

INSTRUCTION MANUAL

System 3000

DVB

Digital Modulator

M2/MDV/FRT

includes options /OPT, 422-S and /LVDS-s

[Software Version 4.5]

ENGLISH (UK)

READ THIS FIRST!

If you do not understand the contents of this manual
DO NOT OPERATE THIS EQUIPMENT.

Training courses on System 3000 equipment are available through DMV Customer Support using the information in the Preliminary Pages of this manual. Also, translation into any EC official language of this manual can be made available, at your cost.

ITALIANO

LEGGERE QUESTO AVVISO PER PRIMO!

Se non si capisce il contenuto del presente manuale
NON UTILIZZARE L'APPARECCHIATURA.

Corsi di formazioni per l'apparecchio System 3000 sono disponibili presso l'assistenza clienti DMV, consultando le informazioni contenute nelle Pagine preliminari di questo manuale. È anche disponibile la versione italiana di questo manuale, ma il costo è a carico dell'utente.

SVENSKA

LÅS DETTA FÖRST!

Om Ni inte förstår informationen i denna handbok
ARBETA DÅ INTE MED DENNA UTRUSTNING.

Utbildningskurser för utrustningen i System 3000 kan anordnas genom DMV kundtjänst med den information som finns på de inledande sidorna i denna handbok. En översättning till detta språk av denna handbok kan också anskaffas, på Er bekostnad.

NEDERLANDS

LEES DIT EERST!

Als u de inhoud van deze handleiding niet begrijpt
STEL DEZE APPARATUUR DAN NIET IN WERKING.

Trainingscursussen voor System 3000 apparatuur zijn via DMV Klantenservice beschikbaar en informatie hierover is te vinden in de eerste pagina's van deze handleiding. U kunt tevens, op eigen kosten, een vertaling van deze handleiding krijgen.

PORTUGUÊS

LEIA O TEXTO ABAIXO ANTES DE MAIS NADA!

Se não compreende o texto deste manual
NÃO UTILIZE O EQUIPAMENTO.

O serviço de Apoio ao Cliente DMV oferece cursos de formação sobre o equipamento System 3000, disponíveis por intermédio da informação contida nas Páginas Introdutórias deste manual. O utilizador poderá também obter uma tradução do manual para o português à própria custa.

SUOMI

LUE ENNEN KÄYTTÖÄ!

Jos et ymmärrä käsikirjan sisältöä
ÄLÄ KÄYTÄ LAITETTA.

DMV - asiakaspalvelu tarjoaa koulutuskursseja System 3000 laitteiden käytössä. Tätä koskevat tiedot ovat käsikirjan alkusivuilla. Käsikirja voidaan myös suomentaa asiakkaan kustannuksella.

FRANÇAIS

AVANT TOUT, LISEZ CE QUI SUIT!

Si vous ne comprenez pas les instructions contenues dans ce manuel

NE FAITES PAS FONCTIONNER CET APPAREIL.

Des stages de formation sur le "System 3000" sont disponibles auprès du Service de Soutien Technique à la Clientèle de DMV, dont vous trouverez les coordonnées dans le Préambule de ce manuel. En outre, nous pouvons vous proposer, à vos frais, une version française de ce manuel.

DANSK

LÆS DETTE FØRST!

Udstyret må ikke betjenes

MEDMINDRE DE TIL FULDE FORSTÅR INDHOLDET AF DENNE HÅNDBOG.

Træningskurser i System 3000 udstyr kan arrangeres gennem DMV Customer Support. Der henvises til de indledende sider i denne håndbog for yderligere oplysninger herom. Vi kan også for Deres regning levere en dansk oversættelse af denne håndbog.

DEUTSCH

ZUERST DIESEN HINWEIS LESEN!

Sollte Ihnen der Inhalt dieses Handbuchs nicht klar verständlich sein

DIESE AUSTRÜSTUNG NICHT BEDIENEN.

Schulungskurse zur Bedienung der Ausrüstungen des Systems 3000 unter Verwendung der in den einleitenden Seiten dieses Handbuchs enthaltenen Informationen stehen über den DMV-Kundendienst zur Verfügung. Ferner ist eine Übersetzung dieses Handbuchs in diese Sprache gegen Berechnung lieferbar.

ΕΛΛΗΝΙΚΑ

ΔΙΑΒΑΣΤΕ ΠΡΩΤΑ ΑΥΤΟ!

Αν δεν καταλάβετε το περιεχόμενο αυτού του βοηθήματος/εγχειριδίου

ΜΗΝ ΛΕΙΤΟΥΡΓΗΣΕΤΕ ΑΥΤΟΝ ΤΟΝ ΕΞΟΠΛΙΣΜΟ.

Μαθήματα για την κατάρτιση σας στη χρήση του Συστήματος 3000 αυτού του εξοπλισμού διατίθενται μέσω του DMV Customer Support - θα βρείτε τις πληροφορίες που χρειάζεστε στις Πρώτες Σελίδες αυτού του βοηθήματος. Επίσης, αυτό το εγχειρίδιο είναι διαθέσιμο σε μετάφραση σε αυτή τη γλώσσα και μπορείτε να το αγοράσετε.

ESPAÑOL

LEA ESTE AVISO PRIMERO!

Si no entiende el contenido de este manual

NO OPERE ESTE EQUIPO.

El servicio posventas DMV (DMV Customer Support) ofrece cursos de adiestramiento para el manejo del equipo del Sistema 3000 usando la información en las páginas preliminares de este manual. Podemos asimismo suministrarle una traducción de este manual al (idioma) previo pago de una cantidad adicional que deberá abonar usted mismo.

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Issue 4 first published in 1996 by:

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Chapter 1: Introduction

Introduces the System 3000 DVB Digital Modulator. Gives some high-level information about the equipment's main features.

Chapter 2: Installation

Gives some preliminary checks to be carried out on receiving the equipment. Considers some points which require addressing during installation. Describes in detail the external connections to the equipment.

Chapter 3: Operation, Front panel and Local Control

Gives extensive information on configuring and controlling the Modulator using the Front Panel keys and the Local Control port. Explains how to mask the alarm and fail responses.

Chapter 4: Remote Control

Gives extensive information on configuring and controlling the Modulator using the Remote Control port.

Chapter 5: Maintenance and Troubleshooting

Explains routine checks which can be undertaken by an operator. Explains the warranty conditions and the different levels of maintenance agreements offered by DMV. Gives advice on servicing. First line troubleshooting checks are described.

Chapter 6: Annexes

Annex A: List of Abbreviations and Acronyms

Annex B: Technical Specifications

Annex C: Extension of ETS 300 421 to Include BPSK Modulation

About This Manual

This manual describes the use of the DMV System 3000 DVB Digital Modulator.

The following System 3000 maintenance manual is also available:

ST.MM.2008: DVB Digital Modulator.

Warnings, Cautions and Notes

Heed Warnings

All warnings on the product and in the operating instructions should be adhered to. The manufacturer can not be held responsible for injuries or damage where warnings and cautions have been ignored or taken lightly.

Read Instructions

All the safety and operating instructions should be read before this product is operated.

Follow Instructions

All operating and use instructions should be followed.

Retain Instructions

The safety and operating instructions should be retained for future reference.

WARNINGS...
WARNINGS GIVE INFORMATION WHICH, IF STRICTLY OBSERVED, WILL PREVENT PERSONAL INJURY OR DEATH, OR DAMAGE TO PERSONAL PROPERTY OR THE ENVIRONMENT. THEY ARE BOXED AND SHADED FOR EMPHASIS, AS IN THIS EXAMPLE, AND ARE PLACED IMMEDIATELY PRECEDING THE POINT AT WHICH THE READER REQUIRES THEM.

CAUTIONS...
Cautions give information which, if strictly followed, will prevent damage to equipment or other goods. They are boxed for emphasis, as in this example, and are placed immediately preceding the point at which the reader requires them.

NOTE...
Notes provide supplementary information. They are highlighted for emphasis, as in this example, and are placed immediately after the relevant text.

EMC Compliance

This equipment is certified to the EMC requirements detailed in the appropriate associated manuals. To maintain this certification, only use the leads supplied or if in doubt contact DMV Customer Support.

Customer Support Information

How Can We Help?

DMV provide continuous product support and services to all our customers. We provide assistance with regards to the operation and servicing of installed equipment, as well as offering training, maintenance agreements, replacement loan service and providing a base repair facility.

Where to Find Us

Customer Support
DMV
34 A - C Parham Drive
Boyatt Wood Industrial Estate
EASTLEIGH
Hampshire
SO50 4NU
United Kingdom

Office hours: 8:00 am to 6:00 pm Local Time

Tel: +44 (0) 1703 498111

Fax: +44 (0) 1703 498102

24 Hours Emergency: +44 (0) 181 771 4000

Procedure for Returning Equipment

In the event of a problem with your equipment, please contact Customer Support to discuss the nature of the problem. If it is serious, requiring the return of all or part of it back to the factory for repair, then proceed as follows:

1. We will allocate you a **Returns Authorisation Number (RAN)** and ask you to complete the **Customer Repair Report**, provided at the back of this manual, as fully and clearly as possible.
2. It would help if a copy of the Customer Repair Report and RAN were faxed to us as soon as possible (at the number given above).
3. Pack the equipment to be returned in the original packing boxes, or other DMV approved packaging materials. Ensure the completed Customer Repair Report is included with the equipment to be returned.
4. Ensure the appropriate address and information labels are attached to the packaging. This may include a Customs Declaration Form if returning equipment from overseas.

It is the responsibility of the sender to ensure the equipment arrives at Customer Support on time and in good condition.

Terms and Conditions

A copy of the DMV standard Terms and Conditions can be obtained from Customer Support (see address above).

Acknowledgements

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Trademarks

VT™ is a trademark of Digital Equipment Corporation.



Chapter 1

INTRODUCTION

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1.1 Scope of this Manual

1.1.1 Equipment Described in this Manual

This manual covers DMV System 3000 Modulators with a 50 Ω IF output and with software version 4.5 installed. It also covers the following modules: Optical; RS422 Serial; LVDS Serial.

1.1.2 Purpose of this Manual

This manual describes the functions and operations of the System 3000 DVB Digital Modulator.

It has been written to assist in the installation and day-to-day care and operation. It does not include any maintenance information which would require the removal of covers.

1.1.3 Where the Modulator fits into the System

The block shown bold in Figure 1.1 is covered by this manual.

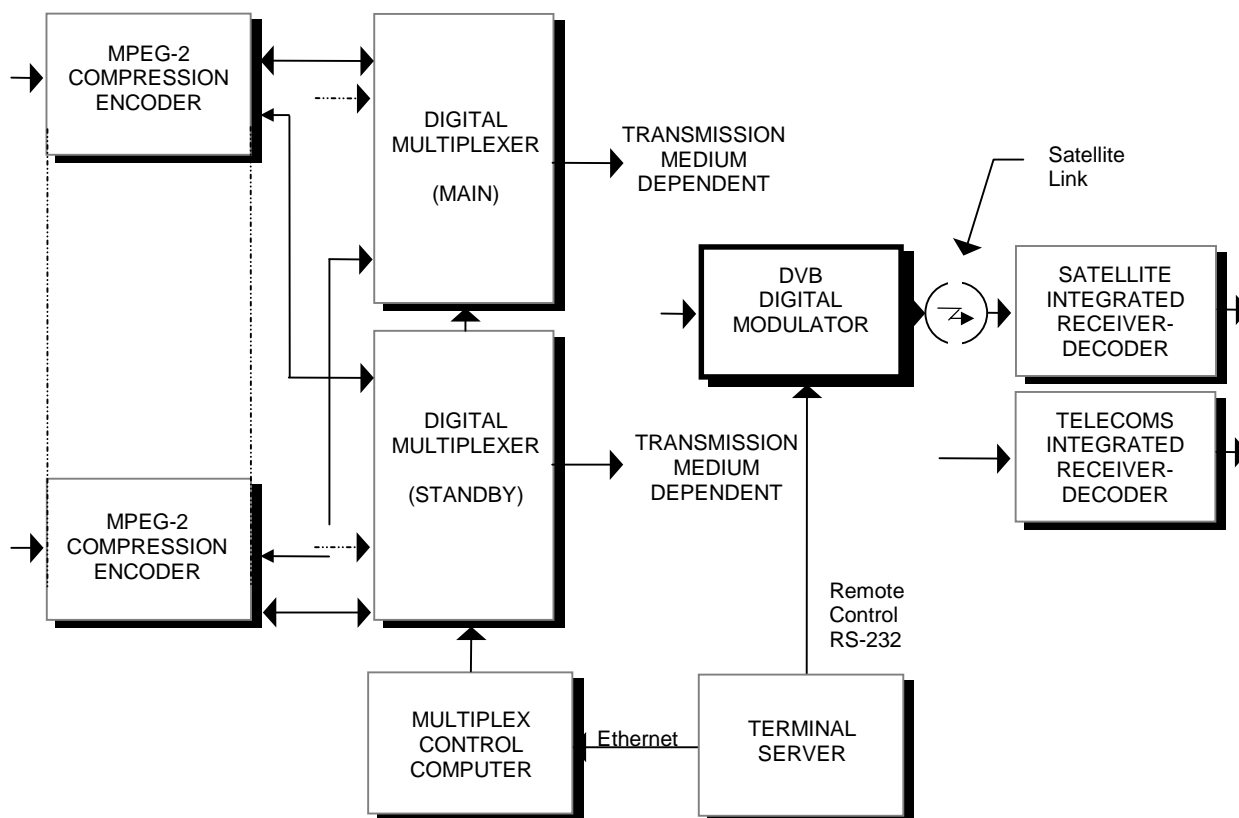


Figure 1.1: Family of System 3000 Products

The DVB Digital Modulator forms part of the System 3000 MPEG-2 range of equipment. It provides the satellite transmission functions specified for MPEG-2 packet signals to the transmission format defined in the European Telecommunication Standard (ETS) "Digital Broadcasting Systems for Television, Sound and Data Services, ETS 300 421" Dec 1994.

1.2 General Features

1.2.1 Availability of BPSK Modulation

This manual carries descriptions of the BPSK modulation function available with this release of firmware. This functionality is provided for future development. Also, it may not be supported by the System 3000 Multiplex Control Computer (MCC). If appropriate, please contact DMV Customer Support for further information.

1.2.2 General Features

The unit is compatible with both professional and direct-to-home satellite transmission of MPEG-2 encoded signals for reception on suitable satellite receivers.

The System 3000 DVB Digital Modulator interfaces directly with the System 3000 MPEG-2 Multiplexer using a DMV proprietary interface format.

The basic Modulator accepts a single RS-422 byte-parallel input at a bit-rate in the range 1.5 - 52.5 Mbit/s. Other input interfaces are available as option-interface units for use as an alternative to the basic input format; these are RS-422 serial, optical fibre and Low Voltage Differential Signalling (LVDS) serial — please check with DMV for currently available options.

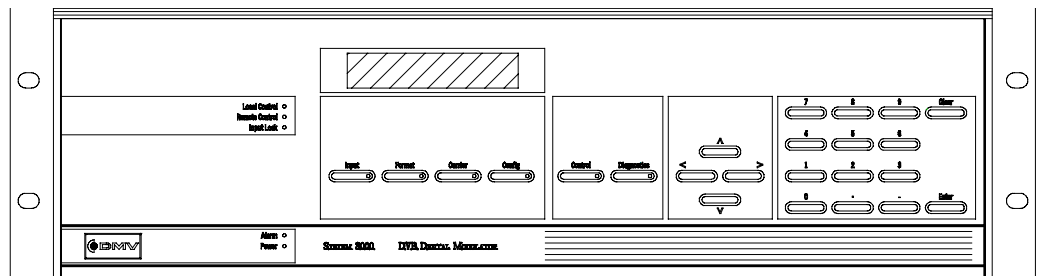


Figure 1.2: System 3000 Digital Modulator Front Panel

1.2.3 Modulation

The Modulator produces either a Binary Phase Shift Keyed (BPSK) or Quadrature Phase Shift Keyed (QPSK) signal with selectable convolutional Forward Error Correction (FEC) rates and provides a tuneable IF output carrier at the industry standard frequencies of 70 MHz (tuning range 20 MHz) and 140 MHz (tuning range 40 MHz).

1.2.4 Physical and Environmental

The Modulator is housed in a 19-inch by 3U enclosure. All inputs and outputs are by way of rear panel connectors. Rack-mounting brackets are provided. Forced air cooling is used. The equipment operates from a mains power supply, having auto-ranging selection covering 100-120 or 220-240 V ac. 50/60 Hz and is designed for use in ambient air temperature conditions in the range +5°C to +40°C.

1.3 Specific Features

1.3.1 DVB Signal Conditioning

The basic Modulator supports a parallel RS-422 clock and data input (in 204 byte packet format) at a user-programmable bit-rate in the range 1.5 - 52.5 Mbit/s. The Modulator phase-locks to the incoming clock frequency using a Phase Locked Loop (PLL) system. There is a reference clock output on the parallel RS-422 port which may be used as a clock by the data source equipment (normally a DMV System 3000 System Multiplexer).

The unit first processes the input signal in accordance with the ETS 300 421 specification as follows:

1. Spectral scrambling;
2. Reed-Solomon encoding;
3. Interleaving;
4. Convolutional encoding.

The data signals are then digitally filtered and converted to analogue format. The digital filters implement the specified square root 35% raised cosine characteristic. The I and Q analogue baseband signals produced by the above processing are then fed to a QPSK modulator.

1.3.2 Modulation

QPSK modulation is implemented at a carrier frequency of 480 MHz. This signal is then frequency down-converted to the required output frequency 70 MHz or 140 MHz. The output range is 70 MHz \pm 20 MHz and 140 MHz \pm 40 MHz in frequency increments of 125 kHz.

The Modulator has a maximum transmit symbol rate of 30 MSymbols/s. The Operator can vary the IF output power between -30 dBm and +2 dBm in 0.1 dB steps. There is also a QPSK monitor output available at a power level of nominally -5 dBm.

1.3.3 Control

All control functions operate via an internal microprocessor. Equipment operation may be implemented by one of three methods which are:

1. Front panel keys with LCD display;
2. Remote controller via rear panel RS-232 interface;
3. VTTM-100 terminal via rear panel RS-232 interface — this control method is provided on early Modulators but may not be supported on later models.

1.3.4 Optional Input Interfaces

The System 3000 range of products can support many options. Please refer to the appropriate manual or contact DMV Customer Support using the information contained in the preliminary pages of this manual.

Alternative input formats are supported by fitting an option-interface card. Optical fibre, RS-422 serial and LVDS serial interfaces are available.

The RS-422 serial and LVDS serial interfaces support an input data format in which Reed-Solomon encoding and interleaving have been applied as defined in ETS 300 421 for satellite transmission. Reed-Solomon decoding and de-interleaving can be selected by the user, thus providing an error correcting capability for transmission errors which have occurred on the input data stream. The output of these interface units to the basic Modulator is de-interleaved. The Modulator always re-applies the specified signal conditioning functions (energy dispersal scrambling, Reed-Solomon encoding, interleaving) for the satellite transmission link.

1.3.5 Alarm / Fail / Reset / Relays

The rear panel connector *RESET/STATUS* connects to internal “volt-free” relay contacts which can be used to indicate alarm or fail conditions selected by the operator. Also, short-circuiting two pins will reset the Modulator.

Internally, the Modulator software checks for certain alarm and failure conditions. These conditions are categorised into logical groups to indicate more general alarm/fail conditions. The operator can define the relationship between the alarm/fail indications and the groups.

