Hillsborough County Sheriff's Office

ATTACHMENTS

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RFP 8-05

for

MICROWAVE SYSTEM
800 MHz TRUNKED SIMULCAST SYSTEM
800 MHz CONVENTIONAL SIMULCAST SYSTEM

PREVENTIVE MAINTENANCE, MAINTENANCE, REPAIRS AND SERVICES

ATTACHMENT (A) ***HILLSBOROUGH COUNTY SHERIFF'S OFFICE***

800 MHz and MICROWAVE SITE LOCATIONS

Site Name	Site No.	Address	Phone No.	Latitude	Longitude	Tower Type	Tower Height	Systems	Mutual-Aid Reptr	Notes
78th Street Site	102	3212 S. 78th Street Tampa, FL 33619	(813) 744-5317	27-55-05	82-22-02	Guyed	400 ft.	East EDACS Simulcast, Microwave	MA-CALL TAC-2 TAC-3 TAC-4	
Taylor Road	108	West Side of Taylor Road Landfill 6209 County Road 579 Hillsborough County, FL	(813) 744-5534	28-00-50.1	82-18-01.9	Guyed	300 ft.	East EDACS Simulcast, Microwave	None	Use Cattle Gate South of Circle K Store
Plant City	109	Highway Maintenance Unit #4 4702 Sydney Road Plant City, FL 33566	(813) 764-0912	27-59-06	82-10-27	Guyed	180 ft.	East EDACS Simulcast, Microwave	None	
Pinecrest	110	Southeast Fire Station #2 6766 Lithia Pinecrest Road Lithia, FL 33547	(813) 655-0807	27-50-57	82-10-28	Self-supporting	180 ft.	East EDACS Simulcast, Microwave	MA-CALL TAC-2 TAC-3 TAC-4	
Wimauma	112	Wimauma Fire Station #22 1120 7th Street Wimauma, FL 33598	(813) 634-2432	27-42-23	82-18-17	Self-supporting	180 ft.	East EDACS Simulcast, Microwave	MA-CALL TAC-2 TAC-3 TAC-4	
BullFrog Creek	114	13010 Bullfrog Creek Road Riverview, FL	(813) 677-9441	27-47-45.9	82-21-09.7	Self-supporting	195 ft.	East EDACS Simulcast, Microwave	None	North of SR672 on Frontage Road East Side of I75 Shared with BELLSOUTH Mobility, Inc.

ATTACHMENT (A)

HILLSBOROUGH COUNTY SHERIFF'S OFFICE

800 MHz and MICROWAVE SITE LOCATIONS

Site Name	Site No.	Address	Phone No.	Latitude	Longitude	Tower Type	Tower Height	Systems	Mutual-Aid Reptr	Notes
EDOC (East)		Emergency Dispatch Operations Center 2709 E. Hanna Ave. Tampa, FL 33610	(813) 272-5665 or (813) 272-6653	28-00-08	82-25-44	Self-supporting	320 ft.	East EDACS Simulcast, Microwave	MA-CALL TAC-2 TAC-3 TAC-4	Same tower and location as West Site
Ruskin	113	Ruskin Fire Station #17 101 1st Avenue NE Ruskin, FL 33570	(813) 645-8205	27-43-09	82-25-58	Guyed	120 ft.	East EDACS Simulcast RX Only, Microwave	None	West of I75, North of SR674 Receive Only Site
Hurrah	111	111 Alafia Church Road East of SR 39 Thatcher Park Fort Lonesome, FL	(813) 634-8729	27-44-23	82-08-32	Guyed	120 ft.	East EDACS Simulcast RX Only, Microwave	None	South of CR 640 on SR 39
EDOC (West)		Emergency Dispatch Operations Center 2709 E. Hanna Ave. Tampa, FL 33610	(813) 272-5665 or (813) 272-6653	28-00-08	82-25-44	Self-supporting	320 ft.	West EDACS Simulcast, Microwave	Same as EDOC EAST	Same tower and location as East Site
Tampa General Hospital (TGH)	103	10th Floor New Bldg. Air Conditioning Unit No. 1 Davis Island, FL 33601	(813) 251-7000 Ext. 6029	27-56-16	82-27-31	Guyed	127 ft.	West EDACS Simulcast, Microwave	None	
Gunn Highway	105	Gunn Highway Fire Station No. 13 7502 Gunn Highway Tampa, FL 33625	(813) 264-3915	28-04-30	82-34-15	Rohn Self-supporting	160 ft.	West EDACS Simulcast, Microwave	MA-CALL TAC-2 TAC-3 TAC-4	

ATTACHMENT (A) ***HILLSBOROUGH COUNTY SHERIFF'S OFFICE***

800 MHz and MICROWAVE SITE LOCATIONS

Site Name	Site No.	Address	Phone No.	Latitude	Longitude	Tower Type	Tower Height	Systems	Mutual-Aid Reptr	Notes
Fire Station 10		Fire Station #10 8430 N. Grady Ave. Tampa, FL 33614	(813) 886-3415	28-01-42	82-30-34.3	Monopole	195 ft.	West EDACS Simulcast, Microwave	None	
Fire Station 20		City of Tampa Fire Station #20 16200 Bruce B. Downs Blvd. Tampa, FL 33647	(813) 979-0193	28-06-23	82-23-29	Self-supporting	195 ft.	West EDACS Simulcast, Microwave	MA-CALL TAC-2 TAC-3 TAC-4	
Cork Knight		Cork Knight Fire Station #26 5302 West Thonotosassa Road Plant City, FL 33565	(813) 757-3915	28-02-49.07	82-11-13.32	Self-supporting	180 ft.	Mutual Aid Microwave	MA-CALL TAC-2 TAC-3 TAC-4	Mutual Aid Site Only
SOC - Sheriff's Operation Center	101	2008 E. 8th Avenue Tampa, FL 33601	(813) 247-8240 (813) 247-0998	27-57-42	82-26-11	Monopole	45 ft.	SO Dispatch Consoles, IMC, Microwave	None	
FIRE RESCUE DISPATCH CENTER		Emergency Dispatch Operations Center 2709 E. Hanna Ave. Tampa, FL 33610	(813) 272-5665 or (813) 272-6653	28-00-08	82-25-44			FIRE RESCUE Dispatch Consoles	Same as EDOC EAST & WEST	
Notes:	1	Mutual Aid System is configured with voted receivers and 7 site conventional simulcast system.								

ATTACHMENT (A) ***HILLSBOROUGH COUNTY SHERIFF'S OFFICE***

800 MHz and MICROWAVE SITE LOCATIONS

Site Name	Site No.	Address	Phone No.	Latitude	Longitude	Tower Type	Tower Height	Systems	Mutual-Aid Reptr	Notes

ATTACHMENT (B)

HILLSBOROUGH COUNTY SHERIFF'S OFFICE

MICROWAVE
AND
SIMULCAST SYSTEM EQUIPMENT

January 31, 2005

MICROWAVE SYSTEM CONFIGURATION

78th Street Site	to	SOC Site	(Loop)
78th Street Site	to	EDOC Site	(Loop)
EDOC Site	to	SOC Site	(Loop)
EDOC Site	to	Gunn Highway Site	
EDOC Site	to	Fire Station 10	
EDOC Site	to	Fire Station 20	
EDOC Site	to	Taylor Road	
EDOC Site	to	Cork Knight	
Taylor Road Site	to	Plant City Site	
78th Street Site	to	Tampa General Hospital Site	
78th Street Site	to	Ruskin Site	
78th Street Site	to	Bull Frog Site	
78th Street Site	to	Wimauma Site	
78th Street Site	to	Pinecrest Site	
78th Street Site	to	EDOC Site	**(Stand Alone Hop)**
78th Street Site	to	SOC Site	**(Stand Alone Hop)**
Pinecrest Site	to	Hurrah Site	

800 MHz EDACS SIMULCAST SYSTEM CONFIGURATION

EAST System	(7-Site)	15-Channel Simulcast System
	(2-Site)	15-Channel Receive Only
WEST System	(5-Site)	15-Channel Simulcast System

CONTROL POINT SITE

78TH Street Site
- (1) CP for East EDACS Simulcast System
- (1) CP for West EDACS Simulcast System
- (1) CP for Mutual Aid Conventional Simulcast System
- (1) C3 Maestro Console

(1) CSD (Communications System Director)
(1) FARSCAN Alarm Monitor
(2) EDACS Simulcast Alarm Monitor Computers

DISPATCH CENTER AND IMC SWITCH SITE
SHERIFF'S OFFICE (SOC)

(1) IMC
(1) EDG
(1) MOM-PC
(1) FARSCAN Alarm Monitor
(20) C3 Maestro Consoles
(16) Backup Orion Radios

FIRE RESCUE DISPATCH

(8) C3 Maestro Consoles
(6) Backup Orion Radios

EAST SYSTEM

(7) Transmit & Receive Simulcast Sites
78th Street Site
Wimauma Site
Pinecrest Site
Plant City
Bull Frog
Taylor Road
EDOC (East)

(2) Receive Only Sites
Ruskin Site
Hurrah Site

WEST SYSTEM

(5) Transmit & Receive Simulcast Sites
Gunn Highway
FS-10
FS-20
TGH
EDOC (West)

800 MHz CONVENTIONAL SIMULCAST SYSTEM CONFIGURATION

County Wide (7-Site) 4-Channel Simulcast System

Gunn Highway
FS-20
EDOC
78th Street
Cork Knight
Pinecrest
Wimauma
Ruskin (RX Only)
Hurrah (RX Only)

GENERAL INFORMATION

MICROWAVE

(17) Microwave Hops
- Harris Corporation DVM 6-8T
- Harris Corporation DVM 6-12T
- Harris Corporation DVM 6-45 Excell
- Intraplex Multiplex

SYSTEM EQUIPMENT TOTALS

MASTR III STATIONS (SIMULCAST)	180
MASTR III AUX RX	30
MASTR III MUTUAL AID CONVENTIONAL	28
MASTR III AUX RX (Mutual Aid)	8

PREPARED	PHONE	DATE	REV	DOCUMENT NO.
ATTACHMENT (C)		10/15/03	A	
APPROVED	CHECKED	YOUR DATE	REVISED 10/15/03	FILE / REFERENCE ANNUAL PM.DOC

Preventive Maintenance for EDACS 800 MHz Simulcast System

REVISED AS OF 10/15/03

1.0 Channel Set-up

In order to perform the Preventive Maintenance (PM) procedure for the EDACS 800 MHz Simulcast Radio System, it is necessary to have the following equipment.

- HP 8920 Service Monitor with tracking generator
- Audio Transmission Test Set
- Laptop computer with TQ-0619 MASTR Utilities program
- Assorted N-type and BNC cables
- RF Adapter kit

NOTE: It is extremely important that the same Service Monitor be used for PM and alignment for a complete system. The HP Service Monitor should be set up according to the HP setup procedure.

NOTE: Prior to test of each channel, using the *RECALL* button on the Service Monitor, recall the *POWERON* setup.

1.1 Removing the Channel from Service

Remove the channel under test from service via Test Partition and disable from Control Channel availability using the CSD at the Control Point.

NOTE: This sequence will allow calls in-progress to complete before the channel is removed from service. Once the active call is completed, no additional calls will be assigned to the channel.

On CSD System and Device Manager, set the channel under test to X for ALLOWED CC and X for CHANNEL TEST. Save and upload changes and verify that the changes were uploaded from the DATABASE side to the SITE side of the screen.

On Call Activity Monitor screen verify that calls in-progress is complete and no additional calls are being placed on the channel under test.

Go back to CSD System and Device Manager and set the channel enable field to blank (RF Disabled). Save and Upload, verify changes on CSD Call Activity Monitor screen.

CAUTION: If the Control Channel is inadvertently forced to move, it will terminate a call in-progress on the channel it is moved to. When Save and Upload are performed, actions on the RF row are immediate; calls in-progress will be terminated on the affected channels. The active Control Channel will be indicated by a C in the TYPE row on the SYSTEM side of the screen. Prior to save and Upload manually place a C in the same channel column on the DATABASE side to prevent moving the Control Channel.

NOTE: Placing the channel under test to blank for Enable will prevent test calls from failing the channel while it is being tested. It will also prevent test calls, due to routine maintenance, from displaying on the daily report.

1.2 Moving the Control Channel

In order to test a channel that is assigned as the Control Channel, the Control Channel must be moved to another channel. This procedure will prevent Public Safety communications from being interrupted when the Control Channel is moved.

Place the desired Control Channel into Test Partition. On CSD Call Activity Monitor set the desired Control Channel to X for CHANNEL TEST and verify that it is also Y for ALLOWED CC. Press the DO key and verify that the changes were uploaded from the DATABASE side to the SYSTEM side of the screen.

On Screen 32, verify that in-progress calls have completed and no additional calls are being placed on the desired Control Channel.

NOTE: Once the active call is completed, no additional calls will be assigned to the channel. This will allow calls in-progress to be completed before the Control Channel is reassigned to this channel.

Then go back to Screen 20, set the desired Control Channel to C for RF, press the DO key and verify that the changes were uploaded to the SITE.

Then, set the new Control Channel to N for CHANNEL TEST and verify that it is also Y for ALLOWED CC. Press the DO key and verify that the changes were uploaded from the DATABASE side to the SYSTEM side of the screen.

CAUTION: If the Control Channel is inadvertently forced to move, it will terminate a call in-progress on the channel it is moved to. When the DO key is pressed, actions on the RF row are immediate; calls in-progress will be terminated on the affected channels. The active Control Channel will be indicated by a C in the RF row on the SYSTEM side of the screen.

1.3 Test Port Cable Loss

NOTE: This section will only be required when the loss level of the injection test cable is unknown or at the first pass at each site.

Due to the distance between the Receiver Sensitivity Port located in the front the channel cabinet closest to the combiner cabinet and the channel under test a long coax test cable will be used for the RF Generation signal. It is important that all channels be checked with the same cable to keep reading consistent.

The signal loss of this long injection cable will have to be calculated as follows:

CABLE LOSS CALCULATION: Connect the long test cable from Service Monitor DUPLEX OUT port to RF IN/OUT port on the Service Monitor.

Select the *DUPLEX* button on the Service Monitor to bring up the DUPLEX screen. Adjust the Service Monitor *Tune Freq* and *RF Gen. Freq* to 820.000 MHz. Set the Service Monitor *Amplitude* to 0 dBm. Select the *Output Port* and change output to *Dupl.*

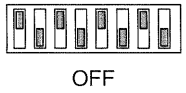
Verify that the *Transmit Power* display in the upper left corner of the Service Monitor registers power in dBm. The amount of cable loss will be the value of *Transmit Power* display. Note this value since it will be used later in this procedure.

2.0 Microwave MUX Levels

Verify the switch settings on the microwave MUX cards. As you hold the board to read it, the switches should be set left to right as follows:

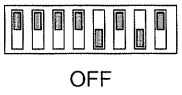
Receive switches - 8.5 dB pad.

Channel Bank Receive



Transmit switches - 17.5 dB pad.

Channel Bank Transmit



2.1 Control Point MUX Level

Measure the Control Point MUX levels using a Transmission Test Set in the TERMINATE mode.

Inject a 1004 Hz tone at -10.0 dBm from the Site on the Analog MUX card and then the Digital MUX card. The results will be recorded on the Control Point data sheet.

On the Analog MUX card, for the appropriate channel under test:

- At the Site, using a Transmission Test Set inject a 1004 Hz tone at -10.0 dBm on the MOD side of the MUX jack field for Audio card under test.

- At the Control Point, connect the Transmission Test Set in the TERMINATE mode, to the DEMOD side of the jack field for the Audio card under test. The level should be -10.0, ±0.3 dBm.

Record the final level on the Control Point data sheet as Analog from Site.

Repeat this procedure for the Digital card:

- At the Site, using a Transmission Test Set inject a 1004 Hz tone at -10.0 dBm on the MOD side of the MUX jack field for Digital card under test.

- At the Control Point, connect the Transmission Test Set in the TERMINATE mode, to the DEMOD side of the jack field for the Digital card under test. The level should be -10.0, ±0.3 dBm.

Record the final level on the Control Point data sheet as Digital from Site.

