ALIGNMENT PROCEDURE

DRAFT 11/9/98

The FMS RF card is tested in three separate steps:
1. DC power supply testing.
2. Micro Chip programming.
3. Transmitter and Receiver test and alignment.

Test Equipment required:

1.	6284A	DC Power Supply	HP
2.	8561E	Spectrum Analyzer	HP
3.	3001-20	Directional Coupler	NARDA
4.	777C-20	20 dB Attennuator	NARDA
5.	8901A	Modulation Analyzer	HP
6.	465B	Oscilloscope	TEKTRONIX
7.	435A	Power Meter	HP
8.	8481A	Power Sensor	HP
9.	54540A	Digital Oscilloscope	HP
10.	PC / RF test code / MPLAB programming code.		
11.	10-00157	Programming Pod	MICROCHIP
12.	RF card Test Fixture		
13.	AC9003-69-31-01	STEPATTENUATOR	WEINSCHEL
14.	DVM		
15.	Misc. leads and cables, interface cables (PC),PROG. CBL		
16.	777C-10	10 dB Attennuator	NARDA

STEP 1: DC power supply testing:

Connect pin 2 of J4 to +12V, connect pin 1 to GND.
Turn on the power supply and verify the following DC voltages measurements in the following steps:

STEP	Voltage	MEASURE
1	12V ±.5	Pin 2 of J4
2	5V ±.2	U1 pin 1
3	5V ±.2	U5 pin 1
4	5V ±.2	U18 pin 1
5	5V ±.2	Positive side of C188
6	8V ±.3	Positive side of C186
7	8V ±.3	U12 pin 1
8	8V ±.3	U34 pin 1
9	9.6V ±.3	Positive side of C8
10	6.5V ±.5	Positive side of C230
11	- 4V ±.5	Negative side of C238

STEP 2: PIC16F84 MICRO CHIP programming.

Perform the following: NOTE: Observe programming cable polarity.
To program Receiver "A":
Open the MPLAB program, Connect the PIC programming cable to J3.
In the toolbar, select Project, from the drop down menu select "rcvra_a\rcvra_a.pjt".
In the toolbar select "Picstart Plus", from the dropdown menu select "Enable Programmer". In the "PICSTART Plus Device Programmer" window select "Oscillator", in the dropdown menu select "XT". In the "PICSTART Plus Device Programmer" window select "Program". The "Program/Verify" window will now appear and next to the "start address block" the word "Programming" will be displayed. Verify the word "Success" is displayed in place of the word "Programming" at the completion of the PIC programming.

To program Receiver "B", connect the PICSTART Plus programming cable to J2.

In the window select "Program". Verify the word "Success" is displayed in place of "Programming" at the completion of the PIC programming. This concludes Receiver "A" and Receiver "B" programming.

In the "PICSTART Plus Device Programmer" window select close. In the toolbar select "File", in the dropdown menu select exit. Select "NO" in the save the current project window display.

NOTE: To program the Transmitter it is necessary to exit the MPLAB program after programming the receivers.

To program the Transmitter:
Open the MPLAB program, Connect the PIC programming cable to J1.
In the toolbar, select Project, from the drop down menu select "premodc\premodc.pjt".
In the toolbar select "Picstart Plus", from the dropdown menu select "Enable Programmer". In the "PICSTART Plus Device Programmer" window select "Oscillator", in the dropdown menu select "XT".
In the "PICSTART Plus Device Programmer" window select "Program". The "Program/Verify" window will now appear and next to the "start address block" the word "Programming" will be displayed. Verify the word "Success" is displayed in place of the word "Programming" at the completion of the PIC programming. .This concludes Transmitter programming.

In the "PICSTART Plus Device Programmer" window select close. In the toolbar select "File", in the dropdown menu select "exit". Select "NO" in the save the current project window displays.

Turn off the power supply and remove programming cable and Programming Pod.