Chapter 2

INSTALLATION

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2.1 Preliminary Checks

2.1.1 Mechanical Inspection

Inspect the equipment for damage-in-transit. If in doubt, please contact DMV Customer Support (see Preliminary Pages).

IMPORTANT NOTE...

Removing the covers of this equipment may invalidate any warranties, cause a safety hazard or/and affect the EMC performance. Please check with DMV Customer Support beforehand.

2.1.2 Moving the Equipment Safely



Do not place this product on an unstable cart, stand, bracket, or table. The product may fall, causing serious injury and serious damage to the product. Use only with a cart, stand, bracket or table recommended by DMV.

An appliance and cart combination should be moved with care. Quick stops, excessive force, and uneven surfaces may cause the appliance and cart combination to overturn.

Do not move or carry the equipment whilst it is still connected

2.2 EMC Compliance Statements

2.2.1 FCC

This equipment complies with Part 15 of the FCC Rules and is verified to Class A. Operation is subject to the following two conditions:

1. this device may not cause harmful interference, and
2. this device must accept any interference received, including interference that may cause undesired operation.

2.3 Installing the Equipment

2.3.1 Read This First!

The System 3000 DVB Digital Modulator must be handled carefully and thoughtfully to prevent safety hazards and damage. It is usually supplied as part of a system installed by DMV engineers. In any case, ensure the personnel designated to install the unit has the appropriate skills and knowledge. Installation should follow instructions and should only use installation accessories recommended by the manufacturers. If in any doubt, contact DMV Customer Support.

2.3.2 Fixing the Equipment

The System 3000 Modulator has been shipped with fixing brackets suitable for a standard 19-inch rack. This equipment is designed for fixed use.

When rack-mounted, this equipment must have shelf supports as well as being fixed at the front panel.

Do not use this product as a support for any other equipment.

2.3.3 Ventilation

CAUTIONS...

1. The fans contained within this unit are not fitted with a dust/insect filter. Pay particular attention to the environment in which it is to be used.
2. Do not install equipment so that the air intake of one aligns with the outlet on another. Provide baffles and adequate spacing.

Ensure it is firmly and safely located and it has an adequate flow of free-air. Allow at least 50 mm free air-space at each side of the equipment. Units in racks can be stacked without ventilation panels between. Racks containing stacked equipment may need to be forced-air cooled to reduce the operating ambient temperature.

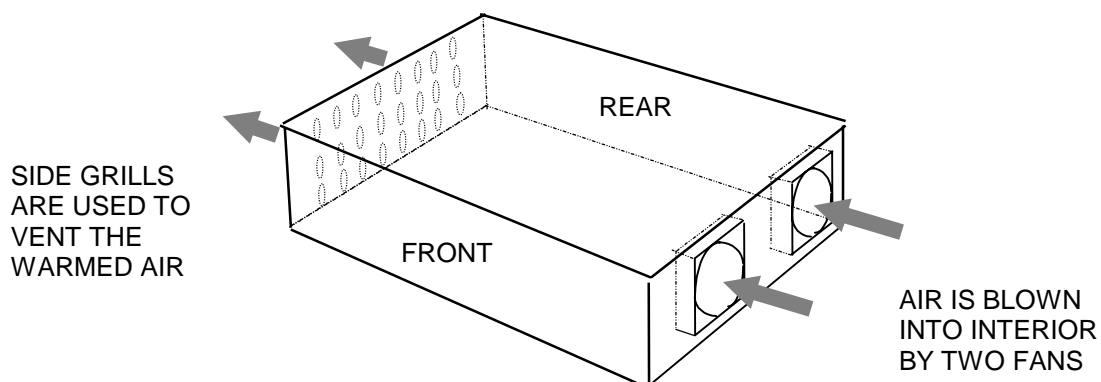


Figure 2.1: Air-Path Through the Enclosure

2.3.4 Installing Cables — Safety

Do not run AC power cables in the same duct as signal leads. Do not move or install equipment whilst it is still attached to the mains supply. Ensure ESD precautions are observed whilst inter-connecting equipments.

2.3.5 Protection from Moisture

**WARNINGS
OBJECT AND LIQUID ENTRY...
NEVER PUSH OBJECTS OF ANY KIND INTO THIS PRODUCT
THROUGH OPENINGS AS THEY MAY TOUCH DANGEROUS
VOLTAGE POINTS OR SHORT-OUT PARTS THAT COULD RESULT
IN A FIRE OR ELECTRIC SHOCK. NEVER SPILL LIQUID OF ANY
KIND ON OR IN THE PRODUCT.**

Do not install this equipment in areas of high humidity or where there is a danger of water ingress.

2.3.6 Lightning Protection

**WARNING...
IF THE MODULATOR HAS BEEN SUBJECT TO A LIGHTNING
STRIKE OR POWER SURGE WHICH HAS STOPPED IT WORKING,
DISCONNECT THE POWER IMMEDIATELY. DO NOT RE-APPLY
POWER UNTIL IT HAS BEEN CHECKED FOR SAFETY. IF IN
DOUBT, CONTACT DMV CUSTOMER SUPPORT.**

Where appropriate, ensure this product has an adequate level of lightning protection. Alternatively, during a lightning storm or when it is left unattended and unused for long periods of time, unplug it from the supply outlet and disconnect the antenna or cable system. This will prevent damage to the product due to lightning and power-line surges.

2.4 AC Supply Operating Voltage and Fusing — Safety Information

2.4.1 AC Power Supply

Take note of the following points before connecting the Modulator to the mains supply.

1. The power supply used in this equipment is a universal mains-voltage input type. There are no mains voltage links etc. to be altered for operation from different mains supplies.
2. Before connecting the modulator to the supply, check the supply requirements specified in Annex B.
3. The equipment is fitted with a single live conductor fuse located in the fuse carrier of the mains input connector on the rear panel. The same fuse is suitable for all specified voltages. Mains connection polarity must be observed.
4. Do not overload wall outlets and extension cords as this can result in a risk of fire or electric shock.

2.4.2 Power Cable

Disposal of Moulded Plugs

WARNINGS...
IF THE MOULDED PLUG FITTED TO THE POWER CABLE SUPPLIED WITH THIS EQUIPMENT IS NOT REQUIRED, PLEASE DISPOSE OF IT SAFELY. FAILURE TO DO THIS MAY ENDANGER LIFE AS LIVE ENDS MAY BE EXPOSED IF THE REMOVED PLUG IS INSERTED INTO A MAINS OUTLET.

AC Power Supply Cable

This equipment is supplied with a two metre detachable power supply cable fitted with a moulded plug suitable for either the USA, UK or Europe.

Protection

Power supply cables should be routed so that they are not likely to be walked on or pinched by items placed upon or against them, paying particular attention to cords at plugs, convenience receptacles, and the point where they exit from the equipment.

Wire Colours

The wires in the power supply cable are coloured in accordance with the colour code shown in Table 2.1.

	UK (BS 1363)	Europe (CEE 7/7)	USA (NEMA 5-15P)
Earth:	Green-and-yellow	Green-and-yellow	Green
Neutral:	Blue	Blue	White
Live:	Brown	Brown	Black

Table 2.1: Supply Cord Wiring Colours

Functional/Protective Earth

WARNING...

1. THE EQUIPMENT MUST BE CORRECTLY EARTHED THROUGH MOULDED PLUG SUPPLIED WITH THE EQUIPMENT . IF THE LOCAL AC POWER SUPPLY DOES NOT HAVE AN EARTH CONDUCTOR DO NOT CONNECT THE EQUIPMENT. CONTACT DMV CUSTOMER SUPPORT FOR ADVICE.
2. THE PROTECTIVE EARTH IS CONNECTED INTERNALLY TO THE FUNCTIONAL EARTH TERMINAL. IF THE REAR PANEL EARTH TERMINAL ASSEMBLY IS LOOSE, DO NOT POWER THE UNIT. CONTACT DMV CUSTOMER SUPPORT FOR ADVICE.

This equipment has a Functional Earth terminal located at the rear panel. This is not a Protective Earth for electric shock protection. The terminal is provided to:

1. ensure all equipment chassis fixed within a rack are at the same technical earth potential. To do this, connect a wire between the functional earth terminal and a suitable point on the rack;
2. eliminate the migration of stray charges when connecting between equipments.

Fuse Replacement

In addition to the fuse in the supply cable plug (if appropriate) there is a power supply fuse located at the rear of the equipment (see Figure 2.3 or Figure 2.4).

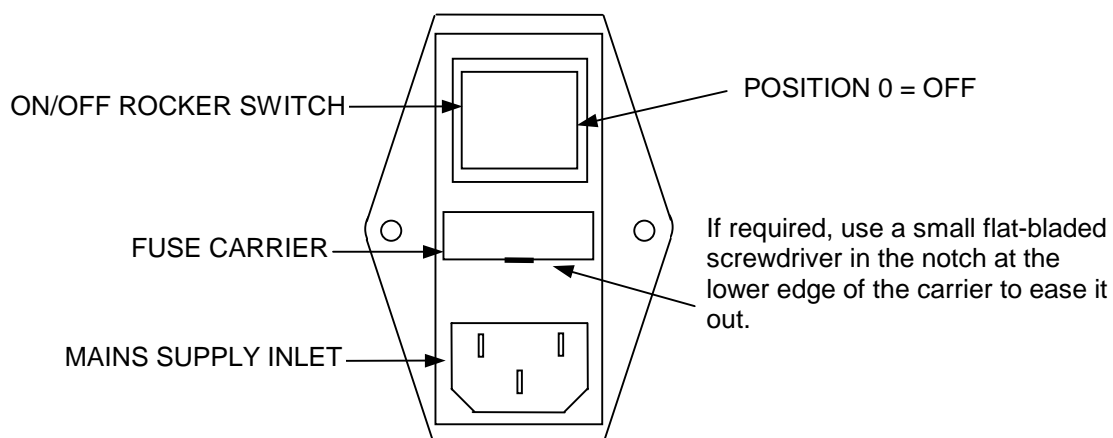


Figure 2.2: Main Connector Fuse-Carrier Location

Fuse Replacement

WARNING...

WHEN REPLACING THE POWER INPUT FUSE, ALWAYS ENSURE THAT A FUSE OF THE CORRECT TYPE AND RATING IS FITTED, ACCORDING TO THE INTENDED OPERATING VOLTAGE. FAILURE TO DO SO WILL RESULT IN INADEQUATE PROTECTION.

The equipment fuse is held in an integral fuse carrier at the a.c. power inlet at the rear of the Modulator.

Item	Specification
Fuse	Fuse in live conductor in power input filter at rear of unit
Fuse type	5mm x 20mm time-delay IEC (EN 60127-2 Sheet 5) High breaking capacity: 1500 A
Fuse rated current	3.15 A
Fuse rated voltage	250 Vac.
Power lead connector fuse (if appropriate)	5 A

Table 2.2: Fuse Information

To replace the a.c. power fuse:

1. Ensure that power is turned off and the power cable is disconnected from the a.c. power inlet.
2. Ease out the fuse carrier by placing a thumbnail (a small, flat-bladed screwdriver may be used) in the fuse carrier.
3. Insert the fuse carrier back in the a.c. power inlet. Ensure that the the fuse is correct for the operating voltage to be used.
4. Replace the fuse in the carrier at the side corresponding to the operating voltage to be used.

2.4.3 Connecting the Equipment to the AC Power Supply

Use the following steps to connect the Modulator to the Local AC power supply.

1. Local AC Power Supply
Ensure the local mains supply is switched OFF
2. Modulator
Ensure the mains input switch on the rear of the Multiplexer is switched OFF and the correct fuse is fitted.
3. Supply Lead
Connect the mains lead to the Modulator mains input connector and then to the local mains supply.

Persistent Fault

If the replacement fuse also blows, do not continue. Disconnect the equipment and contact DMV Customer Support for advice.

2.5 External Connections

2.5.1 General

Rear Panel

There are two rear panel designs associated with the Modulator. These are shown in the following figures. The connections are also shown schematically in Figure 2.5 and Figure 2.6.

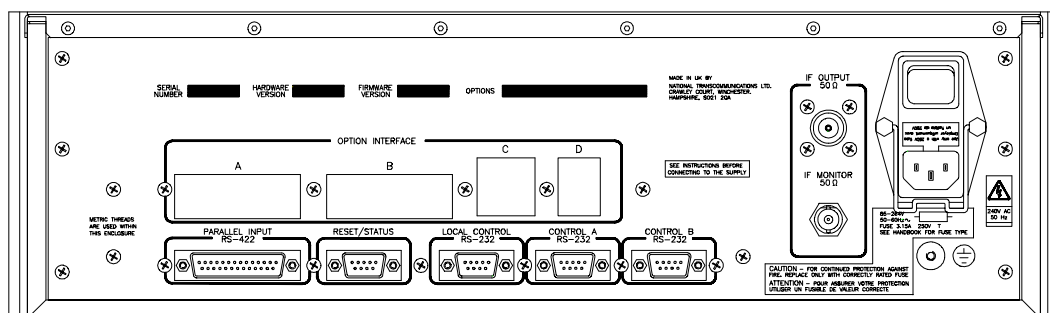


Figure 2.3: Original Rear Panel Layout

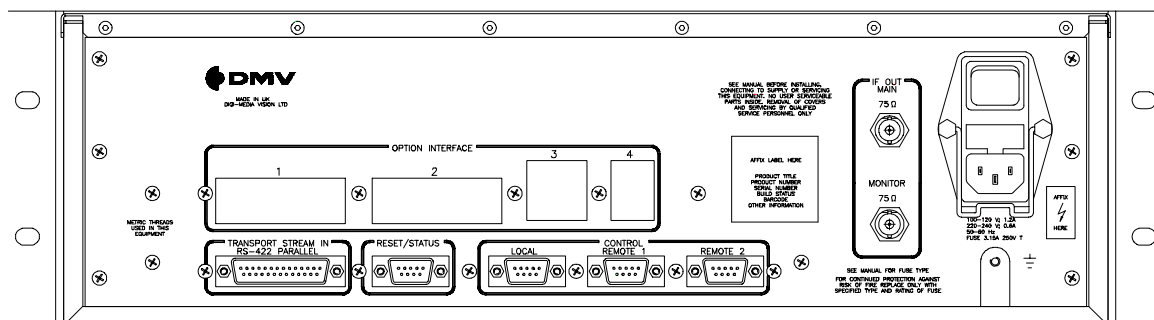


Figure 2.4: DMV Rear Panel Layout

Connector Referencing

The tables overleaf give the connector designations in the following format:

Original Rear Panel Designation : DMV Rear Panel Designation.

A single entry indicates that the legend is the same in both cases.

EMC Requirement

Use the specified cables supplied for signal integrity and compliance with EMC requirements.

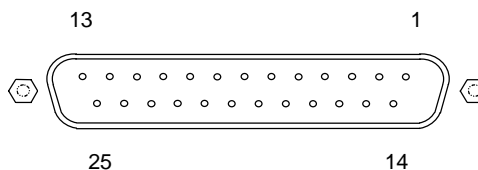
Interface Safety Status

All Modulator signal interfaces are SELV type.

2.5.2 Input Signal Connection

RS-422 Parallel Input

This packet data interface is byte wide and comprises a continuous (204 byte format) data, clock and packet-start bit-stream.

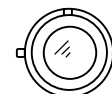


Item	Specification			
Connector type	25-way D-type female			
Connector designation	PARALLEL INPUT RS-422 : TRANSPORT STREAM IN, RS-422 PARALLEL			
Configuration	DCE			
Pins	Pin 1	GND	Pin 14	DATA 0B
	Pin 2	DATA 0A	Pin 15	DATA 1B
	Pin 3	DATA 1A	Pin 16	DATA 2B
	Pin 4	DATA 2A	Pin 17	DATA 3B
	Pin 5	DATA 3A	Pin 18	DATA 4B
	Pin 6	DATA 4A	Pin 19	DATA 5B
	Pin 7	DATA 5A	Pin 20	DATA 6B
	Pin 8	DATA 6A	Pin 21	DATA 7B
	Pin 9	DATA 7A	Pin 22	P SYNC B
	Pin 10	P SYNC A	Pin 23	CLOCK
	Pin 11	CLOCK A	Pin 24	BT_BYTE_CLK
	Pin 12	T_BYTE_CLK	Pin 25	GND
	Pin 13	GND		

Table 2.3: RS-422 Parallel Input

Serial Optical Input (option module)

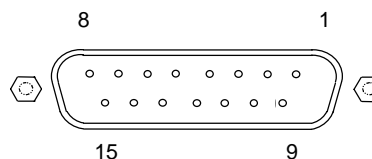
This is an asynchronous interface with a fixed link-byte-rate and a selectable data rate.



Item	Specification	
Connector type	ST (Registered design)	
Connector designation	OPTION INTERFACE 4 (originally D)	
Pins	Centre Screen	Signal Chassis

Table 2.4: Serial Optical Input

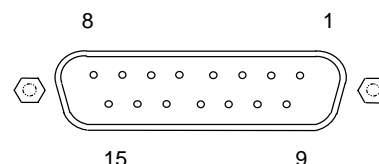
RS-422 Serial Input (option module)



Item	Specification			
Connector type	15-way D-type female			
Connector designation	OPTION INTERFACE 2 (originally B)			
Configuration	DCE			
Pins	Pin 2	IDATA	Pin 9	\IDATA
	Pin 6	OCLK	Pin 13	\OCLK
	Pin 7	ICLK	Pin 14	\ICLK
	Pin 8	GND		

Table 2.5: RS-422 Serial Input

LVDS Serial Input (option module)



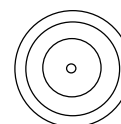
Item	Specification			
Connector type	15-way D-type female			
Connector designation	OPTION INTERFACE 2 (originally B)			
Configuration	DCE			
Pins	Pin 2	IDATA	Pin 9	\IDATA
	Pin 6	OCLK	Pin 13	\OCLK
	Pin 7	ICLK	Pin 14	\ICLK
	Pin 8	GND		

Table 2.6: LVDS Serial Input

2.5.3 Output Signal Connections

Main IF Output

Connect the IF output, at the N-type connector, to the satellite up-link frequency up-converter (via an output router, if required by the redundancy configuration).

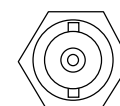


Item	Specification	
Connector designation	IF OUTPUT 50 Ω : IF OUT — MAIN 50 Ω	
Connector type	N (Female)	
Output impedance	50 Ω	
Pins	Centre:	Signal
	Screen:	Chassis

Table 2.7: Main IF Output

IF Monitor Output

If required, connect the IF monitor output, at a BNC connector, to the monitoring equipment. This output need not be terminated in 50 Ω (ie: it can be left open-circuit).



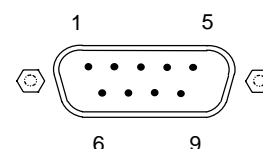
Item	Specification	
Connector designation	IF MONITOR 50 Ω : IF OUT — MONITOR 50 Ω	
Connector type	BNC (Female)	
Output impedance	50 Ω	
Pins	Centre:	Signal
	Screen:	Earth

Table 2.8: IF Monitor Output

2.5.4 Control and Monitoring Connectors

Remote Control Connector

This connector is primarily intended for connection of the System 3000 Multiplex Control Computer (MCC).

