

12b. Microwave Network Field Acceptance Test Plan

The Acceptance Test Plan (ATP) is performed at the completion of the installation on a per hop basis. The ATP procedure is an “out of service” test. This ATP outlines the standards and tests that Motorola or its authorized subcontractor will adhere to. It is suggested that an authorized Commonwealth representative be present during the testing period to witness each of the acceptance action items.

12b.1.1. Antennas and Lines

Antenna lines will be swept and plotted in conformance with manufacturer's specifications. This measurement is performed with the antenna/feed horn connected to the waveguide under test. The sweep will be over the entire operating bandwidth of the waveguide. A marker will be placed at the TX operating frequency and the Return Loss will be indicated. Acceptable Return Loss measurement is per the manufacturer’s specification or better. All swept waveguide graphs must be attached and submitted at the completion of the ATP.

In the case where Motorola installs antennas and lines, antennas for each path will be aligned for a receive signal level as indicated by the Path Data sheet using a DMM voltmeter at the “A” side RXU (non-protected or HSB radio config) or “B” side (SD radio config) AGC monitor point and recorded in DC volts.

12b.1.2. Purging and Pressurization

Prior to putting the transmission line system into service, purge each line to remove the moist air that was trapped inside during installation. Leave a flange(s) open at the antenna end and operate the dehydrator until the volume has been changed at least three times. Secure the flange(s).

Once the system has been purged, run the dehydrator and verify proper pressurization. Cycle time will vary by the type of dehydrator and the quality of the system. Refer to manufacture’s specification in Appendix 5 for system pressure and dehydrator cycle time. Cycle time does not apply to membrane dehydrators.

12b.1.3. System DC Power

On installed battery plants, the individual cell voltage (if accessible) will be measured along with the power plant voltage. If the power plant consists of wet cells, the specific gravity will be measured and a pilot cell designated. All measurements will conform to manufacturer's specifications in Appendix 5. These tests must be performed on wet cells after equalization.

On installed chargers, the Float voltage will be set to the battery manufacturer's specification in Appendix 5. In the case of wet cells, the Equalized Voltage will be set according to the manufacturer's specifications and the batteries will be equalized one time (if required) at installation. If applicable, the High Volt Alarm, Low Volt Alarm and Low Volt Disconnect will be set per charger manufacturer's specification in Appendix 5. Record the settings on the ATP General Information section.

12b.1.4. System Grounding

System Grounding will meet Motorola R56 (as amended) specifications.

12b.2 Section i: Radio Test

Specifications not noted in this ATP procedure are noted on the Microwave Terminal Acceptance test sheet. In the event that equipment under test does not conform to ATP specifications, refer to Alignment and Operation section of CM Manual or consult a MNI representative for recommended adjustments. All results will be recorded on the ATP data sheets where applicable.

Evidence of calibration of test instruments will be provided.

12b.2.1. Power Supply Measurements

Measure and record the DC test points on the front edge of the RF/SP power supplies utilizing a DMM.

12b.2.2. RX Measurements

Record the labeled RX frequency. Labeled RX frequency refers to the label on the RX waveguide filter.

Then calculate RX LO frequency by the following:

If $TX > RX$, then $RX\ LO\ Freq = \text{Labeled } RX\ Freq - 70\text{MHz}$

If $TX < RX$, then $RX\ LO\ Freq = \text{Labeled } RX\ Freq + 70\text{MHz}$

A transmit frequency chart with Local Oscillator (LO) frequencies listed will be included in this ATP.

Measure the RX LO frequency at the RX LO Monitor Port on each receiver with a frequency counter. Measured RX LO should be +/- 2 kHz of calculated RX LO frequency. If not adjust RX LO.

Record the value(s)

12b.2.3. TX Measurements

Access local terminal “071” screen and lock all modules to the side (A or B) under test (if applicable). Measure and record the IF (Modulator monitor port). The IF should be within +/- 2kHz of 70Mhz. Test points for all capacity Modulator modules are on the front card edge with exception of the 3DS3 (TP E11) and SONET/SDH (TP E4).

