



TECHNICAL SPECIFICATION 099-20003-01

Norsat News Terminal

Document # TS099-20003-1
Revision Draft

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Revision History

Revision	Date	Reason For Change	Reviewed By	Author
Draft	12/10/02	Initial Release		M. Scheffer
2				
3				
4				
5				

This Revision Approved By

Date

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1 PURPOSE

This document provides the specifications for the Norsat News Terminal (hereafter also referred to as “the terminal”) for transmission of quality video and data via satellite and the reception of data via satellite. The specifications include functional, performance, environmental and regulatory (where applicable) specifications.

2 SCOPE

This document defines the requirements for the Norsat News Terminal.

3 REFERENCE DOCUMENTS

The following documents form a part of this document to the extent specified herein:

3.1 System Documents

[1] Software Requirements, Norsat News Terminal, Document Number SR099-20003-01

[2]

3.2 Program Documents

N/A

3.3 Standards

- [3] ETS 300 019-1-7 : Equipment Engineering (EE); Environmental conditions and environmental test for telecommunications equipment. Part 1-7: Classification of environmental conditions, Portable and non-stationary use.
- [5] EN 301 430 : Satellite Earth Stations and Systems (SES); Harmonized EN for Satellite News Gathering Transportable Earth Stations (SNG TES) operating in the 11-12 /13-14 GHz frequency bands covering essential requirements under article 3.2 of the R&TTE directive
- [4] EN 300 421 V1.1.2 (1997-08), Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for 11/12 GHz satellite services
- [5] En 301 192 V1.2.1 (1999-06), Digital Video Broadcasting (DVB) DVB Specification for data broadcasting
- [6] ISO/IEC 13818-1,
- [7] ISO/IEC 13818-2
- [8] ISO/IEC 13818-3.



[9] SMPTE 259M

[10] AES3-1992

3.4 Regulatory Documents

General



4 **ACRONYMS AND ABBREVIATIONS**

Some of the following may be used in this document:

AC	Alternating Current
ANT	Antenna Subsystem
CDR	Critical Design Review
CMF	Control & Monitor Functions
DB	Decibels
DBc	decibels relative to carrier
Dbi	decibels relative to an isotropic radiator
DBm	decibels relative to 1 milliwatt
DbW	decibels relative to 1 watt
CMF	Control and Monitoring Function
DC	Direct Current
DPLX	Diplexer
EHF	Extremely High Frequency
EIRP	Equivalent Isotropic Radiated Power
EMC	Electromagnetic Compatibility
ERM	Electromagnetic Compatibility and Radio spectrum Matters
ESA	European Space Agency
ESD	Electrostatic Discharge
ETSI	European Telecommunications Standards Institute
FSS	Fixed Satellite Service
GHz	Giga-Hertz
IDU	Indoor Unit
IF	Intermediate Frequency
IFL	Interfacility Link
Ka	18 GHz to 36 GHz frequency band
Ku	10.7 GHz to 18 GHz frequency band
LMCS	Local Multipoint Communications Systems
LMDS	Local Multipoint Distribution Systems
LNB	Low Noise Block downconverter
LNBFs	Low Noise Block downconverter/feedhorn
LO	Local Oscillator
MAC	Monitoring and Control
Mbps	Megabits per second
MDU	Multiple Dwelling Unit
MMICs	Monolithic Microwave Integrated Circuits
MTBF	Mean Time Between Failures
MTTR	Mean Time To Repair
Ns	Nanosecond
ODU	Outdoor Unit
OMT	Ortho Modal Transducer
PDR	Preliminary Design Review
PLLs	Phased-Locked Loops
Ppm	parts per million
RES	Radio Equipment and Systems
RF	Radio Frequency
Rx	Receive / Receiver
SES	Societe Europeenne Des Satellites
SIMP	SIT Internal Management Protocol



SIT	Satellite Interactive Terminal
SNG	Satellite News Gathering
SSM	Signal Strength Meter
SSPA	Solid State Power Amplifier
SUT	Satellite User Terminals
TBD	To Be Determined
TES	Transportable Earth Station
TRX	Transceiver Subsystem
TRF	Transmit Rejection Filter
UPC	Up Converter
Tx	Transmit / Transmitter
VSAT	Very Small Aperture Terminal
XTAL	Crystal

