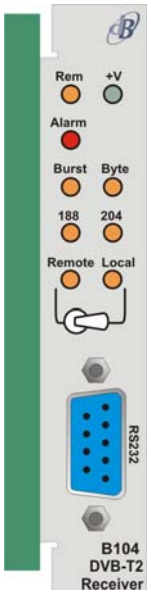
Broadcast

B104

DVB-T/T2 Terrestrial Receiver Module



Handbook

Version 1.0

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Document history

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Firmware versions

Contents

Introduction

The B104 terrestrial receiver

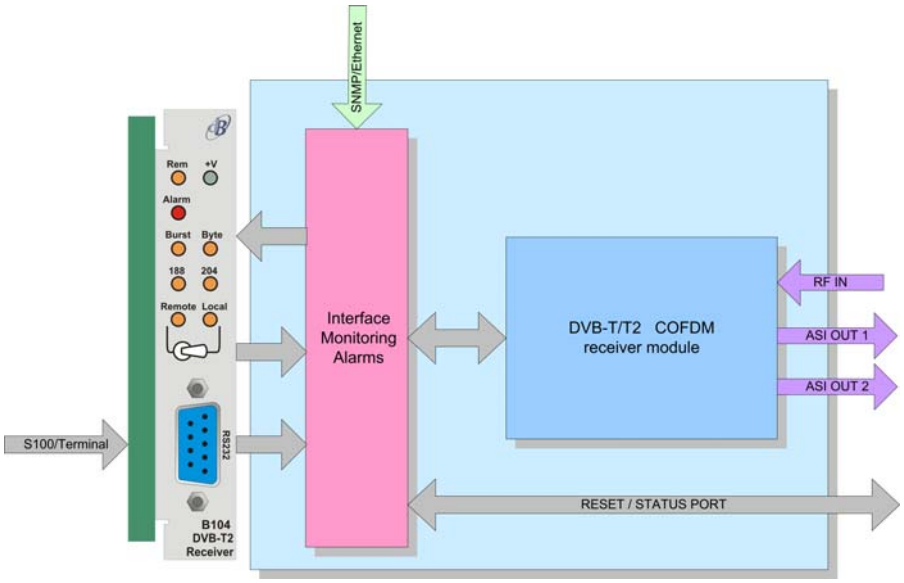
The Hawkeye B104 DVB-T2 Terrestrial Receiver demodulates a DVB-T or DVB-T2 signal to a DVB-ASI Transport Stream (TS) and covers the frequency bands 178MHz to 858MHz.

It is used to monitor modulation performance, including Modulation Error Ratio (MER), Low Density Parity Check (LDPC) and RF Input level. The modulation parameters are displayed and can be compared against a template. Alarms can be raised if signal performance is out of range or parameters are different from the template.

It has applications in re-broadcast transmission systems or for direct monitoring of a transmitter.

The module is housed within the V1606 (3RU) or F010 (1RU) chassis and uses the VB150 rear connector.

Status is indicated on the front panel, with advanced control, configuration and measurement functions available via SMNP, optional S067 configuration software over a LAN or the command line via the front serial interface.



Seven fixed DVB-T2 templates are provided and these are selected using a Graphical User Interface (GUI) or by SNMP.

Remote control options

Using a LAN

Control and monitoring of multiple modules over a network can be achieved via SNMP or by using the optional S067 Hawkeye Module Management software. In each case the frame requires both the B065 RS232/Ethernet controller and the B070 rack controller. The B070 is only supported in the V1606 3RU frame.

Using the front panel serial interface

A built-in Command Line Interface protocol is also implemented to allow control and monitoring from an RS232 terminal or terminal emulator via the front serial interface.

Features

- DVB-T and DVB-T2 terrestrial COFDM to DVB-ASI demodulation with dual DVB-ASI outputs
- Hot-swappable, compact module with basic module status indicators on front panel
- Covers the frequency bands 178MHz to 858MHz
- Supports seven fixed DVB-T2 standard based parameter monitoring templates
- Template parameters include T2 Frames per superframe, FEC block Length, Constellation of L1 Post signalling, Carriers, Constellation (of PLP), Tone Reservation, Scattered Pilot pattern, Guard Interval, Data symbols per T2 frame, FEC blocks per interleaving frame, Time interleaving blocks per DVB- T2 frame.
- Measured parameters for alarms also include RF level, receiver lock status, MER, LDPC, TS bit rate and frequency variation
- Alarm and template configuration over a LAN using SNMP or optional S067 software
- Front serial interface for terminal or PC software control
- Low power consumption
- Reset/Status port on rear connector

The B104 supports up to 256 Physical Layer Pipes (PLPs), though only a single PLP is supported in the UK.

Applications

- DVB-T and DVB-T2 single and multi-service demodulation
- Digital turn-around (DTA) systems
- Signal acquisition for translating or transcoding platforms
- Off-air signal measurement and monitoring with user-defined alarm thresholds

General safety summary

Precautions to avoid personal injury, fire or product damage.

Every care has been taken in the design, manufacture, assembly and testing of this product to obviate health and safety risks to personnel and to prevent fire or other hazards. However, please review the following safety precautions for continued protection.

General use. This product must only be used as specified in this manual. Failure to follow any ratings or directions for use may impair the protection provided.

On receipt of the product. Verify there is no damage and that all accessories are present .

Suspected damage or failure. Do not operate the product. Have it inspected by qualified service personnel or contact dB Broadcast or an authorised distributor.

Operating environment. The unit is for indoor use only. See the Specification chapter for further environmental, physical, certification and safety information.

Do not operate in wet or damp conditions.

Do not operate in an explosive atmosphere.

Power cable. Use only a power cable specified for this product and certified safe for the country of use.

Grounding. *This product must be grounded*. Before making any signal connections, ensure that the product is grounded. The product is grounded through the power cable. To avoid electric shock under fault conditions, the protective grounding conductor within the power cable must be connected to an earth terminal of the building in which the product is located.

Mains supply voltage and fuse ratings. See the Specification chapter. All ratings must be observed.

Ventilation. To prevent overheating do not obstruct ventilation holes.

Cuts and abrasions. When handling the equipment, guard against cuts or abrasions from metal parts of the case or components.

Caution statements identify conditions or practices that could result in damage to this product or other property.

Toxic content. Unwanted or obsolete components must be disposed of safely as some may release toxic vapours if incinerated.

In case of difficulty. Please refer to dB Broadcast.

Lithium battery

A lithium battery is located in this product, which provides back up for the real-time clock. In normal operation this battery has a life in excess of 5 years. If the real-time clock's operation becomes erratic when cycling the power, then the battery may need replacing. Battery replacement should only be performed by a 'skilled and competent technician', or by returning to db Broadcast for repair.

Danger of explosion if battery is incorrectly replaced.

Product damage precautions

Take anti-static precautions. Since this unit contains exposed PCB and electronic components, ensure proper anti-static precautions are observed when handing this equipment.

Provide proper ventilation. To prevent product overheating, provide proper ventilation.

Do not operate with suspected failures. If you suspect there is damage to this product, have it inspected by qualified service personnel.

There are no user serviceable parts. Return to dB Broadcast or an authorized distributor for repair/service.

