



## **Mobexcom P25 DVRS Technical Evaluation**

The Office for Interoperability and Compatibility

Department of Homeland Security

**Test Procedures and Feature Configuration**



**Homeland  
Security**

TE-08-0006

December 2007



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### **Defining the Problem**

Emergency responders—police officers, fire personnel, emergency medical services—need to share vital voice and data information across disciplines and jurisdictions to successfully respond to day-to-day incidents and large-scale emergencies. Unfortunately, for decades, inadequate and unreliable communications have compromised their ability to perform mission-critical duties. Responders often have difficulty communicating when adjacent agencies are assigned to different radio bands, use incompatible proprietary systems and infrastructure, and lack adequate standard operating procedures and effective multi-jurisdictional, multi-disciplinary governance structures.

### **OIC Background**

The Department of Homeland Security (DHS) established the Office for Interoperability and Compatibility (OIC) in 2004 to strengthen and integrate interoperability and compatibility efforts to improve local, tribal, state, and Federal emergency response and preparedness. Managed by the Science and Technology Directorate, and housed within the Communication, Interoperability and Compatibility thrust area, OIC helps coordinate interoperability efforts across DHS. OIC programs and initiatives address critical interoperability and compatibility issues. Priority areas include communications, equipment, and training.

### **OIC Programs**

OIC programs, which are the majority of Communication, Interoperability and Compatibility programs, address both voice and data interoperability. OIC is creating the capacity for increased levels of interoperability by developing tools, best practices, technologies, and methodologies that emergency response agencies can immediately put into effect. OIC is also improving incident response and recovery by developing tools, technologies, and messaging standards that help emergency responders manage incidents and exchange information in real time.

### **Practitioner-Driven Approach**

OIC is committed to working in partnership with local, tribal, state, and Federal officials to serve critical emergency response needs. OIC's programs are unique in that they advocate a "bottom-up" approach. OIC's practitioner-driven governance structure gains from the valuable input of the emergency response community and from local, tribal, state, and Federal policy makers and leaders.

### **Long-Term Goals**

- Strengthen and integrate homeland security activities related to research and development, testing and evaluation, standards, technical assistance, training, and grant funding.
- Provide a single resource for information about and assistance with voice and data interoperability and compatibility issues.
- Reduce unnecessary duplication in emergency response programs and unneeded spending on interoperability issues.
- Identify and promote interoperability and compatibility best practices in the emergency response arena.

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**Department of Homeland Security (DHS)  
Science and Technology Directorate (S&T)  
Office for Interoperability and Compatibility (OIC)**

**TECHNOLOGY EVALUATION PROJECT**

***Technical Evaluation of the  
Mobexcom P25 Digital Vehicular Repeater System***

*Manufactured by Futurecom Systems Group, Inc.*

***Test Procedures and Feature Configuration***

**Document No. TE-08-0006**

December 2007



**Homeland  
Security**

## **Publication Notice**

### **Abstract**

This report presents the testing procedures employed in the technical evaluation of the Mobexcom P25 Digital Vehicular Repeater System (DVRS). The Mobexcom P25 DVRS is designed to enable interoperability between wireless public safety communication systems. It does this by establishing a wireless link between the DVRS and a trunked radio system. For a summary of the results obtained from the testing procedures described here, see the test procedures companion document: *Technical Evaluation of the Mobexcom P25 Digital Vehicular Repeater System – Overview and Test Results* (Document No. TE-08-0005).

### **Disclaimer**

The U.S. Department of Homeland Security's Science and Technology Directorate serves as the primary research and development arm of the Department, using our Nation's scientific and technological resources to provide local, state, and Federal officials with the technology and capabilities to protect the homeland. Managed by the Science and Technology Directorate, the Office for Interoperability and Compatibility (OIC) is assisting in the coordination of interoperability efforts across the Nation.

Certain commercial equipment, materials, and software are sometimes identified to specify technical aspects of the reported procedures and results. In no case does such identification imply recommendations or endorsement by the U.S. Government, its departments, or its agencies; nor does it imply that the equipment, materials, and software identified are the best available for this purpose.

### **Contact Information**

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## Executive Summary

OIC conducted a series of tests to evaluate the functionality of the Mobexcom P25 Digital Vehicular Repeater System (DVRS). The DVRS is composed of two parts. One system component is the Mobexcom Digital Vehicular Repeater (DVR) and it is manufactured by Futurecom Systems Group, Inc. (<http://www.futurecom.com>). The second component of the DVRS is the Motorola XTL 5000 with an O5 Control Head which is manufactured by Motorola, Inc. (<http://www.motorola.com>). The DVRS is part of a collection of vehicular repeater technology products offered by various manufacturers.

This report presents the testing procedures employed in the technical evaluation of the Mobexcom P25 DVRS. To evaluate the Mobexcom P25 DVRS, testing was partitioned into two groups, specification and feature tests. The specification-based tests verify whether the Mobexcom DVRS conforms to the specifications published by the manufacturer. The feature-based tests verify whether advertised features function as the manufacturer's documentation describes. The feature tests also help users understand the use of particular features and how to configure them for correct operation. For a brief summary of the results obtained from the execution of these procedures, general information related to OIC, and general information regarding the Mobexcom P25 DVRS, see the test procedures companion document: *Technical Evaluation of the Mobexcom P25 Digital Vehicular Repeater System – Overview and Test Results* (Document No. TE-08-0005).

## Document Scope and Intended Audience

The report provides the detailed test procedures used to evaluate each feature and specification-based test executed against the DVRS. The technical nature of this document serves anyone who might configure or operate the Mobexcom P25. The report also serves as a reference for duplicating the procedures for evaluating this product.

### 1 Overview of the Mobexcom P25 DVRS

The Mobexcom P25 DVRS is designed to enable interoperability between wireless public safety communication systems. It does this by establishing a wireless link between the DVRS and a trunked radio system. The DVRS comprises two components: the MSU (Motorola XTL 5000), and the repeater unit (the DVR).

The MSU communicates with a trunked P25 system. The repeater unit serves PSUs that are outside the range of the trunked system. These PSUs are referred to as "local-side" PSUs. The repeater unit is interfaced to the MSU via a 25-pin cable. Since the MSU is capable of communicating with the trunked radio system, this link allows the local-side PSUs to communicate with PSUs that are served exclusively by the trunked radio system. These PSUs are referred to as "system-side" PSUs. The wireless link to the trunked system also allows local-side PSUs to communicate with dispatchers.

The DVRS behaves like any other conventional repeater, except it can communicate with a trunked radio system, and it is portable. The DVRS is essentially capable of extending the coverage area of a trunked system to PSUs that are out of range of the trunked radio system.

This extension includes extending talk groups (TGs) that are configured in the trunked radio system to the local-side PSUs during a group call.

A local-side PSU can set up a private call with a system-side PSU. In addition, a user can create a network of DVRSs on an ad hoc basis. Of course, each DVRS has to be programmed to enable communication among all DVRSs that comprise the network.

As with any other trunked or conventional repeater, group calls and private calls are allowed. In a group call, one user can simultaneously broadcast, using the Mobexcom P25 DVRS, to several radios. (The radios may be local-side only, or local- and system-side, depending on the mode.) A local-side PSU can also set up a private call with a specific system-side PSU, and vice versa.

The number of subscribers that can be supported on the system side is a function of the trunked radio system.

Figure 1 illustrates how the DVRS can be integrated with a trunked system to help solve interoperability issues.

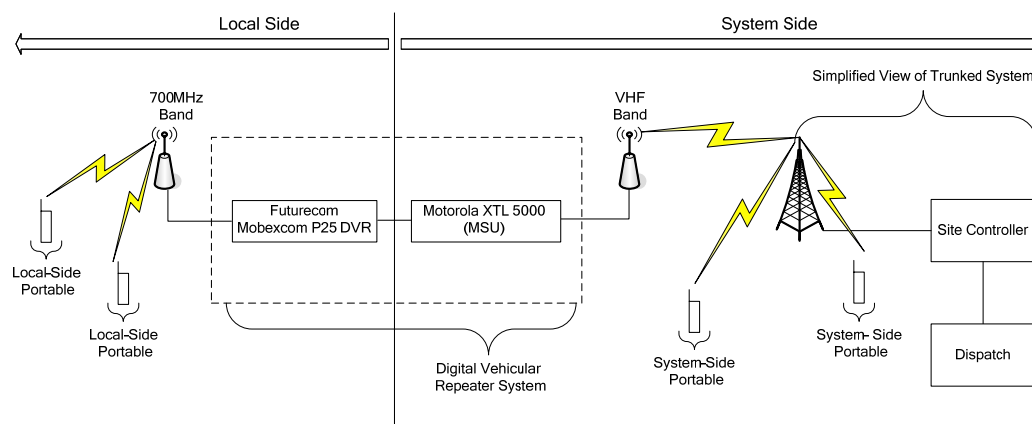


Figure 1: Cross-Band DVRS Configuration Integrated with a Trunked System

### 1.1 Feature Support

The cross-band version of the Mobexcom P25 DVRS in Figure 1 can support Motorola XTS 5000 P25 PSUs, generic PSUs, and analog PSUs. Depending on the type of PSU, the DVRS can support the features in Table 1.

Table 1: DVRS Features per PSU Type

DVRS Feature	XTS 5000 P25 PSU	Generic P25 PSU	Analog PSU
Registration/De-Registration with a Trunked System	Yes	Yes	No
Group Call	Yes	Yes	Yes
Private Call	Yes	No	No

<b>DVRS Feature</b>	<b>XTS 5000 P25 PSU</b>	<b>Generic P25 PSU</b>	<b>Analog PSU</b>
Emergency Call/Alarm	Yes	Yes	Yes
Encrypted Call	Yes	Yes	No
Portable PTT (Push-To-Talk) ID Pass Through	Yes	Yes	No
Call Alert Paging	Yes	Yes	No
Failsoft Indication Generated by Trunked System	Yes	No	No
Out of Range Indication Generated by Trunked System	Yes	No	No
Site Trunking Indication Generated by Trunked System	Yes	No	No
Talk Permit Tones (Generated by PSU)	Yes	No	No
Talk Permit Tones Generated by the DVR	No	No	Yes
Radio Inhibit Originated by Dispatch or Network Management Software	Yes	Yes	No
Radio Check Originated by Dispatch or Network Management Software	Yes	Yes	No
Remote Control of DVRS via Call Alert	Yes	Yes	No
Remote Control of DVRS via Emergency Call/Alarm	Yes	Yes	Yes (MDC 1200)

The following features, in Table 2, are available depending on the mode in which the P25 digital DVRS is operating. Some features of the DVRS are also affected by the PSU type that is being used.

Table 2: Features Available Per Digital DVRS Mode

<b>Feature</b>	<b>DVR Mode: OFF</b>	<b>DVR Mode: SYSTEM</b>	<b>DVR Mode: LOCAL</b>
DVRS Status Display on the O5 Control Head	VR OFF <DVR CH>	VR SYS <DVR CH>	VR LOC <DVR CH>
PSU Affiliation	No	Yes	Yes
Outbound Group Call	No	Yes	Yes
Outbound Private Call	No	Yes	Yes
Mobile (XTL 5000) Microphone PTT	No	No	No
Inbound Group Call	No	Yes	Yes
Inbound Private Call	No	Yes	Yes
Inbound Call Alert	No	Yes	Yes
Inbound Emergency Alarm	Yes	Yes	Yes
Inbound Emergency Call	Yes	Yes	Yes
Remote Control (Steering) of DVRS Using a PSU	Yes	Yes	Yes
Failsoft Indication Generated by Trunked System	No	Yes	No
Out of Range Indication Generated by Trunked System	No	Yes	No
Site Trunking Indication Generated by Trunked System	No	Yes	No
Master/Slave Voting	No	Yes	Yes
DVRS Status Tones at the Mobile (XTL 5000) Speaker	No	Yes	Yes
DVRS Status Tones Passed to the PSU	No	Yes	Yes
Radio Inhibit Originated by Dispatch or Network Management Software	No	Yes	Yes
Radio Check Originated by Dispatch or Network Management Software	No	Yes	Yes

## 1.2 Equipment Illustrations

The left side of Figure 2 shows the DVR portion of the side-by-side version of the Mobexcom P25 DVRS in a metal case with a metal face plate. The right side of Figure 2 shows the MSU portion in a ruggedized metal casing, with the exception of the O5 Control Head. Configuration of the DVR requires a computer attached via a standard USB cable (not included). Configuration of the MSU requires a computer attached via a non-standard USB cable. This non-standard USB to round cable is available only from Motorola, Inc. for about \$45.



Figure 2: Mobexcom DVRS—Cross-Band, Side-by-Side, Mounted Version<sup>1</sup>

The DVR comes with configuration software, known as Tweaker. The Motorola mobile CPS programming software required to program the mobile radio (Motorola XTL 5000) is not included, unless requested when placing the order for the DVRS. A computer meeting the following minimum requirements is necessary: Windows 2000 or newer, 400MHz or higher CPU, 128 MB of RAM (256 MB of RAM if running Windows XP), CD-ROM drive, two USB ports, and a serial port. PSUs are not provided with the DVRS.

In addition to the side-by-side configuration, Futurecom offers a transportable and a fixed DVRS package. Figure 3 shows the transportable DVRS and battery package. The transportable DVRS is housed in a durable suitcase, and includes all necessary electronics and filtering. The transportable package can be powered by either AC power or an optional battery backup kit. The battery backup kit is also packaged in a suitcase. The transportable package requires two antennas, one for the XTL 5000 and one for the DVR.



Figure 3: Transportable DVRS Package (left) and Associated Battery Pack (right).<sup>2</sup>

Figure 4 shows the fixed DVRS package designed for permanent installations. The fixed DVRS package is housed in a wall-mount indoor enclosure, and includes all necessary electronics and filtering.

<sup>1</sup> Picture obtained from the *Mobexcom User's Guide*, Part No. 8A083X20, Rev. 0.

<sup>2</sup> Pictures obtained from the *Mobexcom User's Guide*, Part No. 8A083X20, Rev. 0.



Figure 4: Fixed DVRS Package<sup>3</sup>

For all testing, ensure setup and operation of the unit is conducted in accordance with the:

- *Mobexcom P25 DVRS Installation & Programming Guide*, Part No. 8M083X01, Rev. 1
- *Mobexcom P25 Digital Vehicular Repeater User's Guide*, Part No. 8A083X20, Rev. 0
- *Mobexcom P25 Functional Description*, Part No. 8K083X01, Rev. 3

## 2 General Evaluation Approach: Laboratory Testing

The first phase of evaluation involves laboratory testing and analysis. The aim is answering two basic questions:

- Does the product operate and perform “as advertised” to successfully address the interoperability problems that it was designed to confront?
- Did issues arise during the testing that might affect the use of the product for the purposes advertised?

OIC conducted a series of tests to confirm that the device operates in conformance with published specifications. Further, ancillary tests, of significant interest to the users and agencies in general, were performed to provide a means to benchmark or compare this device to others in its class.

The next sections outline the types of tests and analysis performed. Section 3 lists detailed test and analysis procedures for the Mobexcom P25 DVRS.

### 2.1 Feature Testing

Feature testing determines whether features listed in *Mobexcom P25 Digital Vehicular Repeater User's Guide* operate as described by the manufacturer. The feature tests described in this report include step-by-step instructions the user can actually follow to configure the unit's feature set. All feature testing was performed using Motorola XTS 5000 portables for the local-side subscriber units. The local-side portable subscriber units (PSUs) were configured to operate in the 700 MHz band.

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<sup>3</sup> Picture obtained from the *Mobexcom User's Guide*, Part No. 8A083X20, Rev. 0.



It was necessary to test the Mobexcom P25 DVRS in a trunked P25 environment to validate a majority of its features. The Institute for Telecommunications Sciences (ITS) was able to test Mobexcom P25 DVRS features on the operational, trunked P25 system of the Wyoming Department of Transportation (WY DOT), which operates in the VHF band. The WY DOT staff helped program the mobile radio portion of the DVRS with a trunked radio personality at the appropriate VHF frequency to enable communications with the trunked system. WY DOT had a cache of Motorola XTS-series portable radios programmed to operate on the VHF trunked system (the system-side).

## 2.2 Performance Testing

Performance testing measures how the unit performs compared to the specifications provided by the manufacturer. This report evaluates the following Mobexcom P25 DVRS performance parameters:

- Programmable Power Output
- Transmitter Audio Response
- Transmitter Audio Distortion
- Receiver Sensitivity
- Receiver Intermodulation Product
- Receiver Frequency Deviation
- Receiver Audio Response
- Receiver Audio Distortion

## 2.3 Observations of RF Emissions

Section 4 details the procedures for measuring RF emissions and the results observed for the Mobexcom P25 DVRS.

# 3 Mobexcom P25 DVRS Evaluation

## 3.1 Introduction

To perform any kind of testing, the DVRS must be properly configured according to manufacturer documentation. This report refers to the *Mobexcom P25 Digital Vehicle Repeater Installation & Programming Guide* as the installation guide, and the *Mobexcom P25 Digital Vehicle Repeater User's Guide* as the user guide.

Section 4 of the installation guide was followed to configure the DVRS and the local-side PSUs. For the system to function properly, the DVR, XTL 5000 mobile radio with O5 Control Head, and PSU personality templates (or configuration files) must be matched for frequencies, transmit and receive network identification (NIDs), enabled and disabled of features, etc.

Table 3 lists the recommended general programming sequence.

Table 3: General Programming Sequence

Step	Action	Programming Software Used
1	Create the XTL 5000 mobile subscriber unit (MSU) template with enabled DVR operation.	Mobile Customer Programming Software, or CPS, (Motorola)
2	Export the final .csv file, and save it.	Mobile CPS (Motorola)
3	Create a .dpd file and program the licensed DVR channels. Ensure the DVR frequencies are within the ordered filtering specification.	Tweaker (Futurecom)
4	Import the saved .csv file.	Tweaker (Futurecom)
5	Program the mobile channel attributes as required.	Tweaker (Futurecom)
6	Program the desired Analog and/or Digital mode features in the DVR.	Tweaker (Futurecom)
7	Save the .dpd template.	Tweaker (Futurecom)
8	Create the XTS 5000 PSU template. Ensure DVR operation is enabled.	Portable Radio CPS (Motorola)
9	Save the PSU codeplug.	Portable Radio CPS (Motorola)
10	Provision the local-side PSUs in the trunked system.	Network Management Software

Note that throughout this section, references to several items are specific to the WY DOT system. Table 4 lists naming conventions specific to the WY DOT system and conventions specific to the testing.

Table 4: WY DOT Aliases Defined

Alias	Definition
WYO Link	WYO Link is an alias for a zone that contains trunked personalities WYO 1-WYO 4.
WYO 1	WYO 1 is an alias to indicate a trunked personality type that is associated with talk group (TG) number 1.
WYO 2	WYO 2 is an alias to indicate a trunked personality type that is associated with TG number 3.
WYO 3	WYO 3 is an alias to indicate a trunked personality type that is associated with TG number 5.
WYO 4	WYO 4 is an alias to indicate a trunked personality type that is associated with TG number 7.
765.05B	This is an alias for a DVR analog channel that has been assigned a channel number of 3.

Alias	Definition
765.05D	This is an alias for a DVR digital channel that has been assigned a channel number of 1.

The following test equipment was used to conduct these tests:

- Aeroflex IFR 2975 P25 Radio Test Set
- Tektronix TDS 3012B Digital Storage Oscilloscope
- Audio Precision ATS-1 Dual Domain Audio Test System Audio Analyzer
- Rhode & Schwarz SMIQ Signal Generator
- Agilent 8903B—Baseband Audio Analyzer
- Two Agilent E4438C Signal Generators

In this report, the Tektronix TDS 3012B Digital Storage Oscilloscope is referred to as *DSO*. The Audio Precision ATS-1 Dual Domain Audio Test System Audio Analyzer is referred to as *Audio Test Set*. Lastly, the Aeroflex IFR 2975 P25 Radio Test Set is referred to as *IFR 2975*.

### 3.2 Conformance to Manufacturer’s Feature Description

The tests outlined in the sections that follow determine if the features advertised by the manufacturer conform to what is published in the document set, and summarize the results obtained. Each test comprises the following components:

- The feature under test
- A description of the test
- Initial conditions
- The test procedure
- A summary of the results and their significance

The last component, “Test Case Results and Summary” section of each test, includes one of the following states to summarize how the feature performed compared to its description in the manufacturer’s user guide:

- *Pass*. The feature performed as described in the manufacturer’s user guide.
- *Pass with Exceptions*. The feature performed for the most part as described in the manufacturer’s user guide.
- *Inconclusive*. Documentation discrepancies make it unclear whether the feature performed as the manufacturer described.
- *Fail*. The feature did not perform as the manufacturer described in the user guide.

### 3.3 DVRS Power Up Options

#### 3.3.1 Power Up of the DVRS: OFF Mode

##### Feature Under Test

- Power up of the DVRS in OFF mode

##### Test Case Description

- Based on the programmed personality, verify that the DVR can power up in the OFF mode state.

##### Initial Conditions

- PC with Tweaker software loaded
- USB interface cable connected
- DVRS configured for normal operation per pp. 40–44 of the installation guide

##### Test Procedures

1. From the Tweaker software's DVRS menu tree, select "System Setup 2."
1. On right side of the "System Setup 2" menu, look for the "Power Up Options" box.
2. In the "Mode" box, select "Fixed."
3. In the "Fixed Mode" box, select "OFF."
4. For the "Channel" option, select any DVRS programmed channel.
5. From the DVRS menu tree, select "Hardware Setup."
6. Uncheck the "Automatic VR Activation" box (in the upper-right part of the menu).
7. Locate "Automatic VR Activation OFF," and select "Toggle."
8. Write changes to the DVR.  
After changes have been written to the DVR, "VR OFF XXXX" displays at the O5 Control Head. "XXXX" is the current channel that is selected.
9. Using the O5 Control Head, press the "Zone" softkey. Use the channel select knob to select the desired zone.
10. On the O5 Control Head, press the "Home" button.
11. Use the channel select knob to choose the desired analog or digital channel.
12. Press the "Home" button again.
13. Use the softkey scroll buttons to scroll until "VRS" is listed as a softkey button.
14. Press the "VRS" softkey.
15. Use the channel select knob to select the desired analog or digital channel. This display will contain the selected channel and mode. Example: "VR SYS XXXX," where "XXXX" is the current channel.
16. From the O5 Control Head, power off the DVRS, then power on the DVRS. "VR OFF XXXX" displays.

