TECHNICAL MANUAL
888-2001-895

DRM Modulator System

T.M. No. 888-2001-895

Printed: March, 2006
Rev. A1: 03/16/2007

Returns And Exchanges

Damaged or undamaged equipment should not be returned unless written approval and a Return Authorization is received from HARRIS Broadcast Communications Division. Special shipping instructions and coding will be provided to assure proper handling. Complete details regarding circumstances and reasons for return are to be included in the request for return. Custom equipment or special order equipment is not returnable. In those instances where return or exchange of equipment is at the request of the customer, or convenience of the customer, a restocking fee will be charged. All returns will be sent freight prepaid and properly insured by the customer. When communicating with HARRIS Broadcast Communications Division, specify the HARRIS Order Number or Invoice Number.

Unpacking

Carefully unpack the equipment and preform a visual inspection to determine that no apparent damage was incurred during shipment. Retain the shipping materials until it has been determined that all received equipment is not damaged. Locate and retain all PACKING CHECK LISTs. Use the PACKING CHECK LIST to help locate and identify any components or assemblies which are removed for shipping and must be reinstalled. Also remove any shipping supports, straps, and packing materials prior to initial turn on.

Technical Assistance

HARRIS Technical and Troubleshooting assistance is available from HARRIS Field Service during normal business hours (8:00 AM - 5:00 PM Central Time). Emergency service is available 24 hours a day. Telephone 217/222-8200 to contact the Field Service Department or address correspondence to Field Service Department, HARRIS Broadcast Communications Division, P.O. Box 4290, Quincy, Illinois 62305-4290, USA. Technical Support by e-mail: *tsupport@harris.co*m. The HARRIS factory may also be contacted through a FAX facility (217/221-7096).

Replaceable Parts Service

Replacement parts are available 24 hours a day, seven days a week from the HARRIS Service Parts Department. Telephone 217/222-8200 to contact the service parts department or address correspondence to Service Parts Department, HARRIS CORPORATION, Broadcast Systems Division, P.O. Box 4290, Quincy, Illinois 62305-4290, USA. The HARRIS factory may also be contacted through a FAX facility (217/221-7096).

NOTE:
The # symbol used in the parts list means used with (e.g. #C001 = used with C001).

Manual Revision History

888-2001-895 Technical Manual

REV.	DATE	ECN	Pages Affected
Preliminary	12dec2005		
A	5jan2006	P31528	Released
A1	16mar2007		Added CE info

WARNING: Disconnect primary power prior to servicing.

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English	Hereby, *HARRIS Broadcast Communications* declares that this *DRM MOD-100 Transmitter Modulator* is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.
Finnish	*HARRIS Broadcast Communications* vakuuttaa täten että *DRM MOD-100 Transmitter Modulator* tyyppinen laite on direktiivin 1999/5/EY oleellisten vaatimusten ja sitä koskevien direktiivin muiden ehtojen mukainen.
Dutch	Hierbij verklaart *HARRIS Broadcast Communications* dat het toestel *DRM MOD-100 Transmitter Modulator* in overeenstemming is met de essentiële eisen en de andere relevante bepalingen van richtlijn 1999/5/EG
	Bij deze verklaart *HARRIS Broadcast Communications* dat deze *DRM MOD-100 Transmitter Modulator* voldoet aan de essentiële eisen en aan de overige relevante bepalingen van Richtlijn 1999/5/EC.
French	Par la présente *HARRIS Broadcast Communications* déclare que l'appareil *DRM MOD-100 Transmitter Modulator* est conforme aux exigences essentielles et aux autres dispositions pertinentes de la directive 1999/5/CE
	Par la présente, *HARRIS Broadcast Communications* déclare que ce *DRM MOD-100 Transmitter Modulator* est conforme aux exigences essentielles et aux autres dispositions de la directive 1999/5/CE qui lui sont applicables
Swedish	Härmed intygar *HARRIS Broadcast Communications* att denna *DRM MOD-100 Transmitter Modulator* står I överensstämmelse med de väsentliga egenskapskrav och övriga relevanta bestämmelser som framgår av direktiv 1999/5/EG.
Danish	Undertegnede *HARRIS Broadcast Communications* erklærer herved, at følgende udstyr *DRM MOD-100 Transmitter Modulator* overholder de væsentlige krav og øvrige relevante krav i direktiv 1999/5/EF
German	Hiermit erklärt *HARRIS Broadcast Communications*, dass sich *dieser/diese/dieses DRM MOD-100 Transmitter Modulator* in Übereinstimmung mit den grundlegenden Anforderungen und den anderen relevanten Vorschriften der Richtlinie 1999/5/EG befindet". (BMWi)
	Hiermit erklärt *HARRIS Broadcast Communications* die Übereinstimmung des Gerätes *DRM MOD-100 Transmitter Modulator* mit den grundlegenden Anforderungen und den anderen relevanten Festlegungen der Richtlinie 1999/5/EG. (Wien)
Greek	*ΜΕ ΤΗΝ ΠΑΡΟΥΣΑ HARRIS Broadcast Communications ΔΗΛΩΝΕΙ ΟΤΙ DRM MOD-100 Transmitter Modulator ΣΥΜΜΟΡΦΩΝΕΤΑΙ ΠΡΟΣ ΤΙΣ ΟΥΣΙΩΔΕΙΣ ΑΠΑΙΤΗΣΕΙΣ ΚΑΙ ΤΙΣ ΛΟΙΠΕΣ ΣΧΕΤΙΚΕΣ ΔΙΑΤΑΞΕΙΣ ΤΗΣ ΟΔΗΓΙΑΣ 1999/5/ΕΚ*
Italian	Con la presente *HARRIS Broadcast Communications* dichiara che questo *DRM MOD-100 Transmitter Modulator* è conforme ai requisiti essenziali ed alle altre disposizioni pertinenti stabilite dalla direttiva 1999/5/CE.
Spanish	Por medio de la presente *HARRIS Broadcast Communications* declara que el *DRM MOD-100 Transmitter Modulator* cumple con los requisitos esenciales y cualesquiera otras disposiciones aplicables o exigibles de la Directiva 1999/5/CE
Portuguese	*HARRIS Broadcast Communications* declara que este *DRM MOD-100 Transmitter Modulator* está conforme com os requisitos essenciais e outras disposições da Directiva 1999/5/CE.

Declaration of Conformity - R&TTE Directive

Manufacturer:
Harris Broadcast Systems
3200 Wismann Lane
Quincy, Illinois, 62305, USA

European Agent:
Harris Systems Ltd
Eskdale Rd
Winnersh
Wokingham
Berkshire RG41 5TS - UK

Equipment declared compliant by this Declaration:

DRM-MOD 100 Broadcast Radio DRM Modulator

We hereby declare this equipment to be in Conformity to the following Directive:
Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity.

Directives and Standard(s) used to verify compliance:

EN 301 489-1 V1.4.1 (2002-08)	(EMC) Common Technical requirements
EN 301 489-11 V1.2.1 (2003-05)	(EMC) Specific Conditions for Terrestrial broadcasting transmitters
EN 302 245-2 V1.1.1 (2005-01)	Electromagnetic compatibility and Radio spectrum Matters (ERM); Transmitting equipment for the Digital Radio Mondiale (DRM) broadcasting service; Part 2: Harmonized EN under article 3.2 of the R&TTE Directive
EN 60215 (1989) *+A1:1992; +A2:1994*	Safety requirements for radio transmitting equipment

The DRM-MOD 100 modulator is Declared in conformity for use only as a part of a DRM radio transmitter. The DRM-MOD 100 alone does not limit spurious emissions as required by EN 302-245-2. When the DRM-MOD 100 is installed in a transmitter, The transmitter must be provided with any filtering needed to cause the transmitter output spurious emissions to be lower than the limit set by EN 302 245-2.

A Technical Construction File of tests and observations to verify compliance is filed as QCY-2006-02, dated July 28, 2006. The Technical Construction File was prepared by:

Karl Black – Compliance Engineer — March 12, 2007 (Date)

Based on the above tests and inspections, we hereby declare this equipment compliant.

Geoff Mendenhall
V.P. Engineering — March 14, 2007 (Date)

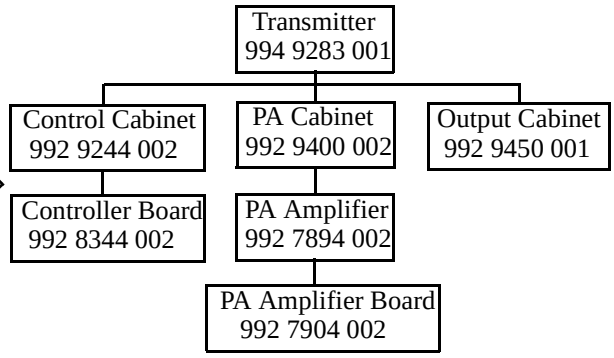
WARNING: Disconnect primary power prior to servicing.

Guide to Using Harris Parts List Information

The Harris Replaceable Parts List Index portrays a tree structure with the major items being leftmost in the index. The example below shows the Transmitter as the highest item in the tree structure. If you were to look at the bill of materials table for the Transmitter you would find the Control Cabinet, the PA Cabinet, and the Output Cabinet. In the Replaceable Parts List Index the Control Cabinet, PA Cabinet, and Output Cabinet show up one indentation level below the Transmitter and implies that they are used in the Transmitter. The Controller Board is indented one level below the Control Cabinet so it will show up in the bill of material for the Control Cabinet. The tree structure of this same index is shown to the right of the table and shows indentation level versus tree structure level.

Example of Replaceable Parts List Index and equivalent tree structure:

Replaceable Parts List Index	Part Number	Page
Table 7-1. Transmitter	994 9283 001	7-2
Table 7-2. Control Cabinet	992 9244 002	7-3
Table 7-3. Controller Board	992 8344 002	7-6
Table 7-4. PA Cabinet	992 9400 002	7-7
Table 7-5. PA Amplifier	994 7894 002	7-9
Table 7-6. PA Amplifier Board	992 7904 002	7-10
Table 7-7. Output Cabinet	992 9450 001	7-12



The part number of the item is shown to the right of the descri
that part number starts. Inside the actual tables, four main headings are used:

- Table #-#. ITEM NAME - HARRIS PART NUMBER - this line gives the information that corresponds to the
- Replaceable Parts List Index entry;
- HARRIS P/N column gives the ten DIGIT Harris part number (usually in ascending order);
- DESCRIPTION column gives a 25 character or less description of the part number;
- REF. SYMBOLS/EXPLANATIONS column 1) gives the reference designators for the item (i.e., C001, R102, etc.) that corresponds to the number found in the schematics (C001 in a bill of material is equivalent to C1 on the schematic) or 2) gives added information or further explanation (i.e., “Used for 208V operation only,” or “Used for HT 10LS only,” etc.).

Inside the individual tables some standard conventions are used:

- A # symbol in front of a component such as #C001 under the REF. SYMBOLS/EXPLANATIONS column means that this item is used on or with C001 and is not the actual part number for C001.
- In the ten digit part numbers, if the last three numbers are 000, the item is a part that Harris has purchased and has not manufactured or modified. If the last three numbers are other than 000, the item is either manufactured by Harris or is purchased from a vendor and modified for use in the Harris product.
- The first three digits of the ten DIGIT part number tell which family the part number belongs to - for example, all electrolytic (can) capacitors will be in the same family (524 xxxx 000). If an electrolytic (can) capacitor is found to have a 9xx xxxx xxx part number (a number outside of the normal family of numbers), it has probably been modified in some manner at the Harris factory and will therefore show up farther down into the individual parts list (because each table is normally sorted in ascending order). Most Harris made or modified assemblies will have 9xx xxxx xxx numbers associated with them.

The term “SEE HIGHER LEVEL BILL” in the description column implies that the reference designated part number will show up in a bill that is higher in the tree structure. This is often the case for components that may be frequency determinant or voltage determinant and are called out in a higher level bill structure that is more customer dependent than the bill at a lower level.

WARNING: Disconnect primary power prior to servicing.

HARRIS Broadcast Systems Division
P.O. Box 4290, QUINCY, IL 62305

PARTS ORDER FORM

HARRIS PHONE: 217-222-8200
HARRIS FAX: 217-221-7096

BILLING INFORMATION

CUSTOMER NAME: _____

ADDRESS: _____

_____

_____

_____

TELEPHONE NUMBER: _____

FAX NUMBER: _____

PREFERRED PAYMENT METHOD: _____

SHIPPING INFORMATION

SHIP TO: _____
(if different from billing information)

ADDRESS: _____

_____

_____

_____

TELEPHONE NUMBER: _____

FAX NUMBER: _____

SHIPPING METHOD PREFERRED: _____

FREQUENCY (If required): _____

EQUIPMENT NAME: _____

EQUIPMENT PART NUMBER: _____

EQUIPMENT SERIAL NUMBER: _____

GUIDE FOR ORDERING PARTS

Please use the following parts order form, filling is as much information as possible. The complete informaiton will allow double checking the part number for correctness or locating a substitude if the part is not available.
The equipment name, part number, and serial number will be found on the metal ID plate on the back of the unit. The serial number MUST be included for any parts ordered under warranty.
Describe the part using the description in the parts list if possible. Include the schematic information, schematic number, or number of next higher assembly. The next higher assembly is usually a 992-xxxx-00x type.

ITEM #	QTY ORD	HARRIS PART NUMBER	DESCRIPTION OF PART (PART'S NAME, DESCRIPTION, SPECIFICATION FROM PARTS LIST IF AVAILABLE)	SCHEMATIC REFERENCE REFERENCE NAME (e.g. C001, R100, etc)	ITEM USED ON (NEXT HIGHER ASSEMBLY IF KNOWN) (e.g. C001 used on 992 8025 001, SCHEMATIC 839 8099 991)	COMMENTS

WARNING:
THE CURRENTS AND VOLTAGES IN THIS EQUIPMENT ARE DANGEROUS. PERSONNEL MUST AT ALL TIMES OBSERVE SAFETY WARNINGS, INSTRUCTIONS AND REGULATIONS.

This manual is intended as a general guide for trained and qualified personnel who are aware of the dangers inherent in handling potentially hazardous electrical/electronic circuits. It is not intended to contain a complete statement of all safety precautions which should be observed by personnel in using this or other electronic equipment.

The installation, operation, maintenance and service of this equipment involves risks both to personnel and equipment, and must be performed only by qualified personnel exercising due care. HARRIS CORPORATION shall not be responsible for injury or damage resulting from improper procedures or from the use of improperly trained or inexperienced personnel performing such tasks. During installation and operation of this equipment, local building codes and fire protection standards must be observed.

The following National Fire Protection Association (NFPA) standards are recommended as reference:

- Automatic Fire Detectors, No. 72E
- Installation, Maintenance, and Use of Portable Fire Extinguishers, No. 10
- Halogenated Fire Extinguishing Agent Systems, No. 12A

WARNING:
ALWAYS DISCONNECT POWER BEFORE OPENING COVERS, DOORS, ENCLOSURES, GATES, PANELS OR SHIELDS. ALWAYS USE GROUNDING STICKS AND SHORT OUT HIGH VOLTAGE POINTS BEFORE SERVICING. NEVER MAKE INTERNAL ADJUSTMENTS, PERFORM MAINTENANCE OR SERVICE WHEN ALONE OR WHEN FATIGUED.

Do not remove, short-circuit or tamper with interlock switches on access covers, doors, enclosures, gates, panels or shields. Keep away from live circuits, know your equipment and don’t take chances.

WARNING:
IN CASE OF EMERGENCY ENSURE THAT POWER HAS BEEN DISCONNECTED.

WARNING:
IF OIL FILLED OR ELECTROLYTIC CAPACITORS ARE UTILIZED IN YOUR EQUIPMENT, AND IF A LEAK OR BULGE IS APPARENT ON THE CAPACITOR CASE WHEN THE UNIT IS OPENED FOR SERVICE OR MAINTENANCE, ALLOW THE UNIT TO COOL DOWN BEFORE ATTEMPTING TO REMOVE THE DEFECTIVE CAPACITOR. DO NOT ATTEMPT TO SERVICE A DEFECTIVE CAPACITOR WHILE IT IS HOT DUE TO THE POSSIBILITY OF A CASE RUPTURE AND SUBSEQUENT INJURY.

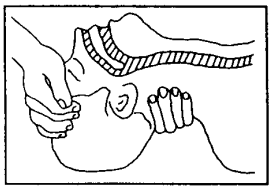
TREATMENT OF ELECTRICAL SHOCK

1. IF VICTIM IS NOT RESPONSIVE FOLLOW THE A-B-CS OF BASIC LIFE SUPPORT.

PLACE VICTIM FLAT ON HIS BACK ON A HARD SURFACE

(A) AIRWAY

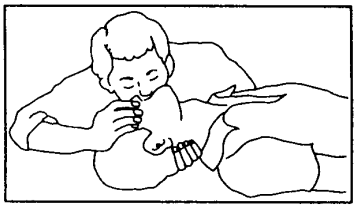
IF UNCONSCIOUS,
OPEN AIRWAY



LIFT UP NECK
PUSH FOREHEAD BACK
CLEAR OUT MOUTH IF NECESSARY
OBSERVE FOR BREATHING

(B) BREATHING

IF NOT BREATHING,
BEGIN ARTIFICIAL BREATHING

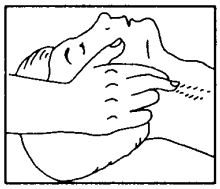


TILT HEAD
PINCH NOSTRILS
MAKE AIRTIGHT SEAL

4 QUICK FULL BREATHS

REMEMBER MOUTH TO MOUTH
RESUSCITATION MUST BE
COMMENCED AS SOON AS POSSIBLE

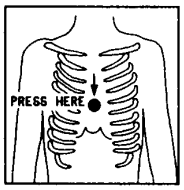
CHECK
CAROTID PULSE



IF PULSE ABSENT,
BEGIN ARTIFICIAL
CIRCULATION

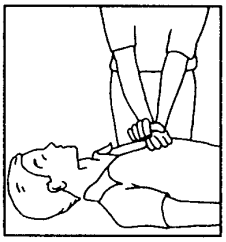
(C) CIRCULATION

DEPRESS STERNUM 1 1/2 TO 2 INCHES



APPROX. RATE OF COMPRESSIONS --80 PER MINUTE
- ONE RESCUER
- 15 COMPRESSIONS
- 2 QUICK BREATHS

APPROX. RATE OF COMPRESSIONS --60 PER MINUTE
- TWO RESCUERS
- 5 COMPRESSIONS
- 1 BREATH



NOTE: DO NOT INTERRUPT RHYTHM OF COMPRESSIONS
WHEN SECOND PERSON IS GIVING BREATH

CALL FOR MEDICAL ASSISTANCE AS SOON AS POSSIBLE.

2. IF VICTIM IS RESPONSIVE.

A. KEEP THEM WARM
B. KEEP THEM AS QUIET AS POSSIBLE
C. LOOSEN THEIR CLOTHING
D. A RECLINING POSITION IS RECOMMENDED

WARNING: Disconnect primary power prior to servicing.

FIRST-AID

Personnel engaged in the installation, operation, maintenance or servicing of this equipment are urged to become familiar with first-aid theory and practices. The following information is not intended to be complete first-aid procedures, it is a brief and is only to be used as a reference. It is the duty of all personnel using the equipment to be prepared to give adequate Emergency First Aid and there by prevent avoidable loss of life.

Treatment of Electrical Burns

1. Extensive burned and broken skin
    a. Cover area with clean sheet or cloth. (Cleanest available cloth article.)
    b. Do not break blisters, remove tissue, remove adhered particles of clothing, or apply any salve or ointment.
    c. Treat victim for shock as required.
    d. Arrange transportation to a hospital as quickly as possible.
    e. If arms or legs are affected keep them elevated.

NOTE:
If medical help will not be available within an hour and the victim is conscious and not vomiting, give him a weak solution of salt and soda: 1 level teaspoonful of salt and 1/2 level teaspoonful of baking soda to each quart of water (neither hot or cold). Allow victim to sip slowly about 4 ounces (a half of glass) over a period of 15 minutes. Discontinue fluid if vomiting occurs. (Do not give alcohol.)

2. Less severe burns - (1st & 2nd degree)
    a. Apply cool (not ice cold) compresses using the cleanest available cloth article.
    b. Do not break blisters, remove tissue, remove adhered particles of clothing, or apply salve or ointment.
    c. Apply clean dry dressing if necessary.
    d. Treat victim for shock as required.
    e. Arrange transportation to a hospital as quickly as possible.
    f. If arms or legs are affected keep them elevated.

REFERENCE:
ILLINOIS HEART ASSOCIATION
AMERICAN RED CROSS STANDARD FIRST AID AND PERSONAL SAFETY MANUAL (SECOND EDITION)

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Section 4

WARNING: Disconnect primary power prior to servicing.

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WARNING: Disconnect primary power prior to servicing.

Section 1 Introduction

1

1.1 Introduction

This technical manual contains the information necessary to install and operate the Harris DRM™ (Digital Radio Mondial) System consisting of the the DRM-CSB 100 Content Server, DRM-MOD 100 Modulator and DRM-MCI 100 Modulator Control Interface.

1.2 General Description

See Harris DRM brochure at rear of this manual.

1.3 Features

See Harris DRM brochure at rear of this manual.

WARNING: Disconnect primary power prior to servicing.

1.4 Block Diagram

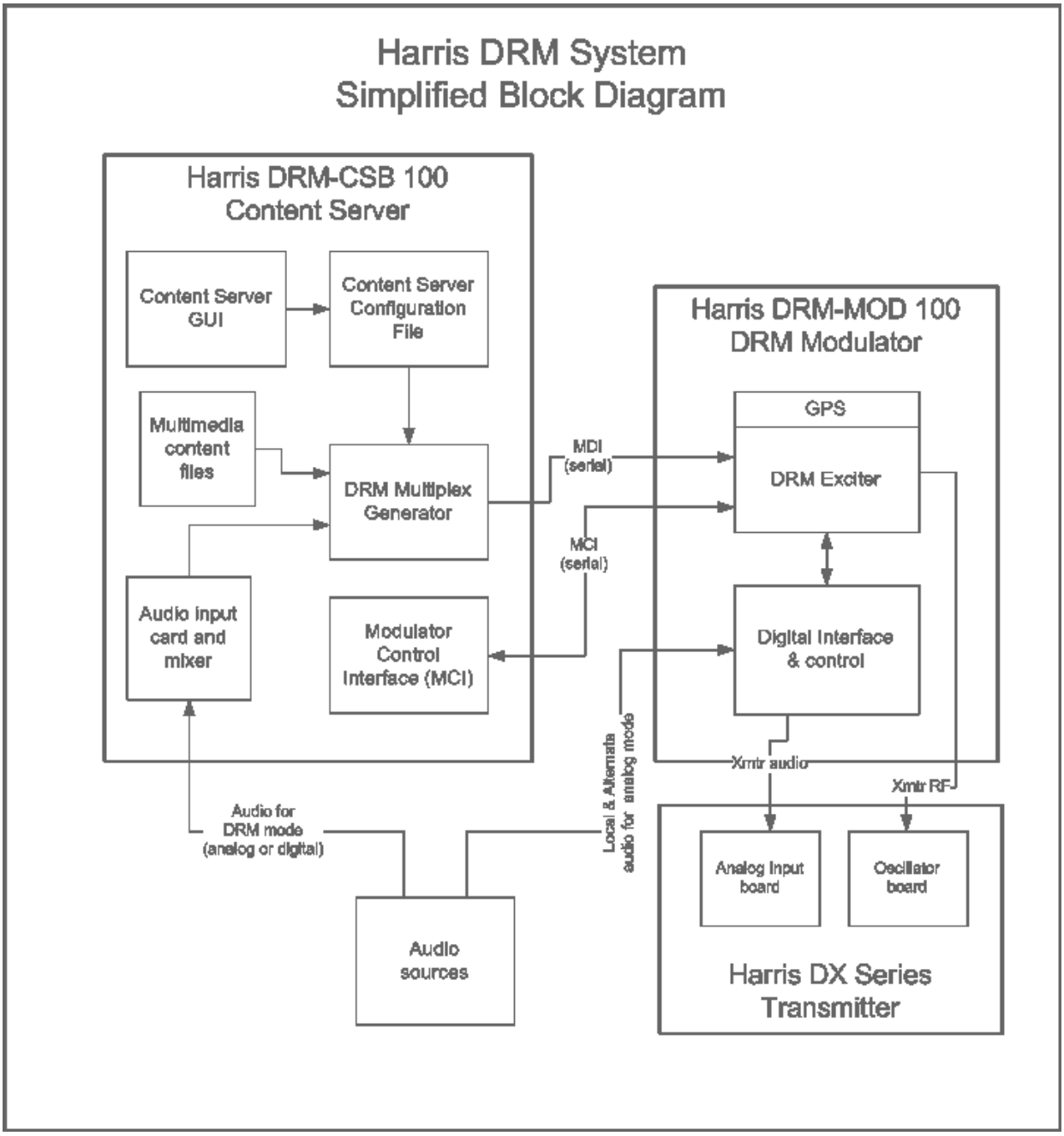


Figure 1-1 Harris DRM System Block Diagram

WARNING: Disconnect primary power prior to servicing.

1.5 Specifications

See Harris DRM brochure at rear of this manual.

Section 2 Installation

2

2.1 Introduction

This section details the procedures to receive, install and prepare the DRM system for use.

2.2 Installation DRM-CSB 100 Content Server

The installation section for the DRM-CSB 100 Content Server contains information regarding rack unit placement, component details, external connections and pre-power up procedures.

2.3 Placement

The DRM-CSB 100 consists of a single 3RU chassis that should be installed in a rack adjacent to the transmitter together with the DRM-MOD 100. (Future Ethernet MDI interface functionality will permit installation in another location closer to the original audio source.) Consideration must also be given to a place for the monitor, keyboard and mouse required by the system. Standard 110/220 volt power is required, preferably through a customer supplied UPS.

2.3.1 System Components

Following is a brief description of the DRM-CSB 100 system hardware components. The base computer system is a 3RU rack chassis which has been factory assembled and configured and does not require user modification except to set the correct input voltage on the power supply. The monitor, keyboard and mouse are normally user supplied.

WARNING: Disconnect primary power prior to servicing.

2.3.1.1 Case

Refer to the separate manufacturer's user's manual for details on the rack mount case, which details both the physical assembly and the fan control and monitor circuitry. The case front door maybe locked with the keys included with the manual.

2.3.1.2 Power Supply

The power supply is heavy duty and switchable between 120 and 240 volts. The input voltage selector and full power switch are located on the back of the supply below the line power cord. The power switch mounted on the front of the chassis next to the hard disk array is a "hot" power switch and does not protect the power supply from over voltage.

NOTE:
Do not plug the unit in until you have confirmed that the supply is configured for your voltage. To check this you will need to open the case and remove the power cord from the back of the supply to gain access to the voltage switch. Once you have the supply configured correctly be sure the power switch mounted on the supply is in the on position, then reconnect the power cord and replace the cover on the case. The power switch mounted on the front of the chassis is a "hot" power switch and does not protect the power supply from over voltage.

Normal power-on requires simply depressing and releasing the front panel switch. Power down should be carried out through the operating system but may be started by depressing releasing the front panel switch.

2.3.1.3 Motherboard

Refer to the separate manufacturer's user's manual for details on the computer motherboard.

2.3.1.4 Hard Disk Array

For superb reliability the DRM-CSB 100 incorporates a RAID 1 mirrored disk array using two identical hard disk drives in a hot-swappable caddy. Refer to the separate manufacturer's user's manual for details on the hard disk array, including the replacement procedure in case of hard disk failure.

2.3.1.5 Auxiliary Drives

The DRM-CSB 100 contains a DVD ROM and floppy drive for software installation and file transfer.

2.3.1.6 Sound Card

The DRM-CSB 100 utilizes the RME HDSP 9632 professional sound card. This is a versatile multi-input device mounted in one of the computer PCI slots. Refer to the separate manufacturer's user's manual for details on the sound card itself. Please refer to the external connections and operations portions of the manual for utilization of this card in your DRM application.

2.3.1.7 Software Key

Mounted inside the DRM-CSB 100 chassis is a USB software license key that enables the DRM Content Server software to operate. If during operation the software indicates the key is missing check to be sure this key has not come loose.

CAUTION:
DO NOT REMOVE THE SOFTWARE KEY FROM YOUR COMPUTER! IT IS A VERIFICATION OF OWNERSHIP OF THE INDICATED SOFWARE LICENSE. THE SOFTWARE WILL NOT OPERATE WITHOUT THIS KEY. IF YOU LOSE THIS KEY YOU WILL BE CHARGED FULL PRICE FOR REPLACEMENT SOFTWARE.

2.3.1.8 Monitor

For best results use a monitor with 1280 x 1024 resolution. Resolution of 1024 x 768 will work but limit usability of the graphical interface. Connect the monitor to the standard VGA connector on the back panel of the DRM-CSB 100.

2.3.1.9 Keyboard and Mouse

Connect user-supplied keyboard and mouse to the corresponding standardized connectors on the back panel of the DRM-CSB 100.

2.3.2 Making the Necessary External Connections

2.3.2.1 Audio Source

The RME HSDP 9632 is a high flexible professional grade sound card that can be configured for various formats of either analog or digital input depending on the user's preference and available feed. Table 2-1 outlines the various options and connection methods.

Table 2-1 Audio Connection Method

Type of Audio Feed	Break Out Cable Requirement	Method of Connection	Configuration Settings	Mixer Settings
ADAT optical	none	Optical cable (TOSLINK) to upper most optical connector on bracket of RME card	Sample: 48.0 kHz AEB: unchecked Breakout cable: unchecked Pref. Sync Ref: ADAT In	default - no sliders up on any channel
SPDIF optical	none	Optical cable (TOSLINK) to upper most optical connector on bracket of RME card	Sample: 48.0 kHz SPDIF In: Optical AEB: checked Breakout cable: unchecked Pref. Sync Ref: ADAT In	In 9 - slider up on A1+2 In 10 - slider up on A1+2 A1 (out) - slider up A2 (out) - slider up
SPDIF coaxial	9 pin w/ 2 RCA & 2 XLR - upper D socket	Coax cable to white phono socket on breakout cable	Sample: 48.0 kHz SPDIF In: Coaxial AEB: checked Breakout cable: unchecked Pref. Sync Ref: ADAT In	In 9 - slider up on A1+2 In 10 - slider up on A1+2 A1 (out) - slider up A2 (out) - slider up
AES/EBU	9 pin w/ 2 RCA & 2 XLR - upper D socket	Balanced cable to female XLR on breakout cable	Sample: 48.0 kHz SPDIF In: AES AEB: checked Breakout cable: checked Pref. Sync Ref: ADAT In	In 9 - slider up on A1+2 In 10 - slider up on A1+2 A1 (out) - slider up A2 (out) - slider up
Analog unbalanced	15 pin w/ 4 phono - lower D socket	Unbalanced stereo cables to Line IN L and LINE IN R phono sockets	Sample: 48.0 kHz AEB: checked Breakout cable: un-checked Pref. Sync Ref: ADAT In Input Level: -10 dBV	In 11 - slider up on A1+2 In 12 - slider up on A1+2 A1 (out) - slider up A2 (out) - slider up
Analog balanced	15 pin w/ 4 XLR - lower D socket	Balanced stereo cables to Line IN L and Line IN R XLR female sockets	Sample: 48.0 kHz AEB: checked Breakout cable: checked Pref. Sync Ref: ADAT In Input Level: +4 dBu	In 11 - slider up on A1+2 In 12 - slider up on A1+2 A1 (out) - slider up A2 (out) - slider up

The default configuration is for Analog balanced input. If that needs to be changed the appropriate configuration and mixer setting are set through the CS Audio Configuration tool which can be run by double clicking it's icon on the desktop once the system is up and running.

2.3.2.2 Serial/Ethernet Connections

Starting with DRM Modulator firmware 1.02, Ethernet capability is included in your DRM Modulator's firmware. This section details the information needed to effectively

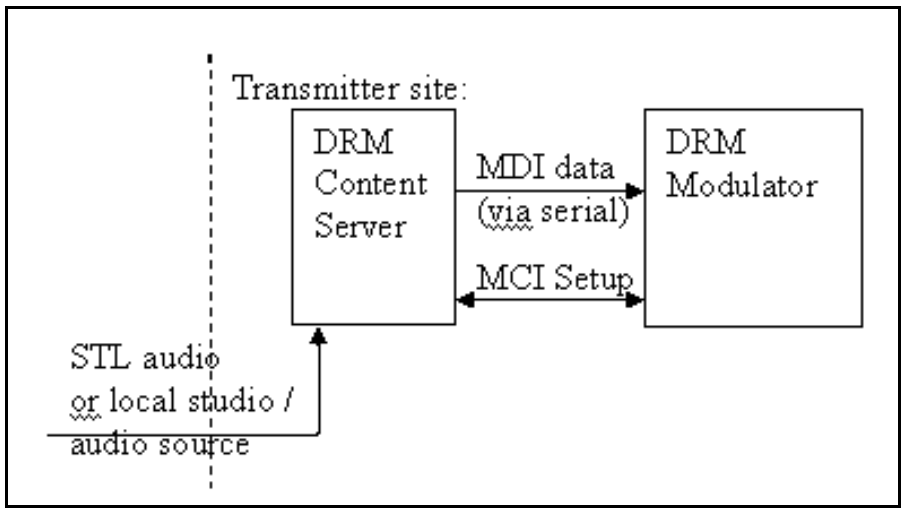
connect and configure the Ethernet settings of your DRM system. It also describes the GPS capabilities of the system.

NOTE:
The DRM Modulator operates in Analog AM mode whenever the Content Server is disconnected, or the system is switched to Bypass via the front panel rocker switch. In order to be able to broadcast Analog AM, analog audio (for instance, from a conventional AM studio-to-transmitter link) must be connected to the Alternate Audio input XLR connector (not shown) on the back of the DRM Modulator.