5 FUNCTIONAL DESCRIPTION

5.1 System Overview

The Norsat News Terminal will be a rugged, portable satellite earth terminal which will communicate with a central teleport or hub station. The Norsat News Terminal will operate from remote locations and will provide the transmission of audio, video and data to the central hub and will receive user data and control information from the central hub. The primary use of this terminal is for Satellite News Gathering (SNG)

5.2 Norsat News Terminal Overview

The Norsat News Terminal will meet the following **principal requirements**:

1. Transmission of quality video + audio using MPEG-2 at greater than 2 Mbps
2. Worldwide operation
3. Interface with customer supplied video, audio and IP data sources.
4. Interface with the customer supplied peripheral devices for the transfer of IP data.
5. Two cases with minimum physical dimensions and weight for easy handling.
6. Quick and easy setup and operation
7. Manual alignment
8. Operation from either AC power sources (110V or 220V) and from a 12 V DC source
9. Reliable and rugged
10. Operation in inhospitable environments
11. MPEG-4 compression as an option.

The Norsat News Terminal will have two physical units connected via an IFL:

1. Antenna/RF Unit
2. Baseband/IF Unit

6 INTERFACES



6.1 External Interfaces

The external interface block diagram for the Video Pico Terminal is shown in Fig.1. The detail of the required interfaces are as stated in the following tables of section 6.

Note that all connectors shall have provision to be quickly and securely fastened without the use of tools. Use of twist-lock , bayonet style or circular screw on connectors are desirable. Connectors shall be located to facilitate easy use. Whenever possible connectors will be keyed such that only the correct mating connector can be secured at each bulkhead connector. All connectors shall be clearly marked.

