

Broadcast Processors DB4 and DB8



Control Loudness

- ▶ Low latency loudness control based on latest ITU recommendations
- ▶ Transition processing to enable consistent loudness control across program boundaries

Maximize Speech Intelligibility

- ▶ Five-band spectral processing to ensure maximum speech intelligibility
- ▶ Advanced limiting for compelling processing of music, and optimization of codec performance

Facilitate Multi-format Transmission

- ▶ Simulcast mono, stereo and 5.1 audio formats with perfect processing for all feeds
- ▶ New UpCon processor included to keep DTV feeds 5.1, even if input falls back to stereo

Broadcast Station Loudness Management

Broadcasting to multiple platforms is one of the main challenges of the digital age. In order to manage loudness and level, broadcast stations need to ascertain the dynamic range of imported material during ingest, and apply the same level management criteria internally.

Finally, an automated loudness processor balances multi-platform transmissions, as well as transitions between programs. The pristine audio processing available with DB4 and DB8, where hundreds of machines can be cascaded without notable audio degradation or delay, makes these machines suitable audio anchors at all three stages: Ingest, production and transmission.

With proper upstream level control in place, the transmission processor only steps in when levels are occasionally wrong, and to prevent too much level jump between programs.

Listener Requirements

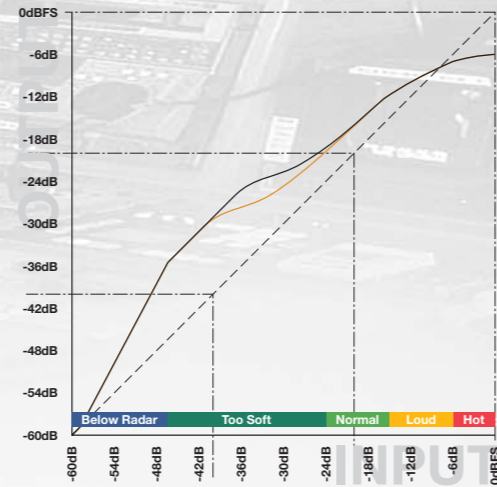
Listeners have a well defined Dynamic Range Tolerance, DRT. Certain level restrictions are ideal for certain listening situations, and if the level fluctuates outside the tolerance area too often, the listener gets annoyed. In the Dynamic Range Tolerance illustration, broadcast is traditionally aimed at a listener in the Living Room or Kitchen region.

Typically, commercials, promos and consumer CDs have a very restricted dynamic range, and therefore appear loud on TV where normalization is based only on peak content. The most dramatic discrepancy between program material and consumer requirements pertains to feature film. To have a feature film aligned with domestic listening conditions without losing too much detail, or distorting the loud parts, low level may need to be brought up by 12-20 dB, and the headroom restricted by 12-16 dB.

Consequently, dynamic range restriction must take place either at the station, or inside the consumer's receiving device. The dynamic range translation should deal with both overly soft and overly loud parts. Ideally, the perfect re-mapping should happen at the receiving end to accommodate a wide range of listening conditions.

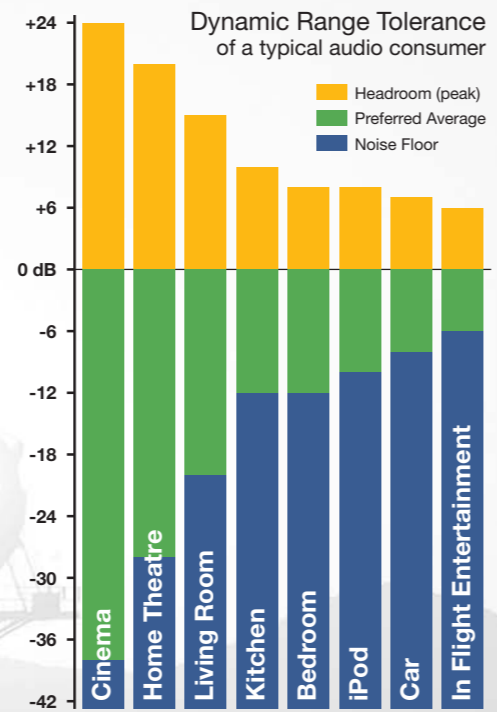
Metadata in conjunction with Dolby AC3 provides some of these capabilities. However, even if the consumer knows how to adjust the dynamic range of a film to her current listening conditions, the optimum dynamics treatment exceeds the capabilities of an AC3 decoder. The dynamic range control in the codec is acceptable for cut and boost ranges of less than 6 dB, but preparing a feature film for broadcast needs considerably more than this. If such a large correction is left only to the AC3 decoder, the wide-band gain changes can be quite audible. Also, film and music corrections require a multi-band structure so listeners don't sacrifice speech intelligibility or get excessive spectral intermodulation added to their music.

