



Product	Loudness Pilot
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Important safety instructions



The lightning flash with an arrowhead symbol within an equilateral triangle, is intended to alert the user to the presence of uninsulated “dangerous voltage” within the product’s enclosure that may be of sufficient magnitude to constitute a risk of electric shock to persons.



The exclamation point within an equilateral triangle is intended to alert the user to the presence of important operating and maintenance (servicing) instructions in the literature accompanying the product.

1. Read these instructions.
2. Keep these instructions.
3. Heed all warnings.
4. Follow all instructions.
5. Do not use this apparatus near water.
6. Clean only with dry cloth.
7. Do not block any ventilation openings. Install in accordance with the manufacturer’s instructions.
8. Do not install near any heat sources such as radiators, heat registers, stoves, or other apparatus (including amplifiers) that produce heat.
9. Do not defeat the safety purpose of the polarized or grounding-type plug. A polarized

plug has two blades with one wider than the other. A grounding type plug has two blades and a third grounding prong. The wide blade or the third prong are provided for your safety. If the provided plug does not fit into your outlet, consult an electrician for replacement of the obsolete outlet.

10. Protect the power cord from being walked on or pinched particularly at plugs, convenience receptacles, and the point where they exit from the apparatus.
11. Only use attachments/accessories specified by the manufacturer.
12. Use only with the cart, stand, tripod,  bracket, or table specified by the manufacturer, or sold with the apparatus. When a cart is used, use caution when moving the cart/apparatus combination to avoid injury from tip-over.
13. Unplug this apparatus during lightning storms or when unused for long periods of time.
14. Refer all servicing to qualified service personnel. Servicing is required when the apparatus has been damaged in any way, such as power-supply cord or plug is damaged, liquid has been spilled or objects have fallen into the apparatus, the apparatus has been exposed to rain or moisture, does not operate normally, or has been dropped.

Warning

- ▶ To reduce the risk of fire or electrical shock, do not expose this equipment to dripping or splashing and ensure that no objects filled with liquids, such as vases, are placed on the equipment.
- ▶ Use a three wire grounding type line cord like the one supplied with the product.
- ▶ Be advised that different operating voltages require the use of different types of line cord and attachment plugs.
- ▶ Check the voltage in your area and use the correct type. See table below:

Voltage	Line plug according to standard
110-125 V	UL817 and CSA C22.2 no 42.
220-230 V	CEE 7 page VII, SR section 107-2-D1/IEC 83 page C4.
240 V	BS 1363 of 1984. Specification for 13A fused plugs and switched and unswitched socket outlets.

- ▶ This equipment should be installed near the socket outlet and disconnection of the device should be easily accessible.
- ▶ Do not install in a confined space.
- ▶ Do not open the unit – risk of electric shock inside.

- ▶ Mains ground must be connected.
- ▶ *Norwegian:*
Apparatet må tilkoples jordet stikkontakt.
- ▶ *Swedish:*
Apparaten skall anslutas till jordat uttag.
- ▶ *Finnish:*
Laitte on liitettävä suojakoskettimilla varus-tettuun pistorasiaan.

Caution:

- ▶ You are cautioned that any change or modifications not expressly approved in this manual could void your authority to operate this equipment.
- ▶ To completely disconnect from AC mains, disconnect the power supply cord from the AC receptacle.
- ▶ The mains plug of the power supply shall remain readily operable.
- ▶ Danger of explosion if battery is incorrectly replaced. Replace only with the same or equivalent type.
- ▶ Ventilation should not be impeded by covering the ventilation openings with items, such as newspapers, tablecloths, curtains, etc.
- ▶ Only used at altitude not exceeding 2000 m.

**Service**

- ▶ There are no user-serviceable parts inside.
- ▶ All service must be performed by qualified personnel.

EMC/EMI

This equipment has been tested and found to comply with the limits for a Class B Digital device, pursuant to part 15 of the FCC rules.

These limits are designed to provide reasonable protection against harmful interference in a residential installations.