2.3.2.2.1 Basic Local Connections

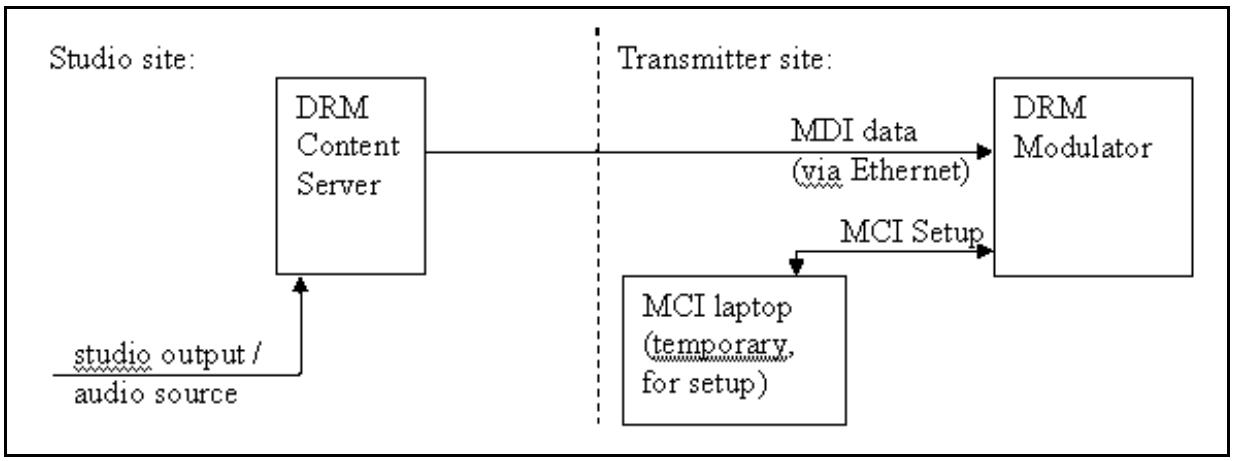
The simplest way to connect the components of your DRM system is to locate your DRM Content Server and DRM Modulator in the same rack at the transmitter site. This is the configuration that has been used most in the past for Harris DRM Content Servers and Modulators.

In this configuration, the DRM Content Server must be located near the DRM Modulator so that serial cables can be connected between them. You may want to use this method temporarily during system setup, even if you want to eventually be able to locate your Content Server remotely. Connect the D9 connectors found on the back panel of both units as labeled **CS Interface to CS Interface** and **MCI Interface to MCI Interface** with the included serial cables.



2.3.2.2.2 Ethernet Connections

With the addition of Ethernet capability (firmware version 1.02 and above), the DRM Content Server can be located remotely. Ethernet *replaces* the serial link between the Content Server computer and the DRM Modulator. This allows the link to be much longer, for example over a dedicated ISDN line (contact your local telephone service provider to check the availability of dedicated lines in your area), or other Ethernet link. This configuration allows easier access to monitor the Content Server and change its DRM encoding settings, service labels, and text messages at the studio site.



NOTE:
One must still connect directly to the DRM Modulator MCI serial port with a serial cable in order to use the MCI application for programming (the MCI is used to change adjustment parameters like DAC Delay, DAC Bias, Test Modes, etc.).
You can setup your DRM Modulator with a laptop at the transmitter site, using a Windows version of the MCI. If you have trouble using the MCI program on your particular laptop, you could bring the DRM Content Server to the Transmitter site, and use the MCI that is installed on it for programming until you are satisfied with your changes, then return the Content Server to your studio.

The DRM Content Server has two Ethernet ports, labeled “Ethernet 0” and “Ethernet 1”. See below for descriptions and configuration options:

“Ethernet 0” is intended to be set to a static (unchanging) IP address on a network, and will be used exclusively as a dedicated connection to send MDI data *to the DRM Modulator.* This can be done via a crossover cable, a normal Ethernet cable with either a hub or switch, a dedicated line, or other Ethernet link.

“Ethernet 1” can be used for the link from the studio and for connection to the internet.

Ethernet Port 0 **connection configurations are summarized below:**

1. Crossover Cable
   Use the “crossover cable” option if you have a crossover cable available, but do not have or do not wish to use a hub or switch. A crossover cable looks like a typical Ethernet cable, but its two ends are wired differently so that two computers can communicate directly without a hub or switch. An Ethernet crossover cable may be available at your local computer or office supply store. The advantage of this option is that eliminates clutter, but its disadvantage is that problems are harder to diagnose.

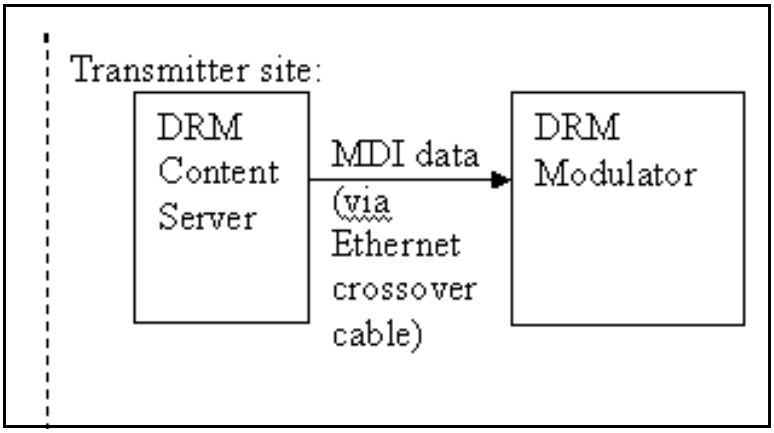


Figure 2-1 Crossover Cable Method

2. Normal Ethernet cables and an Ethernet "Hub"
   The “Ethernet hub” option requires 2 standard straight-through Ethernet cables. Most hubs have a port labeled “Uplink”; that port would not be used in this application. Connect the DRM Content Server to a normal port on the hub. The LED on the hub corresponding to that port should blink with each packet that the Content Server sends. Connect the DRM Modulator to another normal port on the hub. The LED corresponding to the DRM Modulator’s connection should stay on steady.
   During normal operation, do not connect any other computers to the hub. Since the standard DRM MDI protocol between Content Server and Modulator uses the UDP/IP protocol, any packets that experience collisions will not be retransmitted. If there is heavy traffic on the hub from additional computers copying files, reading email, etc, that would cause dropouts in the transmitted DRM signal.
   Switch to this option if you are having problems getting the Ethernet packets from the Content Server to be broadcast by the DRM Modulator. It will allow a diagnostic computer to be connected to the hub as well, to “sniff” packets on this Ethernet segment. “Ethereal” is a program which can help

in this diagnosis. It is available free from http://www.ethereal.com/download.html.

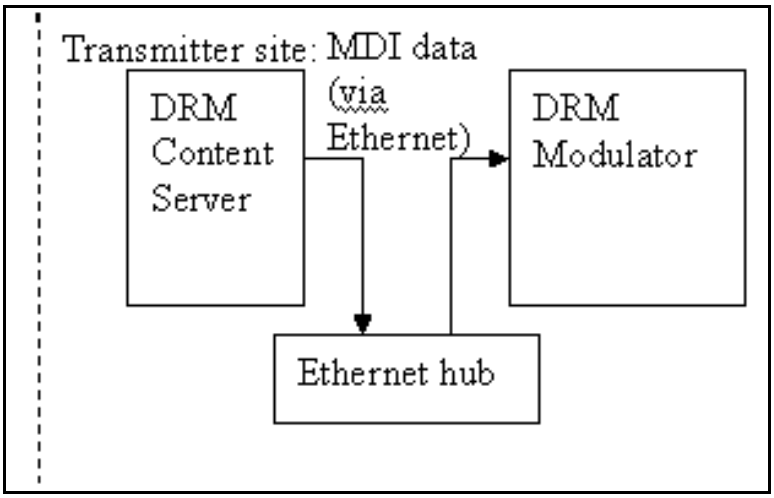


Figure 2-2 Ethernet Hub Method

3. Ethernet "Switch"
   An Ethernet Switch is connected in the same way as an Ethernet Hub. A switch may be more expensive, and will not allow for “packet sniffing” as an Ethernet Hub would.
   You might try this option if you already have an Ethernet Switch as part of a network at the transmitter site. This method has not been tested extensively, but may be convenient if your Content Server and DRM Modulator must be located far apart in the same building.
   If problems occur with this method, check for excessive broadcast traffic on the LAN (Local Area Network) using a packet sniffing program (as

described in the Ethernet Hub section). (Broadcast packets are sent to all ports on a switch, since they are intended for all computers on the LAN.)

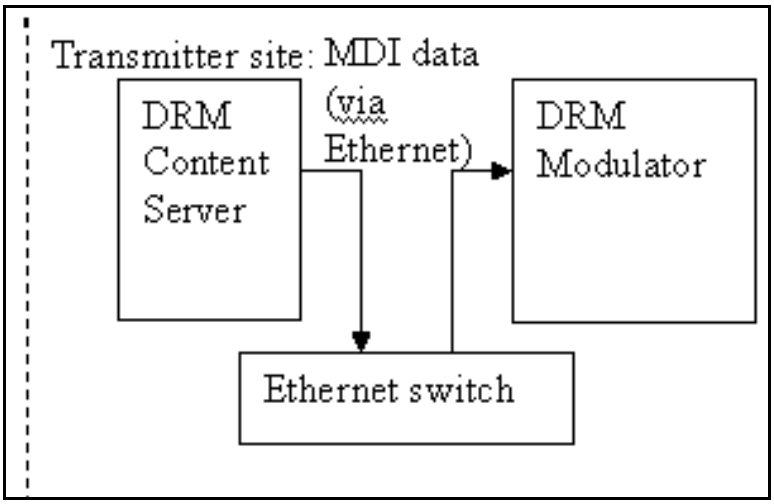


Figure 2-3 Ethernet Switch Method

4. Dedicated line (such as an ISDN line)
   See your dedicated line provider for details on how to connect switches or hubs to each end of the line. One of the reasons for using Ethernet to connect the Content Server to the DRM Modulator is specifically to make it possible to use this kind of connection. The advantage of this method, the transmitted DRM audio is encoded by the DRM Content Server right at the studio site. As a result, the listener hears less background noise when the DRM audio is decoded in his/her receiver. The disadvantage is that it can be difficult to set up, and a dedicated line may cost more than a standard AM studio-to-transmitter link.
   If the DRM Modulator is not receiving Content Server packets, check that Content Server packets are arriving at the Transmitter site using a hub and a packet sniffing program. If they are not arriving, check that they are being transmitted into the dedicated line at the studio site. If the system will still not work, move the DRM Content Server to the Transmitter site, get the system working there, (using one of the above methods), and move the Content Server back to the studio once the dedicated line has been shown to work.

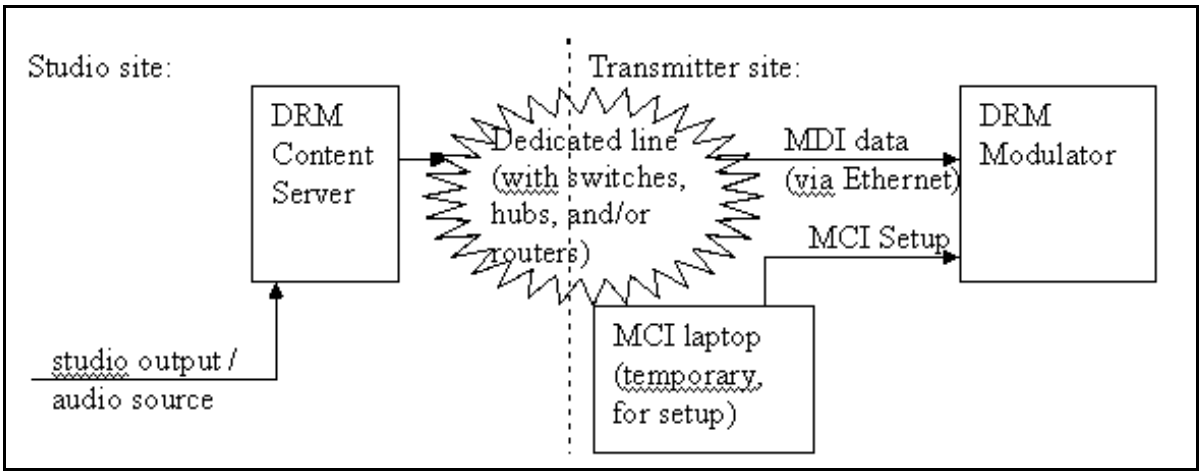


Figure 2-4 ISDN Method

Ethernet Port 1 **connection configurations are summarized below:**

If your Content Server is connected to your local LAN, you may wish to access it remotely, for instance to update text messages. This would make sense if your studio and transmitter are at the same location, or if your Content Server is at your studio and your Modulator at the transmitter site. The following diagrams summarize these two different scenarios.

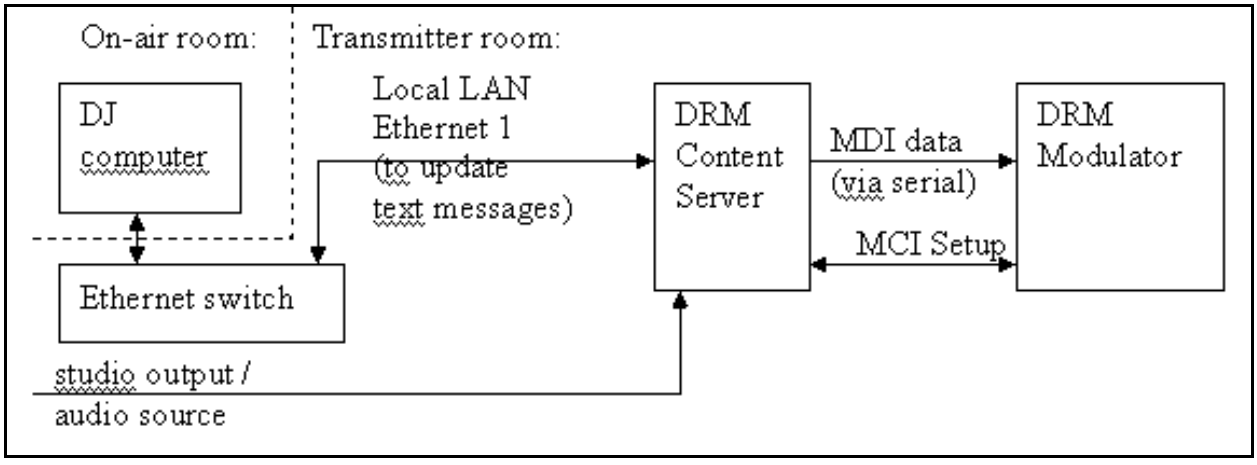


Figure 2-5 Studio and Transmitter at Same Location

In the above setup, your studios are at the same location as your transmitter. Your DJ has a computer in the On-air room that is used to setup text messages, which are then sent over the local LAN to the DRM Content Server using its Ethernet 1 port. Since the

entire radio station is located at one site, the DRM Content Server and DRM Modulator can be mounted in the same rack and connected with serial cables.

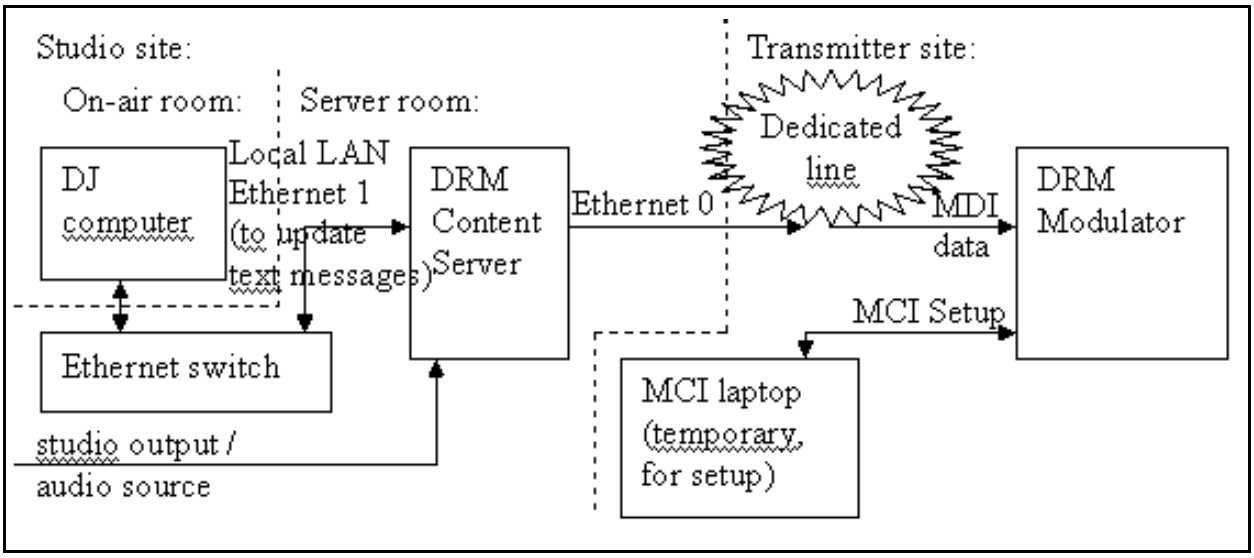


Figure 2-6 Studio and Transmitter at Different Locations

This diagram shows a typical setup for a radio station in which the studios and transmitter are not in the same location. The DJ's computer still communicates over the local LAN with the Content Server as before. However, the DRM Content Server's Ethernet 0 port is now used (instead of the MDI serial port) to send MDI data to the DRM Modulator through a leased / dedicated line.

In either of the above configurations you may need to select an IP address for the Content Server Ethernet 1 connection on the local LAN. If you decide to change the IP addresses of the Content Server Ethernet 0 and DRM Modulator Ethernet connections, you will also need to be cautious about which addresses you choose.

The Content Server Ethernet 0 and 1 addresses can be set to fixed addresses, called "Static IP addresses", or set to automatically configured addresses, called "Dynamic IP addresses", obtained through the DHCP protocol.

NOTE:
It is recommended that you use static IP addresses for all of the addresses in your DRM system. These are the reasons:

- The DRM Modulator can only be set to a static IP address
- The DRM Content Server Ethernet 0 connection should be set to an IP address and Subnet mask that allow it to connect to the DRM Modulator. If you connect the Ethernet 0 connection to a DHCP server so that it is

automatically configured, you will have to find out what IP address it is using, and set the DRM Modulator to a similar address, but one that is not going to be used by the DHCP server to assign to another computer.

- The DRM Content Server Ethernet 1 connection should be set to a static IP address so that the DJ's computer can always connect to the same address in order to modify the text messages. If this address were auto-configured via DHCP, a change in routers or DHCP servers or resetting the router / DHCP server to factory defaults would make it so the DRM Content Server Ethernet 1 connection would have a different IP address than before. Then, one would have to find out what that new address is, and make the DJ's computer connect to that address, instead.

Using DHCP (not recommended), the computer would attempt to get an IP address for that port automatically. It would send a broadcast packet on that Ethernet connection, and listen for a "DHCP server" (a router or other computer on the network configured for this purpose) to respond with an IP address for it to use. The DHCP server would also provide information on how to reach the Internet. In general, DHCP servers typically operate by assigning IP addresses to requesting computer by picking as-yet unassigned addresses in sequence from a pool, for instance, from 192.168.0.100 to 192.168.0.254.

The recommended method is to use Static IP addresses. For your system to perform at its best, you will need to manually assign a static IP address and enter the subnet mask you are using. Also, enter the IP address of the router the CS should attempt to contact in order to access the Internet, called the "Default gateway", and the IP addresses of DNS servers. DNS servers are computers that provide Domain Name Service that the Content Server should contact to resolve domain names to IP addresses. For example a DNS sever would resolve time.nist.gov to 192.43.244.18.

Use the following guidelines when selecting a static IP address for the DRM Content Server Ethernet 1 connection.

NOTE:
Remember that the Ethernet 1 connection is used to connect to the local LAN in the radio station.

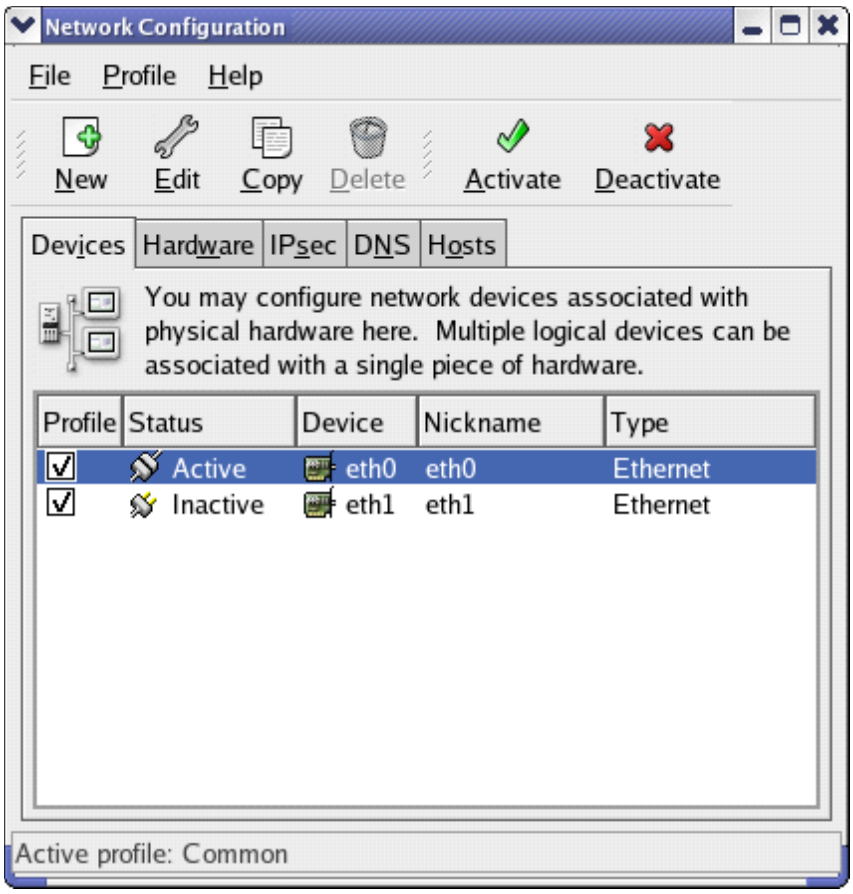
- If you are connecting to an existing network, contact the network administrator, or the company or individual that setup the network. Ask for static IP addresses that you can use that will be on the local LAN's subnet, but outside of the pool of DHCP addresses. Basically, you're placing a new server on the local LAN, your Content Server, and you need a Static IP address for it.
- Make sure that you do not set the IP Address of the DRM Modulator to an IP address that is already used by another device or computer.
- Do not use an Internet IP address unless it is assigned to you.

- Use an address in a private LAN IP block. These blocks are as follows:
    - 10.x.y.z
    - 192.168.y.z
    - 172.16.y.z through 172.31.y.z
- The x and y numbers shown above can have the values 0 through 255.
- IP addresses cannot end in 255 or 0. In the blocks shown above, this means z can only have the values 1 through 254.

2.3.2.2.3 GUI Ethernet Setup

When configuring your Ethernet interfaces within the DRM Content Server software, please keep in mind that the “Ethernet 0” port, also called “eth0”, can only be configured to output DRM MDI data to the DRM Modulator.

If you are using Ethernet MDI (instead of serial cable), and you wish to be able to update DRM text messages remotely, use “Ethernet 1” (eth1) for that access. Once you start the system network configuration tool, you will see something like the following. Your actual screen may differ depending on system configuration.



You can edit the properties of “eth0” or “eth1” by clicking on it to highlight it, and then clicking the “Edit” button, labeled with a wrench icon and the word “Edit”. For instance if you were to edit “eth0”, you might see something like the following:

The important items to notice in this dialog are that the “Activate device when computer starts” checkbox is checked, and the device is configured for the Static (unchanging) IP address of 10.2.2.103, with a subnet mask of 255.255.0.0. The subnet mask must be set to this value in order for the Content Server to be able to access the DRM Modulator when the DRM Modulator has an IP address of the form 10.2.3.x, for example, 10.2.3.102.

You might change this static address if you place the DRM Modulator and Content Server (CS) on a switch with other LAN traffic. If you were to choose static IP addresses for the Modulator and CS that are more similar, for example, 192.168.0.100 and 192.168.0.200, you would be able to use a subnet mask of 255.255.255.0. If you do not understand subnet masks and IP addresses, it would be best for you not to change these values.

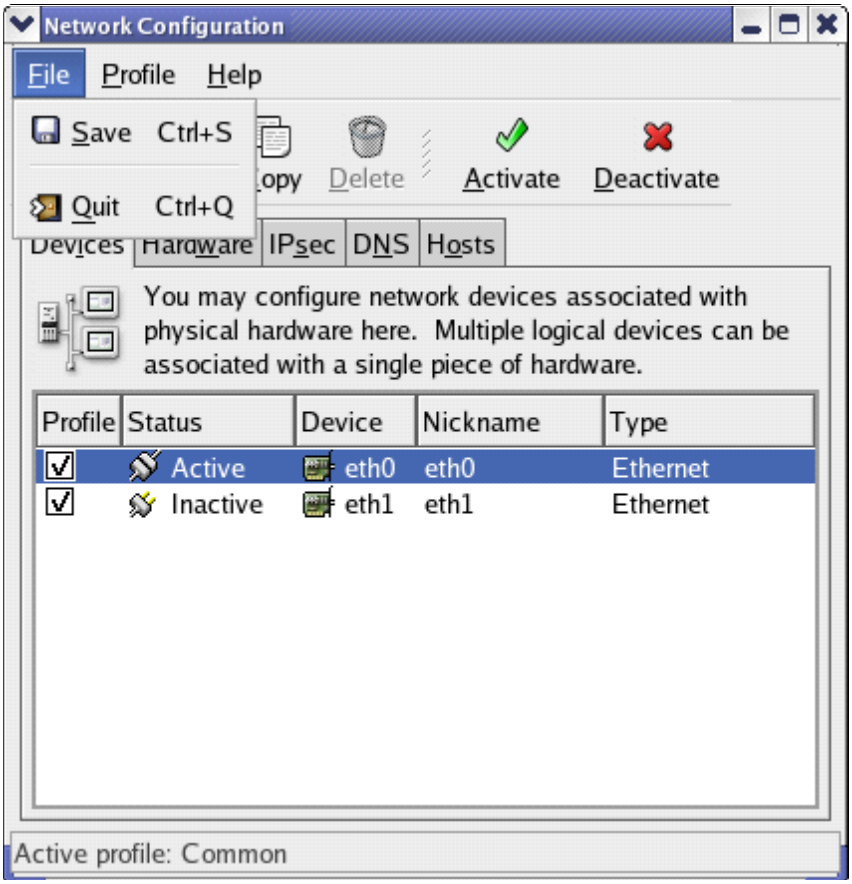
If you edit the “eth1” connection, you might see something like this:

Notice that it is not automatically turned on when the system is turned on. ("Activate device when computer starts" is unchecked.) *This is the usual way to disable an Ethernet connection*. If it were enabled manually, or were changed to be enabled every time the computer is turned on, using the configuration above, it would attempt to get an IP address automatically. It would send a broadcast packet on its "Ethernet 1" connection, and listen for a "DHCP server" (a router or other computer on the network configured for this purpose) to respond with an IP address for it to use. The DHCP server would also provide information on how to reach the Internet. This is typically how one would configure the Content Server to set its system time from the Internet.

If you do not have a DHCP server and wish to use Ethernet time synchronization, or otherwise connect your Content Server to a LAN, you will need to manually assign a static IP address and enter the subnet mask you are using. Also, enter the IP address of the router the CS should attempt to contact in order to access the Internet, called the "Default gateway".

You should enable the “Ethernet 1” connection if you want to attempt time synchronization, or if you wish to access the Content Server remotely, for example, to change the DRM text message.

To quit the Ethernet configuration, choose File / Quit from the menu in the main dialog:



2.3.3 Before You Power Up

NOTE:
Do not plug the unit in or turn it on until you have confirmed that the supply is configured for your voltage. To check this you will need to open the case and remove the power cord from the back of the supply to gain access to the voltage switch. Once you have the supply configured correctly be sure the power switch mounted on the supply is in the on position, then reconnect the power cord and replace the cover on the case. The power switch mounted on the front of the chassis is a “hot” power switch and does not protect the power supply from over voltage.

2.4 Installation DRM-MOD 100 Modulator

The installation section for the DRM-MOD 100 Modulator contains information regarding rack unit placement, component details, external connections and pre-power up procedures.

WARNING

The DRM-MOD100 modulator is to be used as a part of a DRM radio transmitter. The DRM-MOD 100 alone does not limit spurious emissions as required by EN 302-245-2. When the DRM-MOD 100 is installed in a transmitter, The transmitter must be provided with any filtering needed to cause the transmitter output spurious emissions to be lower than the limit of EN 302 245-2.

EMF Requirements

Those who are responsible for the installation and (or) the use of the complete system composed of:

- **The DRM-MOD 1000 modulator**
- **The transmitter in which it is installed**
- **The transmitting antenna**
- **The connections between these equipments**

are fully responsible for EMF requirements of the system according to relevant standards and Council Recommendation 1999/519/EC of 12 July 1999 on the limitation of exposure of the general public to electromagnetic fields (0Hz to 300 GHz).

2.4.1 Placement

The DRM-MOD 100 consists of a single 2U chassis that should be installed in a rack adjacent to the transmitter together with the DRM-CSB 100.

2.4.2 System Components

Following is a brief description of the DRM-MOD 100 system hardware components.

2.4.2.1 Exciter Card

The exciter card is the heart of the DRM system, generating the COFDM modulated RF and amplitude signals with the multiplexed data generated in the DRM-CSB 100 content server. Following is a simplified block diagram of the exciter card.

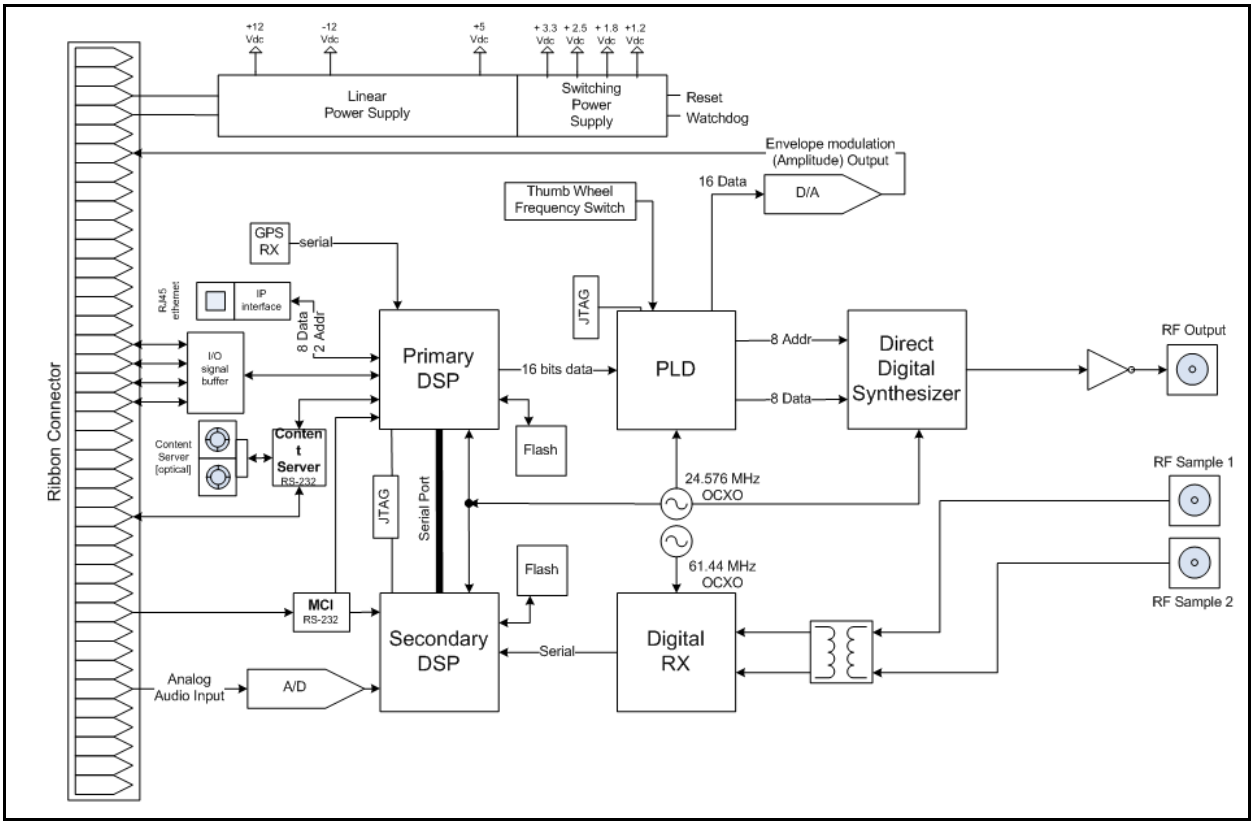


Figure 2-7 DRM-MOD 100 exciter card block diagram

2.4.2.2 Digital Interface

The purpose of the Digital Interface is to Monitor the DRM Exciter and in the event of a Failure switch to the Local Audio Input and command the Transmitter to switch to the Internal Crystal/Exciter to maintain RF Operation.

The Digital Interface can have DRM, ACC, & NORMAL AM Modulation schemes for a single transmitter.

The Digital Interface takes a Normal Audio Input and adds a DC level to the Audio to match the DRM signal. The transmitter only needs to be set up for DC coupled and widening of the Bessel Filter to accommodate the DRM Signal. (The Local audio Input and the Alternate Audio input have the ability to be DC coupled in case you have the ACC option for the transmitter.)