DB4 and DB8 complement the AC3 codec perfectly, making up for its weak sides and ensuring optimized audio delivery for any broadcast platform listener.



Example of dynamic range re-mapping of a 5.1 feature film to domestic listening conditions used by HD stations now

Black curve: Center channel
Orange curve: L, R, Ls, Rs, LFE



Dynamic Range Tolerance for consumers under different listening situations.

DB4 and DB8 have set a new standard for realtime, low latency audio optimization in broadcast ingest, linking and transmission, and are ideal processors for simulcasting to multiple platforms and formats.

Control Interfacing

DB4 and DB8 may be controlled directly from standard ingest and master control applications. Changes are applied using serial control, GPI or ethernet, and groups of up to 32 units can be monitored and logged via SNMP trapping. Local or remotely located units can be controlled from the Icon program (included), which runs under Windows 2000, XP, NT and Mac OSX.

Audio Interfacing

DB4 and DB8 both handle up to 16 audio input and 16 audio output channels. In the standard configuration, 8 input and 8 output channels are available using either AES/EBU balanced, AES/EBU unbalanced (BNC), or SDI interfacing. Additional digital or analog I/O cards may be fitted up to a limit of 16 audio channels both ways.

The SDI card supports SD and HD signals from 525 SD to 1080i (143 to 1485 MHz). While de-embedding and embedding 8 channels of audio (24 bit), selectable from the four SDI groups in chunks of four audio channels, it passes the video content untouched.

AES/EBU cards are 24 bit, 48 kHz, synchronous transfer. The unbalanced I/O card (BNC) includes bypass relays in case of power failure.

Analog I/O cards are very wide dynamic range with selectable full scale level at +6, +12, +18 and +24 dBu. To optimize performance, gain scaling is performed in the analog domain. Analog I/O cards include bypass/mute relays.

Compatibility between DB4 and DB8

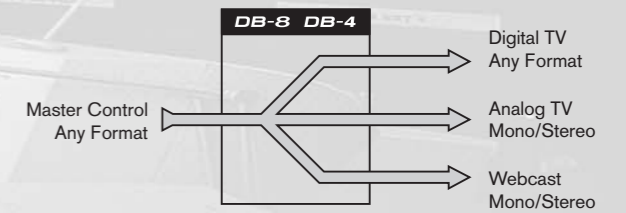
DB8 offers four separate internal processors and is primarily designed for large broadcast centers. DB4 offers two separate internal processors, and may be a more appropriate match for OB, linking or a regional station. The machines, however, are preset compatible, and offer the same processing possibilities. If you know how to operate one of them, you know how to operate both.

New SDI I/O Option

A new SDI card is available for DB4 and DB8. The card de-embeds and embeds 8 channels of audio, while the picture is passed untouched. It supports all SD and HD formats and handles linear audio as well as AAC, Dolby E and Dolby AC3.

The design features two separate SDI inputs, and two parallel, separately buffered outputs. Processing may be inserted on any two of the four SDI groups (8 channels), and re-embedding may take place on any two groups.

DB4 and DB8 are true multi-format



DB4 includes two separate internal processors shown on the Icon user interface as E1 and E2.



DB8 includes four separate internal processors shown on the Icon user interface as E1, E2, E3 and E4.

Processing Infrastructure

DB4 and DB8 offer three different strategies for controlling loudness, dynamic range and audio formats at the station. Flexibility in design has been a key issue, so stations may easily adapt to the changing demands of viewers and even change between how metadata is used or not used at the station.

1. Stations with minimum metadata reliance

The Ingest Gate (i1) is used to bring imported programming into the DRT of the station's DTV transmissions. The new Auto Ingest feature facilitates easy and quick performance of this task. Data reduced audio (e.g. Dolby E, dts or other codecs) is converted into linear audio, and dynamic ranges translated. Downstream of Ingest, metadata need not be dealt with, and can be discarded.