Product inspection. On receipt of the unit, open the box and verify that the unit and all accessory items included. Save the shipping carton and packing materials in case it becomes necessary to ship the unit to dB Broadcast for service or repair.

Installation

The B150 rear panel assembly must be installed prior to fitting the main decoder module. To do this, remove the blanking plate from the required slot in the rear of the frame.

Always remove power whilst fitting the rear module.

Insert the rear panel assembly taking care to align the control and power pins at the top and bottom of the rear panel correctly. The RF connector goes towards the bottom of the frame.

Damage to the module and/or frame may occur if the rear panel assembly is not the correct type or is incorrectly installed.

Secure the rear panel assembly to the frame using the 4 screws that held the blanking plate (M2.5 x 10mm).

Pull down the front panel and insert the module into the appropriate slot taking care to ensure it is within the top and bottom guides. Push the module fully home into the DIN connector in the rear panel assembly.

To remove the module from the frame, pull the unit from the front of the frame using the handle.

RF/ASI I/O

BNC	SIGNAL – B104	Details
RF IN	RF INPUT	Provides RF signal input with a sensitivity of –20 dBm to -80 dBm with nominal 75 Ω impedance.
ASI OUT 1	ASI OUTPUT 1	DVB-ASI compliant transport stream output with nominal 75 Ω impedance.
ASI OUT 2	ASI OUTPUT 2	As above

Hot swap feature

Modules can be inserted and removed without the need to power down the rack system.

If the module is set to remote operation, swapping modules for those of the same type will configure it to the same settings as those of the removed module.

Front panel RS232

RS232 – 9 way 'D' type	
PIN	**SIGNAL**
1	Not used
2	Transmit data (To PC)
3	Receive data (From PC)
4	Not used
5	Signal ground
6	DTR – Data transmit ready (to PC)
7	CTS – Clear to send (from PC)
8	RTS – Ready to send (to PC)
9	Not used
Shell	Chassis ground

A one-to-one serial cable is suitable for use on the front panel serial port. USB-to-serial converter cables may also be used.

Reset/Status port

The Reset / Status Port connector (labelled RESET / STATUS) is located on the rear-panel. The connector is a 9-pin sub miniature D-type with female contacts.

Reset/Status – 9 way 'D' type	
PIN	**SIGNAL**
1	Ground
2	Critical alarm common
3	Non-critical alarm NC
4	Non-critical alarm NO
5	Reset control
6	Critical alarm NO
7	Critical alarm NC
8	Non-critical alarm COMMON
9	Reset input
Shell	Chassis ground

The monitoring outputs are two sets of changeover relay contacts, one for critical alarm status and the other for non-critical alarm status.

Connecting or disconnecting cables whilst the module is powered on can result in damage to its input circuits.

Critical alarm

The critical alarm indicates the total failure of the module. The only critical alarm condition is loss of power.

In the alarm condition, the relay is unenergised i.e. Critical Alarm Common (pin 2) is connected to Critical Alarm NC (pin 7). In the non-alarm condition, the relay is energised i.e. Critical Alarm Common (pin 2) is connected to Critical Alarm NO (pin 6).

Non-critical alarm

The non-critical alarm indicates a recoverable fault condition. There are 4 possible non-critical alarms:

- Self-test failure
- Loss of Sync
- BER over threshold
- Power supply fault

In the alarm condition, the relay is unenergised i.e. Non-critical Alarm Common (pin 8) is connected to Non-critical Alarm NC (pin 4). In the non-alarm condition, the relay is energised i.e. Non-critical Alarm Common (pin 8) is connected to Non-critical Alarm NO (pin 3).

Reset

Reset Control (pin 5) and Reset Input (pin 9) provide the facility to reset the module from an external source e.g. relay contact or switch.

To reset the module connect Reset Control to Reset Input for a period in excess of 10ms.

Tuning and checking the receiver

The receiver can be checked by tuning it to a terrestrial RF feed with an ASI Transport Stream (TS). Correct program content can be verified using picture and audio monitors connected to a DVB MPEG2 Decoder fed from the receiver's ASI TS output.

The receiver can be configured in terms of frequency, bandwidth (7 or 8Mhz) and DVB mode (DVB-T or DVB-T2).

If the channel has an offset an adjustment to the frequency is made; for 8MHz channels 166 KHz is added for an upper offset and 166 KHz is subtracted for a lower offset; 125KHz offsets are used for 7MHz bandwidth.

Using the Command Line Interface

Refer to the Command Line Interface chapter for details of the RS232 set up and serial command format for commands used in the following steps.

1. Power up the rack and ensure the green power indicator (+V) on the front panel is illuminated.
2. Connect an RS232 serial cable to the 9 way D-type connector on the front of the unit from a PC running a serial communications package. This will be required to set up the receiver. Move the Remote/Local switch on the front panel to the Local position.
3. Connect an appropriate terrestrial (DVB-T or DVB-T2) feed to the RF input and tune the receiver to a known channel frequency.
4. To configure the receiver with these parameters you will need to use the serial commands '**FREQ**', '**BANDWIDTH**' and '**DVBMODE**'. FREQ MHz, Bandwidth 7 or 8, DVBMODE 1 (DVB-T) or 2 (DVB-T2).

It is recommended to set BANDWIDTH to an initial value of "0" to make it easier to enter settings via the serial port. The zero bandwidth setting helps to speed up responses as it stops the receiver from attempting to tune. Bandwidth should be set to 7 or 8 to achieve lock after successfully setting frequency and DVB mode.

5. Sync lock can be verified using the serial command '**SYNC**'. If lock is not achieved check signal RF level, all connections and configuration and ensure the terrestrial feed is correct via a separate receiver. If the problem continues contact dB Broadcast Customer Service.

Tuning Examples

Ex 1. To set a frequency of 474MHz with no offset, 8MHz bandwidth and DVB-T2, issue commands as follows:

- BANDWIDTH 0 (initial setting to assist parameter setting)
- FREQ 474000 KHz
- DVBMODE 2
- BANDWIDTH 8
- The message "*INFO Tuned: To 474000 KHz, BW 8, DVB Mode 2" should appear

Each of the commands is followed by a carriage return.

Ex 2. To set a frequency of 474MHz, upper offset (upper adjacent channel), 8MHz bandwidth, DVB-T2, issue commands as follows:

BANDWIDTH 0 (initial setting to assist parameter setting)

- FREQ 474166 KHz
- DVBMODE 2
- BANDWIDTH 8

The message "*INFO Tuned: To 474166 KHz, BW 8, DVB Mode 2" should appear

RF Status

If RFS is typed for the second example, the message below should be seen.

"*RFS dvb3 : ms=1, tl=1, ifAgct=2530, rf=908, mer=23622, carOf=-12, ldpcIter=3"

Mer=23622 (23.6dB); Ldpciter = 3, instantaneous number of iterations.

The tuning process is identical between DVB-T2 and DVD-T, except that DVBMODE would be set to 1 for DVB-T.

Using the GUI

Refer to the Using the S067 GUI chapter for help with the control software.

The GUI must be at release 2.7 or later and the B065 at 2.4 or later.