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- ▶ Reorient or relocate the receiving antenna.
- ▶ Increase the separation between the equipment and receiver.
- ▶ Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- ▶ Consult the dealer or an experienced radio/TV technician for help.

The user may find the following booklet, prepared by the Federal Communications Com-

mission, helpful: "How to identify and Resolve Radio/TV interference Problems." This booklet is available from the US. Government Printing Office, Washington, DC 20402, Stock No. 004-000-0034-4.

For the customers in Canada:

This Class B Digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations ICES-003.

Cet appareil numérique de la classe B respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada ICES-003.

About this manual

This manual will help you learn understanding and operating the TC Loudness Pilot.

To get the most from this manual, please read it from start to finish, or you may miss important information.

This manual is only available as a PDF download from the TC Electronic website.

Please do not operate Loudness Pilot before you have made all connections to external equipment as described in [“Setting up Loudness Pilot”](#) on page 31.

In the subsequent sections of the manual, we assume that all connections are made correctly and that you are familiar with the previous sections.

To download the most current version of this manual, view the product warranty, and access the growing FAQ database for this product, please visit the web page

tcelectronic.com/support/

Getting support

If you still have questions about the product after reading this manual, please get in touch with TC Support:

tcelectronic.com/support/

Before you get started

Register your product

Please register this product so we can inform you about updates and other product-related news. To register your product, please go to:

[tcelectronic.com/support/
account-registration/registration/](https://tcelectronic.com/support/account-registration/registration/)

Stay up-to-date on loudness

There are many aspects to loudness, and keeping track of all of them can be a challenge. This is why TC Electronic has created a dedicated loudness website, where all of these aspects are outlined, explained and discussed. This site is an answer to the question:

“What is loudness – and why is it important?”

Visit the Loudness website at:

tcelectronic.com/loudness/

Unpacking and setup

Package contents

Depending on the configuration you have purchased, the box should contain the following items:

- ▶ 1 Broadcast One unit running Loudness Pilot software
- ▶ 2 power cables
- ▶ 1 USB stick containing...
 - the TC Icon software,
 - the Loudness Pilot software,
 - this manual in PDF format.

Setup

For basic setup information, see [“Quick Setup” on page 35](#).

Software: TC Icon and Loudness Pilot firmware

Operating Loudness Pilot requires a TC Icon remote (sold separately) or a computer running the TC Icon software.

When you are working with a system involving one or multiple Loudness Pilot units, you are interacting with two types of software:

1. **TC Icon software:**

TC Icon is a software application that you install on the computer(s) which you are using to access, configure, operate and update the Loudness Pilot unit(s).

TC Icon software is available for **Microsoft Windows** and **Mac OS X** operating systems.

TC Icon software is free and can be installed on multiple computers.

Downloading and installing TC Icon software is described in this section of the Loudness Pilot manual.

2. **TC Loudness Pilot firmware:**

Loudness Pilot firmware is the software installed on every Loudness Pilot.

Every Loudness Pilot comes pre-installed with the most current firmware version available at the time of production. You can download newer versions of Loudness Pilot firmware from the TC website. Firmware updates will contain bug fixes and/or new features.

Loudness Pilot firmware updates are free.

Use TC Icon software installed on your computer (see above) to transfer firmware to your Loudness Pilot unit(s).

Downloading and installing Loudness Pilot firmware updates is described in [“Updating Loudness Pilot firmware”](#) on page 75.

You should keep both the TC Icon software running on your computer and the software of your Loudness Pilot (the firmware) up to date. Using up-to-date software versions ensures you benefit from bug fixes and the latest features.