Note: When connecting the provided test cable to the TP verify polarity.

Measure and record the TX LO (LBPK LO OUT port) of the transmitter under test and record (**Caution TX LO power may exceed +7dBm**). TX LO frequency is calculated by adding 140 MHz to the T/R spacing. Measured frequency should be within +/- 6 kHz.

Use the following formula to calculate the RF transmit frequency utilizing the measured RX LO frequency annotated from RX Measurements (1.1), the measured IF and TX LO.

If TX > RX, then $(TX\ LO - IF) + RX\ LO = TX\ Frequency$

If TX < RX, then $(TX\ LO - IF) - RX\ LO = TX\ Frequency$

A transmit frequency chart with Local Oscillator (LO) frequencies listed will be included in this ATP.

Verify calculated TX frequency is within 10ppm of labeled TX frequency and record.

Repeat test for redundant applications. Note: 10ppm at 6GHz is equal to 60 KHz

12b.2.4. RF Power Measurements

Access local terminal “071” screen and lock all modules to the side (A or B) under test (if applicable). Access screen “087” and insure APC mode is set to manual.

Measure the flange output power. The value should be with in +/- 0.5 dB of the APC low specification listed in the manual for type of radio. If not adjust TX power.

Record value(s).

Record the labeled attenuation from the TX waveguide monitor port.

Measure and record the RF power out of the online TX monitor port (at TX waveguide filter)

Note: The difference between the measured value at the flange and the measured value at the monitor port should equal the labeled value.

Based on the following formula, calculate Output Power:

Antenna flange output power = (Labeled ONLINE MON) + (Measured ONLINE MON)

Record value(s).

IMPORTANT: Output power could be up to +32dBm. Prior to connecting test equipment remove the IF cable from the Modulator to the TXU under test.

Ensure that the proper attenuation is used for the type of M/W power sensor. Re-install IF cable for testing.

Repeat for redundant applications.

Note: B side is always a nominal 1dB lower than A side for all configurations except for Frequency Diversity, which has equal TX output power for A & B sides.

Verify APC step size. Access screen "087" and select APC ON for 1-2 minutes. Confirm output power meets published specifications (+/- 0.5 dB) for type of unit under test and record. Verify link performance as indicated by screen "004" of remote terminal (far-end) is better than 10^{-13} during APC high.

Note: DHP transmitters may need calibrating of the pre-distorter if transmit power was adjusted or BER exceeds 10^{-13}

12b.2.5. RSL/AGC

This test assumes that the path and antenna alignment has been validated by Motorola as shown by an acceptable receive signal level at the input of the receiver(s). Record calculated RSL from the path data work sheet on the ATP. The ATP will include a Fade Margin Test to be implemented utilizing the following procedure:

Using a *continuously variable* vane attenuator, installed at the TXU output, attenuate near-end transmit power only while monitoring far-end AGC and link BER (internal radio link

performance counter or BER test set). Attenuate near-end transmit power until link BER reaches 1.00×10^{-6} . Note AGC voltage. Continue to attenuate until 1.00×10^{-3} BER. Note AGC voltage. Verify that 10^{-6} and 10^{-3} threshold readings are within +/-1dB of factory data sheet. Repeat for opposite direction.”)

With the radio APC on record the DC voltage from the AGC monitor point on the receiver(s)

From the factory test data sheet convert the voltage to dBm for each receiver. For this to be accurate verify the serial number of the receiver matches the test data sheet. Record the data on the ATP.

Verify the measured receive signal (dBm) meets the calculated RSL as provided via the system Path Data Sheet. This number usually assumes that APC is high.

Note: If the calculated vs. measured is not within +/- 2dB, contact the MNI Program Manager.

Access the local terminal screen “005” for RSL measurements. Readings at this point are for record reference only. Record the “RSL at Antenna” from LDU screen “005”.

Repeat the above measurements with radio APC off. Record the data on the ATP.

Note: For Hot Standby configurations only, the RSL metering for the B side is always a nominal 10dB lower than the A side.