The Digital Interface monitors the status lines of the DRM Exciter. In the event of a failure of the DRM Exciter the Digital interface will switch to the Local Audio Input to maintain RF Operation of the transmitter.

2.4.2.2.1 Digital Interface External Connections

- RF OUT
  Connect to RF Out On the rear panel this is the Phase Modulated RF signal that drives the Transmitter
- RF FWD (for future use)
  Connects to RF FWD. This is used as a RF Fwd sample to drive a feedback circuit
- RF REF (for future use)
  Connects to RF Ref. This is the Feedback sample used to adapt the DRM Signal Automatically.
- GPS (for future use)
  Connects to GPS IN. This is the GPS Antenna Connection for the DRM Exciter.
- Alternate Audio
  This is another Audio input to the Digital Interface. If the Dipswitch #3 is set to ON then in the event of a failure with the DRM Exciter or by Remote command the Digital interface will switch to the Alternate Audio Input.

Example ACC+ Connected to Alternate Audio Input.

When the ACC+ assembly is connected to the Alternate Audio Input on the Digital Interface, the Audio+DC gain will need to be adjusted on the ACC+ Board so when the Digital Interface is in the Bypass Mode or Alternate Mode the DC level is the same.

1. With a DMM placed on TP2 on the Digital Interface, record what the DC level is when in Normal Mode and the Content Server is in MODE 20
2. Select ACC mode via the Remote control input to switch the Digital Interface to Alternate XMSN
3. Adjust R53 full CW (ACC+ assembly must be in BYPASS mode)

4. Adjust the Audio +DC on the ACC+ assembly until the DC level is the same

NOTE:
Note the DC level should be the same value when the Digital interface is in Normal, Alternate, and/or Bypass modes

Table 2-2 External I/O Connector J7

J7-	Description	Input/Output
-1	Ext RF Carrier	OUTPUT
-2	Configurable output changes with Ext RF Carrier Selec CMD	OUTPUT
-3	Mute Out Active Low	OUTPUT
-4	Digital/Analog Transmission (Low = Digital)	OUTPUT
-5	MDI Fault	OUTPUT
-6	MODULATOR Fault	OUTPUT
-7	MDI Status (Low = OK)	OUTPUT
-8	Bypass Mode Status (Low = Bypass Active)	OUTPUT
-9	Alternate Mode Status (Low = Active)	
-10	GROUND	
-11	Transmitter status of operating with External RF Carrier Input	INPUT
-12	+Vdc to Enable DRM Mode	INPUT
-13	Ground to Enable Remote Bypass Mode	INPUT
-14	Ground to Enable Remote Normal Mode	INPUT
-15	Ground to Enable Remote Alternate Mode	INPUT
-16	Ground to Enable Ext Channel 4	INPUT
-17	Ground to Enable Ext Channel 5	INPUT
-18	Ground to Enable Ext Channel 6	INPUT
-19	Ground to Enable Ext Channel 7	INPUT
-20	LOCAL SWITCH COMMON	
-21	LOCAL SWITCH NC (Normal Operation)	
-22	LOCAL SWITCH NO (Bypass Operation)	
-23	J7_VCC Common on Inputs	
-24	J7 VCC Common on Outputs	
-25	NC	

2.4.2.2.1 Content Server (CS)

Connects to J3, Fiber Optic or Ethernet on the Rear of the Panel. The Content Server converts the Audio to the DRM Protocol.

When the Content Server is communicating with the DRM Exciter the MDI LED will be Enabled and the MDI Fault LED will be extinguished on the front panel.

2.4.2.2.2 MCI Interface

Connects to J4 on the rear Panel. The MCI Interface is used in the setup of the DRM Exciter. Connect a computer with the MCI software and make the adjustments with the software to achieve the best Quality DRM Signal.

2.4.3 Pre-power Up Procedures

2.4.3.1 Setting power supply voltage

The power supply is capable of operating from 100-120 VAC or 200-240 VAC. Operating voltage is set automatically and does not require user intervention.

2.4.3.2 Default frequency setting

You should set the primary broadcast frequency of you transmitter on the DRM-MOD 100 exciter card. You do this by setting a set of four rotary switches located at the rear of the board, close to the rear panel of the unit just below the RF output connector.

2.4.3.3 Interface dipswitch, jumper and pot settings

The following tables describe the settings that can be made for the Digital Interface.

Table 2-3 Dipswitch Settings

Dipswitch	Name	Action when (ON)
2, 1		
	0, 0	5 Seconds
	0, 1	20 Seconds
	1, 0	40 Seconds
	1, 1	60 Seconds
3	ALT_AUDIO_EN	In case of a DRM Failure the Digital interface will switch to the Alternate Audio Input (ie ACC, IBOC).
4	FIXED_MODE	Select to “ON” when setting up the DRM Modulator, or if you never want it to switch to Local AUDIO.
5	EXT_RF_ALT_MODE_EN	Ext_RF Control will be Enabled when in Alternate Mode. Example: Select this for IBOC Operation.
6	UNUSED	
7	IBOC_EN	Select to “ON” when an IBOC audio is connected to the Alternate Audio Input.
8	EXT_RF_EN	Will Monitor the Transmitter EXT RF CARRIER Status. J7-11. If status is removed the Digital Interface will switch to the Local Audio Input.
9	MULTI_SW_EN	In the event of a failure of the DRM Exciter the Digital Interface will switch to an alternate Audio Input. When the DRM Exciter fault is no longer present the Digital interface will switch back to DRM Mode.
10	PEAK_DETECTOR_EN	This feature enables the circuit to look at the Audio Output and if No audio is present for a user specified time as set by dipswitch 1& 2 the Digital Interface will switch to the Next Audio Source.

Table 2-4 Jumper Settings

Jumper#	Position	Description
JP16	1-2	Audio to Channel 1 on DRM Exciter
JP17	1-2	Audio to Channel 2 on DRM Exciter
JP3, JP5	1-2	Local Audio Input set to 600 ohm termination
JP13, JP10	1-2	Local Audio Input Audio DC Coupled
JP4, JP6	1-2	Alternate Audio Input 600 ohm termination
JP14, JP11	1-2	Alternate Audio Input Audio DC Coupled
JP8	1-2	External Volts required on J7-24 for pull-ups on J7 Outputs
JP12	1-2	External Volts required for Common side of opto-isolators for J7 inputs
JP1	1-2	+VDC to activate J7-12 Ext_In1
JP2	1-2	-VDC (ground) to ActiveJ7-13 Ext_In1
JP17	1-2	External Volts Required on J10-20 for pull-ups on J10 Outputs

NOTE:
The Potentiometer Settings table, below, assumes the following:

- +10dBm input to the Local Audio Input Connector J5
- DRM exciter has already been setup
- Bypass selection on the Front panel must be enabled
- Transmitter is OFF

Table 2-5 Potentiometer Settings

Pot #	Level	Description
R79	Adjust R79 for 7.00Vp-p at TP17	Local Audio Gain Adjustment
	Set Modulator to BYPASS MODE and set Dipswitch #4 to ON: this puts the Modulator in FIXED DRM MODE. Set MCI Software to TEST MODE with 98% Modulation	
R100/ R80	Adjust R100 and R80 until the Waveform at TP12 is the same when selecting Dipswitch #4 to ON/OFF	DRM Audio Input Audio Matchup
	R100 adjusts the DC BIAS and R80 adjusts the AUDIO+DC	
R53	Adjust R53 for the same Volts Peak-to-Peak value at TP11/TP12	Alternate Audio Adjustment
	Input Audio for the Alternate Audio Input will need to have Audio+DC to use as another backup audio Option	

NOTE:
Any change in the clipping ratio or DC Bias setting on the MCI software will result in a different carrier level when the DRM Content Server is set to AM Mode. You will need to readjust the above settings if you want the Carrier level to be the same in the different modes.

Section 3 Operation

3

3.1 DRM-CSB 100 operation

This section contians normal day-to-day power on and operational procedures and information for the Harris DRM system.

The DRM-CSB 100 Content Server and DRM-MOD 100 Modulator work as a unit. The section focuses on the DRM-CSB 100 Content Server and its software which is the most complex portion of the system. Operation of the DRM-MOD 100 Modulator is detailed in section 3.5

3.1.1 Powering Up

Normal power-on requires simply depressing and releasing the front panel power switch located in the center of the panel next to the floppy drive.

NOTE:
Do not plug the unit in or power it up until you have confirmed that the supply is configured for your voltage. To check this you will need to open the case and remove the power cord from the back of the supply to gain access to the voltage switch. Once you have the supply configured correctly be sure the power switch mounted on the supply is in the on position, then reconnect the power cord and replace the cover on the case. The power switch mounted on the front of the chassis is a “hot” power switch and does not protect the power supply from over voltage.

3.1.2 Adjusting Display

The DRM-CSB 100 assumes a video monitor with 1280 x 968 resolution. If this is not the case the display may indicate in error during boot-up. Hit Ctl-Alt-+ to switch resolutions.

3.2 General Linux operation

The DRM-CSB 100 utilizes a customized version of the CentOS Linux operating system. There are certain basic operating procedures you should know when using this system but which will not normally require adjustment.

3.2.1 Autostart

The DRM-CSB 100 Content Server will boot automatically, without user intervention, into a user account called *drm* . The Content Server multiplex generator and graphical user interface applications will also start automatically. Do not attempt to interrupt this process.

3.2.2 Task Bar

Once the system is up and running normally you will observe a task bar at the bottom of the screen which has this appearance.

The elements in that bar are a series of application icons, 4 alternate desktop buttons, any operating applications and the date and time. Applications are started by a single click on the appropriate icon. The name of the application appears when the mouse is moved over the respective icon.

3.2.3 Multiple Desktops

The multiple desktops allow you to open different applications on different desktops and to switch easily from one to the other. This reduces the clutter of too many open windows on one screen, as well as the need to minimize one window to see another. The two Content Server windows (Mutliplex Generator and GUI) will open automatically on desktop number one. The others may be used for displaying the MCI, editing text messages or configuring the audio input.

3.2.4 Lock Terminal

One of the application icons in the task bar at the bottom of the screen is a padlock for locking the session. Clicking this icon will not interfere with the operation of the Content Server but it will blank the screen and disable the keyboard and mouse. Then when someone attempts to use the system will it will prompt for the *drm* account user

password. This password is *harrisdrm*. Be sure only authorized personnel know this password to unlock the terminal.

3.2.5 Closing Applications

Because of the realtime nature of the applications on the Content Server and to protect from accidental interruption the close button has been hidden from its normal location in the upper right corner of an application window. In order to close an application you must right click on the title bar of the window and select Close. You can also close the currently active window by typing ALT-F4.

3.2.6 Accessing DVD/CD player

Normally the Content Server will operate with audio fed through the audio card from an external source. You may for demonstration purposes play recorded .wav files through the system. To do this you will first need to close the active two Content Server windows running on virtual desktop 1. Note: this will interrupt you DRM signal and cause the DRM-MOD 100 to switch into analog mode. Next insert the appropriate CD in the player accessed from the system front panel. After a moment a browser window of the files on the disk will appear. Now drag the audio file you desire to play onto the Content Server (CS) icon located on the task bar. The Content Server application will start operating with this .wav file as the audio source. The file will repeat continuously until the Content Server is closed.

To remove the CD open a terminal window using the terminal icon on the task bar and type “eject” and Enter, then close the terminal window by typing “exit” and Enter.

NOTE:
Audio files played from a CD in this manner must be .wav files recorded with a sampling rate of 48,000 and 16 bit resolution.

3.2.7 Audio Configuration

As described in the audio source section under installation the RME HSDP 9632 is a high flexible professional grade sound card that can be configured for various formats of either analog or digital input depending on the user’s preference and available feed. The system default configuration is for Analog balanced input. If that describes your audio feed for the DRM system you do not need to make any other adjustments and can ignore the rest of this section.

If you are using a digital or unbalanced, analog input the appropriate configuration and mixer setting are set through the HDPS Configuration and HDSP Mixer tools which can be run by clicking on their appropriate icons on the task bar at the bottom of the screen.

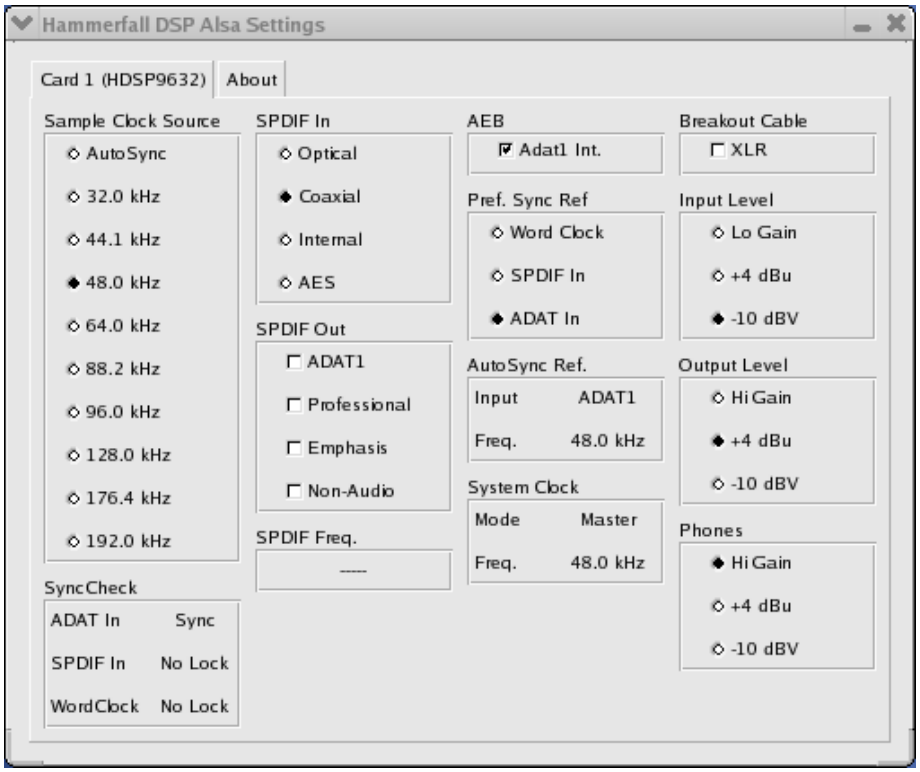
Table 3-1 outlines the various options and connection methods.

Table 3-1 Audio Connection Method

Type of Audio Feed	Break Out Cable Requirement	Method of Connection	Configuration Settings	Mixer Settings
ADAT optical	none	Optical cable (TOSLINK) to upper most optical connector on bracket of RME card	Sample: 48.0 kHz AEB: unchecked Breakout cable: unchecked Pref. Sync Ref: ADAT In	default - no sliders up on any channel
SPDIF optical	none	Optical cable (TOSLINK) to upper most optical connector on bracket of RME card	Sample: 48.0 kHz SPDIF In: Optical AEB: checked Breakout cable: unchecked Pref. Sync Ref: ADAT In	In 9 - slider up on A1+2 In 10 - slider up on A1+2 A1 (out) - slider up A2 (out) - slider up
SPDIF coaxial	9 pin w/ 2 RCA & 2 XLR - upper D socket	Coax cable to white phono socket on breakout cable	Sample: 48.0 kHz SPDIF In: Coaxial AEB: checked Breakout cable: unchecked Pref. Sync Ref: ADAT In	In 9 - slider up on A1+2 In 10 - slider up on A1+2 A1 (out) - slider up A2 (out) - slider up
AES/EBU	9 pin w/ 2 RCA & 2 XLR - upper D socket	Balanced cable to female XLR on breakout cable	Sample: 48.0 kHz SPDIF In: AES AEB: checked Breakout cable: checked Pref. Sync Ref: ADAT In	In 9 - slider up on A1+2 In 10 - slider up on A1+2 A1 (out) - slider up A2 (out) - slider up
Analog unbalanced	15 pin w/ 4 phono - lower D socket	Unbalanced stereo cables to Line IN L and LINE IN R phono sockets	Sample: 48.0 kHz AEB: checked Breakout cable: un-checked Pref. Sync Ref: ADAT In Input Level: -10 dBV	In 11 - slider up on A1+2 In 12 - slider up on A1+2 A1 (out) - slider up A2 (out) - slider up
Analog balanced	15 pin w/ 4 XLR - lower D socket	Balanced stereo cables to Line IN L and Line IN R XLR female sockets	Sample: 48.0 kHz AEB: checked Breakout cable: checked Pref. Sync Ref: ADAT In Input Level: +4 dBu	In 11 - slider up on A1+2 In 12 - slider up on A1+2 A1 (out) - slider up A2 (out) - slider up

3.2.7.1 Audio Configuration Settings

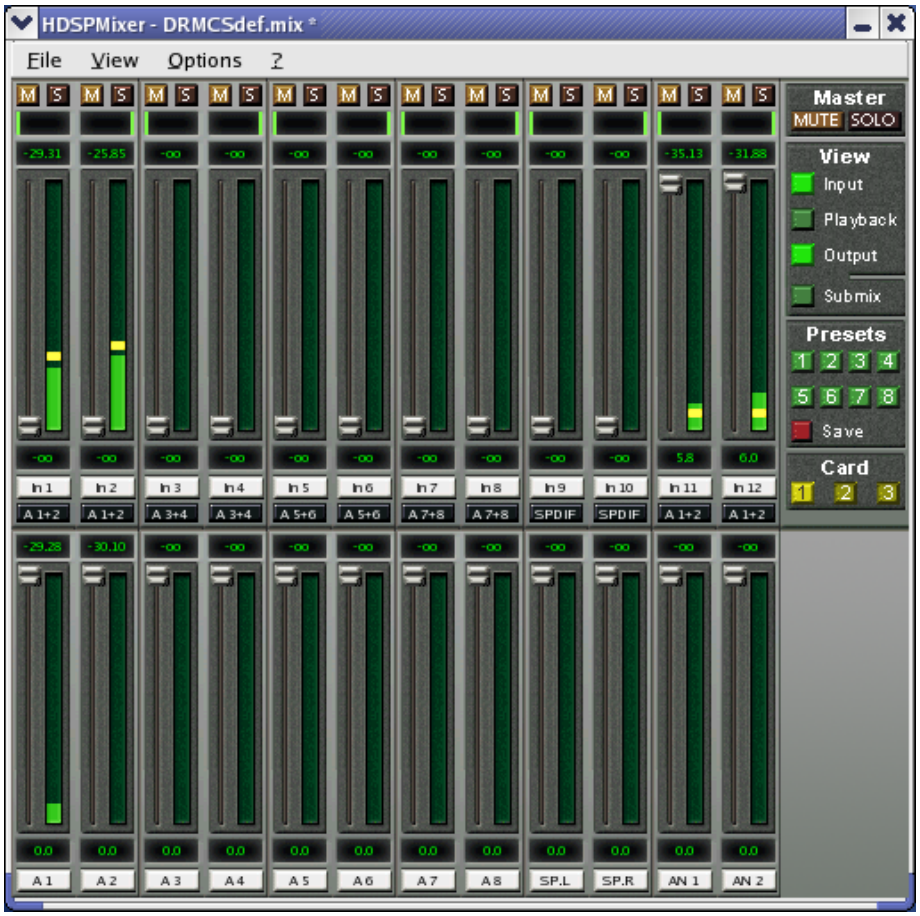
To adjust the configuration settings described in the fourth column of table 3-1 select an unused desktop and click on the HDSPConf icon. The following window will appear.



Select or check the appropriate buttons and check boxes as described in the table. Do not modify settings not referred to in the table. The HDSP Configuration application may then be closed and the settings are saved as default values.

3.2.7.2 Audio Mixer Settings

To adjust the mixer settings described in the fifth column of table 3-1 select an unused desktop and click on the HDSPMixer icon. The following window will appear.



This graphically represents a mixer of the inputs to the system. At the bottom of each slider/VU meter combination is a white label for each input (In 1, In 2, etc.) The inputs of importance to the DRM system are as follows:

- In 1 & 2 – ADAT 1
- In 9 & 10 – SPDIF & AES/EBU
- In 11 & 12 – Analog

Under the input channel label is a button which selects the output associated with that input. The Content Server always uses the audio from output A1+2. Therefore, whichever input you are using must be mixed into A1+2. That is what is described in the mixer settings column in Table 3-1.

For example, to set the mixer for use of the AES/EBU input follow these steps:

a. Click on the button under In 9

b. Select A1+2

c. Click and drag the slider on In 9 all the way up

d. Click on the button under In 10

e. Select A1+2

f. Click and drag the slider on In 10 all the way up.

You follow a similar process for SPDIF or analog inputs.

3.2.8 LAN Connection

To configure the LAN connection on the DRM system for your network select an available desktop and start a terminal window by clicking on the terminal icon on the task bar at the bottom of the screen. In the terminal window execute the following command:

sudo system-config-network

3.2.9 Time Synchronization

To configure the date and time and the Network Time Protocol (NTP) on the DRM system select an available desktop and start a terminal window by clicking on the terminal icon on the task bar at the bottom of the screen. In the terminal window execute the following command:

sudo system-config-date

3.2.10 Shutdown

To shut down the system first close any running applications on all desktops (See Closing Applications above). Then click on the logout icon on the task bar at the bottom of the screen. Confirm and then click shut-down on the login manager window. Wait until the system powers down.

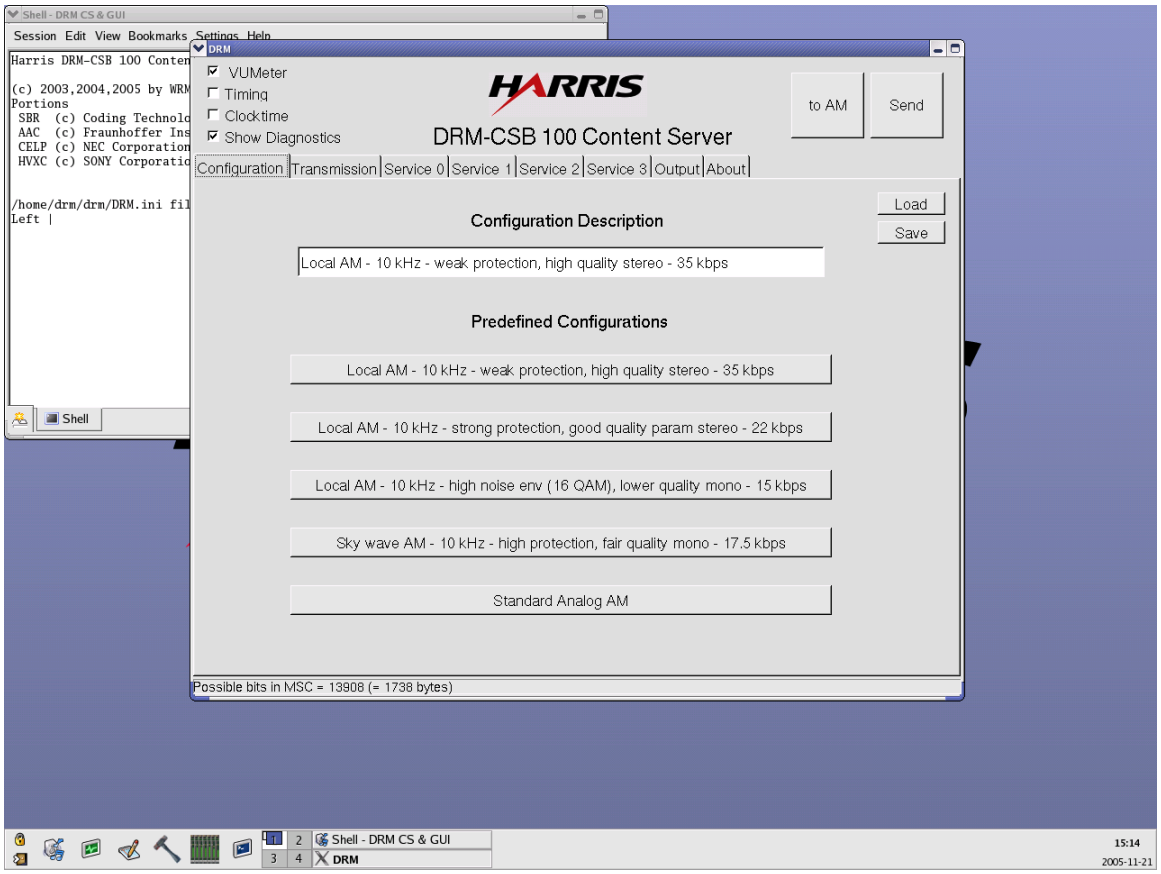
3.3 Content Server Software

The first software to learn how to use is the Content Server software which sends data from the Content Server PC to the DRM Modulator Board. The Content Server software encodes the audio received from the audio device.

3.3.1 Multiplex Generator (CS)

The Content Server Multiplex Generator (CS) is the heart of the system. It is a real-time software application and it starts automatically when you boot the computer. It can also

be started by clicking on the speaker icon on the task bar at the bottom of the screen. Once the application has started the following windows should appear.

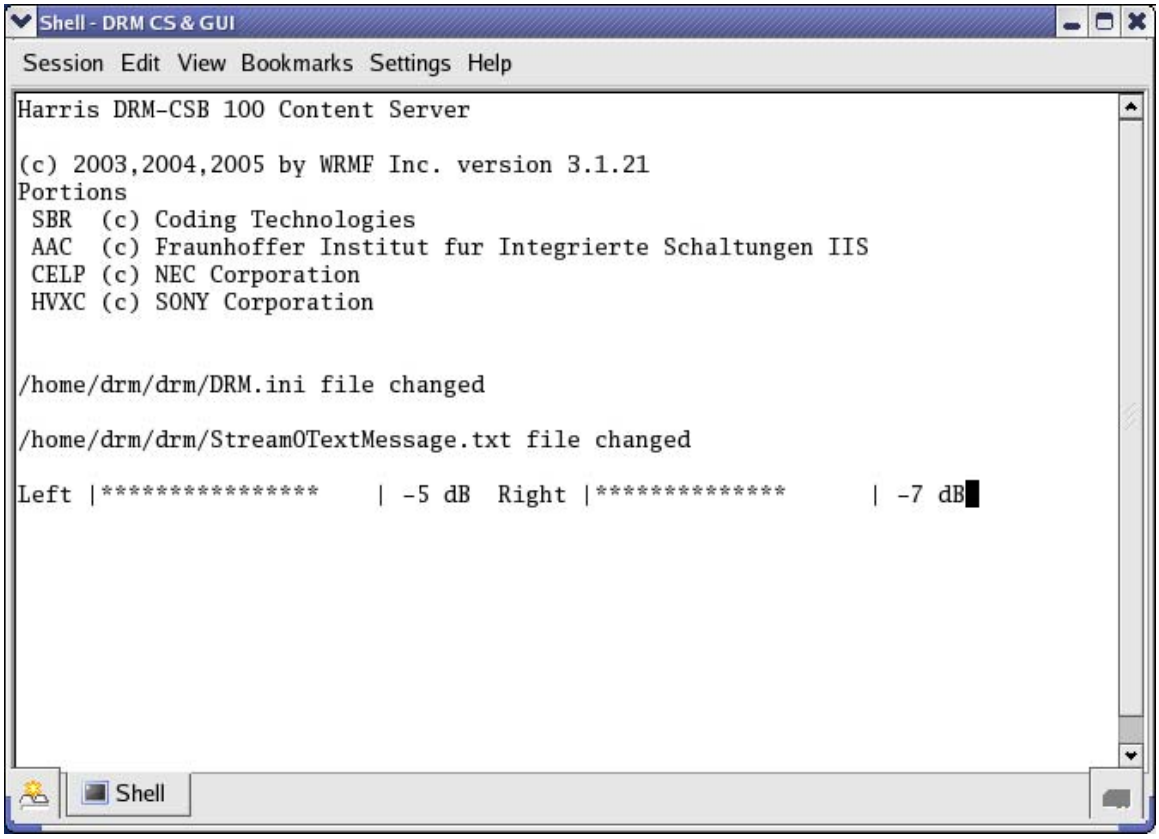


The CS will read the Content Server Configuration File, and a window will open displaying updated information as the Content Server runs. The Configuration File is /home/drm/drm/DRM.ini. The appearance of your Content Server window may vary depending on your current configuration.

3.3.1.1 Audio Source

If you are using an external audio source, such as a program audio input, be sure audio is actually present.

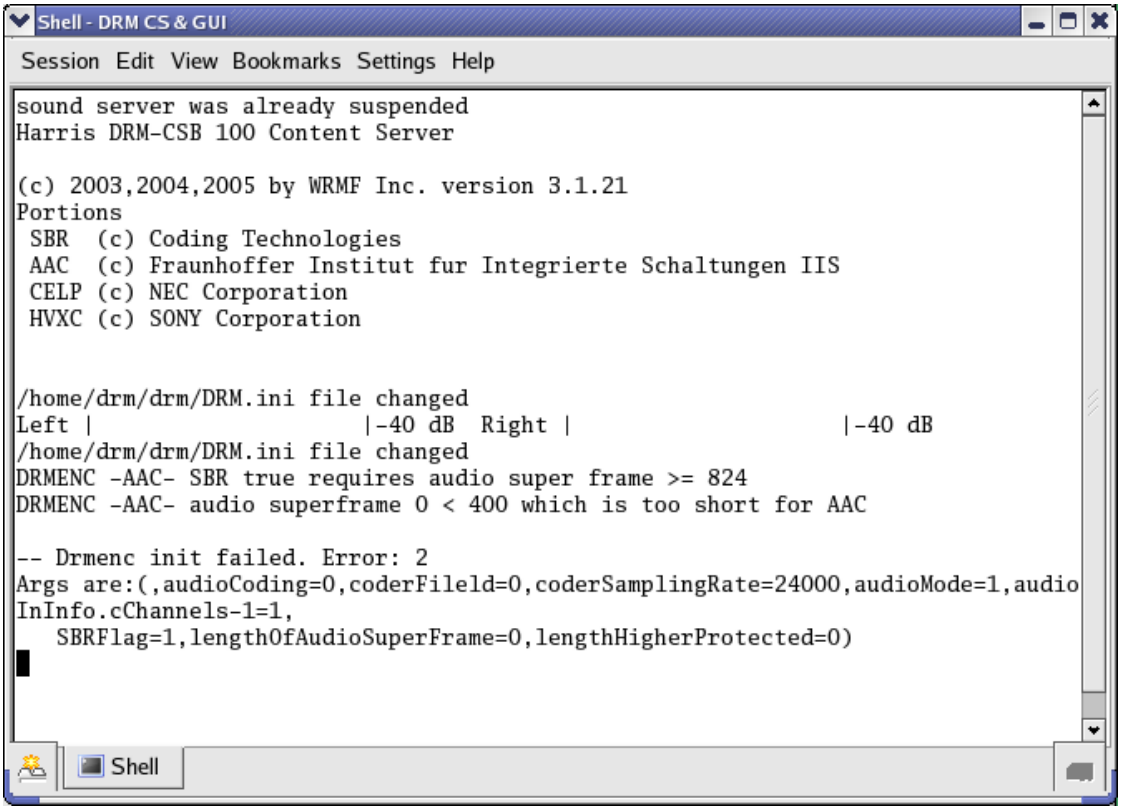
3.3.1.2 VU Meter



If you have the VU meter enabled, you will see the audio level displayed in the Content Server window. You can check the audio level entering your DRM Content Server software audio encoder. It is important that you do this if you are using a live audio source.

You will see asterisks in the Content Server output window indicating the audio level. To the right of the asterisks, you will see negative numbers. The closer these numbers approach zero and the more asterisks precede them; the closer your audio is to being clipped.

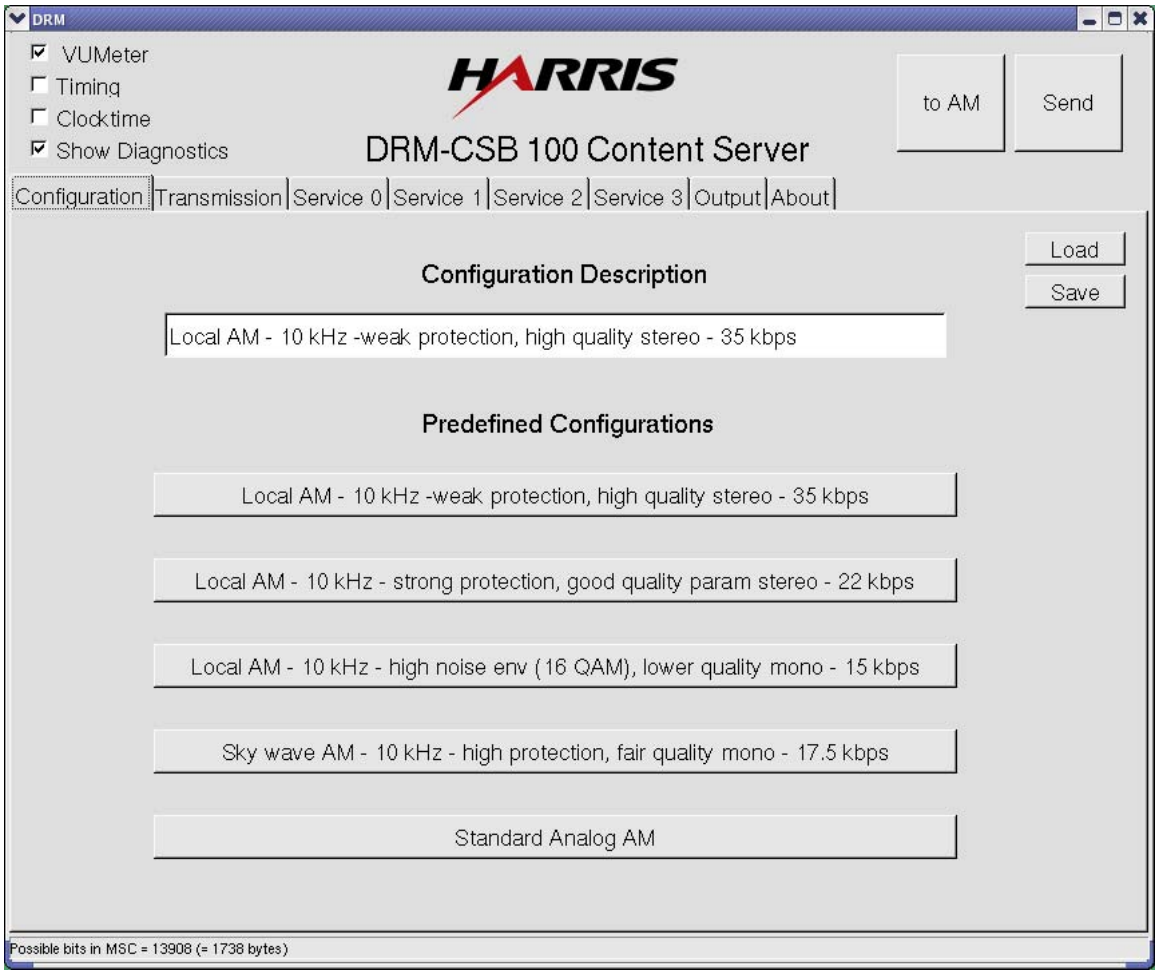
3.3.1.3 Error Messages



Error messages that appear in the CS window can occur if you command the GUI to write an INI file that it is not possible for the CS to process correctly for some reason. If you cannot figure out why the error is occurring in order to correct it, you may try using the GUI to go back to a saved configuration.