ADJUSTMENT: At the Control Point, place the microwave MUX card on an extender board. Re-verify the DIP switch settings. If necessary, adjust the receive potentiometer for -10.0, ±0.3 dBm measured at the Control Point.

2.2 Site MUX Level

Measure the Site MUX levels using a Transmission Test Set in the TERMINATE mode.

Inject a 1004 Hz tone at -10.0 dBm from the Control Point on the Analog MUX card and then the Digital MUX card. The results will be recorded on the Site data sheet.

On the Analog MUX card, for the appropriate channel under test:

- At the Control Point, using a Transmission Test Set inject a 1004 Hz tone at -10.0 dBm on the MOD side of the MUX jack field for Audio card under test.

- At the Site, connect the Transmission Test Set in the TERMINATE mode, to the DEMOD side of the jack field for the Audio card under test. The level should be -10.0, ±0.3 dBm.

Record the final level on the Site data sheet as Analog from Control Point.

Repeat this procedure for the Digital card:

- At the Control Point, using a Transmission Test Set inject a 1004 Hz tone at -10.0 dBm on the MOD side of the MUX jack field for Digital card under test.

- At the Site, connect the Transmission Test Set in the TERMINATE mode, to the DEMOD side of the jack field for the Digital card under test. The level should be -10.0, ±0.3 dBm.

Record the final level on the Site data sheet as Digital from Control Point.

> ADJUSTMENT: At the Site, place the microwave MUX card on an extender board. Re-verify the DIP switch settings. If necessary, adjust the receive potentiometer for -10.0, ±0.3 dBm measured at the Site.

2.3 Outbound Digital Modem Level

Measure the outbound Digital Modem levels from the Control Point on the Digital MUX card using a Transmission Test Set in the BRIDGE mode. The results will be recorded on the both the Control Point and Site data sheets.

On the Digital MUX card, for the appropriate channel under test:

- At the Control Point, using a Transmission Test Set in the BRIDGE mode, jack into the MONITOR jack on the MOD side of the MUX jack field for Digital card under test. The level should be -14.0, ±1.0 dBm.

Record this level on the Control Point data sheet as GETC Data to Site.

- At the Site, using a Transmission Test Set in the BRIDGE mode, jack into the MONITOR jack on the DEMOD side of the MUX jack field for Digital card under test. The level should be -12.0, ±1.0 dBm.

Record this level on the Site data sheet as GETC Data from Control Point.

2.4 Inbound Digital Modem Level

Measure the inbound Digital Modem levels to the Control Point on the Digital MUX card using a Transmission Test Set in the BRIDGE mode. The results will be recorded on the both the Control Point and Site data sheets.

On the Digital MUX card, for the appropriate channel under test:

- At the Site, using a Transmission Test Set in the BRIDGE mode, jack into the MONITOR jack on the MOD side of the MUX jack field for Digital card under test. The level should be -14.0, ±1.0 dBm.

Record this level on the Site data sheet as GETC Data to Control Point.

- At the Control Point, using a Transmission Test Set in the BRIDGE mode, jack into the MONITOR jack on the DEMOD side of the MUX jack field for Digital card under test. The level should be -12.0, ±1.0 dBm.

Record this level on the Control Point data sheet as GETC Data from Site.

2.5 LSD and Alarm Mux Levels

- At the Control Point Measure the LSD data level to site, using a Transmission Test Set in the BRIDGE mode, Jack into the MONITOR jack for the appropriate system/site under test. The level should be -10.0, ±2.0 dBm.

Record this level on the Control Point data sheet as LSD To Site

- At the Site Measure the LSD data level from Control Point, using a Transmission Test Set in the BRIDGE mode, Jack into the MONITOR jack for the appropriate system/site under test. The level should be -10.0, ±2.0 dBm.

Record this level on the Site Data Sheet as LSD From Control Point

- At the Control Point Measure the Alarm data level From / to site, using a Transmission Test Set in the BRIDGE mode, Jack into the MONITOR jack for the appropriate system/site under test. The level should be -14.0, ±2.0 dBm.

Record this level on the Control Point data sheet as Alarm data level from Site and Alarm data level to Site

- At the Site Measure the Alarm data level From / to Control Point, using a Transmission Test Set in the BRIDGE mode, Jack into the MONITOR jack for the appropriate system/site under test. The level should be -14.0, ±2.0 dBm.

Record this level on the Site Data Sheet as Alarm data level from Control Point and Alarm data level to Control Point

ADJUSTMENT: Record levels ONLY. Adjustments are intrusive and must be performed at scheduled time.

3.0 Transmitter Test Set-up

Select the *TX* button on the Service Monitor to bring up the TX TEST screen. Adjust the Service Monitor input frequency to the TX frequency listed on the PM data sheet for the channel under test.

Connect the Service Monitor RF IN port to the station RF OUT on the TX Synthesizer module. Then connect the WWVB receiver STANDARD OUTPUT jack to the Service Monitor external 10 MHz REF INPUT.

Connect laptop to the station. Start the MASTRUTL program and go to POTENTIOMETER SETTINGS.

Either from the Site or the Control Point, place the channel under test into the Analog mode and PTT the transmitter.

- At the Control Point, this is done at the simulcast switch field by placing both the PTT and A/D switches to the up position.

- At the Site, this is done from the MUX by switching both the Analog (PTT) and Digital (A/D) card E & M switches to the up position.

CAUTION: On the left-side station GETC Interface board, remove J4. This removes Low Speed Data (LSD) and will stabilize the displayed frequency and deviation readings.

3.1 Frequency Error

Ensure the transmitter is configured according to the Transmitter Set-up in paragraph 3.0.

Observe the Service Monitor *TX Frequency Error* in the upper left of the display. The frequency error should be less than ±2 Hz. This will verify the station is synchronized to the WWVB time source.

Record the final value on the data sheet as TX Freq Error.

On at least one channel per System, disconnect the external 10 MHz time source from the Service Monitor and verify the frequency error is less than ±30 Hz. This will verify the accuracy of the WWVB time source.

3.2 Synthesizer Output

Ensure the transmitter is configured according to the Transmitter Set-up in paragraph 3.0.

Observe the Service Monitor *TX Power* display. The power level should be 8 mW or greater.

Record this value on the data sheet as TX Synth Output Level.

NOTE: If either Transmitter Frequency Error or Synthesizer Output is not within specifications, replace the TX Synthesizer module.

REPLACEMENT AND ADJUSTMENT: Remove the cover from the TX Synthesizer module and put module on extender card.

Adjust the trimmer slug for 5.0, ±0.05 VDC measured at J3, pin 23A.

Return module to normal configuration and repeat this test.

3.3 Limiter Deviation

Ensure the transmitter is configured according to the Transmitter Set-up in paragraph 3.0.

Ensure the laptop is connected to the station. Using the MASTRUTL program, go to POTENTIOMETER SETTINGS, and set the station DSP LINE IN to 100.

CAUTION: On the left-side station GETC Interface board, ensure J4 is removed. This removes LSD and will stabilize the displayed frequency and deviation.

At the Control Point, inject a 1004 Hz audio signal at 0 dBm into the A600 Jack field (LINE).

NOTE: The actual jack field number will be between A600 and A609 depending on the Site; however, do not use the voted audio jack, since it has amplification and compression prior to being sent out to the Site.

NOTE: If Control Point assistance is not available, at the Site, locally inject a 1004 Hz audio signal at 0 dBm into the MUX card jack field EQ IN position for the station under test.

Turn up the volume knob of the Service Monitor and a 1004 Hz tone should be heard. This will indicate you are properly connected for the test.

Observe *FM Deviation* in the upper right of the Service Monitor display. The level should be 3.30 KHz, ±50 Hz.

Record the final deviation level on the data sheet as Limiter Deviation.

ADJUSTMENT: Adjust TRANSMIT potentiometer on MASTRUTL program for 3.30 KHz deviation.

3.4 Audio Deviation

Ensure the transmitter is configured according to the Transmitter Set-up in paragraph 3.0.

CAUTION: On the left-side station GETC Interface board, ensure J4 is removed. This removes LSD and will stabilize the displayed frequency and deviation.

At the Control Point, inject a 1004 Hz audio signal at -10.0 dBm into the A600 Jack field (LINE), The actual jack field number will be between A600 and A609 depending on the Site; however, do not use the voted audio jack, since it has amplification and compression prior to being sent out to the Site.

NOTE: If Control Point assistance is not available, at the Site, locally inject a 1004 Hz audio signal at -10.0 dBm into the MUX card jack field EQ IN position for the station under test.

Turn up the volume knob of the Service Monitor and a 1004 Hz tone should be heard. This will indicate you are properly connected for the test.

With the laptop still connected to the station, using the MASTRUTL program, go to POTENTIOMETER SETTINGS.

Observe *FM deviation* in the upper right of the Service Monitor display and decrease the DSP LINE IN until the deviation level indicates 2.40 KHz, ±50 Hz.

Record the final deviation level on the data sheet as Audio Deviation.

ADJUSTMENT: Adjust DSP LINE IN potentiometer on MASTRUTL program for 2.40 KHz deviation.

3.5 Low Speed Data

Ensure the transmitter is configured according to the Transmitter Set-up in paragraph 3.0.

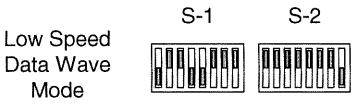
CAUTION: On the left-side station GETC Interface board, ensure J4 is removed. This removes LSD and will stabilize the displayed frequency and deviation.

WARNING: REMOVE THE 25-PAIR CONNECTOR ON THE REAR OF THE STATION. FAILURE TO DO SO MAY PUT THE SITE INTO BYPASS.

Remove the J9 connector from the GETC Interface board and jumper pins 9 & 10. This puts the station into bypass.

Using the *RECALL* button on the Service Monitor, recall LSDWAVE settings.

Place the GETC in the LSD Wave mode by changing the GETC S1 and S2 DIP switches to the following:

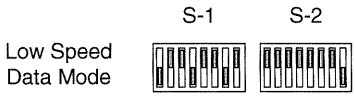


Push the GETC reset button and release. L6 should now be lit and no others.

Select SCOPE from the menu and observe the symmetry of the waveform. The waveform tops and bottoms should exhibit no slope.

ADJUSTMENT: Remove the shield from the TX Synthesizer module, place module on extender card, and adjust VR601 (located near reference in jack J1) for flattest square wave.

Place the GETC in the LSD Data mode by changing the GETC S1 and S2 DIP switches to the following:



Push the GETC reset button and release. L6 should now be lit and no others.

Using the RECALL button on the Service Monitor, recall LSDLEVEL settings.

Read the low speed data frequency from the display in the upper right corner. The deviation should be 600 Hz, ±10 Hz.

Record the deviation level on the data sheet as Low Speed Data Deviation.

ADJUSTMENT: Adjust CHANNEL GUARD on MASTRUTL program for 600 Hz at frequency display.

3.6 High Speed Data

Ensure the transmitter is configured according to the Transmitter Set-up in paragraph 3.0.

CAUTION: On the left-side station GETC Interface board, ensure J4 is removed. This removes LSD and will stabilize the displayed frequency and deviation.

WARNING: REMOVE THE 25-PAIR CONNECTOR ON THE REAR OF THE STATION. FAILURE TO DO SO MAY PUT THE SITE INTO BYPASS.

Remove J9 connector from the GETC Interface board and jumper pins 9 & 10. (Use jumper taken out of J4) This puts the station into bypass.

Place the GETC in the HSD Data mode by changing the GETC S1 and S2 DIP switches to the following:

Push the GETC reset button and release. L7 should now be lit.

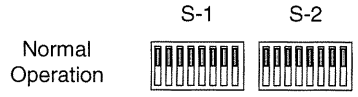
Using the *RECALL* button recall the *HSD*-LEVEL settings. Observe the *FM Deviation* in the upper right of the display and this should be 2.40 KHz, ±50 Hz. Switch to *Scope* and observe the HSD waveform. All transitions should achieve high and low baselines.

Record the deviation level on the data sheet as <u>High Speed Data Deviation.</u>

ADJUSTMENT: Adjust R31 (Blue potentiometer) on the station GETC.

Disconnect the Service Monitor IN/OUTPUT from the station. In the MASTRUTL program, exit the POTENTIOMETER SETTINGS screen.

Place the GETC DIP switches into the original position and reset GETC.



Observe that L1 and L7 are lit.

Remove the J9 jumper on pin 9 and 10 and reconnect the station cable to J9. It is easy to put this on backwards so verify that it is correct and compare with another station if necessary. The ribbon cable should have the white wire on the right hand side as viewed from the front. Reconnect jumper J4 in GETC interface board.
GO TO REAR OF THE STATION AND RECONNECT 25 PAIR CONNECTOR.

3.7 Transmit Power

Ensure the transmitter is configured according to the Transmitter Set-up in paragraph 3.0.

NOTE: When connecting or disconnecting the RF cables, disable the station transmitter as necessary by placing the TX DISABLE switch to the DISABLE position.

Insert the wattmeter in-line after the station RF power sensor, and reconnect the exciter input to the power amplifier.

Measure the forward power and record as the TX Fwd Pwr @ PA Output on the data sheet.

Measure the reflected power and record as the TX Rev Pwr @ PA Output on the data sheet.

Remove the wattmeter from the station and reconnect the transmission line to the station RF power sensor.

At the rear of the station, disconnect the PA Sensor lead and measure the DC voltage with a digital voltmeter.

Record this level as PA Sensor Voltage on the data sheet.

Reconnect the PA Sensor lead to the PA Sensor.

For the System under test, remove the 50-ohm load attached to the Transmit Test Port located on the front of the channel cabinet closest to the combiner cabinet.

Connect the Site Service Monitor RF IN/OUTPUT port to the TX TEST PORT using the calibrated test cable.

Setup Site Service Monitor for TX mode and select the appropriate TX frequency. Observe the *Level* indication on the Service Monitor display.
Compare RF level of channel under test to other working channels in system, level should be approx. -12.0 to -12.5 DBM.

Record the amplitude level from the spectrum analyzer on the data sheet as TX Test Port Output Level.

The Transmitter tests are now complete. Place the PTT and A/D and/or the microwave MUX switches to the down position.

4.0 Receiver Test Set-up

Ensure the PTT and A/D switches and/or the microwave MUX switches are in the down position.

Ensure the Laptop is still connected to the station.

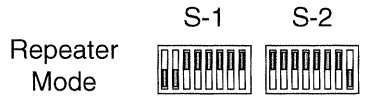
Select the *RX* button on the Service Monitor to bring up the RX TEST screen. Unless directed otherwise, adjust the Service Monitor input frequency to the RX frequency listed on the PM data sheet for the channel under test.

Using the BNC / bantam cable, connect the Service Monitor AUDIO IN HI port to the Monitor jack the T600 jack field for the channel under test.

NOTE: Both inbound and outbound site audio passes through the T600 jack field. The connection to the T600 jack field should be made on the right-hand side labeled TO CONTROL POINT.

Ensure the WWVB receiver STANDARD OUTPUT jack is still connected to the Service Monitor external 10 MHz REF INPUT.

Place the station in repeat audio test mode:



NOTE: If the Service Monitor is setup to generate 75 Hz, it is not necessary to place the Station in the REPEATER MODE.

Press GETC reset button. All GETC front panel lights should go out.

4.1 Frequency Error

Ensure the receiver is configured according to the Receiver Set-up in paragraph 4.0.

Connect the Service Monitor RF IN/OUT port to LO OUT jack on the RX Synthesizer module.

Select the *TX* button on the Service Monitor to bring up the TX TEST screen. Adjust the Service Monitor to the appropriate receive injection frequency, which is the receive frequency minus 70.2 MHz (RX Freq - 70.2 MHz).

Observe the Service Monitor *TX Frequency Error* in the upper left of the display. The frequency error should be less than ±2 Hz at Transmit sites and ±750 Hz at Auxiliary receiver sites.

For Transmit sites only, on at least one station per System, disconnect the external 10 MHz time source from Service Monitor and verify the frequency error is still less than ±30 Hz. This will verify the accuracy of the WWVB time source.

If the Oscillator Error is not within specifications, then replace the RX Synthesizer module.

Record the final level on the Site data sheet as LO Freq Error.