Production remains largely unchanged, using mono or stereo equipment, and does not rely on the generation of metadata. 5.1 programming may be discretely mixed, or 5.1 can be produced using a normal stereo infrastructure in combination with UpCon or UpCon Plus. If datareduction is needed for OB or live feeds, this is dealt with as an isolated encode/decode situation.

The Transmission Gate (T1) acts as realtime loudness corrector, with special attention to junctions between programs, and carries out further dynamic range and format conversions for ATV, Pod and Web services. DTV transmission is datareduced according to regional standards, and passed with metadata that only changes if the audio format does (e.g. from stereo to 5.1). DTV may be up-converted to 5.1 where indicated using UpCon (sports, game shows etc.).

2. Stations with maximum metadata reliance

The Ingest Gate (i2) is used to datareduce import programming and to inspect associated metadata. Downstream of Ingest, metadata must always be available and preserved, meaning no analog transfers or sample rate converters are allowed.

In production studios, metadata has to be manually or automatically attached to all programs. Production can be native mono, stereo or 5.1 as required. OB and Live production can be incorporated using fixed metadata with appropriate upstream dynamics processing.

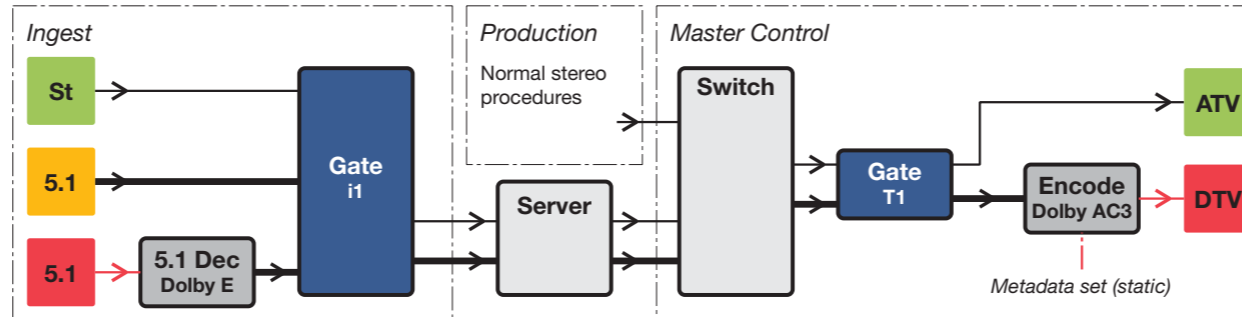
The Transmission Gate (T2) is used as a dynamic range and format converter for ATV, Pod and Web services. DTV transmission relies solely on metadata when it comes to loudness control and speech intelligibility. Routing internally at the station is based exclusively on proprietary, datareduced audio. Data encoders and decoders are used for breakouts and monitoring. Audio/video synchronization needs special attention in designs where an arbitrary number of monitoring posts are needed.

Loudness and Format Control Solutions for TV Broadcast

- Linear Stereo →
- Linear 5.1 →
- Reduced 5.1 →
- Processing
- Reduction Codec

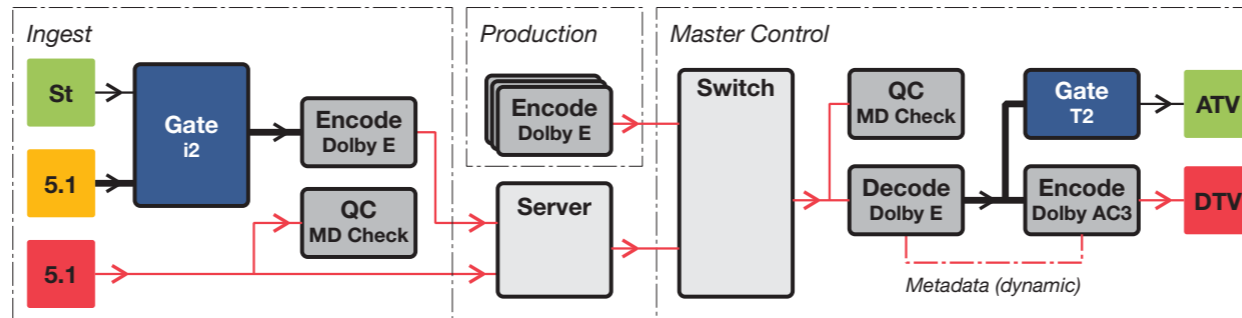
1. Stations with *minimum* metadata reliance

Automatic realtime loudness control at the Station. Linear routing (e.g. 8 channel SDI).