Finding and installing TC Icon software – Microsoft Windows

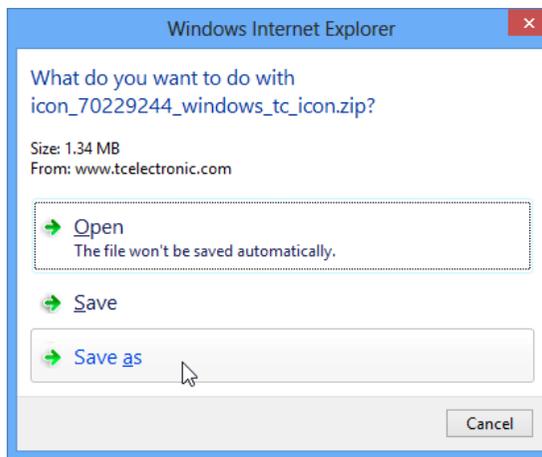
The most current version of TC Icon software for Microsoft Windows at the time of production is provided on the USB stick that came with your Loudness Pilot, but you may want to download the latest version from the TC Electronic website.

You can download the latest version of the TC Icon software for Microsoft Windows from:

tcelectronic.com/support/software/

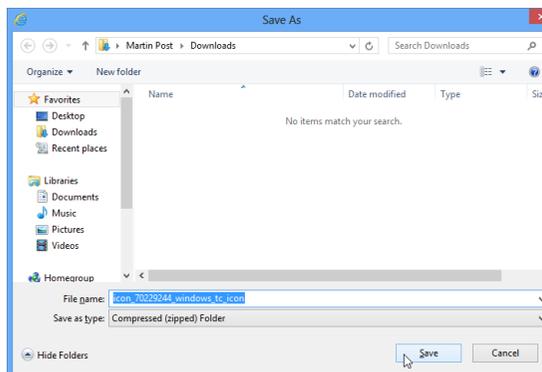
- ▶ On this page, locate the “Loudness Pilot” section.
- ▶ In this section of the support page, look for “TC Icon software” and click the button representing the latest version of the TC Icon software for Microsoft Windows.

Depending on your browser type and configuration, a dialog may be shown asking you what you want to do with this file.



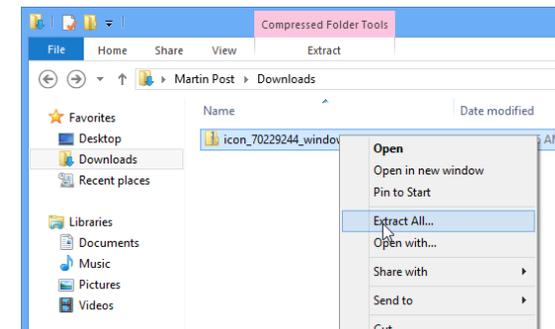
Choose “Save”.

The software will be downloaded to your browser’s default download location. Usually, this is the “Downloads” folder for your user account.

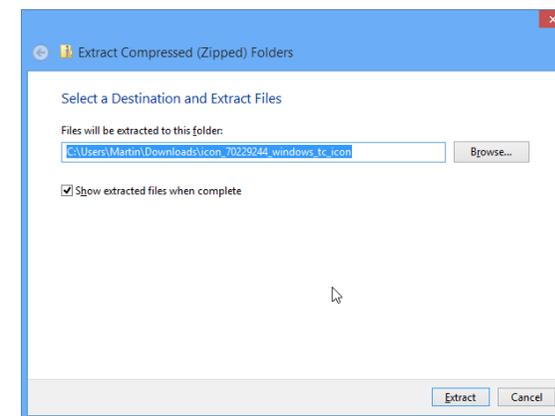


- ▶ Go to the folder containing the ZIP file you just downloaded.

- ▶ Right-click the .ZIP file and choose “Extract All...” from the context menu.

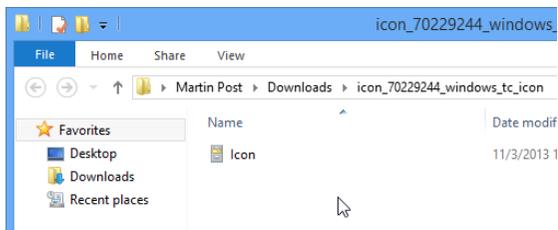


A dialog box will allow you to specify where the extracted files should be stored.