REPLACEMENT AND ADJUSTMENT: Remove the cover from the RX Synthesizer module and put module on extender card.

Adjust the trimmer slug for 5.0, ±0.05 VDC measured at J3, pin 23A.

Reconnect the BNC jumper to the LO OUT port on the RX Synthesizer module.

Return module to normal configuration and repeat this test.

4.2 Distortion

Ensure the receiver is configured according to the Receiver Set-up in paragraph 4.0.

Select the *RX* button on the Service Monitor to bring up the RX TEST screen and inject the Service Monitor output into the RF IN on the RX Front-End module.

Adjust the Service Monitor to the appropriate receive frequency and set the *Amplitude* level to -80 dBm.

Observe the Service Monitor *Distortion*. It should be less than 5%.

Record this level on the Site data sheet as RX Dist.

4.3 SINAD

Ensure the receiver is configured according to the Receiver Set-up in paragraph 4.0.

At the top of the screen on the HP Service Monitor, change the display from *Distortion* to *SINAD*.

Using the MASTRUTL program, adjust the DIGITAL SQUELCH as necessary to unsquelch the receiver.

Select the *Amplitude* box and adjust the dB level so that the *SINAD* meter reads as close to -12 dB as possible. This level should be less than -116.0 dBm at the station.

Record the amplitude reading on the data sheet as Receiver 12 dB SINAD.

4.4 IF Bandwidth

Ensure the receiver is configured according to the Receiver Set-up in paragraph 4.0.

Using the cursor knob, select the *Amplitude* box and increase the *Amplitude* 6 dBm above the 12 dBm SINAD level.

Using the *RF Gen Freq* box, change the frequency to 2.5 KHz above and then below the receiver frequency. Note the *SINAD* level at each position. Both readings should be greater than 12 dB.

Record the readings 2.5 KHz above the center frequency as IF Bandwidth High on the data sheet.

Record the readings 2.5 KHz below the center frequency as IF Bandwidth Low on the data sheet.

If both SINAD readings DO NOT exceed 12 dB, adjust as follows:

ADJUSTMENT: Remove cover from RX IF Module and put module on extender card.

Move the Service Monitor output from the N connector to the IF IN port on the RX IF module.

Using the *RF Gen. Freq* box change the frequency to 70.2 MHz and set modulation using *AFGen1* to 6.0 KHz deviation. Adjust L10 on RX IF module for best *SINAD* reading.

Change *Amplitude* of the Service Monitor to -60 dBm and change modulation using *AFGen1* to 3.0 KHz deviation. Set VR1 of RX IF module for 1 Vrms, ±3% measured at module output (pin 31C on the 96-pin connector J2) or GETC board J7 pin 2.

Return to normal modulation and repeat test. If test fails after adjustment replace RX IF module.

4.5 SINAD @ Test Port

Ensure the receiver is configured according to the Receiver Set-up in paragraph 4.0.

Select the *RX* button on the Service Monitor to bring up the RX TEST screen.

Reconnect the RF IN jack on the RX FRONT-END module.

For the System under test, remove the 50-ohm load attached to the Receiver Test Port located on the front of the channel cabinet closest to the combiner cabinet.

Using the long coax cable, connect the Service Monitor RF IN/OUT jack to the Receiver Test Port.
NOTE: 30FT. RG8X TEST CABLE HAS APPROX. 3.8 DB LOSS.
At the top of the screen on the HP Service Monitor, verify display is set to monitor *SINAD.*

Select the *Amplitude* box and adjust the level so that the SINAD meter reads as close to -12 dB as possible. This level will be approximately -80 dBm. Record on the data sheet as 12 dB SINAD @ Test Port
NOTE: SUBTRACT CABLE LOSS FROM SINAD READING BEFORE RECORDING LEVEL.
EXAMPLE: (-80dbm for 12db SINAD and –4 dBm cable loss) = -84 dBm record this reading.

4.6 Squelch Threshold

Ensure the receiver is configured according to the Receiver Set-up in paragraph 4.0.

At the top of the screen on the HP Service Monitor, verify display is set to monitor *SINAD.*

Select the *Amplitude* box and adjust the dB level so that the *SINAD* meter reads as close to 12 dB as possible. This level should be less than -116.0 dBm at the station.

Using the MASTRUTL program set DIGITAL SQUELCH at 99 and decrease value until receiver just unmutes.

NOTE: Some receivers will not mute. In those cases, leave adjustment set at 99.

Record the final Squelch potentiometer setting on the data sheet as Digital Sq @ 12 dB SINAD.

4.7 Line Audio Output

Ensure the receiver is configured according to the Receiver Set-up in paragraph 4.0.

Perform this step simultaneously while the technician at the Control Point is performing paragraph 5.1.

Ensure the BNC / bantam cable is still connected between the Service Monitor AUDIO IN HI port and the Monitor jack of the T600 jack field for the channel under test.

Select *Amplitude* on the Service Monitor and increase the level to -40 dBm.

On the Service Monitor, verify the line *AC Level* meter indicates a level of -10.0, ±0.3 dBm.

Record the final level on the data sheet as Line Audio Out.

> ADJUSTMENT: With the MASTRUTL program, adjust LINE OUT potentiometer for a level of -10.0, ±0.3 dBm at the Site.

Remove the RF cable from the input to the receiver.

Monitor the audio level with the Service Monitor. The meter should now indicate a frequency of 1950 Hz and a level of -10.0, ±0.3 dBm.

NOTE: Verify that -20.0, ±0.3dBm is being received at J1 on the Voter Analog module at the Control Point. It may be necessary to readjust the output level to obtain the proper level at the Control Point.

Record the final level on the data sheet as Voting Tone Level.

> ADJUSTMENT: At the site with the MASTRUTL program, adjust the VOTING TONE OUT potentiometer in base station receiver for a level of -20.0, ±0.3 dBm at J1 on the Voter Audio module at the Control Point.

5.0 Control Point Set-up

Make the adjustments using the Control Point Site first as the reference to set the Voter Analog Selector module output. Once the voter selector output is set, it does not need to be readjusted for the remaining sites.

Either from the Site or the Control Point, inject 1004 Hz test tone on the channel under test.

- At the Site, use the receiver Line Audio Output procedure in paragraph 4.7 to supply 1004 Hz tone at -10.0 dBm.
- At the Control Point, using a Transmission Test Set, inject a 1004 Hz tone at -10.0 dBm at the channel bank jack field EQ IN for the channel under test.

If necessary, place a jumper between the *Purple* and *Black* test points on the rear of the voter module under test to force select the receiver module.

5.1 Site Analog Voter Level

Ensure the equipment is configured according to the Control Point Set-up in paragraph 5.0.

Perform this step simultaneously while the technician at the Site is performing paragraph 4.7.

At the Control Point, using a second Transmission Test Set in the BRIDGE mode, adjust the level at J1 on the front of the analog voter module to -20, ±0.3 dBm for the receiver under test.

Record the final level on the data sheet as Test Tone @ J1.

ADJUSTMENT: At Voter Analog module, adjust INPUT ADJ (R2) for -20.0, ±0.3 dBm.

5.2 Analog Voter Selector Output Level

Ensure the equipment is configured according to the Control Point Set-up in paragraph 5.0.

Paragraph 5.1 must be performed first to establish a reference level.

Perform this step simultaneously while the technician at the Control Point Site is performing paragraph 4.7.

Using the Control Point Site as a reference, set the Transmission Test Set in the BRIDGE mode, at A600 Voted Audio monitor jack in the analog equipment cabinet, adjust the Voter Audio Selector module level to -10.0, ±0.3 dBm.

Record the final level on the data sheet as Test Tone @ A600 jckfld.

ADJUSTMENT: Adjust the OUTPUT ADJ potentiometer (R10) on the Voter Audio Selector module for -10.0, ±0.3 dBm. This adjustment is for the Control Point Site only. Do not readjust the OUTPUT (R10) potentiometer when aligning the remaining sites.

5.3 Voting (Status) Tone

Ensure the equipment is configured according to the Control Point Set-up in paragraph 5.0.

Perform this step simultaneously while the technician at the Site is performing paragraph 4.7.

Remove the 1004 Hz test tone and verify at J1 on the front of the analog voter module that the voting tone is 1950 Hz, ±5 Hz, and that the level is -20.0, ±0.3 dBm.

NOTE: The 1950 Hz voting tone level is adjusted at the Site NOT the Control Point.

Record the final level on the data sheet as Voting Tone @ J1.

> ADJUSTMENT: At the Site, adjust the VOTING TONE potentiometer of the MASTRUTL program to obtain a level of -20.0, ±0.3 dBm at the Control Point.

5.4 Digital Voters

NOTE: For satellite receiver sites only.

Adjust R1 for 80 mVAC measured at pin 1 of U18 on the digital receiver GETC.

On the Digital Selector, adjust red potentiometer R2 for -10 dBm of modem audio measured across Pins 11 and 12 of TB10 on the back of the Selector GETC.

5.5 Simulcast Cabinet

Each time the site is visited the simulcast cabinet should be opened front and rear.

From the front, the WWVB receivers should have no red lights illuminated. If the Unlock light is on, observe it for several minutes to see if it becomes locked. The selector modules should be in automatic mode. In general, the A receiver set will be selected.

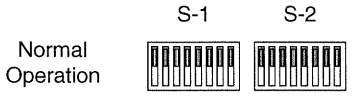
Note TUAI GETC lights and record if any are illuminated. Note that L7 will blink momentarily when a test is being made.

At rear of cabinet, locate two small boards with LED indicators. The upper board will have a yellow LED illuminated. The lower board will have a solid yellow and a red LED that will randomly and momentarily blink off then on.

5.6 Restoration of Service

Prior to placing the channel back into service, double check the following:

Restore the GETC DIP switches to Normal Operation:



Ensure the Station is restored to Normal Operation:

- GETC jumper J4 reinstalled
- GETC Interface board J9 reconnected
- GETC Data 25-pair on rear of station reconnected
- GETC LED indicators
- RF and Power Sensor cables reconnected.

Perform radio check using 2 portables in test partition to insure that the repeater path through the Control Point is good.

Force a test call on the channel. If successful, place the channel back in service.

6.0 Tower Top Amplifier

Prior to test of each channel, using the *RECALL* button on the Service Monitor to recall the *POWERON* setup. Using a coax cable, connect from the Service Monitor Antenna jack into an unused receiver multicoupler port. Using the cursor knob to select and highlight the *Tune Freq.* Box, enter the Base Station Receiver frequency of **MA TAC 3 (822.5125 MHz.)** and then, select the *Spec Anl* screen.

At the Control Point System A cabinet, attach TEST & ALIGNMENT radio to test antenna, select **MA TAC 3** and key up radio. At the Site, note and record the level displayed as **Tower Top Amp On Level**. At the site turn tower top amp power supply off measure and record level as **Tower Top Amp Off Level**.
When done turn tower top amp power supply on. NOTE: DO NOT FORGET TO TURN BACK ON WHEN DONE. Measure RF gain level of other system not under test and use this measurement as a comparison reference.

NOTE: When performing receiver tower top amp checks of Control Point site, setup a handheld radio on an outside antenna at the Site using MA TAC 3 Freq.

6.1 Test Radio Unit and Control Ch Monitor Radio Unit RF Level Checks.

At the Control Point disable all digital alarms at alarm computer for system/site under test.
At the Control Point go to **CSD** and disable the test radio for system under test.
At the Control Point place channels 5 then 15 in test partition and RF disabled on CSD one at a time as needed
for testing in system under test.

CAUTION! DISCONNECT ONLY RF CABLE FROM RADIO BEING TESTED.DO NOT GET CABLES MIXED UP OR DAMAGE TO EQUIPMENT COULD RESULT.

6.2 Control Channel Monitor Radio

At the Site, disconnect coax cable with N male connector from 30DB attenuator at the rear of the control channel monitor radio. Setup HP 8920 Service Monitor. for spectrum analyzer screen. Using an N female barrel connector connect cable to a test cable with male N connector, connect other side of test cable (BNC MALE) to HP 8920 Service. Mon. Antenna port, select HP 8920 input to antenna, then set attenuation level to –10.0dbm. Set Service. Mon. to base station TX freq. of channel 5, then for channel 15 for system under test.
At the Control Point simulcast test panel PTT channel 5 and channel 15 for system/site under test. At Site measure and record RF level on pm sheet as Control Ch. Monitor Rx Level Ch.5
Reset HP 8920 for channel 15 TX freq. At the Site, measure and record RF level on pm sheet as Control Ch. Monitor Rx Level Ch 15.
At Site reconnect RF cable to 30DB attenuator in rear of Control Channel Monitor Radio.

6.3 Test Unit Radio

At the Site, disconnect coax cable with N male connector from 30DB attenuator at the rear of the Test Unit Radio. Setup HP 8920 Service Monitor for spectrum analyzer screen. Using an N female barrel connector connect cable to a test cable with male N connector, connect other side of test cable (BNC MALE) to HP 8920 Service. Mon. Antenna port, select HP 8920 input to antenna, then set attenuation level to –10.0dbm. Set Service. Mon. to base station TX frequency of channel 5, then for channel 15 for system under test.
At the Control Point simulcast test panel PTT channel 5 and channel 15 for system/site under test. At Site measure and record RF level on pm sheet as Test Unit Radio Rx Level Ch 5. Reset HP 8920 for channel 15 TX freq. At the Site, measure and record RF level on pm sheet as Test Unit Radio Rx Level Ch 15.
At Site reconnect RF cable to 30DB attenuator in rear of **Test Unit Radio**. At the Control Point place simulcast test panel PTT switches back to system position (down).
At the Control point when test procedures are completed, enable all digital alarms for the site under test, and enable test unit radio in CSD.

6.4 TEST UNIT RADIO TX POWER TEST

.

PRIOR TO PERFORMING TEST UNIT RADIO TX POWER CHECKS SET UP HP 8920 SERVICE MONITOR AS FOLLOWS.

Screen: Spectrum Analyzer
Frequency: Receive freq of channel being tested (821-823 MHz).
Input: Antenna
Attenuation Level: -40 db
Note: If analyzer screen indicates un-calibrated high sensitivity follow the procedure below to correct it.
From Spectrum Analyzer Display.
Move cursor to Control and select Main.
Move cursor to Choices and select Aux.
Move cursor to Sensitivity and select Normal.
Move cursor to Aux and select.
Move cursor to Choices and select Main.
This test verifies 10W output of test radio. Typical reading at multicoupler output ports: -82db.
At the site, connect proper RF cable from receiver multicoupler port to HP 8920 Service. Mon. antenna port and place
HP 8920 Service. Mon. in spectrum analyzer mode, and select freq of channel under test. At Control Point place a channel in test partition and RF disabled .At the Site when ready ask the Control Point to perform a test call on the channel in test partition .At the site measure and record level on site pm sheet as Test Unit Radio TX Level
NOTE: Place channels 5 and 15 back in service after completion of tests.

Hillsborough County Sheriff's Office

ATTACHMENT (D)

Microwave
And
Multiplex Equipment

Alignment and Test Procedures

Section 1
ROUTINE MAINTENANCE

General information

Periodic Checks

The radio should be checked periodically for proper performance. Routinely observe the alarm indicators (red LEDs) on unit front panels and the status messages on the Display/Keyboard panel. Refer all LED alarm indications to Section 2. Refer all alarm indications to trouble isolation charts in Section 2 and *SCAN GLOSSARY* in Section 4 of Part I.

The Display/Keyboard panel or the optional Display/Keypad unit should be used to do most of the routine maintenance tests. Refer to Section 4 of Part I for how to use the Display/Keyboard panel.

Routine measurements

Routine maintenance measurements, when compared with measurements during initial testing at the factory (see Factory Test Data sheets), will indicate any degradation in the performance of the system. Section 2 provides steps for correcting problems.

These measurements should be made at least once a year:

1. DC voltage outputs of the DC-DC Converter units in the Mux and DTE Modem assemblies (refer to the "Check DC-DC Converter voltages" alignment procedure given in Section 3 of Part I).
2. FCC-required test: Transmitter output power and frequency (refer to the "Measure transmit and receive local oscillator frequencies and phase lock voltage" and the "Measure transmitter output power" alignment procedures given in Section 3 of Part I).
3. Receive signal level (refer to the "Check receive AGC calibration" alignment procedure given in Section 3 of Part I).
4. Eye quality of the eye pattern (refer to the "Align mux and DTE Modem receive section" alignment procedure given in Section 3 of Part I).