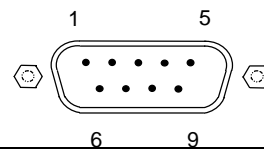


Item	Specification
Connector type	9-way D-type male
Connector designation	CONTROL A RS-232 : CONTROL — REMOTE 1
Configuration	DTE
Pins	Pin 1 Input: Data Carrier Detect (DCD) Pin 2 Input: (Receive Data (RXD)) Pin 3 Output: Transmit Data (TXD) Pin 4 Output: Data Terminal Ready (DTR) Pin 5 Ground Pin 6 Input: Data Set Ready (DSR) Pin 7 Output: Request to Send (RTS) Pin 8 Input: Clear to Send (CTS) Pin 9 Input: Ring Indicator (RI)

Table 2.9: Remote Control

Local Control RS-232 Connector

For the connection of the local control terminal. This is primarily an engineering/development port and, in normal circumstances, is not intended as a user function.



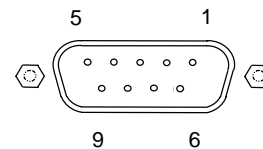
Item	Specification
Connector type	9-way D-type male
Connector designation	LOCAL CONTROL RS-232 : CONTROL — LOCAL
Pins	Pin 2 RXD Pin 3 TXD Pin 5 GND All other pins not connected

Table 2.10: Local Control

For connection to a standard 9-way serial socket on a VT™-100 terminal or PC, a 9-way female to 9-way female lead is required with the following connections: 2 - 3; 3 - 2; 5 - 5.

Reset / Status Signalling Port

Alarm/fault monitoring is available via the RESET / STATUS connector located at the rear panel.



Item	Specification
Connector type	9-way D-type, Female
Connector designation	RESET/STATUS
Pin:	Pin 1 — Protective ground Pin 2 — FAIL (common) Pin 3 — ALARM (make to common when OK) Pin 4 — ALARM (make to common when not OK) Pin 5 — RESET (5 Ω to 0 V)* Pin 6 — FAIL (Make to common when OK) Pin 7 — FAIL (make to common when not OK) Pin 8 — ALARM (common) Pin 9 — RESET (178 Ω to +5 V)*
* Short pins 5 and 9 for system reset.	

Table 2.11: Reset/Fault Connector

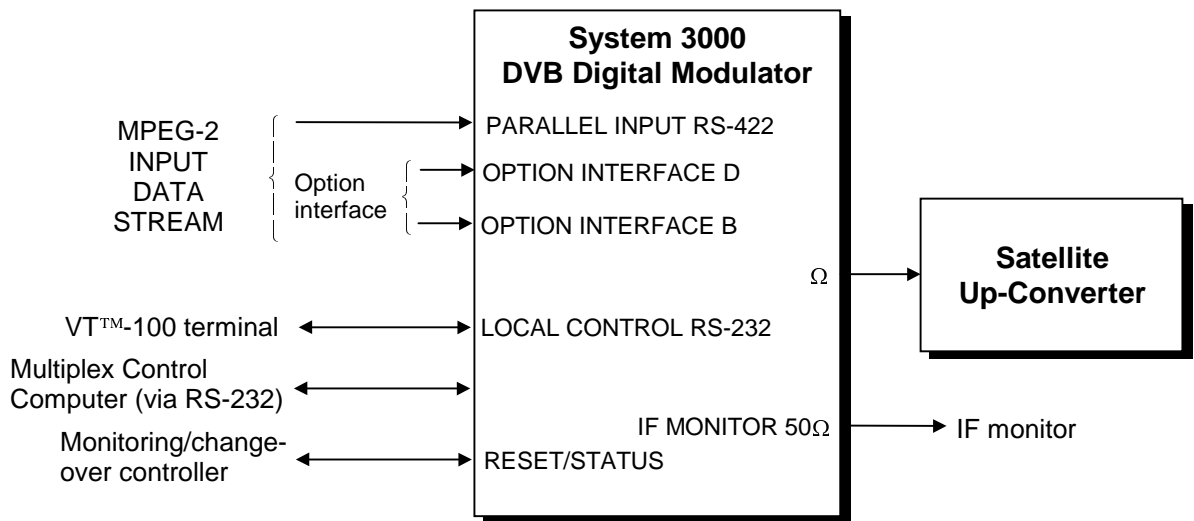


Figure 2.5: Original Equipment Connections

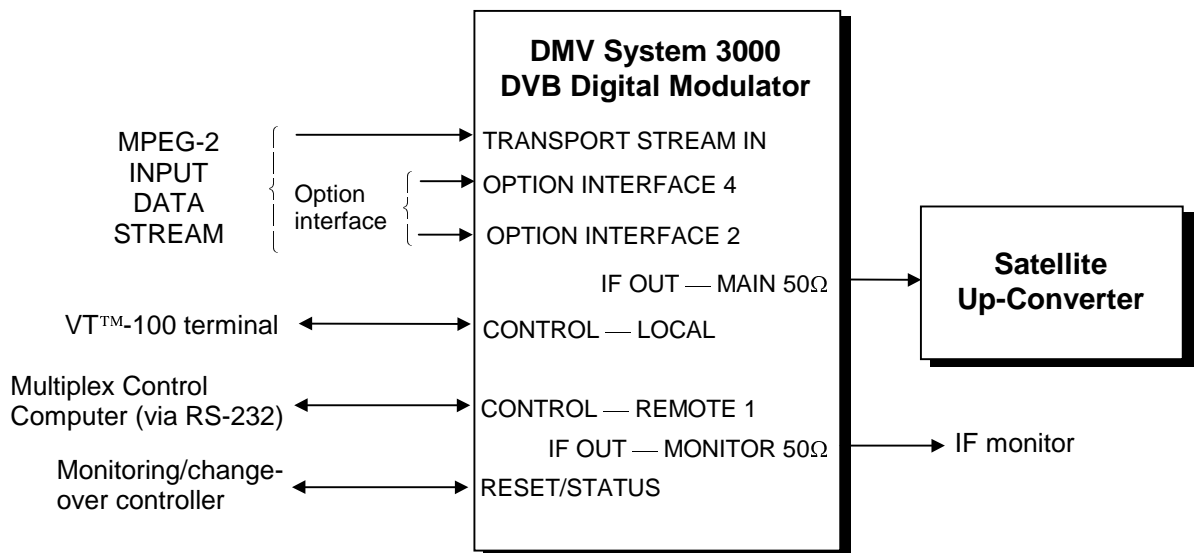


Figure 2.6: DMV Equipment Connections

2.6 Disposing of this Equipment

2.6.1 General

Dispose of this equipment safely at the end of its life. Local codes and/or environmental restrictions may affect its disposal. Regulations, policies and/or environmental restrictions differ throughout the world. Contact your local jurisdiction or local authority for specific advice on disposal.

2.6.2 Beryllium Copper Strips

Beryllium Copper finger strips are used in this equipment to seal the enclosure for EMI protection. This arrangement is perfectly safe during normal operation. Do not file Beryllium Copper or otherwise cause them to produce dust or particles.

Chapter 3

OPERATION, FRONT-PANEL AND LOCAL CONTROL

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3.1 Operation

3.1.1 Powering the Equipment

Switching On

Switch the equipment on at the rear panel and ensure that the two cooling fans are working.

CAUTION...

If the fans are not rotating, switch off the equipment immediately and contact the manufacturer.

Although the System 3000 DVB Digital Modulator may be used immediately after switching on, it is advisable to allow a warm-up period of at least five minutes to achieve operational temperature stability.

LCD Title Message

On power-up, the front panel LCD display will show a different title depending on which option-interface card (if any) is fitted. The upper line will show **MODULATOR** and the lower line will show one of the following:

M2/MDV/FRT	No option-interface card fitted
M2/MDV/422-S	RS-422 serial option-interface card fitted
M2/MDV/OPT	Optical option-interface card fitted
M2/MDV/LVDS-S	LVDS serial option-interface card fitted

Front Panel LED Indications

The Modulator has the following front-panel LEDs.

LED	Description
Power	Green LED; ON indicates that the unit is powered
Alarm	Red LED; ON indicates an alarm condition
Input Lock	Green LED; ON indicates that Modulator is correctly locked to the transport multiplex input signal
Local Control	Amber LED; ON indicates equipment set for control from the front panel or via the LOCAL CONTROL RS-232 : CONTROL — LOCAL port
Remote Control	Amber LED; ON indicates equipment set to remote control via CONTROL A RS-232 : CONTROL — LOCAL port

Table 3.1: Description of Front Panel LEDs

LED Colour Coding Philosophy

The LED colours used in System 3000 equipment are red, green and amber. Red is used to indicate fault conditions, e.g. a missing or faulty input signal; for correct operation, all red LEDs must be off, although some may be on during power-up. Green is used to indicate correct conditions and correct system functioning; for normal operation, all green LEDs must be either on continuously or blinking periodically. Amber is used to indicate various system status conditions, e.g.: selected mode. Thus, for normal operation, amber LEDs may be either on or off or flashing.

This colour coding principle enables identification by the operator of the equipment's operational status, i.e: any red LEDs on or green LEDs permanently off indicates a fault condition.

3.1.2 Bit-Rate, FEC-Rate and Modulation Type

For the basic Modulator, an operator could attempt to set a combination of certain bit-rate, FEC-rate and modulation type (BPSK¹/QPSK) values which could produce a PSK symbol-rate in excess of the upper modulation limit (30 Msymbols/s). To prevent this, the modulation type and/or the FEC-rate is automatically set by the Modulator control system to bring the symbol rate within valid limits. *FEC-rate* and *modulation type* commands entered which would produce an excessive symbol-rate for the set bit-rate cause an *invalid command* message to be displayed and the command to be disregarded.

NOTE...

The operator is not informed of these automatic changes and should be aware of the relationship between the bit-rate (R_i), FEC-rate and BPSK/QPSK symbol-rate (R_s).

If an option module is fitted, there is a direct bit-rate limit for that unit which must not be exceeded.

The allowable bit-rates are listed in Table 3.2.

The proper order of entry of these parameters is:

1. Bit-rate;
2. FEC-rate;
3. Modulation type;
4. Interface.

In this case a valid parameter set can be entered.

When a bit-rate is entered, the control system assumes that the parameters which follow it are consistent with that bit-rate and the equipment bit/symbol-rate limits.

Table 3.2 shows the Modulator Input Interface Maximum Bit-Rate R_i for Indicated Convolutional FEC Rate and Modulation Type.

Convolutional FEC-Rate	Bit-Rate R _i for Indicated FEC-Rate and PSK Modulation Type (Mbit/s)	
	BPSK	QPSK
1/2	15	30
2/3	20	40
3/4	22.5	45
5/6	25	50
7/8	26.25	52.5

Table 3.2: Modulator Input Interface Maximum Bit-Rate

¹ BPSK is implemented in this version of firmware but has not been fully tested. Please refer to DMV Customer Services if further information is required.

3.2 Modulator Control

3.2.1 Control Modes

The Modulator has three control modes: Front-panel; Local RS-232 and Remote. When the Modulator is not being actively controlled, it reverts to *normal* mode. In *normal* mode, the Modulator operates with no control input by the operator. Control can be gained by:

1. The front panel (Front-panel control mode);
2. The local control input (via the connector LOCAL CONTROL RS-232 : CONTROL — LOCAL);
3. The remote controller (using the CONTROL A RS-232 : CONTROL — REMOTE 1 connector).

Control access by any one mode (other than normal) inhibits the others. The Modulator responds to certain non-executable remote commands (e.g.: Status and Health polls). Figure 3.1 illustrates this principle.

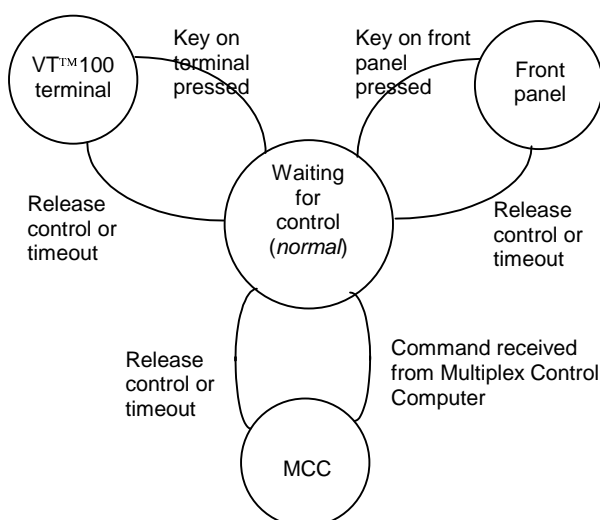


Figure 3.1: Gaining Control of the Modulator

Release of control is available from all three modes of operation. There is an automatic *local time-out* period to prevent control lock-out due to an operator failing to release control manually. If no executable control operations have occurred, reversion to *normal* mode takes place. This period can be set in the range 1-30 minutes with a default set at 60 seconds (refer to para 3.3.13). Factory set defaults are described in Chapter 5.

The MCC shown in Figure 3.1 is the System 3000 Multiplex Control Computer which normally forms the control element of the system. It uses the *CONTROL A RS232 : CONTROL — REMOTE 1* connector.

3.2.2 Saving the Current Configuration

After a Modulator operating configuration change, the new configuration is stored in NV-RAM when control is *released* or a *control time-out* occurs before powerdown. Thus the current operating configuration becomes the power-up configuration when the Modulator enters the *normal control* state.

3.3 Front Panel Control

3.3.1 Front Panel Description

The front panel has six dedicated top-level function keys, each with an in-built green LED indicator, an LCD display with two lines of 20 characters each, cursor keys, a numeric key pad, an *Enter* and a *Clear* key and five status LEDs.

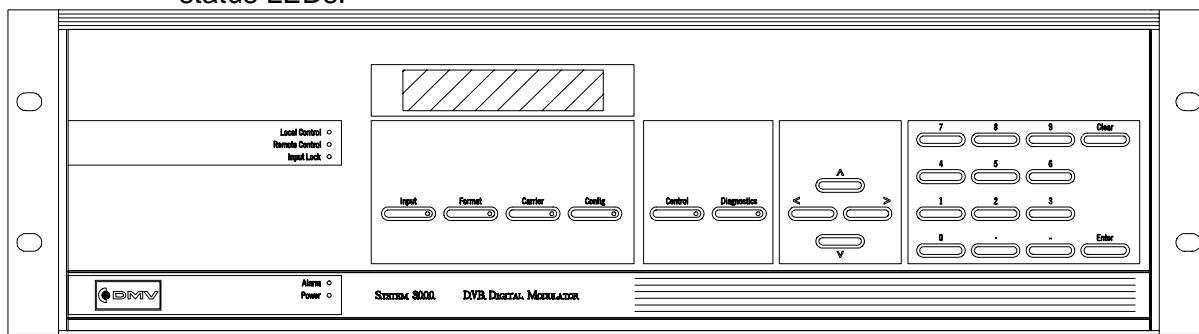


Figure 3.2: Front Panel Layout

LCD displays two 20 character lines which together constitute a *menu display*. Each *menu display* corresponds to a *configuration item* from the overall Modulator *operating configuration*. The *menu display* and *function keys* allow menu selection, or entry of the value of, and/or control of a *configuration item*.

Parameter values may be entered by numeric value (for a continuously variable parameter) or by selection from a parameter value-list (for discrete-value parameters).

Examples of parameters that are of the variable type are the bit-rate and the IF power. The numeric key-pad is used for entering the values required for the variable-type parameters such as *bit-rate* and *frequency* (followed by the *Enter* key).

Example of parameters that are selected from a value list are the *FEC-rate*, *clock source*, setting the *IF output on/off* and selection of the *input interface*.

A configuration item is selected by pointing to the item with the cursor arrow in the parameter list and pressing the *Enter* key. After selection, the Modulator configuration may take some time to change. In these instances the following message is displayed until the change has taken effect.

```
Initialising ...
Please wait ...
```

Each of the six dedicated function keys provides an entry point into a different branch of Modulator control. For example, the *Carrier* function key allows the operator to move down the menu branch used for setting the Modulator *frequency*, *power* and *carrier* state etc. The *Config* key allows the operator to scroll through and view the current configuration (without changing anything). An LED in the function key lights when a key is pressed to indicate that it is active.

Diagrams showing the menus available are shown in Figure 3.5 to Figure 3.10.

3.3.2 Moving Through the Menus

Each function key allows a one-way scroll through its menu branch. When a function key is pressed, the LCD shows the first *menu display* for that function key, as shown in the menu diagrams. The next *menu display* in that branch is shown by moving the cursor (using the arrow keys: ← →) to the required item on the menu and pressing the same function key again. Continual pressing will scroll through each display until the end of the branch, after which a further press of the function key will return back to the top *menu display*.

When scrolling through the *Config* key branch and the *Status* path of the Diagnostics key branch, the up and down arrow keys (↑ ↓) are used to move from one menu display to another. In Figure 3.8 and Figure 3.10, this is indicated by the use of double (instead of single) headed arrows. Single headed arrows indicate that a function key allows movement in one direction only.

3.3.3 Viewing and Changing Modulator Set-up

Initially, only a *view* mode of access is granted when front panel control is first acquired. This prevents any parameters from being changed inadvertently. To allow changes to the Modulator configuration, set the selection/cursor arrow to point to SETUP in the following screen:

```
FP Control Mode :
VIEW SETUP
```

This is situated at the top of the *control* branch, and press *Enter* to select the *set-up* mode of control. The Modulator configuration can now be changed.

If alteration of the configuration is attempted without selecting *set-up* mode, the following message is displayed:

```
!!! View Mode
Only
CLEAR to continue
```

Press the *Clear* key to revert to the previous screen and enter the *set-up* mode.

NOTE...

The Modulator front panel control will automatically revert to *view* mode if the *local time-out period* expires.

3.3.4 Menu-Selectable Parameters

The *menu display* comprises two lines. The upper line describes the configuration item. The lower line displays a list of possible choices for that configuration item (sub-menu, parameter value, mode or control function).

When entering a new menu display screen, the selection arrow points to the current operating selection (on the lower line). The left and right arrow keys move the selection arrow to point to the next selection.

The new item is selected using the *Enter* key.

Figure 3.3 shows (as an example) the menu display for the FEC selection.

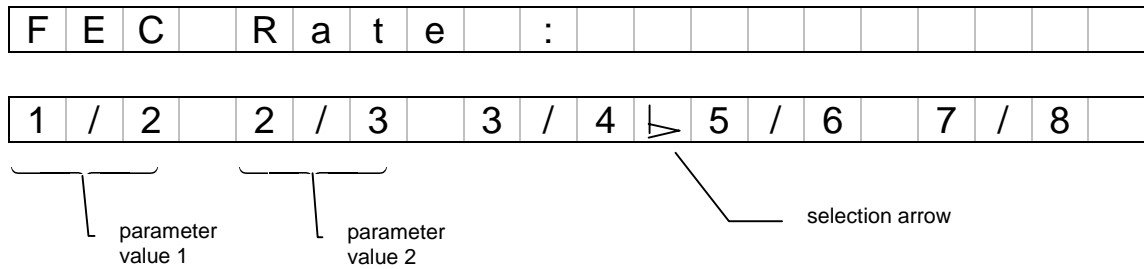


Figure 3.3: LCD Display for FEC Selection

3.3.5 Variable Parameters

Again the *menu display* comprises two lines; the upper line shows the selected configuration item and the lower line gives the current parameter value of that configuration item.

When a new menu screen is entered for a configuration item which has a variable parameter, the cursor is initially on the first digit position of the parameter value. If the next key to be pressed is a digit, the complete parameter value field is cleared and a new value can be entered.

Alternatively, any digit within the parameter's field can be changed by using the right and left arrow keys to move the cursor to the required position and over-typing. Figure 3.4 gives two examples of variable parameter displays.

Prior to pressing the *Enter* key, the parameter can be reset to its current operating value by pressing the *Clear* key. The new parameter setting becomes current after pressing the *Enter* key.

An invalid entry causes the Modulator to emit a low-frequency bleep whilst displaying the following message:

```
Invalid Input -
Press
Clear to continue
```

After pressing the *Clear* key to cancel this message, the display reverts to the current operating parameter value.

