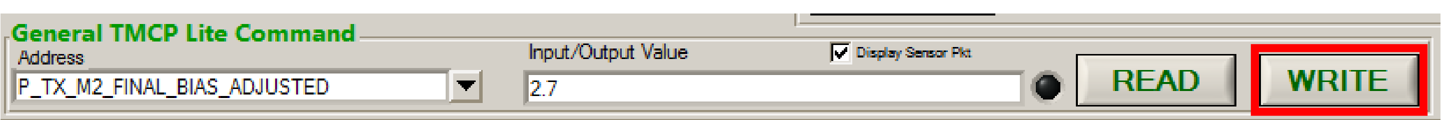


Figure 68 Adjusting P_TX_M2_FINAL_BIAS_ADJUSTED

CAUTION: Small changes in TX_M2_FINAL_ADJUSTED can make large changes in the Final current. Start low in value and slowly adjust up until the desired current is reached. If Final current is allowed to exceed 8 amps, the Final FET (Q3 on the Transmitter board) may fail.

2.7.8.3 Align Data Mode Pre-Driver Bias Control

1) Set **P_TX_M2_DRVR_BIAS_ADJUSTED** to 0
2) Set **P_TX_M2_FINAL_BIAS_ADJUSTED** to 0
3) Read **P_TX_PRE_BIAS_MON** on the main Te2uiA window. Note this number as <u>Pre-Driver Off Current</u>.
4) Click the **"Start Test Sequence"** button on the Mode 2 Bit Error Rate Transmit control window, immediately click READ on the main Te2uiA window, click **"Stop"** on the Mode 2 window.(Figure 69 and 70)

Figure 69 Start Test Sequence active

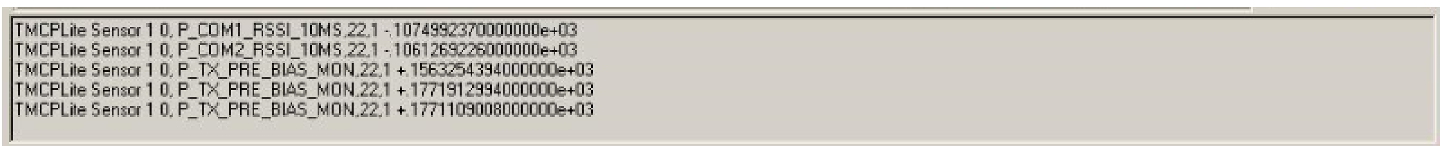


Figure 70 P_TX_PRE_BIAS_MON reading

5) Adjust **P_TX_M2_PRE_DRVR_BIAS_ADJUSTED** (typical 1.7) by typing "**P_TX_M2_PRE_DRVR_BIAS_ADJUSTED**" in the Address box and the value in the Input/output Value Box and clicking "WRITE". Repeat and vary the value until the current reaches <u>Pre Driver Off Current</u> + 125 +/-10 mA is captured on **P_TX_PRE_BIAS_MON** (when **Start Test Sequence** button is active).(Figure 69 and 70). Click "Stop" to stop the Mode 2 Transmission after each time transmitting before varying the parameter value.

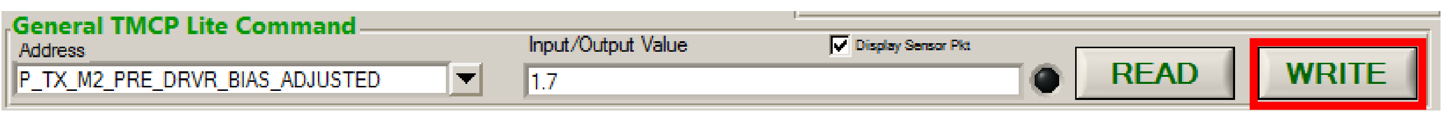


Figure 71 Adjusting P_TX_M2_PRE_DRVR_BIAS_ADJUSTED

For example if Pre-Driver Off Current is 32 mA, adjust **TX_M2_PRE_DRVR_ADJUSTED** until **P_TX_PRE_BIAS_MON** is 157 +/- 10mA for a target current of 125 +/-10 mA is captured on the immediate **P_TX_PRE_BIAS_MON** value read in step 4 (readings will be displayed in the TCMPLite Sensor queue).(Figure 70)

2.7.8.4 Set Driver and Final DC bias values

1) Set **P_TX_M2_DRVR_BIAS_ADJUSTED** to the value obtained in 2.7.8.1 step 7 by typing **"P_TX_M2_DRVR_BIAS_ADJUSTED"** in the Address box and the value in the Input/output Value box and clicking "WRITE".

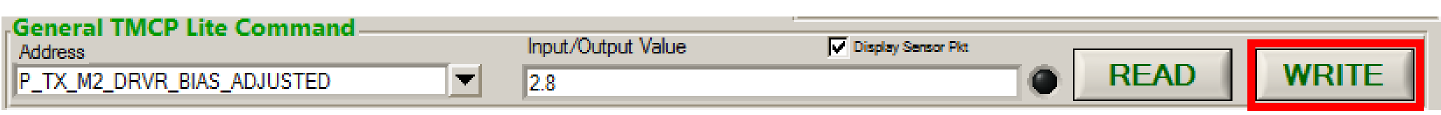


Figure 72 Example of Setting P_TX_M2_DRVR_BIAS_ADJUSTED to the value in 2.6.8.1 step 7

2) Set **P_TX_M2_FINAL_BIAS_ADJUSTED** to the value obtained in 2.7.8.2 step 3 by typing **"P_TX_M2_FINAL_BIAS_ADJUSTED"** in the Address box and the value in the Input/output Value box and clicking "WRITE".