How to use the maintenance log form

Complete the Radio Information Part

1 Enter the Farinon sales order number for the rack in which the radio is mounted in the 'Rack #' space.

2 Enter the site number assigned to the radio in the 'Radio Site #' space.

3 Enter the radio's location (or site name) in the 'Location' space.

4 Finally, enter the name of the coordinating site (far-end radio) in the 'Coordinating Site' space.

The Maintenance Log Form is designed for use in a 5-year period. Copies may be made to extend the use beyond five years, or you may request additional copies from Farinon Customer Service.

What to write in each column

The WHAT TO MEASURE column lists the routine measurement that must be done each year. The WHERE TO MEASURE column lists the access point in the assembly where the measurement should be made. The INITIAL LEVEL column is provided for entering initial alignment measurements. The 1st through 5th YEAR AFTER INSTALLATION columns are provided for entering routine measurements made at yearly intervals. One year after installation, enter your measurements in the 1st YEAR AFTER INSTALLATION column, and so on. The NOTES column is for entering action you took after a failed measurement or comments you might have about a measurement or test. For example, you might note the fact that your measurement fell below the required standard and you made the appropriate adjustment to correct the level.

NOTE

The Routine Maintenance Log Form lists the routine measurements for NP and MHS terminals and repeaters. Fill out only the required routine measurements for your configuration.

DVM2-45/DVM6-45 *Excell-DTE*

Routine Maintenance Log Form

Farinon Rack # _____

Radio Site #_____ Location _____ Coordinating Site _____

WHAT TO MEASURE	WHERE TO MEASURE	INITIAL LEVEL	YEAR AFTER INSTALLATION					NOTES
			1st	2nd	3rd	4th	5th	
-5.2V output	-5.2V test point on Mux DC-DC A1							
+5V output	+5V test point on Mux DC-DC A1							
-5.2V output	-5.2V test point on Mux DC-DC A2							
+5V output	+5V test point on Mux DC-DC A2							
-5.2V output	-5.2V test point on DTE Modem DC-DC A1							
+5V output	+5V test point on DTE Modem DC-DC A1							
-20V output	-20V test point on DTE Modem DC-DC A1							
+10V output	+10V test point on DTE Modem DC-DC A1							
-5.2V output	-5.2V test point on DTE Modem DC-DC A2							
+5V output	+5V test point on DTE Modem DC-DC A2							
-20V output	-20V test point on DTE Modem DC-DC A2							
+10V output	+10V test point on DTE Modem DC-DC A2							
-5.2V output	-5.2V test point on DTE Modem DC-DC B1							
+5V output	+5V test point on DTE Modem DC-DC B1							
-20V output	-20V test point on DTE Modem DC-DC B1							
+10V output	+10V test point on DTE Modem DC-DC B1							

DVM2-45/DVM6-45 *Excell-DTE*

Routine Maintenance Log Form

Farinon Rack # _____

Radio Site #_____ Location _____ Coordinating Site _____

WHAT TO MEASURE	WHERE TO MEASURE	INITIAL LEVEL	YEAR AFTER INSTALLATION					NOTES
			1st	2nd	3rd	4th	5th	
-5.2V output	-5.2V test point on DTE Modem DC-DC B2							
+5V output	+5V test point on DTE Modem DC-DC B2							
-20V output	-20V test point on DTE Modem DC-DC B2							
+10V output	+10V test point on DTE Modem DC-DC B2							
XMTR LO output freq.	XTAL MON or XTAL OUT on XMT LO A1							
XMTR LO output freq.	XTAL MON or XTAL OUT on XMT LO A2							
XMTR LO output freq.	XTAL MON or XTAL OUT on XMT LO B1							
XMTR LO output freq.	XTAL MON or XTAL OUT on XMT LO B2							
XMTR output power	PWR MON on PA A1							
XMTR output power	PWR MON on PA A2							
XMTR output power	PWR MON on PA B1							
XMTR output power	PWR MON on PA B2							
RCVR AGC and RSL	RCVR AGC test point on RCVR RF ASS'Y A1 RSL on Display/Keyboard							
RCVR AGC and RSL	RCVR AGC test point on RCVR RF ASS'Y A2 RSL on Display/Keyboard							
RCVR AGC and RSL	RCVR AGC test point on RCVR RF ASS'Y B1 RSL on Display/Keyboard							
RCVR AGC and RSL	RCVR AGC test point on RCVR RF ASS'Y B2 RSL on Display/Keyboard							

DVM2-45/DVM6-45 *Excell-DTE*

Routine Maintenance Log Form

Farinon Rack # _____

Radio Site #_____ Location _____ Coordinating Site _____

WHAT TO MEASURE	WHERE TO MEASURE	INITIAL LEVEL	YEAR AFTER INSTALLATION					NOTES
			1st	2nd	3rd	4th	5th	
RCVR LO output freq.	XTAL MON or XTAL OUT on RCV LO A1							
RCVR LO output freq.	XTAL MON or XTAL OUT on RCV LO A2							
RCVR LO output freq.	XTAL MON or XTAL OUT on RCV LO B1							
RCVR LO output freq.	XTAL MON or XTAL OUT on RCV LO B2							

Section 3
ALIGNMENT

The steps to alignment

This section describes how to:

1. Measure the DC-DC Converter voltages.
2. Measure transmit local oscillator frequency and phase lock voltage.
3. Measure transmitter output power.
4. Check receive AGC calibration.
5. Perform a visual check of the assembly.
6. Configure the Protection/Diagnostic System.
7. Align the mux and DTE Modem receive section.
8. Check the radio's Bit Error Rate (BER).
9. Perform an additional check on a hybrid system.
10. Check the DS3 Interface assembly.
11. Check the protection system.
12. Optional procedure: check fade margin.

These alignment steps must be performed in the sequence given.

Factory Test Data, Alignment Data, and Routine Maintenance Data

Each radio is set up, aligned, and tested at the factory. Test results are recorded on Factory Test Data sheets which are made part of this instruction manual for reference when aligning and operating the equipment (see APPENDIXES or Sales Order Specific Information binder). Indications obtained during initial alignment should be recorded in the Routine Maintenance Log Form given in Section 1: ROUTINE MAINTENANCE in Part II.

FCC required Tests

Federal Communications Commission (FCC) rules require that the transmitter signal's output power and frequency be verified and recorded in a log during alignment. The Routine Maintenance Log Form is provided for this purpose.

Drawings, Tables, and Charts

During the alignment procedure, it may be necessary to refer to the assembly EW- and BL- drawings, and Factory Test Data sheets which are located in the APPENDIXES or Sales Order Specific Information binder. Figures in Section 2A of Part III illustrate the different assemblies and unit front panels and describe the unit front panel lamps, connectors, test points, controls, switches, etc. These figures may be useful in the alignment procedures.

Adjustments and Tuning

No adjustments are normally required during initial alignment; touch-up tuning should not be attempted unless required after changing a critical component in the signal path. Only the adjustments called out in the procedures should be made; all other controls have been preset at the factory and should not require adjustment in service. If a major adjustment appears necessary, check the measuring technique and test equipment setting before performing the adjustment procedure.

Do not make any adjustments if the measurements fall within the given tolerances.

Tools and Test Equipment

The tools and test equipment required are listed and defined in Section 1 of Part I.

Before you begin . . . read the entire alignment procedure. This will allow you to prepare the time and resources you will need.

Alignment Procedure

1. Check DC-DC Converter voltages

Tools/Test Equipment You Will Need:

1 -- Digital Multimeter

If two DC-DC Converter units are equipped in the Mux assembly, one must be disabled to perform measurements on the other. Disable one unit by pressing and holding down the DISABLE switch on its front panel; release the DISABLE switch after the measurement to re-enable the unit.

The DISABLE switch must be held down at least one second.

Mux Assembly DC-DC Converter

1 Measure the -5.2-volt output voltage(s) at the -5.2V test point on each DC-DC Converter unit equipped in the Mux assembly.

Requirement: -5.1 to -5.3 volts.

If the required indications are met, record the measured voltage(s) in the Routine Maintenance Log Form.

2 Measure the +5-volt output voltage(s) at the +5V test point on each DC-DC Converter unit equipped in the Mux assembly.

Requirement: +4.9 to +5.1 volts.

If the required indications are met, record the measured voltage(s) in the Routine Maintenance Log Form.

If a required indication is not met, go to Section 2 of Part II and isolate and correct the problem before proceeding.

DTE Modem Assembly DC-DC Converter

1 Measure the -5.2-volt output voltage(s) at the -5.2V test point on each DC-DC Converter unit equipped in the DTE Modem assembly.

Requirement: -5.15 to -5.25 volts.

If the required indications are met, record the measured voltages in the Routine Maintenance Log Form.

If a required indication is not met, adjust the -5.2V ADJ control (located on front panel of the DC-DC Converter unit) until the requirement is met.

2 Measure the +5-volt output voltage(s) at the +5V test point on each DC-DC Converter unit equipped in the DTE Modem assembly.

Requirement: +4.95 to +5.05 volts.

If the required indications are met, record the measured voltages in the Routine Maintenance Log Form.

If a required indication is not met, adjust the +5V ADJ control (located on the front panel of the DC-DC Converter unit) until the requirement is met.

3 Measure the +10-volt output voltage(s) at the +10V test point on each DC-DC Converter unit equipped in the DTE Modem assembly.

Requirement: +9.90 to +10.10 volts.

If the required indications are met, record the measured voltages in the Routine Maintenance Log Form.

If a required indication is not met, adjust the +10V ADJ control (located on the front panel of the DC-DC Converter unit) until the requirement is met.

4 Measure the -20-volt output voltage(s) at the -20V test point on each DC-DC Converter unit equipped in the DTE Modem assembly.

Requirement: -19.8 to -20.2 volts.

If the required indications are met, record the measured voltages in the Routine Maintenance Log Form.

If a required indication is not met, adjust the -20V ADJ control (located on the front panel of the DC-DC Converter unit) until the requirement is met.

5 Disconnect test equipment and continue with "Measure transmit and receive local oscillator frequencies and phase lock voltage" on Page 3-6.

2. Measure transmit and receive local oscillator frequencies and phase lock voltage

Tools/Test Equipment You Will Need:

1 -- Digital Multimeter
1 -- Frequency Counter

Measure Transmit and Receive Local Oscillator Frequencies

Measure the transmit and receive local oscillator frequencies at the:

XTAL MON jack [on 2-GHz transmit/receive local oscillator].

or

XTAL OUT jack (on 6-GHz transmit/receive local oscillator).

Requirement: For DVM2-45 Excell-DTE radios, frequency should equal the XTAL MON frequency listed on the Local Oscillator's label, ±100 Hz. For DVM6-45 Excell-DTE radios, frequency should equal the XTAL OUT frequency listed on the Local Oscillator's label, ±100 Hz.

If requirement is not met, adjust the Local Oscillator's XTAL ADJ control (on 2-GHz radio) or XTAL TUNE control (on 6-GHz radio) until the requirement is met.

If the requirement cannot be met, go to Section 3A of Part II and replace the faulty Local Oscillator unit.

Measure Phase Lock Voltage

Measure the phase lock voltage at the:

Φ VOLT feed-thru capacitor pin on the 2-GHz Local Oscillator

or

Φ VOLT MON jack (BNC) center pin on the 6-GHz Local Oscillator.

Requirement: For 2-GHz radios, voltage should equal 9.5 volts, ±0.5 volt. For 6-GHz radios, voltage should equal -8.0 volts, ±0.5 volt.

If the requirement is not met, adjust the RF ADJ control on the 2-GHz or the CAVITY TUNE control on the 6-GHz Local Oscillator until the requirement is met.

3. Measure transmitter output power

Procedure for radios with DS1/DS2 Mux assembly

NOTE

The following part can only be performed on radios with a DS1/DS2 Mux assembly. For radios with a DS3 Interface assembly, perform the part entitled "Procedure for radios with DS3 Interface assembly" on Page 3-14.

Tools/Test Equipment You Will Need:

1 -- Power Meter with medium-power head

Transmitter output power can be measured under two conditions:

(1) With ATPC enabled.
(2) With ATPC disabled.

Determine if ATPC is Enabled or Disabled

Before measuring output power, you must first determine if ATPC is enabled or disabled.

1 Using the Display/Keyboard panel, check the status of the ATPC option:

[a] In the MANUAL MODE MENU, scroll to SEL EQP/CNTL and press EXEC. The EQP/CNTL MENU will appear.

[b] In the EQP/CNTL MENU, scroll to SEL RADIO and press EXEC. The SELECT RADIO EQP menu will appear.

[c] In the SEL RADIO EQP menu, scroll to RADIO A (or RADIO B) and press EXEC. The RADIO A (or B) MENU will appear.

[d] In the RADIO A (or B) MENU, scroll to SEL ATPC and press EXEC. The ATPC A1/A2 (or B1/B2) CMND menu will appear.

[e] In the ATPC CMND menu, scroll to STATUS REPORT and press EXEC. The display should indicate whether

ATPC is enabled or disabled.

2 If ATPC is enabled, continue with the part entitled "Measure Transmitter Output Power With ATPC Enabled" on Page 3-9. If ATPC is disabled, continue with the part entitled "Measure Transmitter Output Power With ATPC Disabled" on Page 3-11.

In the following procedure, the transmitter under test must be on line.

Some errors will be caused when switching transmitters. Increasing output power above those levels given in the Factory Test Data sheet may degrade BER performance.

Measure Transmitter Output Power With ATPC Enabled

1 Do a HI POWER LOCK on the Display/Keyboard panel:

[a] In the MANUAL MODE MENU, scroll to >SEL EQP/CNTL and press the EXEC key. The EQP/CNTL MENU will appear.

[b] In the EQP/CNTL MENU, scroll to >SEL RADIO and press the EXEC key. The SEL RADIO EQP menu will appear.

[c] In the SELECT RADIO EQP menu, scroll to RADIO A (or B) and press the EXEC key. The RADIO A (or RADIO B) MENU will appear.

[d] In the RADIO A (or B) MENU, scroll to SEL ATPC and press the EXEC key. The ATPC A1/A2 CMND (or ATPC B1/B2 CMND) menu will appear.

[e] In the ATPC A1/A2 (or B1/B2) CMND menu, scroll to LOCK HI POWER and press the EXEC key.

2 Measure the transmitter output power at the PWR MON jack on the Power Amplifier front panel.

Requirement: The output power level should equal the level (for the PWR MON jack) given on the Factory Test Data sheet, ±0.5 dB.

If the requirement is met, record the measured output power in the Routine Maintenance Log given in Part II and then continue with Step 3.

If the requirement is not met, skip Step 3 and continue with "Adjust Transmitter Output Power" on Page 3-12.

3 Using the Display/Keyboard panel, release lock on the transmitter:

[a] In the MANUAL MODE MENU, scroll to >SEL EQP/CNTL and press the EXEC key. The EQP/CNTL MENU will appear.

[b] In the EQP/CNTL MENU, scroll to >SEL RADIO and press the EXEC key. The SEL RADIO EQP menu will appear.

[c] In the SELECT RADIO EQP menu, scroll to RADIO A (or B) and press the EXEC key. The RADIO A (or RADIO B) MENU will appear.

[d] In the RADIO A (or B) MENU, scroll to SEL ATPC and press the EXEC key. The ATPC A1/A2 CMND (or ATPC B1/B2 CMND) menu will appear.

[e] In the ATPC A1/A2 (or B1/B2) CMND menu, scroll to RELEASE LOCK and press the EXEC key.

NOTE

During routine maintenance, the transmitter output power should be monitored via the protection-diagnostic system's Display/Keyboard panel (see Section 4). The indication on the Display/Keyboard panel is 0 dB (in high power radios) or NOMINAL (in low power radios) if the output power for the transmitter under test is correctly set (see Factory Test Data sheet).