STEP 3: Transmitter and Receiver:

The following information briefly explains the operation and control of the "TRACKING RF TUNING CONTROL" software.
To enter program type "trkrmon –eng 1 –rftune"
Depressing the first letter in each field will activate that field.
Depress the "X" key to activate the "XMT FREQUENCY" field. Depress the "UP or DOWN ARROW" to change the current frequency, depress "return" to select frequency.
Depress the "K" key to turn the TRANSMITTER "ON or OFF". The "KEY ON TIME" will display the transmitter on time.
Depress the "M" key to activate the "MODULATION " field, continue to depress the "M" key to change the modulation type.
Depress the "B" key to activate the "BIT/CLOCK RATE" field. Depress the "UP or DOWN ARROW" to change the current "BIT/CLOCK RATE", depress "return" to select "BIT/CLOCK RATE".
Depress the "R" key to activate the "RCV FREQUENCY" field. Depress the "UP or DOWN ARROW" to change the current frequency, depress "return" to select frequency.
Depress the "S" key to activate the "SUBCARRIER" frequency field, depress the "S" key again to change frequency, depress "return" to select frequency.
Depress the "T" key to activate the "TRACKER MODE". Depressing the "T" will program all three synthesizers. The word "NORMAL" displayed to the right of "TRACKER MODE" will change from "NORMAL" to "RF TUNE" and back to "NORMAL" when programming has finished.

To "EXIT" program type "ALT X".

Transmitter and Receiver TEST and ALIGNMENT procedure:

The following test are performed using the RF alignment chassis controlled by the PC loaded with "RF TEST CODE". Perform the following:

Install the RF card in the RF alignment chassis.

Turn on the DC power supply.

AUTOTUNE the RF card by depressing the "T" key on the PC keyboard.

"XMT FREQUENCY" will display 467.1875, and the "SYNTHESIZER" will display "LOCKED".

"RCV FREQUENCY" will display 92.3, and the "SYNTHESIZER" will display "LOCKED".

"KEY LINE" will display "OFF"'

"KEY ON TIME" will display "00000"'

"MODULATION" will display "NONE"'

"BIT/CLOCK RATE" will display "15625.00/15625.00"

"TRACKER MODE" will display "NORMAL"

On the RF card adjust R58 and R122 fully clockwise, adjust R202 fully counterclockwise.

On the Spectrum Analyzer recall previously saved "STATE 1" for receiver alignment.

Receiver "A" Alignment.

Connect a "BNC to SMA" test cable from the " RF OUTPUT" on the RF TRACKING GENERATOR to J2. Connect the test cable (BNC to CLIP) from the "RF TRACKING GENERATOR" to "T1" pin 2. Adjust L3, L4 and L6 for maximum gain centered at 92.3 MHz. Increase the OUTPUT LEVEL to –40 dBm and peak again. Readjust the output level to –50 dBm.

With the oscilloscope (SEE 465B OSCILLOSCOPE SETUP),

probe pin 9 of U22 and adjust L9 for maximum amplitude (approx. 300mv/div).

Change the CHANNEL 1 Volts/div to 50mv. Change the TIME/DIV to 2us/div.

Probe pin 10 of U28, and adjust L12 for maximum amplitude (approx. 120mv/div).

Change the CHANNEL 1 Volts/div to .5V/div. Change the TIME/DIV to .2ms/div.

Probe the R89 (potentiometer) side of R90 and adjust R89 for 1.2V PK-PK.

With the DVM, probe the AGC output side of R29, and adjust R58 for negative .5 volts.

Connect the "STEP ATTENNUATOR" with the external antenna to the J2 input. Adjust the attenuator for 0dB of attenuation. Monitor channel 1 on the digital scope and verify that no jitter exists on the data. Adjust the attenuator for 50dB of attenuation and verify that no jitter exists on the data. Remove the attenuator.

Receiver "B" Alignment.

Connect a "BNC to SMA" test cable from the " RF OUTPUT" on the RF TRACKING GENERATOR to J6. Connect the test cable (BNC to CLIP) from the "RF TRACKING GENERATOR" to "T2" pin 2. Adjust L13, L14 and L16 for maximum gain centered at 92.3 MHz. Increase the OUTPUT LEVEL to –40 dBm and peak again. Readjust output level to –50 dBm.

With the oscilloscope (SEE 465B OSCILLOSCOPE SETUP),

probe pin 9 of U41, adjust L19 for maximum amplitude (approx. 300mv/div).

Change the CHANNEL 1 Volts/div to 50mv. Change the TIME/DIV to 2us/div.

Probe pin 10 of U47, and adjust L22 for maximum amplitude (approx. 120mv/div).

Change the CHANNEL 1 Volts/div to .5V/div, Change the TIME/DIV to .2ms/div.

Probe the R154 (potentiometer) side of R155, and adjust R154 for 1.2V PK-PK.

