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BroadMux

Description

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1 General Description

BroadMux (DBX 4300) can **remultiplex 6, 16 or 26 input MPEG2 2 stream**s, conforming to the ASI DVB "Transport Stream" interfaces. The data rate for each input signal can be up to 56 Mbit/s. Each input signal can carry one or more services (SPTS and/or MPTS Transport Streams. Each incoming transport stream can be ISO MPEG-2 compliant, DVB compliant or contains packets without any PSI/SI data.

BroadMux provides the outgoing transport stream through four ASI outputs, all of them delivering the same transport stream. The output useful data rate is up to 56 Mbit/s.

Broadmux can also perform scrambling of incoming remote or local services, and offers interface with several Conditional Access System.

BroadMux is a 2U chassis with power supply (220VAC or 48 VDC) including a **MuxEmb board** plus two optional extension 6U boards.

The **MuxEmb board** remultiplexes up to 6 ASI MPEG-2 Transport Streams and delivers an ASI Transport Stream output. It performs DVB common scrambling. Near seamless splicing between services coming from the 6 ASI inputs as well as opportunistic data insertion in the outgoing stream («**no null packet**») - both being optional software options- are also performed by the MuxEmb board.

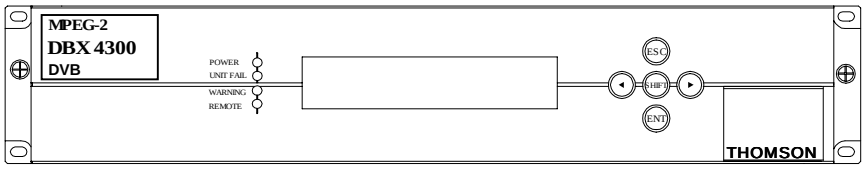
The extension boards is populated with a ten additional ASI inputs board providing from 16 up to 26 possible inputs to the Broadmux. These boards are controlled from the MuxEmb board.

BroadMux is controlled through the DBS 2930 Control & Command software.

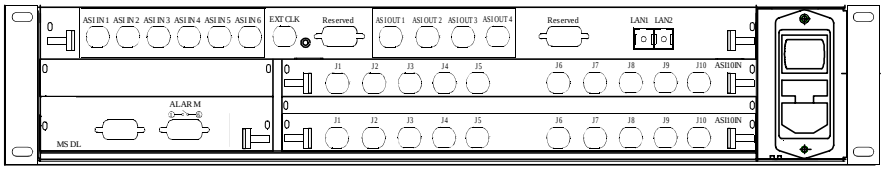
BroadMux provides two interfaces to inject and process private data (interactive applications, EMM channels, etc.) depending of the required bitrate :

- Ethernet (TCP/IP) for low bitrate injection (max. 1Mb/s)
- ASI input (up to 56 Mbit/s)

The Broadmux rear view is shown figure 1, and the functional Broadmux diagram on figure 2.



DBX 4300 front panel



DBX 4300 rear panel

Figure 1 – BroadMux Front panel and Rear View

The mechanical aspects are similar to DBE 4130 Broadcast Encoder. BroadMux is also a 2U (89 mm) high unit. The exact physical dimensions are shown in Figure 2