4 Repeat this test on the other transmitter.

5 Continue with the "Check receive AGC calibration" on Page 3-16.

NOTE

The ATPC transmitter may be disabled to low power or disabled to high power during this procedure. Check the ATPC STATUS REPORT to see if the transmitter is disabled to low power or high power via the Display/Keyboard's SEL EQP/CNTL main menu command.

Increasing output power above those levels given in the Factory Test Data sheet may degrade BER performance.

Measure Transmitter Output Power With ATPC Disabled

1 Calibrate the power meter to the transmit frequency per power meter manufacturer's instructions. Measure the transmitter output power at the PWR MON jack on the Power Amplifier front panel.

Requirement: The output power level should equal the level (for the PWR MON jack) given on the Factory Test Data sheet, ±0.5 dB.

If the requirement is met, record the measured output power in the Routine Maintenance Log given in Part II and then continue with Step 3. If requirement is not met, skip Step 3 and go to "Adjust Transmitter Output Power" on Page 3-15.

NOTE

On routine maintenance, the transmitter output power should be monitored via the protection-diagnostic system's Display/Keyboard panel. The indication on the Display/Keyboard panel is 0 dB (in high power radios) or NOMINAL (in low power radios) if the output power for the transmitter under test is correctly set (see Factory Test Data sheet).

2 Repeat this test on the other transmitter.

3 Continue with "Check receive AGC calibration" on Page 3-16.

NOTE

In the following procedure, the transmitter under test must be on line. Some errors will be caused when switching transmitters.

If the system is equipped with a Low Power Amplifier, skip Step 1 and continue with Step 2.

Adjust Transmitter Output Power

1 Do a HI POWER LOCK via the Display/Keyboard panel's SEL EQP/CNTL main menu command:

[a] In the MANUAL MODE MENU, scroll to >SEL EQP/CNTL and press the EXEC key. The EQP/CNTL MENU will appear.

[b] In the EQP/CNTL MENU, scroll to >SEL RADIO and press the EXEC key. The SEL RADIO EQP menu will appear.

[c] In the SELECT RADIO EQP menu, scroll to RADIO A (or B) and press the EXEC key. The RADIO A (or RADIO B) MENU will appear.

[d] In the RADIO A (or B) MENU, scroll to SEL ATPC and press the EXEC key. The ATPC A1/A2 CMND (or ATPC B1/B2 CMND) menu will appear.

[e] In the ATPC A1/A2 (or B1/B2) CMND menu, scroll to LOCK HI POWER and press the EXEC key.

NOTE

You can also do a HI POWER LOCK via the Display/Keyboard panel's LEARN SYSTEM main menu command.

2 Set the MLC/ALC switch on the Power Amplifier assembly to the MLC position (red MLC ALM lamp should light).

3 Adjust MLC ADJ control until power meter indicates the level for the PWR MON port given on the Factory Test Data sheet.

4 Measure the voltage at the DET LEV test point on the Power Amplifier assembly. Adjust the DET ADJ control until meter indicates the detector voltage level given on the Factory Test Data sheet.

5 Set the MLC/ALC switch to the ALC position and adjust the ALC ADJ control until the power meter indicates the same level as for MLC set in Step 3. The voltage at the DET LEV test point should still equal the level set in Step 4.

If the requirement cannot be met, go to Section 3A of Part II and replace the Power Amplifier assembly.

6 Check the transmitter output power level on the Display/Keyboard panel:

[a] In the MANUAL MODE MENU, scroll to >SELECT MONITOR and press the EXEC key. The SEL MONITOR MENU will appear.

[b] In the SEL MONITOR MENU, scroll to >TX LEVEL A1/A2 (B1/B2) and press EXEC key.

Requirement: The Display/Keyboard panel will indicate 0 dBm. If not, repeat this procedure.

7 If output power was adjusted with ATPC disabled, continue with "Check receive AGC calibration" on Page 3-16. If output power was adjusted with ATPC enabled, do a RELEASE LOCK (see Step 3 in "Measure Transmitter Output Power With ATPC Enabled" on Page 3-9) and then go on to "Check receive AGC calibration" on Page 3-16.

Procedure for radios with DS3 Interface assembly

NOTE

The following part can only be performed on radios with a DS3 Interface assembly. For radios with a DS1/DS2 Mux assembly, perform the part entitled "Procedure for radios with DS1/DS2 Mux assembly" on Page 3-7.

Tools/Test Equipment You Will Need:

1 -- Power Meter with medium-power head

1 Calibrate the power meter to the transmit frequency per power meter manufacturer's instructions. Measure the transmitter output power at the PWR MON jack on the Power Amplifier front panel.

Requirement: The output power level should equal the level (for the PWR MON jack) given on the Factory Test Data sheet, ±0.5 dB.

If the requirement is met, record the measured output power in the Routine Maintenance Log given in Part II and then continue with Step 2.

If the requirement is not met, skip Step 2 and continue with "Adjust Transmitter Output Power" on Page 3-15.

NOTE

During routine maintenance, the transmitter output power should be monitored via the protection-diagnostic system's Display/Keyboard panel. The indication on the Display/Keyboard panel is 0 dB if the output power for the transmitter under test is correctly set (see Factory Test Data sheet).

2 Repeat this test on the other transmitter.

3 Continue with "Check receive AGC calibration" on Page 3-16.

NOTE

In the following procedure, the transmitter under test must be on line. Errors will be caused when switching transmitters.

Adjust Transmitter Output Power

1 Set the MLC/ALC switch on the Power Amplifier assembly to the MLC position (red MLC ALM lamp should light).

2 Adjust the MLC ADJ control until power meter indicates the level for the PWR MON port given on the Factory Test Data sheet.

3 Measure the voltage at the DET LEV test point on the Power Amplifier assembly. Adjust the DET ADJ control until meter indicates the detector voltage level given on the Factory Test Data sheet.

4 Set the MLC/ALC switch to the ALC position and adjust the ALC ADJ control until the power meter indicates the same level as for MLC set in Step 2. The voltage at the DET LEV test point should still equal the level set in Step 3.

If the requirement cannot be met, go to Section 3A of Part II and replace the Power Amplifier assembly.

5 Check the transmitter output power level on the Display/Keyboard panel:

[a] In the MANUAL MODE MENU, scroll to >SELECT MONITOR and press the EXEC key. The SEL MONITOR MENU will appear.

[b] In the SEL MONITOR MENU, scroll to >TX LEVEL A1/A2 (B1/B2) and press EXEC key.

Requirement: The Display/Keyboard panel will indicate 0 dBm.

If this requirement is not met, repeat this procedure.

6 Go on to "Check receive AGC calibration" on Page 3-16.

4. Check receive AGC calibration

Tools/Test Equipment You Will Need:

1 -- Digital Multimeter

NOTE

The yellow AGC ALM lamp on the Receiver RF Assembly front panel may be lit at this time. If it is lit, it is because the received signal level is too low or too high. The correct antenna adjustment should cause the lamp to go off.

If the AGC ALM lamp remains lit after antenna adjustment, it may be due to a high received signal level. Call Farinon Customer Service for assistance in solving this problem.

The receive level indication on the RCVR AGC test point and the display panel (Rx LEVEL) are referenced to the input of the Low-Noise Converter. To determine the received signal level (RSL) at the antenna port, add the loss between the antenna port and the input to the Low-Noise Converter (see the receiver branching loss levels provided in the following table).

Branching Loss Levels for 2-GHz and 6-GHz Radios

MHS RCVRs (7-dB Coupler)		Space Diversity and Nonprotected RCVRs	
RCVR A1/B1	RCVR A2/B2	RCVR A1/B1	RCVR A2/B2
4 dB	10 dB	2 dB	2 dB

1 Measure the voltage at the RCVR AGC test point on the Receiver RF subassembly front panel.

2 With the protection/diagnostic system's Display/Keyboard panel in the SEL MONITOR MENU, display the receive signal level for the receiver under test. The panel will continuously display the receive level for the two associated radio receivers and indicate which one of the two receivers is on line (ON) and which is off line (OFF).

Requirement: Display panel indication (in dBm) should be proportional to the received signal level (RSL). The digital multimeter indication is

also proportional to the RSL as follows:

DVM2-45		DVM6-45	
Voltage level @ RCVR AGC test point	Display Panel Level of RSL	Voltage level @ RCVR AGC test point	Display Panel Level of RSL
-100 mV	-10 dBm	-200 mV	-20 dBm
-200 mV	-20 dBm	-300 mV	-30 dBm
-300 mV	-30 dBm	-400 mV	-40 dBm
-400 mV	-40 dBm	-500 mV	-50 dBm
-500 mV	-50 dBm	-600 mV	-60 dBm
-600 mV	-60 dBm	-700 mV	-70 dBm
-700 mV	-70 dBm	-750 mV	-75 dBm
-800 mV	-80 dBm	--	--

The accuracy of the digital multimeter reading is ±4 dB of the received signal level (RSL); the accuracy of the display panel indication is ±3 dB of the RSL.

If the requirement is not met (the digital multimeter and display panel indications are far apart), go to Section 2 of Part II and correct the problem before continuing these alignment tests.

NOTE

RCVR AGC has been factory-adjusted so that it is linear with the incoming receive signal. If the receiver Low-Noise Converter, RCVR Alarm card, or IF Amplifier unit is replaced, the RF AGC and RCVR AGC will have to be recalibrated for optimum accuracy.

3 Go on to "Perform a visual check of the assembly" on Page 3-18.

5. Perform a visual check of the assembly

Tools/Test Equipment You Will Need: None

Adjust the Display Panel Contrast

1 If unsatisfactory, improve the brightness on the Display/Keyboard panel alphanumeric readout by adjusting pot R7. The R7 pot is adjustable from behind the Mux assembly left door.

2 Press the AUTO key.

Check for Alarms

3 Verify that the Display/Keyboard panel is operating properly: the first line of the display should read DVM 45 SITE #xxx (xxx is the default station or site number).

4 Check alarm lamps on Display/Keyboard panel. No alarm lamp should be lit if transmitter-to-receiver path has been established and causes for any minor alarms have been corrected. If the ACO lamp is lit, press ACO switch to turn it off.

5 Observe the alarm lamps on the plug-in units in the Mux assembly, DTE Modem assembly, IF/RF assembly, and the DVS II assembly (if equipped). Refer to tables in Step Section 2B of Part III for a description of the alarm lamps. Refer to the DVS II IM for a description of alarm lamps on the DVS II.

Requirement: All red FAIL alarm lamps should be off. The yellow LOCAL INPUT lamp on the Display/Keyboard panel will light if an input to an equipped M12/M22 unit in the Mux shelf has been changed since the last time the LEARN SYSTEM routine has been exercised (in DS1/DS1 Mux assembly applications). The LOCAL INPUT lamp will light if a DS3 input is removed (in DS3 Interface assembly applications). You will later perform the LEARN SYSTEM routine; if the LOCAL INPUT lamp remains lit after the LEARN SYSTEM routine, go to Section 2 in Part II and correct the problem before proceeding.

If a red lamp indicating a malfunction is lit, go to Section 2 in Part II and isolate and correct the problem before proceeding.

6 Continue with "Configure the Protection-Diagnostic system (LEARN SYSTEM)" on Page 3-19.

6. Configure the Protection-Diagnostic system (LEARN SYSTEM)

Tools/Test Equipment You Will Need: None

NOTE

Before doing the following steps, ensure there are no alarms (no red LEDs lit). If there is an alarm(s), refer to Section 2 in Part II and isolate and correct the problem before proceeding.

Perform the LEARN SYSTEM routine on the Display/Keyboard panel as follows:

1 Press the AUTO key.

2 Press the EXEC or MENU key on the keypad. The display will change to:

MANUAL MODE MENU	[first line]
>SEL EQP/CNTL	[second line]

3 Scroll (using the ↑/1 or ↓/5 key) until the second line displays:

>LEARN SYSTEM

4 Press the EXEC key. The display will change to:

LEARN EQP MENU	[first line]
>LOCAL EQP	[second line]

5 Press the EXEC key. All red lamps in the Mux assembly will light and then turn off one at a time within a few seconds.

6 Scroll until the display shows:

LEARN EQP MENU	[first line]
>ADDRESS = xxx	[second line; xxx is default/existing site]

7 Press the EXEC key. The display will change to:

ENTER LOCAL	[first line]

>ADDRESS = xxx [second line]

8 Press keypad numbers corresponding to desired site number. For example, if desired station/site is 25, press the 2 and then the 5 key. Display will show new desired station/site number in place of default number.

9 Press EXEC key. The new station/site number is now stored in memory.

10 Press the MENU key (LEARN EQP MENU reappears) then scroll until display is:

LEARN EQP MENU [first line]
>BER THRESHOLD [second line]

11 Press the EXEC key. The display will change to:

SET A/B BER THR [first line]
>SEL A: THR=E-x [second line; x is default threshold]

The default threshold for radios A1 and A2 (or B1 and B2 in radios equipped with DS1/DS2 Mux assembly) is 10^{-6}, at which the protection-diagnostic system is optimally operative. A setting of 10^{-4} or 10^{-8} may also be entered manually. Read Section 4 of Part I.

12 If the receiver (Mux) A threshold setting is to be changed, press the EXEC key (otherwise, scroll to SEL B; THR=E-x to check radio B threshold setting in radios equipped with DS1/DS2 Mux assembly). The display will change to:

SET A BER THR [first line]
>ENTER THR=E-x [second line]

13 Press the keypad number (4, 6, or 8) corresponding to the desired threshold for the radio. The display will show the new threshold setting in place of the old number.

14 Press the EXEC key. The new threshold for radio A (or B) is now stored in memory.

NOTE

Steps 15 through 20 apply to radios equipped with DS1/DS2 Mux assemblies. For DS3 Interface assembly applications, skip to Step 21.

NOTE

Step 15 through Step 20 apply to repeater applications only.

15 Press the MENU key until the LEARN EQP MENU reappears, then scroll until the >M-2 DROP/ADD option is displayed on the second line:

LEARN EQP MENU	[first line]
>M-2 DROP/ADD	[second line]

16 Press the EXEC key, the display will change to:

M-2 DROP/ADD	[first line]
>SEL A1/B1: T2=n	[second line; n is existing first T2 channel to drop/add.]

17 To select a first T2 channel to drop/add, press the EXEC key. The display will change to:

M-2 A1/B1 CMND	[first line]
ENTER T2 = n	[second line]

18 Press the keypad number corresponding to the first T2 channel to drop/add. The display will show the new T2 time slot.

19 Press the EXEC key. The first T2 channel to drop/add is now stored in memory.

20 Press the MENU key (to get back to the M-2 DROP/ADD menu) and then scroll to >SEL A2/B2: T2=n; to select the second T2 channel to drop/add, repeat the procedure in Step 16 through Step 19. Continue with this procedure until all T2 drop/add channels have been defined.

21 Press the AUTO key.

22 Continue with "Align mux and DTE Modem receive section" on Page 3-23.

The LEARN SYSTEM procedure should be performed each time the equipment configuration at any site is altered, or when the site number is changed, or when DS1/DS2 inputs change.

7. Align mux and DTE Modem receive section

Tools/Test Equipment You Will Need:

1 -- Digital multimeter

Check and Adjust the DADE

The differential absolute delay equalization (DADE) adjustment is performed only on protected receivers. This adjustment is made via a 16-position rotary switch (labeled PHASE ADJ S1), a pushbutton switch (labeled S2),and a yellow LED lamp (labeled PHASE DS2) located on the front edge of the Hitless Switch units in the Mux shelf. The DADE must be adjusted on each Hitless Switch unit.

1 Press and hold down the pushbutton switch S2 on the first Hitless Switch unit in the Mux shelf. If the yellow PHASE lamp DS2 is not lit, continue with the next step; if the PHASE lamp DS2 lights, perform the following adjustment:

While still holding down switch S2, adjust rotary switch PHASE ADJ S1 until the PHASE lamp goes off. (Each position on switch S1 provides one bit of delay to the data stream; when lamp PHASE DS2 goes off, the two data streams are aligned.)

If the red FAIL LED lights while adjusting the PHASE ADJ switch, reverse the direction of the switch and go back five positions.

2 Repeat Step 1 on the remaining Hitless Switch units equipped in the Mux shelf.

Check Eye Quality

The following test should be performed on each DTE Modem section. Complete the test on Modem A1 and then do it on Modem A2. At a protected terminal or repeater radio equipped with a DS1/DS2 Mux assembly, continue the test on Modems B1 and B2.