With the DVM, probe the AGC output side of R105, and adjust R122 for negative .5 volts.

Connect the "STEP ATTENNUATOR" with the external antenna to the J6 input. Adjust the attenuator for 0dB of attenuation. Monitor channel 2 on the digital scope and verify that no jitter exists on the data.

Adjust the attenuator for 50dB of attenuation and verify that no jitter exists on the data. Remove the attenuator

Transmitter RF output:
On the spectrum analyzer, recall the previously saved "STATE 2" for transmitter alignment.
The transmitter arrives from manufacturing with the RF sections already pre-tuned.
Connect the "BNC to SMA" test cable from the directional coupler input to "J2".
On the test PC select 460 MHz, key the transmitter "ON", adjust R202 for 2 watts as indicated on the power meter then, key the transmitter "OFF".
Move the cable from the spectrum analyzer input to the "Modulation Analyzer" input, key the transmitter "ON", adjust R194 for 2 KHz deviation. KEY the transmitter "OFF".

Move the test cable from the Modulation Analyzer input to the Spectrum Analyzer input.

U57 outputs 450MHz, 460MHz and 470 MHz as selected by test PC

Receiver LO:
Pin 13 of U21 is oscillating at 103 MHz as selected by test PC for a radio station frequency of 92.3 MHz.

Verify the subcarrier's will switch between 67KHz and 92KHz.
On the test PC select 67 KHz. U30 pin 1 and U49 Pin 1 oscillate at 522 KHz.
On the test PC select 97 KHz. U30 pin 10 and U49 Pin 10 oscillate at 547 KHz.

Verify "VHF SYN LOCK" status: Perform the following:
Turn off alignment chassis DC power. With a DVM, probe Pin 9 of J4 .
Turn on the alignment chassis and verify that Pin 9 of J4 transitions from 5V to 0V, indicating receiver synthesizer lock status.

Verify "XMTR SYN LOCK" status: Perform the following:
Turn off alignment chassis DC power. With a DVM, probe Pin 11 of J4 .
Turn on the alignment chassis and verify that Pin 11 of J4 transitions from 5V to 0V, indicating transmitter synthesizer lock status.

TEST EQUIPMENT SETTINGS:

HP54504A   Oscilloscope   HP

HORIZONTAL:	
horizontal:	2ms/div
delay:	0.00 S
reference:	center
repetitive:	repetitive

TRIGGER:	
GLITCH TRIGGER:	trig'd
	glitch
source-state:	chan 1 low
adjust	level 2.5V

when present	>
width	750.000 us
holdoff	time 1.0000 ms

VERTICAL:

Channel 1:	on	5V/div
Channel 2:	on	5V/div
position:	##	user adjusted
coupling:	dc	
impedance:	1M	

probes set at 10:1

HP8561E   Spectrum Analyzer   /   HP85640A   RF TRACKING GENERATOR

The following Spectrum Analyzer / RF Tracking Generator state setup, is for Receiver alignment:
SAVE AS "STATE 1" SETUP BEFORE STARTING RECEIVER ALIGNMENT.

FREQUENCY:	92.3 MHz	
SPAN:	500.0 KHz	
AMPLITUDE:	RF LEVEL	-45.0 dBm
LOG dB/div:	5 dB/	
RBW:	3.0 KHz	
VBW:	3.0 KHz	
SWEEP TIME	140 ms	

OUTPUT LEVEL dBm	-50
TRACKING ADJUST	user adjusted

HP8561E   Spectrum Analyzer   /   HP85640A   RF TRACKING GENERATOR

The following Spectrum Analyzer / RF Tracking Generator state setup, is for Transmitter alignment:
SAVE AS "STATE 2" SETUP BEFORE STARTING TRANSMITTER ALIGNMENT.

FREQUENCY:	467.1875 MHz	
SPAN:	50.0 KHz	
AMPLITUDE:	RF LEVEL	-10.0 dBm
LOG dB/div:	10 dB/	
RBW:	300.0 Hz	
VBW:	300.0 Hz	
SWP:	1.40 sec	

465B   Oscilloscope   TEKTRONIX

The following oscilloscope setup is for Receiver "A and B" alignment:

TIME/DIV	2ms
COUPLING:	AC
SOURCE:	CHANNEL 1
CHNL 1 VOLTS/DIV	.1 VOLTS, AC COUPLING