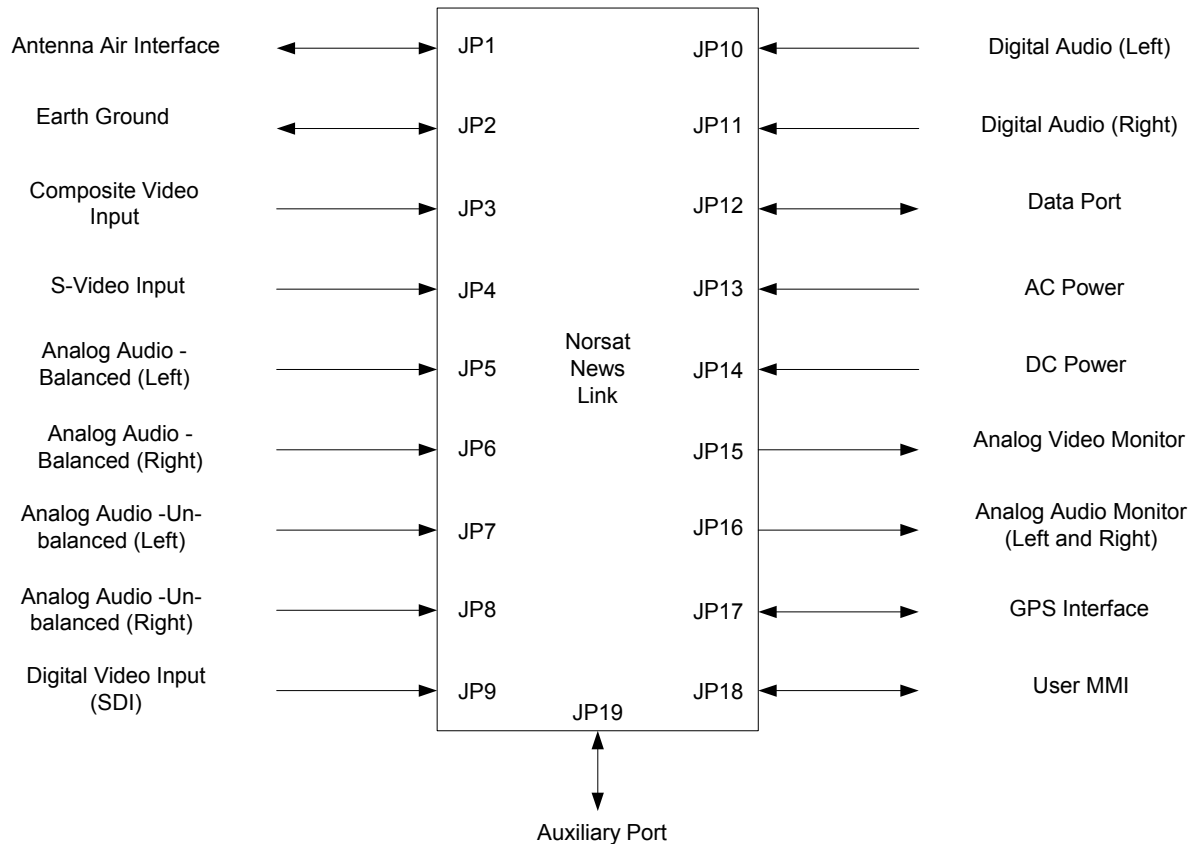


Figure 1: Norsat News Terminal External Interfaces

Table 1: Norsat News Terminal External Interfaces

Interface		Signal Type	Connector
JP1	Antenna air interface	Tx: 14.0-14.5GHz Rx: 10.7-12.75 GHz Vertical/Horizontal linear polarization.	N/A
JP2	Ground Earth Connection	Terminal earthing	Ground lug on antenna structure for wire connection.
JP3	Analog Video Input	Composite Video	BNC (F) 75 ohm



Interface		Signal Type	Connector
JP4	Analog Audio Left Input (SDI version)	Balanced	XLR, 3pin 600 ohm
JP5	Analog Audio Right Input (SDI version)	Balanced	XLR, 3pin 600 ohm
JP6	Analog Audio Left Input	Unbalanced	RCA – TBD
JP7	Analog Audio Right Input	Unbalanced	RCA – TBD
JP8	Digital Video Input (SDI Version)	SDI Component	BNC (F), 75 ohm
JP9	Digital Audio Input Left (SDI version)	AES/EBU	XLR, 3 pin
JP10	Digital Audio Input Left (SDI version)	AES/EBU	XLR, 3 pin
JP11	Data Port	Ethernet	RJ45 Jack
JP12	AC Power Input	110/220 V, 50/60 Hz, 400 W	Circular, ¼ turn locking, three pin
JP13	DC Power Input	12/24V, 400W	Circular, ¼ turn locking, four pin
JP14	Analog Video Monitor Output (monitor encoded video)	Composite Video	BNC (F), 75 ohm
JP15	Analog Audio Output Left (monitor encoded audio)	Balanced or unbalanced ?	XLR or RCA (TBD)
JP16	Analog Audio Output Right (monitor encoded audio)	Balanced or unbalanced ?	XLR or RCA (TBD)
JP17	GPS RF Receive	USB Port	USB Series A, 4 pin connector
JP18	User MMI	Windows based screens	Screen, keyboard and mouse/tracking ball
JP19	Auxiliary Port	USB Port	USB Series A, 4 pin connector
JP20	Telephone Line 1	4-wire	RJ-11
JP21	Telephone Line 2	4-wire	RJ-11

Note that there are two options for R0 an SDI and non SDI version. The SDI version has more/different options available for audio/video input and output. The interface panel will contain both options. Some interfaces may be replaced with covers.

6.2 Internal Interfaces

The interfaces between the major functional units of the Norsat News Terminal are shown in the following figure and summarized in Table 2.