1 Measure the voltage at the EQM LEV test point on Modem A1's Decoder unit.

Requirement: The voltage should be less than +90 mV for an unfaded normal system.

2 Repeat Step 1 on the remaining Modem sections.

3 Go on to "Check the radio's BER performance" on Page 3-24.

8. Check the radio's BER performance

Tools/Test Equipment You Will Need:

1 -- Bit Error Rate Test Set (required for ***Alternate Procedure***)

NOTE

For radios equipped with the DS3 Interface assembly, continue with "Perform additional checks on a hybrid system" on Page 3-28 or with "Check the DS3 Interface assembly" on Page 3-33.

Test Summary

The ***Preferred Procedure*** provides a BER report for the on-line *and* off-line radios using the internal SCAN. The ***Alternate Procedure*** provides a BER report for the on-line equipment and requires using an external Bit Error Rate Test Set.

Preferred Procedure

This test verifies the proper operation of the on-line transmit and receive paths (from transmit M2X unit to receive M2X unit), and monitors the operation of the off-line receive path. A test path is established using the standby M2X unit. Make sure the normal M2X and the normal Hitless Switch are on line before performing this test.

This test may interrupt polling if FARSCAN is equipped and running. Notify your FARSCAN system administrator before performing this test.

1 Using the Display/Keyboard Panel, measure BER:

[a] In the MANUAL MODE MENU, scroll to SELECT MONITOR and press the EXEC key. The SEL MONITOR MENU will appear.

[b] In the SEL MONITOR MENU, scroll to ON/OFF BER A (or B) and press EXEC key.

Requirement: The BER for the on-line radio will be displayed on line 1 of the display panel, while the BER report for the off-line

radio will be displayed on line 2.

If the requirement is met, continue with Step 2.

If the requirement is not met [line 2 on the display panel shows a row of asterisks (*)], check to make sure the protection system did not switch to the standby M2X or standby Hitless Switch. If not, the test path may have been interrupted if the system suffered from a deep fade.

2 Press the AUTO key.

3 At a radio-to-DS3 hybrid repeater or radio-to-optical radio hybrid repeater, continue with "Perform additional checks on a hybrid system" on Page 3-28. At systems equipped with a DS3 Interface assembly, continue with "Check the DS3 Interface assembly" on Page 3-33. Otherwise, continue with "Check the protection system" on Page 3-34.

Alternate Procedure

In this test, the far-end M12 DS1 receive section is looped back into its own transmit section (input) so that a signal inserted at the local end is returned via the remote loopback. The loopback is executed via the protection-diagnostic system's Display/Keyboard panel.

While the Mux assembly is remotely looped back, a DS1/DS2 signal is inserted into each M12/M22 channel at the local end. If a FAIL lamp lights on a local-end unit (or errors are indicated in the test) during the loopback procedure, the unit that has the lit FAIL lamp should be replaced and the problem corrected before continuing.

If a DS1/DS2 jack field is not equipped, patching and monitoring may be done at the office jack field (crossconnect or customer connection panel).

NOTE

It is not necessary to reLEARN the system after the following tests; ignore the yellow INPUT ALM lamp (if lit) on the Display/Keyboard panel during this test.

When test is complete, disable the remote loopback.

This procedure is valid only for the DS1/DS2 Mux assembly equipped with M12 units. This test is not valid for the DS3 Interface assembly.

The following test should be performed only after all previous alignment tests have been completed on the local and remote (distant-end) terminals.

1 Set BERT generator for 1.544-Mb/s random pattern DS1 output signal and connect BERT output to the first channel (DS1 #1) input on the first M12 unit (M12 A1) equipped.

Make sure the coding for the test set output matches the format (AMI or B8ZS) set on the M12 unit (see Table 2-1: in Section 2: INSTALLATION).

2 Set BERT receiver for total error count and connect BERT input to an M12 A1 output corresponding to the input connection (DS1 #1) in Step 1.

3 Select the remote loopback feature (refer to the Section 4: OPERATION) to loop back the signal at the distant-end M12 A1 DS1 #1 receive into the distant-end M12 A1 DS1 #1 transmit. In the MANUAL MODE MENU, execute >SEL EQP/CNTL; in the EQP/CNTL MENU, execute >SELECT MUX; in the SELECT MUX EQP menu, execute >M12/M22 MUX; in the M12/M22 MENU, execute >SELECT A; in the M12/M22 A MENU, execute >SELECT A1; in the M12/M22 A1 CMND menu, execute >SEL REMOTE LOOP; in the M12 A1 LOOP REM menu, scroll to and execute >SELECT DS1 #1; the ENABLED message should appear.

Requirement 1: BERT receiver should indicate error-free operation for one minute. *(In a 2-hour test, there should be no more than one error for a BER of 10^{-10}.)*

Requirement 2: All local red alarm lamps on the Mux assem-

bly units should be off; LOCAL MINOR and SYSTEM MINOR alarm lamps should be lit to indicate a remote loopback is in process.

If the BERT indicates errors, or if a red alarm lamp is lighted, go to Section 3A in Part II Step Section 3Aand replace the faulty unit. The faulty unit is the unit with the red alarm lamp lighted, or, if no lights are lighted and errors are indicated on the BERT, the faulty unit (most probably external to the Mux assembly) can be identified through isolation. After the problem is corrected, repeat Step 1 through Step 3.

4 Transfer BERT connections to M12 A1 DS1 #2 inputs and outputs and, on the Display/Keyboard panel, scroll to and execute >SELECT DS1 #2.

Requirement: Same as for Step 3.

5 Repeat Step 4 with >SELECT DS1 #3 and >SELECT DS1 #4.

Requirement: Same as for Step 3.

6 Upon completion of the M12 A1 loopback test (4 DS1 channels), scroll to and execute >DISABLE REM LOOP in the same M12 A1 LOOP REM menu; the DISABLED message should appear.

7 Return to the M12/M22 A MENU and repeat Step 1 through Step 6 on the next Mux A M12 unit equipped. Remember to select commands corresponding to the appropriate unit (e.g., M12 A2, M12 A3, etc.) in the M12/M22 A MENU.

8 Repeat Step 1 through Step 7 to loopback test a Mux B M12 unit, if equipped. Remember to execute commands in the MUX B and M12/M22 B menus.

9 Disconnect the test equipment. At radio-to-DS3 hybrid repeater or radio-to-optical radio hybrid repeater, continue with "Perform additional checks on a hybrid system" on Page 3-28. At all other configurations, continue with "Check the DS3 Interface assembly" on Page 3-33 or "Check the protection system" on Page 3-34.

9. Perform additional checks on a hybrid system

Tools/Test Equipment You Will Need:

1 -- Optical Power Meter
1 -- Optical Test Cable
1 -- Oscilloscope with 75-ohm termination

The following procedure only applies to a system configured as a radio-to-DS3 hybrid or radio-to-optical hybrid. For all other configurations, continue with "Check the DS3 Interface assembly" on Page 3-33 or "Check the protection system" on Page 3-34.

Check DS3 Output at Radio-to-DS3 Hybrid

At a radio-to-DS3 hybrid repeater, use an oscilloscope (terminated at 75 ohms) to check the DS3 output signal at the BNC connectors on the Mux motherboard. The DS3 signal level should be approximately 2 volts peak-to-peak.

Caution: Clean optical test cable connectors and optical transceiver connectors before and after taking measurements.

Warning: Do not look directly into the fiber face of an optical connector that is linked to an operating transmitter. The light emitted is invisible but may be harmful.

Check Transmit Optical Output

1 Disconnect optical fiber from the Optical Transceiver's OPT OUT jack (J201).

2 Using an optical test cable, connect an optical power meter to the OPT OUT jack (J201).

Requirement: The power level should equal the level given on the Factory Test Data sheet, ±3 dB (for multimode fiber) or ±4 dB (for single mode fiber). Included in the tolerance is a worse case difference of ±2 dB for the optical power meter and ±1 dB for multimode connector loss or ±2 dB for single-mode connector loss.

If the requirement is met, record the power level in the Routine Maintenance Log Form.

If the requirement is not met, there may be a problem in Optical Transceiver circuitry. Refer to Section 2 of Part II to isolate the problem.

3 Disconnect the optical power meter and reconnect the optical fiber (disconnected in Step 1) to the OPT OUT jack on the Optical Transceiver.

4 Repeat Step 1 through Step 3 on the standby Optical Transceiver unit in MHS optical transceivers. In NP optical transceivers, continue with "Check Receive Optical Input" on Page 3-30.

Check Receive Optical Input

1 Disconnect the optical fiber connection from the OPT IN jack (J202) on the Optical Transceiver.

2 Connect the connector end of the optical fiber that was disconnected in Step 1 to the optical power meter.

Requirement: The power should be a minimum of -36 dBm and a maximum of -20 dBm (for LED or Laser PIN detectors), or a minimum of -39 dBm and a maximum of -18 dBm (for LED or laser PINFET detectors).

NOTE

A typical system should deliver power above this minimum to allow for increased system loss. Typically, a 4-dB margin should be allowed for LED systems and a 6-dB margin for Laser systems. Span allowances are 1.5 dB/km (for multimode fiber loss), 0.5 dB/km (for single-mode fiber loss), and 0.1 dB/km (for splice loss). Connector loss is 2 dB for multimode fibers and 3 dB for single-mode fibers, including transmit and receive connector loss. For example, in a typical LED system with a span length of nine kilometers, the span allowance should be about 4 dB; and in a typical laser system with a span length of 10 kilometers, the span allowance should be about 6 dB.

If the requirement is not met and the receive level into the PINFET detector is greater than -18 dBm or less than -39 dBm, consider the notes given above and isolate the fault; correct the problem before proceeding.

If the requirement is not met and the receive level into the PIN detector is greater than -16 dBm or less than -36 dBm, consider the notes given above and isolate the cause; locate and correct the problem before proceeding. If the receive level into the PIN detector is greater than -20 dBm but less than -16 dBm, do the following corrective steps:

[a] Remove the Optical Transceiver unit under test from the shelf (refer to Section 3A of Part II).

[b] Locate the 2" by 2" can in the lower left corner of the unit; remove the two screws that secure the can to the printed circuit board; gently hold down the fiber extending from the can while separating the can from the printed circuit board.

[c] Locate the socketed resistor on the uncovered printed circuit board section and move the resistor from its upper left-hand position to its lower right-hand position. (The Optical Transceiver units are shipped with the socketed resistor installed in its upper left-hand position.)

[d] Replace the can removed in Step [b] and secure with two screws.

[e] Reinstall the Optical Transceiver unit in its shelf position.

3 Disconnect the optical power meter and reconnect the fiber (disconnected in Step 1) to the OPT IN jack on the Optical Transceiver unit.

4 Measure the voltage at the red OPT LEV test point (TP2) and ground on the Optical Transceiver unit.

Requirement: The voltage level within the dashed lines of Fig. 3-1 for the optical receive level measured in Step 2.

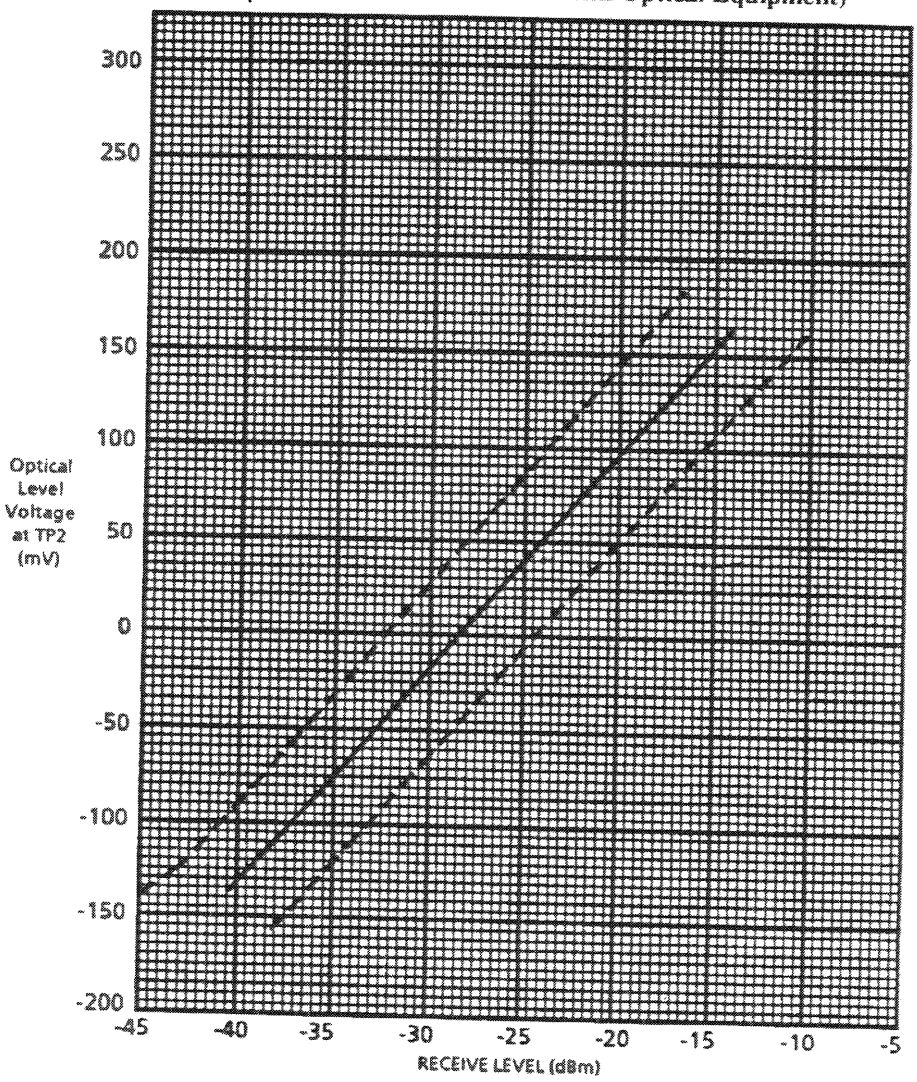
If the requirement is met, record the measured voltage in the Routine Maintenance Log Form.

If the requirement is not met, refer to Section 2 of Part II to correct and isolate the problem.

5 Repeat Step 1 through Step 4 on the standby Optical Transceiver unit in MHS optical transceivers.

6 Disconnect test equipment and continue with "Check the DS3 Interface assembly" on Page 3-33 (only if the DS3 Interface assembly is equipped in place of the DS1/DS2 Mux assembly) or "Check the protection system" on Page 3-34.

Fig. 3-1 -- Optical Level Voltage (TP2) Versus RSL
(For use when at a Radio with Optical Equipment)



NOTES:

Limits include the following measurement tolerances:

(a) ±2 dB for OPT PWR M,
(b) ±1 dB for connectors, and
(c) ±1 dB for Optical Transceiver circuit.

Warning: Do not look directly into the fiber face of an optical connector that is linked to an operating transmitter. The light emitted by the transmitter is invisible but may be harmful.

10. Check the DS3 Interface assembly

Tools/Test Equipment You Will Need:

1 -- Oscilloscope
1 -- DS3 Bit Error Rate Test Set

Perform this procedure only if the DS3 Interface assembly is equipped in place of the DS1/DS2 Mux assembly. If the DS1/DS2 Mux assembly is equipped, continue with "Check the protection system" on Page 3-34.

1 Use an oscilloscope to check the DS3 output signal at the BNC connectors on the DS3 Interface shelf motherboard.

Requirement: The DS3 signal level should be 2Vp-p.

2 Use a DS3 bit error rate test set to check the performance of the DS3 Interface assembly. Loopback the DS3 signal at the opposite end to check the BER performance of the DS3 Interface assembly.

Requirement: With the bit error rate test set for total errors count, there should be no errors indicated in a period of 10 minutes.

11. Check the protection system

Tools/Test Equipment You Will Need: None

Exercise the following manual mode operations (refer to Section 4 of Part I):

[a] Transfer traffic to a standby multiplexer (M12/M22) unit in radios equipped with the DS1/DS2 Mux assembly.