Figure 3.4 shows (as an example) the menu display for bit-rate and IF frequency value entry.

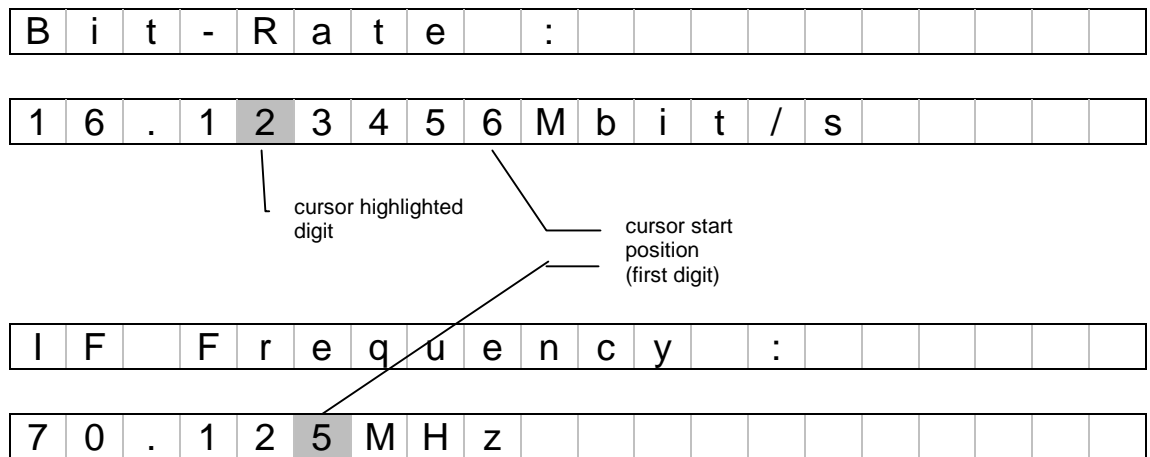


Figure 3.4: Changing Variable Parameter Values

3.3.6 Saving the Current Configuration

After a Modulator operating configuration change, the new configuration is stored in NV-RAM when control is *released* or a *control time-out* occurs before power-down. Thus the current operating configuration becomes the power-up configuration when the Modulator enters the *normal control* state.

3.3.7 Configuring Alarm / Fail Indications

The menu for setting these indications is in the *Control* branch . The menu format is shown below.

Alarm Response:
ABCDEF GH

where AB, CD, EF, GH represents 2-digit decimal numbers. To set the desired conditions, define and enter the numeric values as described in section 3.5 later in this chapter.

3.3.8 Viewing the Modulator Configuration

To view the current configuration of the Modulator, scroll down the *Config* branch.

3.3.9 Viewing the Modulator Status

To view the status of the Modulator, scroll down the *status* path of the *Diagnostics* branch.

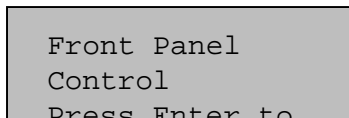
3.3.10 Modtest Test Signals

The Modtest signals available are described in Chapter 5. A specific *Modtest* is started by selecting it in *the Diagnostics, Test, Modtest* branch. However, it must be de-selected for reversion to normal operation on completion of the test, otherwise the Modulator will remain in the test mode indefinitely. To exit the *test* mode, select the last *menu display* in the *Modtest* branch:

```
Modulator Test :
Press Enter to
exit
```

3.3.11 Releasing Control

To set the Modulator into the *normal* control state, select the following option from the *Control* menu.



Press *Enter* and the LCD display reverts to the title message. Releasing control saves the current operating configuration in NV-RAM.

Control is regained by pressing any front panel key. A second key-press is necessary to access the menus.

3.3.12 Option-Interface Cards

The first menu in Figure 3.5 differs depending on whether an option-interface card is fitted. If no card is fitted, the menu is as shown. If a card is fitted, the menu shows the card-type in place of *option*. The right-hand path is only available when an RS-422 serial or an LVDS card is selected.

The *Option i/f Decode* menu (*i/f* stands for interface) enables Reed-Solomon decoding of the input transport multiplex to be switched *ON/OFF*.

NOTE...

This must be ON if RS-422 serial or LVDS input is Reed-Solomon encoded.

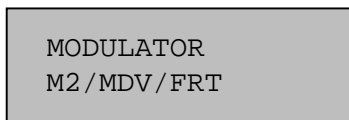
The *Option i/f De-int* menu allows de-interleaving of the input transport multiplex to be switched *ON/OFF*.

NOTE...

This must be ON if RS-422 serial or LVDS input is interleaved.

3.3.13 Local Time-Out

After a *control time-out* period (programmable between 1 and 30 minutes) during which no front panel keys are pressed, the Modulator enters the *normal* control state. The LCD displays the title message, for example:



All the Modulator configuration settings are retained in NVRAM.

3.3.14 Loss of Input Lock

The Modulator is set up to produce a known output in the event of loss of input lock. This is set in the *MOD* menu in Local Control; using the Carrier function key in Front Panel Control mode or the Input Fail Response message in Remote Control mode.

Input Interface	Signal Format Options
RS-422 parallel	Off / $2^{15} - 1$ PRBS
RS-422 serial	Off / $2^{15} - 1$ PRBS (ETS 300 421)
Optical	Off / $2^{15} - 1$ PRBS
LVDS serial	Off / $2^{15} - 1$ PRBS (ETS 300 421)

Table 3.3: Options Available on Loss of the Input Lock

3.3.15 Signature Analysis

Selecting the Test

It is possible to perform an automatic *signature analysis* from the front panel by selecting:

```
Signature
Analysis :
Press Enter to
```

in the *Diagnostics, Test, Misc* branch. This selection causes a number of different *bit-rate* and *FEC-rate* to be *set-up* and a *signature analysis* test to be performed for each combination. The total series of successful tests takes approximately six minutes and the operator is given a message indicating the result of the tests. Failure of any test halts the *signature analysis* process.

Software Version 4.3 Onwards

On successful completion of the test, the bit-rate and the FEC-rate will be set to their previously stored values.

If the signature analysis test fails, the Modulator bit rate and FEC-rate will remain as set by the test when it halted.

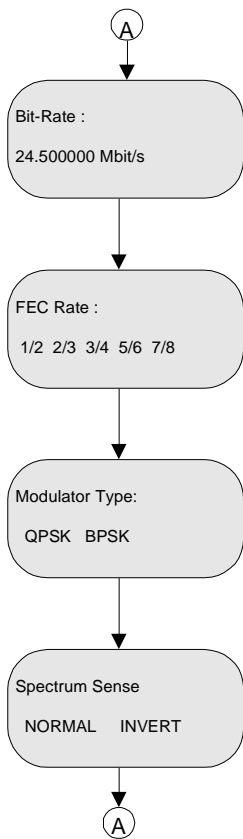
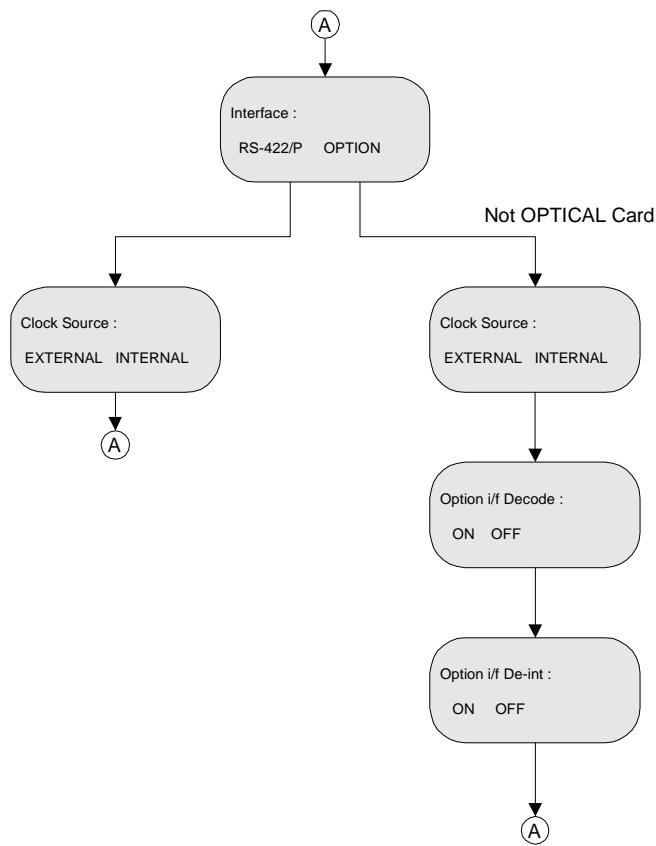


Figure 3.5: Input Function-Key Branch

Figure 3.6: Format Function-Key Branch

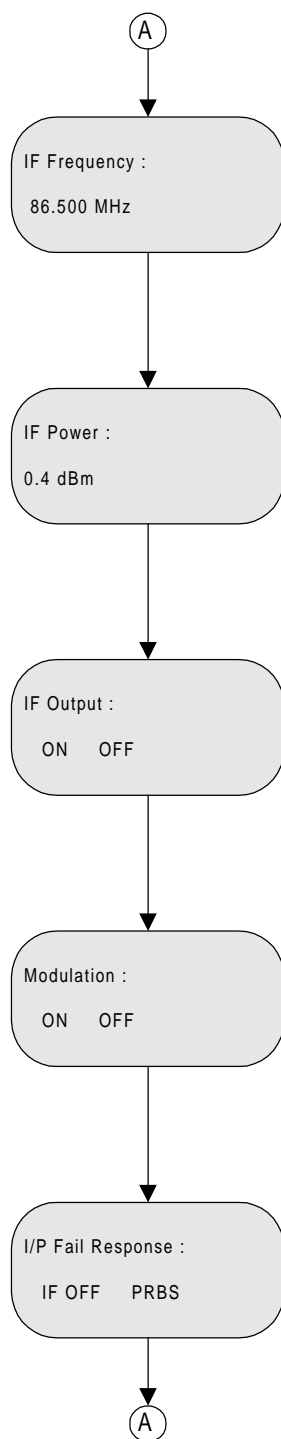


Figure 3.7: Carrier Function-Key Branch

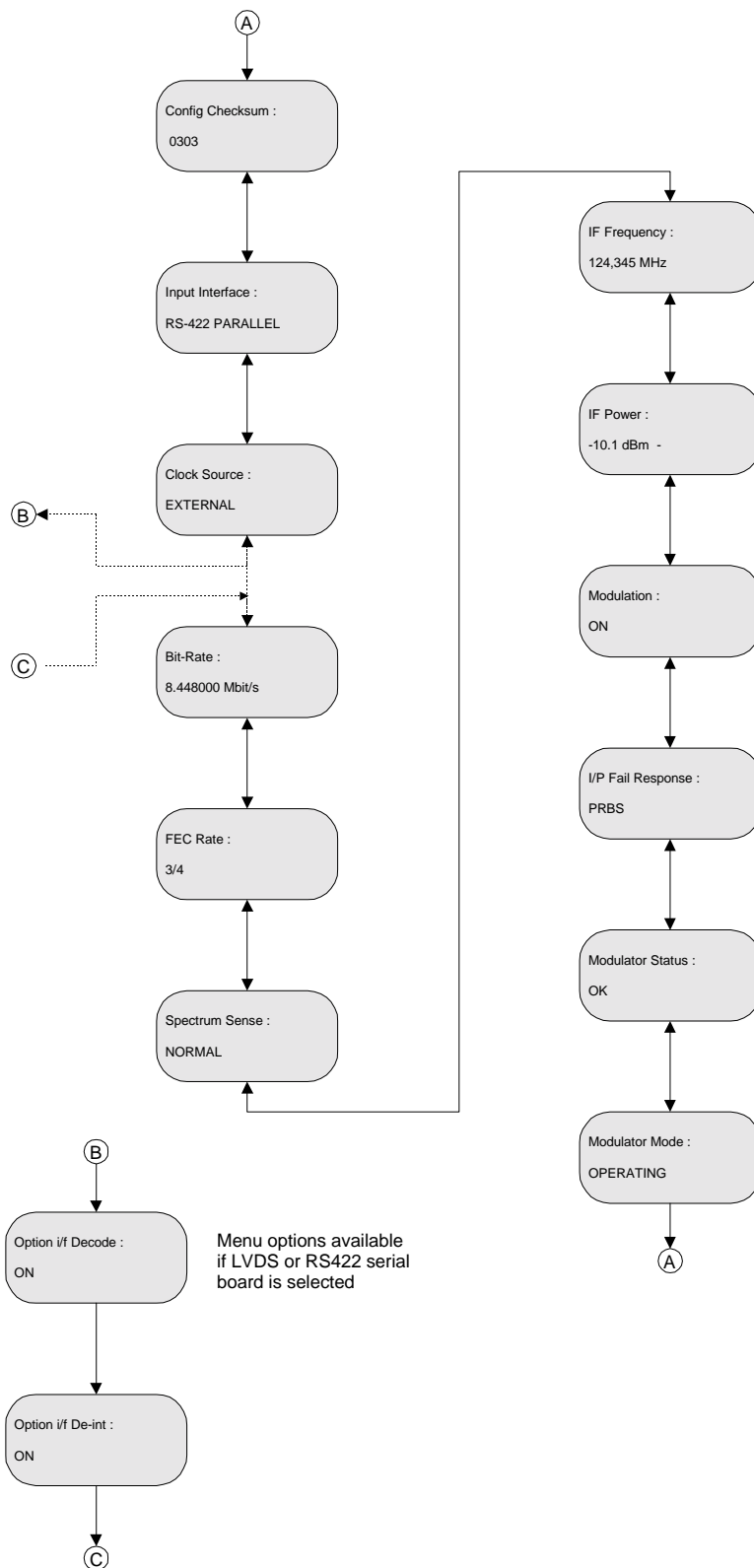


Figure 3.8: Config Function-Key Branch

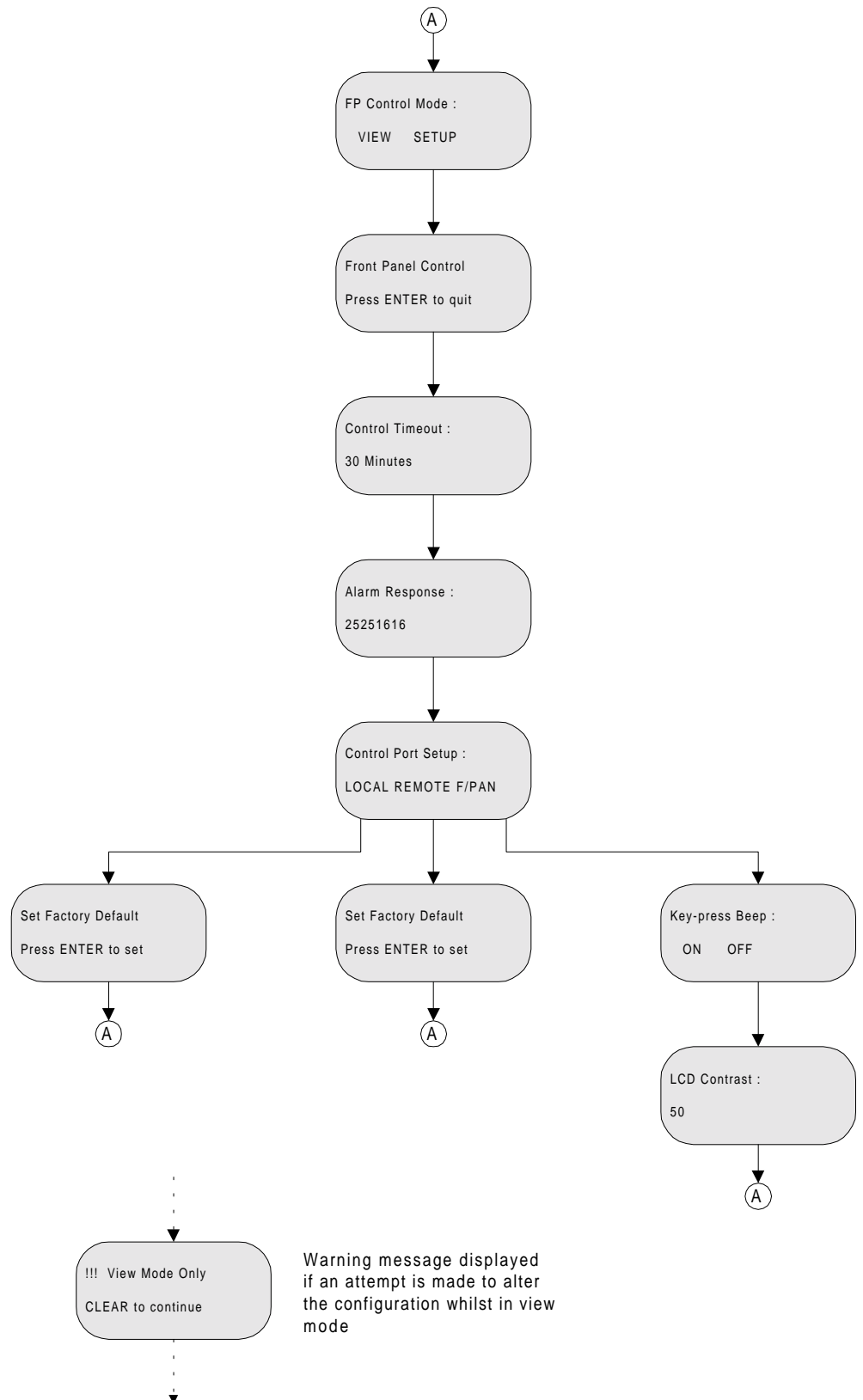


Figure 3.9: Control function-Key branch

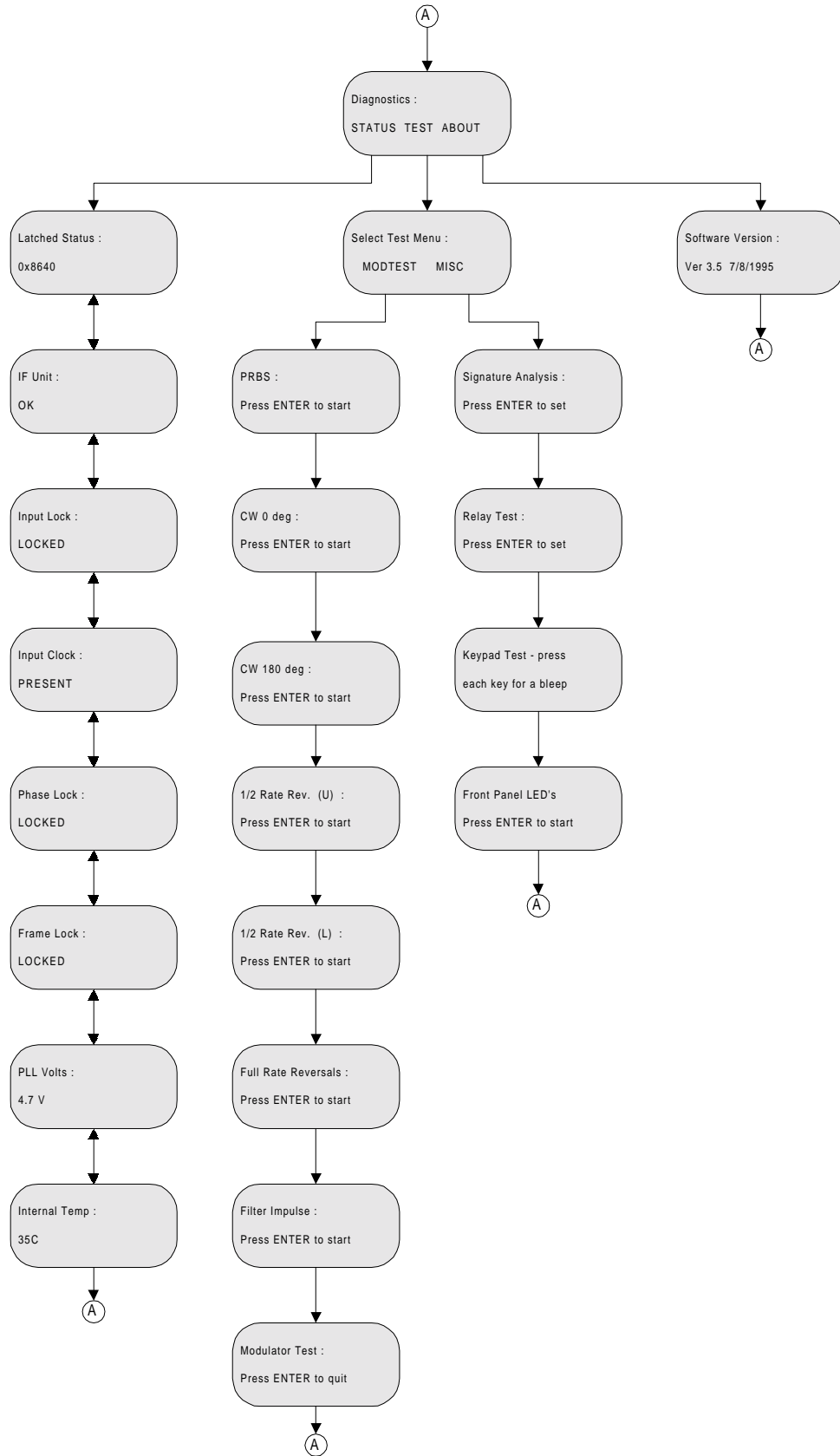


Figure 3.10: Diagnostic Function-Key Branch

3.4 Local Control via a VT™100 Terminal

NTL rear panel

3.4.1 General

Local control and status monitoring, via a VT™100 terminal (or PC terminal emulator), is through *setup*, *command*, *test* and *status*-monitoring menus and screens. This control is accessed through the rear panel LOCAL CONTROL RS-232 : CONTROL — LOCAL port.