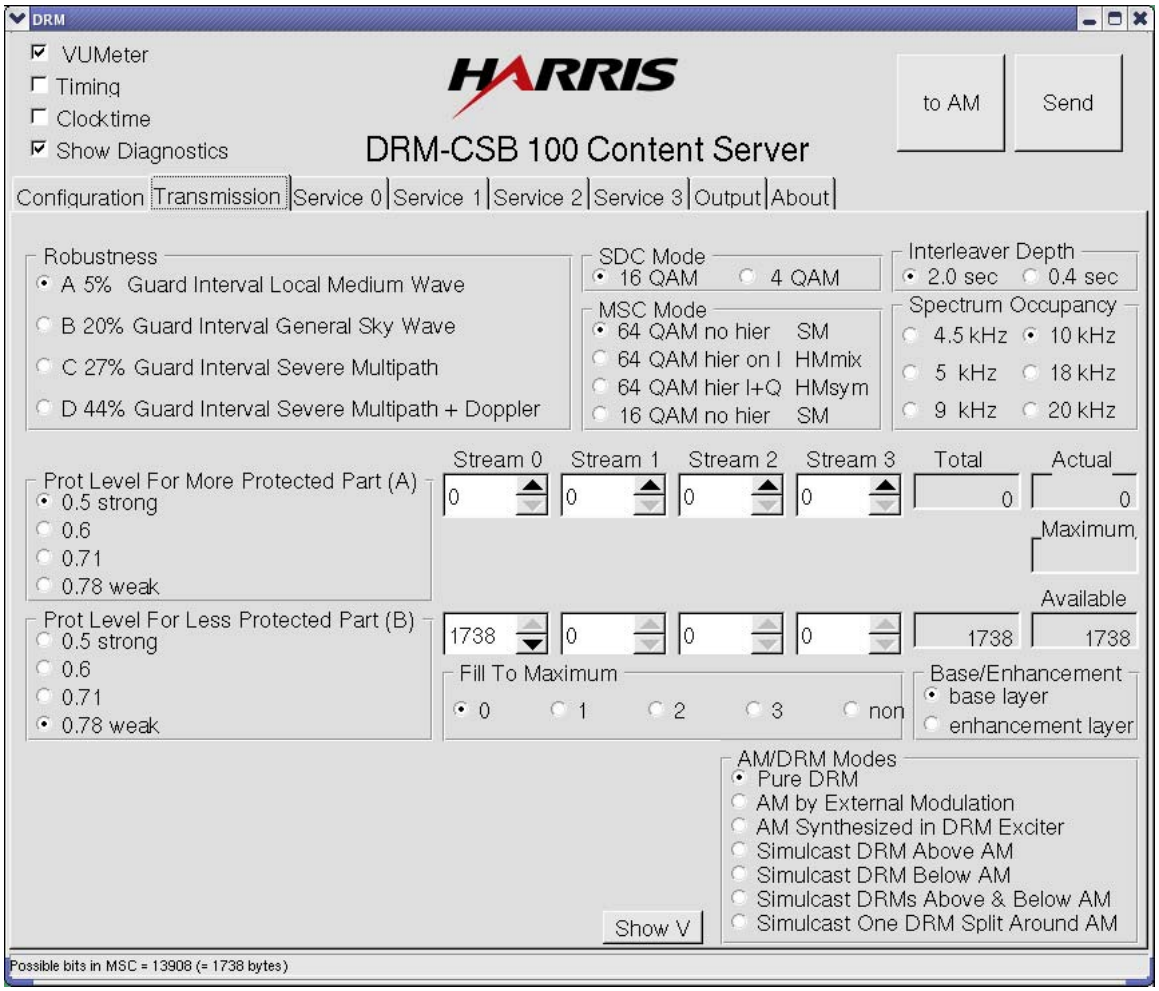
3.3.2 User Interface (GUI)

While the Content Server software encodes audio and communicates with the DRM Modulator Board, the Content Server GUI changes the configuration of your transmitted DRM signal. This section explains how to change DRM Transmission or DRM Service options in the DRM Content Server GUI.



The system always starts in the most recent configuration, read from the Configuration File. Your screens may be different depending what was programmed during test.

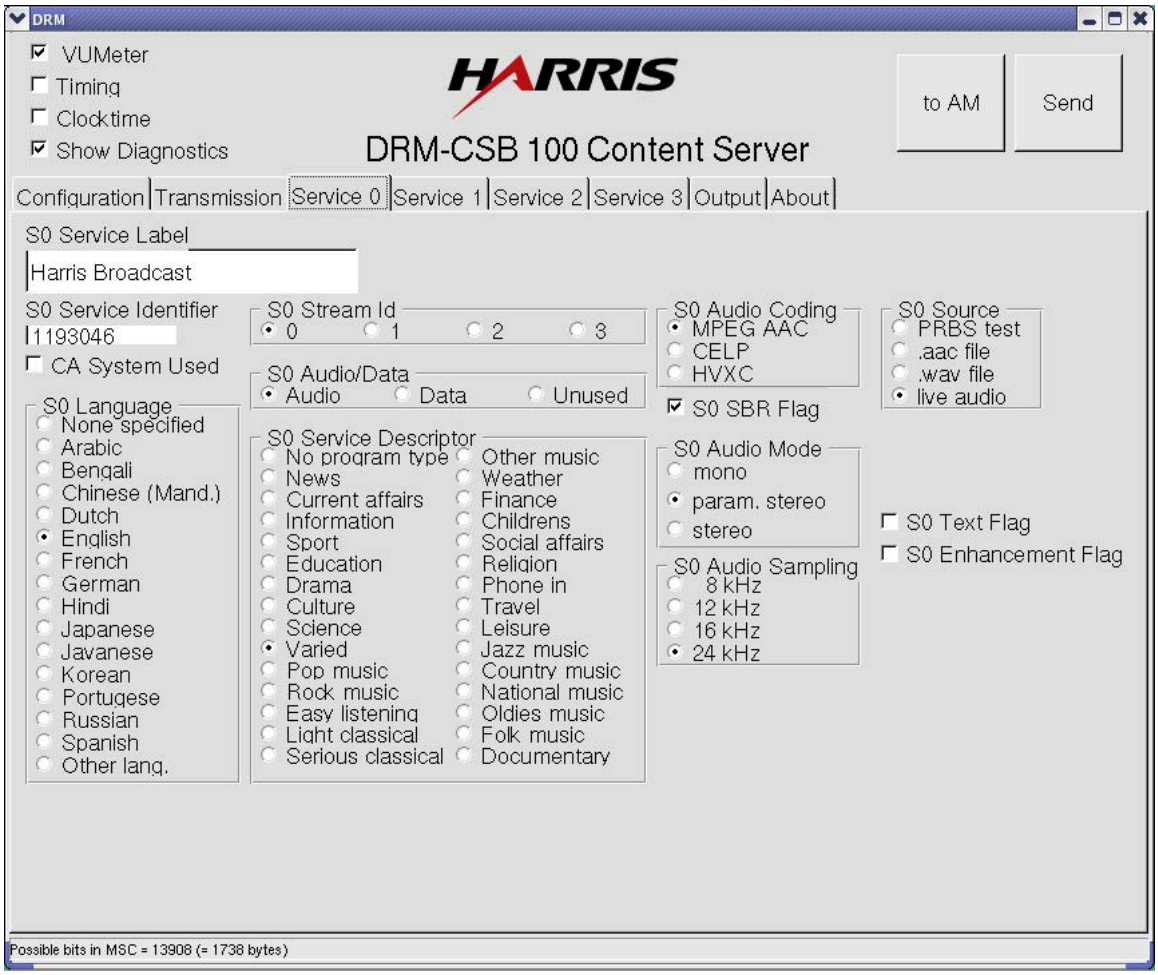
From this main screen you can select the Transmission tab:



This screen lets you choose from the different settings that are part of the DRM system.

From this screen you can select the Service 0 tab:

WARNING: Disconnect primary power prior to servicing.

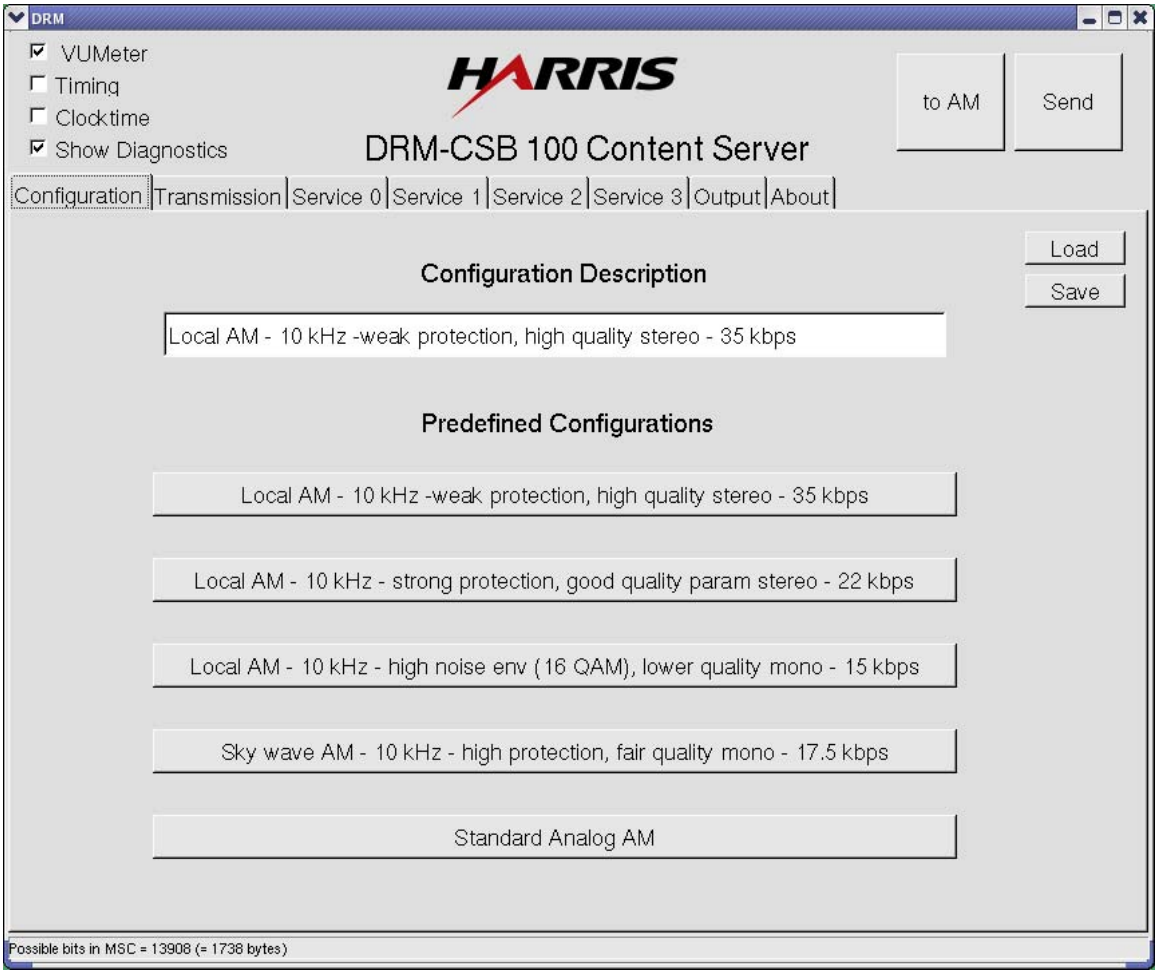


This screen lets you choose from the different settings that are part of the DRM system.

3.3.2.1 Interface with CS via Send Command

The settings from the GUI take effect when you press the Send button. If the Content Server is running, the configuration change takes place immediately. If the Content Server not running, the new configuration will be use the next time it is started. The Send button is located in the top right corner of the Content Server GUI. It sends all information from all tabs to the configuration file.

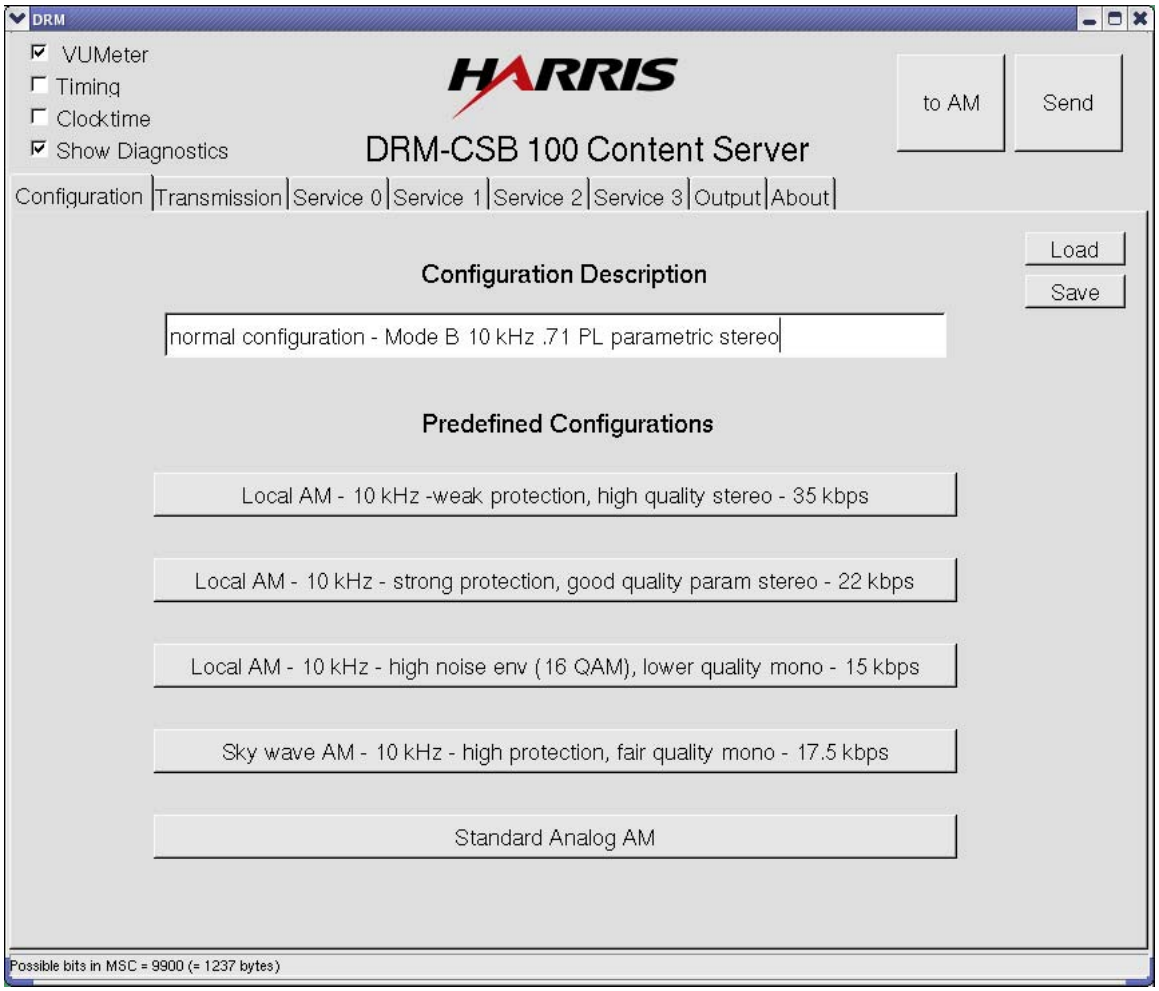
3.3.2.2 Preset Button



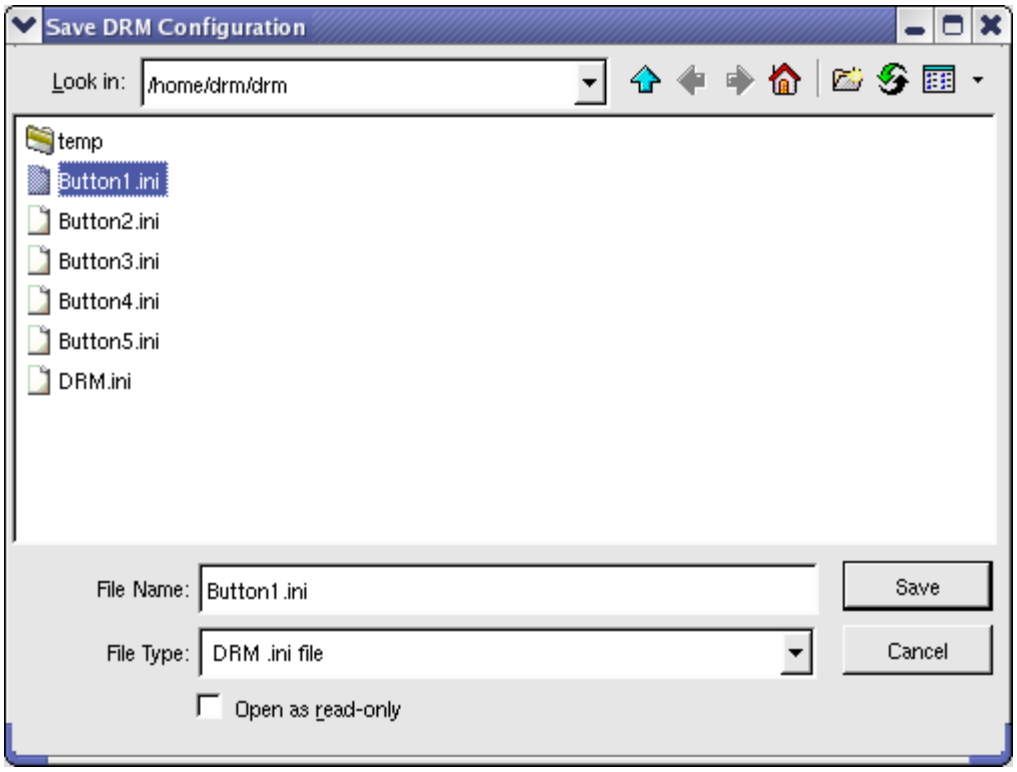
On the Configuration tab in the GUI, pressing one of the Presets buttons will load a complete set of settings into the GUI. Check the settings are what you really want to use, possibly making modifications to make the settings more suitable. Once you are satisfied with the settings, press the Send button to make your changes go on the air. When you press Send, the settings from the GUI will be written to your configuration file so that the CS program will immediately change the DRM signal it is sending to the Modulator.

3.3.2.2.1 Load/Save presets

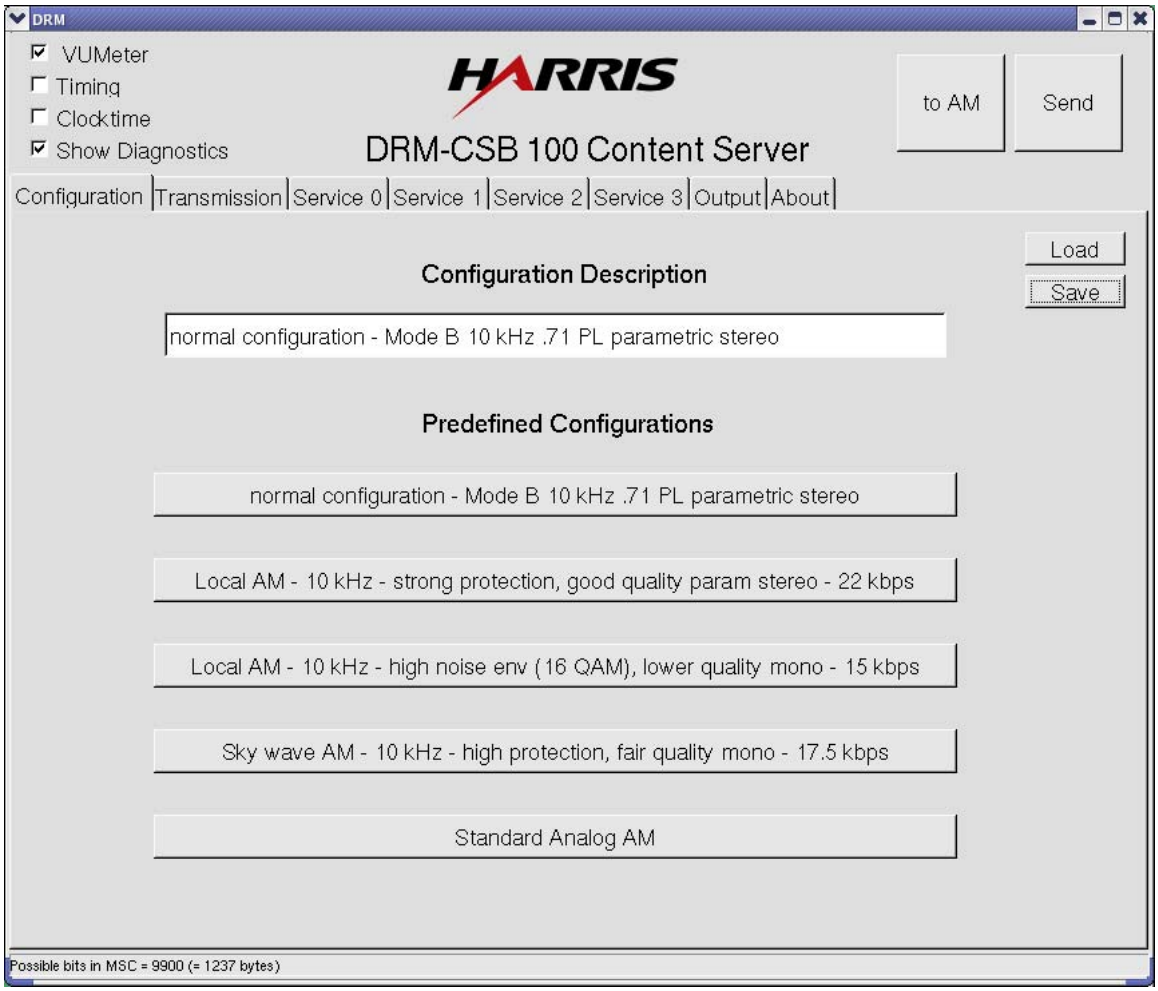
If you want to change one of the Presets, you should give it an appropriate description in the Configuration Description edit box.



Then press the Save button. A window will appear asking which button you want to save your settings to. Click on the button you want to overwrite (Button1.ini through Button5.ini), and click Save. Button 1 is the top preset button, and the button numbers increase going down.



Now, the Preset button should be updated to be labeled with the description that you entered. When you press it, it should load the configuration that you saved.

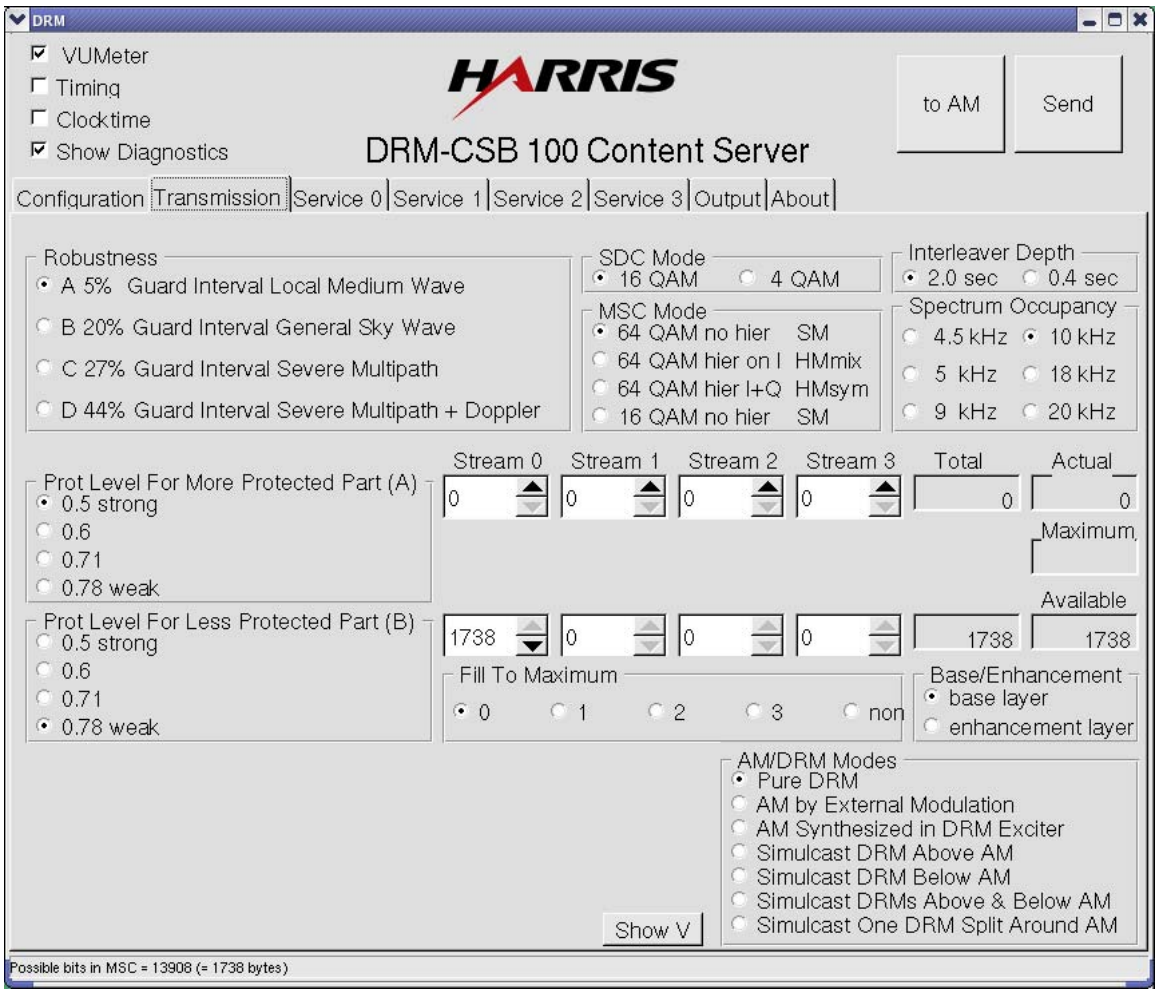


3.3.2.3 Configurations

The Save button allows you to save your configuration to other filenames as well, besides just the Button1.ini through Button5.ini names. The Load button allows you to load a configuration from a configuration file. Remember that the configuration that is currently being broadcast on the air is DRM.ini. It is normally written by pressing the Send button in the GUI.

You can have several configuration files saved, for instance to demonstrate slightly different configurations. Then, use Load (to load the file) and Send (to save it as /home/drm/drm/DRM.ini). The Content Server will begin using the sent configuration.

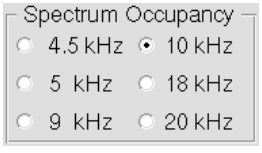
3.3.2.4 Transmission



The Transmission tab of the GUI allows the user to set DRM and AM parameters that apply to the whole transmission.

3.3.2.4.1 DRM options

Spectrum Occupancy



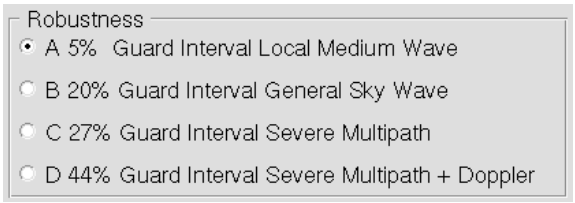
The most basic option which you can set is Spectrum Occupancy. It is described in Section 8.3.1 of the ETSI DRM Specification. The possibilities are 4.5 kHz, 9 kHz, 18

kHz, 5 kHz, 10 kHz, and 20 kHz. The first three were designed for use in Europe, and the last three for use in the United States.

Radio transmissions above a certain power level are regulated by governments and regulatory commissions. A radio station must be licensed to broadcast on the AM bands or on shortwave frequencies. This regulation ensures that transmission will not interfere with existing radio stations. A government will assign a frequency, also called a channel frequency, to a radio station, when it receives a license. The station is required to broadcast radio waves of that frequency, using the amplitudes and phases of the waves to send their information. The signal includes slightly higher and slightly lower frequencies (sidebands) which must be kept within the assigned channel bandwidth. Europe and the USA have different specifications as to the requirements of this envelope inside which a radio station must transmit its signal. If more bandwidth is available, more data can be sent for better audio fidelity. The Spectrum Occupancy specifies the bandwidth that the DRM system will be using. If you use a higher Spectrum Occupancy, the audio will sound better because the DRM system can use more frequencies slightly above and below the center frequency for transmission.

The 18 kHz and 20 kHz modes cannot be received by current FHG receivers. You will typically use 9 kHz in Europe, and 10 kHz in the USA. You can use 4.5 kHz and 5 kHz to demonstrate system capabilities, but because they have lower bandwidth, the audio will not sound as good.

Robustness Mode



Robustness Mode specifies how many of the side carriers will be used for propagation measuring signals that can be used for error correction. If more carriers are used for that, then fewer are used for audio data. So, for short transmissions, using few propagation measurement signals and more audio data is preferable. For long distances and ionosphere bounces, more error correction is needed than for short distances. For a depiction of this, see Annex L in the ETSI DRM Specification. See Section 8.4 of the Specification for details concerning what kinds of propagation test signals there are and what their values are.

In addition, Section 8.2 of the ETSI DRM Specification describes other significant differences between these modes. DRM transmissions are organized into superframes. Each superframe is 1.2 seconds longs and consists of three frames, each frame 0.4 seconds long. This is why the signals on the Content Server to DRM Modulator link are sent every 0.4 seconds. Each frame consists of from 15 to 24 symbols, depending on

Robustness Mode. A symbol is a period of time during which carriers to the right and left of the center frequency keep QAM constellation point values. A carrier at any specific moment takes on a different value depending on which symbol is occurring. If it is a data carrier during that symbol, the amplitude and phase of that carrier depends on the data being transmitted. From 1/9 to 11/14 of every symbol is output again as a guard interval. This repetition gives the receiver a longer time during which to measure the carriers. The carriers may be hard to recognize after a difficult long-distance transmission. In this way, the repetition of part of the signal in a guard interval provides additional error correction. The normal output of the symbol is known as the useful part, and the useful part and guard interval together make up the total symbol time. Mode A uses a guard interval of $1/9^{th}$ of useful part, Mode B $1/4^{th}$, Mode C $4/11^{ths}$, and Mode D $11/14^{ths}$.

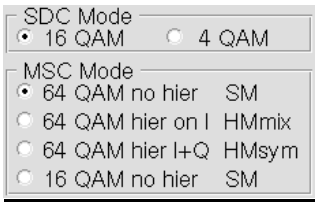
For OFDM the carrier spacing must be the reciprocal of the useful symbol length t_u which is shorter for more robust modes. Symbols in Mode A are 24 ms. long, so carriers are spaced at 41 2/3 Hz; Mode B, 21 1/3 ms and 46 7/8 Hz; Mode C, 14 2/3 ms and 68 2/11 Hz; and Mode D 9 1/3 ms and 107 1/7 Hz. For more details, see Section 8.2 of the ETSI DRM Specification.

Mode A permits the best audio quality, and Mode D gives the worst audio quality but the best error correction. Most of the Medium Wave (MW) / AM transmissions taking place today use Mode B.

Interleaver Depth

The Interleaver Depth setting can be set to two seconds, or four tenths of a second. That is, audio data from a specific audio frame is spread over 2.0 or 0.4 seconds of transmission. Long interleave increases the decoding delay in the receiver, but increases the signal's robustness against impulse noise and selective fading. This is especially important in long-distance broadcasts. So, use short interleave for faster audio reception for short distance transmissions, and use long interleave for long distance broadcasts so that your signal can be decoded with less error.