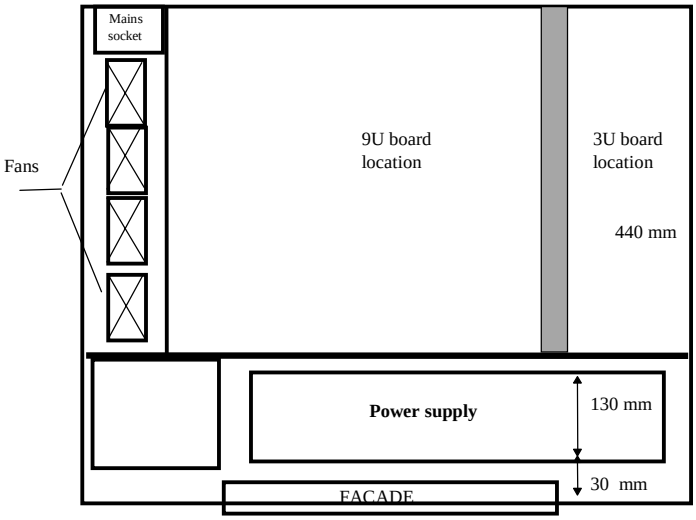


Figure 2 – BroadMux Mechanical Presentation

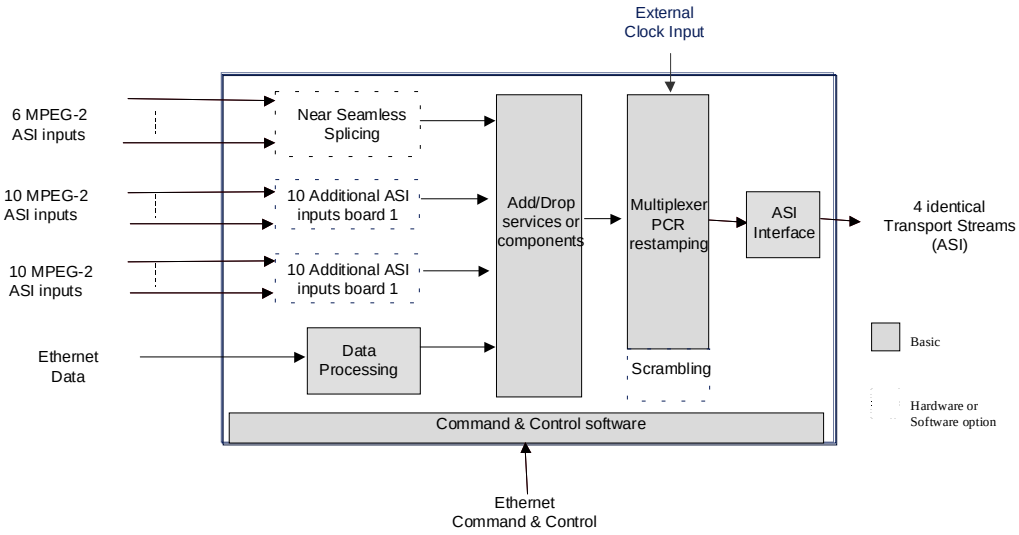


Figure 3 _ Broadmux block diagram

2 Add/Drop capabilities

BroadMux can be configured through the DBS2930 in such a way that :

1. All services (or EMM channels) coming from an ASI input are transmitted with the exception of selected ones.

1. All services (or EMM channels) coming from an ASI input are stopped with the exception of selected ones. This is specially interesting when only specific services from a MPTS input has to be transmitted at the output. In this mode it is possible :

- to change the service_id and service name of the service to be transmitted,
- to transmit all the components of the service with the exception of selected ones (drop component capabilities),
- to stop all the components of the service with the exception of selected ones,
- to change component PID of a component of the service.

Through the DBS 2930, the user may select any service and/or component of a service coming from an input to be transmitted (or stopped) in the output MPEG2 transport stream.

When a service is transmitted to the output, BroadMux performs a PCR correction according to the ISO recommendation. This allows to increase the number of remultiplexing stages keeping the PCR jitter conform to the standard.

Remultiplexing scrambled services is transparent in BroadMux. ECM channels associated to a service are automatically transmitted when the service itself is transmitted.

A component coming from a tributary input can be associated to any service coming from an other input (Add component capability). This allows for instance to inject an Interactive application (private data elementary stream) through an ASI input and to attach this application to all services which are delivered by BroadMux. In this case, the private data stream can be shared between several services.

Service_ids and PIDs conflict management.

BroadMux detects service_ids conflict and allows by modifying its configuration to rename the service_id of any service. When such a service_id conflict occurs, an alarm is raised to warn the operator of the problem.

BroadMux detects also PIDs conflict between incoming streams. Two strategies are implemented in BroadMux depending on the tributary input configuration :

1. If automatic PID reallocation is authorized, BroadMux just chooses a new -not used -PID for the component which is in conflict.The PMT is automatically rebuilt to take into account this PID change.
2. If automatic PID reallocation is not authorized, an alarm is raised when a PID conflict occurs. The operator is then in charge to solve manually the conflict by reallocating a new PID for the component.

3 Bit rate management

In order to control the input bitrates and to avoid disturbances between transmitted services, it is possible to define maximum bitrate constraints on each tributary ASI input, on each incoming service or on each individual incoming elementary stream (see Figure 3).

These different types of bitrate constraints (at tributary level, service level or elementary stream level) are not mutually exclusive. This means that it can be defined a bitrate constraint for the whole tributary **and** for one of the incoming service which is part of this tributary.