[b] Lock traffic to an on-line transmitter.

[c] Lock traffic to an on-line receiver.

[d] Inhibit (disable) and restore (enable) automatic protection switching.

[e] Obtain status summary on local and remote equipment.

[f] Undo a 'lock' or 'transfer.'

Requirement: All the protection system routines must function properly.

If a protection system routine fails to respond as indicated in Section 4 of Part I, go to Section 2 of Part II and isolate the problem to a faulty Protection/Alarm unit, Protection Control unit, or Display/Keyboard panel. Replace the faulty unit (refer to Section 3A of Part II).

12. Optional procedure: Check interference fade margin

Tools/Test Equipment You Will Need:

1 -- Variable coaxial RF attenuator
2 -- Conformable coaxial cables w/SMA connectors
1 -- SMA female-to-female adapter

This procedure checks the amount of interference fade margin available for fading and establishes the received signal level (RSL) at the receiver's threshold when the BER drops to 10^{-6}. This is an optional test and should be performed upon initial installation to verify as-built path performance.

Service is interrupted during the period of this test. To minimize down time, read the entire procedure before starting.

1 If the radio is MHS, lock the transmitter under test on line (to prevent reverse channel switching). If the radio is frequency diversity or nonprotected, continue with Step 2.

2 Locate the cable that connects the output of the transmitter under test to the RF switch (if MHS radio) or to the transmitter waveguide (if FD or nonprotected radio). Disconnect this cable at the output of the transmitter under test.

3 Install an RF attenuator (set to minimum attenuation) between the output of the transmitter under test and the cable disconnected in Step 1.

4 At the receive end, if the radio is MHS, lock the receiver under test on line. Otherwise, continue with Step 5.

5 Prepare to use the SCAN keypad on the VersaT1lity mux assembly to determine the BER and received signal level (RSL) at the distant receiver.

6 Increase the attenuation on the RF attenuator until the BER at the distant receiver drops to 10^{-8} and then 10^{-7}. Then, very carefully and slowly, increase the attenuation until the distant

receiver reports a 10^{-6} BER.

Requirement: RSL at the distant receiver should be between -76 and -70 dBm for the 10^{-6} BER, as seen on the SCAN display.

NOTE

The fade margin is the difference between the RSL under ideal or normal conditions and the RSL when the receiver under test is faded to the point that its BER is 10^{-6}. For example, in this test, if the normal unfaded RSL of the receiver under test is -35 dBm and the RSL when the receiver under test is faded to a BER of 10^{-6} is -76 dBm, then the fade margin is 41 dB [-76 - (-35) = 41].

7 Disconnect test equipment, reconnect radio cables removed in Step 1, and restore transmitter and receiver under test to normal operation.

8 Repeat Step 1 through Step 7 on the remaining transmitter(s).

Section 4
Testing

When the DS-961D Data Module has been configured and installed, test it for proper operation before putting it into service.

There are two ways you can do the testing:

- Local testing using loopback, with the system out of service.
- End to end testing using far end loopback, with the system in service but the channel being tested taken out of service.

Use the following procedure to test the modules:

1. For loopback testing, set up the multiplexer loopback following the instructions in the section on *System Checkout Procedures* in your multiplexer operation manual.

   For end to end testing, set the **LOOP** switch on the far end system ON.

2. Connect a data error analyzer (Telecommunication Techniques Corp. Fireberd 2000 or equivalent) to the jack for channel one on the back of the module adapter, using an RJ-11 cable.

3. Check for synchronization on the output signal.

4. Send single errors on the transmit side and check for single errors on the receive side.

5. Run for 30 seconds and confirm that the signal remains error-free. Observe that the **TX FAULT** LED and the **FRM** LED are not lit.

6. Repeat test on each channel set up for use in the current configuration.

7. If you used end to end testing, return **LOOP** switch at far end to OFF position. The system is now operational.

If there is an apparent malfunction during end to end testing, first check that the configuration at the two ends is identical.

Most problems occur at the common equipment or facility level. Refer to the *Troubleshooting* section in your multiplexer operation manual for system analysis procedures.

Section 5
Specifications

Multiple Synchronous Data Channels	Full duplex, five independent RS-232 data ports
Clock/Data Rates	Five channel operation: A selectable common rate of 1200 bps, 2400 bps, 4800 bps, or 9600 bps Two channel operation: A common rate of 19.2 kbps Three channel operation: Two channels at 19.2 kbps, one at 9600 bps
Timing	Selectable, internal or external
Buffer	Three-bit when using external timing source (terminal timing)
Time Slot	Five channels occupy a single selectable 64 kbps time slot
RS-232 Interface	Supports TXD, RXD, RX TIMING, TX TIMING, TERMINAL TIMING, GROUND
Remote Interface	Compatible with ISiCL remote command language, allows module configuration and status access
Connector	The DS-961D requires the use of an MA-404 Module Adapter, which provides five RJ-11 jacks for the RS-232 interfaces
Temperature	0° - 50°C Operating
Humidity	0% - 90% Non-condensing
Power Consumption	1.2 watts nominal

Specifications Subject To Change Without Notice.

Section 4
TESTING

When the VF-5A Module has been configured and installed, test it for proper operation before putting it into service.

There are two ways you can do the testing:

- Local testing using T1 or aggregate loopback, with the system out of service.
- End to end testing, with the system in service but the channel being tested taken out of service.

Use the following procedure to test the modules:

1. If using T1 or aggregate loopback testing, set up the multiplexer loopback following the instructions in the section on *System Checkout Procedures* in your multiplexer operation manual.
2. Test each channel separately. If using end to end testing, test each channel first first from Site 1 to Site 2, then reverse the setup and test from Site 2 to Site 1.
3. Connect the output of an audio signal generator (Hewlett-Packard HP4935A or equivalent) to the equipment input jack for the channel being tested. Insert a 1004 kHz test tone at -16 dBm referenced to 600 ohms.

For the following steps, check the output on the *same* VF-5A module if you are using loopback testing, or on the module at the *receive* end if you are using end to end testing.

4. Measure channel output at the equipment output jack. The output should be +7 dBm referenced to 600 ohms, +/-0.5 dB.
5. Measure signal to noise ratio with C Message weighting. This should be greater than 33 dB S/N.

6. Activate the M-Lead and observe that the corresponding M indicator LED on the transmit card and the E indicator LED on the receive card both light up.

7. Measure idle channel noise. This should be less than 23 dBrncO.

8. Remove the test equipment and disconnect the loopback if one was used. The module is now available for operation.

If there is an apparent malfunction, first check that the configuration is appropriate for the transmission system in use. If using end to end testing, check that the transmit and receive configuration is identical.

Problems may occur at the common equipment or facility level which affect the operation of this card. Refer to the *Troubleshooting* section in your multiplexer operation manual for system analysis procedures.

Section 4
TESTING

When the VF-5B Module has been configured and installed, test it for proper operation before putting it into service.

There are two ways you can do the testing:

- Local testing using T1 or aggregate loopback, with the system out of service.
- End to end testing, with the system in service but the channel being tested taken out of service.

Use the following procedure to test the modules:

1. If using T1 or aggregate loopback testing, set up the multiplexer loopback following the instructions in the section on *System Checkout Procedures* in your multiplexer operation manual.
2. Test each channel separately. If using end to end testing, test each channel first first from Site 1 to Site 2, then reverse the setup and test from Site 2 to Site 1.
3. Connect the output of an audio signal generator (Hewlett-Packard HP4935A or equivalent) to the input for the channel being tested. Insert a 1004 kHz test tone at 0 dBm referenced to 600 ohms.

For the following steps, check the output on the *same* VF-5B module if you are using loopback testing, or on the module at the *receive* end if you are using end to end testing.

4. Set the E & M status indicator LEDs to monitor the channel being tested (SW6/position 10: DOWN for channel 1, UP for channel 2).
5. Measure channel output. The output should be 0 dBm referenced to 600 ohms, ±0.5 dB.
6. Measure signal to noise ratio with C Message weighting. This should be greater than 33 dB S/N.

7. Activate the M-Lead and observe that the corresponding M indicator LED on the transmit card and the E indicator LED on the receive card both light up.

8. Measure idle channel noise. This should be less than 20 dBrnc0.

9. Remove the test equipment and disconnect the loopback if one was used. The module is now available for operation.

If there is an apparent malfunction, first check that the configuration is appropriate for the transmission system in use. If using end to end testing, check that the transmit and receive configuration is identical.

Problems may occur at the common equipment or facility level which affect the operation of this card. Refer to the *Troubleshooting* section in your multiplexer operation manual for system analysis procedures.

Section 5
SPECIFICATIONS

CONFIGURATION		Two Independent Voice Frequency Channels
FREQUENCY RESPONSE		300 to 3000 Hz, ±0.15 dB
INPUT/OUTPUT LEVEL		Nominal 0 dBm Input, 0 dBm Output
LEVEL RANGE		Adjustable in 0.1 dB steps:
	Input	-19.0 dBm to +5.0 dBm
	Output	-14.0 dBm to +10.0 dBm
IMPEDANCE		600 ohms Input/Output
IDLE CHANNEL NOISE		Less Than 20 dBrncO
SIGNAL to DISTORTION		1004 Hz Input 0 to -30 dBm Greater Than 33 dB C Message
SIGNALING		Selectable, 2E & 2M Type I per channel, or Transmission Only (TO) Mode
M-LEAD INPUT		Input Impedance > 20K Ohms to Ground Busy: -20 to -60 Volts Idle: Open or Ground
E-LEAD OUTPUT		Busy: Less Than 50 Ohms to Ground Idle: Open
TIME SLOTS		One Channel Operation Occupies One Selectable Time Slot
		Two Channel Operation Occupies Two Adjacent Selectable Time Slots
REMOTE INTERFACE		Compatible with ISiCL remote command language, allows module configuration and status access
ENVIRONMENTAL		Temperature: 0° - 50°C Operating
		Humidity: 0% - 90% Non-condensing
POWER		1.0 Watt Nominal

Section 4
TESTING AND TROUBLESHOOTING

Every VF-25 module is tested before it leaves the factory. In addition, each module provides local and remote loopbacks for on-site testing and troubleshooting purposes.

- The **local loopback** on the VF-25 module loops back all four channels together, and is intended for use during initial installation and testing. This loopback occurs directly after the analog-to-digital PCM conversion; that is, the analog audio enters the module, is coded to 8-bit PCM data, and is then immediately decoded and passed back out as analog.

- The **remote loopback** on the VF-25 module allows each channel to be looped back independently, making it useful for testing one channel while the other channels on the card remain in service. For this loopback, the analog signal is encoded and transmitted over the T1 circuit, is decoded by the card at the far end, and is then looped back, re-encoded, and sent back to the originating end.

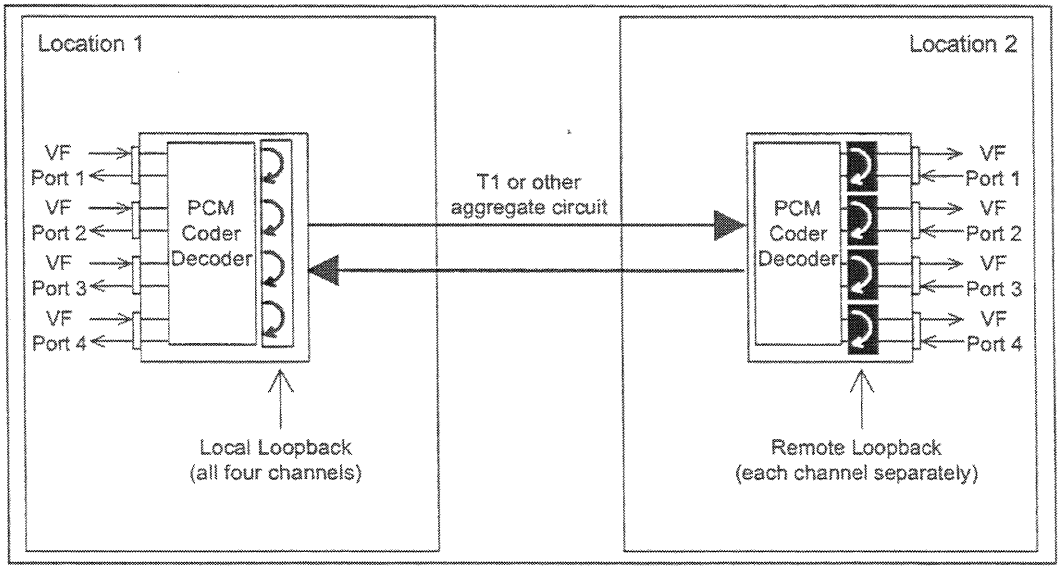


Figure 4-1: VF-25 Loopbacks

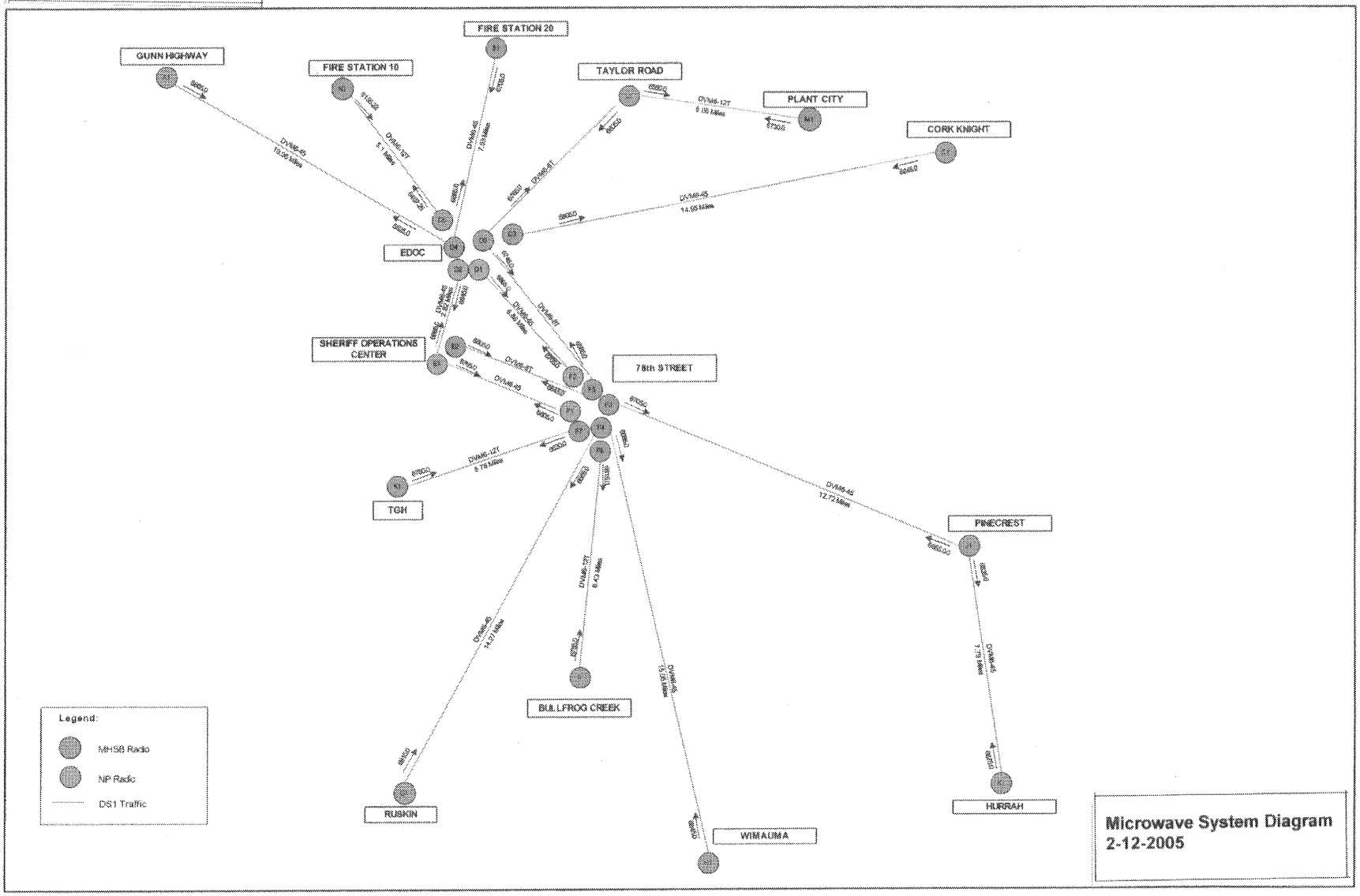
Procedure to Use VF-25 Loopbacks:

1. Activate the desired loopback using P code **P2**, as described in Section 2.8.1, *P Codes*. A local loopback of all four channels may also be activated using the **LOOPBACK** switch (Switch 1, position 6; may be labeled **AUX** on some cards.) When doing a local loopback, test each channel sequentially.
2. Verify that the input and output level jumpers for the channel being tested are in the Normal position (see Table 2-3).
3. Connect the output of an audio signal generator (Hewlett-Packard HP4935A or equivalent) to the input leads for the desired channel. Insert a 1004 Hz test tone at 0 dBm referenced to 600 Ohms.
4. Measure channel output at the output leads for the channel being tested. The output should be 0 dBm referenced to 600 Ohms, ±0.5 dB.
5. Measure signal-to-noise ratio with C message weighting. This should be greater than 33 dB S/N.
6. If you are performing a remote loopback, deactivate the loopback for this channel and activate the loopback for the next channel to be tested. If you are using a local loopback, leave the loopback up until all channels have been tested.
7. Repeat the above steps for each active channel.
8. Remove the test equipment and deactivate all loopbacks.