##### Test Case Results and Summary

*Pass.* This test case verified that when configured properly, the DVRS can power up in the OFF mode. This feature is useful when a user wants the DVRS to be in powered up state, but not have the capability to engage with local- or system-side PSUs.

### **3.3.2 Power Up of the DVRS: On a Slaving-Enabled Channel**

#### **Feature Under Test**

- Power up of the DVRS in LOCAL mode on a preprogrammed DVR channel

#### **Test Case Description**

- Based on the programmed personality, verify that the DVR can power up in the LOCAL mode on the DVR channel that is preprogrammed.

#### **Initial Conditions**

- PC with Tweaker software loaded
- USB interface cable
- DVRS configured for normal operation per pp. 40–44 of the installation guide

#### **Test Procedures**

1. From the Tweaker software's DVRS menu tree, select "Repeater Channel Setup."
2. Locate all desired analog and digital channels, and change the associated "VR Mode" column to "User."
3. From the DVRS menu tree, select "Mobile Radio Channel Setup."
4. In the "TG Mode" column, set all analog and digital channels in all zones to "Local."
5. In the "Manual Mod Chg." column, set all desired analog and digital channels in all zones to "Enable."
6. From the DVRS menu tree, select "System Setup 2."
7. On right side of "System Setup 2" menu, look for "Power Up Options" box.
8. In the "Mode" box, select "Fixed."
9. In the "Fixed Mode" box, select "OFF."
10. In the "Channel" field, enter the desired channel. Note: "0" channels should not be selected.
11. Write changes to the DVR.
12. Press the "Zone" softkey, then use the channel select knob to select the desired zone.
13. Press the "Home" button on the O5 Control Head.
14. Use the channel select knob to choose the desired MSU channel and associated TG.
15. Press the "Home" button again.
16. Use the softkey scroll buttons to scroll until "VRS" is listed as a softkey button. (Note: When configuring the XTL 5000 MSU, select from the available softkeys. All softkeys were made available for these tests.)
17. Press the "VRS" softkey.
18. Use the channel select knob to select the desired analog or digital channel. (Note: After pressing the "VRS" softkey, the channel select knob must be used quickly or the "VRS" softkey will need to be pressed again.)
19. From the O5 Control Head, power off the DVRS, then power on the DVRS. The DVRS will power on in the preprogrammed DVR channel and in the LOCAL mode.

#### **Test Case Results and Summary**

*Pass.* This test case verified that, when configured properly, the DVRS can power up in the LOCAL mode and on a preprogrammed DVR channel. This feature is useful when a user wants the DVRS to power up in a mode where the DVRS is ready to ease communications between

local-side PSUs only, and the user requires that the DVR initially come up on a specific DVR channel.

### **3.3.3 Power Up of the DVRS: SYSTEM Mode (Last Selected DVR Channel)**

#### **Feature Under Test**

- Power up of the DVRS in SYSTEM mode on the last selected DVR channel

#### **Test Case Description**

- Based on the programmed personality, verify that the DVR can power up in the SYSTEM Mode on the DVR channel that was last selected before it was turned off.

#### **Initial Conditions**

- PC with Tweaker software loaded
- USB interface cable
- DVRS configured for normal operation per pp. 40–44 of the installation guide

#### **Test Procedures**

1. From the Tweaker software's DVRS menu tree, select "Repeater Channel Setup."
2. Locate all analog or digital channels of interest and change the associated "VR Mode" column to "User."
3. From the DVRS menu tree, select "Mobile Radio Channel Setup."
4. Locate the "TG Mode" column. Set all analog channels in all zones to "User."
5. From the DVRS menu tree, select "System Setup 2."
6. On right side of "System Setup 2" menu, look for the "Power Up Mode" box.
7. In the "Power Up Mode" box, select "Fixed."
8. In the "Fixed Mode" box, select "OFF."
9. In the "Channel" field, enter 0, or mouse-over the box and right-click "Min = Disable." This will force the DVR to revert to the last used channel on power up.
10. Write changes to the DVR.
11. From the O5 Control Head, press the "Zone" softkey, then use the channel select knob to select the desired zone.
12. Press the "Home" button.
13. Use the channel select knob to choose the desired MSU channel and associated TG.
14. Press the "Home" button again.
15. Use softkey scroll buttons to scroll until "VRS" is listed as a softkey button. (Note: When configuring the XTL 5000 MSU, available softkeys are selected. All softkeys were made available for these tests.)
16. Press the "VRS" softkey on the O5 Control Head.
17. Use the channel select knob to select the desired analog or digital channel. Note: After pressing the "VRS" softkey, the channel select knob must be used quickly or the "VRS" softkey will need to be pressed again.
18. From O5 Control Head, power off the DVRS, then power on the DVRS. The DVRS will power in SYSTEM mode on the DVR channel that was active during the last session.

## Test Case Results and Summary

*Pass.* This test case verified that when configured properly, the DVRS can power up in the SYSTEM mode and on the channel that the user last selected during the previous session. This feature is useful when a user wants the DVRS to power up in a mode where the DVRS is ready to ease communications between local- and system-side PSUs and where the user needs to immediately be on the DVR channel that was in use during the previous session.

### 3.3.4 Power Up of the DVRS: SYSTEM Mode (Preprogrammed DVR Channel)

#### Feature Under Test

- Power up of the DVRS in SYSTEM mode on a preprogrammed DVRS channel

#### Test Case Description

- Based on the programmed personality, verify that the DVR can power up in the SYSTEM mode on the DVR channel that is preprogrammed.

#### Initial Conditions

- PC with Tweaker software loaded
- USB interface cable
- DVRS configured for normal operation per pp. 40–44 of the installation guide

#### Test Procedures

1. From the Tweaker software's DVRS menu tree, select "Repeater Channel Setup."
2. Locate the desired DVR analog or digital channels, and change the associated "VR Mode" column to "User."
3. From the DVRS menu tree, select "Mobile Radio Channel Setup."
4. In the "TG Mode" column, set the desired DVR channels in all zones to "User."
5. From the DVRS menu tree, select "System Setup 2."
6. On right side of "System Setup 2" menu, look for the "Power Up Options" box.
7. In the "Mode" box, select "Fixed."
8. In "Fixed Mode" box, select "OFF."
9. In the "Channel" field, enter the desired channel. Note: "0" should not be selected.
10. Write changes to the DVR.
11. On the O5 Control Head, press the "Zone" softkey, then use the channel select knob to select the desired zone.
12. On the O5 Control Head, press the "Home" button.
13. Use the channel select knob on the O5 Control Head to choose the desired analog or digital MSU channel and associated TG.
14. Press the "Home" button on the O5 Control Head.
15. Use the softkey scroll buttons to scroll until "VRS" is listed as a softkey button.
16. Press the "VRS" softkey on the O5 Control Head.
17. Use the channel select knob to select the desired analog or digital channel. Note: After pressing the "VRS" softkey, the channel select knob must be used quickly or the "VRS" softkey will need to be pressed again.
18. From the O5 Control Head, power off the DVRS, then power on the DVRS. The DVRS will power on in the preprogrammed channel in the SYSTEM mode.

## Test Case Results and Summary

*Pass.* This test case verified that when configured properly, the DVRS can power up in the SYSTEM mode, and on a preprogrammed DVR channel. This feature is useful when a user requires the DVRS to power up in a mode where the DVRS is ready to ease communications between local- and system-side PSUs, and the user requires that the DVR initially come up on a specific channel.

### 3.3.5 Power Up of the DVRS: LOCAL Mode (Last Selected DVR Channel)

#### Feature Under Test

- Power up of the DVRS in LOCAL mode on the last selected DVR channel

#### Test Case Description

- Based on the programmed personality, verify that the DVR can power up in the LOCAL mode on the DVR channel that was last selected.

#### Initial Conditions

- PC with Tweaker software loaded
- USB interface cable
- DVRS configured for normal operation per pp. 40–44 of the installation guide

#### Test Procedures

1. From the Tweaker software's DVRS menu tree, select "Repeater Channel Setup."
2. Locate all desired analog and digital channels, and change the associated "VR Mode" column to "User."
3. From the DVRS menu tree, select "Mobile Radio Channel Setup."
4. In the "TG Mode" column, set all analog and digital channels in all zones to "Local."
5. In the "Manual Mod Chg." column, set all analog channels in all zones to "Enable."
6. From the DVRS menu tree, select "System Setup 2."
7. On right side of the "System Setup 2" menu, look for "Power Up Options" box.
8. In the "Mode" box, select "Fixed."
9. In the "Fixed Mode" box, select "OFF."
10. In the "Channel" field enter 0, or mouse-over the box and right-click "Min = Disable."
11. Write changes to the DVR.
12. Press the "Zone" softkey, then use the channel select knob to select the desired zone.
13. Press the "Home" button on the O5 Control Head.
14. Use the channel select knob to choose the desired MSU channel and associated TG.
15. Press the "Home" button again.
16. Use the softkey scroll buttons to scroll until "VRS" is listed as a softkey button. (Note: When configuring the XTL 5000 MSU, available softkeys are selected. All softkeys were made available for these tests.)
17. Press the "VRS" softkey.
18. Use the channel select knob to select the desired analog channel. Note: After pressing the "VRS" softkey, the channel select knob must be used quickly or the "VRS" softkey will need to be pressed again.



19. From the O5 Control Head, power off the DVRS, then power on the DVRS. The DVRS will power on in LOCAL mode on the last selected DVR channel.

#### **Test Case Results and Summary**

*Pass.* This test case verified that, when configured properly, the DVRS can power up in the LOCAL mode and on the channel that the user last selected during the previous session. This feature is useful when a user wants the DVRS to power up in a mode where the DVRS is ready to ease communications between local-side PSUs only, and where the user needs to be on the DVR channel that was in use during the previous session.

### **3.3.6 Power Up of the DVRS: LOCAL Mode (Preprogrammed DVR Channel)**

#### **Feature Under Test**

- Power up of the DVRS in LOCAL mode on a preprogrammed DVR channel

#### **Test Case Description**

- Based on the programmed personality, verify that the DVR can power up in the LOCAL mode on the DVR channel that is preprogrammed.

#### **Initial Conditions**

- PC with Tweaker software loaded
- USB interface cable
- DVRS configured for normal operation per pp. 40–44 of the installation guide

## Test Procedures

1. From the Tweaker software's DVRS menu tree, select "Repeater Channel Setup."
2. Locate all desired analog and digital channels, and change the associated "VR Mode" column to "User."
3. From the DVRS menu tree, select "Mobile Radio Channel Setup."
4. In the "TG Mode" column, set all analog and digital channels in all zones to "Local."
5. In the "Manual Mod Chg." column, set all desired analog and digital channels in all zones to "Enable."
6. From the DVRS menu tree, select "System Setup 2."
7. On right side of "System Setup 2" menu, look for the "Power Up Options" box.
8. In the "Mode" box, select "Fixed."
9. In the "Fixed Mode" box, select "OFF."
10. In the "Channel" field, enter the desired channel. Note: "0" channels should not be selected.
11. Write changes to the DVR.
12. Press the "Zone" softkey, then use the channel select knob to select the desired zone.
13. Press the "Home" button on the O5 Control Head.
14. Use the channel select knob to choose the desired MSU channel and associated TG.
15. Press the "Home" button again.
16. Use the softkey scroll buttons to scroll until "VRS" is listed as a softkey button. (Note: When configuring the XTL 5000 MSU, available softkeys are selected. All softkeys were made available for these tests.)
17. Press the "VRS" softkey.
18. Use the channel select knob to select the desired analog or digital channel. (Note: After pressing the "VRS" softkey, the channel select knob must be used quickly or the "VRS" softkey will need to be pressed again.)
19. From the O5 Control Head, power off the DVRS, then power on the DVRS. The DVRS will power on in the preprogrammed DVR channel and in the LOCAL mode.

## Test Case Results and Summary

*Pass.* This test case verified that when configured properly, the DVRS can power up in the LOCAL mode and on a preprogrammed DVR channel. This feature is useful when a user wants the DVRS to power up in a mode where the DVRS is ready to ease communications between local-side PSUs only, and the user requires that the DVR initially come up on a specific DVR channel.

## 3.4 DVRS Status Display Features

### 3.4.1 DVRS Status Display: DVR Mode and Channel

#### Feature Under Test

- DVRS status display of the current DVR mode and channel

#### Test Case Description

- Verify that the DVRS current mode and channel alias are displayed on the top line of the LCD display in the O5 Control Head (for example VR SYS CHAN1).

**Initial Conditions**

- The DVR channel under consideration must be programmed to allow the user to set the mode (SYSTEM, LOCAL, and OFF).
- PC with Tweaker software loaded
- USB interface cable
- DVRS configured for normal operation per pp. 40–44 of the installation guide

**Test Procedures**

1. From the O5 Control Head, power on the DVRS.
2. On the top line of the O5 Control Head, observe that “VR SYS XXXX” displays, where “XXXX” is the current DVR channel.
3. Use the softkey scroll buttons to scroll until “VRS” is listed as a softkey button.
4. Pressing the VRS softkey at least two times will cycle through all the possible modes. Pressing the VRS softkey three times will cycle through all the modes and end up back at the initial mode.
5. Press the “Home” button.
6. Use the softkey scroll buttons to scroll until “VRS” is listed as a softkey button.
7. Press the “VRS” softkey.
8. Use the channel select knob to select the desired DVR channel. All the DVR channels that have been programmed in the DVR cycle through as you rotate the channel select knob.

**Test Case Results and Summary**

*Pass.* This test case verifies that the O5 Control Head of the DVRS properly displays the user-selected DVR mode and channel. This feature is useful so that a user knows the mode the DVR is in, and the channel to which it is tuned.

**3.4.2 DVRS Status Display: DVR Status****Feature Under Test**

- DVRS status display indicates the current status of the DVR.

**Test Case Description**

- Verify that the DVR icon changes to indicate the current status (Master, Slave, or Permanent Master) of the DVRS.

**Initial Conditions**

- PC with Tweaker software loaded
- USB interface cable
- DVRS configured for normal operation per pp. 40–44 of the installation guide

**Test Procedures**

Steps 1–5 are the parameters that must be programmed to enable the DVR to take on permanent master status.

1. From the Tweaker software’s DVRS menu tree, select “Digital System Setup.”
2. Locate the Master/Slave section.
3. Uncheck any checked options, specifically “Disable Master/Slave Processing.”

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4. Check the “Permanent Master Status Enabled” option.
5. Write changes to the DVR. After the DVR has completed rebooting, it will come up as a permanent master.
6. In the upper right corner of the O5 Control Head, observe the permanent master icon. (See page 23 of the user’s guide for an example.)

Steps 7–10 describe the process for programming the DVR as a master.

7. From the DVRS menu tree, select the “Digital System Setup” menu.
8. Locate the Master/Slave section.
9. Uncheck all options.
10. Write changes to the DVR. After the DVR has completed rebooting, it will come up as a master.
11. In the upper-right corner of the O5 Control Head, observe the permanent master icon. (See page 23 of the user’s guide for an example.)

Steps 12–20 describe the process for programming the DVR as a slave using only a single DVRS. Normally, one DVRS would be a slave to another DVRS.

12. Ensure the DVR is a master before continuing. From the O5 Control Head, adjust the DVR channel to the desired channel.
13. Power up the local-side PSU.
14. Select the desired channel that matches the DVR channel.
15. Key up the local-side PSU. **Keep PSU keyed up until step 19.**
16. From the O5 Control Head, power off the DVRS, then power up the DVRS.
17. In the upper-right corner of O5 Control Head, observe the receiving slave icon.
18. Continue observing the O5 Control Head, and de-key the local-side PSU.
19. Slave state will be observed for approximately 3 seconds.

#### **Test Case Results and Summary**

*Pass.* This test case verifies that the DVR icon changes in the O5 Control Head display to indicate whether the DVRS is a master, permanent master, or slave. This feature is useful because the user can see the display of the current status of the DVRS (master, permanent master, or slave) in the O5 Control Head. This feature is important when a network of DVRS devices has been configured.

### **3.4.3 DVRS Status Display: Right-Arrow Indicator Receiving**

#### **Feature Under Test**

- The right-arrow DVR receiving indicator appears in the DVRS status display.

#### **Test Case Description**

- Verify that when the DVR is receiving, the right-arrow icon appears in the O5 Control Head display. One way to do this is by using a local-side PSU to originate a private call with a system-side PSU.

**Initial Conditions**

- PC with Tweaker software loaded
- USB interface cable
- DVRS configured for normal operation per pp. 40–44 of the installation guide
- Trunked system is required

**Test Procedures**

1. Ensure that a digital DVR channel is selected. For this test case, we will use a Mobile channel named “WYO 1” that has a DVR channel of 765.05D, which is a digital DVR channel.
2. Change the mode of the DVR channel, 765.05D, to “SYS” via the O5 Control Head.
3. To place a private call that originates at the local-side PSU, use the Motorola Portable CPS to enable the “CALL” feature as a softkey in the PSU. Select “Radio Configuration” > “Display & Menu,” then select the “Menu Items” tab. All available softkey options are listed in the left-hand column. Select “CALL” from this list, and select “Add >>.” The “CALL” feature then appears in the “Selected Items” column. Write this change to the PSU.
4. On the local-side XTS 5000 PSU, select the “CALL” softkey. If the PSU has a keypad, enter the ID of the System PSU, and then press the PTT (push-to-talk) button to initiate the private call.
5. In the upper-right corner of the O5 Control Head, observe the DVR receiving icon.

**Test Case Results and Summary**

*Pass.* This test case verifies the right-arrow icon appears in the O5 Control Head display to indicate that the DVR is receiving a transmission from a local-side PSU. This feature is useful because the current DVR status display in the O5 Control Head informs a user whether the DVR is receiving a transmission from a local-side PSU.

**3.4.4 DVRS Status Display: Left-Arrow Indicator Transmitting****Feature Under Test**

- DVRS status display indicates with a left arrow that the DVR is transmitting.

**Test Case Description**

- Verify that when the DVR is transmitting, the left-arrow icon displays in the O5 Control Head. One way to do this is by originating a group call on a system-side PSU that terminates at a local-side PSU.

**Initial Conditions**

- PC with Tweaker software loaded
- USB interface cable
- DVRS configured for normal operation per pp. 40–44 of the installation guide
- Trunked system is required

**Test Procedures**

1. Ensure that a digital DVR channel is selected. For this test case, we will use a mobile TG named “WYO 1” that is associated with a DVR channel of 765.05D, which is a digital DVR channel.

2. Change mode of the DVR channel, 765.05D, to “SYS” via the O5 Control Head.
3. Ensure that the local-side PSUs are tuned to the desired DVR channel (in this case, 765.05D).

When the system-side PSU is keyed, voice audio is heard at the local-side PSUs.

4. While the system-side PSU is keyed up, observe the DVR transmitting icon (left arrow) in the upper-right corner of O5 the Control Head.

#### **Test Case Results and Summary**

*Pass.* This test case verifies that the left-arrow icon appears in the O5 Control Head display to indicate that the DVR is transmitting down to local-side PSUs. This feature is useful because the current DVR status display in the O5 Control Head informs a user whether the DVR is transmitting to local-side PSUs.

### **3.4.5 DVRS Status Display: Left- and Right-Arrow Indicator**

#### **Feature Under Test**

- DVRS status display indicates with right and left arrows that the DVRS is transmitting and receiving.

#### **Test Case Description**

- When the DVR is transmitting and receiving, verify that the left- and right-arrow indicators appear in the O5 Control Head display.

#### **Initial Conditions**

- PC with Tweaker software loaded
- USB interface cable
- DVRS configured for normal operation per pp. 40–44 of the installation guide

#### **Test Procedures**

1. From the O5 Control Head, power on the DVRS.
2. Power on XTS 5000 local-side PSU.
3. Use the softkey scroll buttons to scroll until “VRS” is listed as a softkey button. (Note: When configuring the XTL 5000 MSU, available softkeys are selected. All softkeys were made available for these tests.)
4. Press the “VRS” softkey until either “VR SYS XXXX” or “VR LOC XXXX” is displayed on the O5 Control Head. “XXXX” represents the channel that the DVR will use. The channel for the local-side PSU and the VR channel on the mobile must match.
5. Key up the local-side PSU.
6. In the upper-right corner of the O5 Control Head, observe the receiving and transmitting icon.

#### **Test Case Results and Summary**

*Pass.* This test case verifies that the left- and right-arrow icons appear in the O5 Control Head display to indicate the DVR is receiving from a local-side PSU, and transmitting to other local-side PSUs. This feature is useful because the current DVR status displayed in the O5 Control Head informs a user whether the DVR is simultaneously receiving from and transmitting to local-side PSUs.

### **3.4.6 DVRS Status Display: VR ERROR**

#### **Feature Under Test**

- “VR ERROR” is shown on the O5 Control Head when there is a problem with the DVR.

#### **Test Case Description**

- When a DVR has detected an error, verify that the VR ERROR message appears in the O5 Control Head display.

#### **Initial Conditions**

- PC with Tweaker software loaded
- USB interface cable
- DVRS configured for normal operation per pp. 40–44 of the installation guide

#### **Test Procedures**

(WARNING: This test case could cause communications problems between the DVR and the PC programming It.)