When a maximum bitrate constraint is violated, BroadMux raises an alarm. Depending on the type of the constraints, it performs automatically the following extra actions :

- **Tributary bitrate constraint**. some incoming elementary streams are stopped until the bitrate constraint is respected. The rule which is applied to choose the elementary streams to be stopped is based on PID value. The lower PID values are first stopped.
- **Incoming Service constraint**. Elementary streams which composed the service are stopped according to their priority : video stream is considered as the highest priority stream followed by the share components streams which have an intermediate priority and then other types of streams like audio, teletext and data which all have the same lowest priority. Elementary streams will be stopped until the current bitrate for the service will not exceed the maximum bitrate constraint.
- **Incoming Elementary stream contraint.** The given stream is stopped and not transmitted in the outgoing multiplex.

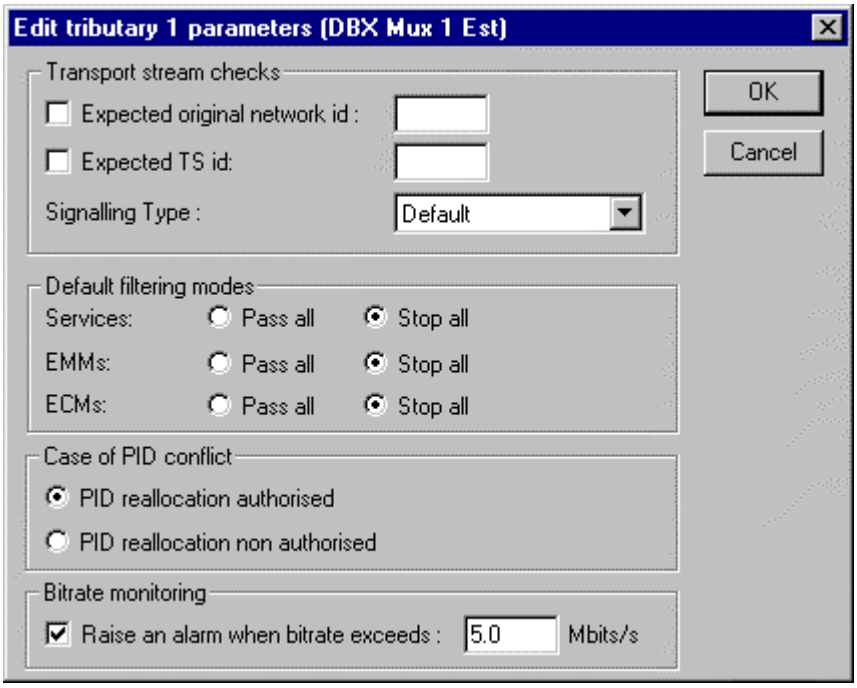


Figure 3 - Tributary bitrate constraint

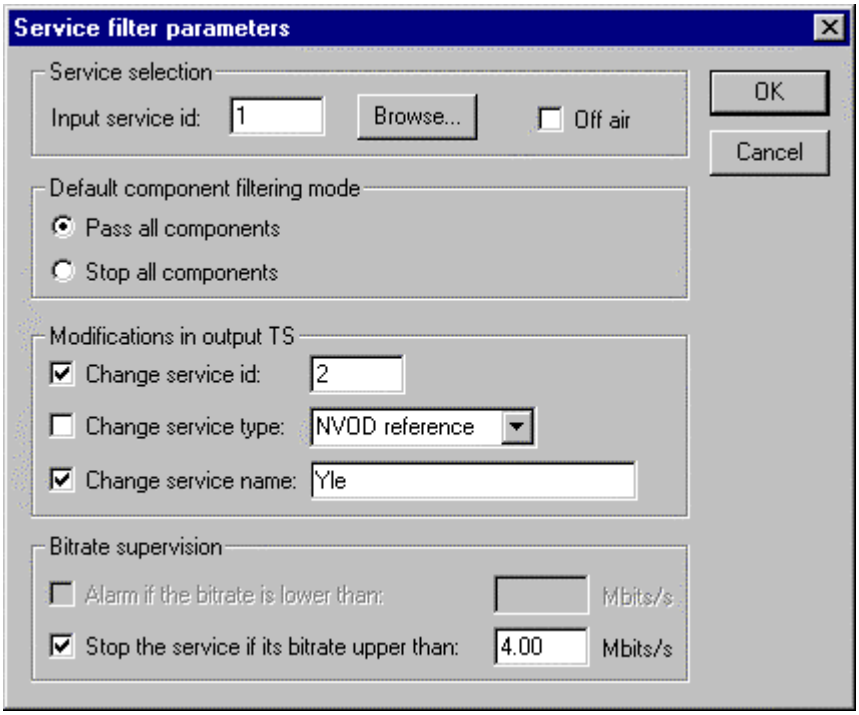


Figure 4 - Service bitrate constraint

4 Data and Opportunistic Data insertion

Data injection is performed through 2 different ways depending of the required bitrate :