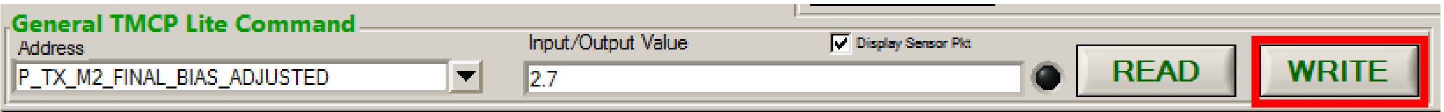


Figure 73 of Setting P_TX_M2_FINAL_BIAS_ADJUSTED to the value in 2.6.8.2 step 3

2.7.8.5 Align Data Mode Power Attenuator

NOTE: Mode 2 attenuator settings are integer increments (63 = maximum and 0 = minimum attenuation). The steps are 0.5 dB which equates to about 2 watts per step Mode 2 transmit power. P_M2_MOD_ATTN_ values are set for mode 2 output power. There can be up to ± 4 Watts power difference from the aligned power depending on transmitter temperature.

1) Enable RF input to the transmitter by setting **P_TX_RF_SUPRESS** to 0.
2) Set the Mode 2 active channel frequency to 118.000 MHz by entering 118 MHz in the Active Channel box and clicking “TUNE” (Figure 74)

Figure 74 Setting VDL Transceiver Frequency to 118 MHZ

3) Set **P_FPGA_M2_TX_PWR_CTRL to** 0 by typing “**P_FPGA_M2_TX_PWR_CTRL**” in the Address box and “0” in the Input/output Value box and clicking “WRITE”.

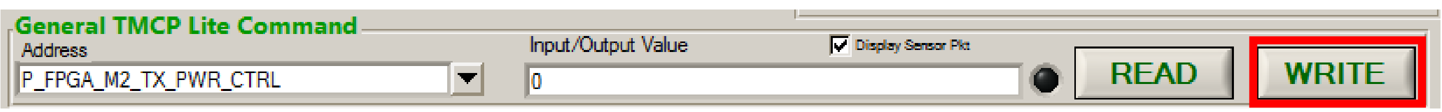


Figure 75 Setting P_FPGA_M2_TX_PWR_CTRL to 0

4) Adjust **P_TX_M2_MOD_ATTN_118MHZ** by typing “**P_TX_M2_MOD_ATTN_118MHZ”** in the address box and entering the value in the Input/output box and clicking “WRITE”. Repeat while varying the values until the output power is **18 ± 1 Watts**. Power should be measure between 2 and 5 seconds after key up. Set the power meter’s range hold function to increase the readout speed.

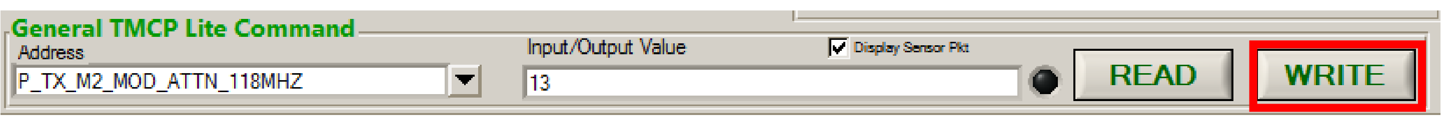


Figure 76 Adjusting P_TX_M2_MOD_ATTN_118MHZ

Figure 77 Changing the active M2 frequency after P_TX_M2_MOD_ATTN_118MHZ change

5) Repeat previous step for:

- **P_TX_M2_MOD_ATTN_123MHZ**
- **P_TX_M2_MOD_ATTN_127MHZ**
- **P_TX_M2_MOD_ATTN_132MHZ**
- **P_TX_M2_MOD_ATTN_137MHZ** (Tune Mode 2 Active Channel to 136.975 MHz)

2.7.8.6 Firmware Power Control Alignment

1) Set **P_FPGA_M2_TX_PWR_CTRL to** 1.
2) Set the Mode 2 active channel frequency to 118.000 MHz. (Figure 74)
3) Adjust **P_TX_M2_PWR_TGT_118MHZ** (typical 1200) by typing "**P_TX_M2_PWR_TGT_118MHZ"** in the address box and entering the value in the Input/output box and clicking "WRITE". Repeat while varying the values until the output power is **18 ± 0.5 W**. The Mode 2 transmission must be stopped every time after transmitting before changing the parameter value. (Figure 69).

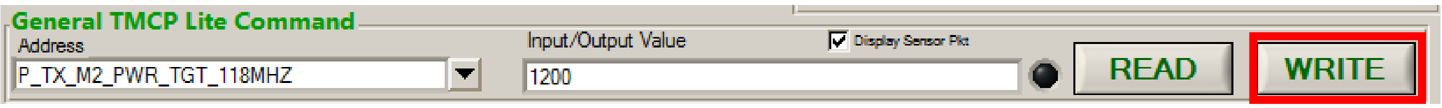


Figure 78 Adjusting P_FPGA_M2_TX_PWR_CTRL

4) Repeat previous steps for:
- **P_TX_M2_PWR_TGT_123MHZ**
- **P_TX_M2_PWR_TGT_127MHZ**
- **P_TX_M2_PWR_TGT_132MHZ**
- **P_TX_M2_PWR_TGT_137MHZ** (Tune Mode 2 Active Channel to 136.975 MHz)

3 *Record MMDS Serial and Part Numbers and Mod Status*

3.1 *MMDS Serial Numbers and Part Numbers*

This section describes the procedure to record the serial, part number and hardware mod status into the non-volatile memory.

P_SERIAL_NUMBER_0
P_SERIAL_NUMBER_1
P_SERIAL_NUMBER_2

P_PART_NUMBER_0
P_PART_NUMBER_1
P_PART_NUMBER_2

P_RADIO_MOD_STATUS
P_RADIO_SERIALNUMBER

The types on these are all 32 bit unsigned integers except for RADIO_SERIALNUMBER which may be any text.

For example:
The configuration is:
Serial number: 100612345 (week 10, year 2006, radio 12345)

MMDS Part number: 205-30997-0000

Then the alignment commands are:

P_SERIAL_NUMBER_0 = 10 (week 10)
P_SERIAL_NUMBER_1 = 06 (year 06)
P_SERIAL_NUMBER_2 = 12345 (the 12345th radio built in 2006)

P_PART_NUMBER_0 = 122 (the first 3 digits of the part number)
P_PART_NUMBER_1 = 01335 (the middle 5 digits of the part number)
P_PART_NUMBER_2 = 0010 (the last 4 digits of the part number)

If the part number is an engineering release containing letters it shall be recorded as 999-99999-9999.