If there is an apparent malfunction, first check that the configuration is appropriate for the transmission system in use. If your are doing end to end testing, check that the transmit and receive configurations are identical.

Problems may occur at the common equipment or facility level which affect the operation of this card. Refer to the *Troubleshooting* section in your multiplexer operation manual for system analysis procedures.

ATTACHMENT (E)



Hillsborough County Sheriff's Office - Microwave Alignment and Test Data Form

Site Name:	
Site Number:	
Far End Site A1,A2	
Far End Site B1,B2	
TX Frequency A1,A2:	
RX Frequency A1,A2:	
TX Frequency B1,B2:	
RX Frequency B1,B2:	
Start Date:	

Technician:	
Power Meter Model:	
Power Meter Serial:	
Frequency Counter Model:	
Frequency Counter Serial:	

Section 1: Power Supply Voltages

Item	Measure at	A1	A2	B1	B2	Ref
PS -5.2V	DVM MUX DC/DC Converter					VDC
PS +5V	DVM MUX DC/DC Converter					VDC
PS -5.2V	Modem Power Supply					VDC
PS +5V	Modem Power Supply					VDC
PS -20V	Modem Power Supply					VDC
PS +10V	Modem Power Supply					VDC

Section 2: Microwave TX Alignment

Item	Measure at	A1	A2	B1	B2	Ref
TX LO Frequency (Labeled)	Shown on Label					MHz
TX LO Frequency Error (Measured B/A)	TX XTAL LO MON					Hz
TX LOCK Voltage	TX PHASE VOLT MON					VDC
TX Output Level	TX RF MON					dBm
PA Detector Voltage	PA DET LEV					VDC

Section 3: Microwave RX Alignment

Item	Measure at	A1	A2	B1	B2	Ref
RX LO Frequency (Labeled)	Shown on Label					MHz
RX LO Frequency Error(Measured B/A)	RX XTAL LO MON					Hz
RX LOCK Voltage	RX PHASE VOLT MON					VDC
RX AGC MON	RX AGC MON					VDC
RX RSL	RSL on Display Keyboard					dBm

Hillsborough County Sheriff's Office Annual RF Test Data Form

Site Name:	
Date:	
Technician:	

Service Monitor Model:	
Service Monitor Serial No.	
Wattmeter Model:	
Wattmeter Serial No.	

Section 1: TX Performance Data

CHAN	TX Freq	TX Freq Error	LSD Deviation	TX Deviation Limit	DSP Line Input	HSD Deviation	Sniffer Voltage	Fwd Power Station Out	Rev Power Station Out	Fwd Power Combiner Out	Rev Power Combiner Out	Combiner No.	Directional Coupler Output
	MHz	Hz	KHz	KHz	KHz	KHz	VDC	Watts	Watts	Watts	Watts		dBm
1	866.2250												
2	866.7500												
3	867.0625												
4	868.5250												
5	868.7125												
6	868.7375												
7	868.1250												
8	866.2500												
9	866.4125												
10	866.7250												
11	867.0375												
12	868.1000												
13	868.3000												
14	868.6875												
15	867.4000												
MA-CALL	866.0125												
MA-TAC2	867.0125												
MA-TAC3	867.5125												
MA-TAC4	868.0125												

Section 2: RX Performance Data

CHAN	RX Freq	1st LO Freq Error	2nd LO Freq Error	1950 Hz RXV	Line Out RXV	12dB Sinad	RX Bandwidth	Squelch Unmute	Squelch Mute	CP Voter Input Level	CP Voter Output Level		
	MHz	Hz	Hz	dBm	dBm	dBm	OK	dBm	dBm	dBm	dBm		
1	821.2250												
2	821.7500												
3	822.0625												
4	823.5250												
5	823.7125												
6	823.7375												
7	823.1250												
8	821.2500												
9	821.4125												
10	821.7250												
11	822.0375												
12	823.1000												
13	823.3000												
14	823.6875												
15	822.4000												
MA-CALL	821.0125												
MA-TAC2	822.0125												
MA-TAC3	822.5125												
MA-TAC4	823.0125												

Hillsborough County Sheriff's Office Annual RF Test Data Form

Site Name:	
Date:	
Technician:	

Service Monitor Model:	
Service Monitor Serial No.	
Wattmeter Model:	
Wattmeter Serial No.	

Section 1: TX Performance Data

CHAN	TX Freq	TX Freq Error	LSD Deviation	TX Deviation Limit	DSP Line Input	HSD Deviation	Sniffer Voltage	Fwd Power Station Out	Rev Power Station Out	Fwd Power Combiner Out	Rev Power Combiner Out	Combiner No.	Directional Coupler Output
	MHz	Hz	KHz	KHz	KHz	KHz	VDC	Watts	Watts	Watts	Watts		dBm
1	866.2250												
2	866.7500												
3	867.0625												
4	868.5250												
5	868.7125												
6	868.7375												
7	868.1250												
8	866.2500												
9	866.4125												
10	866.7250												
11	867.0375												
12	868.1000												
13	868.3000												
14	868.6875												
15	867.4000												
MA-CALL	866.0125												
MA-TAC2	867.0125												
MA-TAC3	867.5125												
MA-TAC4	868.0125												

Section 2: RX Performance Data

CHAN	RX Freq	1st LO Freq Error	2nd LO Freq Error	1950 Hz RXV	Line Out RXV	12dB Sinad	RX Bandwidth	Squelch Unmute	Squelch Mute	CP Voter Input Level	CP Voter Output Level		
	MHz	Hz	Hz	dBm	dBm	dBm	OK	dBm	dBm	dBm	dBm		
1	821.2250												
2	821.7500												
3	822.0625												
4	823.5250												
5	823.7125												
6	823.7375												
7	823.1250												
8	821.2500												
9	821.4125												
10	821.7250												
11	822.0375												
12	823.1000												
13	823.3000												
14	823.6875												
15	822.4000												
MA-CALL	821.0125												
MA-TAC2	822.0125												
MA-TAC3	822.5125												
MA-TAC4	823.0125												

ATTACHMENT (I)

TEST DATA
TEST RADIOS
CONT CHAN MONITOR

DATE: :

Date Received:			

DEPARTMENT:		DEPUTY:		EDACS Prog:	
UNIT ID No.		TELEPHONE:		EDACS Ver:	
LID				ANTENNA:	
HCSO PROP. No.				BATTERY:	
MODEL No.				SPK/MIC:	
COMBINATION No.				ACCESSORY:	
SERIAL No.					

PROBLEM(S) FOUND:				

TRANSMITTER:

POWER OUT: 10.8 - 12.0 Watts		Watts	CURRENT DRAIN: 7.0 Amps		Amps
FREQ ERROR: +/- 100Hz		Hz	TX AUDIO DIST: < 5%		%
DEVIATION LS: .6 KHz +/- 10 Hz		KHz	1 KHz TEST TONE: 2.6 KHz +/- 50 Hz		KHz
DEVIATION HS: 2.4KHz +/- 50 Hz		KHz	TOTAL MAXIMUM: 3.6 KHz		KHz
AUDIO SENS: <160 mvrms		mVrms	SPECTRUM ANAL:		

RECEIVER:

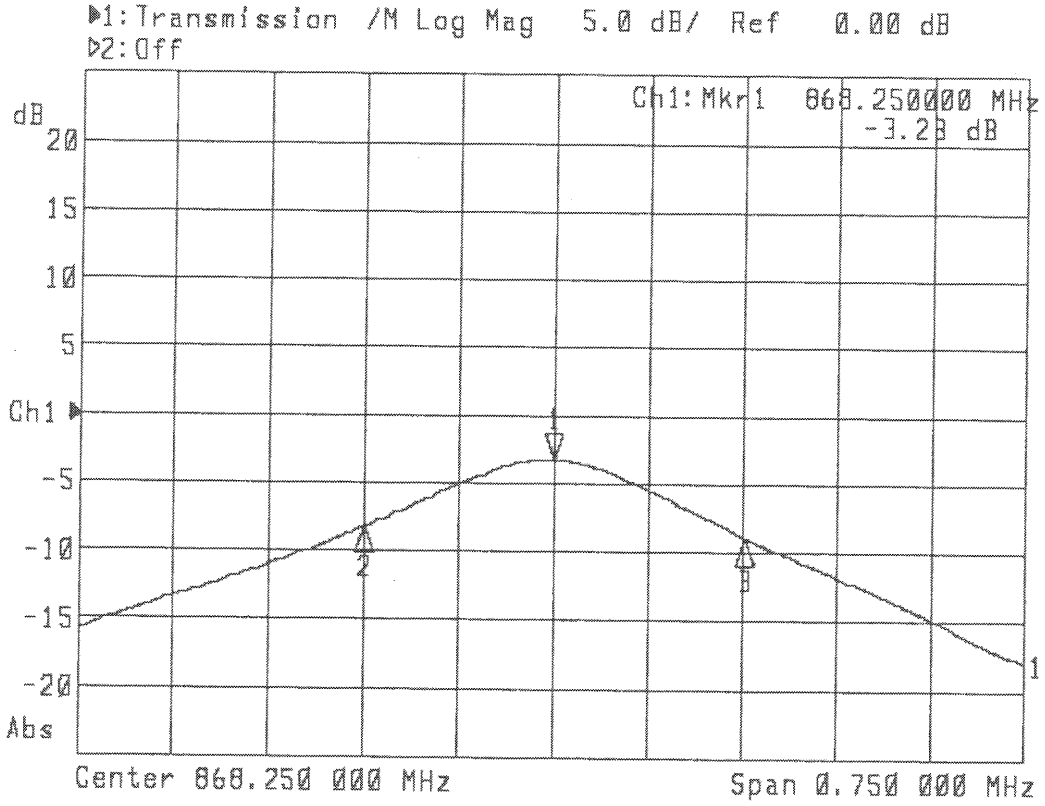
CURRENT DRAIN STANDBY: 1.1 Amps		Amps	CURRENT DRAIN RECEIVE: 3.0 Amps		Amps
FREQ ERROR: +/- 100Hz		Hz	RX AUDIO DIST: < 5%		%
12 dB SINAD SENSITIVITY < 116 dBm		dBm	IF BANDWIDTH 7.5 KHz		KHz
CRITICAL SQUELCH: < 122 dBm		dBm			

BATTERY CHECKED:		FLASH CODE UPDATED:		FLASH CODE VER.	
Parts Ordered Date:		Encryption Order Date:		BY:	
NOTES:					

PARTS:	QTY	PART No.	DESCRIPTION

TESTED BY TECHNICIAN:		DATE:	

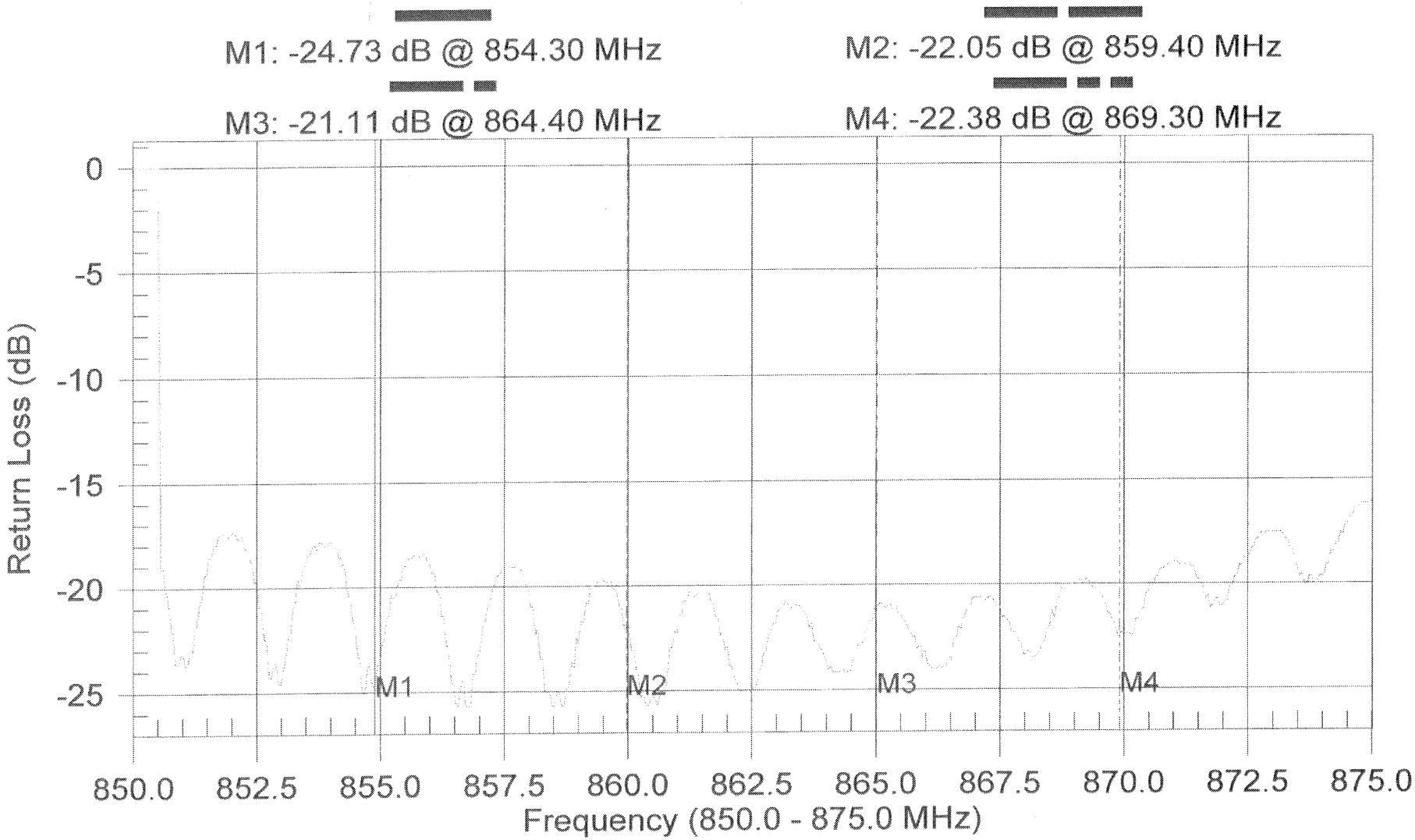
ATTACHMENT (K)
TRANSMIT COMBINER



1: Mkr (MHz)	dB	2: Mkr (MHz)	dB
1> 868.25	-3.23		
2: 868.10	-8.17		
3: 868.40	-8.89		

ATTACHMENT (J)
ANTENNA SWEEPS

Return Loss
BULLFROG TX BLUE



Resolution: 517
BiasTee: OFF
Date: 04/14/2004
Model: S331B

CAL: ON(COAX)
Output Power: -30.00 dBm
Time: 14:25:46
Serial #:

CW On