QAM



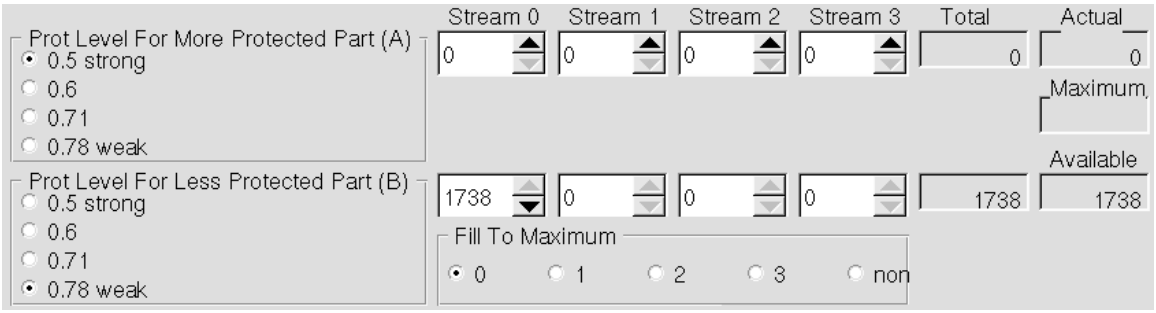
Which QAM you select for your signal also depends on whether you are planning on short distance transmission or long distance transmission. QAM stands for Quadrature

Amplitude Modulation. The same technique is used in computer modems to transmit digital data over analog telephone lines. When it is used in radio, digital data is transmitted over analog airwaves. The first configuration to consider uses SM, short for Standard Modulation. It exists in a better audio quality version where you specify that your SDC is 16 QAM and your MSC is 64 QAM, and a lower audio quality version that gives better weak-signal reception with the SDC in 4 QAM and the MSC in 16 QAM. Your receiver software is capable of displaying the received QAM signal as graph called a constellation diagram. From the perspective of the exciter, the bits that will be sent specify a point in the diagram. For a 64 QAM constellation, there are 64 possible points that the bits can specify. For 16 QAM, there are only 16. So, one carrier from a 64 QAM constellation at a specific moment carries more information than one at 16 QAM. For details on how bits become constellation diagram points, see DRM Specification Section 7.4. A receiver, on the other hand, given a carrier at a given moment, seeks to determine which of the 16 or 64 possible constellation points the carrier is closest to. When there are only 16 points, even if the transmission has been affected by noise long distance transmission, it is more likely to be closest to the correct constellation point.

There are intermediate transmission configurations which attempt to bolster 64 QAM with additional error correction. These two configurations are called 64 QAM HMSym and 64 QAM HMMix. HMSym and HMMix are not available at 16 QAM. HMSym is called what it is because it uses Hierarchical Modulation, as opposed to SM, or Standard Modulation. HMMix uses Hierarchical Modulation for the “I” axis of its QAM constellation diagram, but Standard Modulation for the other axis. HMSym and HMMix capability in the Content Server are still under development.

For short distance transmissions, use an MSC Mode of 64 QAM SM, and an SDC Mode of 16 QAM. For long distances or to demonstrate long distance capability, use an MSC Mode of 16 QAM SM, and an SDC Mode of 4 QAM. The QAM mode of the SDC is one level lower than that of the MSC since it must be received correctly in order to start decoding of the MSC.

Parts A and B



Your encoded audio can be divided into a higher protected part and a lower protected part. The audio encoder places more critical information about the audio at the beginning of each frame. The DRM Modulator can encode the first (higher protected)

part at a more error proof (lower throughput) rate than it does the lower protected part. So, after the different parts leave the audio encoder and it has placed its most valuable data in the higher protected part, the Modulator encodes the parts differently.

You can specify how many bytes (in each 0.4 second DRM frame) will be used for each part. Part A is the higher protected part (HPP), and is not always present. Part B is the lower protected part (LPP). For broadcasts where distant reception is limited by weak signals, there will be fewer noticeable defects in the received audio if the signal is divided into a higher protected part and the lower protected part.

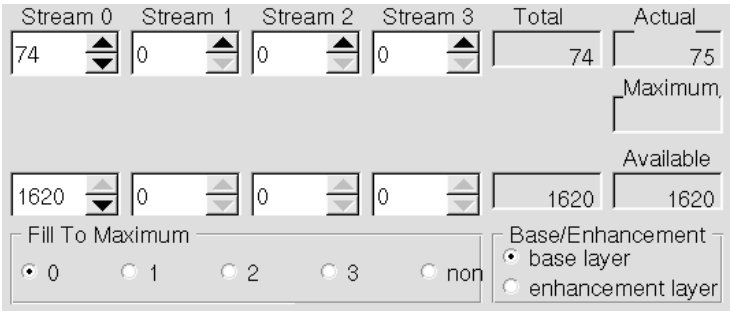


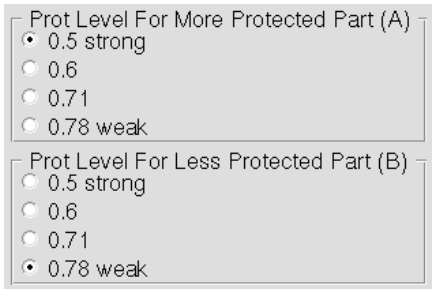
Figure 3-1 Using a small amount of UEP

Some tests have shown that using a small amount of UEP can benefit your DRM signal coverage area. You can experiment with the balance between the parts to find the optimum settings for different broadcast situations. To add a small amount of UEP, click the up arrow to the right of the spinner control for the number of bytes in Part A for Stream 0.

Figure 3-2 Fill To Maximum option

The “Fill To Maximum” selection allows the user to specify that one stream fill all remaining undesignated space in the DRM “pipe”. Leave this set to “0” so the entire bit rate that can be obtained from your DRM signal is used for Stream 0. If “none” is selected, the Content Server will allow you to leave some of your DRM signal completely unused. This unused space is wasted.

Protection Level



The final setting is that of your forward error correction level for each part. The specific meanings of these numbers are listed in Section 7.3.2 and Section 7.5.1 in the ETSI DRM Specification. To summarize briefly, DRM transmits three types of data.

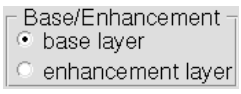
Fast Access Channel, or FAC, data is spread through every symbol of every frame of every superframe. It contains only about 65 bytes, but specifies information that is critical to the decoding of the rest of the signal. For example, it specifies the QAM scheme that the receiver should use to decode the other two types of data. It uses the very robust 4 QAM mode and a low 0.6 code rate, and is protected by an 8-bit CRC. The meaning of each bit of this data is described in ETSI DRM Specification Section 6.3.

The second type of data is the Service Description Channel, or SDC. This channel indicates which overall code rates should be used to decode the bits received from the QAM de-mapping. In the future, you will also be able to send broadcast schedules and alternate frequency information via this channel. This capability has not yet been included in the Content Server.

The final type of data is the Main Service Channel, or MSC. This channel contains the audio and data services and streams. Your DRM System will work with only one stream. The capability to allow up to 4 streams is still under development. The bit capacity of the Main Service Channel is affected by the code rates. A lower code rate (fewer info bits and more check bits) gives better error correction but reduces the available bit rate of the MSC channel.

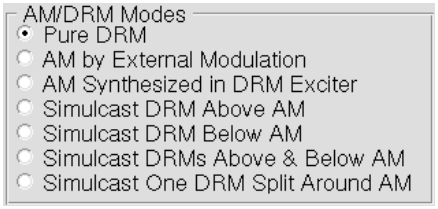
In different QAM configurations, different overall code rates will be available. For example, in 16 QAM SM the choices are 0.5 and 0.62. Your options in 64 QAM SM are overall code rates of 0.5, 0.6, 0.71 or 0.78 for each part. Of these, 0.5 provides the greatest protection and 0.78 the least. Your DRM signal sound best at 0.78, but will not provide enough error protection for your signal to be decodable as far away as if you use a lower code rate.

Base / Enhancement Layer



Leave this setting set to Base Layer. The Enhancement Layer is flag for DRM signals that is not used yet.

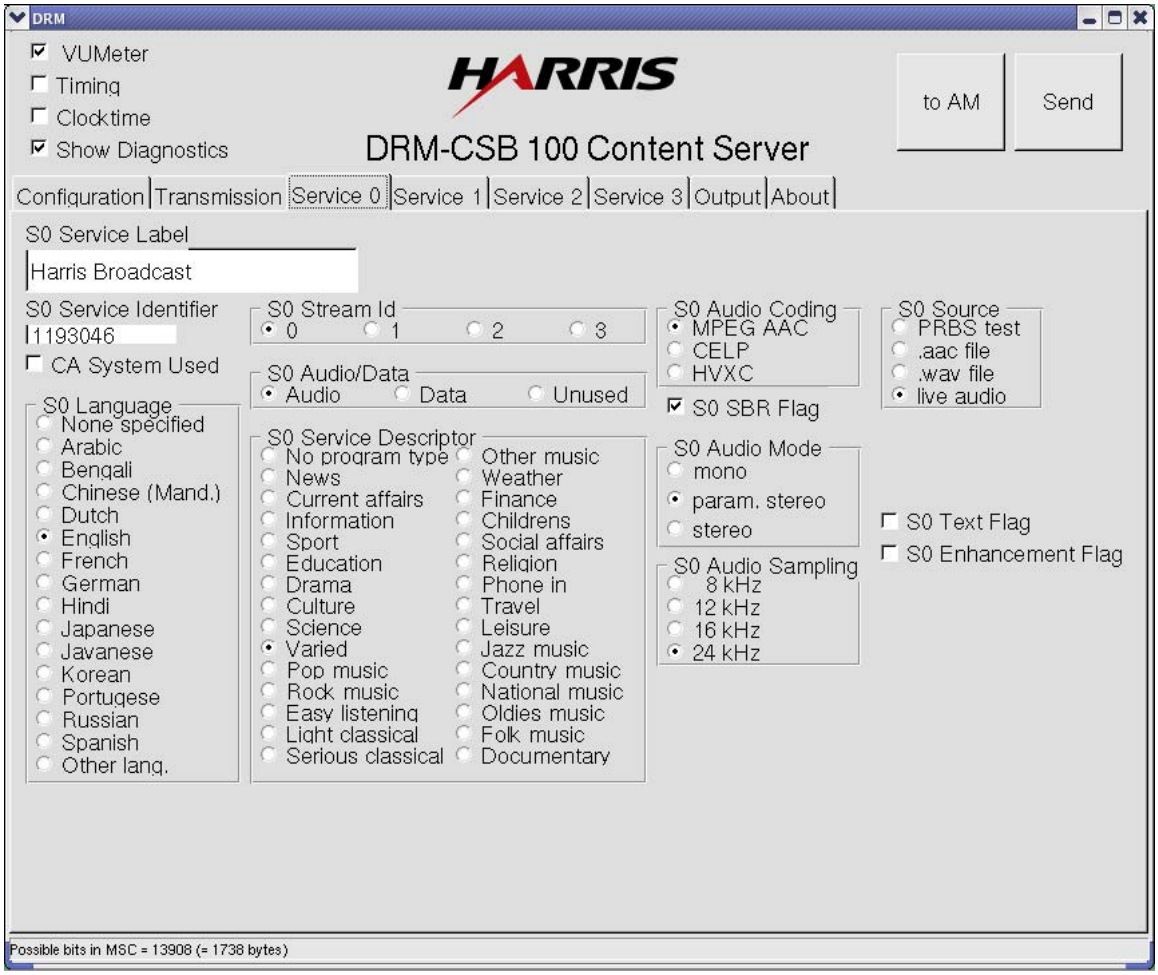
3.3.2.4.2 DRM/AM switching



The DRM system is designed to be able to switch into analog mode. Currently, the DRM Modulator will do this automatically if it detects a problem with the digital transmission. There are also front panel switches to enable the user to force the system into analog mode. Finally, the GUI can command the Modulator to change to analog mode.

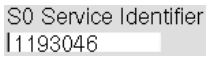
Only the first two options in the AM/DRM Modes section of the GUI should be used. The option labeled “Pure DRM” sends a digital DRM signal containing digitized audio, receivable only by DRM-capable receivers. The option labeled “AM by External Modulation” generates an AM carrier with audio modulated by the input to the DRM Modulator rack mount unit. This outputs a standard analog AM signal only, receivable by legacy analog AM radios. The audio input to the DRM CS computer is not used in this mode; the audio source must be connected to the DRM Modulator rack mount unit audio inputs for your signal to be modulated with audio in this mode. Other modes are still under development.

3.3.2.5 Services



The Stream 0 tab of the GUI allows the user to set DRM and audio parameters that apply to the first stream. The changes you make to many of these values will reach all the way to the Receiver software. For most of these settings, the information is placed in the FAC and sent to the exciter where it is transmitted as part of your DRM signal. The options are set in the Service 0 tab of the DRM Content Server GUI.

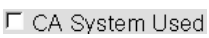
1. The Service Label is displayed by many DRM receivers. It can be used to indicate the name and call letters of the radio station.



2. The Service Identifier is an integer field. It should be used to uniquely identify the service. For example, your Spanish and English language audio services would have different service IDs.

3. The Service Descriptor group of radio buttons lets the user specify the type of programming present. This information will usually be shown on the display of a DRM receiver. Thirty program types are available.

4. The Language radio button group allows you to specify which language you use to broadcast the service. This is also often displayed on receivers. You can set the Language to No language specified, Other Language, or one of the fourteen listed languages. The DRM standard also allows for three-character country of origin codes, but the DRM Content Server software does not offer that feature. The DRM Specification Section 6.3.4 and Section 6.4.3.13 contain more information on language and country of origin specification.



5. The “CA System Used” check box indicates whether conditional access is enabled for this service. Leave this box unchecked. The DRM system allows up to 256 different

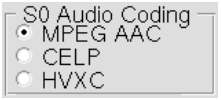
conditional access systems. Conditional access is designed to restrict decoding of your signal to specially-enabled receivers. Your DRM System does not currently support Conditional Access. For more information on conditional access, read Section 6.3.4 and Section 6.4.3.3 of the DRM Specification.

6. The Enhancement Flag check box should be left unchecked. If an enhancement layer is ever added to the basic DRM specification, this check box will be turned on for the content servers which broadcast using the enhancement layer. The full capabilities of their transmissions would only be decodable by receivers which also support the enhancement layer. For more information, see DRM Specification Section 6.3.3.

7. The Audio/Data group of radio buttons lets the user specify whether to the service transmits audio or data, or is unused. The DRM Content Server only allows you to broadcast Audio or PRBS specified as Audio. Services 1, 2, and 3 are not used, and should be specified as Unused in the tabs labeled Service 1, Service 2, and Service 3.

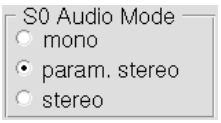
8. The Stream ID radio buttons select the mapping between DRM Services and DRM Streams. Leave Service 0 in Stream 0, Service 1 in Stream 1, etc.

3.3.2.5.1 Audio parameters



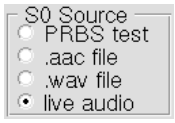
1. The Audio Coding group of radio buttons is designed to allow the user to choose between different audio coding algorithms. The choices are MPEG AAC, CELP, and HVXC. The DRM Content Server is capable of transmitting only in MPEG AAC.

2. The SBR flag is checked by default. SBR, or Spectral Band Replication, allows high audio frequencies to be recreated with sophisticated algorithms in the receiver. The DRM signal will sound best at the receiver when SBR is turned on. Fraunhofer originally created MPEG 4 AAC. Coding Technologies created the SBR extension to MPEG AAC.



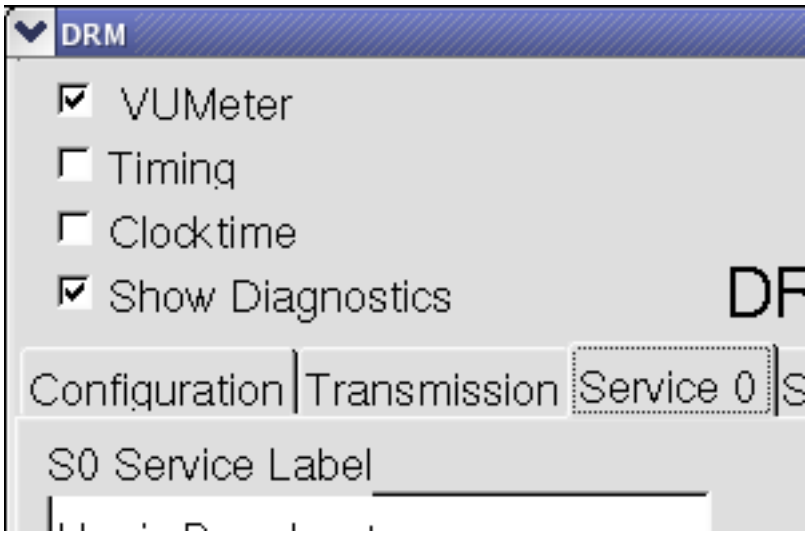
3. The Audio Mode group of radio buttons lets the user change whether the system is broadcasting in stereo, parametric stereo, or mono. Parametric stereo is not as good as stereo. It encodes the low frequencies for the left and right channels together. The high frequency sounds are encoded separately. This is because the human ear is not as directional for low frequencies. All three modes are enabled in this system.

4. The Audio Sampling Rate selection options are 8, 12, 16, and 24 kHz. Higher sample rates sound better. All of the sample rates listed can be used.

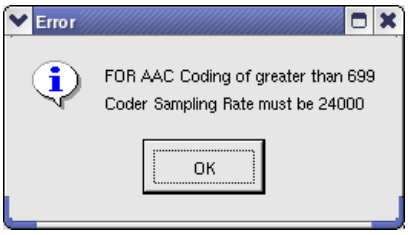


5. The Source selection should be set to “live audio”. Changing this option in the GUI will not affect the Content Server. This is because the since the script which runs the Content Server forces it to use live audio input unless it is started with an audio file, for instance, if a .wav file is dragged onto the icon for “DRM CS & GUI”. The .wav file must be in 48-kHz 16-bit stereo format.

3.3.2.5.2 Limitations

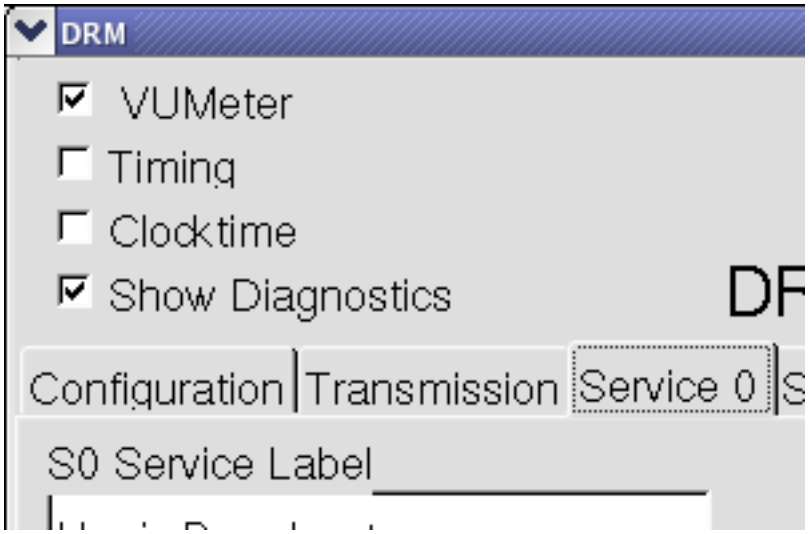


If the Show Diagnostics check box is enabled, the GUI will inform you of changes it has to make to the audio parameters.



Changes are made, for instance, if the Transmission tab has configured your DRM channel to have too few bytes available in every DRM frame for the high quality audio you are requesting. Then, the GUI will change your audio to the highest quality that is available for the bit rate you are have available.

3.3.2.6 CS Diagnostic and Status Output Options



The Timing check box enables and disables the display of timing information from the Content Server. Leave this box unchecked.

The Clock time check box enables and disables the display of the computer clock time on the output. It is also typical to leave this box unchecked.

If you check the VU Meter check box and press Send, you will see the audio level displayed in the Content Server window. You can check the audio level entering your DRM Content Server software audio encoder. It is important that you do this if you are using a live audio source.

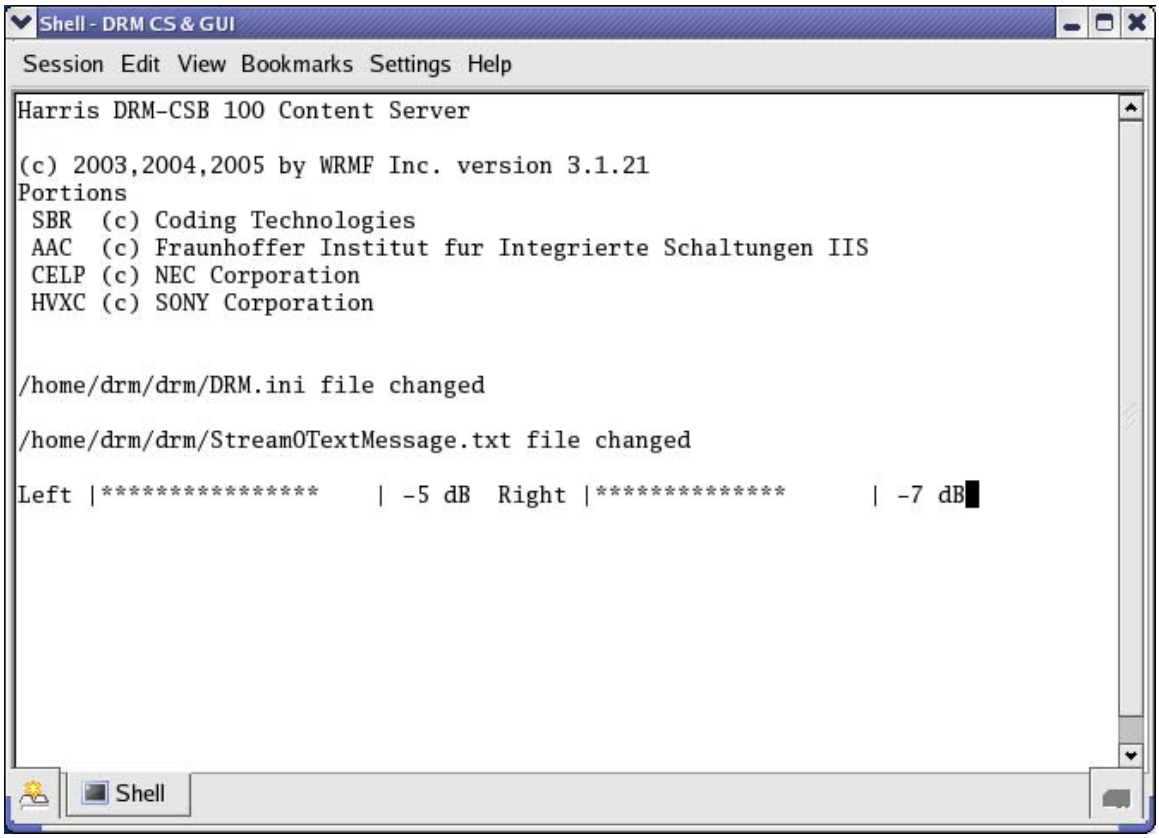
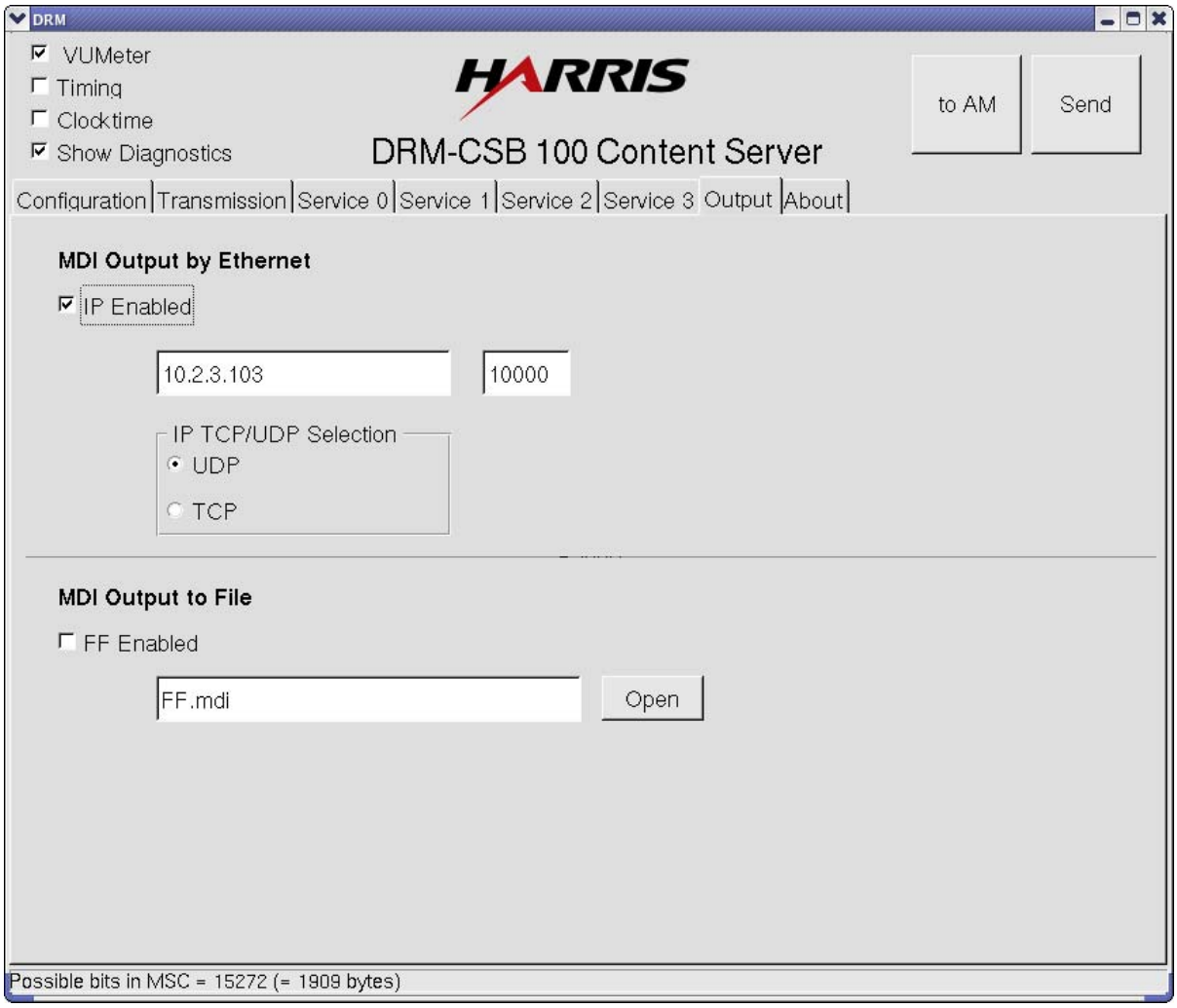


Figure 3-3 VU Meter output in Content Server window when VU Meter is enabled.

You will see asterisks in the Content Server output window indicating the audio level. To the right of the asterisks, you will see negative numbers. The closer these numbers approach zero and the more asterisks precede them; the closer your audio is to being clipped.

3.3.2.7 Output



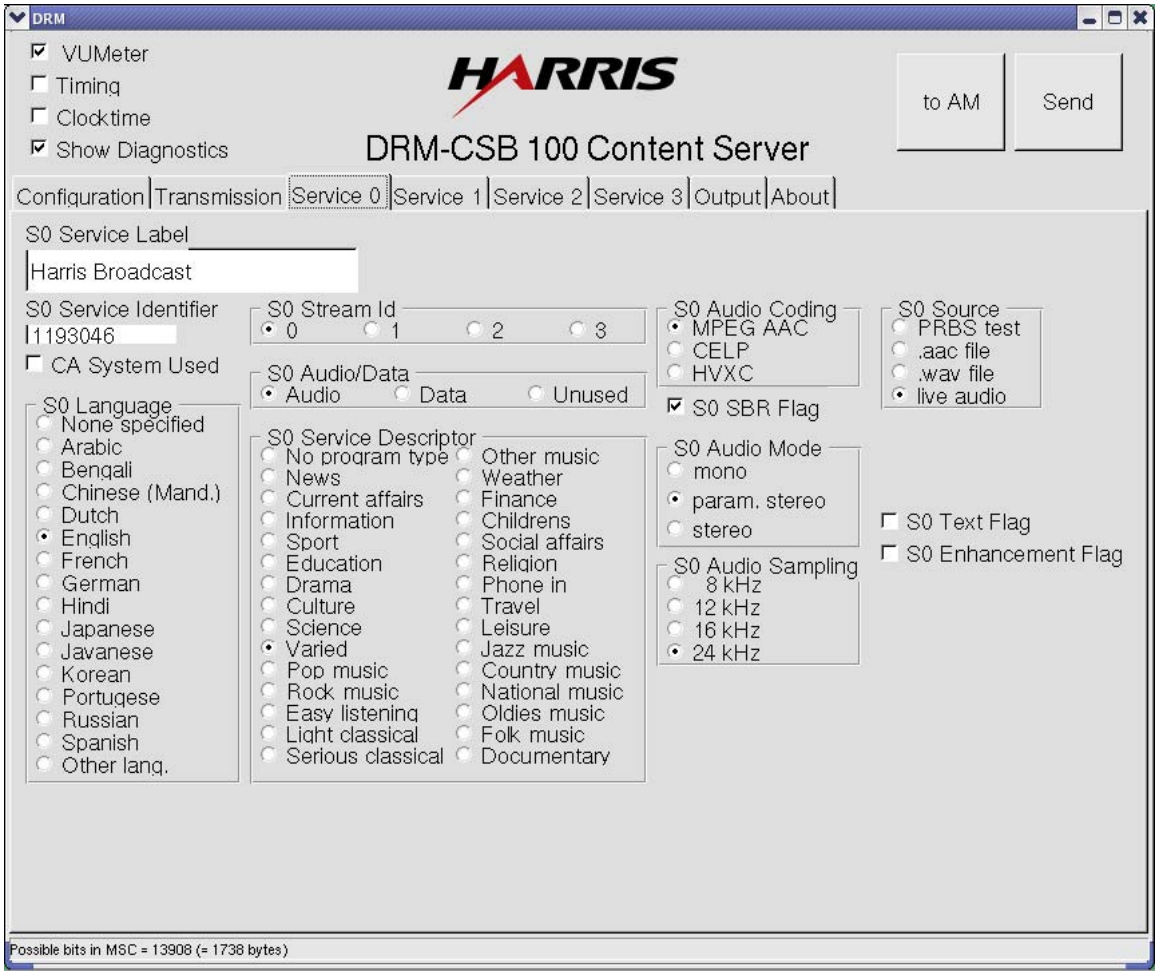
In order to use the Ethernet for the MDI connection between the Content Server and Modulator, you need to have the following set up:

- The “Ethernet 0” connection must be active
- The “Ethernet 0” connection must be connected properly to the DRM Modulator via a crossover cable, or standard Ethernet cables and a hub, switch, or a leased line
- You must have the DRM Modulator set to a known IP address (You can change the DRM Modulator’s IP address using the MCI software and connecting to the Modulator’s MCI serial port)
- The DRM Content Server should be able to access the DRM Modulator’s IP address, given its IP address and subnet mask. For instance, the default IP addresses used for Harris equipment are for the DRM Content Server to be configured to 10.2.2.x,

where x is the serial number of the system. The DRM Modulator would be configured to 10.2.3.x, where x is again the serial number. For example, for serial number 103, the DRM Content Server is at address 10.2.2.103, and the DRM Modulator is at IP address 10.2.3.103. The DRM Content Server uses a Subnet Mask of 255.255.0.0.

- Disconnect the DRM Content Server MDI serial connection to the DRM Modulator
- Set the DRM Content Server GUI to output MDI data via the Ethernet:
    - The IP address you select here should be the IP address of the DRM Modulator. The default value is 10.2.3.x, where x is the serial number. For example, for serial number 103, the default value is 10.2.3.103. The UDP port number should be the same port number as you set in the MCI for the DRM Modulator to listen on. The default UDP port is 10000 (ten thousand).
    - At this point, TCP is not supported by the DRM Modulator and should not be used. Only UDP should be selected.
    - Once you save your Content Server GUI Ethernet settings to the INI file by pressing the “Send” button, please close the Content Server and Content Server GUI and restart them. Then, your new Ethernet settings will be used.
    - Do not use the “MDI Output to File” option unless you need the Content Server to be generating a large file that shows the output of the Content Server for compatibility testing or development. Otherwise, always keep this option disabled.

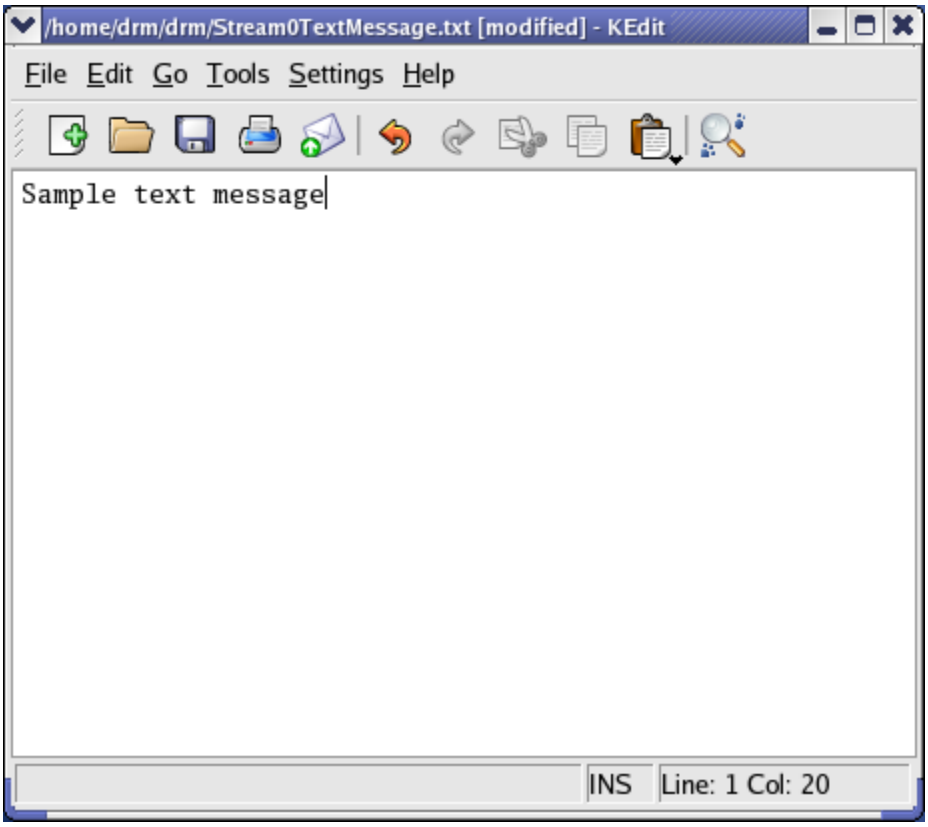
3.3.3 Text Messages



The Text Flag check box enables the transmission of text messages. The Text Flag check box is in the Service 0 tab of the GUI.