1. From the Tweaker software’s DVRS menu tree, select “System Setup 2.”
2. On the top-left side of “System Setup 2” menu, locate the “Local Mode” box.
3. Uncheck the “Local Mode” box, i.e., disable “Local Mode.”
4. Write changes to the DVR.
5. In the upper line (the DVR information line) on the O5 Control Head, observe that this initial message, “VR ERROR,” flashes.
6. In the DVR information line on the O5 Control Head, observe that this second message, “RC ERROR 0800,” flashes.  
The preceding messages will continue to alternately flash.
7. To restore normal operation, repeat steps 1–4; however, in step 3, be sure to check (enable) the “Local Mode” box.

#### **Test Case Results and Summary**

*Pass.* This test case verifies that the “VR ERROR” message appears (alternating with the actual error code) in the O5 Control Head display to indicate the DVR has detected an error. This feature is useful because the current DVR status displayed in the O5 Control Head informs a user whether the DVR is malfunctioning. This also informs the user that the DVR likely requires repair.

## **3.5 DVRS Tone Operation**

### **3.5.1 Talk Permit Tones Sent By DVR: Analog PSU**

#### **Feature Under Test**

- Talk permit tones sent by the DVR to an analog PSU

#### **Test Case Description**

- Verify that talk permit tones generated by the DVR propagate to an analog PSU.

**Initial Conditions**

- PC with Tweaker software
- USB interface cable
- Local-side analog PSU

**Test Procedures**

1. From the Tweaker software's DVRS menu tree, select "System Setup 1."
2. Locate "Repeater Active Tones" at the top of the menu, and check the box to enable the feature.
3. From the DVRS menu tree, select "Tone Setup."
4. Locate the "Rptr Activation Tones" section and "Portable Tone Level."
5. Settings range from 0 percent to 100 percent. This test was executed with the tone level set at 100 percent.
6. Write changes to the DVR.
7. Power on the local-side PSU. An XTS 5000 radio programmed with analog personality was used.
8. From the O5 Control Head, press the "Zone" softkey, then use the channel select knob to select the desired zone.
9. Press the "Home" button on the O5 Control Head.
10. Use the channel select knob to select the desired ANALOG MSU channel and associated TG.
11. Press the "Home" button on the O5 Control Head again.
12. Use the softkey scroll buttons to scroll until "VRS" is listed as a softkey button. (Note: When initially configuring the XTL 5000 MSU, the user is presented with a list of functions that can be assigned to a softkey. For this test, all functions were assigned a softkey.)
13. Press the "VRS" softkey.
14. Use the channel select knob to select the desired DVR channel. Note: After pressing the "VRS" softkey, the channel select knob must be used quickly, or the "VRS" softkey will need to be pressed again.
15. Listen for talk permit tones (also known as Go-Ahead Leading tones) on the local-side PSU.

**Test Case Results and Summary**

*Pass.* This test case verified that the DVRS can pass a Go-Ahead tone to a local-side analog PSU. The Go-Ahead tone allows a user of the local-side analog PSU to know that the system is available for use and is not busy.

**3.5.2 DVRS OFF/SYSTEM/LOCAL Mode: DVRS Status Tones—MSU Speaker****Feature Under Test**

- DVRS status tones at the MSU speaker. The DVRS status tones are: VRS Button Press, DVR Invalid Option, DVR Control Timeout, DVR Denied, Permanent Master ON/OFF, and DVR Active.

**Test Case Description**

Verify the following using the XTL 5000 MSU speaker:

- DVR OFF—Verify DVRS status tones at the MSU speaker are disabled.



- DVR SYSTEM—Verify DVRS status tones at the MSU speaker are enabled.
- DVR LOCAL—Verify DVRS status tones at the MSU speaker are enabled.

#### Initial Conditions

- PC with Tweaker software loaded
- USB interface cable
- Portable CPS programming software and programming cable
- MSU speaker must be connected to the O5 Control Head

#### VRS Button Press: “SYS” and “LOC” Modes

- Listen for the sound at the MSU speaker during the performance of the following tests each time the “VRS” button is pressed.

#### DVR Invalid Option: “SYS” and “LOC” Modes

1. From the O5 Control Head, power on the DVRS.
2. Use the channel select knob to select a channel that is not programmed. “VR DISABLED” displays.
3. Use the softkey scroll buttons to scroll until “VRS” is listed as a softkey button. (Note: When configuring the XTL 5000 MSU, available softkeys are selected. All softkeys were made available for these tests.)
4. Press the “VRS” softkey. A low-pitched tone is heard at the MSU speaker.

#### DVR Control Timeout: “SYS” and “LOC” Modes

DVR control timeout test procedures:

1. From the O5 Control Head, power on the DVRS.
2. Use the channel select knob to select a channel that is DVRS-programmed. “VR YYY XXXX” displays, where “YYY” is the mode and “XXXX” is the DVR channel.
3. Use the softkey scroll buttons to scroll until “VRS” is listed as a softkey button. (Note: When configuring the XTL 5000 MSU, available softkeys are selected. All softkeys were made available for these tests.)
4. Press the “VRS” softkey at least once. The display flashes: “VR SYS 765.05C.” The display stops flashing, and a long high-pitched tone is heard at the MSU speaker.

#### DVR Denied: “SYS” and “LOC” Modes

DVR Denied:

1. From the O5 Control Head, power on the DVRS.
2. Use the channel select knob to select a channel that is **NOT** DVRS-programmed.
3. Key up the XTL 5000 MSU microphone.
4. Listen for a long, low-pitched tone.

#### Permanent Master ON/OFF: “SYS” and “LOC” Modes

Parameter configuration to program a DVR as a master:

1. From the Tweaker software’s DVRS menu tree, select “Digital System Setup.”
2. Locate the Master/Slave section, and uncheck all boxes in this section.
3. Write changes to the DVR.

4. Press the “Zone” softkey, then use the channel select knob to select the desired zone.
5. Press the “Home” button on the O5 Control Head.
6. Use the channel select knob to choose the desired MSU analog or digital channel.
7. Press the “Home” button.
8. Use the softkey scroll buttons to scroll until “VRS” is listed as a softkey button. (Note: When configuring the XTL 5000 MSU, available softkeys are selected. All softkeys were made available for these tests.)
9. Press the “VRS” softkey and hold it. “PERM MASTR ON” will briefly be displayed.
10. In the upper-right corner of O5 Control Head, observe the permanent master icon. (See for comparison page 23 of the user’s guide for an illustration of the MASTER icon.)
11. Listen for a quick, high-pitched chirping sound followed by a longer high-pitched sound. The quick high-pitched tone is the sound for this test.
12. Press the “VRS” softkey and hold it. “PERM MASTER OFF” will briefly be displayed.
13. In the upper right corner of O5 Control Head, observe the master state icon. (Refer for comparison to page 23 of the user’s guide for an illustration of the MASTER state icon.)
14. Listen for a quick, high-pitched chirping sound followed by a longer high-pitched sound. The quick high-pitched tone is the sound for this test.

#### **DVR Active (0–255 Sec. Programmable) Regardless of Master/Slave Status:**

Tests were conducted in permanent master, master, and slave status (at 5 sec., 10 sec., 25 sec., and 255 sec.) A setting of 0 will produce no tones:

1. From the Tweaker software’s DVRS menu tree, select “System Setup 1.”
2. Find “DVR Active Warning Tone” (third box from the bottom).
3. Enter the desired number of seconds between tone soundings.
4. Write to the DVR. (Note: Allow the DVR time to cycle before continuing.)
5. From the O5 Control Head, adjust the volume control.
6. Listen for the tone. Every X number of seconds (the number entered in step 3 of this list), the tone is heard at the MSU speaker.

#### **Test Case Results and Summary**

*Pass.* This test case verified that all DVRS status tones can be heard at the MSU speaker. This set of tones informs a user of the current state of the DVRS.

### **3.5.3 DVRS OFF/SYSTEM/LOCAL Mode: DVRS Status Tones PSU—XTS 5K**

#### **Feature Under Test**

DVRS status tones at a local XTS 5K PSU when XTS 5K is operating on a digital channel. When the PSU is operating on a digital channel, the only tone the DVRS can repeat is the go-ahead tone (a series of three short beeps).

#### **Test Case Description**

Verify the following using an XTS 5000 PSU:

- DVR OFF—Verify DVRS status tones at the PSU are disabled.
- DVR SYSTEM—Verify DVRS status tones at the PSU are enabled.

- DVR LOCAL—Verify DVRS status tones at the PSU are enabled.

#### Initial Conditions

- PC with Tweaker software loaded
- USB interface cable
- Portable CPS programming software and programming cable

#### Test Procedures

##### DVR OFF

1. Ensure that a digital DVR channel is selected. For this test case, we will use a mobile TG named “WYO 1” that is associated with a DVR channel of 765.05D, which is a digital DVR channel.
2. Change the mode of the DVR channel, 765.05D, to “OFF” via the O5 Control Head.
3. Use the Motorola Portable CPS on a local-side PSU, and select “Radio Configuration > “Radio Wide” > “Alert Tones.” Ensure the “Alert Tones” option is checked (enabled). Write to the local-side PSU.
4. Key up the local-side PSU. The series of three short beeps (the go-ahead tone) will not be heard.

##### DVR SYSTEM

1. Ensure that a digital DVR channel is selected. For this test case we will use a mobile TG named “WYO 1” that is associated with a DVR channel of 765.05D, which is a digital DVR channel.
2. Change the mode of the DVR channel, 765.05D, to “SYSTEM” via the O5 Control Head.
3. Use the Motorola Portable CPS on a local-side PSU, and select “Radio Configuration” > “Radio Wide” > “Alert Tones.” Ensure the “Alert Tones” option is checked (enabled). Write to the local-side PSU.
4. Key up the local-side PSU. The series of three short beeps (the go-ahead tone) is heard.

##### DVR LOCAL

1. Ensure that a digital DVR channel is selected. For this test case, we will use a mobile channel named “WYO 1” that has a DVR channel of 765.05D, which is a digital DVR channel.
2. Change the mode of the DVR channel, 765.05D, to “Local” via the O5 Control Head.
3. Use the Motorola Portable CPS on a local-side PSU, and select “Radio Configuration” > “Radio Wide” > “Alert Tones.” Ensure the “Alert Tones” option is checked (enabled). Write to the local-side PSU.
4. Key up the local-side PSU. The series of three short beeps (the go-ahead tone) is heard.

#### Test Case Results and Summary

Pass. This test case verified that the DVRS can pass a Go-Ahead tone to local-side XTS 5000 PSUs that are operating on a digital channel. The Go-Ahead tone allows a user of the local-side XTS 5000 PSU to know that the system is available for use and is not busy.

### 3.6 DVRS Mode Operation

#### 3.6.1 OFF Mode Operation: MSU Receiving from System on Selected MSU TG/Channel

##### Feature Under Test

- When the DVR is in the OFF mode, system-side transmissions are not repeated locally. They are only heard at the MSU speaker.

##### Test Case Description

- While in the OFF Mode, verify that the DVR doesn't repeat audio received by the MSU. The MSU speaker should emit audio.

##### Initial Conditions

- PC with Tweaker software loaded
- USB interface cable
- DVRS configured for normal operation per pp. 40–44 of the installation guide
- Access to a trunked system is required

##### Test Procedures

1. Obtain a system-side PSU.
2. For a trunked channel and TG of interest (in this case, WYOLink WYO 1 was used), use the O5 Control Head to change the DVR mode to "OFF." To do this, use the navigation key to scroll to the "VRS" softkey.
3. Press the "VRS" softkey, and select the "OFF" mode.
4. Use the volume knob on the O5 Control Head to adjust the volume of the mobile radio speaker to an appropriate listening level.
5. Key up the system-side PSU. You should hear audio at the mobile speaker.
6. Verify that no audio is passed to the local-side PSUs by using the volume knob on the O5 Control Head to adjust the MSU speaker level to the minimum setting. Adjust the volume on the local-side PSU to an appropriate listening level.
7. Re-key the system-side PSU. No audio should be heard at the local-side PSU.

##### Test Case Results and Summary

*Pass.* This test case verifies that when the DVR is in the OFF mode, system-side transmissions are not repeated locally. They are only heard at the MSU speaker. This feature is useful when a user has not yet exited the vehicle or structure where the DVRS has been located. This feature allows the user to passively monitor (or listen to) system-side activity.

#### 3.6.2 DVRS Mode Selection: Mode Change by User Prohibited

##### Feature Under Test

- The "Manual Mode Change" option in the "Repeater Channel Setup" and "Mobile Channel Setup" menus.

### Test Case Description

- Verify that, if the mode change by the user is prohibited in the specific DVRS personality, the user can only select, via the VRS button, between the slaved (either LOCAL or SYSTEM) and OFF DVR modes.

### Initial Conditions

- PC with Tweaker software loaded
- USB interface cable
- DVRS configured for normal operation per pp. 40–44 of the installation guide
- Access to a trunked system is required

### Test Procedures

1. From the Tweaker software's DVRS menu tree, select "System Setup 2."
2. Locate "Power Up Options" on right side.
3. For "Mode," select "Programmed."
4. For "Channel," select the desired analog or digital channel.
5. From the DVRS menu tree, select "Repeater Channel Setup" menu.
6. Look for "VR Mode" column.
7. Set the channel number selected in step 4 as "LOC."
8. For the same channel number in the "Man Mode Ch." column, select "DIS."
9. From the DVRS menu tree, select "System Setup 2."
10. "Rptr Independent Channel Change" must be unchecked. Manual DVR channel association (slaving) to the MSU TGs is disabled.
11. From the DVRS menu tree, select "Mobile Radio Channel Setup."
12. Slave the DVR channel and DVR mode to a desired MSU TG. Locate the desired MSU TG that will be the master.
13. Select the channel that corresponds to the channel selected in steps 4 and 7. This DVR channel will be slaved to the TG that was selected in step 12.
14. Set the "TG Mode" column to "LOC." This is the DVR mode that is slaved to the TG that was selected in step 12.
15. Set the "Manual Mode Chg." column to "Disabled."
16. Write to the DVR.
17. In the O5 Control Head, change to the MSU TG that was selected in step 12.
18. Use softkey scroll buttons to scroll until "VRS" is listed as a softkey button. (Note: When configuring the XTL 5000 MSU, available softkeys are selected. All softkeys were made available for these tests.)
19. Press the "VRS" softkey.
20. Only modes "OFF and LOC" will be available.

### Test Case Results and Summary

*Pass.* This test case verified that if the mode change by the user is prohibited in the specific DVRS personality, the user can only select, via the VRS button, between the slaved (either LOCAL or SYSTEM) and OFF DVR modes. This test case also verified that MSU speaker audio is present. This feature may be useful when it is desired to restrict a user's ability to change the mode of the DVR.

### **3.6.3 *DVR Disabled Mobile Radio TGs/Channel***

#### **Feature Under Test**

- DVRS disabled option

#### **Test Case Description**

- Verify that when the user selects a “DVRS Disabled” TG/Channel on the O5 Control Head that the VR DISABLED message appears on the O5 display. Further, that pressing the VRS button results in a DVR invalid option tone, and DVR operation is prohibited (all functions are disabled).

#### **Initial Conditions**

- PC with Tweaker software loaded
- USB interface cable
- DVRS configured for normal operation per pp. 40–44 of the installation guide
- Motorola CPS XTL 5000 programming software and associated USB to round programming cable

#### **Test Procedures**

1. Using the Motorola Mobile CPS, select “Radio Configuration” > “Radio Wide,” then select the “Advanced” tab. Configure a digital conventional (or trunked) channel in the MSU that does not have the “DVRS Hardware” box checked. Alternatively, if there are already channels in the MSU that are configured for DVRS operation, uncheck the “DVRS Hardware” box.
2. Write changes to the MSU.
3. From the O5 Control Head, use the channel select knob to select a channel that does not have the “DVRS Hardware” option enabled. “VR DISABLED” displays in the O5 Control Head.
4. Use the softkey scroll buttons to scroll until “VRS” is listed as a softkey button. (Note: When configuring the XTL 5000 MSU, available softkeys are selected. All softkeys were made available for these tests.)
5. Press the “VRS” softkey. A low-pitched tone indicates DVR operations are prohibited.

#### **Test Case Results and Summary**

*Pass.* This test verified that, when the user selects a “DVRS Disabled” TG/Channel on the O5 Control Head, the VR DISABLED message appears on the O5 display. Pressing the VRS button results in a DVR invalid option tone, and DVR operation is prohibited (all functions are disabled). It is important for a user to be aware of this feature because, without enabling this feature on the channel of interest in the MSU, DVR operation is not possible.

### **3.6.4 *OFF Mode Operation: PSU Activity on DVR Channel***

#### **Feature Under Test**

- Behavior of the DVR OFF mode when a local-side PSU keys up

**Test Case Description**

- When the DVR is in OFF mode, verify that the DVRS transmit function to both the system-side and the local-side is disabled when a local-side PSU keys up. In addition, the MSU speaker should emit no audio.

**Initial Conditions**

- PC with Tweaker software loaded
- USB interface cable
- DVRS configured for normal operation per pp. 40–44 of the installation guide
- Access to a trunked system is required

**Test Procedures**

1. From the O5 Control Head, power on the DVRS.
2. Power on two local-side XTS 5000 PSUs.
3. Power on a system-side XTS 5000 PSU.
4. Select a DVRS-programmed channel in the XTL 5000 MSU that is matched to the desired trunked system channel and TG.
5. The local-side XTS 5000 PSU should be tuned to the appropriate DVR channel.
6. Press the “VRS” softkey until in the DVR is in “SYS” mode (example of O5 Control Head display: “VR SYS 765.O5A”).
7. Key up one of the local-side XTS 5000 PSUs.
8. Listen for audio on the system-side PSU and on the other local-side PSU.
9. Now press the “VRS” softkey again to switch the DVR to the “OFF” mode (example of O5 Control Head display: “VR OFF 765.O5A”).
10. Key up one of the local-side PSUs.
11. Listen for audio on the system-side PSU, on the other local-side PSU, and on the MSU. No audio will be heard.

**Test Case Results and Summary**

*Pass.* This test case verified that when the DVR is in OFF mode, the DVRS transmit function to both the system-side and the local-side is disabled when a local-side PSU keys up. In addition, this test case verified that the MSU speaker should emit no audio. This feature is useful when a user wants to block local-side PSU communication, but desires to monitor system-side activity.

**3.6.5 SYSTEM Mode Operation: Use of MSU Microphone PTT****Feature Under Test**

- MSU microphone PTT allows the user to communicate with system-side PSUs, but not with local-side PSUs while the DVR is in SYSTEM mode.

**Test Case Description**

- When the user presses the MSU’s microphone PTT, and the DVR is in SYSTEM mode, verify that the DVR does not key up. Also, verify that the MSU keys up and is able to send transmissions to system-side PSUs.

**Initial Conditions**

- PC with Tweaker software loaded

- USB interface cable
- DVRS configured for normal operation per pp. 40–44 of the installation guide
- Access to a trunked system is required

### Test Procedures

1. From O5 Control Head, power on the DVRS (this will also power on the XTL 5000 MSU).
2. Press the “Zone” softkey, then use the channel select knob to select the desired zone.
3. Press the “Home” button in the O5 Control Head.
4. Use the channel select knob to choose an analog or digital MSU channel that matches with a valid trunked system channel and TG.
5. Press the “Home” button.
6. Use the softkey scroll buttons to scroll until “VRS” is listed as a softkey button. (Note: When configuring the XTL 5000 MSU, available softkeys are selected. All softkeys were made available for these tests.)
7. Press the “VRS” softkey.
8. Use the channel select knob to select the desired analog or digital DVR channel. (Note: After pressing the “VRS” softkey, the channel select knob must be used quickly or the “VRS” softkey will need to be pressed again.)
9. Press the “VRS” softkey until “VR SYS XXXX” is displayed. “XXXX” corresponds to the DVR channel that was selected.
10. Power on a local-side PSU.
11. Set the channel of this local-side PSU to match that of the DVR.
12. Power on the system-side PSU.
13. Set the channel and TG of this system-side PSU to match the channel and TG used for the XTL 5000 MSU.
14. Key up the microphone on XTL 5000 MSU, and observe the following:
  - i. Listen for audio on the system-side PSU (there will be audio).
  - ii. Listen for audio on the local-side PSU (there will not be audio).
  - iii. In the upper-right corner on the O5 Control Head, observe the RED TX indicating the mobile is transmitting.

### Test Case Results and Summary

*Inconclusive.* This test verified that the MSU microphone PTT allows the user to communicate with system-side PSUs, but not with local-side PSUs, while the DVR is in SYSTEM mode. According to *Mobexcom P25 Functional Description* (Part No. 8K083X01, Rev. 3), the MSU should key up when the microphone PTT is pressed. On the other hand, the user guide states that the MSU should not key up when the microphone PTT is pressed. Therefore, it is not clear if the result obtained from this test case is the intended operation. Based on the behavior observed, it is important a user understands that when the MSU microphone is keyed up, and the DVR is in SYSTEM mode, the transmission is not repeated to the local-side PSUs.



### **3.6.6 LOCAL Mode Operation: MSU Receiving from System on Selected MSU TG/Channel**

#### **Feature Under Test**

- Call Setup—System Repeat in Local Mode Enabled

#### **Test Case Description**

- Verify that the DVR may be programmed to repeat audio received by the MSU to the local-side PSU users over the DVR channel, when the DVR is in LOCAL mode. MSU speaker audio should be present.