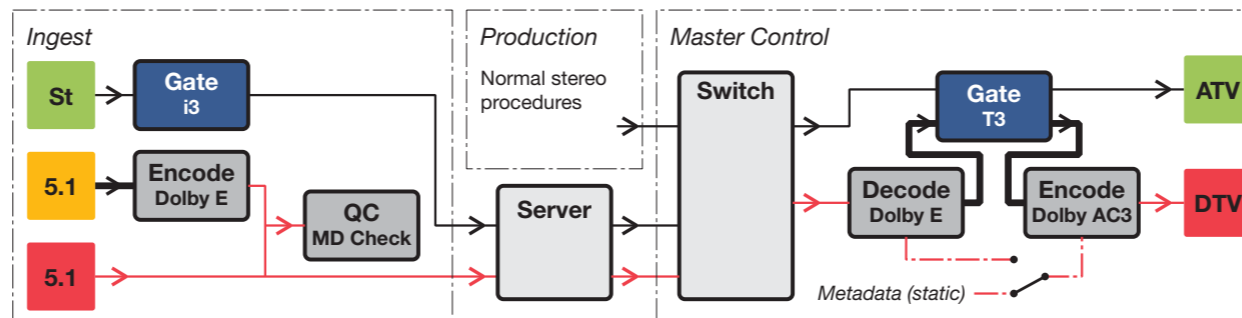
2. Stations with *maximum* metadata reliance

Loudness control in digital transmission based solely on Metadata. Data reduced routing.



3. Stations using metadata *only for Film*

Normal content transmitted using automatic realtime loudness control and format (fixed metadata). Feature films transmitted with or without dynamic range correction (dynamic metadata).



3. Stations using metadata only for films

The Ingest Gate (i3) is used to bring imported programming into the DRT of the station's DTV transmissions. The new Auto Ingest feature facilitates easy and quick performance of this task. 5.1 material is datareduced before being transferred to the server. Metadata is assigned to ingested 5.1 material provided without metadata. Downstream of Ingest, metadata is only used for selected 5.1 transmissions.

Production remains largely unchanged, using mono or stereo equipment, and does not rely on the generation of metadata. 5.1 programming may be discretely mixed, or 5.1 can be produced using a normal stereo infrastructure in combination with UpCon or UpCon Plus. If datareduction is needed for OB or live feeds, this is dealt with as an isolated encode/decode situation.

The Transmission Gate (T3) acts as realtime loudness corrector with special attention to junctions between programs, and carries out further dynamic range and format conversions for ATV, Pod and Web services. In DTV, metadata normally only changes if the audio format does. DTV may be up-converted to 5.1 where indicated using UpCon (sports, game shows etc.). Selected 5.1 programs, e.g. feature films, may be transmitted using the original dynamic metadata, while the Transmission Gate simultaneously provides suitable format and dynamic range conversions for ATV, Pod and Web services. Mono and stereo routing internally at the station is based on linear digital audio. Selected 5.1 programs are routed datareduced for the preservation of metadata.

Latency and Delay Handling

DB4 and DB8 provide extremely low latency processing. Even realtime loudness control is performed in less than 1 ms, so frame delay or re-sync is not necessary.

However, additional to other processing, audio may be delay compensated and re-synchronized separately on all SDI channels. The compensation delay implementation is based on the famous on-line delay algorithm from the D22 processor, where the amount of delay may be adjusted without pitch change or click artefacts while audio is passed.

This unique delay feature makes audio timing adjustable at 24 bit resolution from 1 ms to 4 sec (100 frames at 25 fps, or 120 frames at 30 fps) on all eight channels.

Loudness Processing

Unlike electrical level, loudness is subjective. Listeners weigh the most important factors differently: Sound pressure level, frequency contents and duration.

Therefore, defining the loudness of a sound shows a certain Between Listener Variability (BLV), even within homogenous groups, while differences in age, sex, culture etc. can add further to the variation. Also, individual loudness assessments by the same person are only consistent to some extent, and depends on the time of day, mood, attention etc. This type of variation is called Within Listener Variability (WLV). Because of the variations, a generic loudness measure is only meaningful if it is based on large subjective reference tests and solid statistics.