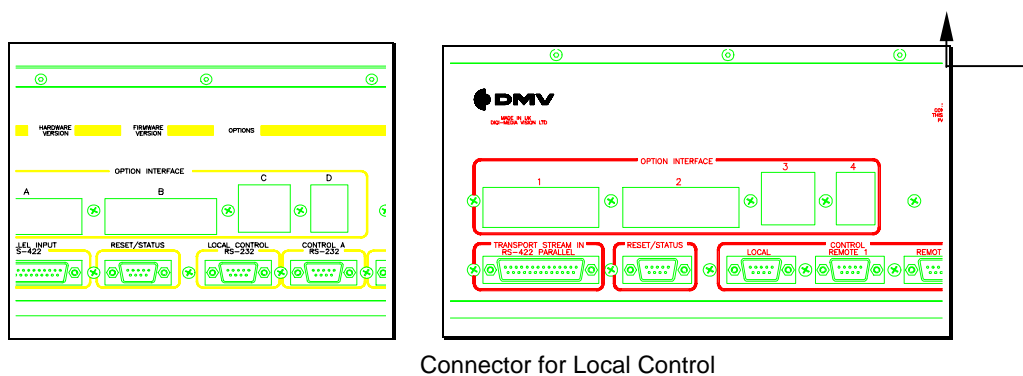


Figure 3.11: Rear Panel Layouts Showing Connector for Local Control

3.4.2 Gaining Control

Control is gained by pressing any key on the terminal keyboard provided the Modulator is in the *normal control* state.

3.4.3 Control Menu System

The software provides a menu system split into a tree structure. The following diagram shows the command menu structure.

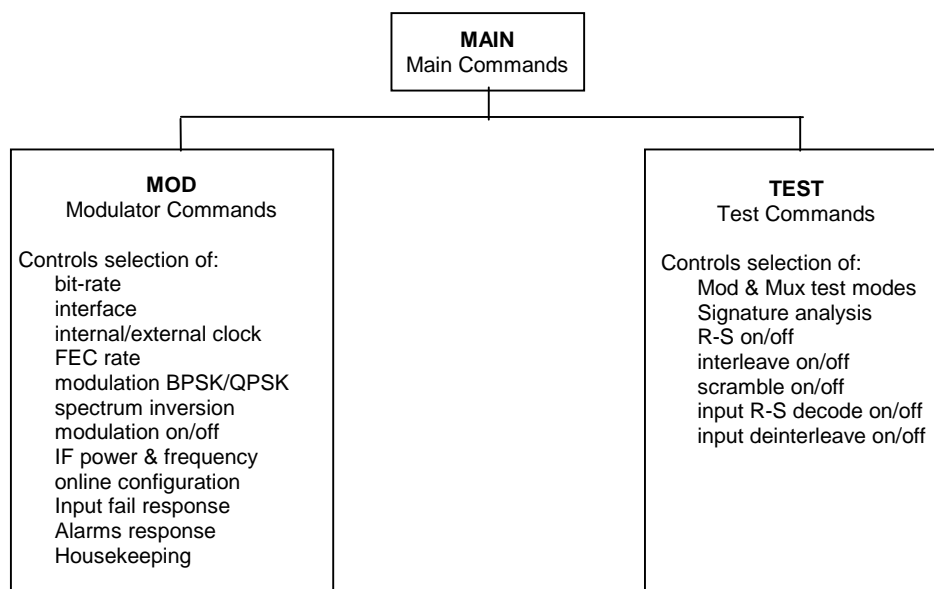


Figure 3.12: Command Menu Structure

Current Modulator status (*Status*) and Operational configuration (*Config*) screens are accessed from *MAIN*, *MOD* or *TEST*. System reset (*Reset*) is accessed from *MAIN*.

3.4.4 Navigating the Menus

Main menu

MAIN level is entered when control is gained and the user may move to the sub-menus by typing the sub-menu name. Return to MAIN from sub-menu is achieved by typing Q. Typing ? at any stage lists a summary of available commands at that menu level. Typing Q from the *MAIN* menu releases control.

Releasing Control

If no key operations occur during the *control time-out* period (see Section One), the Modulator automatically reverts to the *normal* state. This is indicated by the following screen message:

```

...Released
Control
    
```

The Modulator can be set into the *normal* state from the MAIN menu by the Q (Quit) command.

Menu conventions

These are as follows:

- {...} indicates parameter entry (type command, parameter, press return key)
- | indicates options

MAIN Menu Screen Display

```

*****
* NTL DVB Modulator:      Main Commands      *
*****
Control Software Version:  : (version number and date)

Modulator Commands       : MOD
Test Commands            : TEST
Print alarm status       : S or STATUS
Print configuration      : C or CONFIG
Reset                    : RESET
Help                     : ?
Quit local control       : Q
    
```

Main Commands Description

MOD	Enter Modulator commands menu
TEST	Enter test commands menu
STATUS	Print Modulator monitoring and alarm status
CONFIG	Print Modulator configuration currently operating
RESET	Software reset
Q	Reverts Modulator to “normal” state

MOD Sub-Menu Screen Display

```

*****
* NTL DVB Modulator:      Modulator Commands      *
*****
Set/print bit-rate        : BR {Mbit/s}
Select interface          : INTERFACE {RS422 | OPT}
Select int/ext clk       : CLKS {INT | EXT}
Set/print FEC rate       : FEC {N/M}
Set modulation type      : MODT{BPSK | QPSK}
Set spectrum invert      : SPINV {ON | OFF}
Set modulation on/off    : MODU {ON | OFF}
Set/print IF power       : IFP {dBm | OFF | ON}
Set/print IF frequency   : IFF {MHz}
Set online configuration : ONLINE
Input Fail Response      : IPFAIL {ON | OFF}
Alarms Response         : ALARMS {AB CD EF GH}
Name the current config  : NAME {configuration name}
Write configuration      : WRCFG {configuration number}
Read configuration       : RDCFG {configuration number}
Print configuration list  : LIST
Quit to MAIN            : Q
    
```

Modulator Commands Description

BR	Set input bit-rate (Mbit/s)
INTERFACE	Select RS-422 parallel or Option-interface.
CLKS	Select internal or external clock source.
FEC	Select convolutional FEC rate in the form N/M.
MODT	Set BPSK or QPSK modulation
SPINV	Select spectrum invert option. OFF corresponds to DVB specified data to transmit phase coding ² .
MODU	Set normal modulation or CW.
IFP	Set IF power.
IFF	Set IF frequency. (Note: Frequency is automatically rounded to nearest 125 kHz.)
ONLINE	Set Scrambling ON, Reed-Solomon coding ON, Interleaving ON, Test signals OFF, Modulation ON.
IPFAIL	Select action to be taken upon loss of input lock.
ALARMS	Program as described in Annex 6.
NAME	Define a name for current configuration.
WRCFG	Save a configuration under the indicated Configuration Number. Configuration 0 is a factory default configuration. A checksum corresponding to the configuration allows the correct configuration to be rapidly verified. ³
RDCFG	Recall a configuration between 0 and 9. This configuration is automatically made operational.
LIST	Print the list of Configuration Numbers and Names.

² This function is the same as Spectrum Sense in the Front Panel and Remote Control modes. SPINV Off = Spectrum Sense Normal.

³ Configuration 1 is loaded on power-up. The Modulator operating Configuration is always Configuration 1. There are a total of 10 available configurations, which are referenced by a number in the range [0..9]. WRCFG {configuration number} saves the current configuration in the selected configuration number.

TEST Sub-Menu Screen Display

```
*****
* NTL DVB Modulator:      Test Commands      *
*****
Set MOD test mode          : MODTEST {OFF | test signal number}
Set MUX test mode          : MUXTEST {OFF | test signal number}
Signature analysis         : SIG {I | Q}
Set R-S on/off            : RS {ON | OFF}
Set interleave on/off     : INTERLEAVE {ON | OFF}
Set scramble on/off       : SCRAMBLE {ON | OFF}
Opt decode on/off         : DECOD {ON | OFF}
Opt de-interleave on/off  : DEINT {ON | OFF}
Quit to MAIN              : Q
```

NOTE...

DECOD and *DEINT* commands are only displayed if either option-interface card RS-422 serial or LVDS is fitted and selected.

Test Commands Description

- MODTEST** Select modulation test signals generated post convolutional encoder. Described in Chapter 5.
- MUXTEST** The Modulator contains an eight packet period test sequence generator which is enabled by use of the MUXTEST command. There are six predefined test patterns. These are described in Chapter 5.
- SIG I, SIG Q** Signature analysis for verifying the correct operation of digital circuitry in the Modulator.
- To run a signature test, proceed as follows:
- Enter TEST menu from MAIN and set MUXTEST 0.
 - When prompt returns on screen, type SIG I for I channel signatures.
 - Type SIG Q for Q channel signatures.
 - On completion, set MUXTEST OFF or ONLINE to return to normal operating configuration.
- See Table 3.4 for signatures.
- RS** Set Modulator Reed-Solomon coding ON/OFF.
- INTERLEAVE** Set Modulator interleaving ON/OFF.
- SCRAMBLE** Set Modulator scrambling ON/OFF.
- DECOD** Set Reed-Solomon decoding of input transport multiplex ON/OFF.

NOTE...

This must be ON if RS-422 serial or LVDS input is Reed-Solomon encoded.

- DEINT** Set de-interleaving of input transport multiplex ON/OFF.

NOTE...

This must be ON if RS-422 serial or LVDS input is interleaved.

The table below gives the signatures obtained for the indicated software versions.

FEC	R _i	Software Version <3.		Software Version >3.	
		SIG I	SIG Q	SIG I	SIG Q
		Reference	Reference	Reference	Reference
	Mbit/s				
1/2	24	79EF	DB8F	5413	F1A7
2/3	32	8196	A702	0672	952C
3/4	36	4BF1	74EA	A12B	4217
5/6	40	579E	864D	A1AF	9E89
7/8	42	D0E3	7641	89AB	2EBB
1/2	18	8B03	12B9	F396	5218
2/3	24	D6E3	A4A0	F69E	A3A2
3/4	27	91E9	3B71	733B	49DB
5/6	30	E73D	B327	3CFB	8502
7/8	31.5	EF1E	9B66	9965	D8AB
1/2	12	4365	40C0	15CA	E508
2/3	16	A0F8	812B	4BD6	DACB
3/4	18	C739	7DCC	9F95	7615
5/6	20	7BAE	09DE	6ABA	95FE
7/8	21	A1E5	CA0F	997A	D284
1/2	9	EE92	D8FD	3328	E596
2/3	12	C29C	4897	A7F8	6162
3/4	13.5	A6AD	B887	BFA9	9244
5/6	15	048C	2E5D	7C25	35E9
7/8	15.75	E1E0	D8A1	EF9D	7FF8
1/2	6	05F9	36C6	C13F	B681
2/3	8	00B9	0C28	EF31	6CC1
3/4	9	BF6F	194B	96C6	6FCE
5/6	10	64B3	582F	8CEE	328E
7/8	10.5	B285	CCE6	2465	C49B
1/2	3	1E07	3D2D	04CA	19B2
2/3	4	560F	3F8C	EBA3	1B08
3/4	4.5	604A	1C1A	E8C2	8A09
5/6	5	8CFD	066A	108E	F532
7/8	5.25	C73B	5D12	8BF8	7A5D
1/2	1.5	904D	B50F	346C	F643
2/3	2	5962	3D39	E137	A434
3/4	2.25	7115	FBBC	D598	0574
5/6	2.5	F9CA	0717	0D25	5103
7/8	2.625	626A	BAB2	930B	D8DA
5/6	1.5	A379	6015	5428	8626
7/8	1.575	A10E	482C	6A3F	5456

Table 3.4: Signatures

4. STATUS Screen Display

Latched Status	0000
Clock	Present
Phase-lock	Locked
PLL volts	4.8V
Frame-lock	Locked
Input-lock	Locked
IF unit	OK
Temperature	29C

The above is a typical display when there is a valid signal input to the Modulator.

3.4.5 Summary of Operations to Control Modulator Configuration

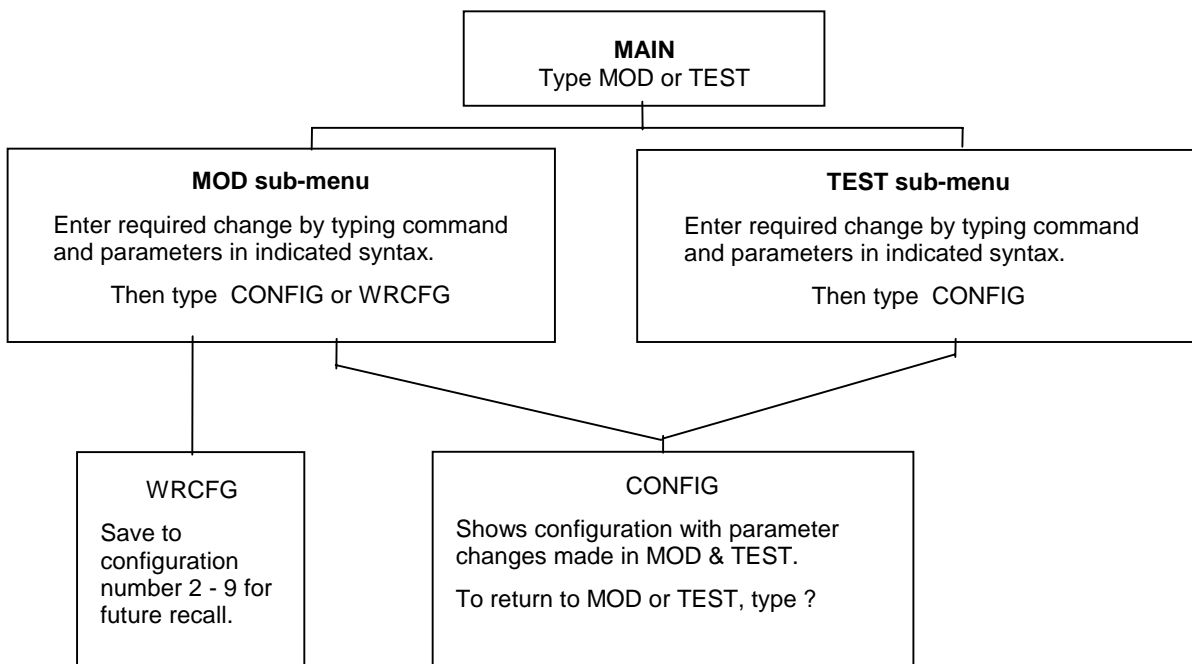


Figure 3.13: Summary of Operations to Control Modulator Configuration

3.4.6 Connecting a Control Computer / Terminal

Connect the port labelled LOCAL CONTROL RS-232 : CONTROL — LOCAL.

Local Control Port Specification

EIA RS-232 (ITU-T V.24) for the connection of the local control terminal. This is primarily an engineering/development port and, in normal circumstances, is not intended as a user function.

Item	Specification
Connector type	9-way D-type male
Connector designation	LOCAL CONTROL RS-232 : CONTROL — LOCAL
RS-232 designation	DTE
Baud rate	19 200
Protocol	8 data bits, 1 stop bit, no parity, Modulator ends transmission with LF, Terminal ends transmission with LF)
Connector pinout	Pin 2 RXD Pin 3 TXD Pin 5 GND All other pins not connected

Table 3.5: Local Control

For connection to a standard 9-way serial socket on a VT™100 or PC, a 9-way female to 9-way female lead is required with the following connections: 2 - 3; 3 - 2; 5 - 5.

Typical Local Terminal Emulation

VT™-100 ID	
No New line	
Local Echo off	
Typical Display setup:	80 columns Interpret controls No autowrap Jump scroll Cursor Block cursor style

Table 3.6: Typical Local Terminal Emulation

3.5 Configuring Alarm / Fail Responses

3.5.1 General

The Modulator control system identifies the specific alarm and fail conditions listed in Table 3.7. These specific fault conditions are categorised into logical groups to give more general alarm/fail signalling conditions to the user. The user can define the actions taken corresponding to the logical grouped alarm/fail indications.

Software check	
Name	Description
R_CLK_ALARM	Receive clock failure
INPUT_UNLOCK_ALARM	No input lock
PLL_UNLOCK_ALARM	Phase-locked-loop unlocked
FRAME_LOCK_ALARM	Not in frame lock
TMP_ALARM	Temperature too high
CE_FIFO_ALARM	Convolutional encoder FIFO alarm
FMT_FIFO_ALARM	Multiplex formatter FIFO alarm
RECONFIG_ALARM	Modulator has been reconfigured
CARRIER_ALC_ALARM	Synthesiser ALC alarm
SYNTH_1_ALARM	RF card synthesiser 1 alarm
SYNTH_2_ALARM	RF card synthesiser 2 alarm
OPT_INT_ALARM	Alarm condition on option-interface card

Table 3.7: Fault Conditions Monitored by Control Software

3.5.2 Fault Condition Groups

Group Categorisation

Table 3.8 shows the group categorisation for each fault condition.