Connect the PC to the BO65 Ethernet port, run the GUI and click on the B104 card in the card frame.

Tuning Example

Ex 1. To set a frequency of 474MHz with no offset, 8MHz bandwidth and DVB-T2, proceed as follows:

- Open the DVB MODE tab

If T2 is selected, the DVB-T pages are greyed out.

- Select T2 if T1 is selected, the message “Changing the DVB mode may cause a loss of signal. Are you sure you wish to change DVB Mode?” appears. Select Yes.
- Select the T2 configuration tab and set frequency to 474,000 KHz and Channel Bandwidth to 8 MHz
- The receiver is now tuned to the incoming RF
- Select the DVB-T2 summary page to view measured RF parameters

The tuning process is identical between DVB-T2 and DVD-T, except that DVBMODE would be set to 1 for DVB-T.

Operation

The B104 can be controlled locally using the RS232 port using low-level commands from a terminal, remotely via Ethernet SNMP or using S067 Hawkeye Module Management software.

Front panel controls and LEDs

The front panel offers local monitoring & control features by means of its LEDs and switches.

LED Indicators:

Rem	remote mode active - amber
+V	indicates DC power present & OK - green
Alarm	indicates fault condition detected - red
Burst/Byte	ASI mode; Burst or Byte - amber
188, 204	ASI packet length in bytes; 188/204 (DVB-T) or 188 (DVB-T2) - amber
Rem/Local	Remote; SNMP via Ethernet or Local; (RS232) - amber

The two position front panel control switches between Remote (left position) and Local RS232 control (right position).

Local RS232 control

Control is possible using a standard RS232 terminal or similar application such as Windows® HyperTerminal. It is possible to drive this port remotely over a LAN using a LAN to serial converter unit (not supplied).

Command protocol and a list of local control commands are detailed in the Command Line Interface chapter.

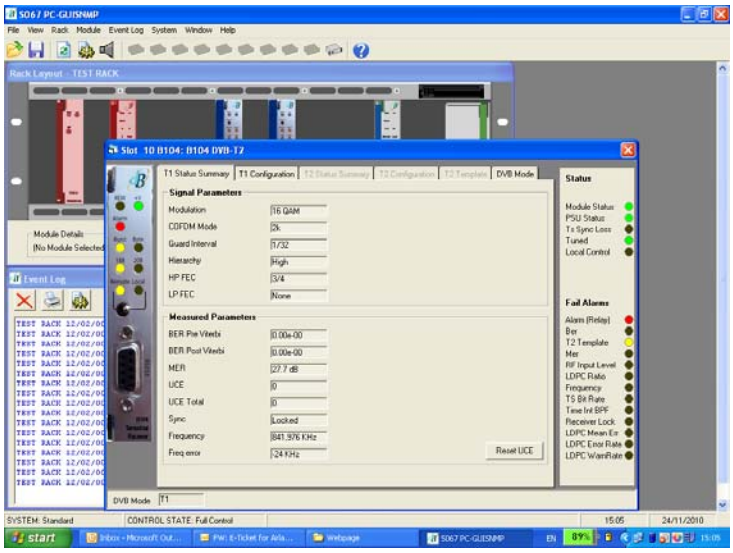
Remote control

When the front panel switch is in the ‘Remote’ position, control of multiple frames can be achieved over a network. There are two ways this can be achieved; using SNMP or by using the optional S067 Hawkeye Module Management software. The use of the S067 GUI is covered in the Using the S067 GUI chapter.

Using the S067 GUI

The S067 software can control up to 10 V1606 3RU racks from a single PC. Each rack can be identified by either the IP address or a user-defined name.

The active rack graphic, which mimics the actual appearance of the rack, shows module status (red indicates an alarm condition), communication link status, rack operating temperature and power supply voltage levels.



Alarms from all connected racks are aggregated and can be viewed in real time or stored to a nominated file for later analysis.

For either SNMP or S067 remote control, frames require both the B065 RS232/Ethernet controller and the B070 rack controller in the V1606 frame.

Note The B104 cannot be controlled over DARTnet.

Software Installation

If the software came on a CD follow the on-screen instructions when the CD is inserted in the PC.

The latest version of the S067 software may be downloaded from the dB Broadcast website http://www.dbbroadcast.co.uk.

To install the downloaded software extract the files to a temporary folder on your PC and run setup.exe.

Tip If the distribution CD has no autorun-installer search for the setup.exe file on the CD and run that.

Software Operation

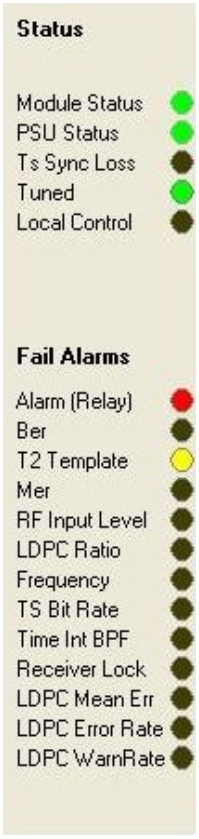
The configuration screens and their enabled functions depend on the type of module attached. With a B104 there are status menus and alarms with tabbed screens that currently include T1 Status Summary, T1 Configuration, T2 Status Summary, T2 Configuration, T2 Template and DVB Mode.

Functions not supported by an attached module are greyed out. If no module is connected all possible configuration screens appear. More than one instance of the software may run at the same time allowing multiple modules to be controlled simultaneously from one PC.

Note The following discussion provides examples for DVB-T2 operation only.

Status and Alarm Menus

These menus are on the right hand side of the displayed tabs.



Status	Indicator
Module Status	Green - normal
PSU Status	Green - normal
TS Sync Loss, Transport Stream loss	Green – normal, amber - loss
Tuned	Green - tuned
Local Control	Black (off) – normal, amber - local

Fail Alarms	Indicator
Alarm (Relay)	Red – relay in fail state
Ber	Amber – alarm set
T2 Template	Amber – alarm set
Mer	Amber – alarm set
RF Input Level	Amber – alarm set
LDPC Ratio	Amber – alarm set
Frequency	Amber – alarm set
TS Bit Rate	Amber – alarm set
Time Int BPF	Amber – alarm set
Receiver Lock	Amber – alarm set
LDPC Mean err	Amber – alarm set
LDPC Error rate	Amber – alarm set
LDPC Warning rate	Amber – alarm set

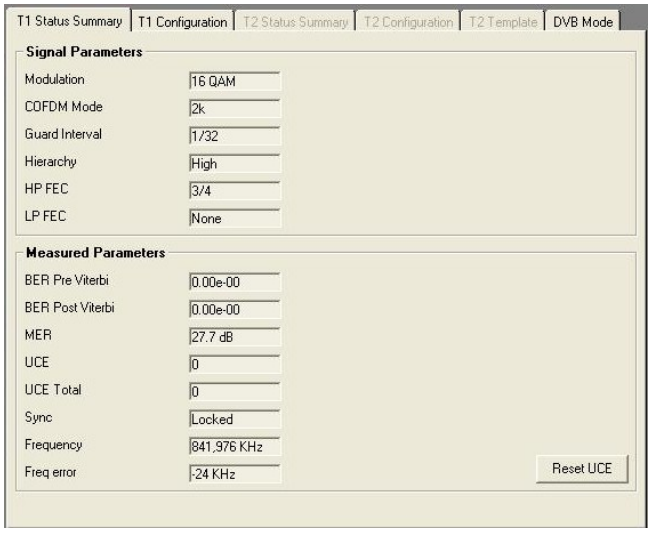
DVB Mode

Select the T1 or T2 radio button for DVB-T or DVB-T2 respectively.