TC Electronic has carried out extensive loudness investigations and statistical analysis in association with McGill University, and contributed to the standardization efforts carried out by ITU. More information can be found in technical papers on TC's website: www.tcelectronic.com/TechLibrary

Even though different loudness models are used in different types of audio equipment, advanced measures can work well with previous loudness models. The screen dump illustration shows before and after loudness correction with DB8 using the TC Grid measure, as measured on a Dolby LM100 meter using a gated Leq(A) model. In DB4 and DB8, the control and logging of loudness can be based on the standard ITU Leq loudness measure, or on TC proprietary models, such as Grid or Larm.

Improved AC3 Handling and Transmission



This screen dump shows the loudness of 12 challenging broadcast segments measured by a Dolby LM100 meter 1) before DB4 and 2) after. The processor employs a more advanced loudness measure than the LM100 meter, but they still work well together, and the processor eliminates new metadata workloads at the station.

Dynamic Range Processing

The main part of dynamic range translation and loudness control should be done at the station, leaving only minor corrections to be performed at the consumer. This ensures competitive audio with regards to quality and speech intelligibility, and prevents asking more from the AC3 decoder than it can deliver in a civilized manner. Good audio results without station workload penalties can be realized with AC3 codecs using complementary processing at the station. The Dynamic Range Translation illustration shows rational transfer characteristics available with DB4 and DB8. This type of processing complies with the DRT of the consumer, without affecting level already on target.



Example of dynamic range re-mapping: From home theatre/DVD to living room listening conditions.

UpCon Processing

UpCon is a new, automatic, realtime 5.1 up-conversion processor included with DB8 and DB4. It continuously monitors the format of the incoming audio, and if the signal falls back from a true 5.1 to stereo, UpCon seamlessly cross-fades into a convincing 5.1 surround up-conversion without adding any interruptions or artifacts. Detection does not require metadata or GPIs to function correctly and the processing delay is only 2.8 ms (less than 1/10th frame). Therefore, no extra delays are required to maintain A/V sync. UpCon is used in Transmission or Ingest to ensure the availability of an uninterrupted 5.1 signal.

UpCon Plus Processing

DB8 and DB4 now include UpCon Plus functionality. UpCon Plus offers the ability to transform a stereo broadcast studio or OB truck into a 5.1 production environment, providing truly unique and engaging feeds to both the stereo and 5.1 transmission.

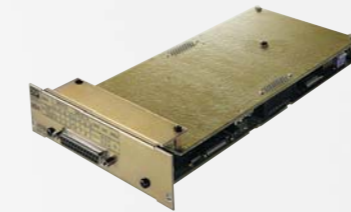
Besides from normal stereo production tools, only one DB4 or DB8 and extra speakers are needed. UpCon Plus has already been used in many combined ATV/DTV broadcasts, including major award ceremonies and sports events such as the 2006 FIFA World Cup™ in Germany.



The standard configuration of DB4 and DB8 includes 8 channels of AES/EBU In/Out, balanced or unbalanced. The picture shows a unit with one optional SDI interface plus two optional analog In/Out cards. This machine has 12 inputs and 12 outputs. The maximum number of separate inputs is 16. The maximum number of separate outputs is 16.



Optional Analog I/O card
ADA 24/96



Optional Extra Digital I/O card
AES8 AES/EBU w/o hardware bypass
AES8 Coax AES/EBU with hardware bypass



SubD breakout cable included with
AES/EBU balanced I/O cards.

Technical Specifications

AES/EBU I/O Card

Number of audio channels	8 channel In, 8 channel Out
Connectors, balanced version	AES/EBU, DB25, 110 Ohm
Connectors, unbalanced version	AES/EBU, BNC, 75 Ohm
Word clock input	BNC, 75 Ohm, 0.6 to 10 Vpp
Processing delay	< 0.8 ms
Additional delay	0-4 sec per audio channel
Frequency response DIO	DC to 23.9 kHz +/- 0.1 dB @ 48 kHz
Output dither	HPF/TPDF 8-24 bit and Off
Sample rates	44.1 or 48 kHz
Jitter rejection	> 65 dB @ 500 Hz
Input variation before sample slip	+27% / -73% of sample period

Control Interface

Ethernet, SNMP and remote control	10/100 Mbps, Base-T
Serial remote control	RS485/RS422, 19.2 or 31.25 kbps
GPI control input	Change between 2, 4 or 8 presets
SMPTE input	Input for timed program changes
PCMCIA interface	68 pin type 1 cards, PCMCIA 2.0