3.2 *Radio Mod Status*

1) **Set P_RADIO_MOD_STATUS** based on the information from the Work Order

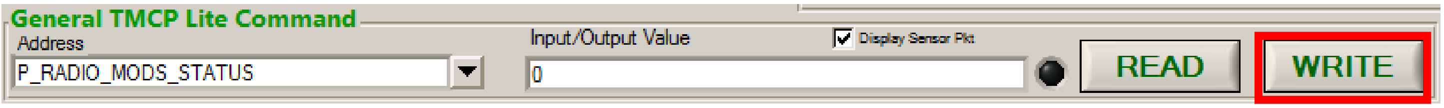


Figure 79 Setting P_RADIO_MOD_STATUS

3.3 *Radio Serial Number*

1) **Set P_RADIO_SERIALNUMBER** based on the information from the Work Order

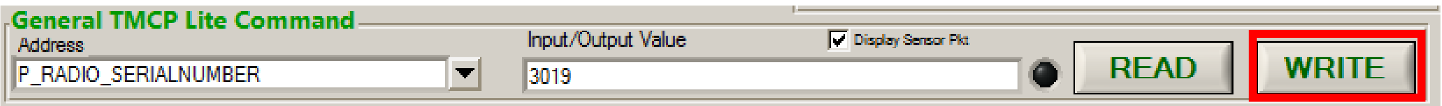


Figure 80 Setting P_RADIO_SERIALNUMBER

4 *Manual MPS Test*

The following tests should be perform after the radio alignment as per MMDS VDL MANUAL FINAL PROCEDURE 57000687-000.

4.1 Interference Frequency at 6MHz or Greater from Channel Frequency MPS 6.1.14.1
4.2 SINAD with Interference Signal Applied MPS 6.1.14.2

4.1 *Interference Frequency at 6MHz or Greater from Channel Frequency MPS 6.1.14.1*

1) Connect a coaxial from the Signal Generator to the Com antenna.

2) In the TE2AUI , set the **VHF COMM ACTIVE CHANNEL** to 127.00MHz

3) Set the signal generator at RF frequency 121.00MHz, RF level -35dBm and 0% modulation.

4) Type **P_WB_FFT_MAX_AMP** in **General TMCP Lite Command Address** window.

5) Click **Read.** Note the value shown in the **INPUT/OUTPUT** window. Record this value (a)
Eg. 1.1352786 e+07 is 11352786

6) Set signal generator to -5dBm and toggle **TX Interlock** switch to **"ON".**

7) Wait for approximately 10 seconds and Click **Read.** Note the value shown in the **INPUT/OUTPUT** window.
Record the value (b)
Eg. 7.45161 e+05 is 745161

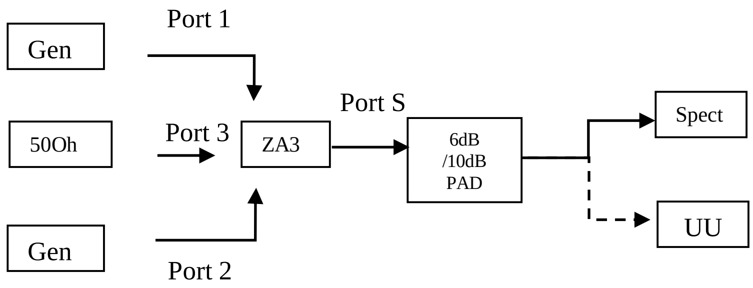
8) Calculate the interference signal (Y) use below formula and note down the test data sheet. It should be NLT 54dB

$$Y = (20 * log_{10}\left(\frac{a}{b}\right)) + 30$$

{ FFT_ratio = 20*$\log_{10}$ (interlock OFF/interlock ON) +30 }

9) Switch **TX Interlock** to "**OFF**".

4.2 *SINAD with Interference Signal Applied MPS 6.1.14.2*



1) Setup test equipment as per picture above.

2) Connect either 6dB or 10dB Attenuator to Port S of ZA3 (ZA3CS-450-9W)

3) Set Spectrum Analyzer center frequency to 131 MHz, span 50 KHz, Ref level -40 dBm, attenuation 0dB, Res BW and VBW 1 KHz, marker 131 MHz.

4) Set the signal generator #1 at RF frequency 131.00MHz, 1 kHz tone and 30% modulation, adjust RF level until Spectrum get -93 dBm signal.

5) Set Spectrum Analyzer center frequency to 121 MHz, span 50 KHz, Ref level 20dBm, attenuation 30dB, Res BW and VBW 1 KHz, marker 121 MHz.

6) Set the signal generator #2 at RF frequency 121.00MHz, 0% modulation, and adjust RF level until Spectrum get 0 dBm signal. Off RF output.

7) Connect (6dB/10dB) Attenuator to UUT COM antenna port

8) Connect **AUDIO O/P HI** from test panel to Audio Analyzer **INPUT**.

9) Set Test Panel **AUDIO SELECT** to **COM1**

10) Switch Audio Analyzer measurement to **AC LEVEL**

11) Adjust VHF COMM Volume in TE2AUI until Audio Analyzer shows 7 +/-0.1Vrms.

12) Set Squelch Override to **"ON"** on the Te2Aui alignment software

13) Switch **TX Interlock** to **"ON"**

14) Switch on signal generator #2 RF output.

15) Measure for radio SINAD using the audio analyzer.

16) Note down the SINAD at the test data sheet. It should be NLT6dB.

17) Switch **TX Interlock** to "**OFF**".

18) Set Squelch Override to **"OFF"** on the Te2Aui alignment software

If any of these two tests failed, perform the manual notch alignment as per <u>section 8 Appendix C Procedure for Manual Notch Control Alignment</u> in this document and repeat above test cases.