To change which text message is transmitted, click on the notebook and pencil icon labeled “DRM Text Message”.

A window will appear with a simple text editor allowing the user to edit the text message. The file will be saved as /home/drm/drm/Stream0TextMessage.txt.



When you save the file, the new text message will begin to be transmitted by the DRM Content Server. Longer text messages will take slightly longer to transmit. Typically, once an entire message has been transmitted, it will appear on the display of the receiver. It may remain on the receiver's display until a new text message is completely received.

Text messages can be 128 characters in length. Most receivers display that message on 7 lines. Each time you change the message and save it the CS will detect that change and begin transmitting the new message. If you have an automation system that automatically generates messages those may be copied via LAN using a script which will secure copy to the file /home/drm/drm/Stream0TextMessage.txt. This will require knowing the user account name which is *drm* and the user password which is *harrisdrm*.

Text messages on the Content Server can be updated over its Ethernet ports. Make sure that you use an SSH client that is capable of transferring files, such as WinSC (WinSCP is available from http://winscp.net/ or http://winscp.sourceforge.net/).

3.4 Modulator Control Interface (MCI) Software

This application controls specific parameters the optimize the DRM signal generation. These are modulator and transmitter specific and not part of the DRM specification. To start the MCI select the desired desktop and click the MCI icon on the task bar at the bottom of the screen. The icon looks like a heartbeat monitor display.

Then, the MCI main dialog box should appear.

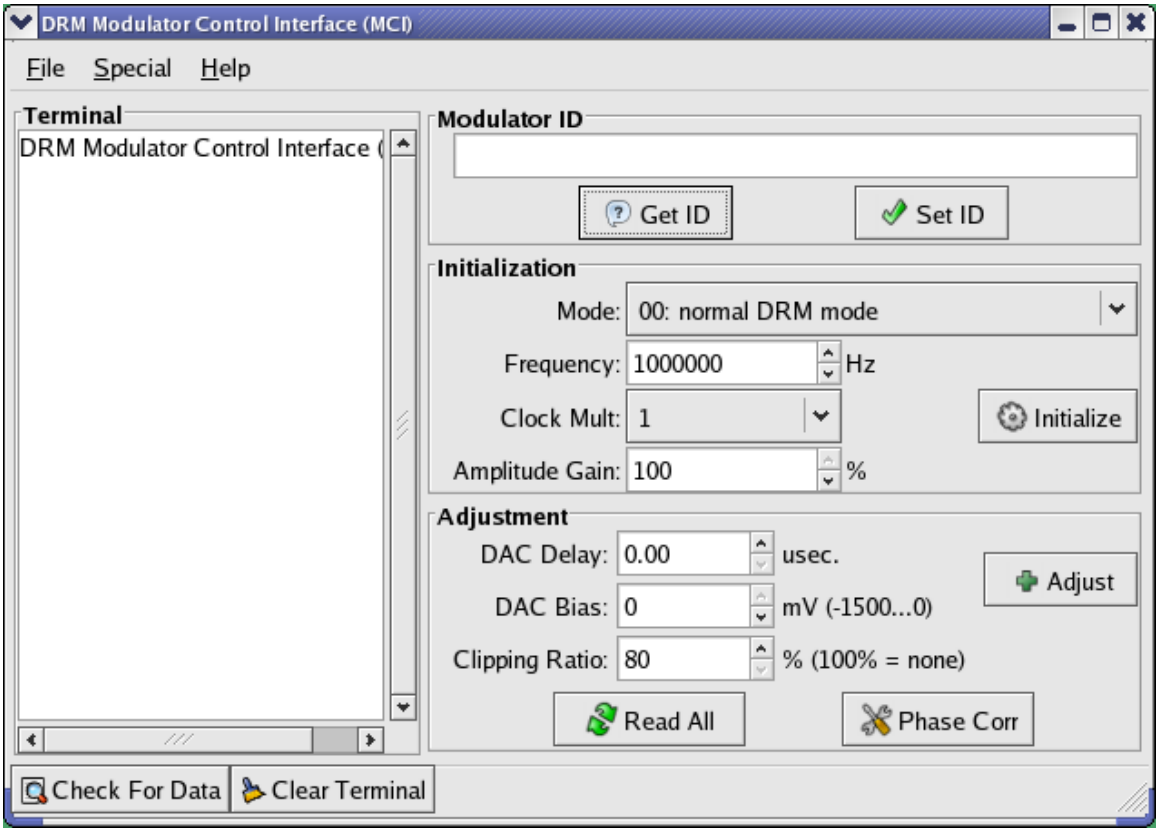


Figure 3-4 MCI after initial startup

From this screen you must enter in the transmitter's carrier frequency in Hz. It should match the frequency in kHz that is set on the switches on the DRM Modulator board. Under the Mode section select the down arrow and scroll down to Mode 22.

On the DAC Delay section, use the up arrow to select 10.56 as a starting point. On the DAC Bias section, use the down arrow to select -1250 as a starting point. On the Clipping Ratio section, use the up arrow to set it to 100.

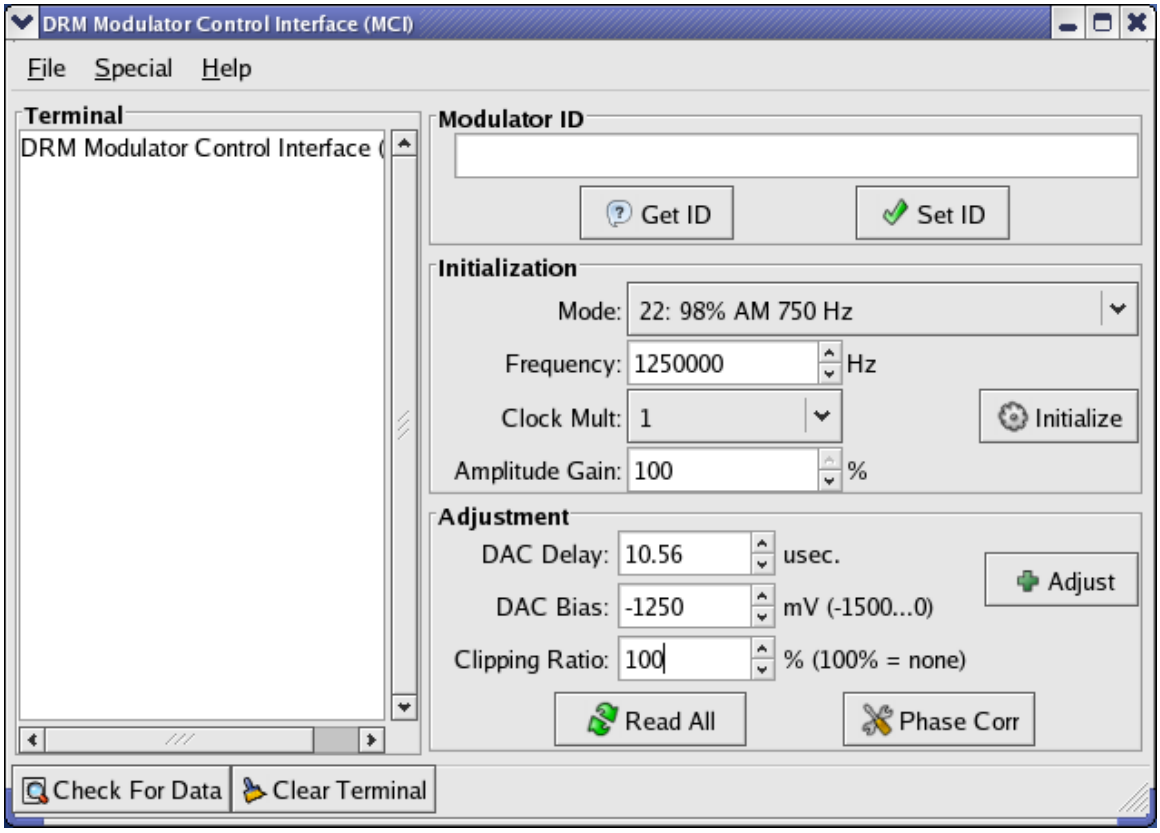


Figure 3-5 Example of having entered initial settings into the MCI before sending them to the Modulator

Later, you must change DAC delay, DAC bias, and phase correction coefficients. These will be different but similar for each transmitter that rolls off the assembly line.

The time delays in the RF and envelope paths to the modulated amplifier have to be equal within 1 sec. Transmitters normally have significantly more delay in the audio section than in the RF. Using the DRM MCI Program, the Modulator can be set to compensate for delay differences from 0 to 165 sec in 0.33 sec steps. It also can compensate for time delay variation of up to 5 sec over the audio frequency range.

Another common transmitter problem is IPM (incidental phase modulation). Even with constant drive phase, the phase of the RF output varies with the output voltage amplitude. The most abrupt variations appear as the output approaches 0 (100% negative modulation in AM) The Modulator can generate an AM carrier, 98% amplitude modulated with a 750 Hz sine wave for use with an external RF Phase Meter to test this. The MCI program permits the operator to compensate for IPM at 25 points over the range from 0 to peak output.

3.5 Turn On the Modulator Chassis

Remove the top cover on the Modulator Chassis. When all connections have been made and the Content Server and Modulator Control Interface are running, turn on the modulator with the rear panel switch.

If the DRM Modulator Board is creating a DRM signal, two green LED lights near the ribbon cable connector on the DRM Modulator / Exciter board will flash continuously. They are labeled DL2 and DL3.

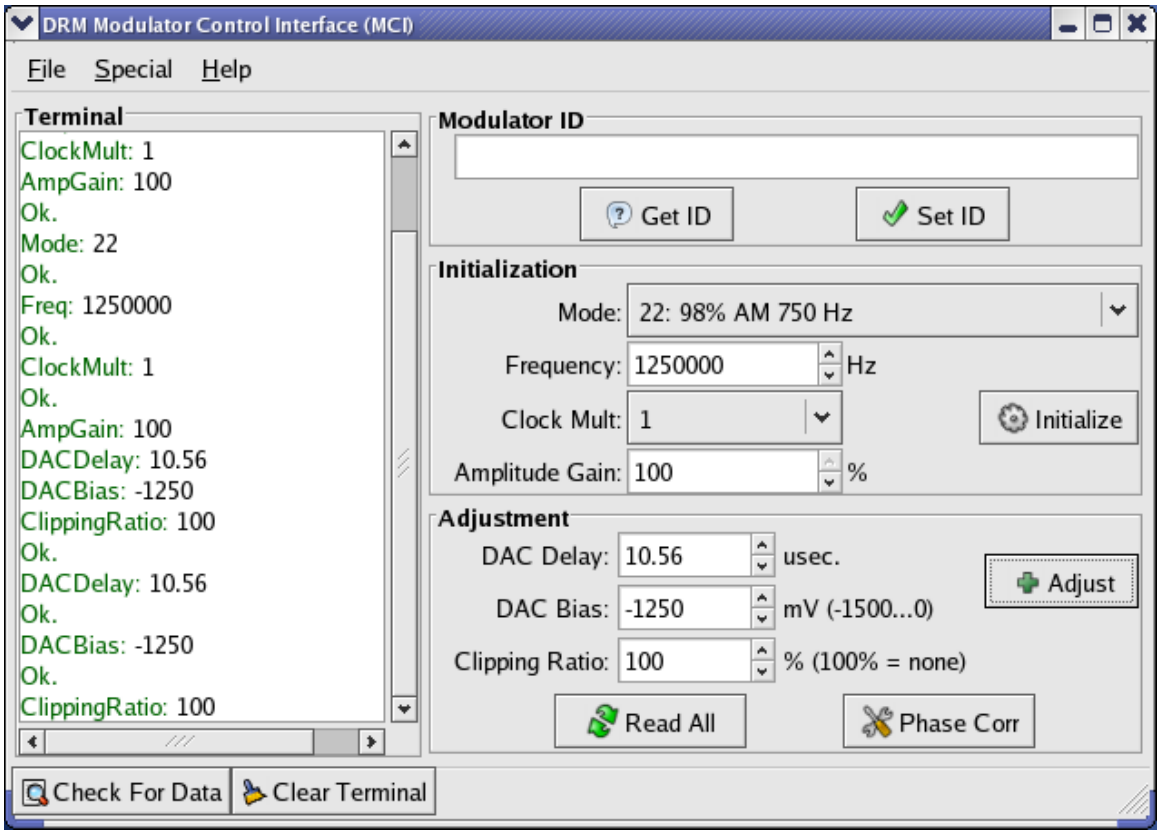


Figure 3-6 After pressing "Initialize" and "Adjust" to send initial settings to Modulator

On the Modulator Control Interface PC click the "Initialize" button that is next to the mode selection window. Click "Adjust" button as well. If the system is in communication these parameters should be visible on the screen.

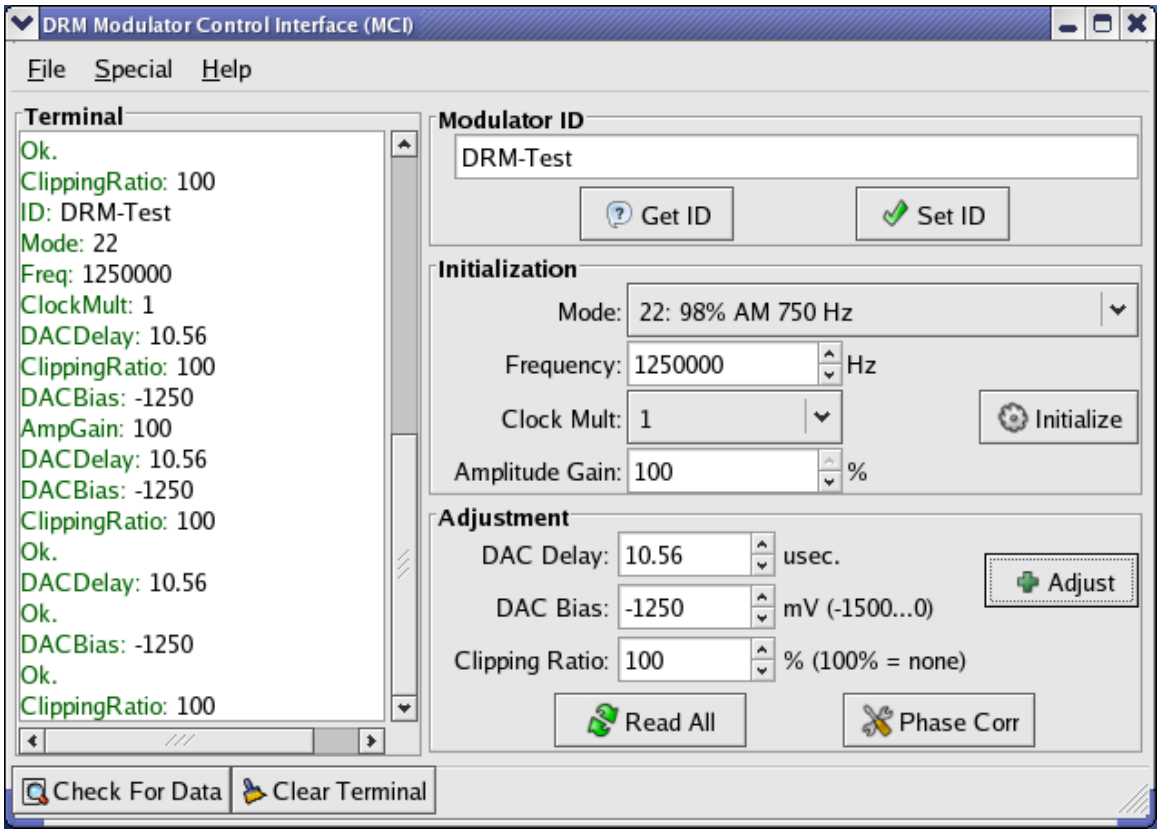


Figure 3-7 Successfully read back parameters from Modulator with "Get ID" and "Read All", and reapplied them with "Adjust"

Press the "Get ID" and "Read All" buttons to load the transmitter ID and parameters from the Modulator memory and display them in the Modulator Control Interface. Apply your changes with "Adjust". They will be transmitted over the serial cable and saved to the RAM in the DSP chip on the DRM Modulator Board.

3.6 Transmitter Optimization

There are three critical adjustments that can be set by the Modulator Control Interface to compensate for the characteristics of a specific transmitter.

a. Setting of the DC Bias corresponding to zero output (the reference level for DRM amplitude signals). With a DX Series transmitter, this is approximately set by turning the "maximum power" (carrier level) control to minimum. Fine adjustments can then be made by setting the DAC Bias parameter in the Modulator Control Interface (MCI)

b. Nearly all transmitters have more delay in the amplitude (audio) signal chain than in the RF signal chain. The difference can vary from a few microseconds for the DX series to approximately 120 microseconds for the DAX series transmitters.

Compensation for the difference is set with the “DAC Delay” parameter in the MCI. An error of as little as 1 microsecond will noticeably degrade a good spectrum. This is adjustable in steps of 1/3 microsecond.

c. All transmitters also have a phase shift in the final power amplifier that varies with the RF level (modulation). To read and adjust the compensation for the amplitude dependent phase shift, click on the Phase button of the Modulator Control Interface. This opens a window called Phase Correction Coefficients.

In DRM mode, in the DX Series transmitters, the transmitter “Audio Gain” becomes the average and peak power control, and “Maximum Power” sets the bias level.

3.6.1 Preliminary Setup, Power and Bias

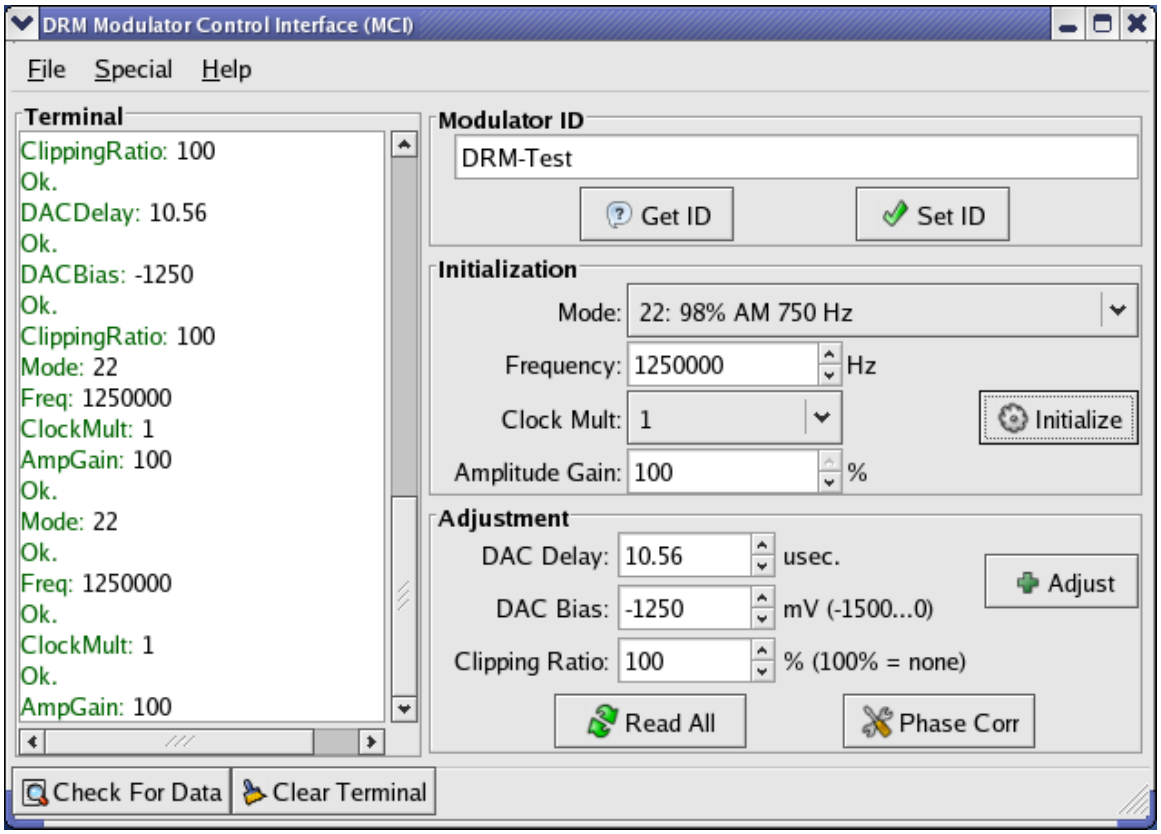


Figure 3-8 Modulator set to Mode 22 (AM Carrier modulated with a 750 Hz audio tone)

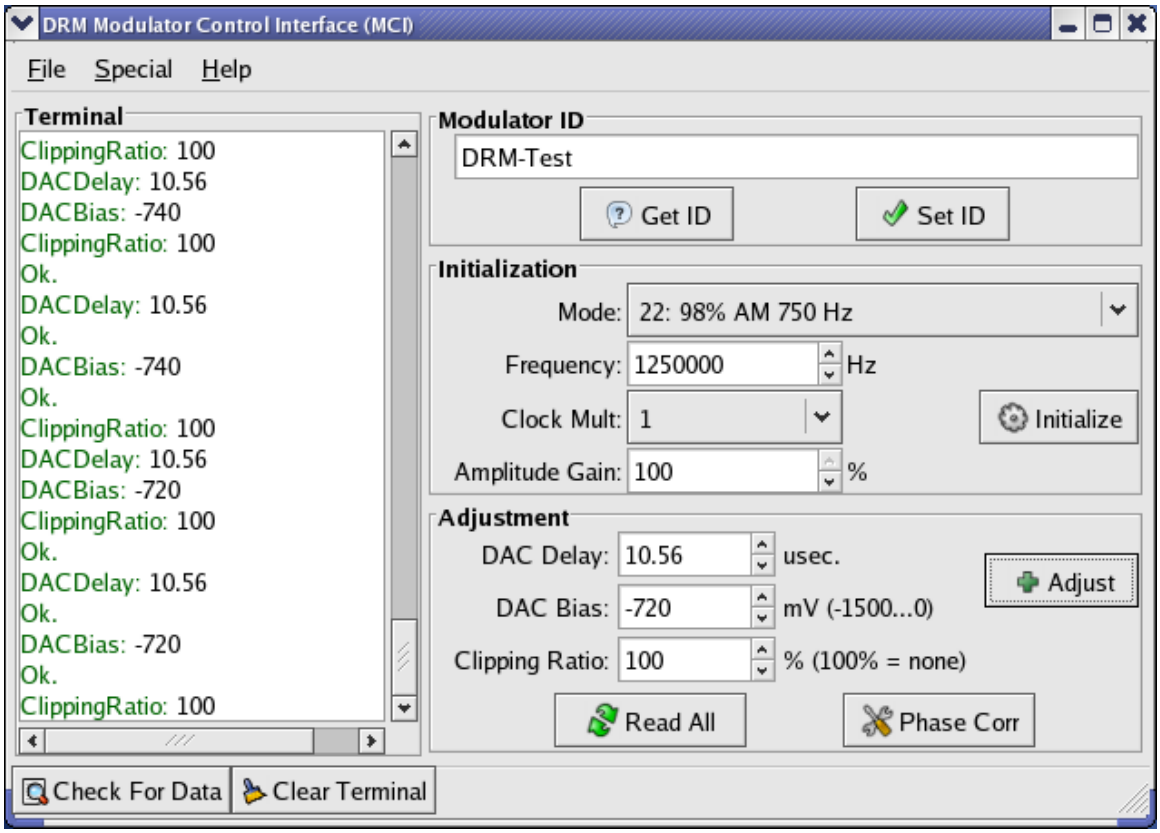


Figure 3-9 Adjusted the DAC Bias to approximately correct level.

1. Set the “mode” on the MCI to mode 22, carrier with “98% AM 750 Hz.” Adjust the “Audio Gain” control for the desired AM mode power as indicated on the transmitter “Output Power” meter. Using an oscilloscope or modulation analyzer, adjust the DAC Bias so that the negative peaks are at approximately –98% modulation (just above the clipping level). While making this adjustment it will probably be necessary to re-adjust the “Audio Gain” control to maintain the desired carrier power. This sets the DAC Bias to approximately the correct level for DRM operation and the peak power in DRM mode will now correspond to approximately 125% positive peak modulation (the designed peak output of the transmitter).
2. The “Output Power” meter on the DX, and most other transmitters, indicates average (carrier) RF output voltage converted to power in kilowatts. It therefore measures the carrier power in normal AM transmission and deliberately ignores the sideband power. It does not give a useful indication of average power in DRM mode.

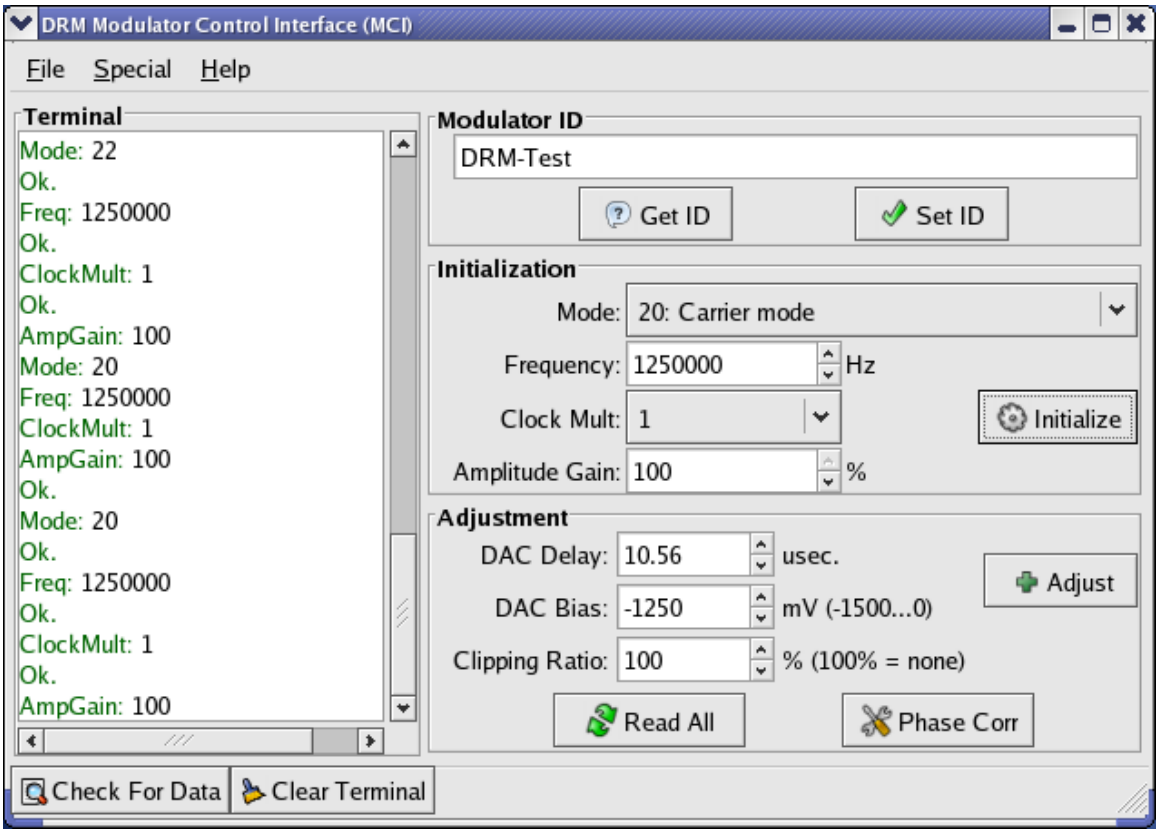


Figure 3-10 Modulator now set to AM Carrier only (Mode 20)

3. Since the DX transmitters operate at nearly constant efficiency over the modulation cycle, the front panel “DC Amperes” is the best indication of average DRM power output. For an approximate calibration of power vs. amperes, put the MCI in Mode 20 (Carrier only). Using the “Low”, “Medium” and “High” Power Level push buttons on the transmitter, record the DC current and Output Power for each level. A plot of Amperes vs. Power will be a nearly straight line intersecting the zero power axis at a few amperes (the driver current).

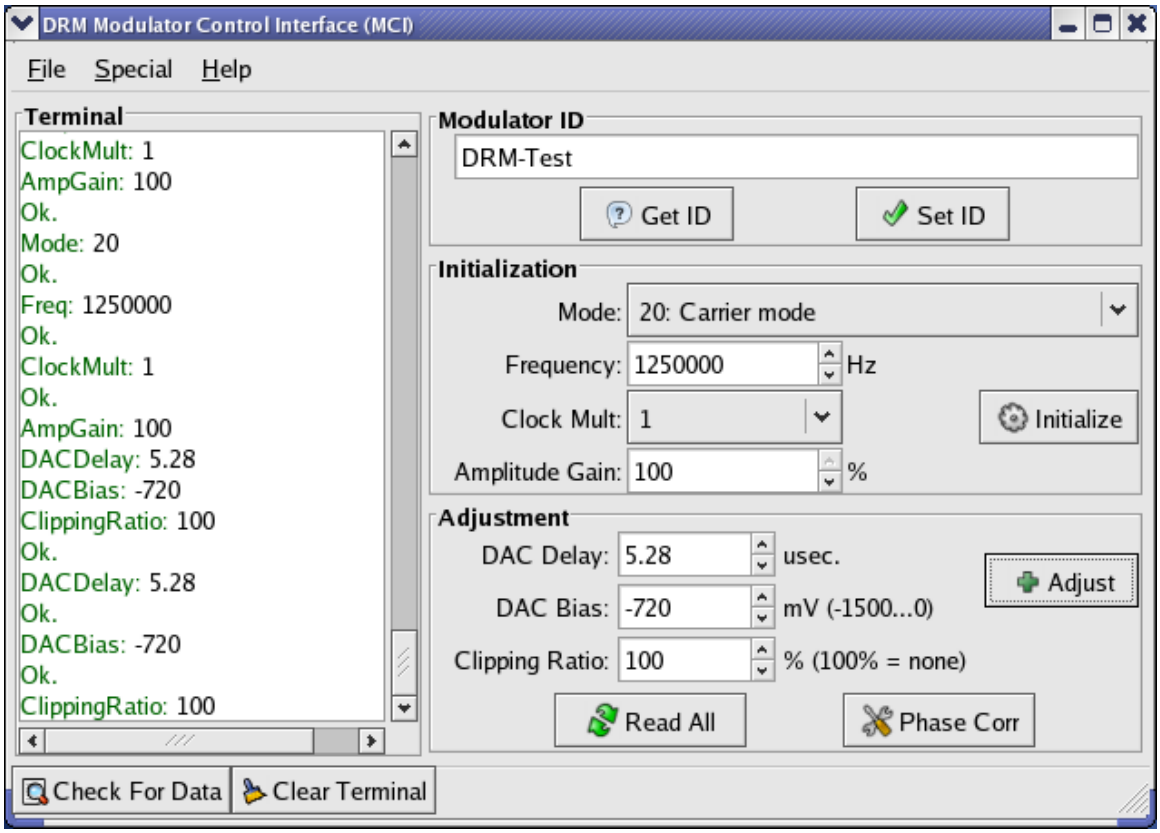


Figure 3-11 DAC Delay set based on transmitter design

4. If the amplitude channel delay for the transmitter design is known, set the MCI “DAC Delay” to this value. All MCI changes become effective only when the associated “Adjust” button is selected (for settings in the “Adjustment” area of the MCI) or the “Initialize” button (for settings in the “Initialization” area of the MCI).

3.6.2 Optimization

1. Connect a Spectrum Analyzer and Modulation Analyzer to the RF Sample output of the transmitter as specified in the DRM System Manual. The Spectrum Analyzer should be set for 100 Hz resolution. Be careful to connect the test equipment through the specified attenuators to avoid overload and possible damage to its input circuits. The RF Sample output level is about a watt of RF.