#### **Initial Conditions**

- PC with Tweaker software loaded
- USB interface cable
- DVRS configured for normal operation per pp. 40–44 of the installation guide
- Access to a trunked system is required

#### **Test Procedures**

1. In the Tweaker software, from the menu tree, select the Digital System Setup menu. Check the box “Call Setup—System Repeat Mode in Local Mode,” if the feature is not already enabled, and write the change to the DVR.
2. Obtain a system-side PSU.
3. For the desired MSU TG (in this case, “WYO 1” was used), via the O5 Control Head, change the DVR mode to “LOC.” To do this, use the navigation key to scroll to the “VRS” softkey.
4. Press the “VRS” softkey, and select the “LOC” mode.
5. Use the volume knob on the O5 Control Head to adjust the volume of the mobile radio speaker to an appropriate listening level.
6. Key up the system-side PSU. Audio should be heard from the XTL 5000 MSU speaker.
7. While the system-side PSU is keyed, adjust the volume on the local-side PSU to an appropriate listening level. Audio from the system-side PSU will be heard at the local-side PSU and at the mobile speaker.
8. Adjust the system-side PSU to an appropriate listening level. Key up the local-side PSU to verify that no audio is passed to the system-side PSUs.

#### **Test Case Results and Summary**

*Pass.* This test case verified that the DVR may be programmed to repeat audio received by the MSU to the local-side PSU users over the DVR channel, when the DVR is in LOCAL mode. This test case also verified that MSU speaker audio is present. This is a useful feature when a user wants local-side PSUs to listen to system-side activity occurring on a given system-side TG.

### **3.6.7 LOCAL Mode Operation: Use of MSU Microphone PTT**

#### **Feature Under Test**

- MSU microphone PTT allows the user to communicate with system-side PSUs, but not with local-side PSUs while the DVR is in LOCAL mode.

### Test Case Description

- When the user presses the MSU's microphone PTT and the DVR is in LOCAL mode, verify that the DVR does not key up. Also, verify that the MSU keys up and is able to send transmissions to system-side PSUs.

### Initial Conditions

- PC with Tweaker software loaded
- USB interface cable
- DVRS configured for normal operation per pp. 40–44 of the installation guide
- Access to a trunked system is required

### Test Procedures

1. From the O5 Control Head, power on the DVRS. (This will also power on the XTL 5000 MSU.)
2. Press the “Zone” softkey, then use the channel select knob to select the desired zone.
3. Press the “Home” button on the O5 Control Head.
4. Use the channel select knob to choose the desired MSU analog or digital channel.
5. Press the “Home” button.
6. Use the softkey scroll buttons to scroll until “VRS” is listed as a softkey button. (Note: When configuring the XTL 5000 MSU, available softkeys are selected. All softkeys were made available for these tests.)
7. Press the “VRS” softkey.
8. Use the channel select knob to select the desired analog or digital DVR channel. (Note: After pressing the “VRS” softkey, the channel select knob must be used quickly, or the “VRS” softkey will need to be pressed again.)
9. Press the “VRS” softkey until “VR LOC XXXX” is displayed. “XXXX” is the desired DVR channel that was selected previously.
10. Power on the local-side PSU.
11. Set the channel on the local-side PSU to match the channel used for the DVR.
12. Power on the system-side PSU.
13. Set the XTL 5000 MSU channel to match the desired trunked system channel.
14. Key up the microphone on XTL 5000 MSU, and observe the following:
  - i. Listen for audio on the system-side PSU (there will be audio).
  - ii. Listen for audio on the local-side PSU (there will not be audio).
  - iii. In the upper-right corner on the O5 Control Head, observe the RED TX indicating the mobile is transmitting.

### Test Case Results and Summary

*Inconclusive.* This test case verifies that when the user presses the MSU's microphone PTT and the DVR is in LOCAL mode, the DVR does not key up. This test case also verifies that the MSU keys up and is able to send transmissions to system-side PSUs. This test case also verified that MSU speaker audio is present. According to the *Mobexcom P25 Functional Description* (Part No. 8K083X01, Rev. 3), the MSU should key up when the microphone PTT is pressed. On the other hand, the user's guide states that the MSU should not key up when the microphone PTT

is pressed. Therefore, it is not clear if the result obtained from this test case is the intended operation. Based on the observed behavior, this feature might be useful when all local-side voice traffic needs to be funneled through a single individual. This individual would be the local-side PSUs “representative” to the system-side PSUs and to dispatch.

### **3.6.8 DVRS OFF Mode: Microphone PTT (MSU)**

#### **Feature Under Test**

- MSU microphone PTT allows the user to communicate with system-side PSUs, but not with local-side PSUs while the DVR is in OFF mode.

#### **Test Case Description**

- In DVR OFF mode using the XTL 5000 MSU microphone, verify microphone PTT (MSU) is enabled.

#### **Initial Conditions**

- PC with Tweaker software loaded
- USB interface cable
- DVRS configured for normal operation per pp. 40–44 of the installation guide
- Access to a trunked system is required

#### **Test Procedures**

1. From the O5 Control Head, power on the DVRS. (This will also power on the XTL 5000 MSU.)
2. Press the “Zone” softkey, then use the channel select knob to select the desired zone.
3. Press the “Home” button on the O5 Control Head.
4. Use the channel select knob to choose the desired MSU analog or digital channel.
5. Press the “Home” button.
6. Use the softkey scroll buttons to scroll until “VRS” is listed as a softkey button. (Note: When configuring the XTL 5000 MSU, available softkeys are selected. All softkeys were made available for these tests.)
7. Press the “VRS” softkey.
8. Use the channel select knob to select the desired analog or digital DVR channel. (Note: After pressing the “VRS” softkey, the channel select knob must be used quickly or the “VRS” softkey will need to be pressed again.)
9. Press the “VRS” softkey until “VR OFF XXXX” is displayed. “XXXX” is the desired DVR channel that was selected previously.
10. Power on the local-side PSU.
11. Set the channel on the local-side PSU to match the channel used for the DVR.
12. Power on the system-side PSU.
13. Set the XTL 5000 MSU channel to match the desired trunked system channel.
14. Key up the microphone on XTL 5000 MSU, and observe the following:
  - i. Listen for audio on the system-side PSU (there will be audio).
  - ii. Listen for audio on the local-side PSU (there will not be audio).

- iii. In the upper-right corner on the O5 Control Head, observe the RED TX indicating the mobile is transmitting.

### Test Case Results and Summary

*Pass.* This test case verifies that when the user presses the MSU's microphone PTT and the DVR is in OFF mode, the DVR does not key up. This test case also verifies that the MSU keys up and is able to send transmissions to system-side PSUs. This test case also verified that the MSU speaker audio is present. Based on the observed behavior, this feature might be useful when a user is in a vehicle and there are no local-side PSUs with which to communicate. The user can communicate with system-side users.

## 3.7 Extension of Trunked System Features via the DVRS

### 3.7.1 Registration via the DVRS

#### Feature Under Test

- Registration via the DVRS

#### Test Case Description

- The purpose of this test case is to verify for an XTS 5000 PSU that the DVRS will allow a local-side PSU to register with the trunked system.

#### Initial Conditions

- The system-side PSU requires a trunked system with which to communicate
- DVRS configured for normal operation per pp. 40–44 of the installation guide

#### Test Procedures

From the XTL 5000 MSU O5 Control Head:

1. Press the “Zone” softkey, then use the channel select knob to select the desired zone.
2. Press the “Home” button.
3. Use the channel select knob to choose the desired channel.
4. Press the “Home” button.
5. Use the softkey scroll buttons to scroll until “VRS” is listed as a softkey button (Note: When configuring the XTL 5000 MSU, the user selects the softkeys available for display. For this test, all softkeys were made available.)
6. Press the “VRS” softkey.
7. Use the channel select knob to select the desired analog channel. (Note: After pressing the “VRS” softkey, the channel select knob must be used quickly, or the “VRS” softkey will need to be pressed again.) The display will now be active in the selected channel and mode.  
Example: “VR SYS XXXX”

On the local-side XTS 5000 PSU:

1. Power on the radio.
2. Select the zone and channel that corresponds to what has been selected for the DVR.
3. Key up local-side XTS 5000 PSU.

4. At the network management console on the trunked system, observe the registration message in the zone watch mobility report. As an example, the message that was observed during testing is shown below:

```
[08/15/06 15:41:49] Mobility Update - Unit Registration ; Operating Unit =
57(0x39)[SecId=2] DVRS-ITS-4P ; Device = Radio ; Requester Affiliation { Type =
Registered Not Affiliated ; Talkgroup = Undefined ; Site = 1 ; Zone = 1 } ; Protocol = Astro25
; Fixed Unit { ID = 57(0x39) ; WACN ID = 781824(0xBEE00) ; System ID = 420(0x1A4) } ;
Mobility Response = Accepted ; Mobility Response Site# [ 1 ]Local ZoneID = 1 ;
```

#### Test Case Results and Summary

- *Pass.* This test case verified that when a local-side PSU is turned on, the DVRS allows it to register with the trunked system. The fact that a local-side PSU can register with the trunked system is significant because this demonstrates that the DVRS is extending the range of the trunked system.

### 3.7.2 De-Registration via the DVRS

#### Feature Under Test

- De-registration via the DVRS

#### Test Case Description

- Verify that the DVRS will allow an XTS 5000 local-side PSU to de-register from the trunked system.

#### Initial Conditions

- A trunked system is required for the system-side
- DVRS configured for normal operation per pp. 40–44 of the installation guide

#### Test Procedures

1. Follow the steps in test case 3.3 to register a local-side PSU with the trunked system.
2. After the local-side PSU registration message has been observed on the trunked system's Zone Watch application, turn the local-side PSU off.
3. At the trunked system network management console, observe the de-registration message on the Zone Watch mobility report. As an example, the message that was observed during testing is shown below:

```
[08/15/06 15:41:23] Mobility Update - Deregistration ; Reason = Deregistered by ISP ;
Operating Unit = 57(0x39)[SecId=2] DVRS-ITS-4P ; Device = Radio ; Requester Affiliation {
Type = Deregistered ; Talkgroup = Undefined ; Site = 1 ; Zone = Undefined } ; Protocol =
Astro25 ; Fixed Unit { ID = 57(0x39) ; WACN ID = 781824(0xBEE00) ; System ID =
420(0x1A4) } ; Mobility Response Site# [ 1 ]Local ZoneID = 1 ;
```

#### Test Case Results and Summary

*Pass.* This test case verified that when a local-side PSU is turned off, the DVRS allows it to de-register from the trunked system. The fact that a local-side PSU can deregister from the trunked system is significant, because it demonstrates that the DVRS is acting to extend the range of the trunked system.

### 3.7.3 DVRS OFF/SYSTEM/LOCAL Mode: PSU Affiliation—XTS 5K

#### Feature Under Test

- Local-side PSU affiliation with a trunked system

#### Test Case Description

Affiliation is the process of joining a TG. Verify the following using an XTS 5000 PSU:

- DVR OFF—PSU Affiliation is disabled/not available.
- DVR SYSTEM—PSU Affiliation is enabled.
- DVR LOCAL—PSU Affiliation is enabled.

#### Initial Conditions

- PC with Tweaker software loaded
- USB interface cable
- DVRS configured for normal operation per pp. 40–44 of the installation guide
- Access to a trunked system is required
- Local-side PSUs must be programmed into the trunked system's database

#### Test Procedures

##### DVR OFF Mode

1. Ensure that a digital DVR channel is selected. For this test case, we will use a mobile TG named “WYO 1” that has an association with a DVR channel of 765.05D, which is a digital DVR channel.
2. Change the mode of the DVR channel, 765.05D, to “OFF” via the O5 Control Head.
3. When the local-side PSU is keyed, a low-pitched channel denied tone is heard. No Display Icon, which indicates that the repeater is transmitting locally or system-wide, should appear in the O5 head.
4. Verify that no affiliation messages for the local-side PSU appear in the trunked system network management Zonewatch application.

##### DVR SYSTEM Mode

1. Ensure that a digital DVR channel is selected. For this test case we will use a mobile TG named “WYO 1” that has an association with a DVR channel of 765.05D, which is a digital DVR channel.
2. Change the mode of the DVR channel, 765.05D, to “SYS” via the O5 Control Head.

When the local-side PSU is keyed, the PSU ID number displays on the O5 Control Head and on the system-side PSU.

Verify that an affiliation message for the local-side PSU appears on the trunked system network management application known as Zonewatch. An example of the affiliation is shown below:

```
[08/15/06 15:08:41] Mobility Update - Group Affiliation ; Operating Unit = 57(0x39)[SecId=2]
DVRS-ITS-4P ; Operating Group = 80000001(0x1)[SecId=1] WyoLink 1 ; Device = Radio ;
Requester Affiliation { Type = Talkgroup Affiliation ; Talkgroup = 80000001(0x1)[SecId=1]
WyoLink 1 ; Site = 1 ; Zone = 1 } ; Protocol = Astro25 ;
```

**DVR LOCAL Mode**

1. Ensure that a digital DVR channel is selected. For this test case, we will use a mobile TG named "WYO 1" that has a DVR channel of 765.05D, which is a digital DVR channel.
2. Change the mode of the DVR channel, 765.05D, to "LOC" via the O5 Control Head.
3. Ensure the PSU local-side PSU is turned off before starting the test.
4. On power up of the local-side PSU, a registration and group affiliation message displays in the trunked system Zonewatch application. An example of the affiliation message is shown below:

```
[08/15/06 15:08:41] Mobility Update - Group Affiliation ; Operating Unit = 57(0x39)[SecId=2]
DVRS-ITS-4P ; Operating Group = 80000001(0x1)[SecId=1] WyoLink 1 ; Device = Radio ;
Requester Affiliation { Type = Talkgroup Affiliation ; Talkgroup = 80000001(0x1)[SecId=1]
WyoLink 1 ; Site = 1 ; Zone = 1 } ; Protocol = Astro25 ;
```

5. When the local-side PSU is keyed, the PSU ID number displays on the O5 Control Head, but no subsequent group affiliation messages display in the Zonewatch application. Audio is heard on the local-side PSUs, but not on the system-side PSUs.

**Test Case Results and Summary**

*Pass.* This test verified that when the DVR is in either SYSTEM or LOCAL mode, a local-side PSU can affiliate with a particular trunked system TG. This feature demonstrates that the coverage of the trunked system is being extended to the local-side PSUs.

**3.7.4 DVRS OFF/SYSTEM/LOCAL Mode: Radio Inhibit—XTS 5K****Feature Under Test**

- The ability of the DVRS to pass a radio inhibit command (that originated at dispatch or the network management console) down to a local-side PSU.

**Test Case Description**

Verify the following using an XTS 5000 PSU:

- DVR OFF—Verify radio inhibit is disabled.
- DVR SYSTEM—Verify radio inhibit is enabled by observing that the radio inhibit function is passed to the local-side PSUs through the DVRS when SYSTEM mode is selected.
- DVR LOCAL—Verify radio inhibit is enabled by observing that the radio inhibit function is passed to a local-side PSU through the DVRS when LOCAL mode is selected.

**Initial Conditions**

- PC with Tweaker software loaded
- USB interface cable
- DVRS configured for normal operation per pp. 40–44 of the installation guide
- Access to a trunked system is required
- Local-side PSUs must be programmed into the trunked system's database
- Portable CPS programming software and programming cable

## Test Procedures

### DVR OFF Mode

1. Use the Motorola Portable CPS to enable the Radio Inhibit feature on the local-side PSUs. Select “Conventional” > “Astro Systems.” Then, select the astro system with which you are working (in this test case we were working with Astro System #2). Select the “Advanced” tab, and check the “Radio Inhibit” box near the bottom of the tab.
2. Ensure that a digital DVR channel is selected. For this test case we will use a mobile TG named “WYO 1” that is associated with a DVR channel of 765.05D, which is a digital DVR channel.
3. Change the DVR channel, 765.05D, mode to “OFF” via the O5 Control Head.
4. From the trunked system network management console, attempt to send a radio inhibit message to the local-side PSU of interest. The console operator should not see the local-side PSU’s ID, and therefore disabling the radio should not be possible.
5. The selected local-side PSU will not power down.

### DVR SYSTEM Mode

1. Use the Motorola Portable CPS to enable the Radio Inhibit feature on the local-side PSUs. Select “Conventional” > “Astro Systems.” Then, select the astro system with which you are working (in this test case we were working with Astro System #2). Select the “Advanced” tab, and check the “Radio Inhibit” box near the bottom of the tab.
2. Ensure that a digital DVR channel is selected. For this test case we will use a mobile TG named “WYO 1” that is associated with a DVR channel of 765.05D, which is a digital DVR channel.
3. Change the DVR channel, 765.05D, mode to “SYS” via the O5 Control Head.
4. From the trunked system network management console, send a radio inhibit message to the local-side PSU of interest. The console operator should see the ID of the local-side PSU. The selected local-side PSU will then be disabled. The display will be blank, and if the local-side PSU is keyed, it will not transmit. The PSU will also be unable to receive.

### DVR LOCAL Mode

The table on page 33 of the user guide incorrectly indicates this feature is available. However, Futurecom says it is a Phase II feature. As of August 2006, the feature does not work

## Test Case Results and Summary

*Pass:* DVR OFF Mode, DVR SYSTEM Mode. *Fail:* DVR LOCAL Mode. This test case verified that a radio inhibit command can be passed from the network management console to a local-side PSU of interest when the DVR is in SYSTEM mode. This test also verified that the radio inhibit command does not work when the DVR is in LOCAL mode. This test also verified that when the DVR is in OFF mode, the radio inhibit command will not be propagated down to the local-side PSU of interest. The radio inhibit function is useful when a local-side PSU has been stolen or lost and it needs to be disabled.

### 3.7.5 DVRS OFF/SYSTEM/LOCAL Mode: Radio Check—XTS 5K

#### Feature Under Test

- The ability of the DVRS to pass a radio check command (that originated at dispatch or the network management console) down to a local-side PSU



### Test Case Description

Verify the following using an XTS 5000 PSU:

- DVR OFF—Verify radio check is disabled.
- DVR SYSTEM—Verify radio check is enabled. To do this, verify that the radio check function is passed to the PSUs through the DVRS when SYSTEM mode is selected.
- DVR LOCAL—Verify radio check is enabled. To do this, verify that the radio check function is passed to the PSUs through the DVRS when LOCAL mode is selected.

### Initial Conditions

- PC with Tweaker software loaded
- USB interface cable
- DVRS configured for normal operation per pp. 40–44 of the installation guide
- Access to a trunked system is required
- Local-side PSUs must be programmed into the trunked system's database
- Portable CPS programming software and programming cable

### Test Procedures

#### DVR OFF Mode

1. Use the Motorola Portable CPS to enable the radio check feature on the local-side PSUs. Select “Conventional” > “Astro Systems.” Then, select the astro system with which you are working (in this test case we were working with Astro System #2). Select the “Advanced” tab, and check the “Radio Inhibit” box near the bottom of the tab.
2. Ensure that a digital DVR channel is selected. For this test case we will use a mobile TG named “WYO 1” that is associated with a DVR channel of 765.05D, which is a digital DVR channel.
3. Change the DVR channel, 765.05D, mode to “OFF” via the O5 Control Head.
4. From the trunked system console, attempt to send a “Radio Check” message to the local-side PSU of interest. The console operator will be unable to see the ID of the local-side PSU; therefore, the “Radio Check” message will not be sent to the local-side PSU.

#### DVR SYSTEM Mode

1. Use the Motorola Portable CPS to enable the radio check feature on the local-side PSUs. Select “Conventional” > “Astro Systems.” Then, select the astro system with which you are working (in this test case we were working with Astro System #2). Select the “Advanced” tab, and check the “Radio Inhibit” box near the bottom of the tab.
2. Ensure that a digital DVR channel is selected. For this test case we will use a mobile TG named “WYO 1” that is associated with a DVR channel of 765.05D, which is a digital DVR channel.
3. Change the DVR channel, 765.05D, mode to “SYS” via the O5 Control Head.
4. From the trunked system console, send a “Radio Check” message to the local-side PSU of interest. The console operator should see the ID of the local-side PSU.

Information specific to the local-side PSU being checked displays in the network management system console, including the PSU user name, the TG, the trunked site, and the zone. As an example, Portable User Name = DVRS-ITS-4P, ID=57; TalkGroup = Wyolink1, ID=8000001, Site=85 South, ID=1, Zone=Zone001, ID=1.

## DVR LOCAL Mode

The table on page 33 of the user guide incorrectly indicates this feature is available. However, Futurecom says it is a Phase II feature. As of August 2006, the feature does not work.

### Test Case Results and Summary

*Pass:* DVR OFF Mode, DVR SYSTEM Mode. *Fail:* DVR LOCAL Mode. This test case verified that a radio check command can be passed down from the network management console to a local-side PSU of interest when the DVR is in SYSTEM mode. This test also verified that the radio check command does not work when the DVR is in LOCAL mode. This test also verified that when the DVR is in OFF mode, the radio check command will not be propagated down the local-side PSU of interest. The radio check function is useful when a dispatcher wants to identify (or obtain information related to) a given local-side PSU.

### 3.7.6 System Status Reporting: Out of Range

#### Feature Under Test

- DVRS is capable of passing out of range message.

#### Test Case Description

- Verify that the out of range reporting function is passed to the local-side PSUs through the DVRS only when SYSTEM mode is selected and only when an XTS 5000 is used.

#### Initial Conditions

- PC with Tweaker software loaded
- USB interface cable
- DVRS configured for normal operation per pp. 40–44 of the installation guide
- Access to a trunked system is required
- Local-side PSUs must be programmed into the trunked system's database
- Portable CPS programming software and programming cable

#### Test Procedures

1. Ensure that a digital DVR channel is selected. For this test case we will use a mobile TG named "WYO 1" that is associated with a DVR channel of 765.05D, which is a digital DVR channel.
2. Change the DVR channel, 765.05D, mode to "SYS" via the O5 Control Head.
3. Use the Motorola Portable CPS to enable display of the "OUT OF RANGE" indicator on the PSU. Select "Radio Configuration" > "Radio Wide," then select the "General" tab. From the "Out of Range" drop-down menu, select "Alert & Display." Write these changes to the PSU.
4. Disconnect the antenna from the DVRS mobile radio.

A message that reads "OUT OF RANGE" displays on all local-side PSU LCD screens. This message is accompanied by a low-pitched tone that periodically sounds.