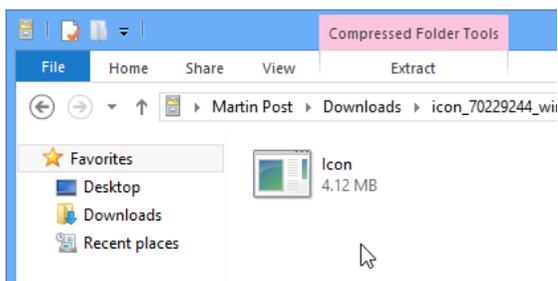
Accept the defaults or change the path.

- ▶ After extracting the ZIP file, you will see a .CAB (“Cabinet”) file in Windows Explorer.

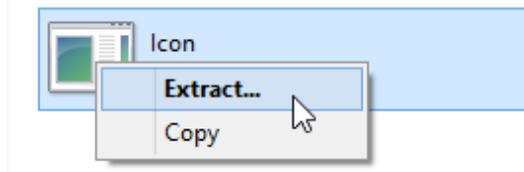


- ▶ Double-click the .CAB file.

An “Icon” application file will be shown.

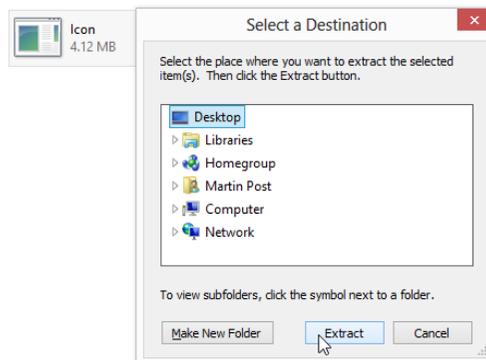


- ▶ Right-click the “Icon” application file and choose “Extract...” from the context menu.



In the dialog box that is shown next (“Select destination”), select a folder where you can

easily find the application – e.g., the Windows desktop.



- ▶ Click “Extract” to extract the application to the selected destination.
- ▶ Launch the TC Icon application that you just extracted by double-clicking its icon.

TC Icon will try to establish connections to all connected TC devices on a local network, including your Loudness Pilot.

If a connection cannot be established, please refer to [“Networking basics and troubleshooting”](#) on page 32.

If you experience technical problems during software download or installation, please ask a person with administrator privileges on this computer for assistance.

Updating TC Icon software

To update the TC Icon software on your computer when a newer version is released,

- ▶ quit the TC Icon software if it currently running on your PC,
- ▶ download and extract the newer version as described in this section and
- ▶ replace the currently installed version by copying the newer version over it.

Finding and installing TC Icon software – OS X

The most current version of TC Icon software for OS X at the time of production is provided on the USB stick that came with your Loudness Pilot, but you may want to download the latest version from the TC Electronic website.

You can download the latest version of the TC Icon software for OS X from:

tcelectronic.com/support/software/

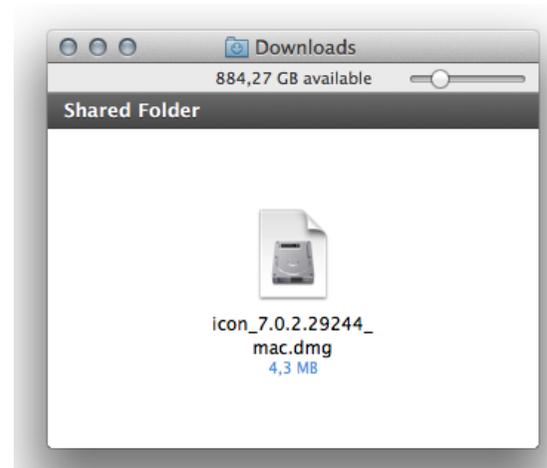
- ▶ On this page, locate the “Loudness Pilot” section.
- ▶ In this section of the support page, look for “TC Icon software” and click the button representing the latest version of the TC Icon software for OS X.

Depending on your browser type and configuration, a dialog may be shown asking you what you want to do with this file. Choose “Save”.

The software will be downloaded to your browser’s default download location. Usually, this is the “Downloads” folder for your user account.