	Group 5	Group 4	Group 3	Group 2	Group 1
Software Name	INT_FAILURE	INT_ALARM	PARAMETER_INCORRECT	CONFIG_CHANGE	EXT_ALARM_SIGNAL
Group Category	Internal Modulator failure	Internal Modulator alarm	Internal parameter out of limits	Internal configuration changing	External input has caused an alarm
Description	Modulator equipment failure such as PSU failure or synthesiser not locked	Modulator equipment alarm whereby Modulator functions but alarm condition exists, eg: excessive internal temperature		When Modulator is reconfiguring due to a parameter change, the output signal may be invalid	Modulator transmit signal may be invalid due to external input conditions
Combination of Internal Alarms	carrier_alc_alarm synth_1_alarm synth_2_alarm	tmp_alarm		reconfig_alarm ce_fifo_alarm fmt_fifo_alarm	input_lock_alarm pll_unlock_alarm frame_lock_alarm opt_int_alarm r_clk_alarm

Table 3.8: Fault Condition Groups

3.5.3 Setting Fault Indication Configuration

Indicators

There are four ways in which the Modulator can indicate an alarm or fail condition to the user. These are:

1. Via the front panel alarm LED
2. Via the alarm relay
3. Via the fail relay
4. Through setting a flag within the MCC health poll

The user can select any combination of alarm groups to produce any of the above actions. Selection is made by allocating a two-digit decimal number (00..31) for each action represented by the codes AB, CD, EF and GH.

These codes refer to the actions as follows:

- AB** Sets conditions for switching front panel alarm LED.
- CD** Sets conditions for switching alarm relay.
- EF** Sets conditions for switching fail relay.
- GH** Sets conditions for switching MCC change-over flag during health poll.

The values of AB, CD, EF, and GH are obtained from Table 3.9 by adding together the numbers associated with the particular alarm groups that are required to give the action.

	Group 5	Group 4	Group 3	Group 2	Group 1	Default
Software Name	INT_FAILURE	INT_ALARM	PARAMETER_INCORRECT	CONFIG_CHANGE	EXT_ALARM_SIGNAL	
Group Category	Internal Modulator failure	Internal Modulator alarm	Internal parameter out of limits	Internal configuration changing	External input has caused an alarm	
AB Alarm LED	16	8	4	2	1	25
CD Alarm Relay	16	8	4	2	1	25
EF Fail Relay	16	8	4	2	1	16
GH MCC Change-Over Flag	16	8	4	2	1	16

Table 3.9: Command Code Values

Thus, if for example the front panel alarm LED is required to light when Group 5 or Group 1 conditions occur, the value to be used for AB would be 16+1 =17.

Implementing the Selection

Programming instructions are given in the following parts of the manual.

1. Front panel control — see paragraph 3.3.7 of this Chapter.
2. Local RS-232 control — see Mod Sub-Menu Screen Display on page 3-19.
3. Remote control port — Chapter 4.

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Chapter 4

REMOTE CONTROL

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4.1 General

4.1.1 Control Modes

The Modulator has three control modes: Front-panel; Local RS-232 and Remote. When the Modulator is not being actively controlled, it reverts to *normal* mode. In *normal* mode, the Modulator operates with no control input by the operator. Control can be gained by:

1. The front panel (Front-panel control mode);
2. The local control input (via the connector LOCAL CONTROL RS-232: CONTROL — LOCAL);
3. The remote controller (using the CONTROL A RS-232 : CONTROL — REMOTE 1 connector).

Control access by any one control mode (other than normal) inhibits access by the others. The Modulator responds to certain non-executable remote commands (e.g.: Status and Health polls).

Figure 4.1 illustrates this principle.

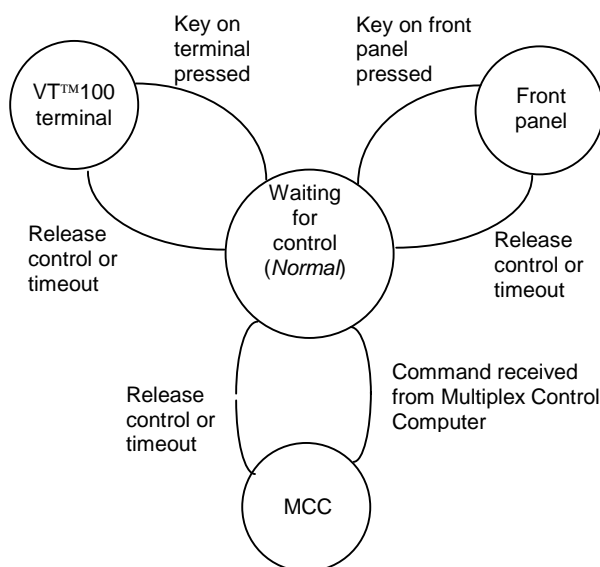


Figure 4.1: Gaining Control of the Modulator

Release of control is available from all three modes of operation. There is an automatic *local time-out* period to prevent control lock-out due to an operator failing to release control manually. If no executable control operations have occurred, reversion to *normal* mode takes place. This period can be set in the range 1-30 minutes with a default set at 60 seconds (refer to para 3.3.13). Factory set defaults are described in Chapter 5.

The MCC shown in

Figure 4.1 is the System 3000 Multiplex Control Computer which normally forms the control element of the system. It uses the CONTROL A RS232 : CONTROL — REMOTE connector

4.1.2 Remote Control Overview

The Modulator accepts remote control messages via the Control A RS-232 : CONTROL — REMOTE connector on the rear panel.

The control computer can either be connected directly to the Modulator using the appropriate cable and connectors or it can be connected over a telephone line using a data Modem.

The control computer acts as the master and the Modulator as a slave. The Modulator sends response messages to the control computer as a result of the receipt of command messages from the control computer, i.e. no unsolicited messages are sent by the Modulator to the control computer.

Messages exchanged between the control computer and Modulator are based on an ACK/NAK protocol, with the master control computer sending a message to the slave Modulator and then waiting for a response, before issuing the next command message.

All message exchange takes place asynchronously at 1200 baud, (no parity and 8 data bits), with full hardware handshaking if all the RS-232 connector pins are used, or with no handshaking if only transmit, receive and the common connectors are utilised. For communication purposes the Modulator behaves as a DTE.

The Modulator does not support X-ON, X-OFF flow control and the user should be aware that messages may contain reserved characters used in this method of flow control.

The Modulator will only allow remote control providing it is not currently being controlled from the front panel key-pad or from a terminal connected to the local control RS-232 connector at the rear panel. The control computer obtains control by sending the Modulator a "request control" message and terminates a control session with a "release control" message.

The control computer is able to request the status and health condition of the Modulator at any time by sending a poll message. The Modulator responds irrespective of the control mode.

All messages to the Modulator (except for the release control command) are confirmed by a return message to the control computer.

4.1.3 Saving the Current Configuration

After a Modulator operating configuration change, the new configuration is stored in NV-RAM when control is *released* or a *control time-out* occurs before powerdown. Thus the current operating configuration becomes the power-up configuration when the Modulator enters the *normal control* state.

4.2 Control Functionality Considerations

4.2.1 Obtaining Control

The control computer is able to determine the control mode of the Modulator by examining the response to a health poll. If bit 7 of the Modulator health *value* is set to 1 then the Modulator is in front panel or local control and is not able to respond to the control computer's commands. However if bit 7 is set to 0 the control computer can obtain control by sending a "request control" message.

If control is granted, then the "request control" message is acknowledged with a response message from the Modulator, and the Modulator is in *remote control mode*. If the Modulator is unable to grant control to the control computer then the "request control" message is ignored and no response message is returned.

4.2.2 Control Time-Out - Going to 'Normal' State

After a control time-out period, during which no messages are received from the control computer, the Modulator reverts to its *normal* state.

In *remote control mode* the amber coloured LED on the front panel, labelled "Remote Control", is on and the front panel LCD reverts to the Modulator title screen, e.g.:

**MODULATOR
M2/MDV/FRT**

The control time-out is programmable between 1 and 30 minutes. No indication is sent to the control computer to inform it that the Modulator has gone into the *normal* state, from the *remote control state*.

4.2.3 Releasing Control

The user can set the Modulator into the *normal* state rather than waiting for a control time-out to occur.

This is implemented from the control computer by sending a "release control" message to the Modulator. No acknowledgement response is sent out from the Modulator when a release control message is received.

4.2.4 Bit-Rate, FEC-Rate and Modulation Type

For the basic Modulator, an operator could attempt to set a combination of certain bit-rate, FEC-rate and modulation type (BPSK¹/QPSK) values which could produce a PSK symbol-rate in excess of the upper modulation limit (30MSymbol/s). To prevent this, the modulation type and/or the FEC-rate is automatically set by the Modulator control system to bring the symbol rate within valid limits. *FEC-rate* and *modulation type* commands entered which would produce an excessive symbol-rate for the set bit-rate cause an *invalid command* message to be displayed and the command to be disregarded.

NOTE...

The operator is not informed of these automatic changes and should be aware of the relationship between the bit-rate (Ri), FEC-rate and QPSK symbol-rate (Rs).

¹ BPSK is implemented in this release of firmware but has not been fully tested. Please refer to DMV Customer Support if further information is required.

If an option module is fitted, there is a direct bit-rate limit for that unit which must not be exceeded.

The proper order of entry of these parameters is:

1. Bit-rate;
2. FEC-rate;
3. Modulation type;
4. Interface.

In this case a valid parameter set can be entered.

When a bit-rate is entered, the control system assumes that the parameters which follow it are consistent with that bit-rate and the equipment bit/symbol-rate limits.

Table 4.1 shows the Modulator Input Interface Maximum Bit-Rate R_i for Indicated Convolutional FEC Rate and Modulation Type.

Convolutional FEC-Rate	Bit-Rate R_i for Indicated FEC-Rate and PSK Modulation Type (Mbit/s)	
	BPSK	QPSK
1/2	15	30
2/3	20	40
3/4	22.5	45
5/6	25	50
7/8	26.25	52.5

Table 4.1: Modulator Input Interface Maximum Bit-Rate

4.3 Communications Protocol

4.3.1 Acknowledgement of Messages

The protocol used for communicating between the control computer and Modulator is based on an ACK/NAK (acknowledge / not acknowledged) system.

1. Both polling messages and command messages receive an acknowledgement.
2. The exception to this is the release control command - setting *normal* state, which is not acknowledged.

The control computer sends command messages to the Modulator, and receives messages in return, which can be either:

- a) Command could not be received correctly (e.g.: Bad checksum);
- b) Command not actioned due to incorrect parameter (e.g.: Incorrect IF power);
- c) Acknowledgement of message, actioned correctly.

4.3.2 Command Timing

The time it takes for the Modulator to return an acknowledge / no acknowledge message varies according to the type of message returned:

1. Messages that are received incorrectly return NAK first;
2. Messages that are correctly received but have syntax or contextual errors will then return a NAK;
3. Finally if the message is processed correctly, an ACK is returned and the command is executed.

Some of the commands sent to the Modulator can take several seconds to implement, and during this time further commands will not be actioned. Health and status polls may also be ignored whilst the Modulator is reconfiguring.

To indicate this bit 4 of the health poll value is set, as indicated in the following diagram:

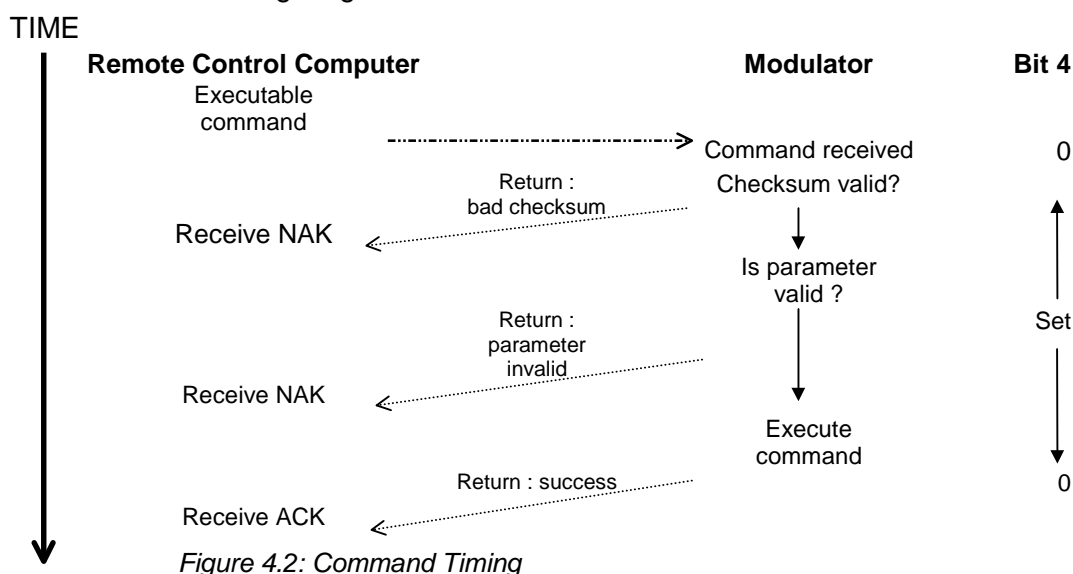


Figure 4.2: Command Timing

4.3.3 Command Interpretation

Commands from the control computer are interpreted using the following structure:

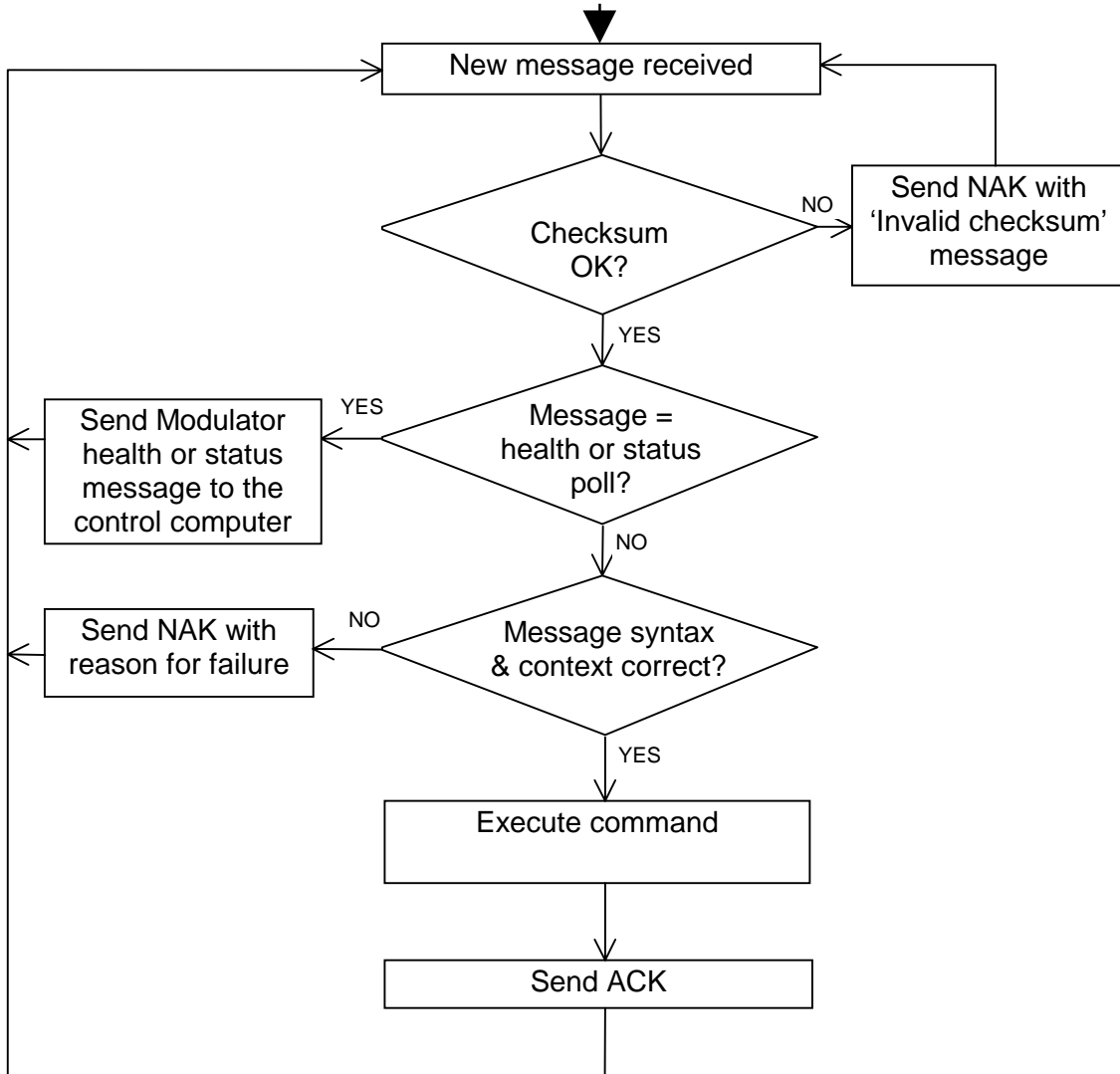


Figure 4.3: Command Structure

4.3.4 Message Protocol

Data Fields

In the following section:

< > indicates a data field;

() indicates an item consisting of a sequence of data fields.

All characters are represented by their ASCII hexadecimal values and all numbers are hexadecimal. A hexadecimal value is distinguished from decimal by being prefixed with a "0x", thus 0x20 (hexadecimal) is the same as 32 decimal.

Message Format

All messages adopt the following format:

<start> <length> (TLV) <checksum>

start indicates the start of a message. The field comprises two 8-bit characters of either:

‘**’ for an inward message to the modulator, or

‘\$\$’ for a response or outward message from the modulator.

length specifies the length of the data from the start of the TLV sequence up to, and including, the checksum byte. The field is an 8-bit unsigned integer.

checksum is the sum of all the bytes in all of the TLVs, ignoring the carry bit. The field is an 8-bit unsigned integer with valid values from 0x00 to 0xFF.

TLV specifies an individual message’s Type, Length and Value, the format of which is:

<type> <length> <value>

where:

type specifies the type of command/response. The field is an 8-bit unsigned integer, with valid values given in paras 4.3.6 and 4.3.7.

length specifies the number of bytes of data comprising the **value** which follows this field. The field is an 8-bit unsigned integer, with valid values determined by the **type**; if of length 0, the value field is not present.

value is the command/response data. It comprises a number (**length**) of 8-bit unsigned integers, see paras 4.3.6 and 4.3.7 for details.

Message Size

Minimum message size: 6 bytes - 2 start characters; 1 packet length; 1 type; 1 length; 1 checksum.

Maximum message size - control computer to modulator: 10 bytes (bit rate command).

Maximum message size - modulator to control computer: 70 bytes (configuration response message).

4.3.5 Polling for Modulator Health and Status

Polls to Modulator

Two polls can be sent to the modulator:

1. Status poll, value 0x32.
2. Health poll, value 0x5A.

NOTE...

Both will receive a response, regardless of the current modulator control mode.

Polling Message Format

The message format for these polls from the remote computer is exactly the same as for other commands, however only the first four bytes are interpreted by the modulator software.

NOTES...

1. The two start bytes are checked, to determine the start of the poll.
2. The next byte to arrive is ignored. (packet length),
3. The following byte giving the type of poll is acted upon, without waiting for the TLV length and checksum bytes.
4. Thus a poll will never receive a 'bad checksum' response.

Examples of health and status poll messages are:

Start 1	Start 2	Length	Type (Status)	TLV Length	Check Sum
0x2A	0x2A	0x03	0x32	0x00	0x3C
			(health)		
0x2A	0x2A	0x03	0x5A	0x00	0x5A

Table 4.2: Examples of Health and Status Poll Messages

Response to Health Poll

The response to a health poll is a standard message with a single byte in the *value* field of the TLV representing the health state of the Modulator.