### Test Case Results and Summary

*Pass.* This test case verified that the out of range message is passed to the local-side PSUs when the DVRS is out of range of the trunked system. This feature is useful when initially setting

up the DVRS in the field. This message tells users whether they can establish a link with the trunked system.

### **3.8 Outbound (System to DVRS) Feature Operation**

#### **3.8.1 DVRS OFF/SYSTEM/LOCAL Mode: Outbound Group Call–XTS 5K**

##### **Feature Under Test**

- Outbound Group Call feature of the DVRS

##### **Test Case Description**

Verify the following using an XTS 5000 PSU:

- DVR OFF—Verify outbound group call is disabled.
- DVR SYSTEM—Verify outbound group call is enabled by observing that all calls received by the MSU on the selected TG on the O5 Control Head are repeated by the DVRS to the local-side PSUs affiliated with the same TG.
- DVR LOCAL—Verify outbound group call is enabled by observing that the DVRS can pass outbound group calls received by the MSU to the local-side PSUs if they are all affiliated with the same TG.

##### **Initial Conditions**

- PC with Tweaker software loaded
- USB interface cable
- DVRS configured for normal operation per pp. 40–44 of the installation guide
- Access to a trunked system is required
- Local-side PSUs must be programmed into the trunked system's database

##### **Test Procedures**

###### **DVR OFF Mode**

1. Ensure that a digital DVR channel is selected. For this test case we will use a mobile TG named "WYO 1" that is associated with a DVR channel of 765.05D, which is a digital DVR channel.
2. Change the DVR channel, 765.05D, mode to "OFF" via the O5 Control Head.
3. When the system-side PSU is keyed, the mobile radio speaker sounds, but the local-side PSUs do not. No Display Icon displays in the O5 Control Head, which indicates that the repeater is transmitting locally or system wide.

###### **DVR SYSTEM Mode**

1. Ensure that a digital DVR channel is selected. For this test case we will use a mobile TG named "WYO 1" that is associated with a DVR channel of 765.05D, which is a digital DVR channel.
2. Change the DVR channel, 765.05D, mode to "SYS" via the O5 Control Head.
3. When the system-side PSU is keyed, the system-side PSU ID number displays on the O5 Control Head and on system- and local-side PSUs. If the H-14 option (Digital Display

Enable) is loaded in the local-side PSUs (assuming the PSUs are Motorola XTS 5Ks), then the ID of the transmitting PSU displays.

4. Verify that an affiliation message for the system-side PSU appears on the trunked system Zonewatch display. Also, verify that audio can be heard at the local- and system-side PSUs that belong to the same TG as the originating system-side PSU.

#### DVR LOCAL Mode

1. Ensure that a digital DVR channel is selected. For this test case we will use a mobile TG named "WYO 1" that is associated with a DVR channel of 765.05D, which is a digital DVR channel.
2. Change the DVR channel, 765.05D, mode to "LOC" via the O5 Control Head.
3. In the Tweaker software, ensure that the "Call Setup—System Repeat in Local Mode" option under the "Digital System Setup Menu" is enabled.
4. When the system-side PSU is keyed, the system-side PSU ID number displays on the O5 Control Head and on system- and local-side PSUs. If the H-14 option (Digital Display Enable) is loaded in the local-side PSUs (assuming the PSUs are Motorola XTS 5Ks), then the ID of the transmitting PSU displays.
5. Audio will be heard at the system- and local-side PSUs. Audio will also be heard at the Mobile speaker.
6. Verify that an affiliation message for the system-side PSU appears on the trunked system Zonewatch display.
7. Verify that when a local-side PSU keys up, no audio is heard on the system-side PSUs or at the mobile radio's speaker.

#### Test Case Results and Summary

*Pass.* This test case verified that a group call originated at a system-side PSU will propagate to system-side and local-side PSUs that are part of the same TG as the originating PSU when the DVR is in either SYSTEM or LOCAL modes. The difference is that when the DVR is in LOCAL mode, an audio transmission that originates at a local-side PSU will not propagate to system-side PSUs or to the MSU's speaker. This test case demonstrates the ability of the DVRS to extend a group call that originates at a system-side PSU to local-side PSUs.

### 3.8.2 DVRS OFF/SYSTEM/LOCAL Mode: Outbound Private Call—XTS 5K

#### Feature Under Test

- DVRS outbound private call feature

#### Test Case Description

Verify the following using an XTS 5000 PSU:

- DVR OFF—Verify outbound private call is disabled.
- DVR SYSTEM—Verify Outbound Private Call is enabled by observing that an affiliated system-side user can make a private call to a local-side affiliated PSU through an active DVRS.
- DVR LOCAL—Verify Outbound Private Call is enabled by observing the DVRS pass outbound private calls when the destination local-side PSU is affiliated through the DVRS.

**Initial Conditions**

- PC with Tweaker software loaded
- USB interface cable
- DVRS configured for normal operation per pp. 40–44 of the installation guide
- Access to a trunked system is required
- Local-side PSUs must be programmed into the trunked system's database

**Test Procedures****DVR OFF Mode**

1. Ensure that a digital DVR channel is selected. For this test case we will use a mobile TG named "WYO 1" that is associated with a DVR channel of 765.05D, which is a digital DVR channel.
2. Change the DVR channel, 765.05D, mode to "OFF" via the O5 Control Head.
3. To place a private call that originates at the system-side PSU, use the Motorola Portable CPS to enable the "CALL" feature as a softkey in the PSU. Select "Radio Configuration" > "Display & Menu," then select the "Menu Items" tab. All available softkey options are listed in the left-hand column. Select "CALL" from this list, and select "Add >>." The "CALL" feature then appears in the "Selected Items" column. Write this change to the PSU.
4. On the system-side PSU, select the "CALL" softkey. If the PSU has a keypad, enter the ID of the local-side PSU, and then press the PTT button to initiate the private call.
5. Observe that the private call originated by the system-side PSU fails by listening for a low-pitched tone.
6. Voice will not be heard between the local- and system-side PSUs of interest.
7. Voice is not heard by other local- or system-side PSUs.

**DVR SYSTEM Mode**

1. Ensure that a digital DVR channel is selected. For this test case we will use a mobile TG named "WYO 1" that is associated with a DVR channel of 765.05D, which is a digital DVR channel.
2. Change the DVR channel, 765.05D, mode to "SYS" via the O5 Control Head.
3. To place a private call that originates at the system-side PSU, use the Motorola Portable CPS to enable the "CALL" feature as a softkey in the PSU. Select "Radio Configuration" > "Display & Menu," then select the "Menu Items" tab. All available softkey options are listed in the left-hand column. Select "CALL" from this list, and select "Add >>." The "CALL" feature then appears in the "Selected Items" column. Write this change to the PSU.
4. On the system-side PSU, select the "CALL" softkey. If the PSU has a keypad, enter the ID of the local-side PSU, and then press the PTT button to initiate the private call.
5. Answer the private call on the local-side PSU by pressing the "CALL" softkey and then the PTT button.
6. Voice is heard between the local- and system-side PSUs of interest.
7. Voice is not heard by other local- or system-side PSUs.

**DVR LOCAL Mode**

1. Ensure that a digital DVR channel is selected. For this test case we will use a mobile TG named "WYO 1" that is associated with a DVR channel of 765.05D, which is a digital DVR channel.
2. Change the DVR channel, 765.05D, mode to "LOC" via the O5 Control Head.

3. To place a private call that originates at the system-side PSU, use the Motorola Portable CPS to enable the "CALL" feature as a softkey in the PSU. Select "Radio Configuration" > "Display & Menu," then select the "Menu Items" tab. All available softkey options are listed in the left-hand column. Select "CALL" from this list, and select "Add >>." The "CALL" feature then appears in the "Selected Items" column. Write this change to the PSU.
4. On the system-side PSU, select the "CALL" softkey. If the PSU has a keypad, enter the ID of the local-side PSU, and then press the PTT button to initiate the private call.
5. Answer the private call on the destination local-side PSU by pressing the "CALL" softkey and then the PTT button.
6. Voice is heard between the local- and system-side PSUs of interest.
7. Voice is not heard by other local- or system-side PSUs.

### Test Case Results and Summary

*Pass.* This test case verified that when the DVR is in either SYSTEM or LOCAL modes, it is possible to originate a private call at a system-side PSU, and terminate the call at a local-side PSU. This demonstrates the ability of the DVRS to extend a private call that originates at a system-side PSU to a local-side PSU.

### 3.8.3 Outbound Call Alert: DVRS in Local Mode

#### Feature Under Test

- DVRS outbound call alert capability

#### Test Case Description

- Verify the DVRS passes system-side PSU outbound call alerts when the destination local XTS 5K PSU is affiliated through the DVRS.

#### Initial Conditions

- PC with Tweaker software loaded
- USB interface cable
- DVRS configured for normal operation per pp. 40–44 of the installation guide
- Access to a trunked system is required
- Local-side PSUs must be programmed into the trunked system's database
- Portable CPS programming software and programming cable

#### Test Procedures

1. Ensure that a digital DVR channel is selected. For this test case we will use a mobile TG named "WYO 1" that is associated with a DVR channel of 765.05D, which is a digital DVR channel.
2. Change the DVR channel, 765.05D, mode to "SYS" via the O5 Control Head.
3. On the local- and system-side PSUs, use the Motorola Portable CPS to configure a key for call alert paging. Select "Radio Configuration" > "Controls" > Buttons." From the "Side Buttons" drop-down list, select "CALL ALERT."
4. On the system-side PSU, select the button that was programmed for call alert paging. If the PSU has a keypad, enter the ID of the local-side PSU, and then press the PTT button to send the call alert page.

5. On the local-side PSU, “ACKNOWLEDGEMENT RECEIVED” displays due to the call alert page being originated by the system-side PSU. “PAGE RECEIVED” displays on the local-side PSU.
6. When either radio is keyed, voice is heard between the local- and system-side PSUs of interest.
7. Voice is also heard by other local- and system-side PSUs.

#### **Test Case Results and Summary**

*Pass.* This test case verified when the DVR is in LOCAL mode, outbound call alert capability is enabled—an affiliated system XTS 5K PSU can send a call alert page to a local-side affiliated XTS 5K PSU. This feature is useful when a system-side user wants to page another local-side user even though the DVRS is in LOCAL mode.

### **3.8.4 DVRS Outbound Encrypted Call (SYSTEM and LOCAL Modes)**

#### **Feature Under Test**

- DVRS is capable of passing an outbound encrypted group call.

#### **Test Case Description**

- For the XTS 5000 PSU verify encrypted calls are passed by the DVRS from a system-side PSU to a local-side PSU for the following modes:
- SYSTEM Mode: With the DVR in system mode, verify that the DVRS will pass an encrypted group call from a system-side PSU to a local-side PSU. Verify that other local-side PSUs and system-side PSUs on the same TG, which are not programmed with the same encryption key, are not able to receive the call.
- LOCAL Mode: With the DVR in local mode, verify that the DVRS will pass an encrypted group call from a system-side PSU to a local-side PSU. Verify that other local- and system-side PSUs on the same TG, which are not programmed with the same encryption key, are not able to receive the call.

#### **Initial Conditions**

- PC with Tweaker software loaded
- USB interface cable
- DVRS configured for normal operation per pp. 40–44 of the installation guide
- Access to a trunked system is required
- Local-side PSUs must be programmed into the trunked system's database.
- Motorola KVL encryption key programmer

#### **Test Procedures**

##### **DVR SYSTEM Mode**

1. Program a system- and a local-side Motorola XTS PSU with an encryption key using the Motorola KVL encryption key programmer. In addition, a system- and a local-side Motorola XTS that is not programmed with an encryption key is required for this test.
2. Switch the system-side XTS PSU from clear mode to encrypted mode. On the XTS 5000 radios, this is a physical rotary style switch that has two positions, encrypted or clear.

3. Press the PTT on the system-side PSU, and initiate a group call. Voice is heard at the local-side PSU that has been programmed with the appropriate encryption key. All other local-side and system-side PSUs on the same trunk group that have been programmed with the appropriate encryption key, will not receive any voice.

#### DVR LOCAL Mode

1. Program a system- and a local-side Motorola XTS radio with an encryption key using the KVL encryption key programmer. In addition, a system- and a local-side Motorola XTS that is not programmed with an encryption key is required for this test.
2. In the DVR Tweaker software, ensure that under the “Digital System Setup Menu,” the box for “Call Setup—System Repeat in Local Mode” is checked (enabled).
3. Switch the system-side radio from clear mode to encrypted mode. On the XTS 5000 radios, this is a physical rotary style switch that has two positions, encrypted or clear.
4. Press the PTT on the system-side PSU, and initiate a group call. Voice is heard at the local-side PSU that has been programmed with the appropriate encryption key. In addition, all other local-side and system-side PSUs that are on the same TG and that are not programmed with the appropriate encryption key, will not receive any voice.

#### Test Case Results and Summary

*Pass.* This test case verified that encrypted group calls can be passed by the DVRS when the encrypted group call is originated by a system-side PSU. This feature is useful if encrypted transmission is required between a system-side user and certain local-side users.

### 3.9 Inbound (DVRS to System) Feature Operation

#### 3.9.1 DVRS OFF/SYSTEM/LOCAL Mode: Inbound Group Call—XTS 5K

##### Feature Under Test

- Inbound group call feature of the DVRS

##### Test Case Description

Verify the following for an XTS 5000 PSU:

- DVR OFF—Verify inbound group call is disabled
- DVR SYSTEM—Verify inbound group call is enabled by observing that when a local-side PSU is affiliated with a specific TG, the user can PTT the local-side PSU, and talk to other local-side users affiliated with the same TG, to system-side users affiliated with the same TG, or to both.
- DVR LOCAL—Verify inbound group call is enabled by observing that the DVRS repeats group calls received from a local-side PSU to the rest of the local-side PSUs when the PSUs are affiliated with the same TG through the DVRS. Also, verify that inbound group calls are not repeated to any system-side users while the DVRS is in the local mode.

##### Initial Conditions

- PC with Tweaker software loaded
- USB interface cable
- DVRS configured for normal operation per pp. 40–44 of the installation guide



- Access to a trunked system is required
- Local-side PSUs must be programmed into the trunked system's database

### Test Procedures

#### DVR OFF Mode

1. Ensure that a digital DVR channel is selected. For this test case we will use a mobile TG named "WYO 1" that is associated with a DVR channel of 765.05D, which is a digital DVR channel.
2. Change the DVR channel, 765.05D, mode to "OFF" via the O5 Control Head.  
When the local-side PSU is keyed, audio is not heard at the mobile radio speaker nor at the system-side PSU's. No Display Icon displays in the O5 Control Head, which indicates that the repeater is transmitting locally or system wide. Also, a low-pitched tone is heard at the originating local-side PSU, indicating that the group call failed.

#### DVR SYSTEM Mode

1. Ensure that a digital DVR channel is selected. For this test case we will use a mobile TG named "WYO 1" that is associated with a DVR channel of 765.05D, which is a digital DVR channel.
2. Change the DVR channel, 765.05D, mode to "SYS" via the O5 Control Head.  
When the local-side PSU is keyed, the local-side PSU ID number displays on the O5 Control Head and on system- and local-side PSUs. If the H-14 option (Digital Display Enable; this is only applicable to Motorola PSUs) is loaded in the local-side PSUs, then the ID of the transmitting PSU displays.
3. Verify that the id of the originating local-side PSU appears on the trunked system Zonewatch application under the trunked site that the call originated on.
4. Audio is heard on both local- and system-side PSUs that are affiliated with the same TG as the originating local-side PSU.

#### DVR LOCAL Mode

1. Ensure that a digital DVR channel is selected. For this test case we will use a mobile TG named "WYO 1" that is associated with a DVR channel of 765.05D, which is a digital DVR channel.
2. Change the DVR channel, 765.05D, mode to "LOCAL" via the O5 Control Head.  
When the local-side PSU is keyed, the originating local-side PSU ID number displays on the O5 Control Head and on all other local-side PSUs that are affiliated with the TG of interest. If the H-14 option (Digital Display Enable; this is only applicable to Motorola PSUs) is loaded in the local-side PSUs, then the ID of the transmitting PSU displays.
3. Audio is heard at all local-side PSUs affiliated with the TG of interest.
4. Verify that when the originating local-side PSU keys up, no audio is heard on the system-side PSUs that are affiliated with the same TG or at the mobile radio's speaker.

### Test Case Results and Summary

*Pass.* This test case verified that a group call, originated at a local-side PSU, will propagate to system- and local-side PSUs that are part of the same TG as the originating PSU when the DVR is in either SYSTEM or LOCAL modes. The difference is that when the DVR is in LOCAL mode, an audio transmission that originates at a local-side PSU will not propagate to system-side PSUs or to the MSU's speaker. This test case demonstrates the ability of the DVRS to extend a group call that originates at a local-side PSU to system-side PSUs.

### 3.9.2 DVRS OFF/SYSTEM/LOCAL Mode: Inbound Private Call—XTS 5K

#### Feature Under Test

- DVRS inbound private call feature

#### Test Case Description

Verify the following using an XTS 5000 PSU:

- DVR OFF—Verify Inbound Private Call is disabled
- DVR SYSTEM—Verify Inbound Private Call is enabled. To do this, verify that an affiliated local-side PSU user can make a private call to another local-side affiliated PSU or to an affiliated system-side PSU.
- DVR LOCAL—Verify Inbound Private Call is enabled. To do this, verify that an affiliated local-side PSU can make a private call to another local-side affiliated PSU or to an affiliated system-side PSU.

#### Initial Conditions

- PC with Tweaker software loaded
- USB interface cable
- DVRS configured for normal operation per pp. 40–44 of the installation guide
- Access to a trunked system is required
- Local-side PSUs must be programmed into the trunked system's database

#### Test Procedures

##### DVR OFF Mode

1. Ensure that a digital DVR channel is selected. For this test case we will use a mobile TG named “WYO 1” that is associated with a DVR channel of 765.05D, which is a digital DVR channel.
2. Change the DVR channel, 765.05D, mode to “OFF” via the O5 Control Head.
3. To place a private call that originates at the local-side PSU, use the Motorola Portable CPS to enable the “CALL” feature as a softkey in the PSU. Select “Radio Configuration” > “Display & Menu,” then select the Menu Items” tab. All available softkey options are listed in the left-hand column. Select “CALL” from this list, and select “Add >>.” The “CALL” feature then appears in the “Selected Items” column. Write this change to the PSU.
4. On the local-side PSU, select the “CALL” softkey. If the PSU has a keypad, enter the ID of the system-side PSU, and then press the PTT button to initiate the private call.
5. Observe that the private call originated by the local-side PSU fails by listening for a low-pitched tone.
6. Voice will not be heard between the local- and system-side PSUs of interest.
7. Voice is not heard by other local- or system-side PSUs.

##### DVR SYSTEM Mode

1. Ensure that a digital DVR channel is selected. For this test case we will use a mobile TG named “WYO 1” that is associated with a DVR channel of 765.05D, which is a digital DVR channel.
2. Change the DVR channel, 765.05D, mode to “SYS” via the O5 Control Head.

3. To place a private call that originates at the local-side PSU, use the Motorola Portable CPS to enable the "CALL" feature as a softkey in the PSU. Select "Radio Configuration" > "Display & Menu," then select the "Menu Items" tab. All available softkey options are listed in the left-hand column. Select "CALL" from this list, and select "Add >>." The "CALL" feature then appears in the "Selected Items" column. Write this change to the PSU.
4. On the local-side PSU, select the "CALL" softkey. If the PSU has a keypad, enter the ID of the system-side PSU, and then press the PTT button to initiate the private call.
5. Answer the private call on the system-side PSU by pressing the "CALL" softkey, and then the PTT button.
6. Voice is heard between the local- and system-side PSUs of interest.
7. Voice is not heard by other local- or system-side PSUs.

#### DVR LOCAL Mode

1. Ensure that a digital DVR channel is selected. For this test case we will use a mobile channel named "WYO 1" that is associated with a DVR channel of 765.05D, which is a digital DVR channel.
2. Change the DVR channel, 765.05D, mode to "LOC" via the O5 Control Head.
3. To place a private call that originates at the local-side PSU, use the Motorola Portable CPS software to enable the "CALL" feature as a softkey in the PSU. Select "Radio Configuration" > "Display & Menu," then select the "Menu Items" tab. All available softkey options are listed in the left-hand column. Select "CALL" from this list, and select "Add >>." The "CALL" feature then appears in the "Selected Items" column. Write this change to the PSU.
4. On the local-side PSU, select the "CALL" softkey. If the PSU has a keypad, enter the ID of the destination local-side PSU, and then press the PTT button to initiate the private call.
5. Answer the private call on the destination local-side PSU by pressing the "CALL" softkey and then the PTT button.
6. Voice is heard only between the two local-side PSUs of interest.
7. Voice is not heard by other local- or system-side PSUs.
8. Next, originate a second private call from a local-side PSU to a system-side PSU.
9. Answer the private call on the destination system-side PSU by pressing the "CALL" softkey and then the PTT button.
10. Voice will only be heard between the originating local-side PSU and the destination system-side PSU.
11. Voice is not heard by other local- or system-side PSUs.

#### Test Case Results and Summary

*Pass.* This test case verified that when the DVR is in either SYSTEM or LOCAL modes it is possible to originate a private call at a local-side PSU, and terminate the call at a system-side or local-side PSU. This demonstrates the ability of the DVRS to extend a private call that originates at a local-side PSU to a system-side PSU.

### 3.9.3 DVRS OFF/SYSTEM/LOCAL Mode: Inbound Call Alert—XTS 5K

#### Feature Under Test

- Inbound call alert feature of the DVRS

#### Test Case Description

Verify the following using an XTS 5000 PSU:

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- DVR OFF—Verify inbound call alert is disabled.
- DVR SYSTEM—Verify inbound call alert is enabled by observing that an affiliated local-side PSU can push page, select an ID, press the PTT button, and send a call alert page to another affiliated local-side PSU or to an affiliated system-side PSU.
- DVR LOCAL—Verify inbound call alert is enabled by observing that an affiliated local-side PSU can send a call alert page to another local-side affiliated PSU or to another affiliated system-side PSU.