Note Changing the DVB mode while using the B104 output may cause loss of signal.

T1 Status Summary

The Status Summary tab shows received parameters and DVB-T modulation settings.



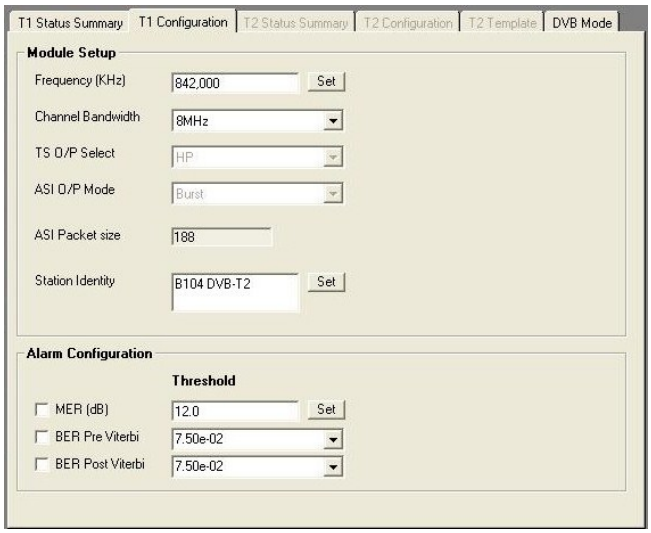
Signal Parameters

Parameter	Description	Values
Modulation	Sub-carrier modulation scheme	QPSK, 16QAM, 64QAM
COFDM Mode	FFT size (k=1,024)	2k, 8k
Guard Interval	Inter symbol gap	1/4, 1/8, 1/16, 1/32
Hierarchy	No hierarchical mode at present	Currently fixed as High
HP FEC	Displays the Forward Error Correction protection scheme	1/2, 2/3, 3/4, 5/6, 7/8

Measured Parameters

Parameter	Description	Values / Units
BER Pre Viterbi	Pre Viterbi decoder error rate	
BER Post Viterbi	Post Viterbi decoder error rate	
UCE	Uncorrected errors - Reed Solomon errors	Integer
UCE total	Count of UCE's since last Reset UCE	Integer
Sync	Indicates if the receiver is locked to the input RF	Locked, Unlocked
Frequency	Reports the actual frequency that the receiver is tuned to achieve lock	KHz
Frequency Error	The difference between the frequency that the B104 was set to and the frequency required to achieve lock	KHz

T1 Configuration



Module Setup

For module setup see Tuning and checking the receiver in the Installation chapter.

Alarm Configuration

There are two relay alarms, critical alarm and non critical alarm available on the rear connector. The critical alarm is dedicated to power failure.

The DVB-T non-critical alarm is programmed on the T1 Configuration tab.

MER

Sets minimum MER value, enter value and press Set. Tick box enables alarm.

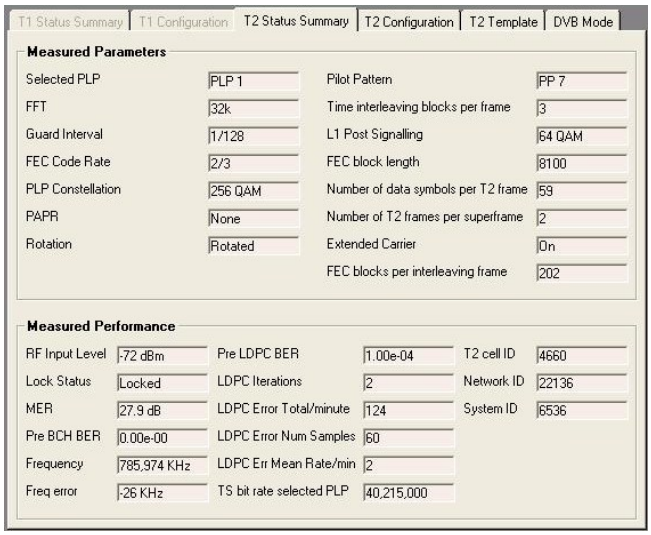
BER

Pre Viterbi alarms are set using the ranges provided in the drop down tabs. The alarms are enabled by clicking the tick box.

BER is not recommended for monitoring the receiver, owing to the very sharp characteristic of these measurements.

T2 Status Summary

The Status Summary tab shows received parameters and DVB-T2 modulation settings.



Measured Parameters

The signalling parameters contained in the DVB-T2 transmission are displayed.

Parameter	Description	Values
Selected PLP	Displays the current selected PLP	Currently PLP1 is selected
FFT	Displays the current FFT of the selected PLP	1K, 2K, 4k, 8K, 16K, 32K
Guard Interval	Guard Interval of the selected PLP	1/4, 19/256, 1/8, 19/128, 1/16, 1/32, 1/128
FEC code Rate	Displays the FEC of the selected PLP	1/2, 3/5, 2/3, 3/4, 4/5, 5/6
PLP Constellation	Displays the constellation of the selected PLP	QPSK, 16QAM, 64QAM, 256QAM
PAPR	Displays the Tone reservation of the transmission	TR, ACE, TR and ACE, None, Unknown
Rotation	Displays if the constellation is rotated or not	Rotated, None
Pilot Pattern	Displays the Pilot pattern of the transmission	PP7 is the only pattern used in the UK, other countries may use other values which will be displayed
PP1..PP8	Displays the number of Time Interleaving blocks per frame	In the UK this is set to 3
L1 Post signalling	Displays the constellation of the L1 post signalling	BPSK, QPSK, 16QAM, 64QAM
FEC Block Length	Displays the FEC block length.	Integer
Number of Data Symbols per T2 frame	Displays the number of Data Symbols per T2 frame	Changes depending on the DVB-T2 transmission parameters
Number of T2 frames per Superframe	Displays the number of frames per Superfrmane	Integer. In the UK this is set to 2
Extended Carriers	Displays if extended carriers are selected	ON –OFF
FEC Blocks per Interleaving Frame	Changes depending on the DVB-T2 transmission parameters	Integer

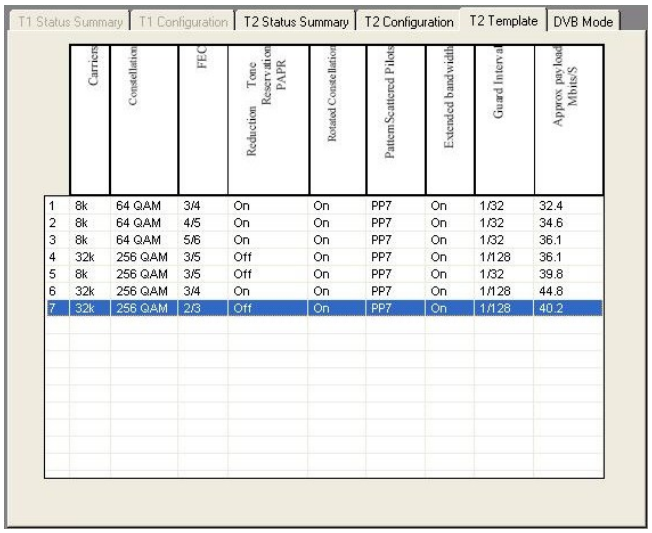
Measured Performance

The following parameters monitored by the B104 provide a measure of performance.