Honeywell

5 *NVM Parameter Record*

Follow below procedure from TE2 tool to record the NVM parameters (refer figure 81)

1) Select **Alignment**
2) Click **OK** on logging info pop up window
3) Select **System->MMDS Read**.
4) Open the file **Read All NVM.txt** from C:\Te2Aui\doc (Path may be different from system to system) -> click OK
5) Enter file name as SNxxxx_NVM.txt, here xxxx is the unit Serial Number. Example for radio with SN 3020, save file name as SN3020_NVM.txt in local server (These files should be retained along with Radio test reports for entire life of the radio).
6) Turn off UUT Power off
7) If any re-alignment happen, repeat steps from 1 to 6 to re-record the NVM parameters

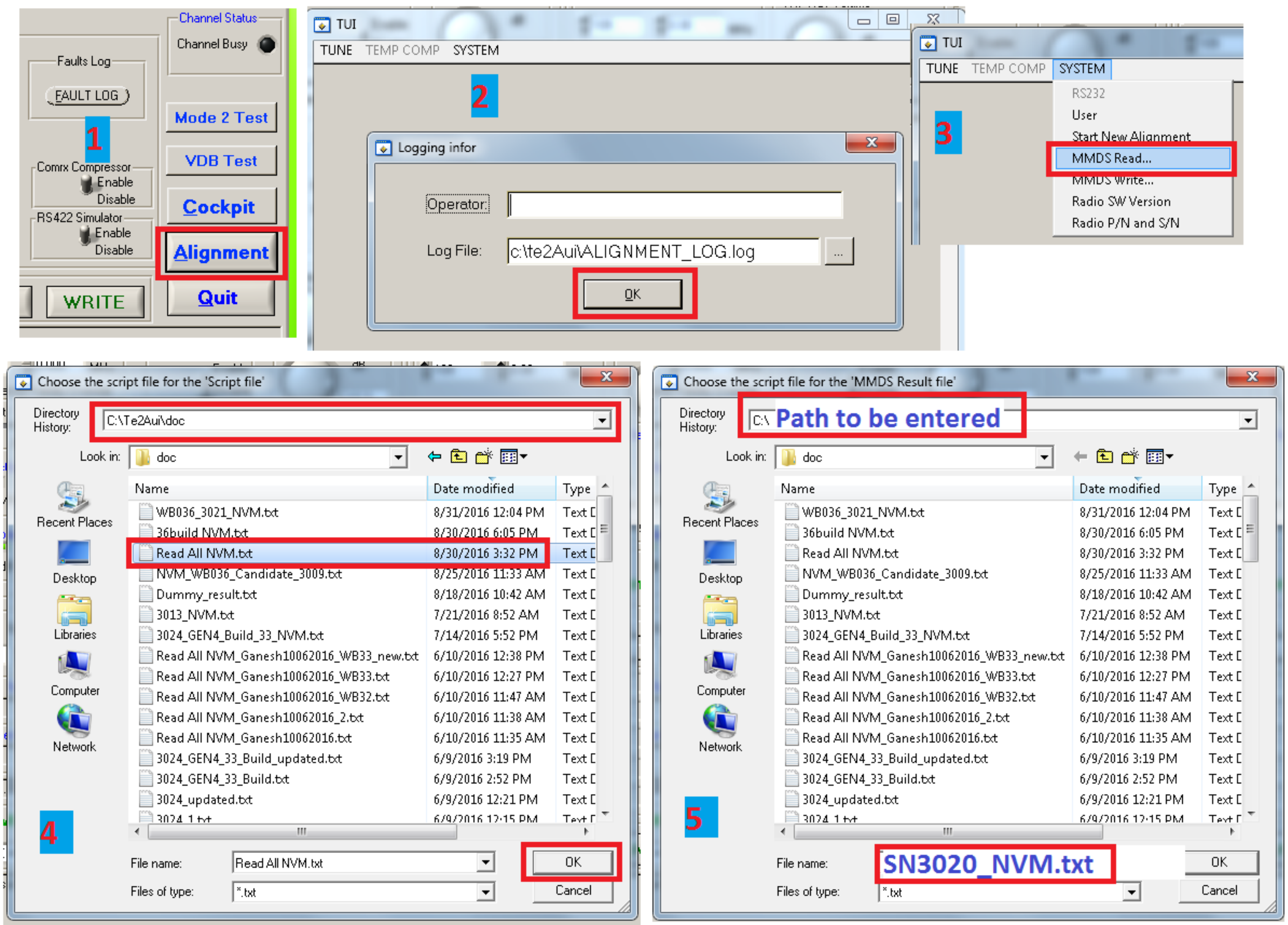
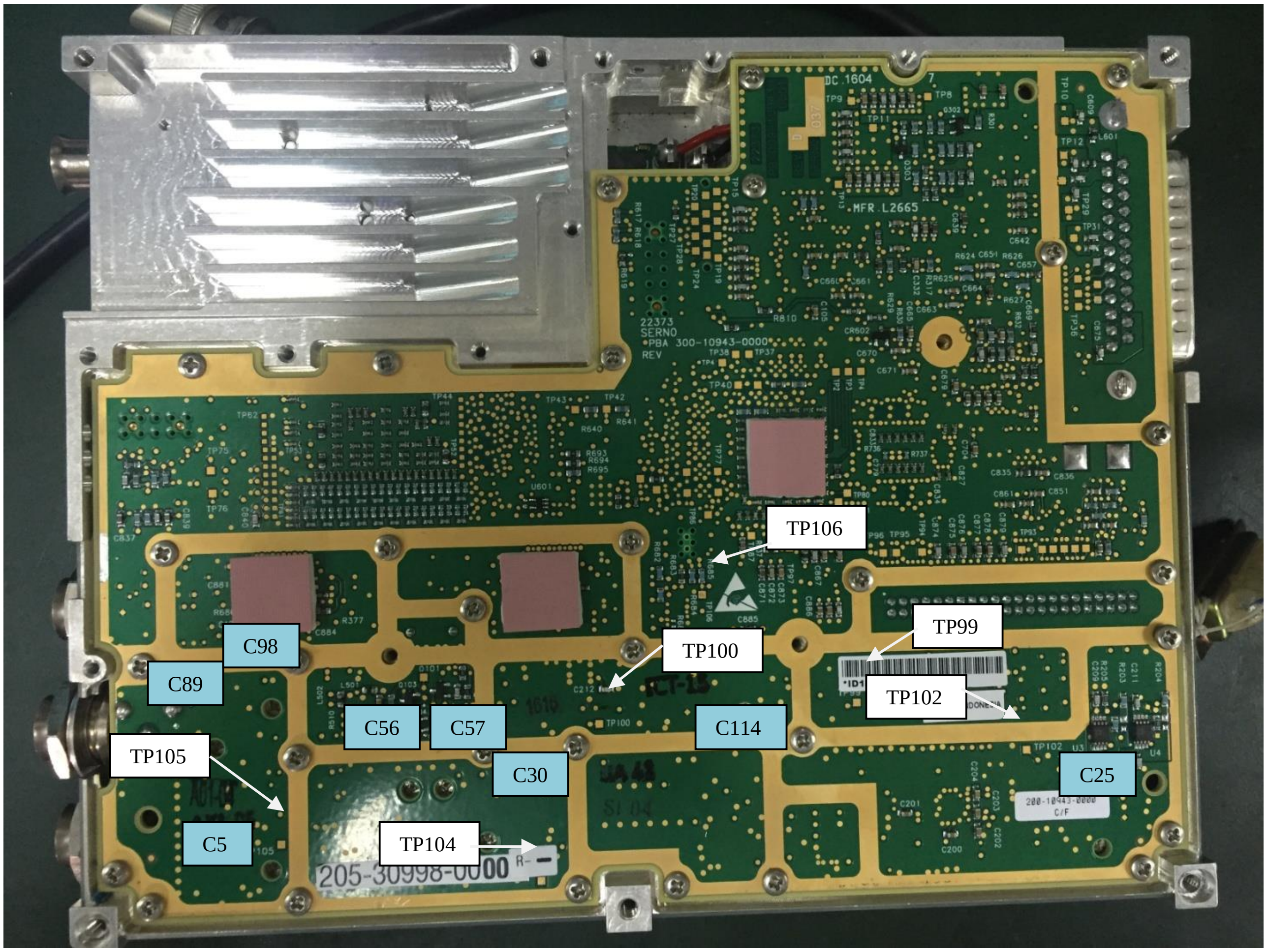
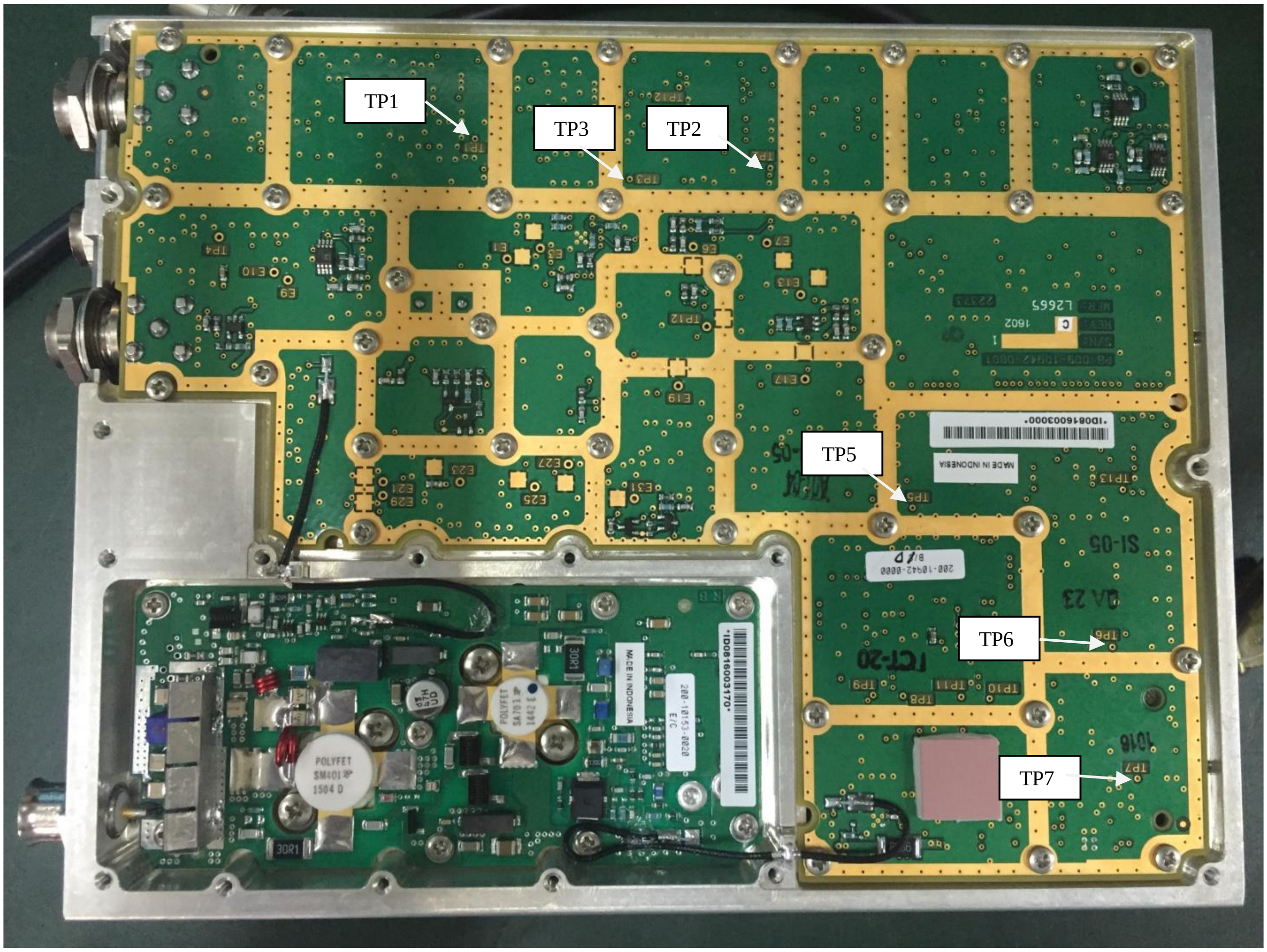


Figure 81 NVM parameters record procedure

6 *Appendix A Test Point Location*



Appendix A Figure 1 DSP/NAV board



Appendix A Figure 2 CAGM Board

7 *Appendix B Procedure for Manual IF AGC Alignment*

The IF AGC alignment procedure sets the correct gain for the receiver.