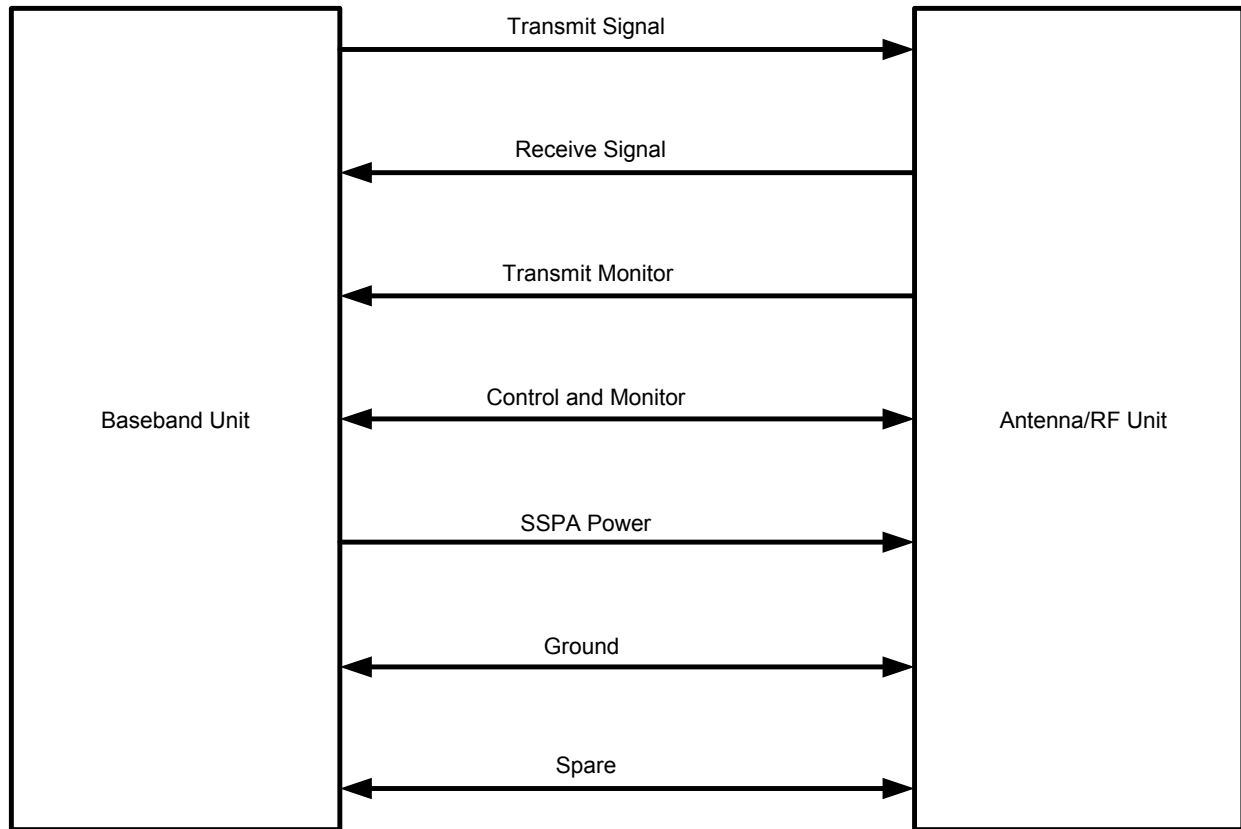


Figure 2: Norsat News Terminal Internal Interfaces

Table 2: Norsat News Terminal Internal Interface Summary

Interface		Signal Type	Connector
Jx1	Transmit	L-band Transmit signal 24V DC 10 MHz Reference	N connector Female bulkheads Male cable ends
Jx2	Receive	L-band Receive 24 VDC	N-connector Female bulkheads Male cable ends
Jx3	Transmit Monitor	L-band Transmit	N-connector Female bulkheads Male cable ends
Jx4	Control and Monitor	RS-232 2 pins	Circular, twist lock multipin connector Female bulkheads Male cable ends
Jx5	DC Supply	24V, DC 2 pins	Circular, twist lock multipin connector Female bulkheads Male cable ends



Jx6	Spare	4 pins	Circular, twist lock multipin connector Female bulkheads Male cable ends
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Note that the Control and Monitor, DC Supply and spare pins shall use the same multi-pin connector. This connector will be a circular twist lock or screw type connector

7 PERFORMANCE

7.1 Electrical:

7.1.1 Norsat News Terminal Performance

The Norsat News Terminal consists of the Antenna/RF Unit and the Baseband Unit connected by an Interfacility Link. The following tables specify the electrical performance of the Norsat News Terminal.