Parameter	Description	Values/Units
RF Input Level	Indicates the input RF level in dBm.	dBm
Lock Status	Indicates if the receiver is locked to the input RF. This is locked to the DVB-T2 signalling.	Locked, Unlocked
MER	Measured Modulation Error Ratio (MER) performance of the input RF in dB	dB
Pre BCH BER	Measures Pre BCH BER	
Frequency	Reports the actual frequency that the receiver is tuned to achieve lock	KHz
Frequency error	The difference between the frequency that the B104 was set to and the frequency required to achieve lock	KHz
Pre LDPC BER	Reports the Pre LDPC BER	
LDPC Iterations	The number of LDPC iterations required to correct the input signal	Instantaneous value updated continuously
LDPC Error Total/minute	Sum of LDPC instantaneous value sampled over a one minute period	
LDPC Error Num Samples	Number of LDPC samples taken over a one minute period	
LDPC Err Rate/min	Sum of the LDPC instantaneous values divided by the number of samples over a one minute period.	Average value provides a stable method of measuring signal quality
TS bit rate selected PLP	Transport stream bit rate of selected PLP, measured at the output of the demodulator	
T2 Cell ID	Extracted from the input DVB-T2	
Network ID	Extracted from the input DVB-T2	
System ID	Extracted from the input DVB-T2	

Templates

Templates are a short form method of checking that the input RF is as it is expected.



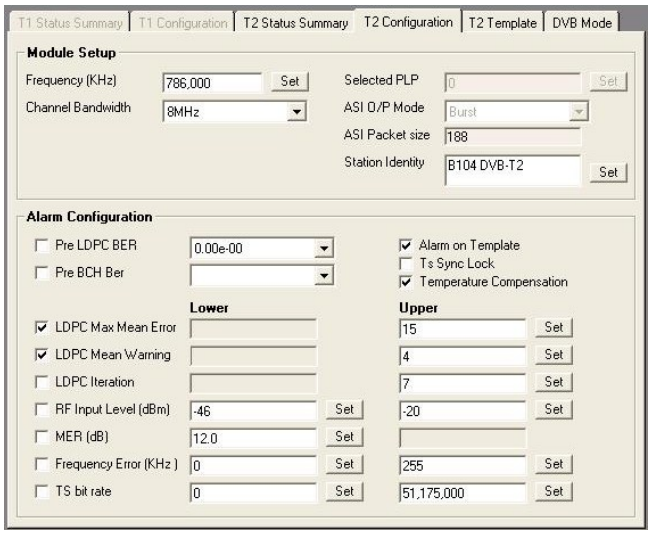
There are 7 pre-programmed DVB-T2 templates which are the UK unified modes. In the UK, Template 7 is the required template.

Template	1	2	3	4	5	6	7
T2 Frames per Superframe	2	2	2	2	2	2	2
FEC Block Length	10800	10800	10800	8100	8100	8100	8100
Constellation of L1 Post Signalling	64QAM	64QAM	64QAM	64QAM	64QAM	64QAM	64QAM
Carriers	8k	8k	8k	32k	8k	32k	32k
Constellation	64QAM	64QAM	64QAM	256QAM	256QAM	256QAM	256QAM
FEC	3/4	4/5	5/6	3/5	3/5	3/4	2/3
Tone Reservation PAPR Reduction	On	On	On	Off	Off	Off	Off
Scattered Pilots Pattern	PP7	PP7	PP7	PP7	PP7	PP7	PP7
Guard Interval	1/32	1/32	1/32	1/128	1/32	1/128	1/128
Data Symbols Per T2 frame	242	242	242	59	238	59	59
FEC Blocks per I/L Frame	151	151	151	202	200	200	202
Time IL blocks / T2 Frame	3	3	3	3	3	3	3

To use a template click on the template tab and select the required template. The template alarm must then be enabled. The template alarm is found in the T2 configuration tab. If the incoming DVB-T2 signal does not match the T2 parameters, then an alarm is set.

If the DVB-T2 input signal does not match a pre-programmed template, each T2 parameter can be checked using the DVB-T2 Summary page.

T2 Configuration



Module Setup

For module setup see Tuning and checking the receiver in the Installation chapter.

Station Identity

A user entered twenty character alphanumeric. When the B104 is interrogated remotely, the station ident is reported over the SNMP MIB. This enables operators to check that they are looking at the receiver.

Alarm Configuration

There are two relay alarms, critical alarm and non critical alarm available on the rear connector. The critical alarm is dedicated to power failure.

The DVB-T2 non-critical alarm is programmed on the T2 Configuration tab.

BER

Pre LDPC and Pre BCH BER alarms are set using the ranges provided in the tabs drops downs. The alarms are enabled by clicking the tick box.

BER is not recommended for monitoring the receiver, owing to the very sharp characteristic of these measurements.

Alarm on Template.

Click the tick box to create a tick and enable the alarm. When the template alarm is enabled, the input RF is compared to the template selected on the template tab.

The comparison is made by comparing the T2 signalling with the template settings. If the DVB-T2 transmitter parameters change the B104 receiver will automatically follow the input RF.

The template is a shorthand mechanism to check the input DVB-T2. Each template element can be separately interrogated using the SNMP MIB or the B104 GUI.

TS Lock

Setting this alarm causes the B104 to alarm on loss of sync.

The receiver will lock using BPSK to the DVB-T2 signalling which is probably more robust than the DVB-T2 payload normally sent using 256QAM.

Temperature Compensation

Enables temperature compensation, this is not an alarm.

LDPC

LDPC Iterations are the number of iteration required to correct the incoming DVB-T2 signal. The higher the number of LDPC iterations, the harder the corrector is working.

LDPC is an instantaneous value which may have peaks owing to interference, which may cause false alarming.

LDPC mean is calculated by the summation of sampled LDPC iterations over a one minute period. The summation is then divided by the number of samples taken in the one minute period to give the LDPC Mean error. This is a stable method of monitoring signal quality.

Two alarms are provided for Mean error, a warning value and a maximum value.

LDPC Iteration

This is the instantaneous value of LDPC iterations. This value may peak and give rise to false alarms.

LDPC iterations, if used, should be set to > 4 to prevent false alarming.

LDPC Max Mean Error

LDPC Max Mean Error alarm is the maximum number of LDPC mean errors before an alarm is set. It is suggested that LDPC Max Mean alarm is initially set to 15, as warning that signal is very close to failure.

Once LDPC Mean error has reached 15, a STB will find it difficult to lock to the signal and decode a clean picture.