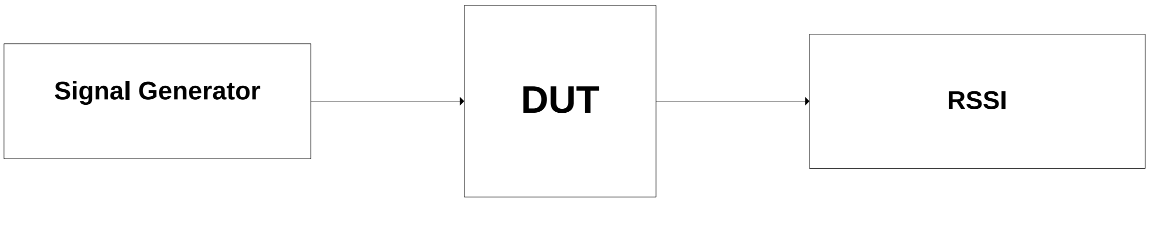


Figure 1. Test Setup.

1) Test Setup as shown in figure 1.
2) Insure that the "**COM Tx Interlock**" switch on the test panel/box is in the OFF position.
3) Set COM to receive mode at 127 MHz.
4) Set control parameters to their default values.
5) Set signal generator to –25dBm at 127MHz, no modulation.
6) Disable COM wideband RX mode by setting P_**WB_ENABLE_WB=**0.
7) Adjust the P_**COM_IF_AGC** while pressing the TE2 Update COM RSSI button until an RSSI of –9.0 (+/- 0.5) dBc is obtained. The Com IF AGC has a range of 0 to 31.5 dB in 0.5 dB steps. This range corresponds to P_**COM_IF_AGC** values of 0 to 63.
8) Set P_**COM_IF_AGC_NORMAL** = P_**COM_IF_AG**C
9) Set P_**COM_IF_AGC_INTERLOCK_COM_LOW** = P_**COM_IF_AGC_NORMAL** found in step 8.
   P_COM_IF_AGC_INTERLOCK_COM_HIGH = P_COM_IF_AGC_NORMAL found in step 8.
10) Adjust the P_**COM_IF_A**GC until an RSSI of –22.0 (+/- 0.5) dBc is obtained.
11) Set P_**WB_HW_IF_AGC_REG0** = **COM_IF_AGC** found in step 10.
12) Power cycle the unit so that the proper operational AGC value is loaded into the radio.

8 *Appendix C Procedure for Manual Notch Control Alignment*

The notch filter characterization stores the notch filter parameters so that the notches can be tuned to the correct frequency during operation. Notch characterization is done at 3 frequencies on each notch. Notch alignment at a given frequency consists of three control levels: on frequency, maximum attenuation low, and maximum attenuation high. On frequency means the center of the notch is on the frequency of alignment. Maximum attenuation low means that the center of the notch is lower in frequency than the frequency of alignment, and the attenuation at the frequency of alignment is the maximum allowable if a desired COM signal is being received on this frequency. Maximum attenuation high means that the center of the notch is higher in frequency than the frequency of alignment, and the attenuation at the frequency of alignment is the maximum allowable if a desired COM signal is being received on this frequency.

1) The alignment frequencies are 118, 128 and 138 MHz. The notch voltage range is +/- 10V and the units are in volts. During their use, the notches are typically set to the 1 to 3 volt range. When not in use the notches are tuned out of band with a voltage of +10V. The adjustment range of each Notch voltage is 0 to 4.095.
2) Align at 118 MHz
   a. Set the COM channel frequency to 118 MHz
   b. Set the COM input to 118 MHz, -40 dBm, no modulation
   c. Read P_**COM1_RSSI_10MS** (or press the "Update COM RSSI" button on the 2280A Control Head Simulator) and write down to use later. This value is our Reference Level for setting notch attenuation.
   d. Align Notch 1
      i. Adjust P_**WB_NOTCH1_VOLTAGE** until P_**COM1_RSSI_10MS** is minimized (most negative number possible). Note that these are precise adjustments that require changes as small as +/- 0.001 to minimize the RSSI reading as much as possible.
      ii. Write the P_**WB_NOTCH1_VOLTAGE** control level to P_**NOTCH1_118**

iii. Adjust P_**WB_NOTCH1_VOLTAGE** lower until P_**COM1_RSSI_10MS** is reduced from the Reference Level by the amount specified in the table below for Notch 1, 118 MHz, Low (in this case -3 dB, so if Reference Level is -20.65 then adjust the notch low until the RSSI reads -23.65)
iv. Write the control value to P_**NOTCH1_118_LO**
v. Adjust P_**WB_NOTCH1_VOLTAGE** higher (above the on channel control value) until the RSSI is reduced from the Reference Level by the amount specified the table below for Notch 1, 118 MHz, High.
vi. Write the control value to P_**NOTCH1_118_HI**
vii. Set P_**WB_NOTCH1_VOLTAGE** back to 4.095.

e. Repeat for Notch 2 and for Notch 3 (addresses and parameter names can be found in "KTR 2280A MMDR Transceiver Minimum Performance Specification" PSD57000252-001)

3) Repeat the 118 MHz alignment steps at 128 MHz and at 138 MHz
4) Read the temperature P_**MMDS_OP_TEMP** and write to P_**NOTCH_ALIGN_TEMP**

Maximum Attenuation Levels for Notches

Alignment Guidance	118 Low	118 High	128 Low	128 High	138 Low	138 High
Max Attenuation Notch 1 =	-3	-3	-3.5	-3	-4	-3
Max Attenuation Notch 2 =	-5	-4	-4.5	-4	-4	-4
Max Attenuation Notch 3 =	-6	-5	-5.5	-5	-5	-4

Typical Alignment Values for Notches

Alignment Guidance	118	118 Low	128 High
Max Attenuation Notch 1 =	1.736	1.533	1.818
Max Attenuation Notch 2 =	1.783	1.688	1.846
Max Attenuation Notch 3 =	1.657	1.567	1.743

8.1.1 COM Squelch Calibration

Verify (change if necessary) default settings for P_**CNR_SQUELCH_SETTING = 12** and **P_RSSI_SQUELCH_SETTING = 88**.