### Initial Conditions

- PC with Tweaker software loaded
- USB interface cable
- DVRS configured for normal operation per pp. 40–44 of the installation guide
- Access to a trunked system is required
- Local-side PSUs must be programmed into the trunked system's database

### Test Procedures

#### DVR OFF Mode

1. Ensure that a digital DVR channel is selected. For this test case we will use a mobile TG named “WYO 1” that is associated with a DVR channel of 765.05D, which is a digital DVR channel.
2. Change the DVR channel, 765.05D, mode to “OFF” via the O5 Control Head.
3. On the local- and system-side PSUs, use the Motorola Portable CPS to configure a key for call alert paging. Select “Radio Configuration” > “Controls” > “Buttons.” From the “Side Buttons” drop-down list, select “CALL ALERT.”
4. On the local-side PSU, select the button that was programmed for call alert paging. If the PSU has a keypad, enter the ID of the system-side PSU, and then press the PTT button to send the call alert page.
5. Observe that the call alert page originated by the local-side PSU fails by listening for a low-pitched tone and observing a “NO ACKNOWLEDGEMENT” message on the LCD.
6. Voice will not be heard between the local- and system-side PSUs of interest.
7. Voice is not heard by other local- or system-side PSUs.

#### DVR SYSTEM Mode

1. Ensure that a digital DVR channel is selected. For this test case we will use a mobile TG named “WYO 1” that is associated with a DVR channel of 765.05D, which is a digital DVR channel.
2. Change the DVR channel, 765.05D, mode to “SYS” via the O5 Control Head.
3. On the local- and system-side PSUs, use the Motorola Portable CPS to configure a key for call alert paging. Select “Radio Configuration” > “Controls” > “Buttons.” From the “Side Buttons” drop-down list, select “CALL ALERT.”
4. On the local-side PSU, select the button that was programmed for call alert paging. If the PSU has a keypad, enter the ID of the System PSU, and then press the PTT button to send the call alert page.
5. On the local-side PSU, observe that “ACKNOWLEDGEMENT RECEIVED” displays due to the call alert page being originated by the local-side PSU. “PAGE RECEIVED” displays on the system-side PSU.

When either radio is keyed, voice is heard between the local- and system-side PSUs of interest.

6. Voice is heard by other local- and system-side PSUs.

#### DVR LOCAL Mode

1. Ensure that a digital DVR channel is selected. For this test case we will use a mobile TG named "WYO 1" that is associated with a DVR channel of 765.05D, which is a digital DVR channel.
2. Change the DVR channel, 765.05D, mode to "LOC" via the O5 Control Head.
3. On the local- and system-side PSUs, use the Motorola Portable CPS to configure a key for call alert paging. Select "Radio Configuration" > "Controls" > "Buttons." From the "Side Buttons" drop-down list, select "CALL ALERT."
4. On the local-side PSU, select the button that was programmed for call alert paging. If the PSU has a keypad, enter the ID of the system-side PSU and then press the PTT button to send the call alert page.
5. On the local-side PSU, observe that "ACKNOWLEDGEMENT RECEIVED" displays due to the call alert page being originated by the local-side PSU. "PAGE RECEIVED" displays on the system-side PSU.
6. When either radio is keyed, voice is heard between the local- and system-side PSUs of interest.
7. Voice is also heard by other local- and system-side PSUs.
8. Next, originate a call alert page on a local-side PSU by selecting the button that was programmed for call alert paging. Enter the ID of the destination local-side PSU, and press the PTT button to send the call alert page.
9. On the local-side PSU, observe that "ACKNOWLEDGEMENT RECEIVED" displays due to the call alert page being originated by the local-side PSU. "PAGE RECEIVED" displays on the destination local-side PSU.
10. When either radio is keyed, voice is heard between the originating local-side PSUs and other local-side PSUs, including the destination local-side PSU. Voice is not heard by system-side PSUs.

#### Test Case Results and Summary

*Pass.* This test case verified that when in SYSTEM mode, the inbound call alert is enabled—an affiliated local-side PSU can push page, select an ID, press the PTT button, and send a call alert page to another local-side affiliated PSU or to an affiliated system-side PSU. This test case also verified when the DVR is in LOCAL mode, inbound call alert is enabled—an affiliated local PSU can send a call alert page to another local affiliated PSU or to another affiliated system PSU. This feature is useful when one user wants to page another LOCAL or system-side user.

### 3.9.4 DVRS OFF/SYSTEM/LOCAL Mode: Inbound Emergency Alarm—XTS 5K

#### Feature Under Test

- DVRS inbound emergency alarm capability

#### Test Case Description

Verify the following using an XTS 5000 PSU:

- DVR OFF—Verify inbound emergency alarm is enabled.

- DVR SYSTEM—Verify inbound emergency alarm is enabled by observing that when a local-side PSU user sends an emergency alarm while in DVR Mode, the active master DVRS processes the emergency to the system.
- DVR LOCAL—Verify inbound emergency alarm is enabled by observing that when a local-side PSU user sends an emergency alarm while in DVR Mode, the active master DVRS processes the emergency to the system.

#### Initial Conditions

- PC with Tweaker software loaded
- USB interface cable
- DVRS configured for normal operation per pp. 40–44 of the installation guide
- Access to a trunked system is required
- Local-side PSUs must be programmed into the trunked system's database

#### Test Procedures

##### DVR OFF Mode

1. Ensure that a digital DVR channel is selected. For this test case we will use a mobile TG named "WYO 1" that is associated with a DVR channel of 765.05D, which is a digital DVR channel.
2. Change the DVR channel, 765.05D, mode to "OFF" via the O5 Control Head.
3. On the local-side PSUs, use the Motorola Portable CPS to configure the emergency alarm feature. Select "Conventional" > "Astro Systems > Astro System > Astro System X," then select the "Emergency" tab. From the "Emergency Type" drop-down menu, select "Alarm Only."
4. On the local-side PSU, press the red emergency button on top of the PSU.
5. Once the button is pressed on the originating local-side PSU, observe that "Emergency" displays in the O5 Control Head, and a short tone is heard.
6. Observe that the system- and local-side PSUs display the ID of the local-side PSU that originated the emergency alarm.
7. On the O5 Control Head, observe that the DVR has changed to system mode.
8. At the network management console, observe that the ID of the local-side PSU appears in the Zonewatch application.

##### DVR SYSTEM Mode

1. Ensure that a digital DVR channel is selected. For this test case we will use a mobile TG named "WYO 1" that is associated with a DVR channel of 765.05D, which is a digital DVR channel.
2. Change the DVR channel, 765.05D, mode to "SYS" via the O5 Control Head.
3. On the local-side PSUs, use the Motorola Portable CPS to configure the emergency alarm feature. Select "Conventional" > "Astro Systems" > "Astro System" > "Astro System X," then select the "Emergency" tab. From the "Emergency Type" drop-down menu, select "Alarm Only."
4. On the local-side PSU, press the red emergency button on top of the PSU.
5. Once the button is pressed on the originating local-side PSU, observe that "Emergency" displays, and a short tone is heard.
6. Observe that the system- and local-side PSUs display the ID of the local-side PSU that originated the emergency alarm.

7. At the network management console, observe that the ID of the local-side PSU appears in the Zonewatch application.

#### DVR LOCAL Mode

1. Ensure that a digital DVR channel is selected. For this test case we will use a mobile TG “WYO 1” that is associated with a DVR channel of 765.05D, which is a digital DVR channel.
2. Change the DVR channel, 765.05D, mode to “LOC” via the O5 Control Head.
3. On the local-side PSUs, use the Motorola Portable CPS to configure the emergency alarm feature. Select “Conventional” > “Astro Systems” > “Astro System” > “Astro System X,” then select the “Emergency” tab. From the “Emergency Type” drop-down menu, select “Alarm Only.”
4. On the local-side PSU, press the red emergency button on top of the PSU.
5. Once the button is pressed on the originating local-side PSU, observe that “Emergency” displays, and a short tone is heard.
6. Observe that the system- and local-side PSUs display the ID of the local-side PSU that originated the emergency alarm.
7. At the network management console, observe that the ID of the local-side PSU appears in the Zonewatch application.

#### Test Case Results and Summary

*Pass.* This test case verified that when the DVR is in system mode, inbound emergency alarm is enabled—when a local-side PSU user sends an emergency alarm while in DVR Mode, the active master DVRS processes the emergency to the system. This test case also verified that when the DVR is in local-side mode, the inbound emergency alarm feature is enabled—when a local-side PSU user sends an emergency alarm while in DVR Mode, the active master DVRS processes the emergency to the system. This test case also verified that the inbound emergency feature works when the DVR is in the OFF mode. This is a useful feature when the user is in a critical situation and doesn’t have the ability or time to send a voice transmission.

### **3.9.5 DVRS OFF/SYSTEM/LOCAL Mode: Inbound Emergency Call—XTS 5K**

#### Feature Under Test

- DVRS inbound emergency call capability

#### Test Case Description

Verify the following using an XTS 5000 PSU:

- DVR OFF—Verify inbound emergency call is enabled.
- DVR SYSTEM—Verify inbound emergency call is enabled by observing that when a local-side PSU user sends an emergency call while in SYSTEM mode, the active master DVRS processes the emergency to the system.
- DVR LOCAL—Verify inbound emergency call is enabled by observing that if the DVRS receives an emergency call from a local-side PSU, the DVRS will switch to system mode and process the emergency when the DVR is designated as a master.

#### Initial Conditions

- PC with Tweaker software loaded
- USB interface cable

- DVRS configured for normal operation per pp. 40–44 of the installation guide
- Access to a trunked system is required
- Local-side PSUs must be programmed into the trunked system's database

### Test Procedures

#### DVR OFF

1. Ensure that a digital DVR channel is selected. For this test case we will use a mobile TG named "WYO 1" that is associated with a DVR channel of 765.05D, which is a digital DVR channel.
2. Change the DVR channel, 765.05D, mode to "OFF" via the O5 Control Head.
3. On the local-side PSUs, use the Motorola Portable CPS to configure the emergency call feature. Select "Conventional" > "Astro Systems > Astro System > Astro System X," then select the "Emergency" tab. From the "Emergency Type" drop-down menu, select "Alarm & Call."
4. On the local-side PSU, press the red emergency button on top of the PSU.
5. Once the button is pressed on the originating local-side PSU, observe that "Emergency" displays, and a short tone is heard.
6. In the originating local-side PSU LCD, observe that "ACK RECEIVED" displays.
7. The originating local-side PSU can then PTT to send voice to local- and system-side PSUs.
8. Observe that the system- and local-side PSUs display the ID of the local-side PSU that originated the emergency call.
9. At the O5 Control Head, observe that the DVR has changed to system mode.
10. At the network management console, observe that the ID of the local-side PSU displays in the Zonewatch application.

#### DVR SYSTEM

1. Ensure that a digital DVR channel is selected. For this test case we will use a mobile TG named "WYO 1" that is associated with a DVR channel of 765.05D, which is a digital DVR channel.
2. Change the DVR channel, 765.05D, mode to "SYS" via the O5 Control Head.
3. On the local-side PSUs, use the Motorola Portable CPS to configure the emergency call feature. Select "Conventional" > "Astro Systems" > "Astro System" > "Astro System X" then select the "Emergency" tab. From the "Emergency Type" drop-down menu, select "Alarm & Call."
4. On the local-side PSU, press the red emergency button on top of the PSU.
5. Once the button is pressed on the originating local-side PSU, observe that "Emergency" displays, and a short tone is heard.
6. Observe that "ACK RECEIVED" displays on the originating local-side PSU LCD.
7. The originating local-side PSU can then PTT to send voice to local- and system-side PSUs.
8. Observe that the system- and local-side PSUs display the ID of the local-side PSU that originated the emergency call.
9. At the network management console, observe that the ID of the local-side PSU displays in the Zonewatch application.



## DVR LOCAL

1. Ensure that a digital DVR channel is selected. For this test case we will use a mobile TG named "WYO 1" that is associated with a DVR channel of 765.05D, which is a digital DVR channel.
2. Change the DVR channel, 765.05D, mode to "LOC" via the O5 Control Head.
3. On the local-side PSUs, use the Motorola Portable CPS to configure the emergency call feature. Select "Conventional" > "Astro Systems" > "Astro System" > "Astro System X" then select the "Emergency" tab. From the "Emergency Type" drop-down menu, select "Alarm & Call."
4. On the local-side PSU, press the red emergency button on top of the PSU.
5. Once the button is pressed on the originating local-side PSU, observe that "Emergency" displays, and a short tone is heard.
6. Observe that "ACK RECEIVED" displays in the originating local-side PSU LCD.
7. The originating local-side PSU user can then PTT to send voice to local- and system-side PSUs.
8. Observe that the system- and local-side PSUs display the ID of the local-side PSU that originated the emergency call.
9. At the network management console, observe that the ID of the local-side PSU displays in the Zonewatch.
10. Observe that the O5 Control Head indicates that the DVR has changed from "LOC" to "SYS."

### Test Case Results and Summary

*Pass.* This test case verified that an emergency call that originates with a local-side PSU, regardless of what mode the DVR is in, is processed to the trunked system. This is a useful feature when a local-side user in a critical situation needs to have voice transmission processed by the trunked system to dispatch or other system-side PSUs.

### 3.9.6 DVRS Inbound Encrypted Call (SYSTEM and LOCAL Modes)

#### Feature Under Test

- DVRS is capable of passing an inbound encrypted group call.

#### Test Case Description

For the XTS 5000 PSU, verify encrypted calls are passed by the DVRS from a local-side PSU to a system-side PSU:

- SYSTEM Mode: With the DVRS in system mode, verify that the DVRS will pass an encrypted group call from a local-side PSU to a system-side PSU. All other local- and system-side PSUs that are on the same TG, which are not programmed with the same encryption key, should be unable to receive the transmission.
- LOCAL Mode: With the DVRS in local mode, verify that the DVRS will pass an encrypted group call from one local-side PSU to a different local-side PSU. All other local- and system-side PSUs that are on the same TG, which are not programmed with the same encryption key, should be unable to receive the transmission.

#### Initial Conditions

- PC with Tweaker software loaded

- USB interface cable
- DVRS configured for normal operation per pp. 40–44 of the installation guide
- Access to a trunked system is required
- Local-side PSUs must be programmed into the trunked system's database
- Motorola KVL encryption key programmer

### **Test Procedures**

#### **DVR SYSTEM Mode**

1. Program system- and a local-side Motorola XTS radios with an encryption key using the KVL encryption key programmer.
2. Switch the local-side PSU from clear mode to encrypted mode. On the XTS 5000 radios, this is a physical rotary style switch that has two positions, encrypted or clear.
3. Press the PTT on the local-side PSU, and initiate a group call. Voice is heard at the system- and local-side PSUs that have been programmed with the appropriate encryption key. All other local- and system-side PSUs that are on the same TG, and that have not been programmed with the appropriate encryption key, will not receive any voice.

#### **DVR LOCAL Mode**

1. Program system- and a local-side Motorola XTS PSUs with an encryption key using the KVL encryption key programmer.
2. Switch one local-side radio from clear mode to encrypted mode. On the XTS 5000 radios, this is a physical rotary style switch that has two positions, encrypted or clear.
3. Press the PTT on the local-side PSU, and initiate a group call. Voice will not be heard at the system-side PSU that has been programmed with an encryption key. In addition, all other local- and system-side PSUs that are on the same TG, and that are not programmed with the appropriate encryption key, will not receive any voice.

### **Test Case Results and Summary**

*Pass.* This test case verified that encrypted group calls can be passed by the DVRS when the encrypted group call is originated by a local-side PSU. This feature is useful if encrypted transmission is required between a local-side user and specific system-side users, or from a local-side user to other specific local-side users.

## **3.10 DVRS Automatic and Remote Feature Operation**

### **3.10.1 Remote Call Control via Emergency Call**

#### **Feature Under Test**

- DVRS mode can be controlled remotely when a local-side PSU originates an emergency call.

#### **Test Case Description**

- Use an XTS 5000 PSU to verify that, when the DVR is in OFF mode and it receives an emergency call from a local-side PSU, the DVR will switch to SYSTEM mode and process the emergency call to the trunked system.

**Initial Conditions**

- A trunked system is required.
- DVRS configured for normal operation per pp. 40–44 of the installation guide
- PC with Tweaker software
- USB interface cable

**Test Procedures**

1. From the O5 Control Head, press the “Zone” softkey, then use the channel select knob to select desired zone.
2. Press the “Home” button on the O5 Control Head.
3. Use the channel select knob on the O5 Control Head to choose the desired channel.
4. Press the “Home” button on the O5 Control Head again.
5. Use the softkey scroll buttons to scroll until “VRS” is listed as a softkey button.
6. Press the “VRS” softkey on the O5 Control Head.
7. Use the channel select knob to select the desired MSU channel and associated TG.
8. After the DVR channel has been selected, press the “VRS” softkey again. Continue pressing the “VRS” softkey until “VR OFF XXX” displays (where XXX is the current channel).
9. Power on local-side PSU. For this test, an XTS 5000 was used.
10. On the local-side PSU, select the zone and channel that corresponds to the current DVR channel.
11. Press the orange-colored emergency signal button on top of the PSU.
12. Observe that “EMR XX” displays on an XTS series system-side PSU.
13. Press the PTT key on the local-side PSU and transmit audio.
14. When the transmission of the emergency message is complete, press the emergency signal button for approximately 2 seconds.
15. On the local-side PSU, observe that the radio is no longer in emergency mode.
16. On the system-side PSU, observe that the emergency status message is cleared.

**Test Case Results and Summary**

*Pass.* This test case verified that when the DVRS is in OFF mode initially, a local-side PSU that originates an emergency call can cause the DVRS to change to SYSTEM mode. This in turn causes the trunked system to process the call to the system-side PSUs. This feature is useful when a local-side user in a critical situation requires communication with system-side users and dispatch.

**3.10.2 Auto De-Activation of DVR via Inactivity Timer****Feature Under Test**

- Automatic de-activation on the expiration of an inactivity timer

**Test Case Description**

- Verify that the DVR can switch automatically to the OFF mode upon expiration of its inactivity timer (programmable from 0 to 180 minutes). The timer is restarted every time the DVR detects PSU activity.

**Initial Conditions**

- PC with Tweaker software loaded
- USB interface cable
- DVRS configured for normal operation per pp. 40–44 of the installation guide

**Test Procedures**

1. From the Tweaker software's DVRS menu tree, select "System Setup 2."
2. Locate "No Activity Timer Repeater" box in the lower-right corner.
3. Select the desired timer duration. This duration, according to the installation guide, is supposed to be settable by the user between 0 and 120 minutes (where 0 minutes is the same as the timer being disabled). For this test, 1 minute was used.
4. From the DVRS menu tree, select "System Setup 2."
5. Locate "Fixed Mode," in the "Power Up Options" section.
6. Ensure that it is **NOT** set to "OFF."
7. Write changes to the DVR.
8. At the O5 Control Head, observe that "VR YYY XXXX" displays (where "YYY" is the mode and "XXXX" is the channel).
9. In the programmed amount of time (1 minute in this case), the DVR will go inactive, and the display will change to "VR OFF XXXX."

**Test Case Results and Summary**

*Inconclusive.* This test case verifies that the DVR can switch automatically to OFF mode upon expiration of its inactivity time. The user guide states that the timer's range should be between 0 and 180 minutes. An attempt was made to set the timer to 180 minutes, and it turned out that this value was out of range. However, the timer can be set to a maximum value of 120 minutes, which agrees with what is stated in the installation guide. It is not known whether what is stated in the user guide is a typographical error, or if the timer is really supposed to have a maximum duration of 180 minutes. This feature is useful if the user requires that the DVR turn itself off after a certain number of minutes.

**3.10.3 DVR Automatic Entry****Feature Under Test**

- DVR Mode and Channel slaving (association) with a certain MSU TG and Channel

**Test Case Description**

- This test case has two purposes: 1) Verify that a given TG can be associated with a specific DVR channel and DVR mode. 2) Verify that when the user switches from one TG to another slaving-enabled TG at the mobile radio, the DVR automatically changes modes and channels if the new TG is associated with a different DVR mode and channel.

**Initial Conditions**

- PC with Tweaker software loaded
- USB interface cable

- The VR channel list for all conventional channels cannot have any digital channels selected, and the VR channel must be associated with an analog VR channel that has been enabled in the VR Ch List.
- Trunked personality types in the “Mobile Radio Channel Setup” can be associated with analog VR channels, in addition to digital VR channels.
- DVRS configured for normal operation per pp. 40–44 of the installation guide

### Test Procedures

1. From the Tweaker software’s DVRS menu tree, select “System Setup 2.”
2. “Rptr Independent Channel Change” must be unchecked. Ensure that DVR channel association (slaving) to the MSU TGs is disabled.
3. From the DVRS menu tree, select “Mobile Radio Channel Setup” menu.
4. For WYO 3, set the “VRch” to 3. Because the independent channel change has been disabled, the VRch field determines which DVR channel is automatically chosen upon selection of the specified Mobile Radio mode, which can be a TG or a channel.
5. For WYO 4, set the “VRch” to 1.
6. For WYO 3, set the “TG mode” to “Local,” and set the “Manual Mode Change” to “enabled.”
7. For WYO 4, set the “TG mode” to “System,” and set the “Manual Mode Change” to “disabled.”
8. For WYO 3, verify that all channels are checked in the “VR Channel List,” and that VR channel 3 is marked as a slave.
9. For WYO 4 verify that all channels are checked in the “VR Channel List,” and that VR channel 1 is marked as a slave.
10. From the DVRS menu tree, select “Repeater Channel Setup.”
11. Identify channel 3. Find the “VR Mode” column and set it to “SYS,” then find the “Manual Mode Ch” column and set it to “Disable.”
12. Identify channel 1. Find the “VR Mode” column and set it to “SYS,” then find the “Manual Mode Ch” column and set it to “Enable.”
13. Write changes to the DVR.
14. Use the channel select knob to select mobile radio TG WYO 3.
15. Verify that the DVR status line on the O5 Control Head reads as “VR LOC 765.05B.”
16. Use the channel select knob to change the mobile radio TG to “WYO 4.”
17. Verify that the DVR status line on the O5 Control Head reads as “VR SYS 765.05D.”
18. Use softkey scroll buttons to scroll until “VRS” is listed as a softkey button. (Note: When configuring the XTL 5000 MSU, the user selects the available softkeys. All softkeys were made available for these tests.)
19. Press the VRS softkey again, and verify that only “SYS” mode and “OFF” are available for mobile radio TG WYO 4.