LDPC Mean Warning

It is suggested that LDPC Mean alarm is initially set to 7, as warning that signal quality has fallen.

RF Input Level Alarm

RF Input level sets a minimum and maximum input level before the RF input level alarm is set. The alarm must also be enabled.

The B104 is not a substitute for a calibrated power meter.

MER Alarm

MER is a measurement of the signal quality of the incoming RF signal. While alarming with MER is useful, it is recommended that LDPC mean is used to alarm.

Frequency Error

Frequency error is used to check the input RF signal is at the correct frequency. The frequency error can be positive or negative and is the difference between the tuned frequency and the received frequency.

Lower and upper range limits are set for frequency error. A value of 30KHz for upper and lower is initially suggested.

The B104 is not a substitute for a precision frequency counter, but it does provide a useful monitoring facility.

TS Bit Rate Alarm

The B104 monitors the TS bit rate output from the receiver. The alarm is set over a minimum and maximum range. Bit rate is another method to check that the DVB-T2 parameters are being transmitted correctly to the receiver.

The Command-Line Interface

The Command-Line Interface (CLI) may be used for configuration, monitoring and control. It is provided to facilitate scripting and as an entry point for integration into existing software systems. It provides full access to all B104 features using a standard terminal emulation program such as HyperTerminal.

If using HyperTerminal, we recommend using the PE version available from http://www.hilgraeve.com/htpe/order.html , due to a back scroll buffer bug which appears in the free version shipped with versions of MS Windows. This bug was corrected in Windows 2000 SP4 but appeared again in the version shipped with Windows XP.

The command line protocol is available via the front RS232 serial connection.

Serial port connection

The front panel serial connector (labelled RS232) allows local control and monitoring using a PC. See the Installation chapter for connector information and pin-out.

Before initiating remote control set the PC serial port as follows:

Speed:	19200 baud
Decoder protocol:	1 start bit, 8 data bits, no parity, 1 stop bit
Interface:	RS232
Handshaking:	RTS/CTS

Remote commands

The following serial remote control commands are supported:

BANDWIDTH

Sets the bandwidth, 7 or 8 MHz.

BANDWIDTH <7 or 8>

DVBMODE

Sets the DVBMODE to DVB-T (1) or DVB-T2 (2).

DVBMODE: <1 or 2>

FREQ

Set the frequency in 10xMHz, i.e. 2000 = 20GHz.

FREQ: <10xMHz>

CONSTEL

Report the current constellation.

CONSTEL?

The translation for constellation and L1 constellation is:

Response	Meaning
0	BPSK
1	QPSK
2	16 QAM
3	64 QAM
4	256 QAM

CHIPID

Report the demodulator chip identity to demonstrate the I2C interface is functional.

CHIPID?

MER

Report the current MER as dBX1000.

MER?

In DVB-T2 mode this is the Filtered MER as recommended by Sony.

MERLL

Set or report the minimum MER to be measured before the error/alarm flag is set.

MERLL?

Report MER lower limit threshold.

MERLL <dB X 10>

Set the lower limit threshold as ten times the number of decibels; range 120 to 320.

MEREN

Report, enable or disable the MER lower limit threshold breached alarm.

MEREN?

Report MER lower limit alarm status.

MEREN <0 or 1>

Enable (1) or disable (0) the MER lower limit alarm.

LDPCITER

Report the number of LDPC iterations.

LDPCITER?

LDPCITERUL

Set the maximum number of LDPC iterations received before the LDPC Iteration alarm/flag is asserted.

Value	Threshold
0	0.00e-00
1	2.50e-05
2	5.00e-05
3	7.50e-05
4	1.00e-04
5	2.50e-04
6	5.00e-04
7	7.50e-04
8	1.00e-03
9	2.50e-03
10	5.00e-03
11	7.50e-03
12	1.00e-02
13	2.50e-02
14	5.00e-02
15	7.50e-02

LDPCRAT

Report the LDPC Ratio.

LDPCRAT?

LDPCRATUL

Set or report the LDPC Ratio Upper limit before an alarm is triggered.

LDPCRATUL?
LCPDRATUL <limit>

LDPCRATEN

Report, enable or disable the LDCP ratio alarm.

LDPCRATEN?
LDPCRATEN <0 or 1>

FREERR

Report the frequency error.

FREERR?

FREQERRUL

Set or report the frequency error upper limit, exceeding this limit will set the frequency error alarm.

FREQERRUL?

FREQERRUL <limit>

Where limit is in the range 0..255.

FREQERRLL

Set or report the limit below the centre frequency that triggers the frequency error alarm.

FREQERRLL?

FREQERRLL <limit>

Where limit is in the range 0..255 below the centre frequency.

FREQERREN

Report, enable or disable the frequency error alarm.

FREQERREN?

FREQERREN <0 or 1>

ESTCFREQ

Report the estimated centre frequency.

ESTCFREQ?

EXTBW

Report whether or not an extended carrier is in use.

EXTBW?

PILOT

Report the pilot pattern.

PILOT?

Return the pattern 1 to 8.

GI

Report the guard interval.

GI?

FFT

Report the FFT.

FFT?

Response	Meaning
0	1K
1	2K
2	8K
3	16K
4	32K

BERPREVIT

Report the pre-Viterbi Bit Error Rate.

BERPREVIT?

In T1 mode this is the pre-Viterbi BER.

BERPREVITUL

Report or set the upper limit for the pre-Viterbi Bit Error rate. If this is exceeded an alarm is set.

BERPREVITUL?

BERPREVITUL <new limit>

BERPREVITEN

Report, enable or disable the BER prev viterbi error alarm.

BERPREVITEN?

BERPREVITEN <0 or 1>

BERPOSTVIT

Report the bit error rate.

BERPOSTVIT?

In DVB-T mode this is the post-Viterbi BER.

BERPOSTVITUL

Report or set the upper limit for the post-Viterbi Bit Error rate. If this is exceeded an alarm is set.

BERPOSTVITUL?

BERPOSTVITUL <new limit>

BERPOSTVITEN

Report, enable or disable the BER post viterbi error alarm.

BERPOSTVITEN?

BERPOSTVITEN <0 or 1>

HPFEC

Report the high priority FEC.

HPFEC?

Return Value	FEC
0	1/2
1	2/3
2	3/4
3	5/6
4	7/8

LPFEC

Report the low priority FEC.

LPFEC?

Return Value	FEC
0	1/2
1	2/3
2	3/4
3	5/6
4	7/8

UCE

Report the uncorrected error count.

UCE?

UCETOTAL

Report the uncorrected error total.

UCETOTAL?

HIER

Report the hierarchy:

HIER?

Return Value	Hierarchy
0	Non hierarchical
1	A=1
2	A=2
3	A=4

SYMBPERFRA

Report symbols per DVB-T2 frame.

SYMBPERFRA?

FRAPERSUP

Report symbols per DVB-T2 superframe.

SYMBPERSUP?

PREBCHBER

Report the Pre BCH bit error rate.

PREBCHBER?

IFAGCOUT

Report the intermediate frequency AGC output.

IFAGCOUT?

RFS

This was introduced to allow easier characterisation of the daughter board and reports a summary of the RF status, duplicating several of the other commands.