8.1.2 COM Receiver First Local Oscillator Tuning Check

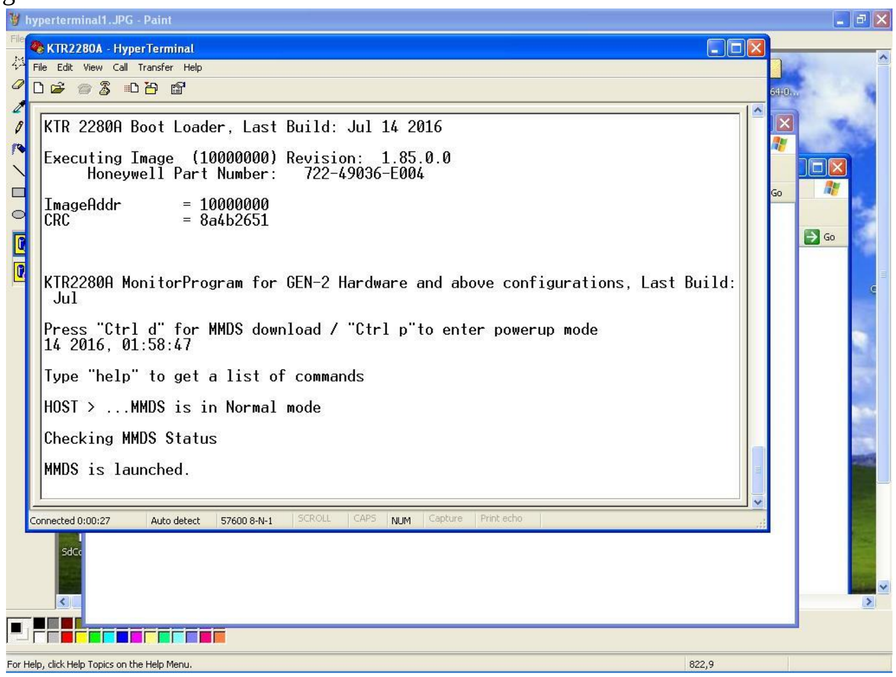
With the First Local Oscillator Tuned to 157 MHz (read P_**COM_LO_FREQ**), check the voltage at TP5 and verify a DC voltage of between 3.5 and 6.5 Vdc. Reference 002-10942-0000 sheet 6 and 300-10942-0000 sheet 3 for location of TP5.

8.1.3 Verification of COM Sensitivity after Alignment

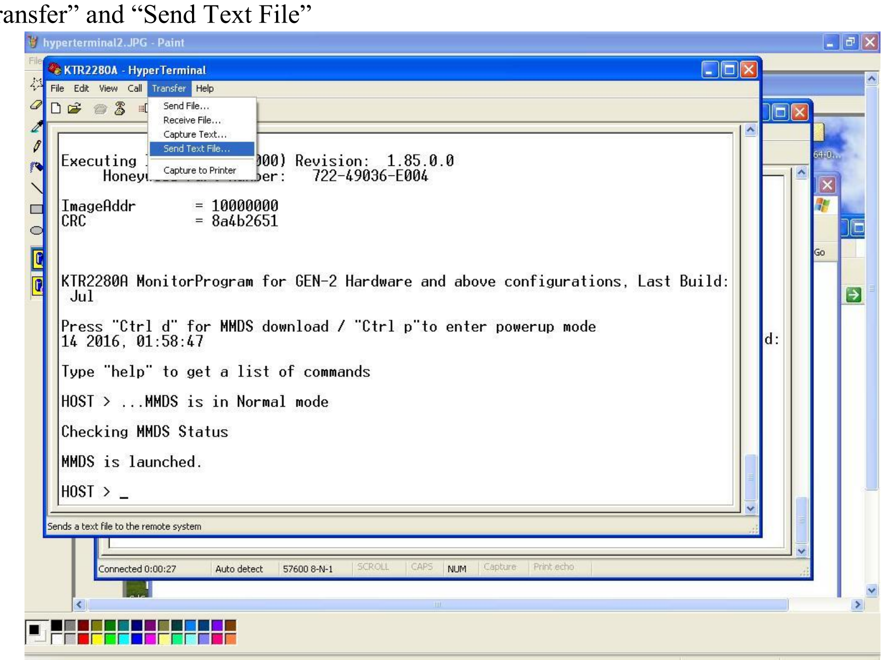
1. Cycle unit power.
2. Connect a 118.000 MHz signal generator with 1kHz 30% AM to the COM antenna port. Adjust the radio to Channel 118.000 MHz. While monitoring SINAD of the COM audio, adjust the signal generator's RF output power until 6dB is reached. The 6dB sensitivity of the radio should be better than -107dBm.
3. Connect a 136.975 MHz signal generator with 1kHz 30% AM to the COM antenna port. Adjust the radio to Channel 136.975 MHz. While monitoring SINAD of the COM audio, adjust the signal generator's RF output power until 6dB is reached. The 6dB sensitivity of the radio should be -107dBm.