Table 3: Norsat News Terminal Overall Specifications

	Parameter	Specification
1	Tx Frequency	14.0-14.5GHz
2	Rx Frequency	10.7-12.75 GHz
3	Polarization (Tx/Rx)	V/H or H/V
4	EIRP	> 51 dBW
5	Off-Axis EIRP Emission Density (Co-pol) 2.5 <= a <= 7.0 7.0 < a <= 9.2 9.2 < a <= 48 48 <= a <= 180	In any 40 kHz band 33-25log(a) dBW +12 dBW 36-25log(a) dBW -6 dBW
6	Off-Axis EIRP Emission Density (X-pol) 2.6 <= a <= 7.0 7.0 < a <= 9.2	In any 40 kHz band 23-25log(a) dBW +2 dBW
7	Off-Axis (a > 7 degrees) Spurious EIRP (Carrier Off) 1.0-10.7 GHz 10.7-21.2 GHz 21.2-40 GHz	(any 100 kHz band) -42 dBm -36 dBm -30 dBm
8	Off-Axis (a>7 degrees) Spurious EIRP (Carrier On) 1.0-3.4 GHz 3.4-10.7 GHz 10.7-11.7 GHz 11.7-21.2 GHz 21.2-40 GHz	(any 100 kHz band) -41 dBm -35 dBm -29 dBm -12 dBm -23 dBm
9	On axis Spurious	< 4 dBW per 4 kHz band
10	G/T (system only, no sky noise)	> 21 dB/K (NF<1.0, Rx Gain = 40 dBi)

Items 5 through 9 of the above table are a summary of the requirements of ETSI EN 301-430.



7.1.2 Antenna/RF Unit Performance

The Antenna/RF unit is composed of the following components:

1. Antenna;
2. Transceiver; and
3. Peripherals.

7.1.2.1 Antenna

The required specifications for the Antenna of the Antenna/RF Unit are listed in the following table.

Table 4: Electrical Antenna Requirements

	Parameter	Specification
1	Tx Frequency Rx Frequency	14.0-14.5GHz 10.7-12.75 GHz
2	Antenna Reflector Size	< 1 m ²
3	Transmit Polarization	Vertical or Horizontal
4	Receive Polarization	Horizontal or Vertical (orthogonal to Tx)
5	Tx gain	≥ 41 dB across Tx frequency band
6	Rx gain	≥ 40 dB across Rx Frequency band

Note that the Tx Gain allows for 1 dB of losses in waveguide between SSPA and antenna feed.

7.1.2.2 Norsat News Terminal Transceiver

The following tables summarizes the electrical performance at the output of the transceiver. Some parameters include contributions from the Baseband Unit.

Table 5: Norsat News Terminal Transmit Performance

	Parameter	Specification
1	Tx frequency range	14.0 – 14.5 GHz
2	Tx frequency resolution	< 1 kHz
3	Tx frequency error	< 10 kHz
5	1 dB C.P. of SSPA	>40 dBm
6	Spectral Regrowth	Better than 25 dBc @ 1 dB C.P.
7	Output Signal Level Range	20 dB (20 dBm – 40 dBm)
8	Output Signal Step Size	0.5 dB
9	Output Signal Accuracy	+/- 1 dB
10	Flatness Variation over temperature	+/- 2 dB TBD
11	Flatness Variation 10 MHz 72 MHz 500 MHz	+/- 0.5 dB +/- 1 dB +/- 2 dB
12	Combined Flatness Variation (Temperature and Frequency)	5 dB p-p
13	Phase noise 100 Hz 1 kHz 10 kHz ≥ 100 kHz	-60 dBc -70 dBc -80 dBc -90 dBc



	Parameter	Specification
14.	NOISE TX ON	< -85 dBm/Hz
15	Noise SSPA Muted	< -115 dBm/Hz

As a design guideline assume that half the phase noise, transmitted noise and muted noise specification is allocated to the Antenna/RF Unit and half is assigned to the Baseband Unit.

Table 6: Norsat News Terminal Receive Performance

	Parameter	Specification
1.	Rx Frequency range	10.7 – 11.2 GHz 10.95 – 11.7 GHz 12.25 – 12.75 GHz Frequency ranges selected by changing LNB
2.	Rx LO stability	+/- 10 kHz
3.	Input Signal Power	Operational TBD Beacon TBD
4.	Rx Noise Figure	1.0 dB max.
5.	Receiver phase noise 100 Hz 1 kHz 10 kHz 100 kHz	-70 dBc -75 dBc -80 dBc -85 dBc

7.1.2.3 Antenna/RF Unit Peripherals

Antenna/RF Unit shall include the following peripherals to aid in the antenna alignment with the satellite. These include the following and the required performance of each is listed in the table below.