1. Through the Ethernet data port (max. 1 Mb/s). This solution is used for EMM channels or private data injection. It allows remote injection through a TCP/IP router. The TBS proprietary TCP/IP protocol used to inject data is packet or section based. When the section based protocol is used, BroadMux packetizes the sections before broadcasting them. The UDP Simulcrypt protocol can also be used in case of packets based data.

2. Through an ASI tributary input (up to 56 Mbit/s). This second way allows to inject components and to reaffect these component to any services coming from other tributary inputs. Both data burst and data packet (with one packet buffering) modes are supported.

Opportunistic data insertion can be used when data is injected through the Ethernet data port. Opportunistic data insertion consists in replacing stuffing bytes in the outgoing stream by user data. It ensures bandwidth optimization (i.e. no null packet in the output stream) :

1. The available bandwidth before oppportunistic data insertion data does not exceed 1 Mbit/s.

2. Opportunistic data are supposed to be **asynchroneous and recurrent**. Examples of such data types are IRD code downloading, files transfert or push data. Opportunistic Insertion is made when space is available in the outgoing stream. It means that BroadMux regulates the incoming stream with respect to the available capacity in the output stream. Such facility is supported by using TBS TCP/IP proprietary protocol allowing injection of DVB sections and packets. It is supposed that the Ethernet Network used provides the required oppportunistic data bandwith.

5 Near Seamless Splicing

BroadMux integrates a near seamless splicer. The Near Seamless Splicer provides a way to switch between two programs, the national program and the local program coming from different ASI inputs (only the 6 ASI inputs of the MuxEmb board can be used for Near Seamless Splicing)

The BroadMux performs **Near Seamless Splicing** between both programs without any additional equipment. Both programs are supposed to be unscrambled.

The **Near Seamless Splicing** is based on the following processing :

1. The broadMux stops the program to be replaced (for example the national program) at the GOP boundary.

2. It starts transmission of the replacement program (local program in our example) at a GOP boundary after a delay. This delay is used to provoke buffer underflow in the IRD.

3. The first B images of the inital GOP are processed to limit visual artefact.

4. Audio streams are spliced using beginning of audio PES. During splicing the audio is muted.

There is no specific constraint on the incoming signals.

During the splicing, the picture is frozen or blanked (according to Set-Top-Box used) during a maximum of 2 GOPs (approx. 1 second) and no audio disturbances are noticeable.

Near Seamless Splicing can be triggered through **Inband commands**. Inband Commands are conveyed using the MPEG-2 signal itself. Inband switching ensures that splicing is performed exactly at the right time and simultaneously within different regional sites. Inband switching is derived from SMPTE 312 and is fully implemented in the Thomson DBE4100 encoder, DBX2200 multiplexer and BroadMux.

6 PSI/SI management

Mandatory (MPEG) PSI tables (PAT, CAT, PMT) are automatically managed by BroadMux according to the incoming corresponding tables and its configuration. This ensures consistency between BroadMux configuration and PSI data which are broadcasted. So when the PID of a component is manually changed from the command software - in case of PID conflict for instance-, BroadMux rebuilds simultaneously and automatically the PMT which is affected by this modification. And the other hand, when an incoming table is changed (new audio component in a PMT), **this change is automatically taken into account in the output without having to change BroadMux configuration.**

As for the other compulsory signalling tables, the processing is as follows :

The SDT actual, TDT and TOT are automatically managed by BroadMux.
The SDT actual is built according to the incoming corresponding SDT actual received in the tributaries and to BroadMux configuration (that is to say sent and locally created services)
As for the TDT and the TOT, the time information is either entered manually by the operator or provided automatically by specific time reference messages through the Ethernet Control port.

The NIT actual can be edited in the DBS 2930 Control & Command Software and then broadcasted, or provided through TBS proprietary protocol using an external SI Management System SIMS.(DiviTech, Thomcast)

Incoming EIT_{actual} present/following and schedule are transmitted as output when the corresponding service is itself transmitted. BroadMux is transparent to EIT actual.