12b.2.6. Radio Auto/Manual Switching (Hot Standby config only)

Manual protective switching capabilities will be performed and verified via the local access port Path Switching Screen “071”. Switching will be done with a DS1 pseudo random pattern QRSS signal applied. Automatic protective switching will be achieved by removing duplicate modules. Verify DS1 signal is recovered and no bit errors occurred after each switch is complete.

12b.2.7. Radio Loopbacks (confirmation)

Radio Loopback functions will be demonstrated when/where applicable via local terminal screen “081”. Apply a DS signal and verify error-free operation during each loopback.

12b.2.8. Radio Alarm Status

An individual alarm check will be performed to verify module fault reporting via Alarm summary screen “035”. Verify appropriate radio alarm and front panel LED response for

simulated faults. Clear all alarms and verify alarm status LED's are extinguished and mark off results on performance data sheet.

12b.3 Section II: Service Channel/Orderwire

12b.3.1. SCU/OWU (functionality)

The Service Channel will be strapped/configured per Commonwealth specifications. Orderwire/Service Channels will be tested utilizing standard voice conversations. An address will be assigned to a site consisting of an OWU. DTMF signaling will be confirmed by dialing into a corresponding site. An "all call" (star key of handset) tone will be generated and confirmed via OWU buzzer or speaker panel amplifier (where applicable). Repeat test for redundant Service Channels.

OWU's are non-redundant.

12b.4 Section III: OC3/DS3/DS1 Testing

12b.4.1. OC3/DS3/DS1 Routing (description)

All OC3/DS3/DS1 circuits in the system are to be wired and routed in accordance with the system channel plan. Each circuit should be routed to a demarcation point that provides access for testing. The typical demarcation point is a DSX3 or DSX1 panel or punch block. Briefly describe DS3/DS1 equipment routing on performance data sheet.

Example: 28 T1 radio routed to DSX panel and cross-connected to co-located 28 T1 radio.

Note: Duration of test on individual circuits will depend upon the customer's requirement. Typically, the circuit under test duration will be 5-10 seconds to verify error free operation and proper circuit routing/termination.

12b.5 Section IV: UPSR Turn-Up

This section provides a high-level overview of the steps required to provision a FLASHWAVE 4100 system described in Appendix 5 and place it in a network. It defines the steps or operations that will be performed and the sequence for performing the operations. Refer to Chapter 2, SONET Turn-Up Procedures for additional information regarding the following provisions in Appendix 5.

Note: MNI will have staged, provisioned and tested all SONET Add/Drop Mux's with the associated microwave equipment prior to delivery. This section is for field reference.

12b.5.1. UPSR Provisioning

Provision the line equipment.

Note: If auto-provisioning is enabled, both the equipment and the facility are provisioned when the plug-in units are inserted.

Provision the line facilities, Section Data Communications Channel (SDCC) link (where applicable) and SSM synchronization.

Note: This completes the assignments required to establish communications, except for connecting the fiber cables.

Provision the service unit equipment, facilities and cross-connections. A database backup will be performed to CD/DVD storage media.

In a typical UPSR configuration, the line unit in slot 1 (OC-n) communicates with one NE on the ring (East NE) and the line unit in slot 2 (OC-n) communicates with one NE on the ring (West NE).

Note: If auto-provisioning is enabled, both the equipment and the facility are provisioned when the plug-in units are inserted.

12b.6 Section V: Subtending UPSR Ring Process

Subtending UPSR rings in a FLASHWAVE 4100 are service circuits that are used to transport high-speed data from multiple NE's that are connected to a UPSR ring. The data can be terminated locally, passed on to another subtending (another service circuit) ring, or passed on to other NEs over the high-speed lines (line units). That is subtending rings are either protected or unprotected service circuit cross-connections in the local NE but are UPSR connections in the subtended NE.

Note: MNI will have staged, provisioned and tested all SONET Add/Drop Mux's prior to delivery. This section is for field reference.