Four bits are used in the modulator health byte:

- bit 7** 1 when the modulator is in *local* or *front panel* control
0 when the modulator is in *normal* or *remote* control
- bit 6** 1 when a critical failure condition exists
0 when no critical failure condition exists
- bit 5** 1 not able to receive configuration commands
0 can receive config commands from control port
(This bit is used when the unit is powering up to indicate if the modulator is fully powered up and configured.)
- bit 4** 1 Modulator is reconfiguring (see para 4.3.2)
0 Modulator reconfigured

Response to Status Poll

The response to a status poll is a standard message with two bytes in the *value* field of the TLV representing the internal status of the modulator.

In the status word:

1. 0 = Normal state for each bit
2. 1 = Condition has occurred

where:

- bit 0** no input clock
- bit 1** input not locked
- bit 2** phase locked loop not locked
- bit 3** no frame lock
- bit 4** internal temperature too high
- bit 5** convolutional encoder FIFO alarm
- bit 6** mux. formatter FIFO alarm
- bit 7** modulator is being reconfigured
- bit 8** IF board synthesiser ALC alarm
- bit 9** IF board synthesiser number 1 alarm
- bit 10** IF board synthesiser number 2 alarm
- bit 11** alarm condition exists on option interface board
- bit 12** reserved
- bit 13** reserved
- bit 14** reserved
- bit 15** reserved

4.3.6 Inward Messages (from Multiplex Control Computer to Modulator)

BIT RATE			
Type	Length	Value	
0x08	0x04	<byte 1>	Bit Rate - bits (31..24)
		<byte 2>	Bit Rate - bits (23..16)
		<byte 3>	Bit Rate - bits (15..8)
		<byte 4>	Bit Rate - bits (7..0)

Value is the hexadecimal representation of bit-rate is in units of bit/s. eg: 0x016E3600 represents a bit-rate of 24Mbit/s.

INTERFACE SELECT			
Type	Length	Value	
0x09	0x01	0x00	option
		0x01	RS422

MODULATION TYPE			
Type	Length	Value	
0x10	0x01	0x00	QPSK
		0x01	BPSK

SPECTRUM SENSE			
Type	Length	Value	
0x0F	0x01	0x00	Normal
		0x01	Invert

CLOCK SOURCE			
Type	Length	Value	
0x11	0x01	0x00	internal
		0x01	external

CONVOLUTIONAL FEC-RATE			
Type	Length	Value	
0x13	0x01	0x03	1/2
		0x04	2/3
		0x05	3/4
		0x06	5/6
		0x07	7/8

IF FREQUENCY			
Type	Length	Value	
0x14	0x02	<byte 1>	IF frequency - bits 15..8
		<byte 2>	IF frequency - bits 7..0

Value is the hexadecimal representation of the IF frequency in units of 125 kHz (eg: a value of 0x02D0 represents an IF Frequency of 90 MHz)

IF POWER			
Type	Length	Value	
0x15	0x02	<byte 1>	IF Power - bits (15..8)
		<byte 2>	IF Power - bits (7..0)

Value is the hexadecimal representation of the IF Power in steps of 0.1 dBm units. *Value* is interpreted as a signed integer eg: a value of 0x000A represents an IF power of +1.0 dBm and a value of 0xFFFF represents an IF power of -0.1 dBm

1. An IF power value of 0x1000 is used to specify IF output off.
2. An IF power value of 0x2000 is used to specify IF output on.

INPUT FAIL RESPONSE			
Type	Length	Value	
0x17	0x01	0x00	Cut carrier
		0x01	Carrier remains on with PRBS

MODULATION			
Type	Length	Value	
0x19	0x01	0x00	Modulation off
		0x01	Modulation on

SET ONLINE OPERATION			
Type	Length	Value	
0x1C		0x00	Set to normal traffic mode

MODULATOR CONFIGURATION REQUEST			
Type	Length	Value	
0x24	0x00		Request current Modulator configuration

SIGNATURE ANALYSIS			
Type	Length	Value	
0x1D	0x01	0	I channel
		1	Q channel

READ STORED CONFIGURATION			
Type	Length	Value	
0x1A	0x01	0..9	Reads configuration (represented by a value in the range 0..9)

WRITE STORED CONFIGURATION			
Type	Length	Value	
0x1B	0x01	2..9	Write current configuration to NV memory

ALARM RESPONSE			
Type	Length	Value	
0x59	0x04	0..31	(each byte) Refer to para. 3.5 for more details.

MODULATOR TEST MODE			
Type	Length	Value	
0x1E	0x01	0..7	(for each byte) Refer to Table 4.5 for modtest signals.

MUX TEST MODE			
Type	Length	Value	
0x20	0x01	0	Off
		1..5	(for each byte) Refer to Table 4.3 for muxtest signals..

RELEASE CONTROL			
Type	Length	Value	
0x49	0x01	0x01	Return Modulator to <i>normal</i> mode. This command is <i>not</i> acknowledged by the Modulator.

POLL: STATUS REQUEST			
Type	Length	Value	
0x32	0x00		Request current Modulator status. Polling messages can be sent when the modulator is in any control mode.

POLL: HEALTH REQUEST			
Type	Length	Value	
0x5A	0x00		Request current Modulator health. Polling messages can be sent when the modulator is in any control mode.

4.3.7 Outward Messages (from Modulator to Multiplex Control Computer)

BIT RATE			
Type	Length	Value	
0x08	0x01	0x01	Bit-rate valid.
		0x02	Bit-rate out of range.
		0x03	Invalid convolutional FEC-rate.
		0x04	Invalid symbol rate.

INTERFACE SELECT			
Type	Length	Value	
0x09	0x01	0x01	OK.
		0x0E	Value other than 0x00 or 0x01 received.
		0x0C	No option interface available.

MODULATION TYPE			
Type	Length	Value	
0x10	0x01	0x01	OK
		0x19	Invalid modulation type
		0x03	Invalid convolutional FEC-rate
		0x02	Bit-rate out of range.
		0x04	Invalid symbol rate.

SPECTRUM SENSE			
Type	Length	Value	
0x0F	0x01	0x01	OK.
		0x0F	Value other than 0x00 or 0x01 received.

CLOCK SOURCE			
Type	Length	Value	
0x11	0x01	0x01	OK.
		0x11	Value other than 0x00 or 0x01 received

CONVOLUTIONAL FEC-RATE			
Type	Length	Value	
0x13	0x01	0x01	OK.
		0x03	Invalid convolutional FEC-rate.
		0x04	Invalid symbol rate.
		0x12	FEC-rate out of range (<3 or >7)

IF FREQUENCY			
Type	Length	Value	
0x14	0x01	0x01	OK.
		0x05	IF frequency out of range.

IF POWER			
Type	Length	Value	
0x15	0x01	0x01	OK.
		0x06	IF power too low
		0x07	IF power too high

INPUT FAIL RESPONSE			
Type	Length	Value	
0x17	0x01	0x01	OK.
		0x0F	Value other than 0x00 or 0x01 received.

MODULATION			
Type	Length	Value	
0x19	0x01	0x01	OK.
		0x0F	Value other than 0x00 or 0x01 received.

SET ONLINE OPERATION			
Type	Length	Value	
0x1C	0x01	0x01	OK.
		Other	Not OK.

MODULATOR CONFIGURATION			
Type	Length	Value	
0x24	0x0B	12bytes	Config name.
	0x01	0..99	Front panel display LCD Contrast
	0x01		Reserved
	0x02	1..1800	Control timeout in seconds
	0x01		Control — Remote 1 baud-rate
	0x01		Control — Remote 2 baud-rate
	0x01		Control — Local baud-rate
	0x08		Interface bit-rate Ri (bit/s)
	0x01		MUX formatter mode info (Table 4.3)
	0x01		Modulator miscellaneous setup (Table 4.4)
	0x04		IF frequency Hz
	0x02		IF output power level
	0x02		Reserved
	0x01		Muxtest sequence for setup (Table 4.5)
	0x01		Modulator test mode (Table 4.6)
	0x01		Modulator operational mode (Table 4.8)
	0x01		Setup for option interface (Table 4.7)
	0x01		Alarm LED programmed value (para. 3.5)
	0x01		Alarm relay programmed value (para. 3.5)
	0x01		Fail relay programmed value (para. 3.5)
	0x01		Changeover programmed value (para. 3.5)
	0x01		Control Software version
	0x01		Hardware version
	0x11		Reserved (makes structure 64 bytes long)

bit 0	1	Muxtest selected
	0	Muxtest not selected
bit 1	1	Scrambling on
	0	Scrambling off
bit 2	1	Reed Solomon encoding on
	0	Reed Solomon encoding off
bit 3	1	Interleaving on
	0	Interleaving off
bit 7	1	RS-422 parallel interface selected
	0	Option interface selected

Table 4.3: Modulator Configuration: MUX Formatter Mode

Value	FEC Rate	
3	1/2	A value between 3 and 7 in first 3 bit positions, (bits 0, 1 and 2), specifies the Modulator FEC rates.
4	2/3	
5	3/4	
6	5/6	
7	7/8	
bit 3	1	Front panel bleep on
	0	Front panel bleep off
bit 4	1	Clock source external
	0	Clock source internal
bit 5	1	Modulation type BPSK
	0	Modulation type QPSK
bit 6	1	Spectrum sense inverted
	0	Spectrum sense normal
bit 7	1	Bit mode clock
	0	Byte mode clock

Table 4.4: Modulator Configuration: Miscellaneous

Byte Value	
0	Giving test data: Signature analysis PRBS test
1	“ :contains packet number [0 to 7]
2	“ :contains byte number [0 to 203 sequentially]
3	“ :contains null packets [0]
4	“ :contains one 1 bit every 12 null bytes [0s]
5	“ :contains alternate packets of 0x00 and 0xFF

Table 4.5: Modulator Configuration: MUX Test Signals — see Chapter 5

Byte Value	
0	Operating mode
1	PRBS
2	0deg CW
3	180deg CW
4	Half rate reversals (low)
5	Half rate reversals (high)
6	Full rate reversals
7	Filter impulse response

Table 4.6: Modulator Configuration: MOD Test Signals — see Chapter 5

bit 4	1	De-interleaving on
	0	De-interleaving off
bit 5	1	Decoding on
	0	Decoding off

Table 4.7: Modulator Configuration: Option Interface Setup

bit 0	1	Operating mode
	0	Test mode
bit 1	1	Modulation on
	0	Modulation off
bit 2	1	Input fail response - carrier on with PRBS
	0	Carrier off
bit 3	1	In a control mode
	0	In “Normal” mode

Table 4.8: Modulator Operational Mode

BAD CHECKSUM		
Type	Length	
0x4B	0x00	Modulator could not interpret last message, due to invalid checksum.

This message is not sent in response to a poll with a bad checksum.

MODULATOR HEALTH			
Type	Length	Value	
0x5A	0x01	bit 7	1 - Modulator is in Local / Front Panel Mode 0 - Modulator is in Normal / Remote Mode
		bit 6	1 - Modulator is unhealthy 0 - Modulator unable to receive commands
		bit 5	1 - Modulator is unhealthy 0 - Modulator unable to receive commands
		bit 4	1 - Modulator reconfiguring 0 - Modulator not reconfiguring
		bits 3..0	Unused

See para 4.3.5 (and para 4.3.2 relating to bit 4) for full details.

MODULATOR STATUS			
Type	Length	Value	
0x32	0x02	bit 0	1 - no input clock
		bit 1	1 - Input not locked
		bit 2	1 - PLL not locked
		bit 3	1 - No Frame lock
		bit 4	1 - Internal temperature too high
		bit 5	1 - Convolutional encoder FIFO alarm
		bit 6	1 - MUX formatter FIFO alarm
		bit 7	1 - Modulator is being reconfigured
		bit 8	1 - IF board ALC alarm
		bit 9	1 - IF board synthesiser 1 alarm
		bit 10	1 - IF board synthesiser 2 alarm
		bit 11	1 - Alarm condition exists on option interface
		bit 12	reserved
		bit 13	reserved
		bit 14	reserved
		bit 15	reserved

SIGNATURE ANALYSIS			
Type	Length	Value	
0x1D	0x01	8	Failed to read signature
		9	Reserved
		10	Unstable signature
		20	Invalid channel

READ STORED CONFIGURATION			
Type	Length	Value	
0x1A	0x01	1	OK
		19	Invalid configuration Number

WRITE STORED CONFIGURATION			
Type	Length	Value	
0x1B	0x01	1	OK
		19	Invalid configuration number

MODTEST MODE			
Type	Length	Value	
0x1E	0x01	1	OK

MUXTEST MODE			
Type	Length	Value	
0x20	0x01	1	OK
		11	Bad test pattern write

ALARM RESPONSE			
Type	Length	Value	
0x59	0x01	1	OK

4.4 Remote Control Connector

This is primarily intended for connection of the System 3000 Multiplex Control Computer (MCC).

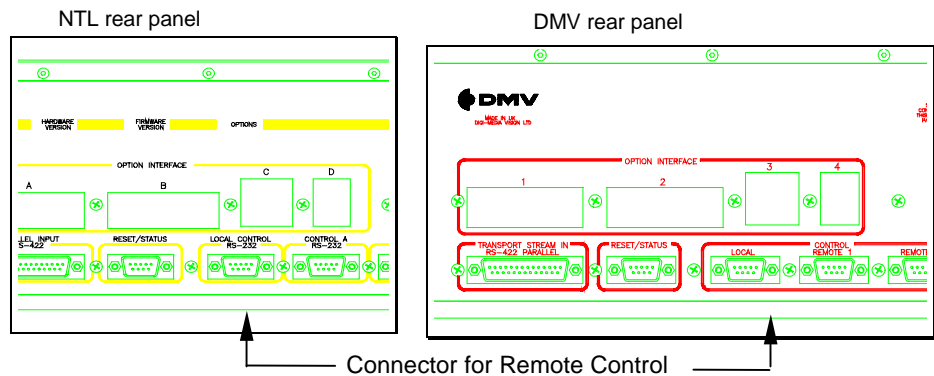


Figure 4.4: Rear Panel Layouts Showing Connector for Remote Control

Item	Specification
Connector type	9-way D-type male
Connector designation	CONTROL A RS-232 : CONTROL — REMOTE 1
Baud rate	1200
Protocol	See para 4.3
Configuration	DTE
Connector pinout	Pin 1 Input: Data Carrier Detect (DCD) Pin 2 Input: (Receive Data (RXD) Pin 3 Output: Transmit Data (TXD) Pin 4 Output: Data Terminal Ready (DTR) Pin 5 Ground Pin 6 Input: Data Set Ready (DSR) Pin 7 Output: Request to Send (RTS) Pin 8 Input: Clear to Send (CTS) Pin 9 Input: Ring Indicator (RI)

Table 4.9: Remote Control Connector

Chapter 5

MAINTENANCE AND TROUBLESHOOTING

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BLANK

5.1 Routine Checks

5.1.1 Cooling Fans

This equipment must never be operated unless both cooling fans are working; this should be checked periodically. Failure to ensure a free flow of air around the unit may cause overheating.

5.1.2 Cleaning

Unplug this product from the wall outlet before cleaning. Do not use liquid cleaners or aerosol cleaners. Use a damp cloth for cleaning.

5.2 Maintenance

5.2.1 Warranty

The equipment supplied to the customer is covered for a period of 12 months from delivery, by standard DMV warranty service.

In the unlikely event that this item of equipment should fail, please use the Customer Support information at the front of this manual for the procedure covering its return.

The warranty covers the following:

- all material defects in the equipment for a period of 12 months;
- all parts and labour charges;
- all returned items will be repaired within 15 working days from receipt at the customer care centre;
- Return the repaired item to the customer, carriage paid;
- Provide assistance to the customer through the Customer Help Line number (see the Customer Support information at the front of this manual).

The warranty does not cover the following:

- Any engineering visit/s to the customer's premises.

5.2.2 Levels of Maintenance

There are three levels of maintenance that can be offered to support this equipment. More information can be obtained from DMV Customer Support. These levels of maintenance are:

- Delta Δ
A basic level of service geared to customers requiring an equipment repair facility only.
- Sigma Σ
A level of service for customers with small to medium size installations.
- Omega Ω
This is a higher level of service which includes all the benefits of Sigma level maintenance with a replacement loan service and other enhancements.

5.3 Servicing

5.3.1 Servicing

Do not attempt to service this product as opening or removing covers may expose dangerous voltage or other hazards. Refer all servicing to service personnel who have been authorised by DMV.

5.3.2 Conditions Indicating a Requirement for Service

Unplug Modulator from the wall outlet and refer servicing to qualified service personnel under the following conditions:

1. When the power-supply cord or plug is damaged.
2. A new fuse blows within a short time of replacement or if there is a reason to suspect a faulty power supply.
3. If liquid has been spilled, or objects have fallen into the product. If the product has been exposed to rain or water.
4. If the product does not operate normally by following the operating instructions. Adjust only those controls that are covered by the operating instructions, as an improper adjustment of other controls may result in damage and will often require extensive work by a qualified technician to restore the product to its normal operation.
5. If the product has been dropped or the case has been damaged.
6. When the product exhibits a distinct change in performance.

— This indicates a need for service.

5.3.3 Replacement Parts

When replacement parts are required, be sure the service technician has used parts specified by the manufacturers or have the same characteristics as the original part. Unauthorised substitutions may result in fire, electric shock or other hazards.

5.3.4 Checks on Completion of Servicing

Upon completion of any service or repairs to this product, ask the service technician to perform safety checks to determine that the product is in safe operating condition. Also performance and EMC checks may be required.

5.4 Troubleshooting

5.4.1 General

CAUTIONS..

1. Maintenance on this equipment must only be undertaken by properly trained personnel appointed or authorised by DMV.
2. Unauthorised maintenance or the use of non-approved replacements may invalidate any warranties and/or affect the equipment specification.

This information is intended to help isolate a fault within the Modulator.

NOTE...

If the following information fails to clear the abnormal condition, please contact Customer Support on:

+44 (0) 1703 498111 (8.00 am to 6.00 pm Local time)

+44 (0) 181 771 4000 (24 hour emergency).

Customer support information is given in the preliminary pages of this book.

5.4.2 Replacing Fuses

Fusing Information

WARNING...

BEFORE REPLACING THE REAR PANEL FUSE, DISCONNECT THE EQUIPMENT FROM THE SUPPLY. FAILURE TO DO THIS MAY EXPOSE HAZARDOUS VOLTAGES. UNPLUG THE EQUIPMENT FROM THE LOCAL SUPPLY SOCKET.

CAUTION...

Ensure the mains fuse fitted in the rear panel fuse carrier is of the correct type and rating. For continued protection against fire, the fuse must always be replaced by a fuse of the correct type and rating.

Item	Specification
Fuse	Fuse in live conductor in power input filter at rear of unit
Fuse type	5 mm x 20 mm time-delay IEC (EN 60127-2 Sheet 5) High breaking capacity: 1500A
Fuse rated current	3.15 A
Fuse rated voltage	250 Vac.
Power lead connector fuse (if appropriate)	5 A

Table 5.1: Fuse Information

Persistent Fault

If the replacement fuse also blows, do not continue. Disconnect the equipment and contact DMV Customer Support for advice.

5.4.3 Preliminary Checks

If the equipment fails to function as expected, follow the general procedure outlined here:

1. Check whether it is the Modulator, the Multiplexer or the Up-converter which is at fault.
2. Does the data link exist; is the Modulator receiving a clock and bitstream?
3. Check Modulator status. Observe front panel LEDs. Does a different Modulator work correctly? Check the Modulator *Power* and *Alarm* LEDs on the front panel (*Power* LED should be on, *Alarm* LED off).
4. Check that the Modulator is configured as intended (refer to operating instructions).
5. Check that the transport multiplex source is connected and functioning correctly.
6. Examine any *Alarm* / *Fail* warnings from the RESET/STATUS interface (see Chapter 3).
7. Check all external connections.
8. Carry out signature analysis tests.
9. Check the IF output power and spectrum.