Regarding the optional signalling tables, the EITactual schedule and all the « other » (NITother, SDTother, EITother) tables as well as BAT table are provided externally by the SI Management System.

SI extraction/injection
SI sections (EIT present/following actual, SDT actual) can be extracted from incoming TS and made available through the Ethernet interface. In association with a SIMS (SI Management System), this can be used to create a « barker channel » including all other SI tables (such as SDT other, EIT present/following other, etc.) describing the complete channels offer. An off-the-shelve solution for creating such a barker channel is available when the DiviTech (SIMS) for instance, is used in conjonction with TBS multiplexers. The protocol used for SI sections exchange is based on SI updates (exchanges are performed only when a new version of a subtable is available) on TCP/IP. This allows remote exchange of subtables and relies on very low bitrates.

PSI/SI tables storage
PSI/SI tables are stored within BroadMux. Storage is reserved for PSI/SI before playing out, and the storage parameters can be modified through the DBS2930.

Play-out

PSI/SI tables are played out by BroadMux according to repetition rates which are configurable by the Command Software.

7 Conditional Access

The MPEG2 / DVB Common Scrambling function is implemented in the BroadMux.

The Conditional Access Management system currently installed in THOMSON equipment are Viaccess, Mediaguard, NagraVision, Conax and Irdeto/M-Crypt both in THOMSON encoder and BroadMux

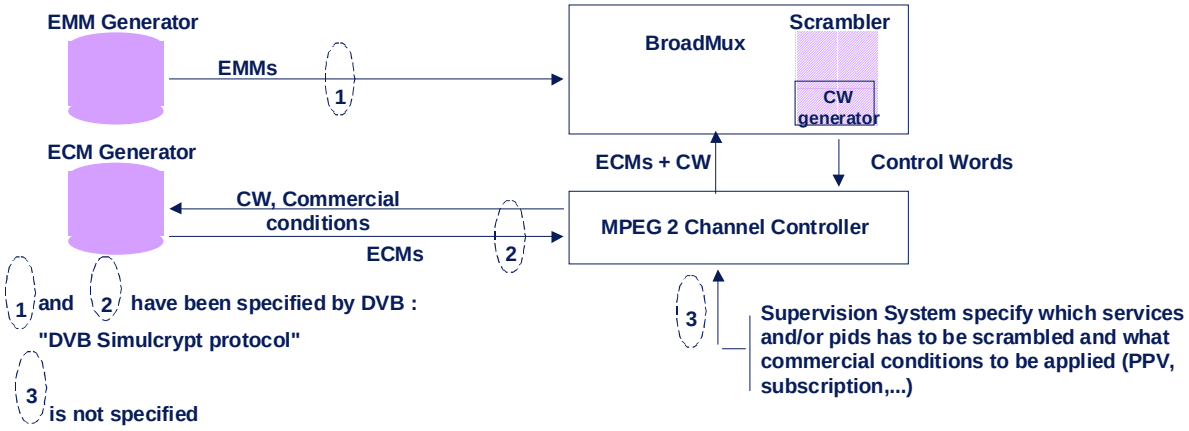
However any other access control system selected by the customer could be implemented with appropriate software adaptation both at transmitting and receiving ends.

BroadMux allows to :

- scramble a single component by designing its PID.
- scramble a service by designing its service_id. In this case all components of a service are scrambled. Moreover when the service definition changes (a new component is added to the service for instance), BroadMux will automatically scramble the new component without any need of change its condition access configuration.
- scramble all services which are output by BroadMux. Again when a new service is transmitted (due to a new Add/drop service configuration), it is scrambled automatically without any need of change the conditional access configuration.
- scramble with different commercial conditions up to 64 services and/or components.
- define up to 8 ECMs per service and/or component of a service. Each ECM can be defined by the same CA system (MultiECM) or from different CA systems (Simulcrypt application).

For services and components scrambled locally in Broadmux, the Supervision System DBS2930 allocates an ECM path (or several). The ECM message is supplied from an external ECM generator and the CW are provided by Broadmux to the ECM generator through the MCC.

Figure 6 – Scrambling processing



8 Command & Control

A Windows NT based Control & Command software (DBS 2930) is provided with BroadMux for basic management. (e.g. multiplexer configuration, alarms display, bitrate monitoring, ...). Communication between the multiplexer and the Command & Control Software is performed through a control/command Ethernet control interface, using TCP/IP. This protocol is open, well documented and allows remote control of the BroadMux.