### Test Case Results and Summary

*Pass.* This test case verifies that a given TG programmed in the mobile radio can be associated with a specific DVR channel and mode. This test also verifies that if a user switches from one slaving-enabled TG to another slaving-enabled TG at the mobile radio, the DVR automatically changes modes and channels if the new TG is associated with a different DVR mode and channel. This feature is useful because a certain DVR mode and channel is always required when the MSU is tuned to a given TG, and the feature creates a permanent association in the

DVR to link these entities. This feature could reduce the burden of users remembering all of the possible combinations of MSU TG, DVR mode, and DVR channel.

**3.10.4 DVRS OFF/SYSTEM/LOCAL Mode: Remote Control (Steering) of DVR Using an XTS 5K**

**Feature Under Test**

- o PSU remote control capability of the DVR

**Test Case Description**

Verify the following using an XTS 5000 PSU:

- o DVR OFF—Verify DVRS steering is enabled by observing that a local-side PSU user can send a call alert page to a specific DVRS ID, and execute a remote change of the DVR mode from OFF to SYSTEM.
- o DVR SYSTEM—Verify steering is enabled.
- o DVR LOCAL—Verify local PSU steering of the DVRS is enabled. Do this by observing that a local-side PSU user can send a call alert page to a specific DVRS and execute a remote change of the DVR mode from Local to SYSTEM.

**Initial Conditions**

- o PC with Tweaker software loaded
- o USB interface cable
- o DVRS configured for normal operation per pp. 40–44 of the installation guide
- o Access to a trunked system is required
- o Local-side PSUs must be programmed into the trunked system's database

**Test Procedures**

**DVR OFF Mode**

1. In the Tweaker software, find the ID of the DVRS ID by looking under “Digital System Setup Menu.” Check that the VR ID is set to a unique number.
2. Once you identify the VR ID, initiate a call alert page using a local-side PSU. Press the button programmed to send a call alert page, and then use the keypad to enter the VR ID. Press the PTT button to send the call alert page to the DVRS of interest.

The following table illustrates two possible scenarios when working with only a single DVRS in the OFF mode. The post-conditions in the table were verified.

Table 5: DVR OFF—Remote Control of DVR with XTS 5K

Local XTS 5K PSU Action	DVRS Before (Preconditions)	DVRS After (Post-Conditions)
Call Alert Page to: DVRS Channel = 765.05D TG = WYO 1	a) Off b) Master c) DVR CH = 765.05D TG = WYO 1	a) System b) Master c) DVR CH = 765.05D TG = WYO 1
Call Alert Page to: DVRS	a) Off	a) System

Local XTS 5K PSU Action	DVRS Before (Preconditions)	DVRS After (Post-Conditions)
channel = 765.05D TG = WYO 1	b) Master c) DVR CH = 765.05D TG = WYO 2	b) Master c) DVR CH = 765.05D TG = WYO 1

DVR SYSTEM Mode

1. In the Tweaker software, find the ID of the DVRS ID under “Digital System Setup Menu.” Check that the VR ID is set to a unique number.
2. Once you identify the VR ID, initiate a call alert page using a local-side PSU. Press the button programmed to send a call alert page, and then use the keypad to enter the VR ID. Press the PTT button to send the call alert page to the DVRS of interest.

The following table illustrates one possible scenario when working with only a single DVRS in the SYSTEM mode. The post-conditions in the table were verified.

Table 6: DVR SYSTEM—Remote Control of DVR with XTS 5K

Local XTS 5KPSU Action	DVRS Before (Preconditions)	DVRS After (Post-Conditions)
Call Alert Page to: DVRS Channel = 765.05D TG = WYO 1	a) System b) Master c) DVR CH = 765.05D TG=WYO 2	a) System b) Master c) DVR CH = 765.05D TG = WYO 1

DVR LOCAL Mode

1. In the Tweaker software, find the ID of the DVRS ID under “Digital System Setup Menu.” Check that the VR ID is set to a unique number.
2. Once you identify the VR ID, initiate a call alert page using a local-side PSU. Press the button programmed to send a call alert page, and then use the keypad to enter the VR ID. Press the PTT button to send the call alert page to the DVRS of interest.

The following table illustrates two possible scenarios when working with only a single DVRS in the LOCAL mode. The post-conditions in the table were verified.

Table 7: DVR LOCAL—Remote Control of DVR with XTS 5K

Local XTS 5K PSU Action	Before (Preconditions)	After (Post-Conditions)
Call Alert Page to: DVRS CH = 765.05D TG = WYO 1	a) Local b) Master c) DVR CH = 765.05D TG = WYO 1	a) System b) Master c) DVR CH = 765.05D TG = WYO 1
Call Alert Page to: DVRS CH = 765.05D TG = WYO 1	a) Local b) Master c) DVR CH = 765.05D TG = WYO 2	a) System b) Master c) DVR CH = 765.05D TG2 = WYO 1

### Test Case Results and Summary

*Pass.* This test verified the local-side XTS 5K PSU can control the DVR by sending a call alert page to the appropriate DVRS ID. This feature is could be useful to a local-side user in the field who has no access to the O5 Control Head, but who needs to control the DVR mode and TG.

## 3.11 DVRS Specification Tests

### 3.11.1 Programmable Power Output

#### Test Case Description

- Verify that the power output of the repeater can be programmed between 0.1 Watt (W) to 10 W.

#### Initial Conditions

- PC with Tweaker software loaded
- USB interface cable
- DVRS in a conventional analog configuration and in the SYSTEM mode
- An Agilent E4438C vector signal generator to calculate cable loss

#### Test Procedures

1. Press the “Zone” softkey, then use the channel select knob to select desired zone.
2. Press the “Home” button on the O5 Control Head.
3. Use the channel select knob to choose the desired channel.
4. Press the “Home” button.
5. Use the softkey scroll buttons to scroll until “VRS” is listed as a softkey button. (Note: When configuring the XTL 5000 MSU, the user selects the available softkeys. All softkeys were made available for these tests.)
6. Press the “VRS” softkey.
7. Use the channel select knob to select the desired channel. Note: After pressing the “VRS” softkey, the channel select knob must be used quickly or the “VRS” softkey will need to be pressed again.
8. From the Tweaker software’s DVRS menu tree, select “Repeater Channel Setup.”
9. Locate the channel that is used for test purposes, then locate the “TX Pwr. (dBm)” column.



10. Adjust the dBm value. Each time you change a value, write an update to the DVR. For accurate readings, the DVRS must have time to cycle before transmitting.

Note: Measurements were taken at 20 dBm (0.1 W), 30 dBm (1 W), 35 dBm (3.2 W), 37 dBm (5 W), 39 dBm (8 W), and 40 dBm (10 W). (dBm has to do with decibels relative to a milliwatt signal.)

An Agilent E4438C was used to create a waveform to calculate cable loss. The cable loss value = -54.2 dBm.

Table 8: DVR Power Measurement Results

TX Level in dBm (Set in the Tweaker Software)	TX Level in Watts	Reading in dBm	Results in dBm (After Taking in Account Cable Loss)
20	0.1	-31.8	22.4
30	1.0	-23.5	30.7
35	3.2	-19.0	35.2
37	5.0	-17.1	37.1
39	8.0	-15.1	39.1
40	10.0	-14.2	40.0

**Test Case Results and Summary**

Pass. The test case verified that the DVR’s power output is user-programmable. The user can adjust the output power of the DVR to maintain communications with local-side PSUs, depending on the extent of the geographic coverage area.

**3.11.2 Transmitter Audio Response: Analog Mode**

**Test Case Description**

- o Verify that the transmitter audio response (frequency response) of the DVR over the frequency range of 300 Hz to 3,000 Hz is 6 dB per octave. Also verify that the response is constrained to an upper bound of +1 dB and a lower bound of -3 dB.

**Initial Conditions**

- o DVRS in a conventional analog configuration and in the LOCAL mode
- o Agilent 8903B baseband audio analyzer
- o IFR 2975 test set

**Test Procedures**

1. Cable up the HP 8903B to the baseband audio port of the DVR. Then cable the antenna port of the DVR to the transmit/receive (T/R) port on the IFR 2975.
2. Configure the HP 8903B to transmit a signal that has an amplitude of 300 mV.
3. In the HP 8903B, initially set the frequency of the transmitted signal to 300 Hz.
4. Configure the IFR 2975 to demodulate the RF transmission received from the DVR. Figure 5 illustrates the equipment configuration.
5. Use the HP 8903B to transmit the 300 mV signal to the DVR at a frequency of 300 Hz.

6. Use the marker feature on the oscilloscope on the IFR 2975 to determine the high and low values for the frequency deviation at the peak amplitude of the demodulated baseband signal.
7. Repeat steps 5 through 6 in steps of 100 Hz up to 1 KHz. From 1 KHz, step up 200 Hz at a time to 3 KHz. The data in the following table was obtained using this method.

Table 9: Transmitter Frequency Response Data

Frequency of 300mV Signal Generated by HP 8903B (Hz)	Frequency Deviation: Low Value (KHz)	Frequency Deviation: High Value (KHz)
300	.24	.26
400	.54	.57
500	.66	.69
600	.79	.80
700	.92	.93
800	1.05	1.07
900	1.17	1.20
1000	1.29	1.32
1200	1.55	1.59
1400	1.79	1.80
1600	1.95	2.00
1800	2.26	2.29
2000	2.43	2.50
2200	2.37	2.47
2400	2.60	2.67
2600	2.57	2.65
2800	2.50	2.90
3000	2.50	2.90

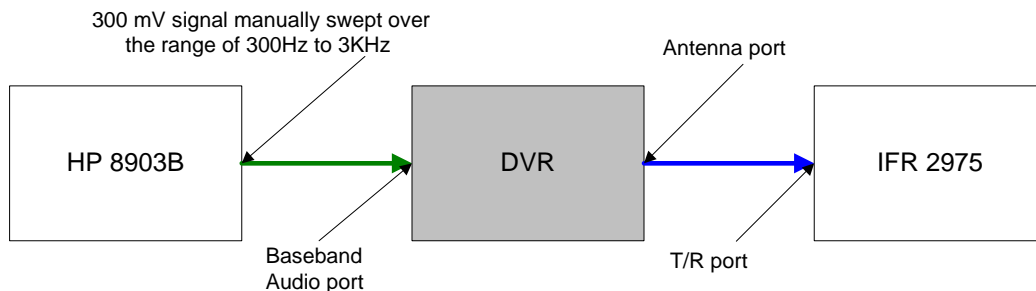


Figure 5: Block Diagram of Transmitter Frequency Response Test

### Test Case Results and Summary

*Pass with Exceptions.* Figure 6 shows that at about 300 Hz, the measured data dips slightly below the lower limit. Some of this behavior may be attributable to a margin of error introduced by the test equipment used to perform this measurement. However, it is more likely that the device has difficulty dealing with a baseband signal that is at a frequency of 300 Hz. The test case verified that the DVR's transmitter frequency response conforms to the vendor's specification. This test ensures that the device is transmitting signals in the audible band (300 Hz to 3 KHz) at the correct power level, which ultimately affects the quality of the audio heard by the user.

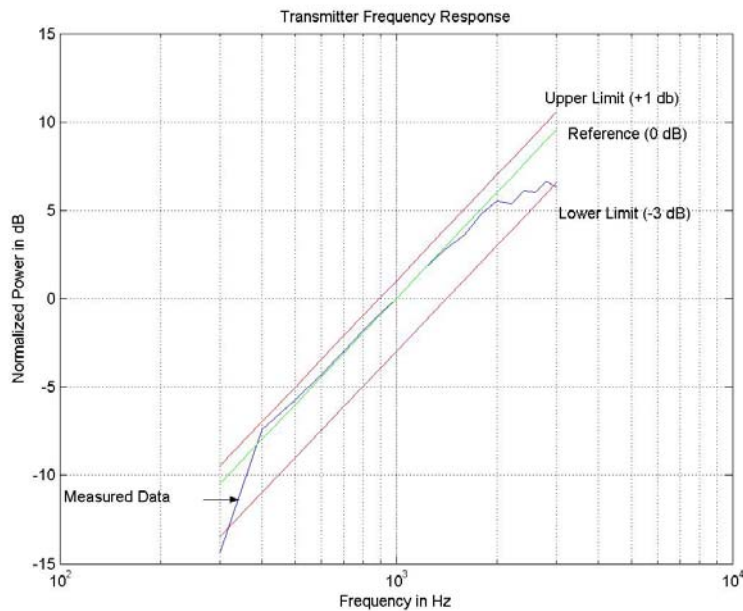


Figure 6: Transmitter Frequency Response Curve

### 3.11.3 Transmitter Audio Distortion: Analog Mode

#### Test Case Description

- Verify that the audio distortion due to the transmitter is less than 2 percent.

#### Initial Conditions

- IFR 2975
- DVRS in LOCAL mode

#### Test Procedures

1. Cable up the audio analyzer to the DVR using the manufacturer-supplied test cable. Use the DSO to verify the 315 mV 1 KHz tone from the audio analyzer.
2. Cable up the IFR 2975 to the DVR's antenna port, as shown in Figure 7.
3. Configure the IFR 2975 to receive the DVRS-modulated output.
4. Use the IFR 2975 to measure total harmonic distortion (THD) and signal including noise and distortion (SINAD), using the built-in meters.

5. Configure the frequency range of the noise and signal to be between 250 Hz and 3.5 KHz in the THD meter.
6. Start the test by using the audio analyzer to generate a 1 KHz tone to the DVR.
7. Use the THD meter to observe and record the level indicated by the meter.
8. Use the SINAD meter to observe and record the level indicated by the meter.

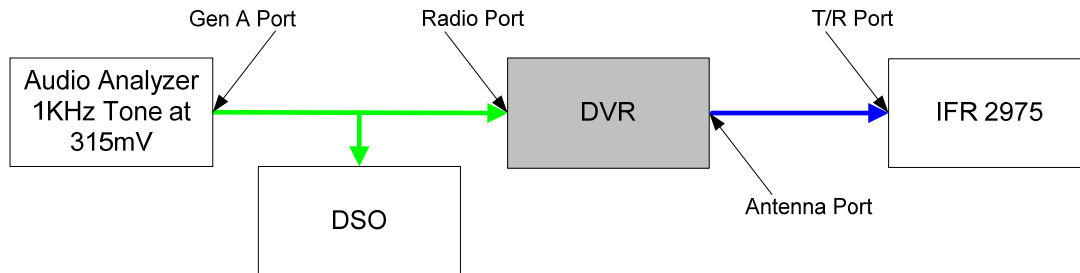


Figure 7: Transmitter THD+N and SINAD Block Diagram

### Test Case Results and Summary

*Pass.* The transmitter THD+N measurement was 0.46 percent. The SINAD measurement was 50 dB. This THD+N value is better than the specification of 2 percent published by the vendor. The SINAD test was performed, though values were not specified by the vendor. The THD+N value indicates the level of distortion in the DVR's transmitted audio signal. Test results show that the transmitted audio does not experience significant distortion, thereby minimizing the impact on voice quality.

### 3.11.4 Receiver Sensitivity: Analog Mode

#### Test Case Description

- Verify that the receiver sensitivity is -115 dBm (0.32 uV).

#### Initial Conditions

- SMIQ signal generator
- Agilent 8903B baseband audio analyzer
- DVRS is in a conventional analog configuration and in the LOCAL mode

#### Test Procedures

1. Cable the RF port of the SMIQ signal generator to the Rx port of the DVR. See Figure 4. Cable the baseband audio port of the DVR to the input port on the Agilent 8903B.
2. Configure the carrier frequency of the SMIQ signal generator to match the receiver frequency of the DVR. In this case, the carrier used was 795.05 MHz. Also in the SMIQ signal generator, set up a baseband signal for FM modulation. This signal's frequency should be 1 KHz, with a frequency deviation of 1.5 KHz.
3. Set the output level of the SMIQ signal generator to initially transmit at -47 dBm.
4. Start the test by transmitting the modulated FM signal from the SMIQ signal generator to the DVR. The SINAD on the 8903B will be above 12 dBm.
5. Slowly lower the transmit power level in the SMIQ signal generator until a frequency of 1,000 Hz and about 12 dB SINAD is observed on the Agilent 8903B.
6. Note and record the transmit power level on the SMIQ signal generator.

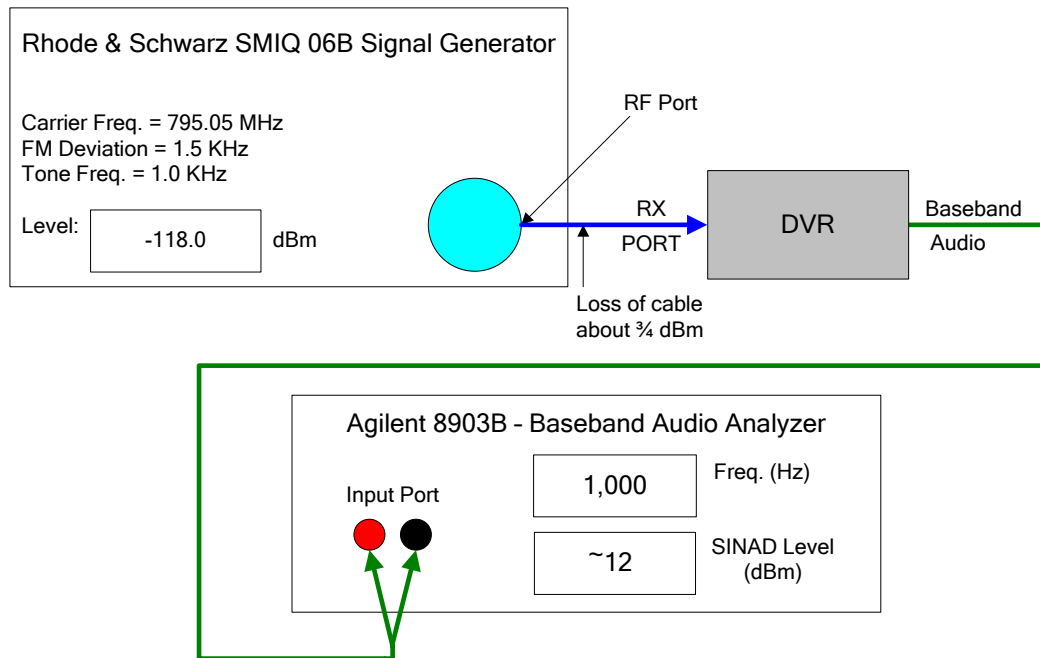


Figure 8: Block Diagram of Receiver Sensitivity Test

**Test Case Results and Summary**

*Pass.* The receiver sensitivity measurement was -118.75 dBm. This is better than the specification of -115 dBm published by the vendor, and indicates the DVR receiver can successfully demodulate a very weak RF transmission. The measurement also suggests that the DVR’s geographical coverage area may be slightly larger than expected. The test case verified that the DVR’s receiver sensitivity conforms to the vendor’s specification.

**3.11.5 Receiver Intermodulation: Analog Mode**

**Test Case Description**

- o Verify that the intermodulation at the receiver is 75 dB.

**Initial Conditions**

- o SMIQ signal generator
- o Two Agilent E4438C signal generators
- o IFR 2975
- o Attenuators and combiners
- o DVRS in LOCAL mode

**Test Procedures**

1. Configure the SMIQ signal generator to transmit a 1 KHz signal (with 1.5 KHz of deviation) FM modulated and with a carrier frequency of 795.05 MHz.
2. Configure an Agilent E4438C signal generator to transmit a 400 Hz signal (with 1.5 KHz of deviation) FM modulated, and with a carrier frequency that is 50 KHz above 795.05 MHz (795.10 MHz). Set the signal level to -75 dB. This will act as the first interferer.

3. Configure a second Agilent E4438C signal generator to transmit only a carrier frequency that is 100 KHz above 795.05 MHz (795.15 MHz). Set the signal level to -75 dB. This will act as the second interferer.
4. Configure the IFR 2975 to receive on a frequency of 795.05 MHz. From the IFR 2975 menu set, bring up the SINAD meter tool.
5. Interconnect the test equipment to the DVR as shown in Figure 9.
6. Using the SMIQ signal generator, begin by transmitting a signal that has a level of -50 dB. Observe the SINAD meter on the IFR 2975. The meter should read significantly above 12 dB at this point.
7. On the SMIQ signal generator, start adjusting the level of the transmitted signal downward until the SINAD meter on the IFR 2975 reaches 12 dB.
8. When the SINAD meter on the IFR 2975 reaches 12 dB, record the SMIQ signal generator signal level. It should be around -118 dB.
9. On the SMIQ signal generator, adjust the signal level by +3 dB. So, if the SMIQ signal generator is at -118 dB, the new level will be -115 dB. The SINAD meter on the IFR 2975 will now read higher than 12 dB.
10. Increase the levels on both interferer signal generators *simultaneously* to force the IFR 2975 SINAD meter back to a level of 12 dB. Record the signal levels of each interferer. They should be about the same: around -42 dB.
11. To determine the intermodulation rejection level of the receiver, take the value noted in step 8 and subtract it from the value obtained in step 10. In this test case, the intermodulation calculation was  $-42 - (-118) = 76$  dB.