1. Inclinometer
2. Levels
3. Compass

Table 7: Inclinometer Performance

	Parameter	Specification
1.	Display	Digital
2	Accuracy	Better than 0.5 degrees
3	Power	Battery operated
4	Location	Mounted to accurately indicate the elevation of the antenna beam. A software offset may be preset to allow easier operation

Note that the display shall indicate the elevation angle of the antenna beam.

Table 8: Levels Performance

	Parameter	Specification
--	-----------	---------------



1.	Display	Digital
2	Accuracy	Better than 0.5 degrees Auto compensation may be desirable
3	Power	Battery operated
4	Location	Mounted to accurately indicate the levelness of antenna

This may be replaced with a spirit bulls eye level.

Table 9: Compass Performance

	Parameter	Specification
1.	Display	Digital
2	Accuracy	Better than 0.5 degrees
3	Compensation	Compensation procedure required
4	Power	Battery operated
5	Location	Mounted to accurately indicate the azimuth of the antenna beam.

7.1.3 Baseband/IF Unit

The Baseband /IF Unit performs the following functions:

- a) MPEG-2 encoding of user supplied video
- b) IP encapsulation (IP packets encapsulated in MPEG packets)
- c) Multiplexing to provide a single Transport Stream (TS) to modulator
- d) DVB-S compliant coding, interleaving, scrambling and modulation
- e) Upconversion of modulated signal to L-band
- f) Reception of DVB-S compliant MPEG-2 transport stream
- g) Extraction of IP packets from the received transport stream
- h) Spectrum analyzer functionality to view received signal (beacon and DVB-S signal)
- i) Spectrum analyzer functionality to view transmitted signal
- j) Display of transmitted video
- k) Antenna Pointing Calculations
- l) Two-way voice capability

Is there a requirement to store video onto disk?

The following Table summarizes the overall performance of the Baseband /IF Unit

	Parameter	Specification
1.	Maximum Delay (encoding, buffering etc)	< 600 ms
2	Aggregate output data rate (includes encoded audio, encoded video, IP data and overhead)	10 Mbps
3	Modulated symbol rate	1 – 10 MSps
4	Receive Symbol Rate	1.5 – 45 MSps



7.1.3.1 Audio/Video Encoding

The MPEG-2 Encoder shall accept a single video and two mono audio or one stereo inputs, processes and compresses the inputs and produces a MPEG-2 Transport stream. The video input shall be one of the following:

- a) Composite Video
- b) SDI Component

The audio inputs (two channels L and R) shall be one of the following :

- a) Analog balanced mono audio (L and R)
- b) Analog unbalanced mono audio (L and R)
- c) AES/EBU digital inputs (Stereo)

The video processing shall be compliant with ISO/IEC 13818-2 and the audio processing shall be compliant with 13818-3. The system information shall be configurable and shall include:

- a) PID
- b) TBD

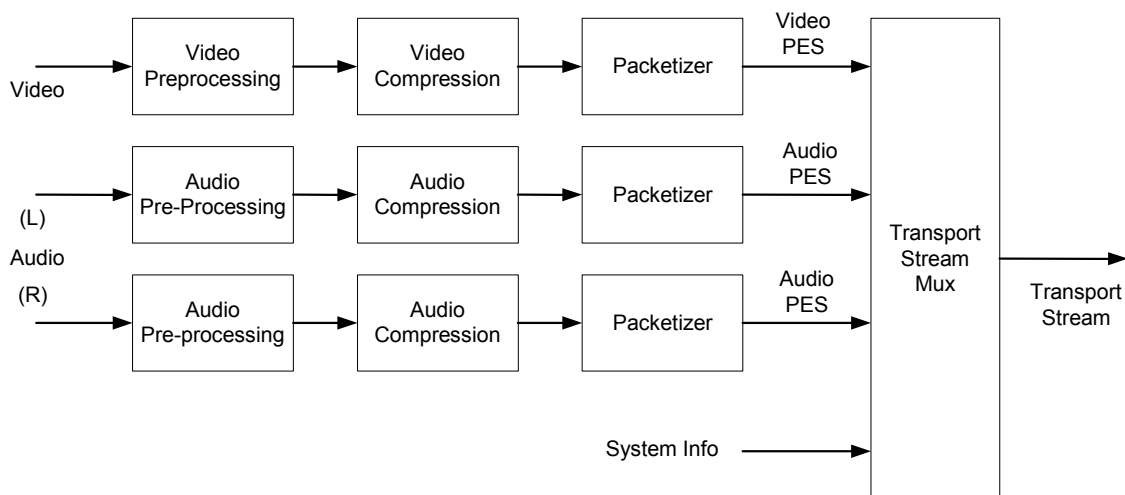


Figure 3: Simplified Block Diagram of Encoder Processing

Table 10: Video Input Characteristics

	Parameter	Specification
	Composite Video	
1	Format	Composite NTSC (30 fps) or PAL (25 fps)
2	VIDEO LEVEL	1 V p-p +/- 0.3V p-p
3	Bandwidth	x.x MHz (NTSC) TBD 5.5 MHz (PAL)



	Parameter	Specification
4	Impedance	75 Ohms unbalanced
5	Return Loss	> 25 dB
6	Connector	BNC
	SDI	
	Specification	Per SMPTE 259M
	Connector	BNC

Table 11: Audio Input Formats

	Parameter	Specification
	Balanced Audio	
1	Format	2 balanced mono inputs
2	Level	-7 to 24 dBu
3	Level Adjust	+/- 15 dB
4	Frequency Range (+/- 0.25 dB)	20 Hz to 20 kHz
5	Impedance	> 10k Ohm
6	Connector	-XLR
	Un-Balanced Audio	
7	Format	2 balanced mono inputs
8	Level	
9	Level Adjust	
10	Frequency Range (+/- 0.25 dB)	
11	Impedance	
12	Connector	
	AES/EBU	
13	Specification	Per AES3-1992

The encoder performance is summarized in the following table:

	Parameter	Specification
1	Video Encoding	One video source
2	Video Encoding Rate	1.5 – 15 Mbps (MP@ML)
3	Audio	Two mono sources
4	Audio Encoding Rate	32 – 384 kbps (each channel)
5	Maximum Delay	< 600 ms
6	Profiles Supported	MP



7	Levels Supported	ML
8	Group of Pictures (GOP) Supported	15/3

The following functions can be controlled:

- a) video source
- b) audio source
- c) video encoding rate
- d) audio encoding rate
- e) GOP
- f) Profile and Level
- g) Output Buffer
- h) Resolution

The following items are monitored on the encoder:

- a) all control settings
- b) buffer underflow/overflow alarms
- c) alarms (TBD)

7.1.3.2 IP Encapsulation

The baseband unit shall use IP encapsulation for data transmission to the hub. Data may be either externally generated (eg. User laptop) or internally generated (eg. Management functions, VOIP). Each channel shall have its own PID. At least four channels will be supported.

The baseband unit shall support the TCP/IP Protocol Suite and some IPv4 based protocols. Note that the symmetric bi-directional routes cannot be guaranteed so protocols that require this cannot be supported. The Baseband/IF Unit shall accept TCP/IP data via an Ethernet 10/100 BaseT interface. The IP packets shall be encapsulated in MPEG2 packets according to the Multi-Protocol Encapsulation (MPE). The following protocols are supported:

- a) TCP/IP
- b) Telnet
- c) TBD

Both CBR and VBR services are provided. Data shall have a lower priority than the audio and video. The data rate shall be configurable from 32 kbps to 2.048 Mbps in 1 kHz increments.

Traffic statistics shall be collected.

7.1.3.3 Channel Coding and Modulation

The DVB Modulator accepts the MPEG-2 Transport Stream containing the audio, video and data packets and processes it as defined in ETS 300-421. The transport stream is made up of 188 byte packets containing one sync byte and 187 bytes of payload. Figure 6 depicts the DVB-S processing:

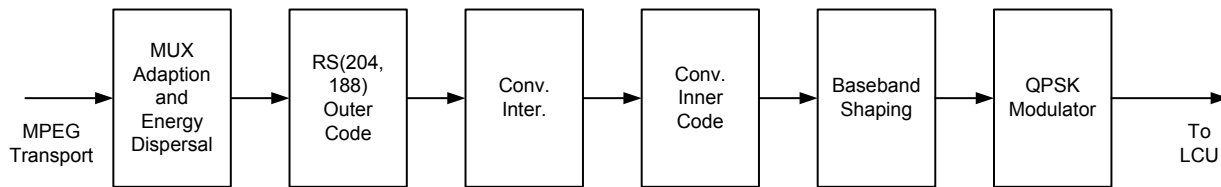


Figure 4: DVB Modulator Functional Block Diagram

The input transport stream is randomized by combining the MPEG transport stream with a pseudo random binary sequence that has been loaded into a shift register. The randomizing is performed to ensure sufficient binary transitions and to meet ITU transmitted power requirements. The process encompasses eight frames and then is re-initialized. Sync bytes are not randomized and every eighth sync bit is inverted to provide an initialization signal for the descrambler.

Following randomization, each packet (including the sync byte) is block coded using a RS (204, 188, 8). Each encoded packet is made up of 1 sync byte, 187 data bytes and 16 bytes of redundancy.

After block coding, the packets are convolutionally interleaved creating interleaved frames. The convolutional interleaver maintains periodicity of the coded MPEG packet (204 bytes). Interleaving is performed to spread burst errors over many frames and thus improve the performance of the RS code.

The interleaved frame is then convolutional coded and then punctured to provide inner code rates of 1/2, 2/3, 3/4, 5/6 and 7/8. The base convolutional code is a K=7, rate 1/2 code. Thus rate 1/2 inner code does not use puncturing. The outputs of the convolutional coder/puncturer are applied to I and Q signals.

The I and Q signals are square root raised cosine filtered. The roll off factor is 0.35. The shaped I and Q signals are QPSK modulated. The mapping of I and Q uses Grey coding and absolute mapping. The modulator may also spectrally invert the QPSK signal if required.

7.1.3.4 Upconversion, Frequency Control Level Control

The modulated signal is upconverted to L-band. The center frequency of the modulated signal shall be configurable with a resolution of less than 1 kHz.

The Baseband unit shall provide at least 30 dB of level control.

7.1.3.5 Reception of DVB-S/MPEG-2 transport stream

The Baseband Unit shall receive, amplify, demodulate, decode and recreate IP data from an MPEG-2 /DVB-S transport stream received from the satellite.

A minimum of four channels shall be supported:

- a) User data
- b) Management data
- c) VOIP Line 1
- d) VOIP Line 2.



7.1.3.6 Spectrum Analyzer Functions

The Baseband Unit shall provide the capability to view the received and transmitted spectrums. On the receive side, main purpose is to aid in alignment and to verify correct satellite acquisition. The spectrum analyzer shall be capable of monitoring a satellite beacon with a narrow bandwidth and also to view the entire receive frequency spectrum. In addition it shall be possible to monitor the Norsat News Terminal transmitted signal that is translated and broadcast by the satellite to the central hub.

On the transmit side, it shall be possible to monitor the occupied bandwidth and sideband regrowth of the transmitted signal.

The Spectrum analyzer shall have the following capabilities:

	Parameter	Specification
1.	Frequency	Transmit – 14-14.5 GHz Receive – 10.7 to 12.75 GHz
2	Display Bandwidth (Span)	10 kHz to 500 MHz
3	Video Bandwidth	1 kHz (or equivalent)
4	Resolution Bandwidth	1 kHz (or equivalent)
5	Noise Floor	-100 dBm (or equivalent)
6	Display	Vertical: dBm, 10 dB/div, 5 dB/div, 2 dB/div, 1 dB Div, 8 divisions displayed Horizontal: Frequency, freq/div depends on span, 10 divisions displayed
7	Video Averaging	Yes
8	Frequency Accuracy	Per frequency reference
9	Amplitude Accuracy	Absolute - +/- 2 dB Relative - +/- 0.5 dB
10	Markers	Peak Search Delta Marker Display lines (Frequency and amplitude)
11	Special Functions	Occupied BW calculation

Is there a requirement to monitor the 70 MHz or L-band modulated signals?

Note the above specifications include any necessary down conversions.

7.1.3.7 Display of Source Video

The Baseband/IF Unit shall be capable of displaying the source video that is being transmitted. The display shall be in real time with the following requirements:

	Parameter	Specification
1.	Data Rate	Per encoding rate
2	Size and Resolution	SW configurable
3	Format	NTSC (30 fps) or PAL (25 fps)
4		
5		