12b.6.1. Subtending Provisioning

Provision the service circuits (slots 3 through 14 in the Large shelf or 3 through 8 in the Small shelf).

Provision the cross-connects for these service circuits.

Go to the subtended NE(s) and perform the operations to establish a UPSR ring.

12b.6.2. Cables/Connections (seated and secured)

Inspect all optical cables/connectors for proper seating and termination.

12b.7 Section VI: UPSR Loop Testing

The following tests will demonstrate the functionality of the loop protection equipment within a UPSR looped network. This test will verify that data can be re-routed via manual/automatic means.

This test assumes that the designated DS1 under test will have Terminal line access via demarcation point with DS1 data applied from a calibrated test set.

12b.7.1. UPSR Auto Loop Switch (functionality)

Identify the local and remote terminals. Connect test equipment to the appropriate interface port of the circuit under test. Verify the test sets are synchronized.

Remove the working fiber plug-in unit at the local site to simulate a failure. Removing the card from service will introduce a momentary burst of errors to the circuit under test.

A successful switch is defined as, a switch, which reverts data to an alternate path that is defined by the microwave channel plan. Additionally, the switch will not produce a situation that would result in the termination equipment losing synchronization.

Reset the test set and verify that the test sets are synchronized and that no additional errors are detected.

Re-insert the plug-in unit that was removed. Re-insertion of a plug-in unit does not interrupt traffic on the alternate path. Route data back over to the primary direction. A momentary burst of errors is expected. Reset test sets and verify that additional errors are detected.

Repeat Automatic switching test for selected circuits in the microwave channel plan.

12b.8 Section VII: Final System 24 Hour BER

IMPORTANT: Before commencing a 24 Hour BER, the CM's Time and Date "054" will be set. Both the Statistics Menu "006" and the Alarm Log "038" will also be cleared or reset for each terminal.

12b.8.1. 24 Hr System BER

A BER test will be performed on a twenty-four (24) hour per hop basis or system basis where applicable. This test will be performed on the radio and/or system "A" side for twelve (12) hours with the remaining twelve (12) hours on the "B" side. This test will be a DS1 circuit end-to-end test, and should be run over primary and protect loop and/or SONET ring network elements and

A & B equipments for MHSB. ESF B8ZS circuits will be tested with a 2 in 23 pattern. AMI circuit will use QRSS pattern.

A minimum of (12) hour BER is required for Non-Redundant radio applications unless otherwise specified. End to end DS1 circuits will meet a BER of 1×10^{-9} .

12b.8.2. UPSR Ring Direction (verified)

Testing of the UPSR ring will be performed by configuring Add/drop terminals onto the primary direction for (12) hours with the remaining (12) hours configured to the Alternative direction. The UPSR ring testing may be executed in conjunction with redundant radio testing applications.

IMPORTANT: Motorola's test equipment results will conform to parameters as defined in ITU Rec. G-821. Record all results in the Final System Acceptance data sheet of the ATP.

Describe test configuration (to include loop backs, daisy chaining...etc) and any/all additional test requirements and results in the blank section provided on the Final System Acceptance data sheet of the ATP.

12b.9 Section VIII: Remedies

If there is a failure to meet Commonwealth's specifications on any of the items in the ATP and the fault cannot be immediately remedied, the exception will be noted and the test continued. A re-test of the item for the purpose of clearing the exception will be witnessed by the Commonwealth within a twenty-four (24) hour period, upon remedy of the fault. Motorola will cover the expense for the Commonwealth for retesting.

List all remedies and the date of completion on the ATP.

12b.10 Section IX: Final Acceptance

All test equipment real time results will have been witnessed by a Commonwealth representative and recorded onto the final page of the ATP. Final System Acceptance must be signed and dated by the appropriate Commonwealth representative.

Printed BER results and copies of all recorded field data will be provided.

The Motorola representative will attach and submit all swept waveguide graphs for all antennas & lines and results of the fade margin tests.

Signed ATP will be returned to the Motorola PM or project representative. Copies will be distributed upon request.

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