5.4.4 Fault LED

The *Alarm* LED on the front panel is triggered by a number of exception conditions. This action is user programmable (see *Configuring Alarm/Fail Responses* in Chapter 3 of this manual).

5.4.5 Lightning Protection

WARNING...
IF THE MODULATOR HAS BEEN SUBJECT TO A LIGHTNING STRIKE OR POWER SURGE WHICH HAS STOPPED IT WORKING, DISCONNECT THE POWER IMMEDIATELY. DO NOT RE-APPLY POWER UNTIL IT HAS BEEN CHECKED FOR SAFETY. IF IN DOUBT, CONTACT DMV CUSTOMER SUPPORT.

Where appropriate, ensure this product has an adequate level of lightning protection. Alternatively, during a lightning storm or when it is left unattended and unused for long periods of time, unplug it from the supply outlet and disconnect the antenna or cable system. This will prevent damage to the product due to lightning and power-line surges.

5.4.6 Testing the Unit

Chapters 3 and 4 include information on the various means of controlling the Modulator. The following lists the tests available. Follow the instructions in those chapters (as appropriate) to run the tests.

NOTE...

In the explanations which follow, the prefix 0x is a C device for indicating that the following numerical values are hexadecimal.

MODTEST

Select modulation test signals generated post convolutional encoder. Table 5.2 following describes the tests.

Test Number	Description
MODTEST 1	$2^{15}-1$ PRBS ($2^{10}-1$ for pre-version 4 software)
MODTEST 2	CW carrier(0°)
MODTEST 3	CW carrier (180°)
MODTEST 4	Half rate reversals (1) - (Sideband suppression test 1)
MODTEST 5	Half rate reversals (2) - (Sideband suppression test 2)
MODTEST 6	Full rate reversals
MODTEST 7	Filter Impulse response test signal

Table 5.2: MODTEST Descriptions

MUXTEST

The Modulator contains an eight packet period test sequence generator which is enabled by use of the MUXTEST command. There are six predefined test patterns, these are described in Table 5.3:

Test Number	Description
MUXTEST 0	PRBS pattern, for use with signature analysis for verification of correct operation of the Modulator. The exact pattern depends on the configuration of the Modulator. The command should be re-run following alteration of the state of the DVB functions.
MUXTEST 1	Packet data is packet number, e.g. packet 0 has data 0x00, packet 1 has 0x01, packet 7 has 0x07. (Used for checking interleaving.)
MUXTEST 2	Packet data is ramp from 0x00 to 0xCB. Each of the 8 packets is identical.
MUXTEST 3	Packet data is all zero. (Used for checking correct scrambling sequence.)
MUXTEST 4	Packet data is 0x00, with 0x01 every 12 bytes. (Used for checking convolutional encoder impulse response.)
MUXTEST 5	Even packets have 0x00 data, odd packets have 0xFF. (Used for interleaving test.)

Table 5.3: MUXTEST Descriptions

5.4.7 Signature Analysis

Signature analysis tests can be run from either the Front Panel, Local Control port or the Remote Control port.

- Front Panel - use the Diagnostics, Test, Misc branch. The result of the test is either PASS or halt on fail.
- Local Control - Main Menu, Test Sub-menu. This displays the figures for the I and Q circuits. the value depends on the setting of R_i and FEC (see Chapter 3 for a table of values).
- Remote Control - A Signature Analysis request can be sent to the Modulator.

5.4.8 Factory Defaults

The Modulator has pre-programmed default settings. These can be entered using the Front Panel Control function key.

The default configuration for the Modulator is shown in Table 5.4.

Configuration name	Default
LCD contrast	50
Control time-out	60 seconds
Control A baud rate	1200 baud
Local Control baud rate	19 200 baud
Bit-rate	8.448 Mbit/s
Interface selected	RS-422 parallel
Interleaving	ON
Reed Solomon FEC	ON
Scrambling	ON
Muxtest	Not selected
Convolutional FEC-rate	3/4
Clock source	External
IF frequency	70.000 MHz
IF power	0.0 dBm
Operational mode	Normal
Modulation	ON
Input fail response	Carrier ON with PRBS
RS-422 Serial decode	ON (if present)
RS-422 Serial de-interleave	ON (if present)
Alarm LED response	25
Alarm relay response	25
Fail relay response	16
Changeover	17

Table 5.4: Default Configuration for the Modulator

Chapter 6

ANNEXES

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A: List of Abbreviations and Acronyms

The following list is intended to cover most of the abbreviations and acronyms used in DMV's System 3000 Technical Manuals. All terms may not be included in this manual.

5B6B	Block code (5 binary bits encoded to 6 binary bits)	kg	kilograms
ac	alternating current	L-band	950-2050 MHz frequency band
async	asynchronous	LED	Light Emitting Diode
B3ZS	Interface Code (Bipolar with three successive zeros substituted) (Similar coding scheme to HDB3)	LNBS	Low Noise Block
BER	Bit Error Ratio	LO	Local Oscillator
BPSK	Binary Phase Shift Keying	LVDS	Low Voltage Differential Signalling
CA	Conditional Access	MCC	Multiplex Control Computer
clk	Clock	µm	micro metres (10 ⁻⁶ metres)
CRC	Cyclic Redundancy Check	mm	millimetres
dB	decibel	MPEG-2	Moving Picture Expert Group standard 2 (also known as ISO 13818)
dBm	Power, dB relative to 1 mW	MSymbols/s	Mega Symbols per second (10 ⁶ Symbols per second)
dc	direct current	nm	nano metres (10 ⁻⁹ metres)
DCE	Data Communications Equipment	NRZI	Non-Return-to-Zero
DDS	Direct Digital Synthesiser	NTL	National Transcommunications Ltd
Demod	Demodulator	NTSC	National Television System Committee (USA)
Demux	De-multiplexer	NVRAM	Non-Volatile Random Access Memory
DIL	Dual In Line	OSD	On-Screen Display
DIN	Deutsches Institut für Normung	PAL	Phase Alternation Line
DMV	DigiMedia Vision/Digi-Media Vision Ltd	PC	Personal Computer
DTE	Data Terminal Equipment	PCR	Program Clock Reference
DVB	Digital Video Broadcasting	PID	Packet Identifier
EIA	Electronics Industries Association (USA)	ppm	parts per million
ECL	Emitter Coupled Logic	PSI	Program Specific Information (MPEG term)
ECM	Entitlement Checking Message	PSR	Professional Satellite Integrated Receiver-Decoder
EMC	Electromagnetic Compatibility	PSU	Power Supply Unit
EMM	Entitlement Management Message	QPSK	Quadrature Phase Shift Keying
ESD	Electrostatic Sensitive Device	RF	Radio Frequency
ETS	European Telecommunication Standard	SELV	Safety Extra Low Voltage (EN 60950)
ext	external	SI	Service Information (DVB term)
FCC	Federal Communications Commission	sync	synchronous
FDM	Frequency Domain Modulation	TDM	Time Division Multiplex
FEC	Forward Error Correction	TNV	Telecommunication Network Voltage
HDB3	Interface Code (High Density Bipolar with three successive zeros max)	U	44.45 mm (rack height standard)
Hz	Hertz (cycles/second)	UK	United Kingdom
hSymbols/s	hecto Symbols per second (100 Symbols per second)	USA	United States of America
IEC	International Electrotechnical Committee	V	Volt
IF	Intermediate Frequency	W	Watt
I/F	Interface		
int	internal		
IRD	Integrated Receiver-Decoder		
ISO	International Standards Organisation		
ITU-T	International Telecommunications Union - Telecommunications		

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B: Technical Specifications (50Ω IF Output)

B.1: Definitions

1. R_i = input interface bit-rate (204 byte packet format).
2. For the RS-422 parallel (byte) interface, $R_{byte} = R_i/8$.
3. R_u = user bit-rate = $R_i \times (188/204)$ where R_u is the user bit-rate defined at the modulator input interface (pre R-S encoding).
4. R_s = transmit symbol-rate

= $(R_i/2)/FEC$ (QPSK)
= R_i/FEC (BPSK)

 where FEC is the convolutional FEC rate (<1).

B.2: Modulator Specifications

Modulator Inputs

Transport Multiplex Inputs

Each equipment variant accepts a standard RS-422 parallel format with bit-rates $1.5 \leq R_i \leq 52.5$ Mbit/s. In addition each option module allows a further input format to be used. These are detailed in Table B.1. Unused inputs need not be connected. Bit-rates are interface bit-rates R_i . A 204 byte packet transmission format is used.

Option	Bit-rates (Mbit/s)
M2/MDV/OPT(Optical)	Fibre optic FDDI compliant, multimode on ST® type connector: $1.5 \leq R_i \leq 50$
M2/MDV/422-S (RS-422 Ser.)	$1.5 \leq R_i \leq 8.448$
M2/MDV/LVDS-S (LVDS Ser.)	$1.5 \leq R_i \leq 45$

Table B.1: Option Module Input Bit-Rate

Bit-Rate (R_i) Range

Minimum bit-rate: 1.5 Mbit/s

Maximum bit-rate: Dependent on convolutional FEC rate

Table B.2 shows the Modulator Input Interface Maximum Bit-Rate R_i for Indicated Convolutional FEC Rate and Modulation Type.

Convolutional FEC-Rate	Bit-Rate R_i for Indicated FEC-Rate and PSK Modulation Type (Mbit/s)	
	BPSK	QPSK
1/2	15	30
2/3	20	40
3/4	22.5	45
5/6	25	50
7/8	26.25	52.5

Table B.2: Modulator Input Interface Maximum Bit-Rate

NOTE...

With input via an option-interface module, the maximum bit-rate R_i is defined by the minimum value in Table B.2 (for the basic Modulator) or option-interface bit-rate Table B.1.

Item	Specification
Clock Modes ¹	External clock Internal clock
Modulator phase-locks to input clock. Modulator provides clock to source equipment.	
Bit-Rate R _i Increment	1bit/s (programmable)
Input Clock / Data	External clock
Frequency Accuracy (Static)	Internal clock
	± 15 ppm
	± 15 ppm
Clock/Data Jitter Tolerance	ITU-T G.823/G.824 limits ²
Jitter Transfer Function	1 Hz nominal, low-pass function
Input Data Buffer Size	± 64 byte

Table B.3: Input Specification

Modulator Output

Item	Specification
Transmission Format	a) 8-frame sync sequence generation (sync inversion)
ETS 300 421 transmit functions	b) Energy dispersal scrambling
	c) Reed-Solomon encoding (204,188)
	d) Convolutional interleaving
	e) Convolutional encoding rates 1/2, 2/3, 3/4, 5/6, 7/8
	f) QPSK/BPSK ³ modulation format
	g) $\sqrt{\text{Cosine}}$ roll-off filters
IF Spectrum Sense	Selectable Normal/Inverted
Transmission modes	Carrier ON/OFF; Modulation ON/OFF

Table B.4: Output Specification

Main IF Output

Item	Specification
IF frequency	70 ± 20 MHz; 140 ± 40 MHz
Carrier frequency steps	125 kHz
Carrier frequency error	< 5 kHz
Output power (nominal)	-30 dBm to +2 dBm in 0.1 dB steps
Harmonic outputs	< -35 dBc, < -40dBc typical
Carrier on/off ratio	> 50 dB, (> 60 dB typical) - (Output power > -10 dBm)
Discrete carrier suppression	> 40 dB (QPSK) mode
Connector designation	IF OUTPUT 50 Ω
Connector type	N (Female)
Output impedance	50 Ω
Return loss	> 20 dB, 50 < f < 180 MHz

Table B.5: Main IF Output Specification

IF Monitor Output

Item	Speciication
Output power	- 5 dBm (±1 dB depending on selected value of main output power) nominal
Connector designation	IF MONITOR 50Ω
Connector type	BNC (Female)
Output impedance	50 Ω
Return loss	> 15 dB, 50 < f < 180 MHz
Main/monitor output isolation (both directions)	> 40 dB, 50 < f < 180 MHz

Table B.6: IF Monitor Output Specification

¹ These options are supported for RS-422 parallel input, RS-422 serial and LVDS serial. The optical card automatically sets the clock to external mode.

² Blue Book Volume III - Fascicle III.5, IXth Plenary Assembly, Melbourne, 14 - 25 November 1988

³ ETS 300 421 applies to QPSK modulation only. See Annex C for a description of BPSK coding.

B.3: Performance

IF-Loop Performance⁴

E_b/N_o ratio as defined in ETS 300 421 when interworking with DMV Demodulator S5485 (used in DMV System 3000 Professional Satellite Receiver Decoder) in 70 MHz to L-band IF loop configuration. See Table B.7 for maximum E_b/N_o ratios.

Convolutional FEC Rate	Demodulator Input E_b/N_o Ratio (dB) for Correct System Operation	
	Referred to R_u	Referred to R_i
1/2	4.5	4.1
2/3	5.0	4.6
3/4	5.5	5.1
5/6	6.0	5.6
7/8	6.4	6.0

Table B.7: Demodulator Input E_b/N_o Ratio (dB) for Correct System Operation

Output Power Spectrum⁴

Designed for compliance with ETS 300 421 Figure A.1

Carrier Phase Noise

Carrier phase noise spectrum is defined in Table B.8.

IF Frequency Range	Modulator Phase Noise (dBc/Hz) at Indicated Frequency Offset from Carrier and Indicated IF Frequency Range					
	± 1 kHz		± 10 kHz		± 100 kHz	
	Typ	Max	Typ	Max	Typ	Max
70 MHz	-76	-70	-86	-80	-112	-90
140 MHz	-74	-70	-86	-80	-112	-90

Table B.8: Modulator Output Phase Noise Spectrum

⁴ Applies to QPSK modulation type only.

B.4: Environmental

Conditions

Parameter		Specification
Operational	Temperature	5°C to 40°C (41°F to 104°F) ambient
	Humidity	0% to 95% (non-condensing)
	Cooling requirements	Forced cooling by internal fans — air flow from right to left as viewed from front panel
	Installation	Rack-mounted, fixed use only
Storage/ Transportation	Temperature	0°C to +70°C (+32°F to +158°F)
	Humidity	0% to 95% (non-condensing)

Table B.9: Environmental Specification

Physical

Parameter	Specification
Rack standard	19 inch 3U rackmount case (1U ≡ 44.45 mm)
Access	Top cover (fastened by screws — operator access not intended)
Height	135 mm (5.3 inches)
Width	440 mm (17.3 inches) excluding fixing brackets
Overall width	482 mm (19 inches) including fixing brackets
Depth	435 mm (17.1 inches) over rear connectors
Weight	11 kg (24.3 lbs) (approximate)

Table B.10: Physical Specification

Power Supply

Parameter	Specification
Power distribution system	Type TN (IEC 950 para. 1.2.12.1): Power distribution system having one point directly earthed, the exposed conductive parts of the installation being connected to that point by protective earth conductors. This equipment must NOT be used with single-phase three-wire systems.
Connection to supply	Pluggable Equipment Type A (IEC 950 para. 1.2.5): Equipment which is intended for connection to the building power supply wiring via a non-industrial plug and socket-outlet or a non-industrial appliance coupler or both. Correct mains polarity must always be observed. Do not use reversible plugs with this equipment.
Class of equipment	Class I Equipment (IEC 950 para. 1.2.4): electric shock protection by basic insulation and protective earth.
Rated voltage	100-120 V / 220-240 V (single phase)
Rated current	1.2 A / 0.6 A
Rated frequency	50/60 Hz
Voltage selection	Autosensing
Input connector	CEE 22/IEC 3-pin male receptacle
Fuse	Fuse in live conductor in power input filter at rear of unit.
Fuse type	5 mm x 20 mm time-delay (T) IEC (EN 60127-2 sheet 5) High breaking capacity: 1500 A
Fuse rated voltage	250 V
Fuse current rating	3.15 A
Consumption	100 VA (nominal); 80 W (nominal)
Power lead connector fuse	5 A

Table B.11: Power Supply Specification

Safety

This equipment has been built and is production tested to comply with the following safety standard:

EN 60950	Safety of information technology equipment including electrical business equipment.
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EMC Compliance

The basic Modulator (M2/MDV/FRT) and associated option modules (M2/MDV/OPT - Optical interface; M2/MDV/LVDS-S - LVDS serial interface) have been designed and type-tested to comply with the following standards:

EN 55022 1994	European	Emission Standard Limits and methods of measurement of radio disturbance characteristics of information technology equipment — Class B.
EN 50082-1 1992	European	Generic Immunity Standard Part 1: Residential, commercial and light industry environment.

For other options, please contact DMV Customer Support.

FCC_A	USA	The FCC Rules and Regulations, Title 47, Part 15, Subpart B. Conducted and radiated emission limits for a Class A digital device. ANSI C63.4 (1992) Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
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CE Marking

The CE mark is affixed to indicate compliance with the following Directives:
89/336/EEC of 3 May 1989 on the approximation of the laws of the Member States relating to electromagnetic compatibility.



73/23/EEC of 19 February 1973 on the harmonisation of the laws of the Member States relating to electrical equipment designed for use within certain voltage limits.

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C: Extension of ETS 300 421 to Include BPSK Modulation

C.1: Introduction

NOTE...

ETS 300 421 December 1994 specifies only QPSK type modulation.

This annex specifies BPSK modulation as implemented in the System 3000 DVB Digital Modulator.

C.2: Description

The conceptual block diagram shown in Figure C.1 illustrates the implementation of the BPSK function. Also shown (in Figure C.2) is the BPSK constellation showing the bit mapping in the signal space.

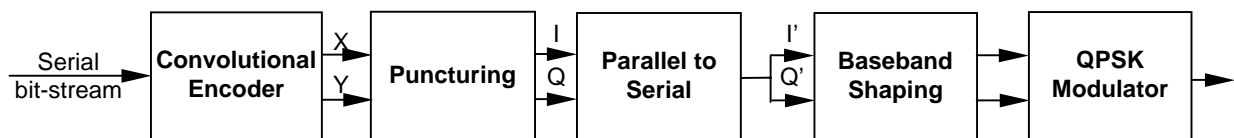


Figure C.1: Conceptual Diagram

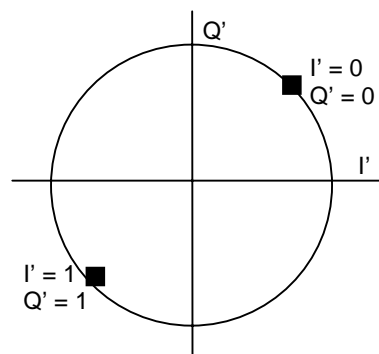


Figure C.2: BPSK Constellation

The convolutional encoding, puncturing, baseband shaping and QPSK modulator functions shown in Figure C.1 are identical to those for QPSK. The only difference is the insertion of the parallel to serial converter which alternately selects the I and Q outputs of the puncturing block and feeds identical signals in parallel to the I' and Q' inputs of the QPSK modulator block.

Code rate	Bit sequence (I' = Q')
1/2	X ₁ Y ₁
2/3	X ₁ Y ₁ Y ₂ X ₃ Y ₃ Y ₄
3/4	X ₁ Y ₁ Y ₂ X ₃
5/6	X ₁ Y ₁ Y ₂ X ₃ Y ₄ X ₅
7/8	X ₁ Y ₁ Y ₂ Y ₃ Y ₄ X ₅ Y ₆ X ₇

Table C.1: Puncture Code Definition for BPSK Modulation

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