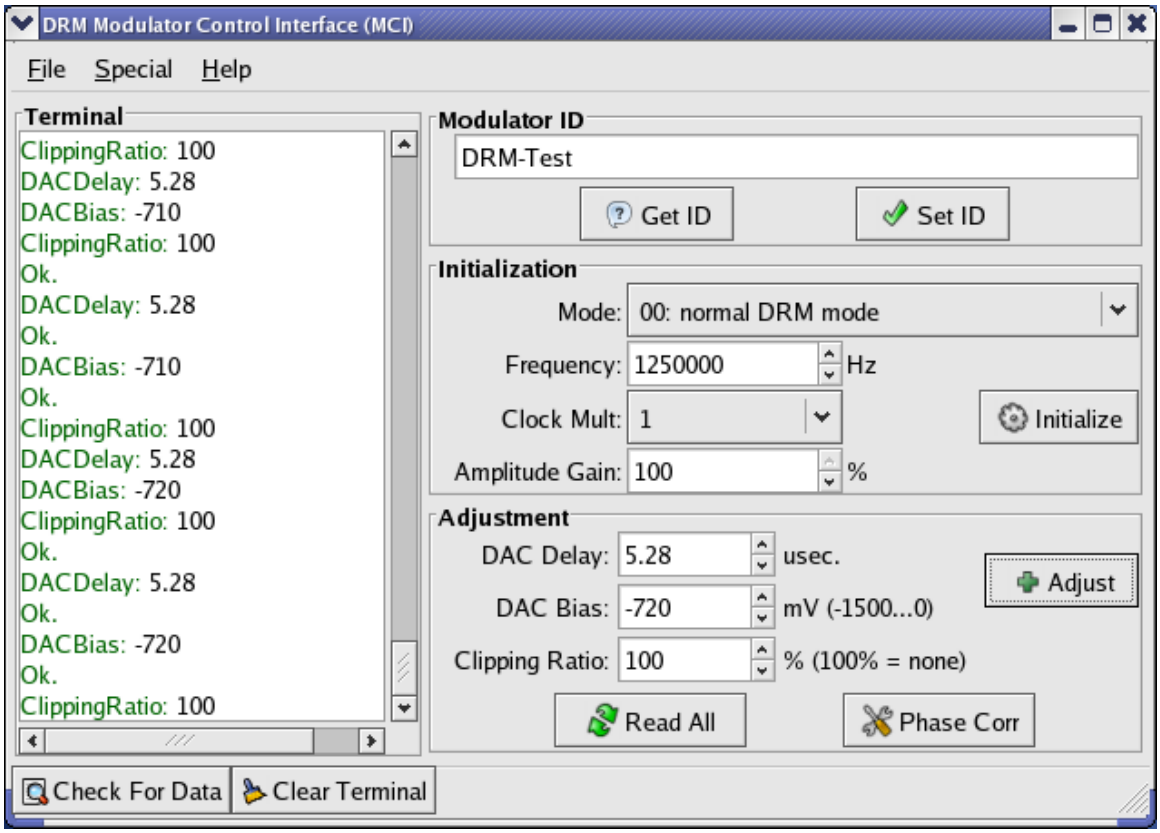


Figure 3-12 Adjusting DAC Delay and DAC Bias in Mode 0

2. Place the Modulator in Mode 0, normal DRM Mode and send data to it from the Content Server. If the Content Server is unavailable, use the MCI to select one of the PRBS (pseudo random binary sequence) test modes available in the Modulator which closely approximates the desired operating mode of the transmitter.
3. Adjust the DAC bias (using the MCI) for minimum out-of-band (OOB) noise from 10 to 25 kHz to each side of the desired output on the spectrum analyzer. Start with about 100 mv. steps. Best results will usually be obtained with a bias 100 to 200 millivolts more negative than that used in the AM modulation test. As the bias is changed, the OOB noise will decrease and then start to increase again. On the first iteration the minimum may be quite broad. Leave this control at the minimum.
4. Adjust the DAC delay also in approximately 1 sec. (microsecond) steps for minimum OOB noise.
5. Repeat steps 3 and 4, using smaller steps until both minima are sharp. The noise at 25 kHz each side of the center frequency should be about 60 to 65 dB below the in-band signal level.

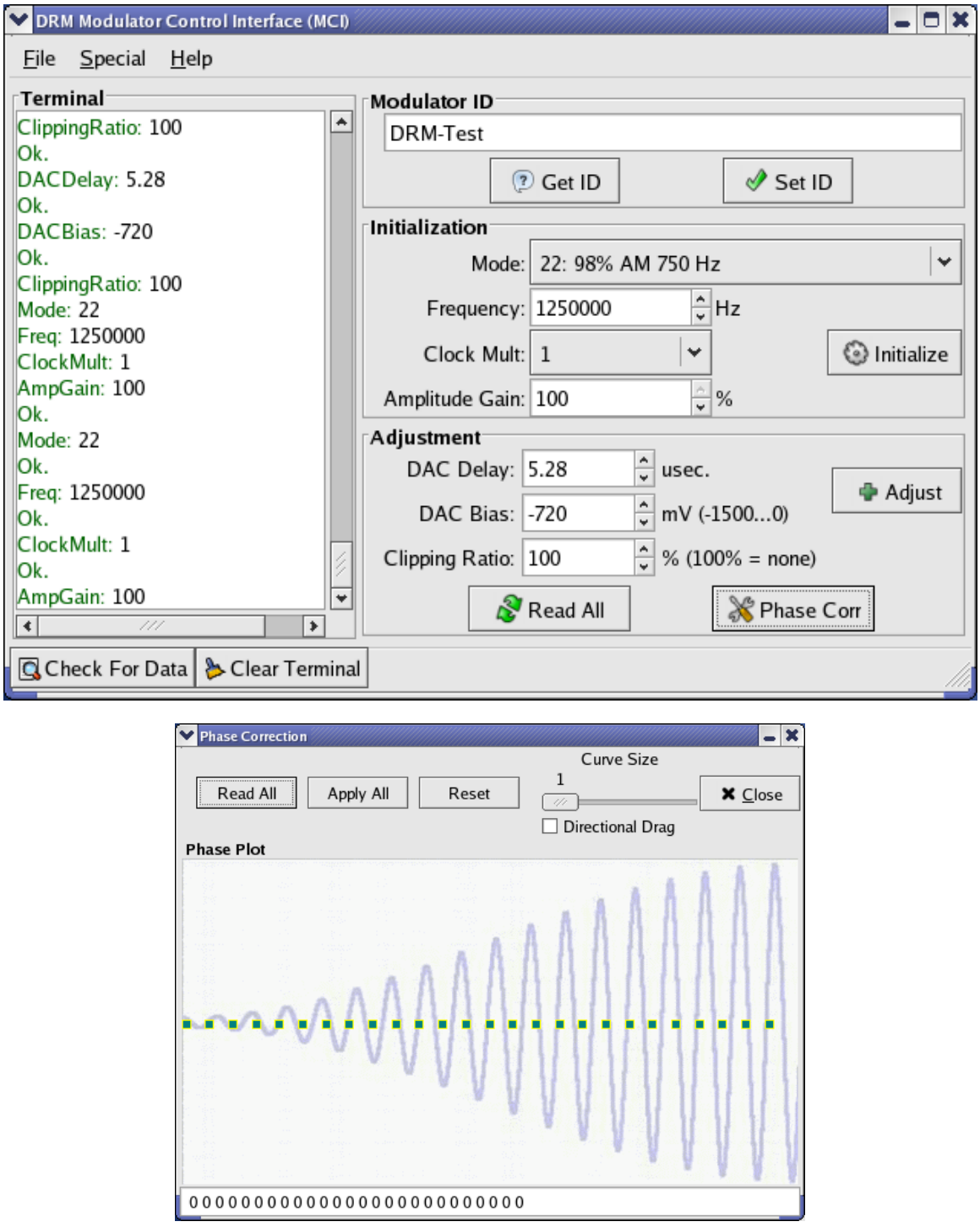


Figure 3-13 Modulator set to Mode 22 with MCI Phase Correction window opened

6. Place the Modulator in AM Mode 22 and activate the Phase Corr button of the MCI. This opens another program window with a graphical presentation of the IPM (amplitude dependent Incidental Phase Modulation) correction. Adjust the bias until the negative modulation is between 96% and

98% as indicated on the Modulation Analyzer or an oscilloscope. Set the Modulation Analyzer to detect phase modulation and feed its demodulated signal output to the oscilloscope. The oscilloscope sweep should be synchronized to the demodulated AM or the Amplitude output of the Modulator. The Analog Input circuit board of the transmitter also has audio testpoints which can be used as sync signals.

7. If the RF signal on negative peaks is too small the Modulation Analyzer will lose its lock on the carrier and give an unstable display. Slightly more positive bias will usually correct this. The objective of this adjustment is to make the output phase as constant as possible over the amplitude range covered by the AM modulated signal.

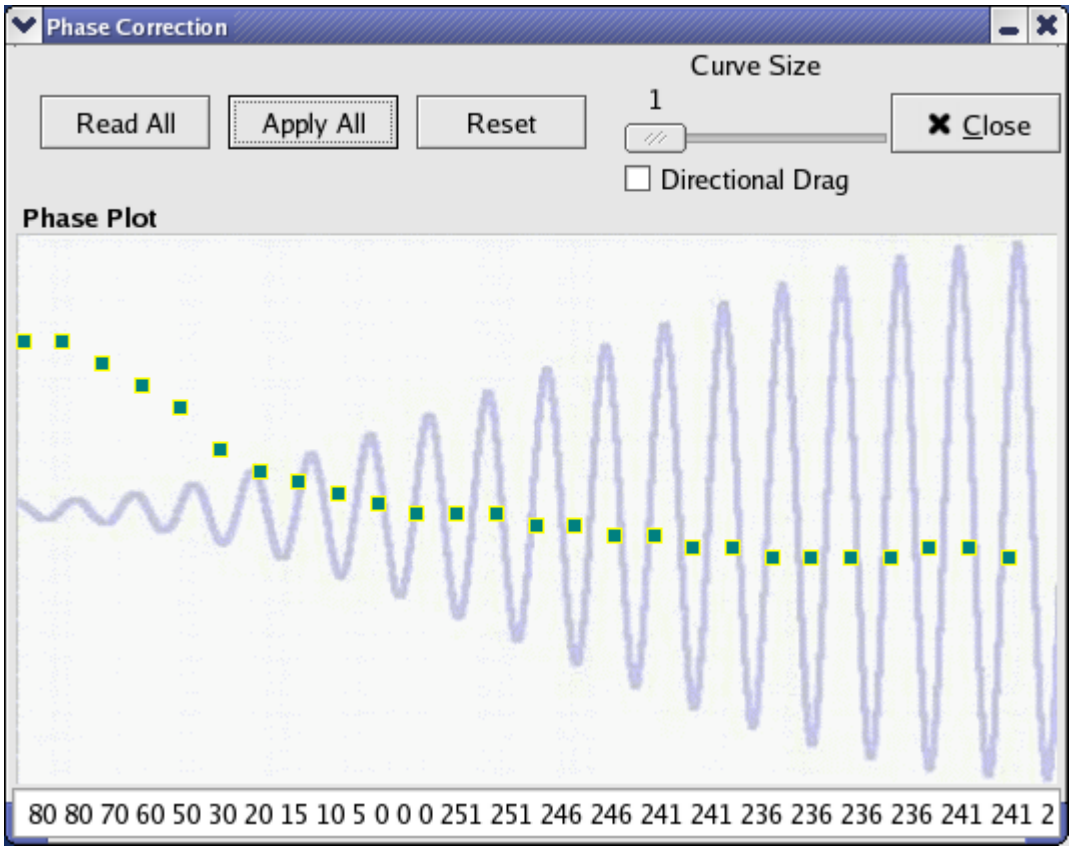


Figure 3-14 IPM correction window showing generic DX series curve

8. The default compensation in the Modulator may have been set during testing by saving parameters to the flash. If you have recently updated your firmware, the firmware version will contain some version-specific default compensation values. It can be read by selecting the Read All button in this window. You can start with this curve, or set all compensation to zero (with the Reset button), and then vary the compensation using the mouse or touchpad of the MCI computer. A generic DX series curve is: 80, 80, 70,

60, 50, 30, 20, 15, 10, 5, 0, 0, 0, 251, 251, 246, 246, 241, 241, 236, 236, 236, 236, 241, 241, and 236. Changes become effective only when the Apply All button is selected.

9. As indicated by the background waveform in the window, sliders to the left affect the phase near the RF minimum, and those to the right near the maximum. Those at the extreme right correspond to amplitudes above the peak of the test signal and should be set to the same value as the last one that affects the measured phase.

10. If a modulation analyzer is not available, a more tedious method is to adjust the phase compensation to minimize the amplitude of the phase modulation products at +/- 1500 Hz from the carrier frequency.

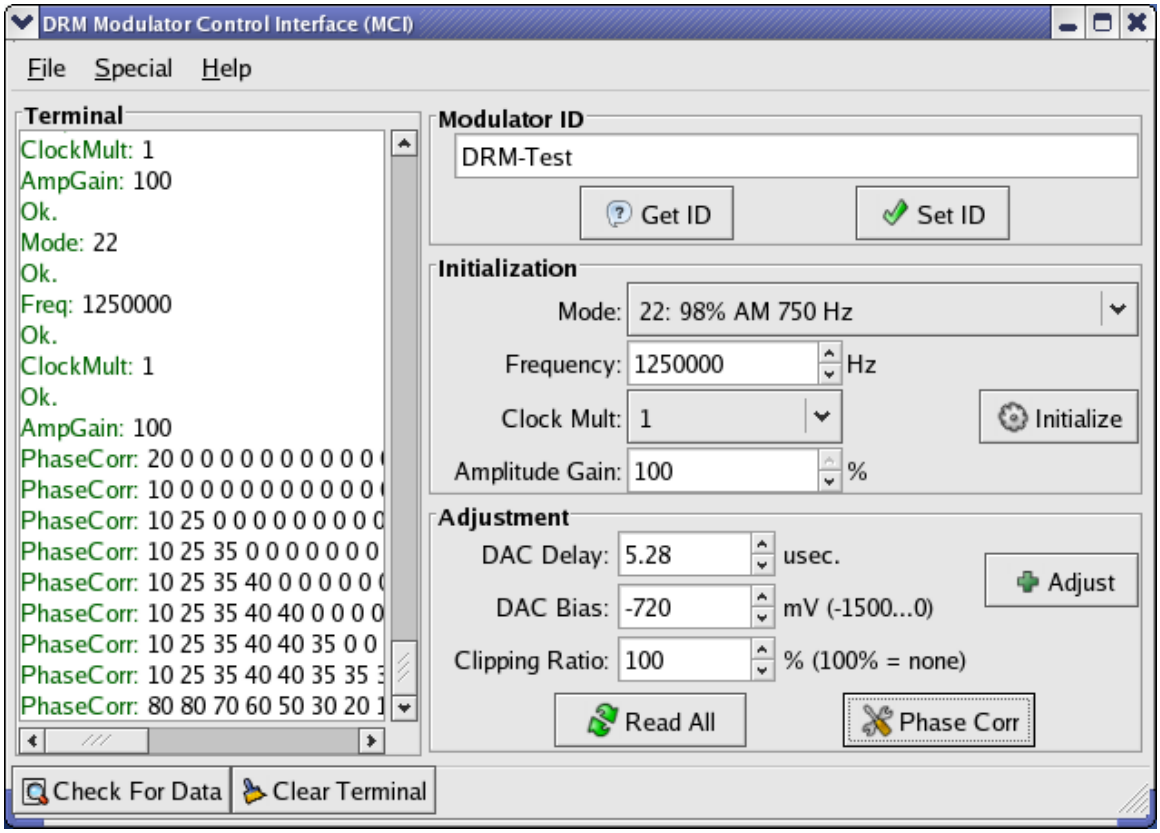
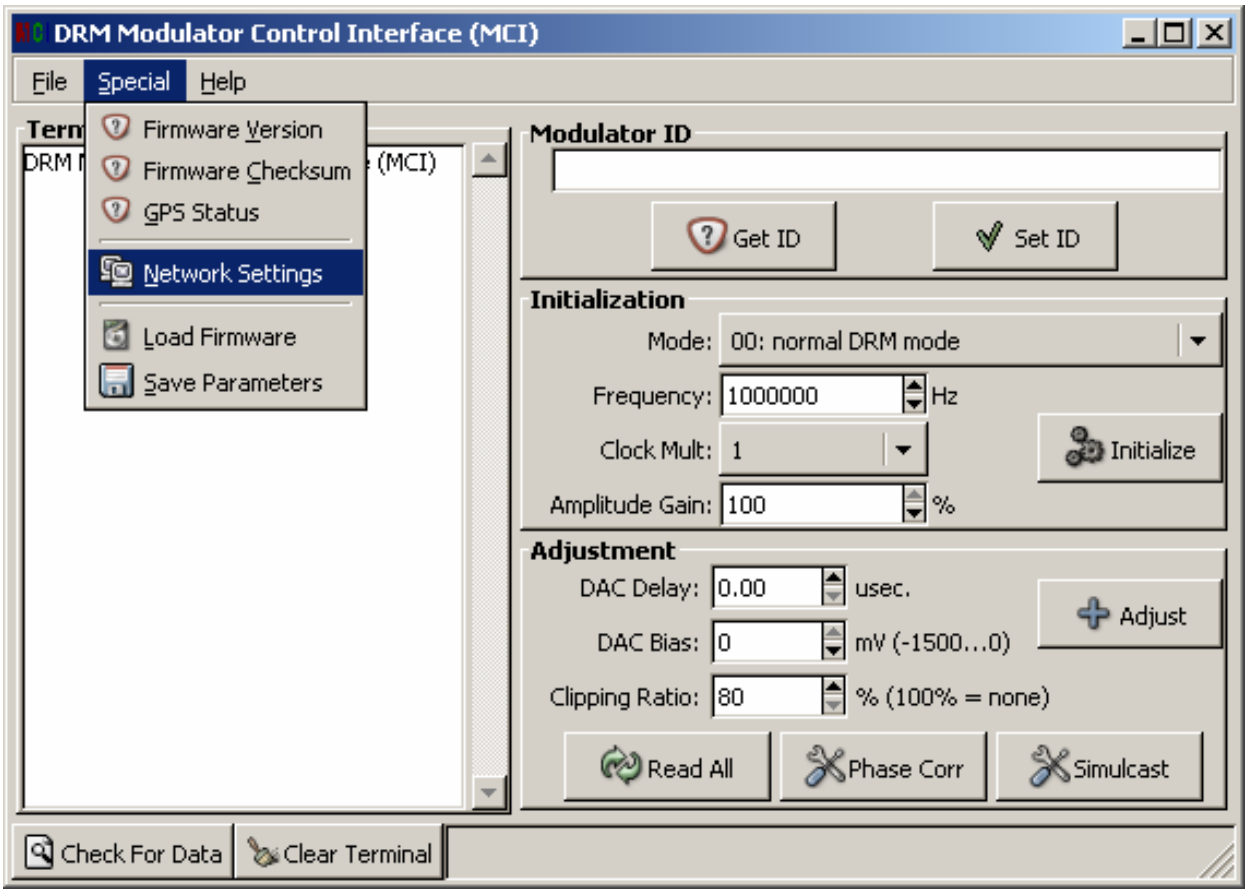


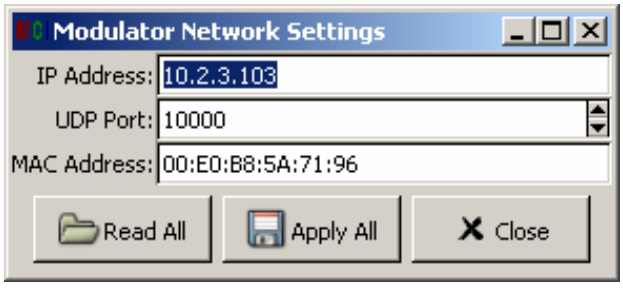
Figure 3-15 MCI main window after Phase Correction window closed

11. After adjusting and applying the IPM correction, close this window by selecting Close and repeat steps 3 and 4 as required.

3.7 Network Settings

The DRM Modulator is always setup via serial port from the MCI program. Its "Special" menu contains an entry that allows you to set the Ethernet IP address, port number, and MAC address for the DRM Modulator. These settings affect what IP address the DRM Modulator occupies on the Ethernet network. If you change these settings, make sure you also change the Content Server GUI "Output" tab to send to the new Ethernet address and port number (if you do not use the Ethernet port on your DRM Modulator, ignore these settings).





WARNING: Disconnect primary power prior to servicing.

If you know what you are doing, you can change the IP address and UDP port of your DRM Modulator. You might do this if you are integrating your DRM system into a local network, or want to configure it to work with an existing router or routers. Harris DRM Modulators are shipped with the IP addressing scheme 10.2.3.x, where x is the serial number of your DRM Modulator board. For example, 10.2.3.103 is the IP address of the DRM Modulator board having serial number 103.

The port number referred to here is the UDP port number that the DRM Modulator will listen on for MDI packets. Valid port numbers are 0 through 65535. It is advisable to use a high port number, for example, somewhere in the range from 2000 (two thousand) to 30000 (thirty thousand). The default port for Harris DRM equipment is 10000 (ten thousand).

Do not change the MAC address unless you have a good reason to do so. When changing the MAC address, be sure that you do not conflict with the MAC address of any other device on your network, or that could ever be connected to your network. (This is why you should not change the MAC address; you do not know what may be connected to your network in the future. Manufacturers are required to ship equipment with unique MAC addresses.) The following MAC addresses are invalid: 00:00:00: 00:00:00 and ff: ff: ff: ff: ff: ff.

Many people familiar with networking ask if the DRM Modulator needs to have a Subnet Mask or default Gateway set. The DRM Modulator does not have these settings because it does not access the Internet, and only sends ARP replies. Everything else it does is receiving ARP requests and UDP packets.

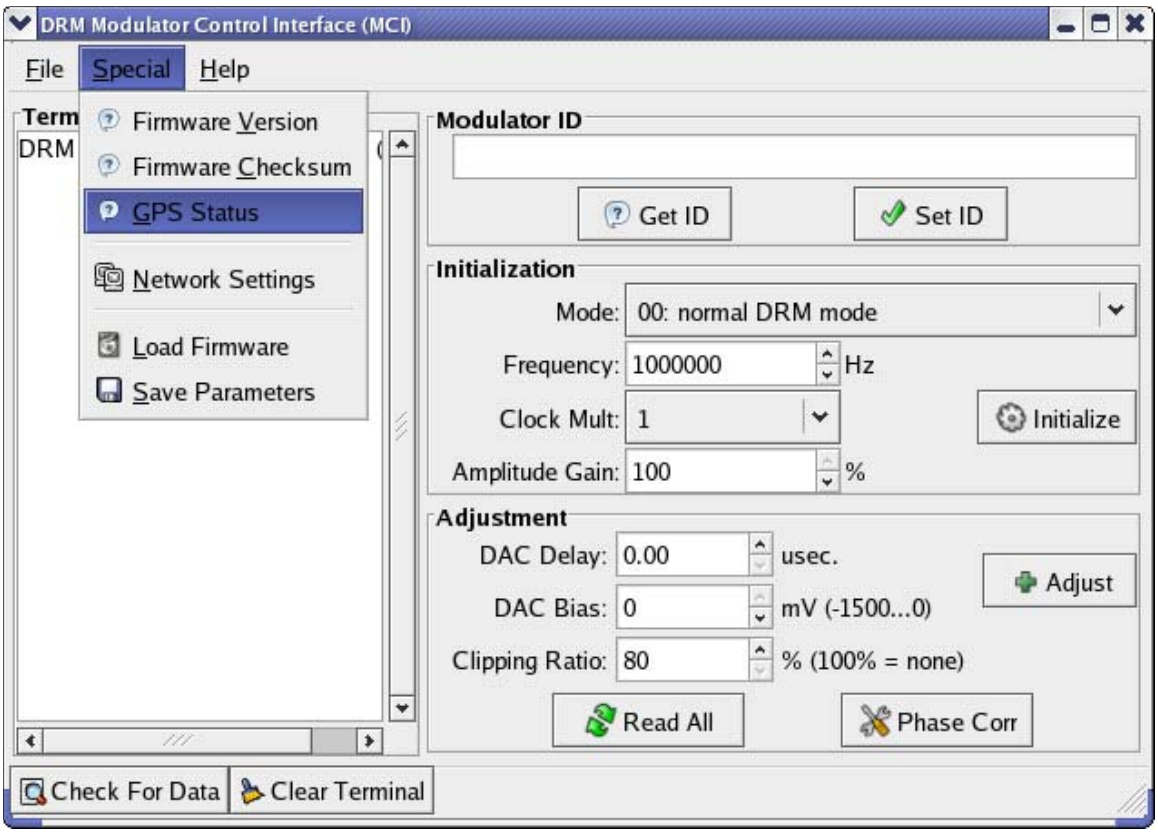
3.8 GPS Status

The DRM Modulator firmware (starting with version 1.02) is capable of communicating with a GPS module mounted as a mezzanine board. The add-on module is the Motorola M12+ Timing Receiver. The GPS timing capability on the modulator is used to trim the local oscillator. Trimming the local oscillator allows the broadcast frequency to be right on target. It also keeps the DRM Modulator from operating too slow or too fast in its digital broadcasting.

More critically, GPS synchronization keeps the DRM Modulator from operating too fast or too slow in consuming data from the DRM Content Server. If it were to operate too fast, the input would eventually (in several weeks or months) be consumed, and 1.2 seconds of audio would be repeated once on the air. If it operated too slowly, 1.2 seconds of audio would be skipped.

Single-Frequency Networks (SFNs) require that several Modulators can be fed the same DRM MDI stream. Despite propagation delay from the common Content Server, each modulator can use the “transmit timestamp” present in the MDI stream to compare with GPS time in order to begin broadcasting that DRM data at precisely the same moment as all of the other DRM Modulators in the Single-Frequency Network. This requires 10 seconds of buffering DRM MDI data in the DRM Modulator, and is not implemented on this version of the DRM Modulator.

When the DRM Modulator is first turned on, the GPS receiver module will take up to 200 seconds (typically) to get a good fix on GPS satellites. You can query the GPS status by using the Special / GPS Status menu entry in the MCI.



An example output during normal operation could appear as follows:

GPS Status: Antenna Status: Antenna OK (normal)
GPS Status: Receiver Status: 3D Fix (normal operation)
GPS Status: Visible GPS Satellites (5-12 is normal): 9
GPS Status: Tracked GPS Satellites (5-12 is normal): 9

You may notice that when you first turn on the Modulator, the number of satellites listed as “Visible” may be zero for several minutes. This is normal. The number of satellites listed as “Tracked” is more important. The DRM Modulator will not adjust the onboard oscillator trim unless all of the following conditions are met:

- A Content Server input must be connected
- “3D Fix” must be obtained by the GPS receiver
- GPS Receiver antenna status must be reported as “OK”

If those conditions are all met, the DRM Modulator will automatically clock its local oscillator using the GPS timing information.

3.8.1 Resolving GPS problems

The **GPS Antenna** status can be returned as any of the following:

- Antenna OK (normal)
- Antenna Overcurrent (short)
- Antenna Undercurrent (open circuit)
- Connector problem to GPS receiver – not receiving antenna bias voltage from DRM Modulator board.
- Unknown

If you receive the “Antenna Undercurrent” error, please make sure that your antenna is connected. If it is overcurrent, check that the cable is not crushed. If you suspect a problem with the cable, try using a short length of cable between the GPS antenna and the corresponding connector on the DRM Modulator.

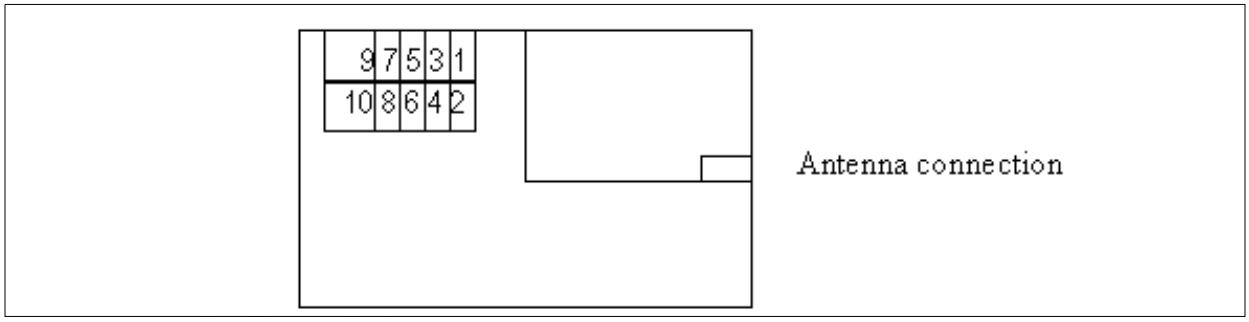
Please make sure to place your antenna in a location where a clear horizon-to-horizon view of GPS satellites can be obtained. Otherwise, for example, if you just set your antenna on a ledge inside a window in a metal building, you will probably only get a 2D fix, but spend a lot of time in Acquiring and Bad Geometry. The GPS system on your DRM Modulator would be ineffective. Instead, with the antenna mounted outdoors or just underneath a wide skylight, it should be possible to obtain a 3D fix, with, for example, 9 of 9 satellites visible being tracked.

The **GPS Receiver** status can be returned as any of the following:

- Reserved
- Bad Geometry – GPS antenna needs a better view of the sky: not just a patch overhead, but horizon-to-horizon
- Acquiring (starting up normally)
- Position Hold
- Propagate Mode
- 2D Fix
- 3D Fix (normal operation)
- No communication between DRM Modulator board and GPS receiver module.

Remove GPS module and check to see that its connector to DRM Modulator board still makes contact after shipment. Bend connector pins slightly if needed.

If you receive error messages about the DRM Modulator not being able to communicate with the GPS module or not receiving its bias voltage, please consider bending these pins on the GPS module:



1. Transmit data
2. Receive data
3. +3 volts DC
4. 1 pulse per second
5. ground
6. +2 volts to +2.2 volts DC battery voltage
7. +5 volts DC antenna bias voltage

Pins 1, 2, and 3 should be bent slightly if you receive the error “No communication between DRM Modulator board and GPS receiver module. Remove GPS module and check its connector to DRM Modulator board still makes contact after shipment. Bend connector pins slightly if needed.” This is common with brand-new never-used GPS receiver modules and just-assembled DRM Modulator boards. After shipping, the pins could become unbent, so this may need to be performed again.

Pin 7 should be bent if you receive the error “Connector problem to GPS receiver – not receiving antenna bias voltage from DRM Modulator board.”

3.9 Saving MCI Settings.

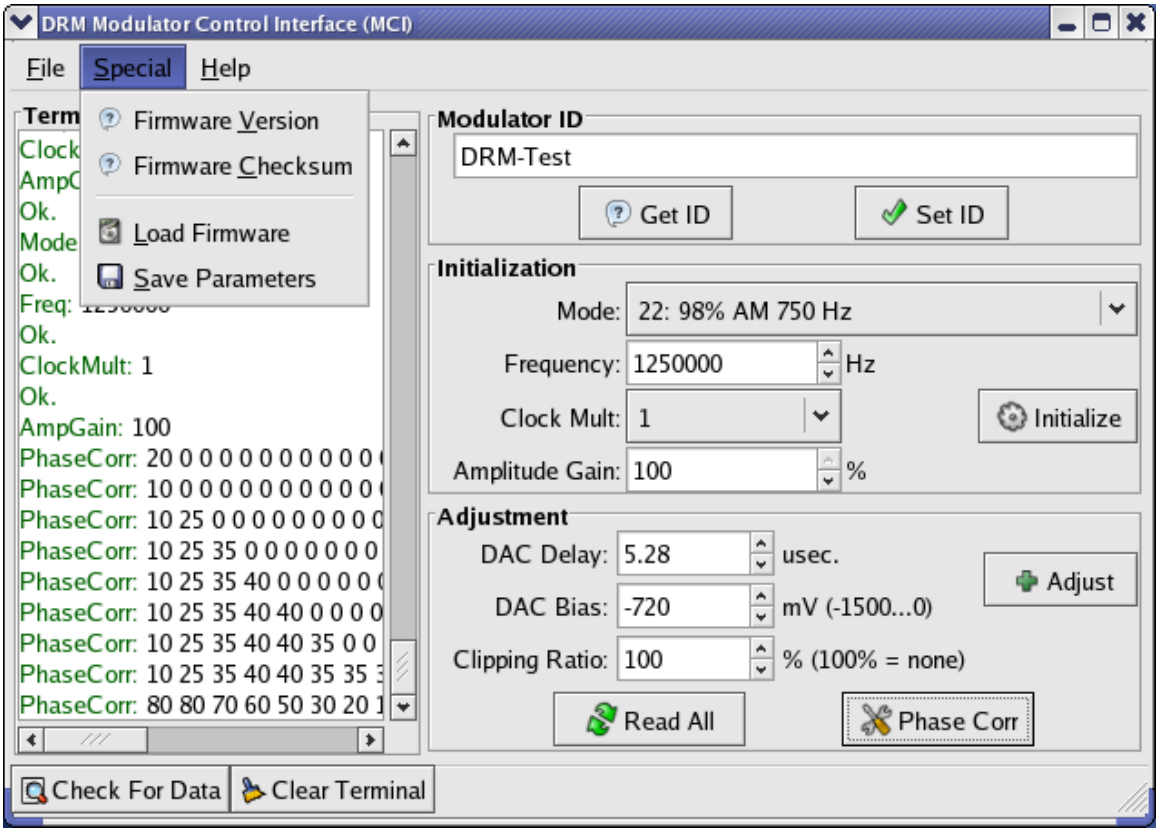


Figure 3-16 MCI Special menu

The DRM Modulator and MCI are capable of saving the settings to the flash if the firmware version is greater than 1.00. Check the firmware version by selecting Special->Firmware Version from the MCI menu.

The settings are saved with the Special->Save Parameters option in the MCI menu. Version 1.02 has 75 settings-saving slots. Ethernet parameters are now saved along with the rest of the settings. So, the following parameters can be saved to the flash:

- DAC Delay
- DAC Bias
- DDS Scale
- Clip ratio
- Amplitude Gain
- MAC address
- IP address

- UDP port number
- Transmitter ID
- IPM correction coefficients

Frequency is also saved, but the switches on the board dictate what frequency the modulator broadcasts on when it boots. At power on or boot time, frequency is read from the switches on the board, and is matched, if possible, with a set of settings from the flash that were saved at that frequency.

If you use up all of the slots, you will need to reload the firmware in that boot slot in order to be able to save settings again. (For this reason, you should only issue the command when you are sure you have settings you want to keep for a while. Also for this reason, avoid overusing the command on boot slot 0, the factory default configuration, since you cannot reprogram that boot slot's program to allow you to use parameters slots there again.) A settings slot becomes "used up" every time you save parameters to the flash.