9 *APPENDIX D Procedure for Resetting the NVM Parameters*

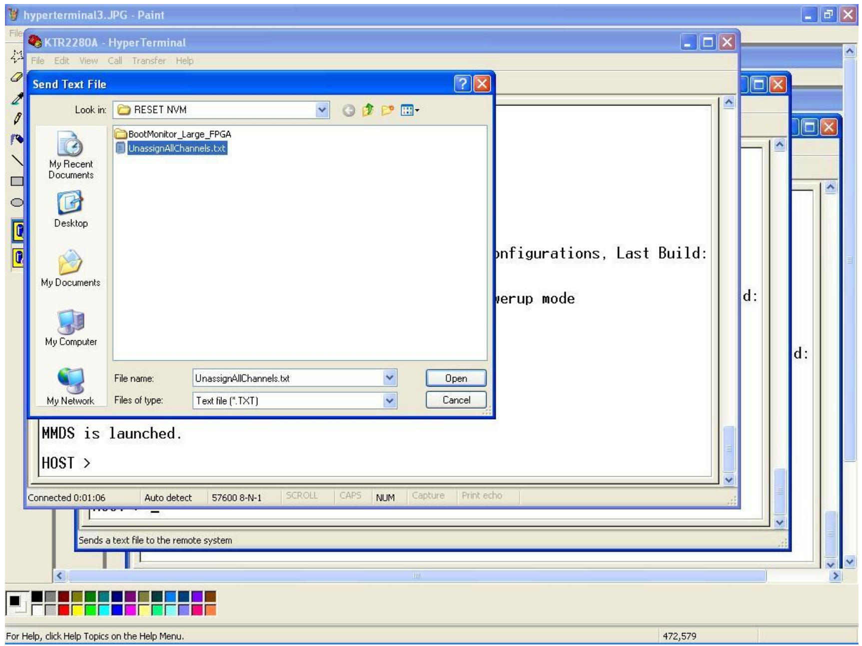
1. Set Test Panel “DOWNLOAD” to ON and “TEST MODE” to OFF
2. Load HostA_BOOT and HostA_APP files to unit through GPS Loader from My Documents/Troubleshoot/NVM RESET/BootMonitor_Large_FPGA folder
3. Set Test Panel “DOWNLOAD” to OFF and “TEST MODE” still OFF
4. Open KTR2280A.ht inside My Documents/Troubleshoot/NVM RESET folder
5. Wait until the message below



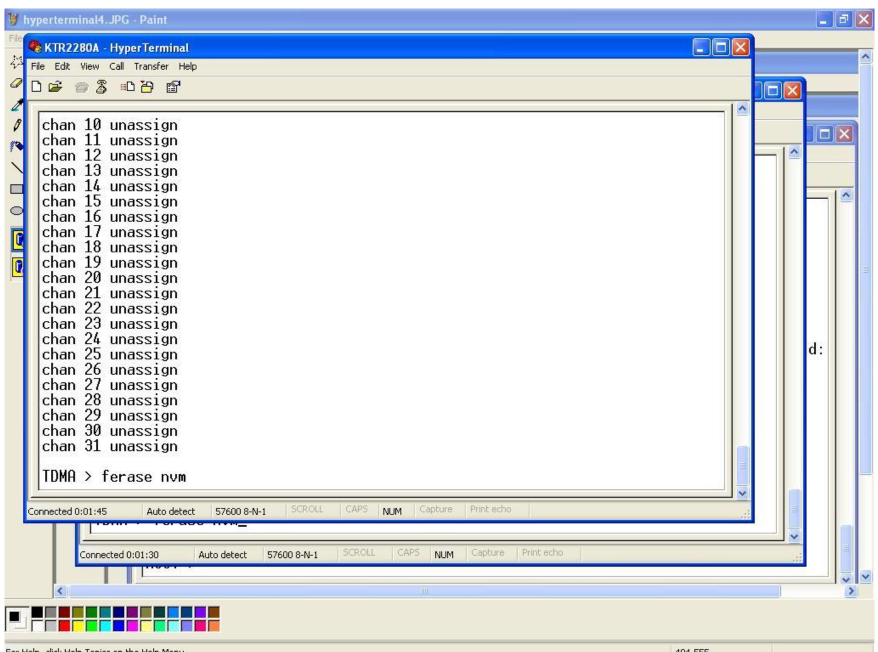
6. Press EnterClick “Transfer” and “Send Text File”

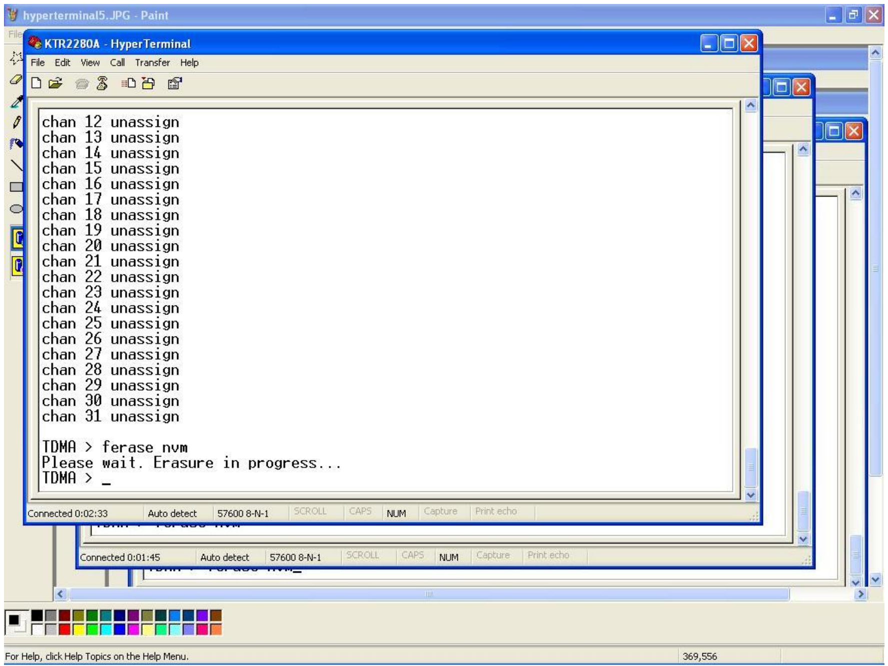


7. Open “UnassignAllChannels.txt” in My Documents/Troubleshoot/NVM RESET folder



8. Type para 85 85 4 and press enter
9. Type "ferase nvm" and press enter





10. After finished, reload back original HostA_BOOT and HostA_APP from My Documents