The DBS 2930 allows to :

- Specify which services from the incoming TS has to be passed to the output. The control & command software permits to express configurations like:

    1. « pass all services except those specified ».
    2. « stop all services except those specified ».

- Renumber service_ids or PIDs in case of conflicts.
- Specify which services from the incoming TS and with which access conditions have to be scrambled.
- Get status information from BroadMux.
- Get current bitrate of any service and/or service component coming from an tributary input or deliverd by the DBX 2200.
- Get alarms from BroadMux.
- Reboot BroadMux.
- Switch a nominal equipment to a spare one.
- Set the local/UTC time
- Play a BroadMux configuration at a given date/time (local insertion).
- Get events from BroadMux. An event is generated when an alarm appears or diseappears, when the BroadMux configuration changes,; when a TCP/IP connexion is established or broken, etc.

All these command and control possibilities are already available in the DBS 2930 with the DBX2200 multiplexer. From the DBS 2930, the BroadMux configuration is **strictly similar** to the DBX2200 multiplexer and the same Graphical User Interfaces is proposed to the user for BroadMux. From the DBS 2930, the main differences are related to additional features BroadMux that is to say basically, more ASI inputs (i.e. when a 10 ASI inputs extension board is plugged into BroadMux) and opportunistic data processing.

As with the DBX2200 multiplexer, BroadMux can be triggered from the DBS 2930 Play-List Editing & Running Application.

For robustness purposes, configuration and principal tables are stored in Non Volatile Memory, on multiplexing board, so that power shortage or Control&Command failure should have minimum consequences on signal output.

Same Inband commands could be sent to DBX2200 multiplexer and BroadMux. In the first case (DBX2200 multiplexer), Economical splicing will be performed when near seamless splicing will be triggered in BroadMux.

Furthermore, BroadMux can be used as spare equipment for DBX2200 multiplexer and vice-versa. This should facilitate the deployment of BroadMux in customer systems which are already using DBX2200 multiplexer (see next section for more details about Redundancy Management).

9 Redundancy Management

BroadMux can be secured using an extra equipment : **the MPEG2 channel controller**. The MPEG2 channel controller is a mediation device between the Command & Control Software and the MPEG2 equipments. It is dedicated to redundancy Management. BroadMux redundancy can be performed in a N+ P basis using ASI routers.

BroadMux can be secured (respectively can secure) by a spare DBX2200 Multiplexer as soon as its number of ASI inputs is lower (respectively higher or equal) than the spare equipment.

10 Interoperability

The interoperability of BroadMux is one of its strong feature. The DBX2200 multiplexer has been designed to be used in a stand-alone manner i.e. as a remultiplexer able to groom a bouquet from different bouquets delivered by different content providers/encoder suppliers. **Although this functionnality seems to be obvious for any remultiplexer, it is not so easy to reach**. The main reason is due to the fact that some aspects of the DVB standard are opened to different implementations. As an example, some transport streams are designed in such a way that an unique PCR stream is defined for all the services of a transport stream (meaning that all the video are synchronised).

The DBX 2200 is now an three years old product. It is used in very different environments for its remux capabilities and because it was faced to a lot of different DVB implementations, its software has been upgraded improving its interoperability with other encoders/multiplexers and IRD suppliers.

BroadMux will have exactly the same capabilities regarding interoperability.

11 Miscellaneous

Full software and hardware check up each time BroadMux is rebooted. Software upgrades of BroadMux is performed through TCP/IP and can be managed remotely.

12 Ordering guide

Commercial Reference	Description
N4300220AG	Broadmux DVB Multiplexer with 6 TS inputs and without scrambling capability (scrambling software option has to be added for function effective) / 220V power supply
N4300220BG	Broadmux DVB Multiplexer with 6 TS inputs and with desactivated DVB-CS / 220V power supply
N4300048AG	Broadmux DVB Multiplexer with 6 TS inputs and without scrambling capability (scrambling software option has to be added for function effective) / 48V power supply
N4300048BG	Broadmux DVB Multiplexer with 6 TS inputs and with desactivated DVB-CS / 48V power supply
Hardware Options	
N43H0AS1AG	Extension of the capability of the Broadmux by adding 10 additional ASI inputs
N43HMSDLAG	Alarme Relay Closure Module
Software Options	
N43SDVCFAG	DVB Common Scrambling
N43S0PPDAG	Opportunistic Data
N43SNSSPAG	Near Seamless Splicing Capabilities