RFS?

The results include:

Result	Existing Command	Description
dvb		DVB mode
ms		Indicates algorithm is in measurement state **Note:** results have no meaning unless in measurement state
tl	TSLOCK	Transport Stream Lock
ifAgct	IFAGCOUT	Intermediate frequency AGC output
rf	RFINPUTLEVEL	RF input level
mer	MER	MER
carOf	CARRIEROFFSET	Carrier Offset (frequency error)
ldpcIter	LDPCITERATIONS	Number of LDPC iterations

LOCK

Report TS lock status.

LOCK?

Returns

*LOCK LOCKED

or

*LOCK UNLOCKED

LOCKEN

Report, enable or disable the alarm/indicator.

LOCKEN?

LOCK <0 or 1>

RFIN

Report the level of the RF input, in the Sony API this is reported as Rf Agc Out.

RFIN?

RFINUL

Set or report the RF input upper limit. On exceeding this limit the alarm is set.

RFINUL?

RFINUL <limit>

The limit is in the range 20 to 90, which represents –20 to –90dB.

RFINLL

Set or report the RF input lower limit. On falling below this limit the alarm is set.

RFINUL?

RFINLL <limit>

The limit is in the range 20 to 90, which represents –20 to –90dB.

RFINEN

Report, enable or disable the RF input alarm.

RFINEN?

RFINEN <0 or 1>

ROTATE

Report whether the constellation is rotated.

ROTATE?

L1CONST

Report the Layer 1 constellation.

L1CONST?

Response	Meaning
0	BPSK
1	QPSK
2	16 QAM
3	64 QAM

INTERLEAVEFRA

Report the number of time interleaving blocks per second.

INTERLEAVEFRA?

PAPR

Report the PAPR in use:

PAPR?

Response code	Explanation
0	None
1	ACE
2	TR
3	TR and ACE
4	Unknown

PLP

Report the selected PLP.

PLP?

The range is 0 to 255 but currently always 0.

TSRATE

Report the transmission stream data rate.

TSRATE?

TSRATELL

Set or report the limit below which the transmission stream data rate alarm is set.

TSRATELL?

TSRATELL <new limit>

TSRATEUL

Set or report the limit above which the transmission stream data rate alarm is set.

TSRATEUL?

TSRATEUL <new limit>

TSRATEEN

Enable or disable the transmission stream data rate alarm.

TSRATEEN?

TSRATEEN <0 or 1>

IPGAIN

Report the Input Gain.

IPGAIN?

System defaults

This section lists the system default values for user definable settings.

Item	Default setting
Frequency	597 MHz
DVBMODE	DVB-T2
Bandwidth	8MHz
ASI format	Byte
ASI packet length	188 bytes

Trouble Shooting

B104 refuses to lock to incoming RF

Check that there is an input RF signal that it is within specification (-20dBm to -70dBm). Check that the correct frequency has been selected.

Check that the correct channel bandwidth been selected.

Check that this channel is a DVB-T or DVB-T2 broadcast.

If in doubt, go to DVB MODE tab, select DVB-T and tune to a known working DVB-T channel.

Picture blocking and break up (decoder connected to receiver ASI output)

Decoder blocking is frequently caused by a poor RF feed. Open the “T2 Status Summary” and check the following.

- Freq Error (KHz) > 30KHz; has the tuner has been tuned to the wrong frequency or is an upper or lower offset (±166KHz) in use? Re-tune the B104 to the correct frequency.
- LDPC Iterations > 7, the RF input signal is it low amplitude or subject to interference?
- LDPC > 15, the input RF is extremely poor and on the point of failure.
- MER <20dB poor input signal, is the input level low?

General reception issues

Most reception issues are usually caused by poor RF inputs. Check the following:

Is the antenna connected?

Has the antenna feed been split too many ways?

Is the antenna cable run too long?

Is the antenna pointed at the transmitter?

Does the antenna cable have > 5V DC on it?

If an analogue receiver gives a poor quality picture, ghosted, noisy, picture break ups then improve the RF feed before connecting a DVB-T or DVB-T2 receiver.

Glossary

8-VSB	Eight discreet amplitude level, “vestigial side-band” broadcast transmission technology. VSB is an analogue modulation technique used to reduce the amount of spectrum needed to transmit information through cable TV, or over-the-air broadcasts used in the NTSC (analogue) standard. 8-VSB is the U.S. ATSC digital television transmission standard.
Adjacent Channel Interference	Interference caused by extraneous power from signal in an adjacent channel. The problem is often caused by the inability to produce perfect filters without roll off. See *Frequency Offset*.
Ambient	The atmospheric conditions surrounding a given item. Normally in terms of factors which influence or modify, such as temperature or humidity.
Amplitude	The magnitude of variation in a changing quantity from its zero value.
ASI	Asynchronous Serial Interface.
Attenuation	A reduction in power. It occurs naturally during wave travel, through lines, waveguides, space or a medium such as water. It may be produced intentionally by placing an attenuator in circuit. The amount of attenuation is generally expressed in decibels per unit of length.
ATSC	Advanced Television Systems Committee. Formed to establish technical standards for US advanced television systems. Also, the name given to the digital broadcast transmission standard.
Bandwidth	The range of frequencies over which signal amplitude remains constant (within some limit) as it is passed through a system.
BER	Bit Error Rate. A measure of the errors in a transmitted signal. Bit errors are caused by interference or loss of signal, which can result in disruption to the stream of bits composing the DTV picture.
BNC	A radio frequency connector with an impedance of 75Ω, designed to operate in the 0 to 4 GHz frequency range.

C/N	Carrier to Noise ratio. A measurement of the ratio of RF signal power to noise power.
COFDM	Coded Orthogonal Frequency Division Multiplexing. An Orthogonal FDM scheme transmits many streams of data on multiple carries simultaneously. Orthogonality reduces co-channel interference and multiple carries minimises losses due to selective interference. The Coded version, C(OFDM) uses integrated forward error-correction coding and statistical analysis based on channel-state information (CSI) to achieve substantial performance benefits compared to uncoded or non-CSI OFDM. COFDM resists fading, is very tolerant of multipath interference and is well suited to building Single-Frequency Networks (SFNs). It is used extensively in European digital television (DVB-T) and digital radio (DAB) systems.
dB (Decibel)	A logarithmic unit used to describe signal ratios. For voltages dB = 20 Log10(V1/V2).
DID	Data identifier.
DTV	Digital television. This comprises all the components of digital television, including HDTV, SDTV, datacasting and multicasting.
DVB	Digital Video Broadcasting
DVB-C	Digital Video Broadcasting baseline system for digital cable television.
DVB-S	Digital Video Broadcasting baseline system for digital satellite television.
DVB-T	Digital Video Broadcasting baseline system for digital terrestrial television.
DVB-T2	An extension of DVB-T that allows higher modulation order using advanced error detection and correction (from DVB-S2) to allow higher bit rates.
FEC	Forward Error Correction. A receiver technique for correcting errors in the received data.
Frequency Offset	Intentional shift of a radio carrier frequency to avoid interference with other transmitters. See *Adjacent Channel Interference*.