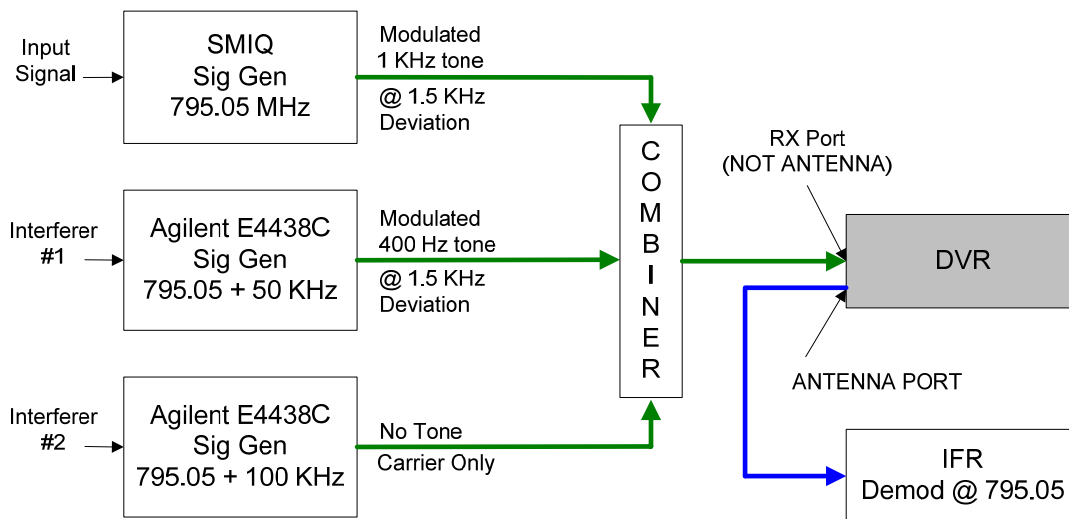


Figure 9: Block Diagram for Receiver Intermodulation Test

### Test Case Results and Summary

**Pass.** The calculated intermodulation rejection level was 76 dB. This exceeds the manufacturer's specification of 75 dB. In general, the larger the intermodulation rejection level is, the better. In this case, the DVR receiver can tolerate interferers that have a maximum signal level of about -42 dB before the desired input signal starts to be negatively affected. The most notable negative effect of a strong interferer would be reduced audio quality. The test case verified that the DVR's intermodulation level conforms to the vendor's specification.

### 3.11.6 Receiver Frequency Deviation: Analog Mode

#### Test Case Description

- Verify that the DVR receiver frequency deviation for a 12.5 KHz channel is +/- 2.5 KHz.

#### Initial Conditions

- Tektronix TDS 3012B Digital Storage Oscilloscope (DSO)
- IFR 2975
- A PC with Tweaker software installed
- A USB interface cable
- DVRS is in either SYSTEM or LOCAL mode

#### Test Procedures

1. Configure the function generator feature of the DSO to transmit a 1 KHz signal to the baseband port on the DVR. Initially, the amplitude of this signal should be set to zero volts.
2. Configure the IFR 2975 to receive from the DVR's antenna port on a frequency of 765.05 MHz.
3. Use the IFR 2975 menu set to bring up the frequency deviation meter.
4. In the Tweaker software, set the frequency deviation level under the Hardware Setup menu to 2.5 KHz. Write the change to the DVR.
5. Slowly increase the amplitude of the signal in step 1 until the frequency deviation meter reaches 2.5 KHz.

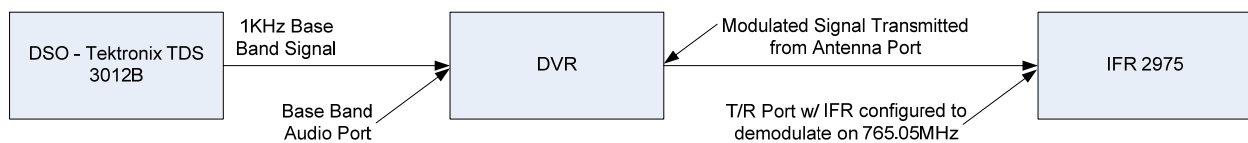


Figure 10: Block Diagram for DVR Receiver Frequency Deviation Test

#### Test Case Results and Summary

*Pass.* This test case verified that the DVR receiver can deviate from the center frequency it is set to by a maximum of 2.5 KHz when the channel width is 12.5 KHz. A frequency deviation of more than 2.5 KHz could negatively affect audio quality. The test case verified that the DVR's frequency deviation conforms to the vendor's specification.

### 3.11.7 Receiver Audio Response: Analog Mode

#### Test Case Description

- Verify that the receiver audio response (frequency response) of the DVR, over the frequency range of 300 Hz to 3,000 Hz, is 6 dB per octave, and that the response is constrained to an upper bound of +1 dB and a lower bound of -3 dB.

#### Initial Conditions

- DVRS in a conventional analog configuration and in the LOCAL mode
- Agilent 8903B baseband audio analyzer

- o IFR 2975

**Test Procedures**

1. Cable up the HP 8903B to the baseband audio port of the DVR. Then cable the receive port of the DVR to the RF transmission port on the SMIQ signal generator. See Figure 7.
2. Configure the SMIQ signal generator to initially transmit a baseband signal (the message signal) with a frequency of 300 Hz that is FM modulated, with a carrier frequency of 795.05 MHz.
3. Use the SMIQ signal generator to transmit the FM modulated signal configured in step 2.
4. Use the Agilent 8903B to observe and record the voltage level of the baseband audio received from the DVR.
5. Repeat steps 2 through 4 in increments of 100 Hz up to 1 KHz. From 1 KHz, step up 200 Hz at a time to 3 KHz. The data in Table 10 was obtained using this method. The normalized power level was calculated using the voltage level obtained when a 1 KHz message signal was sent. The following formula was used to calculate the normalized power level:

$$\text{Normalized Power} = 20 \cdot \log_{10} (V/V_{\text{Ref}})$$

where  $V_{\text{Ref}} = .185$  Volts

Table 10: Receiver Frequency Response Data

Frequency of SMIQ Signal Generator Message (Hz)	Voltage Level of Baseband Signal from DVR (Volts)	Normalized Power Level (dB) (Using Voltage Level at 1 KHz as Reference)
300	.3	4.19
400	.44	7.50
500	.35	5.53
600	.3	4.19
700	.26	2.96
800	.23	1.90
900	.21	1.10
1000	.185	0
1200	.15	-1.80
1400	.13	-3.00
1600	.12	-3.76
1800	.10	-5.30
2000	.09	-6.26
2200	.08	-7.28
2400	.075	-7.84
2600	.070	-8.44
2800	.063	-9.36
3000	.058	-10.07



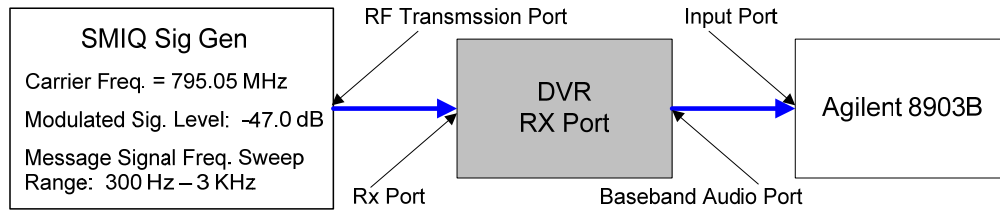


Figure 11: Block Diagram of Receiver Frequency Response Test

**Test Case Results and Summary**

*Pass with Exceptions.* Figure 12 shows that, between 300 Hz to 350 Hz, the measured data dips below the lower limit. Some of this may be attributable to the measurement technique; however, the level of the measured data at 300 Hz is significantly below the lower limit, while the measured data from 350 Hz to 3 KHz is right on the reference line. The test case verified that the DVR’s transmitter frequency response for the most part conforms to the vendor’s specification. This test ensures that the DVR can receive, demodulate, and render baseband signals (in the range of 300 Hz to 3 KHz) at the correct power level, which ultimately affects user-heard audio quality.

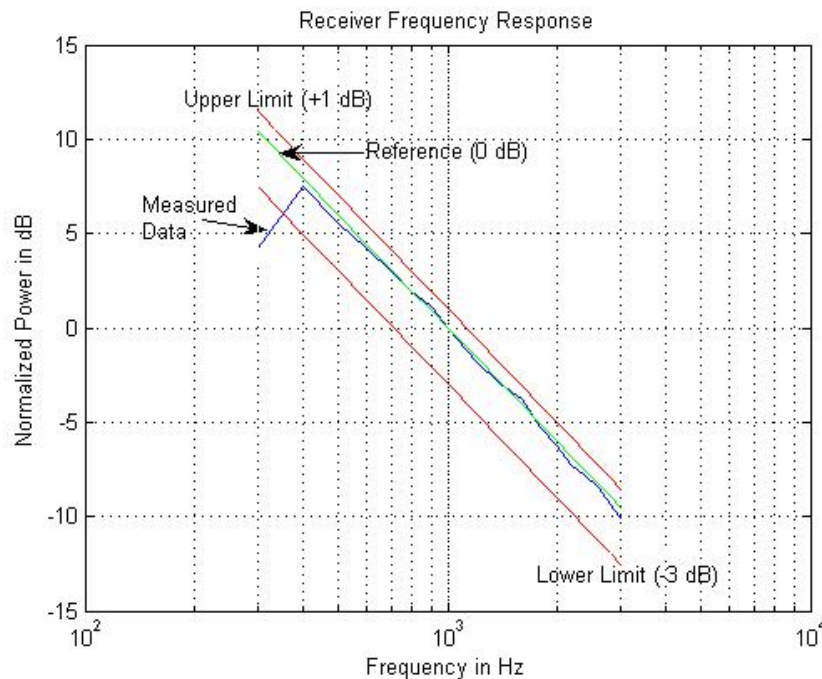


Figure 12: Receiver Frequency Response Curve

**3.11.8 Receiver Audio Distortion: Analog Mode**

**Test Case Description**

- Verify that audio distortion (the THD) due to the transmitter is less than 2 percent.

### Initial Conditions

- IFR 2975
- DVRS in LOCAL mode

### Test Procedures

1. Cable up the IFR 2975 to the DVR's Rx port as shown in Figure 13.
2. Configure the IFR 2975 to transmit a 1 KHz tone and to FM modulate at 765.05 MHz. Set the RF transmit signal level to -47 dBm.
3. Use the IFR 2975 built-in meters to measure THD and SINAD.
4. Configure the frequency range of the noise and signal to be between 250 Hz and 3.5 KHz in the THD meter.
5. Use the IFR 2975 to transmit the modulated 1 KHz tone to the DVR.
6. Use the THD meter to observe and record the level indicated by the meter.
7. Use the SINAD meter to observe and record the level indicated by the meter.

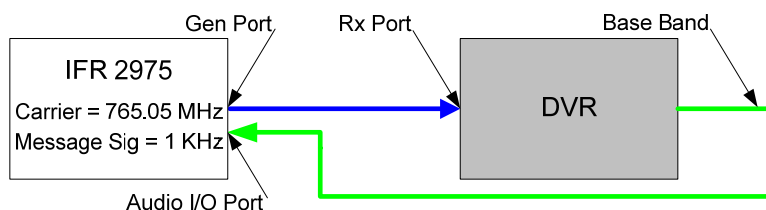


Figure 13: Receiver THD+N and SINAD Block Diagram

### Test Case Results and Summary

*Pass.* The receiver THD+N measurement was 0.48 percent. The SINAD measurement was 55 dB. This THD+N measurement is better than the vendor's published specification of 2 percent. The SINAD test was performed, although the vendor specified no value. The THD+N measurement indicates the level of audio signal distortion emitted by the DVR. The observed measurement indicates the DVR is hardly distorting the audio signal.

## 4 Observations of RF Emissions

Because the Mobexcom P25 DVRS must operate in environments with other RF equipment, an informal RF emissions scan was made in the 20 MHz to 500 MHz range. This section details those measurement procedures and results.

### Test Procedure

1. Configure the RF spectrum analyzer to measure RF energy from 20 MHz to 500 MHz, which encompasses the VHF band where interference was observed. See Figure 10.
2. Position the antenna probe at 0.5 meters from the device you are testing.
3. Power off the device you are testing, and use the spectrum analyzer to record the RF energy across the frequency band of interest.
4. Power on the device you are testing, and repeat the preceding step.

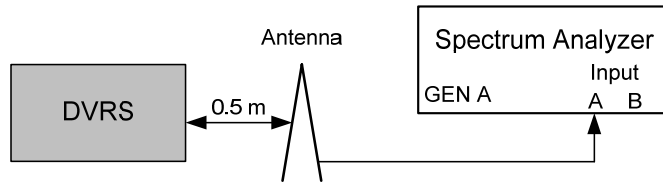


Figure 14: RF Emissions Block Diagram

**Test Case Results and Summary**

The following two plots, in Figure 15 and Figure 16, show no emissions of significance, indicating the DVRS most likely will not interfere with the operation of other electronic devices.

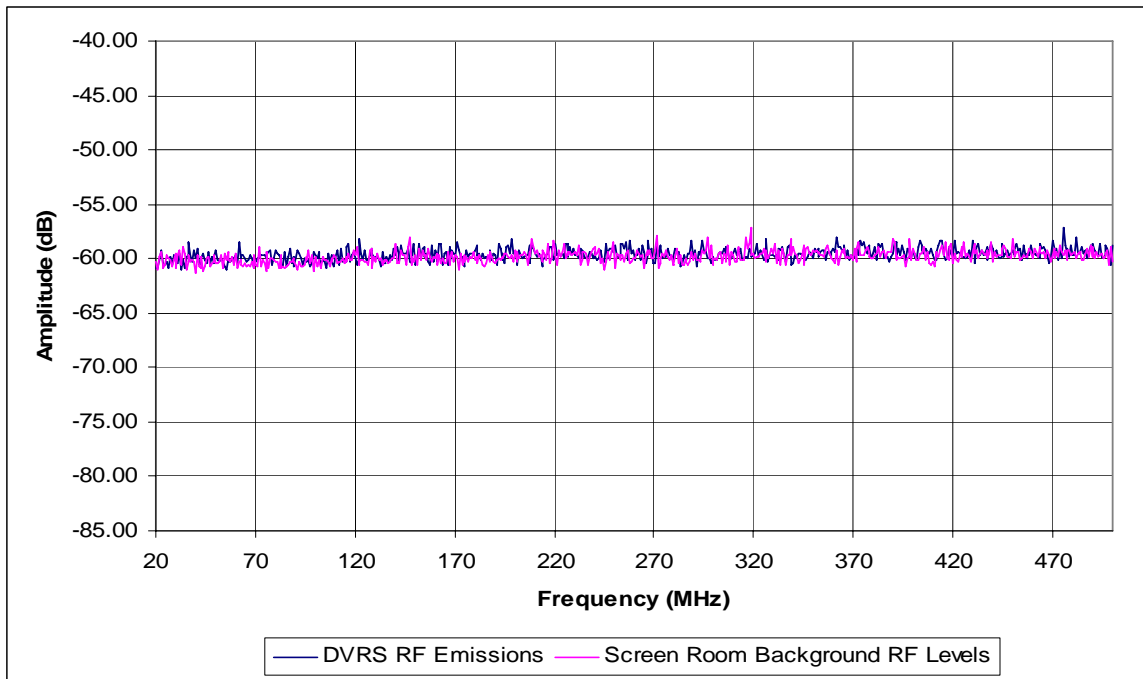


Figure 15: Vertical Scan of DVRS

(Note: This is not a formal compliance test.)

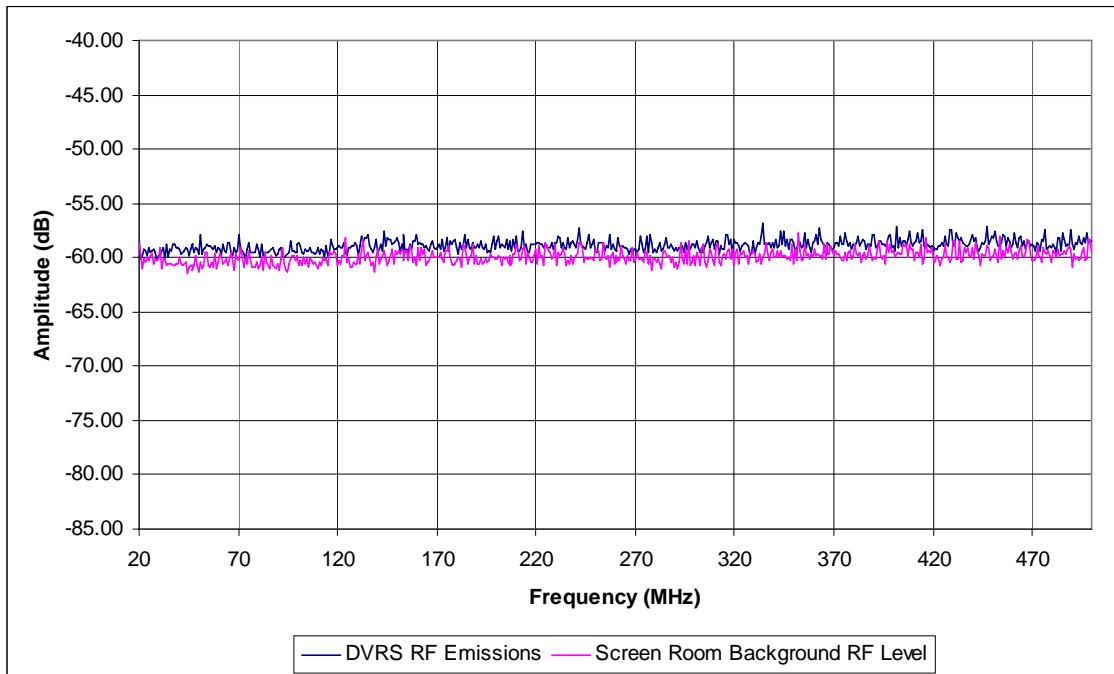


Figure 16: Horizontal Scan of DVRS

(Note: This is not a formal EMC compliance test.)

## Appendix A: Glossary of Terms and Acronyms

Channel—A group of characteristics, such as transmit and receive frequency pairs, radio parameters, encryption encoding, etc.

Conventional Radio System—Refers to radio-to-radio communications, sometimes through a base station repeater or vehicular repeater

dB—Decibels

DHS—U.S. Department of Homeland Security

Dispatcher—An individual who has radio system management duties

DVR—Digital Vehicular Repeater

DVR Mode—Determines the communication exchange capabilities between system users and local portable users; can be set to OFF, LOCAL or SYSTEM

DVRS—Digital Vehicular Repeater System, interfaced to an XTL 5000 Mobile radio with O5 Control Head

DVR ID—Programmable (in the DVR) ID, which is used for mode and TG steering. To remotely change the mode and TG on the DVRS, the PSU user sends a call alert page to the specific DVR ID

FCC—Federal Communications Commission

FFT (Fast Fourier Transform)—A computationally efficient means of computing the frequency content of a waveform

Inbound Call—Local-side, PSU-originated call received by the DVR

ITS—Institute for Telecommunication Sciences, an agency of the U.S. Department of Commerce's National Telecommunications and Information Administration (NTIA)

Local Mode—DVR mode which provides extended portable-to-portable voice and data range by repeating local-side PSU (optionally MSU) communications, without keying up the mobile radio interfaced to the DVR

LMR (Land Mobile Radio)—A common descriptor of the type of radio communication system frequently used by public safety practitioners

Mode MSU or PSU—A programmed combination of operating parameters. DVR – OFF, SYSTEM or LOCAL (see DVR mode)

MSU—Mobile Subscriber Unit

NIST—National Institute of Standards and Technology, an agency of the U.S. Department of Commerce's Technology Administration

O5—Odyssey 5 Control Head using CAN bus

OIC—The Office of Interoperability and Compatibility within the DHS Science and Technology (S&T) Directorate

OLES—The Office of Law Enforcement Standards within NIST

Outbound Call—System Call received by the MSU

P25—Project 25

Phase I—First DVR and XTL5000 Firmware Release: Target Release Date of Q1 2006

Phase II—Second DVR and XTL5000 Firmware Release: Target Release Date of Q4 2006

PSU—Portable Subscriber Unit

PTT—Push-to-talk. The PTT engages the transmitter (of the Portable or Mobile radio and/or DVR) when pressed

RF—Radio Frequency. Part of the general frequency spectrum: 10 kHz to 10,000,000 MHz

RSSI—Received Signal Strength Indicator

RX—Received or Receiver

S&T—Science and Technology Directorate of DHS

SINAD—The ratio of Signal + Noise + Distortion to Noise + Distortion

System Mode—DVR mode which provides extended voice and signaling communications between system users and local portable users over the selected DVR channel and mobile radio mode

Talk Group (or TG)—A group of radio users who communicate with each other by using the same communication path

THD+N—The sum of the Total Harmonic Distortion plus Noise. THD is the ratio of the power of all harmonic frequencies introduced by a system to the power of the fundamental frequency to which the frequencies are added

Trunking—The automatic sharing of radio frequencies by a large number of users based on communication path sharing for the length of a conversation

TX—Transmitted, or transmitter

UHF (Ultra High Frequency)—Frequencies from 300 MHz to 3,000 MHz

USB—Universal Serial Bus

VHF (Very High Frequency)—Frequencies from 30 MHz to 300 MHz

V<sub>p</sub>—Peak voltage

V<sub>pp</sub>—Peak-to-peak voltage

VR—Vehicular Repeater

XTL 5K—Motorola XTL 5000 mobile subscriber unit

XTS 5K—Motorola XTS 5000 portable subscriber unit

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