General

Number of audio channels	Max 16 inputs, 16 outputs
Dimensions	3,5x19x12 inches (2 RU)
Weight	8.6 kg / 19 lbs.
Mains voltage	100 to 240 VAC, 50-60 Hz auto-select
Power consumption	45 watt

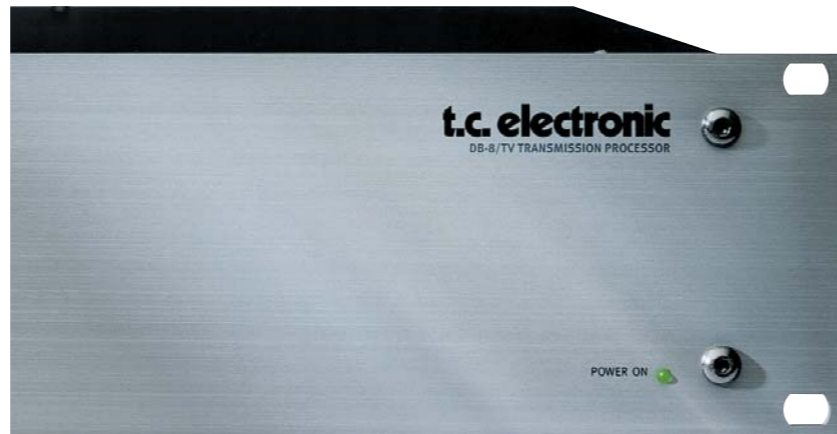
Optional Analog I/O Card

Number of audio channels	2 channel In, 2 channel Out
AD and DA conversion resolution	24 bit, delta-sigma
Selectable full scale level	+6, +12, +18, +24, +30 dBu
Dynamic range	> 113 dB unweighted
THD+n	< -95 dB @ 1 kHz, -3 dBFS

Optional SDI I/O Card

Number of audio channels	8 channel In, 8 channel Out
Connectors	2 BNC In, 2 BNC Out, 75 Ohm
Function	Audio de-embed/embed, video thru
Formats supported	SD and HD, 143 - 1485 MHz
Input selection	Input 1 or 2, SDI group 1-4

Note: Due to continuous development and standardization, all specifications are subject to change without notice



Technical Integrity

DB4 and DB8 are based on a high speed, low power consumption processing architecture. The ubiquitous TC Electronic System 6000 has provided a well-tested platform for our broadcast processors, and with more than 5000 machines in daily operation at the world's best film, music and broadcast studios, we dare guarantee extremely high reliability and low derating. DB4 and DB8 are not just PC's in disguise, and do not rely on fragile, moving parts such as hard drives or extensive cooling.

Years of dedicated research on distortion reduction, channel correlation and bandwidth limiting is built into these processors in order to optimize audio quality at the transmission as well as the receiving end of the signal chain. Therefore, DB4 and DB8 get the most out of any data reduction codec, be it MPEG4, Dolby AC3, MP3, AAC, DTS etc. At the station, it can route and delay Dolby E encoded signals, so the same signal-path can be used partly for linear stereo, partly for data-reduced audio.

Synchronous 48kHz sampling and 48 bit processing throughout, in combination with massive jitter rejection, ensure high audio resolution and perfect timing, even when long, digital transmission lines are used to feed a processor.

The DB8/DB4 platform is without compromises and allows you to take advantage of processing and conversion technology used by the world's leading film, music and broadcasting facilities of today. In fact, hundreds of machines can be cascaded without degrading the transmitted sound. Please visit www.tcelectronic.com for further information and related whitepapers.



Multiple PC control stations and DB8 or DB4 mainframes can be networked using standard TCP/IP and Ethernet components.

TC Processors for Broadcast

TC Electronic is a leading supplier of digital audio equipment for the music, film and broadcast industry. TC interacts with broadcast regulatory groups, academic communities and users around the world, and employ one of the biggest R&D departments in audio processing to keep equipment at the edge.

Comprehensive studies of the broadcast signal chain and constant evaluation of processing needs, combined with our extensive knowledge of surround audio and dynamics control, enable us to lead the way in defining operational procedures and processing in times of transitioning broadcast to digital.

TC Broadcast Audio Processors facilitate the delivery of optimum, standardized and predictable sound at the end listener with a minimum of production time expenditure at the station.

www.tcelectronic.com