Whenever you save the parameters, the configuration is saved to the boot slot that was selected when the modulator was last booted. That is, changing the boot jumpers after booting the modulator does not change which boot slot is used for saving parameters to the flash.

Every time the modulator is booted, its boot jumper settings and frequency switches are read. If no parameters exist in the flash for the selected frequency, some default values are used.

To save the settings to the flash:

1. Make sure your frequency switches are set to the frequency you want to use.
2. Boot to the boot slot you want to save your settings in.
3. Adjust the modulator using the MCI to operate with the settings you want to use.
4. In the MCI interface, choose the menu item Special -> Save Parameters.
5. You can check that your settings are saved by resetting the modulator or turning it off and back on, and then issuing a "Read All" command from the MCI. You can even select "Phase Corr" in the MCI, and select "Read All" in the IPM correction window to read the saved IPM coefficients from the Modulator. You should see the same parameters that you just saved.

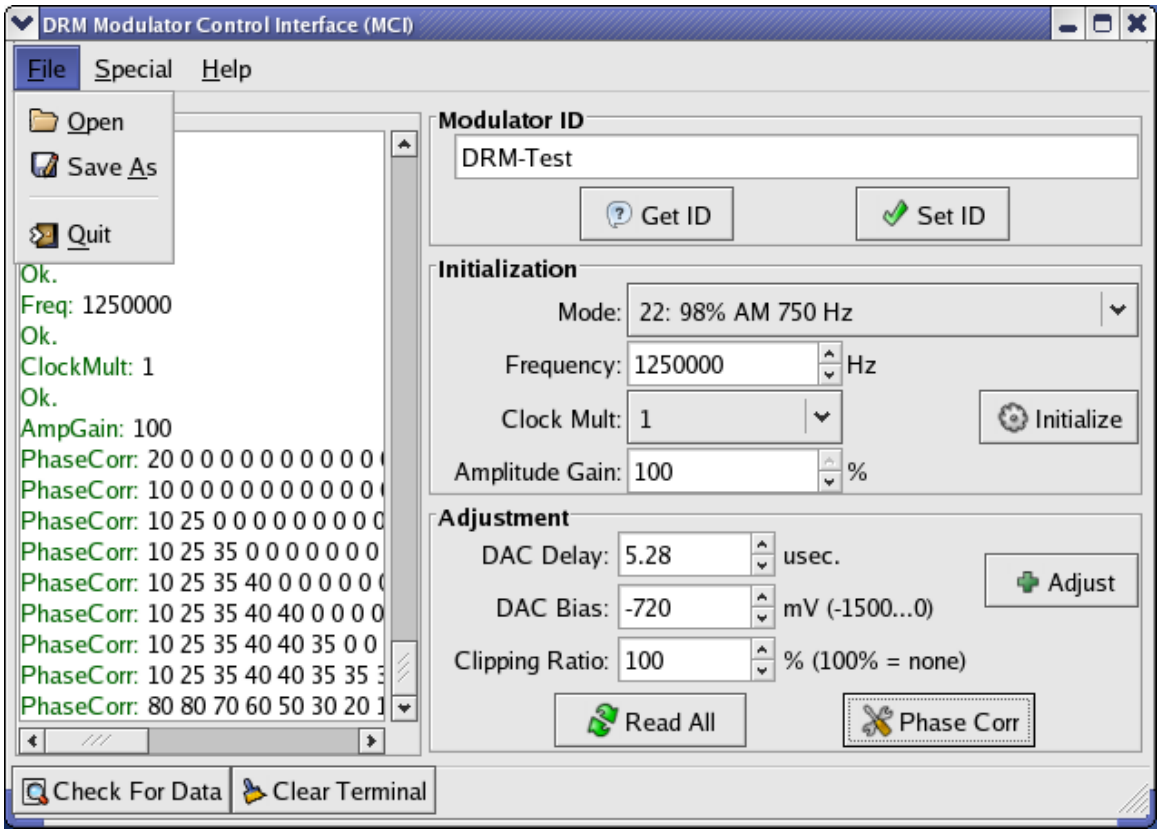


Figure 3-17 MCI File menu

You can also save MCI settings to a file on the Content Server computer. The options for saving and loading MCI settings files are in the File menu in the MCI. To save your settings to a file, use File->Save As. To read settings in from a file, use “File->Open”.

3.10 Digital Interface LED Indications

Table 3-2 Digital Interface LED Descriptions

LED #	Description
DS1	Transmitter is operating in Digital Audio Mode
DS2	Transmitter is operating in Normal Analog Audio Mode
DS3	MDI (Multiplexed Distribution Interface) has failed
DS4	The DRM MODULATOR has failed
DS5	The Transmitter is Operating in Bypass Analog Audio Mode
DS6	Data is being transmitted to the DRM Exciter via the Content Server
DS7	The transmitter is muted due to the switching of mode
DS8	Peak Audio Detector Timeout Fault
DS9	Transmitter is operating in Alternate Audio Mode
DS10	The Digital Interface is in Local Control

NOTE:
For more information concerning the Digital Interface board see Technical Manual 888-2001-893.

Section 4 Theory

4

4.1 Obtaining the ETSI Specification

Your DRM system creates a DRM signal which is compliant with the ETSI specification. ETSI is the European Telecommunication Standards Institute. The DRM Exciter Board performs the actions listed in Chapters 7, 8 and 9 of the ETSI spec. The spec is available by searching for “DRM” at http://pda.etsi.org/pda/queryform.asp and choosing the most up-to-date search result. It should be on the order of 184 pages. You may plan to read the ETSI specification or print and display it with your DRM development system. Before display or deep reading, it is recommended that you first skim Sections 7, 8, and 9. Figure 1 in Section 4.2 is also instructive.

4.2 From Audio to DRM Exciter Board Input

In the Content Server the incoming mono or stereo analog audio signal is digitized by a consumer or professional audio interface card, typically at 16 bits/sample, 24 ksps (kilosamples/second). This 384 kbps (kilobits/second) signal is then passed through an MPEG AAC encoder which reduces the bit rate to approximately 20 kbps with surprisingly little loss in perceived audio quality. Stereo 768 kbps data can be encoded to about 26 kbps. This data compression is extremely important if we are to transmit the signal in a 9 or 10 kHz bandwidth. Ten 40 ms. AAC frames are combined to form one 400 ms. MSC frame and combined with control info in the FAC and SDC to form one DRM frame for transmission to the exciter. The RS-232 link can operate at 38.4, 57.6, or 115.2 kBdps (kilobauds/sec).

4.3 Interference types and solutions

Unlike the IBOC system which is designed exclusively for local broadcasting, the DRM system is designed to deliver a decodable signal to receivers even via ionospheric transmission paths such as MF nighttime skywave and HF (shortwave) to distant

locations. The ionosphere is very unkind to digitally modulated and conventional AM signals. It produces the following forms of signal distortion:

4.3.1 Multipath radio wave propagation

The ionosphere is composed of several layers which may only be partially reflecting. The layers are not the smooth surfaces drawn in textbooks; they may be patchy and even tilted particularly at sunrise and sunset. Energy from the transmitter frequently reaches the receiver via several paths with different 'reflection' points. In MF broadcasting at night, severe multipath may occur at the fringes of the daytime (groundwave) coverage area when a skywave (ionospheric) signal also arrives at the receiver with comparable strength, having traveled some 200 km. more than the groundwave signal. Since radio signals travel at 300 km/ms. the time difference between the signals is about 0.65 ms. At some frequencies the two signals add, at others they subtract and cancel. The spacing between cancellation frequencies is the reciprocal of the time delay or 1500 Hz in this example. The delay varies over time with the result that the nulls sweep across the channel. In AM a particularly obnoxious audio distortion occurs when a multipath null cancels or reduces the carrier, leaving the receiver unable to demodulate the sidebands.

In the case of digitally modulated signals this causes extreme phase and amplitude distortion which makes demodulation impossible. In the 1980s the long distance telephone companies shifted from analog to digital terrestrial microwave systems. They found that the digital systems were very resistant to flat (non frequency selective) fading due to rainfall attenuation, but they were surprised to find that these systems were very sensitive to multipath fading when unusual weather conditions caused tropospheric ducting, because one symbol interfered with those following.

Low data rate digital signals are resistant to multipath if the guard time between symbols is greater than the delay spread of the signals arriving at the receiver, but transmission of kilobits/per second requires distributing the data among a rather large number of low data rate carriers.

4.3.2 Side frequencies

This introduces another problem. Most forms of digital modulation produce many side frequencies for each carrier, so that if multiple carriers are closely spaced they interfere with each other. The solution for this problem is Orthogonal Frequency Division Multiplex (OFDM). The sidebands of a carrier amplitude or phase modulated with a square pulse form a spectrum whose amplitude varies as:

$$A * \sin(x) / x$$

(where $x = \pi / t$ in radians and t is the duration of the pulse)

This familiar function has a maximum at the unmodulated carrier frequency and nulls (zero values) spaced at frequencies f_c +/- n/t Hz, where n = 1, 2, 3 … Thus multiple carriers spaced 1/t Hz apart are free of intercarrier interference.

One of the first practical applications of OFDM was the 1955 Collins Kineplex multi-channel teletype system. It placed 12 300-baud QPSK TTY (spaced 300 Hz apart) in each 4 kHz sideband of a dual independent sideband transmitter, a total of 24 TTY channels per transmitter. This implementation used a separate oscillator, phase modulator and receiver channel for each subcarrier. This point-to-point system used requested repeats (IRQ) for error correction.

Newer implementations generate and modulate the multiple carriers digitally in a digital signal processor (DSP) at much lower cost and circuit complexity. The amplitude and phase (or real and imaginary parts) for each carrier during one symbol is placed in an array of vectors. Taking the Inverse Fast Fourier Transform (IFFT) of this array gives a sampled output signal which is the sum of all the modulated subcarriers during the duration of one symbol. Interpolation, frequency translation, and digital to analog conversion produce a transmittable output.

To get the required total bit rate for encoded audio, necessary control information and forward error correction into a single broadcast channel, it is necessary to use digital modulation which sends several bits per frequency per symbol. In the DRM system one carrier for the duration of one symbol is called a cell. DRM uses 4 QAM with 2 bits / cell, 16 QAM with 4, and 64 QAM with 6.

COFDM (coded OFDM) adds forward error correction (FEC) and interleaving in both time and frequency to make OFDM much more robust. In the 64 QAM mapping, 2 bits (1 in phase and 1 quadrature, which is 90° out of phase) change the signal between adjacent points (a small very voltage difference in the demodulator), 2 produce 2 times this change, and the last 2 4 times. The bits which produce large differences are, of course, much less susceptible to errors due to noise or intersymbol interference. The most susceptible bits are therefore encoded at a low FEC code rate (low ratio of information bits to check bits) and the least susceptible with a high code rate (few check bits). The Viterbi decoding algorithm used in the receivers is most effective in correcting scattered random errors, but vulnerable to burst errors. However, errors caused by impulse noise may knock out an entire symbol, and interference from non-DRM transmitters and multipath tend to knock out the same carriers in several successive symbols. This is combated by interleaving the encoded data in frequency and in time (between symbols). After de-interleaving in the receiver adjacent bit errors are scattered throughout the frame for easier correction.

The MSC bit stream is divided into two, three or six different portions depending on QAM configuration and whether a higher protected part is used. Each portion is encoded at a component code rate which depends on the overall code rate and its level in the QAM constellation (most, mid or least significant bit). The convolutional encoder looks at the newest and 6 previous input bits and generates four new code bits. For

different component code rates, more or fewer of these four output bits will be used. If more are used, then there is a greater chance of the receiver recovering the value of the input bit. ETSI DRM Specification Section 7.3.2 and Section 7.5.1 describe this process in greater detail.

4.3.3 Receiving in the same phase that was transmitted

The receiver lacks a phase reference for demodulation. Because transmission paths vary in length over time the received phase is continually varying relative to the transmitted phase. To correct for this a number of cells scattered through the frame are designated as gain pilots. These are transmitted with the same amplitude and phase in every frame and used as references to demodulate data cells which are close to them in time and frequency. In the case of ionospheric propagation there may also be rapid variations in phase due to Doppler shifts caused by changes in layer height, particularly at sunset. For this reason the more robust modes use shorter symbols and more closely spaced reference cells.

4.3.4 Getting the signal ready for the transmitter

This channel encoding requires a great deal of digital processing of the data in the exciter (and even more in the receiver) but more processing is necessary to convert the output of the IFFT to a form suitable for use in a radio transmitter.

4.3.5 Changing frequency

The spectrum of the IFFT output is centered on a zero frequency with the subcarriers at positive and negative frequencies. Negative frequencies do not exist in a simple amplitude varying (real) signal, but they do exist if a signal has both in-phase (real) and quadrature (imaginary) components, as a + bj. This signal can be converted to one centered on any real frequency by multiplying it by a signal of the form sin(ω t) + cos(ω t) where $\omega = 2\pi f$. However, doing this at a megahertz frequency requires excessive computing resources. It is done much more efficiently using a special purpose Direct Digital Synthesis chip.

4.3.6 Amplifying

The I (in-phase) and Q (quadrature) signals could be fed to two DACs in a DDS to directly generate a transmittable RF signal, but amplification in a high power linear amplifier is very inefficient. The reason is the 10dB+ peak-to-average power ratio of the signal. This is true of any signal composed of a large number of independently modulated carriers.

Much more efficient amplification is possible using the EER method (envelope elimination and restoration) with a high level modulated transmitter like the DX series.

This amplification method was originally developed for high power single-sideband transmission, which has a similar peak-to-average ratio problem.

The IQ signal is converted to two signals. One is a constant amplitude RF signal containing all the phase information from the IQ signal. This is fed through the normal RF driver chain of the transmitter to the modulated amplifier stage. The phase of a complex signal can be derived using the arctan(x) function. The other is the magnitude (amplitude) of the IQ signal which is fed to the audio input of the transmitter.

Interestingly, both of these signals have a bandwidth much greater than the band width of the desired output signal, but when they are combined in an ideal analog multiplier the out-of-channel sidebands can be cancelled to –50 to –60 dB below the desired in-band carriers. If either of these signals is band-limited the cancellation fails.

To do this in a practical transmitter requires a few transmitter modifications, and pre-compensation in the exciter for other characteristics of the transmitter. The audio (envelope amplitude) input should have a flat response from dc to 40 kHz or better, with a nearly constant time delay over this range. Reducing the component values in the DX input Bessel filter by a factor of 4 has given satisfactory results. The RF driver should have a bandwidth of at least 0.5 MHz.

The RF output (carrier level) control on the Analog Input board should be set to its minimum. In a DX series Harris transmitter, this is the R27 “MAX POWER ADJUST” potentiometer you are instructed to turn fully counterclockwise in the process of installing your DRM Exciter Board. Fine adjustment of the zero output level is done in the exciter using the DRM Diagnostic Program.

The time delays in the RF and envelope paths to the modulated amplifier have to be equal within 1 sec. Transmitters normally have significantly more delay in the audio section than in the RF. Using the Diagnostic Tool software included with your DRM Demo System, the exciter can be set to compensate for delay differences from 0 to 165 sec in 0.33 sec steps. It also can compensate for time delay variation of up to 5 sec over the audio frequency range.

Another common transmitter problem is IPM (incidental phase modulation). Even with constant drive phase, the phase of the RF output varies with the output voltage amplitude. The most abrupt variations appear as the output approaches 0 (100% negative modulation in AM). The exciter can generate an AM carrier, 98% amplitude modulated with a 750 Hz sine wave for use with an external RF Phase Meter to test this. The Diagnostic Tool permits the operator to compensate for IPM at 25 points over the range from 0 to peak output.

4.4 DRM-MOD 100 Operation

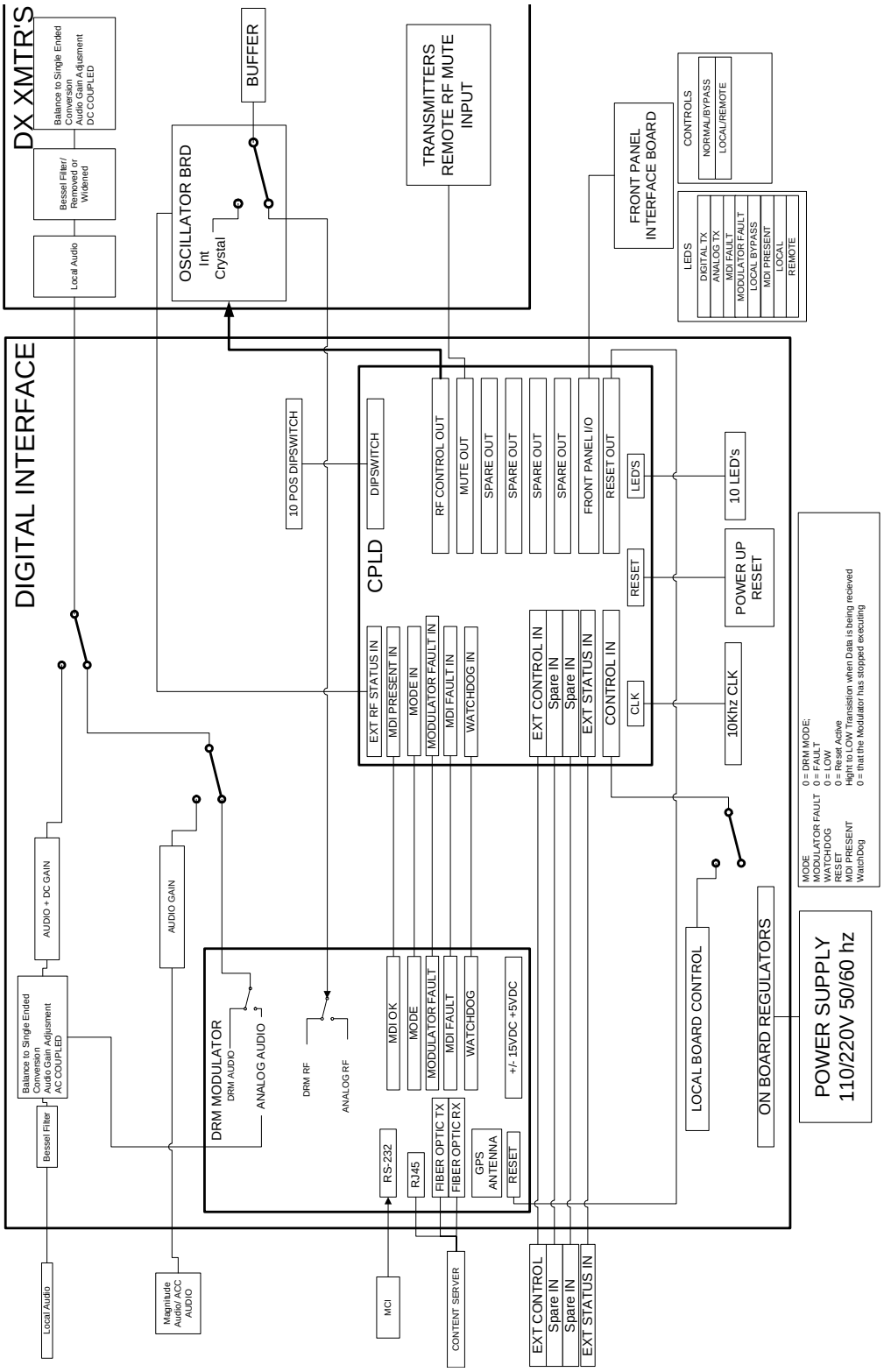


Figure 4-1 Digital Interface Block Diagram

WARNING: Disconnect primary power prior to servicing.

4.4.1 DRM INTLK

The Digital Interface detects that a DRM Exciter is connected by the Intlk signal. The Digital interface sends a low signal out via Q18, R186 to the DRM Exciter and it has a loop thru signal and passes it back to TP42. When TP42 is LOW then a DRM exciter is connected to the system.

4.4.2 DRM RST

The RST line at this time is not used in the Digital Interface Logic.

4.4.3 DRM WDOG

The WDOG Watch Dog circuit, when in operation, is a 400ms pulse signal. The Digital interface has an internal timer that counts from 0 to 4 seconds. The WDOG input resets this timer. If the timer reaches 4 seconds then the digital interface will make a switch to a different Audio Source to the Transmitter.

4.4.4 DRM MDI_F

This signal will go low when there is no communication between the DRM Exciter and the Content Server. IF this signal goes Low the digital interface will make a switch to a different Audio Source to the Transmitter.

4.4.5 DRM MDI_OK

This signal represent the MDI data between the Content Server and the DRM Exciter. It changes pulse widths depending on the Mode that is selected by the MCI Software. The Digital interface has an internal Timer that counts from 0 to 2 seconds. The MDI_OK input resets this timer. If the timer reaches 2 seconds then the MDI Status LED on the Front panel/Remote Status will be disabled.

4.4.6 DRM MODE_0, MODE_1, MODE_2

This is a 3 Bit combination from the DRM Exciter to tell the Digital Interface what mode it is in. For example when MODE_0 is low this represents that the DRM Exciter is in DRM Mode. When it is High this represents the DRM Exciter is in AM MODE. This signal tells the Digital interface that is needs to switch to a different Audio Source for AM MODE. In AM Mode the Transmitter uses the RF signal from the DRM Exciter but uses the AUDIO from the Local Audio Input on the Rear of the Assembly.

4.4.7 DRM SP1

Spare input not used at this time.

4.4.8 DRM EXT_MODE

This is an Input to the DRM Exciter to tell it what mode to go in. If the Front panel Bypass mode is selected then a Low signal will be sent to the DRM Exciter telling it to go to AM MODE. This signal will also go Low when in the Alternate Audio Mode.

4.5 System Time Synchronization

Synchronization of the system time is important in the Content Server for accurate time data transmission in the Service Description Channel (SDC) of the DRM signal. This information is often displayed on the receiver.

Time synchronization is also especially important in Single-Frequency Networks (SFNs). This DRM system is not currently capable of SFN operation. Single-Frequency Networks (SFNs) require that several Modulators can be fed the same DRM MDI stream. Despite propagation delay from the common Content Server, each modulator can use the “transmit timestamp” present in the MDI stream to compare with GPS time in order to begin broadcasting that DRM data at precisely the same moment as all of the other DRM Modulators in the Single-Frequency Network. This requires 10 seconds of buffering DRM MDI data in the DRM Modulator. It also requires that the Content Server can create accurate timestamps. Those timestamps are derived from the system time.

The Content Server system time synchronization is done with a standard “NTP” (Network Time Protocol) mechanism. If your Content Server cannot access any NTP servers, you may have a GPS receiver connected to it via the Ethernet 1 port in order for the GPS to serve as an NTP server for the Content Server.

4.5.1 Audio Card GPS Option

The DRM Content Server sends DRM MDI data to the DRM Modulator at 400ms (millisecond) intervals, which is every 4/10ths of a second. Technically, during normal live operation, your DRM Content Server uses the professional audio card clock to determine the timing it uses between successive outputs of DRM MDI data. Your DRM Content Server may have a Word Clock module add-on to the RME professional grade audio card. This Word Clock input should be used to synchronize the audio card sampling clock to other digital devices in the audio system, such as a digital console, or other AES/EBU sound sources. In the case that you also purchased the Content Server GPS option the Content Server Word Clock module and all other digital audio devices that feed it should be synchronized to the master 48 kHz signal generated by the GPS Receiver. This is independent of the NTP master time received over Ethernet by the Content Server. Word Clock interconnections are made via coaxial cable from the respective BNC connectors on the various devices. Using this word clock, your DRM Content Server will not easily fall behind or get ahead of the DRM Modulator’s consumption of MDI packets, provided that both systems are locked to GPS timing. Please refer to the RME Word Clock module and GPS Receiver documentation for further details on this topic.

With either system not locked to GPS time, the DRM Modulator could operate "too fast" or "too slow" in consuming data from the DRM Content Server.
EXAMPLE: If it were to operate too fast, the buffered input would eventually (perhaps

in several weeks or months) be consumed, and *1.2 seconds of audio would be repeated once* on the air. If it operated too slowly, *1.2 seconds of audio would be skipped*.

HARRIS®

DRM-MOD 100
Modulator for DRM

drm

Harris DRM – The future of radio technology starts here.

The DRM-MOD 100 Modulator offers world-class plug-and-play DRM capability for DX, 3DX and DAX transmitters. What could be easier?

The Harris DRM-MOD 100 Modulator must have known its own destiny. Designed from its inception to work seamlessly with the rugged and reliable Harris digital-ready DX, 3DX and DAX lines of transmitters, the DRM-MOD 100 offers easy installation, rapid set-up, and full DRM functionality. Integrated with the DX,3DX and DAX transmitter series and our DRM-CSB 100 Content Server, the DRM-MOD 100 Modulator is a key element in Harris' industry-leading DRM solution, which has been designed to provide broadcasters simplicity, flexibility, upgradeability, and value.

The DRM-MOD 100 Modulator integrates with the legendary line of Harris DX transmitters, from the DX10 to the DX2000. By planning the design architecture of the DRM-MOD 100 Modulator with the DX transmitter in mind, Harris engineers created powerful out-of-the-box features and benefits for the DX owner, including:

- **Easy Installation with DX, 3DX and DAX Transmitters –** The DRM-MOD 100 Modulator is a rack mounted item that integrates with the normal transmitter oscillator board, thereby assuring tight control of all oscillator functions, COFDM modulation, SWR protection, and easy transition from analog to digital operation via the content server command.
- **Simple Connectivity –** The DRM-MOD 100 Modulator can be fed from a local Content Server via RS232 or remotely fed via an STL or Ethernet network feed.
- **Flexible Dual-Mode Operation –** The DRM-MOD 100 Modulator includes the ability to switch easily between DRM and analog operation via commands from a local or remote content server or from a local control switch.
- **Reliable On-Air Continuity –** The DRM-MOD 100 Modulator provides a user-selectable "fallback" setting, designed to immediately change to analog mode in the event of loss of the DRM feed.
- **Convenient Set-Up and Evaluation –** The DRM-MOD 100 Modulator comes with a Modulator Control Interface tool set, the DRM-MCI 100 for use with a customer-supplied computer. The MCI tool set is used for initial DRM-MOD 100 set up and periodic system checking.
- **Maximum Server Flexibility –** The DRM-MOD 100 Modulator can be fed from any DRM-compliant content server (such as the Fraunhofer Content Server solution).

Harris makes upgrading to DRM as simple as possible. With the digital-ready DX transmitter as the ideal starting point for your DRM future, the Harris DRM-MOD 100 Modulator is the smart choice for a flexible, integrated, and cost-effective transition when you are ready to begin DRM broadcasts.

Modulator Specifications DRM-MOD 100

Parameter	Specification	Notes
Frequency Range	500KHz – 1.7MHz	MW AM Band
Frequency Accuracy	+/- 4 PPM Internal	+/- 1Hz With GPS
Phase Compensation	Open Loop	Table Driven From MCI
Spectral Purity	Per ETSI spec	Per ETSI ES 201 980 v2.1.1
Number of Serial Ports	2	One Std / One Fiber Optic
Serial Port Date Rate	38.4Kbaud	
Operating Temperature	0-50°C	
Supply Voltage	± 18VDC to ±28VDC	110 to 240 VAC in Chassis
+22 VDC Supply Current	1000mA	
- 22 VDC Supply Current	200mA	
Envelope Output Voltage	10 Vpp (min)	
Envelope Output Type	Differential	
Envelope Output DC Adjust	-8v to 0v	
RF Output	Square Wave	

Modulator Product DRM-MOD 100

Transmission Configurations

Robustness Mode
Modes A, B, C and D

Spectrum Occupancy
4.5 kHz, 5 kHz, 9 kHz, 10 kHz, 18 kHz and 20 kHz

18 kHz
All modes

QAM Mode
SM 16 QAM MSC, 4 QAM SDC
SM 64 QAM MSC, 16 QAM SDC

Interleaver Depth
0.4 second short interleaving
2.0 second long interleaving
18 kHz, 20 kHz
4.5 kHz, 5 kHz, 9kHz, 10 kHz

Code rates (Protection Levels)
All Standard Modulation Rates

Equal/Unequal Error Protection
Equal Error Protection (EEP)
Unequal Error Protection (UEP)

Other Features:

Test Modes Independent of CS
Analog Mode
Basic Phase Compensation
GPS Synchronization
Serial Distribution Interface
Ethernet Distribution Interface
Compatibility with Industry DI

To learn more about Harris DRM solutions and our complete line of digital and digital-ready technology, visit us online at www.harris.com/globalradio.

*Specifications are subject to change. For a complete listing of the most current specifications, please visit our Website at **www.broadcast.harris.com**.*

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HARRIS

DRM-CSB 100

Content Server/ Multiplexer for DRM

Harris DRM – The future of radio technology starts here.

The DRM-CSB 100 Content Server/Multiplexer offers reliable DRM

The Harris DRM-CSB 100 Content Server/Mutliplexer gets you there in a hurry. Combined with the MOD 100 Modulator and the rugged and reliable Harris digital-ready DX line of transmitters, the DRM-CSB 100 provides basic DRM broadcasting today, with long-term upgradeability for your digital radio future.

Loaded with all the standard required DRM features for various modes of operation, the DRM-CSB 100 Content Server/Multiplexer provides audio encoding, including station ID and language identifiers, and program format messaging. By designing the DRM-CSB 100 to work seamlessly with the MOD 100 Modulator and the DX series transmitter, Harris engineers have created powerful, out-of-the-box features and benefits for the digital radio broadcaster:

- **Broad DRM Programming Capability –** The DRM-CSB 100 offers a full complement of transmission settings required for DRM broadcasting. The DRM-CSB 100 Content Server/Multiplexer offers basic DRM operation with a single audio feed and program associated data, allowing a low cost solution to start DRM transmissions. As receivers and DRM capability develops and a full featured content server is added at the studio, the DRM-CSB continues to function as a transmitter server for maximum flexibility and control at your transmitter site. (See full listing of DRM settings under "Specifications" section on the back of this sheet.)
- **Flexible Installation –** Located at the transmitter site for direct RS232 connection or located remotely at the studio via Ethernet, the DRM-CSB 100 Content Server/Multiplexer is designed for flexible integration into your broadcast production environment.
- **Full Encoding Capability –** The DRM-CSB 100 includes AAC Plus with SBR audio encoding. CELP and HVXC encoding is optional.
- **Stable, Reliable Operating Software –** The Harris DRM-CSB 100 Content Server/Multiplexer is built on the Linux Operating System for proven stability and up-time from the studio or at the transmitter site.
- **Convenient Dual-Mode Control –** The DRM-CSB 100 Content Server/Multiplexer allows transmitter mode control for analog or DRM operation.
- **Hardware Built-to-Last –** The DRM-CSB 100 is configured on a two-rack unit PC with professional audio inputs, and a rugged, field-tested chassis. (Requires optional monitor keyboard and mouse for operation.)

Content Server Specifications DRM-CSB 100

Parameter	Specification	Notes
Serial port data rate	38.4Kbaud	
Number of serial ports	1	
SDC types	0 & 9	AFS index not implemented
Robustness modes	Modes A, B, C & D	
User Interface	GUI	
Services	1	Audio only
Data input	RT audio	
Configuration control	Local	
Output format	Per MDI standard	MDI standard on RS232
Protection Levels	4	

DRM-CSB 100 Content Server Specifications

Content Server Product DRM-CSB 100	Current Features	Future Software Upgrade
Audio Encoding Configurations		
Type of Audio Encoding		
MPEG-4	●	
SBR	●	
Non-SBR	●	
CELP		●
HVXC		●
Audio Sampling Rates		
8 kHz	●	
12 kHz	●	
16 kHz	●	
24 kHz	●	
Stereo/Mono		
Mono	●	
Parametric Stereo	●	
Stereo	●	
Audio Source		
Live input	●	
WAV file	●	
Service Configurations		
Number of Services		
1 service	●	
2 to 4 services		●
Types of Services		
Audio Services	●	
Text Message	●	
Packet Mode		
Conditional Access		
Display and Reconfiguration		
3 character Service Identifiers	●	
16 Service Language Specification Possibilities	●	
30 Service Program Type Possibilities	●	
16 Character Service Labels	●	
Date and Time	●	
Advance Notice of Reconfigurations		●
3 Character Target Language		●
2 Character Country of Origin		●
Alternate Frequency Signalling		●
Multimedia		
Multimedia Functionality		

Content Server Product DRM-CSB 100	Current Features	Future Software Upgrade
Transmission Configurations		
Robustness Mode		
Modes A, B, C and D	●	
Spectrum Occupancy		
4.5 kHz, 5 kHz, 9 kHz and 10 kHz		
Modes A, B, C and D	●	
18 kHz		
Mode A	●	
Modes B, C and D	●	
20 kHz		
Modes A and B	●	
Modes C and D	●	
QAM Mode		
SM 16 QAM MSC, 4 QAM SDC	●	
SM 64 QAM MSC, 16 QAM SDC	●	
HMSym 64 QAM MSC, 16 QAM SDC		●
HMMix 64 QAM MSC, QAM SDC		●
Interleaver Depth		
0.4 Second Short Interleaving	●	
2.0 Second Long Interleaving	●	
18 kHz, 20 kHz	●	
4.5 kHz, 5 kHz, 9kHz, 10 kHz	●	
Code Rates (Protection Levels)		
All Standard Modulation Rates	●	
HMSym and HMMix Rates	●	
Equal/Unequal Error Protection		
Equal Error Protection (EEP)	●	
Unequal Error Protection (UEP)	●	
Other Features:		
CS control of analog/DRM modes	●	
Basic MCI Integrated With CS	●	
Professional Audio Card	●	
Serial Distribution Interface	●	
Ethernet Distribution Interface	●	

To learn more about Harris DRM solutions and our complete line of digital and digital-ready technology, visit us online at www.harris.com/globalradio.

*Specifications are subject to change. For a complete listing of the most current specifications, please visit our Website at **www.broadcast.harris.com**.*

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