GHz	Gigahertz. One billion cycles per second (10^9 cps).
Headend	Electronic control centre of a cable system. The site for collecting signals from many sources, processing them and preparing them for distribution.
KHz	Kilohertz. One thousand cycles per second (10^3 cps).
LDPC	Low Density Parity Check.
LSB	Least Significant Bit.
MER	Modulation Error Ratio.
MHz	Megahertz. One million cycles per second (10^6 cps).
Modulation	A process that moves information around in the frequency domain in order to facilitate transmission or frequency-domain multiplexing.
MPEG	Moving Picture Experts Group. Industry standard for compressing and decompressing digital audio video signals
MSB	Most Significant Bit.
MSps	Mega-symbols per second.
Multiplexer	An electronic device that allows multiple channels to be combined into a single signal.
OFDM	See COFDM.
Packet	A variable-sized unit of information that can be sent across a packet-switched network.
PAL	Phase Alteration Line. 50 Hz video format used in much of the world outside of the USA.
PCR	Program clock reference.
PID	Packet identifier.
PLP	Physical Layer Pipe.
PSI / SI	Program specific information.

QAM	Quadrature Amplitude Modulation. A digital modulation technique that allows very efficient transmission of data over media with limited available bandwidth.
QPSK	Quadrature Phase Shift Keying. A digital technique that is widely employed in direct broadcast satellite or terrestrial transmission systems
RF (Radio Frequency)	In broadcasting applications, the signal after the modulation process.
RS	Reed-Solomon.
SNR	Signal to Noise Ratio.
Symbol Rate	Replacement term for Baud; a unit of signalling speed, the number of times a signal on a communications circuit changes.
Termination	An impedance at the end of transmission line that matches the impedance of the source and of the line itself. Proper termination prevents amplitude errors and reflections. ASI transmissions use 75Ω transmission lines, so a 75Ω terminator must be at the end of any signal path.
Tuner	Any device or apparatus used for selecting and controlling the operating frequency of a circuit or equipment, such as the channel selector in a television receiver.
UTP	Unshielded Twisted Pair.
Viterbi	Algorithm for Forward Error Correction.

Specification

Performance	
All single PLP (Mode A) modes defined within DVB-T2 specification EN302755 supported	
RF input	
Tuning Range:	178 to 858 MHz
Tuning Step	125KHz 7MHz channel 166.7KHz 8MHz channel
Input Level:	-20dBm to 80dBm
Input Return Loss:	6dB typical.
Input Impedance:	75Ω F Type
DC voltage on input	+5V maximum
Modulation	
Guard Interval	1/4, 19/128, 1/8, 1/32, 1/128
Code Rate	1/2, 2/3, 3/4, 5/6, 7/8
Modulation	QPSK, 16, 64, 256 QAM
FFT	1K, 2K, 4K, 8K, 16K, 32K
Measured Parameters	
DVB-T2 Template	T2 Frames per superframe, FEC block Length, Constellation of L1 Post signaling, Carriers, Constellation (of PLP), Tone Reservation, Scattered Pilot pattern, Guard Interval, Data symbols per T2 frame, FEC blocks per interleaving frame, Time interleaving blocks per DVB- T2 frame.
General	L1 signalling information, input RF level, receiver lock status, MER, LDPC error ratio, LDPC iterations, frequency error, TS bit rate.
ASI Output	
Connector:	2 x 75Ω BNC
ASI format:	Burst or byte mode selectable (DVB-T only)
Power	
Input Voltage:	15VDC – provided by rack PSU(s)
Power Consumption:	8 W Maximum

Environmental (Safety certification and compliance)	
Temperature (Operating):	0 °C to +40 °C
Storing Temperature:	-20 °C to +70 °C
Altitude (maximum operating):	2000 meters (6500 feet)
Relative Humidity (maximum operating)	80% for temperatures up to 31°C, decreasing linearly to 40% at 50°C
Physical	
Dimensions Height:	100 mm (4 inches)
Width:	25 mm (1 inch)
Depth:	265 mm (10.5 inches) (not including rear panel)
Net Weight:	0.35 kg (0.75 pounds)

Safety standards	
U.S. Nationally Recognised Testing Laboratory Listing:	UL3111-1, standard for electrical measuring and test equipment
Canadian Certification:	CAN/CSA 22.2 No. 1010.1 Safety requirements for electrical equipment for measurement, control and laboratory use.
European Union Compliance:	Low Voltage Directive 73/23/EEC, amended by 93/68/EEC IEC 61010-1 Safety requirements for electrical equipment for measurement, control and laboratory use.

Safety certification	
Equipment Type:	Test and Measuring
Safety Class:	Class I (as defined in IEC 61010-1, Annex H) – grounded product
Over voltage Category:	Over voltage Category II (as defined in IEC 61010-1, Annex J)
Pollution Degree:	Pollution Degree 2 (as defined in IEC 61010-1) Note: Rated for indoor use only

EC Declaration of Conformity – EMC: Meets intent of Directive 89/336/EEC and 92/3EEC for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:
EC Declaration of Conformity – Low Voltage: Compliance was demonstrated to the following specification as listed in the Official Journal of the European Communities: Low Voltage Directive 73/23/EEC, amended by 93/68/EEC IEC 61010-1

Safety requirements for electrical equipment for measurement, control and laboratory use	
EN50081-1 Emissions:[1]	
BS EN55022:	Class B radiated and conducted emissions
BS EN55013:	Emissions standard for Broadcast Equipment
EN50082-1 Immunity: [1]	
BS EN61000-4-2:	ESD Requirements
BS EN61000-4-3:	Radiated susceptibility
BS EN61000-4-4:	Electrical Fast Transient Burst requirement
BS EN61000-4-5:	Surges requirement
BS EN61000-4-6:	Conducted susceptibility
BS EN61000-4-11:	Voltage Dips and Interruptions
BS EN55103-2:	Immunity for Product Family Standard, Audio, Video Audio Visual and Entertainment lighting control apparatus for professional use

FCC Compliance: Emissions comply with FCC Code of Federal Regulations 47, Part 15,Subpart B, Class A Limits[1]
FCC Information: This device complies with part 15 of the FCC Rules. 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. **WARNING:** The user must install the system as per manufacturer's instructions, to comply with the requirements of FCC.

[1] Compliance demonstrated using high-quality, shielded cables.

Ordering information

B104 module

B104	DVB-T / DVB-T2 terrestrial receiver module

3U Probel Vistek configuration

V1606-dB-2PSU	3U Chassis, 14 module slots, 2 PSU slots (2 PSUs included)
V1606-dB-48V	3U Chassis, 14 module slots, 2 48V PSU slots (2 48V PSUs included)

1U Probel Vistek configuration (dual PSU)

F010	1U Chassis, 2 module slots, 2 PSUs (PSUs included)

Passive rear connectors

VB150	BNC rear connector for B104 module

Hawkeye Module Management

Optional components for single point of control over Ethernet SNMP or RS232 recommended for use with Hawkeye modules in V1606 (3RU) frames.

B065	RS232/SNMP rack controller module; requires B070
B070	Rack controller (DART)
S067	PC-GUI control software, one per B065