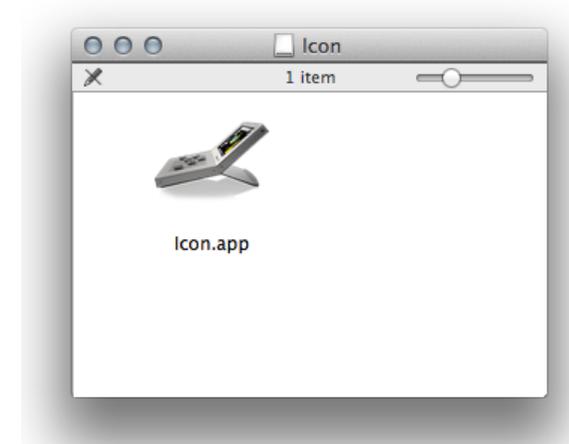
- ▶ Go to the folder containing the file you just downloaded.
- ▶ If you are seeing a .ZIP file, double-click it to extract its contents. However, your browser

may already have extracted the contents from the .ZIP file automatically.

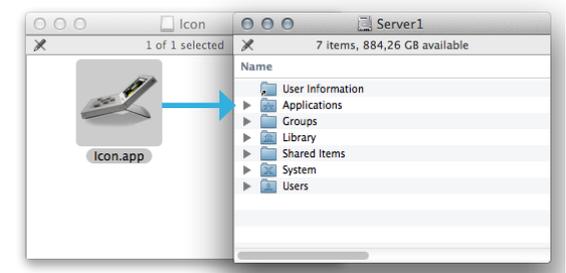


- ▶ After the ZIP file has been extracted, you will see a .DMG (“Disk Image”) file in the Finder.
- ▶ Double-click the .DMG file to mount this disk image.

An “Icon” disk image containing an “Icon” app will be shown.



- ▶ Copy the TC Icon application from the disk image to your hard disk by dragging it to the “Applications” folder, or to another folder where you can easily find it.



- ▶ You can now unmount (eject) the disk image by right-clicking it and selecting “Eject” from the context menu.



- ▶ Launch TC Icon by double-clicking the application.

TC Icon will try to establish connections to all connected TC devices on a local network, including your Loudness Pilot.

If a connection cannot be established, please refer to [“Networking basics and troubleshooting”](#) on page 32.

If you experience technical problems during software download or installation, please ask a person with administrator privileges on this computer for assistance.

Updating TC Icon software

To update the TC Icon software on your computer when a newer version is released,

- ▶ quit the TC Icon software if it currently running on your Mac,
- ▶ download and extract the newer version as described in this section and
- ▶ replace the currently installed version by copying the newer version over it.

Loudness Pilot: An introduction

Loudness Pilot will help you deliver great-sounding, loudness compliant audio experiences to your listeners.

Loudness Pilot is the perfect solution for broadcast stations that need hassle-free mono and stereo loudness control. It can handle multiple TV channels or languages, or simultaneous delivery to multiple independent platforms – for instance TV and mobile.

In other words: Loudness Pilot is the loudness solution for local and regional broadcasters – cost-effective, easy-to-use and tailored for stereo.

Perfect loudness management for Stereo and Mono

Busy regional and local broadcasters will find peace of mind with this unit that is fully compliant with all major loudness and broadcast standards. It even includes the option to add TC Electronic's renowned Radar Meter as a separate license – see [“LM2 \(optional\)” on page 96](#) and [“Extending your product’s capabilities with optional licenses” on page 121](#).

Loudness Pilot combines uncompromising audio processing with a competitive price that puts unparalleled audio quality within the reach of all users.

Ultra-low latency – ultra-high redundancy

Loudness Pilot is the very best loudness-correction technology packed into an easy-to-use, dual-stereo or dual-mono form offering exceptionally low latency and very flexible routing possibilities. And it comes packed with dual redundancy features. Your signal will never be in jeopardy with dual power inputs, dual fuses, dual fans and a Relay Bypass feature on both the SDI and AES versions.

Comply with loudness standards

TC Electronic has been listened to by those actively setting broadcast standards. We have even donated our technology to many of the same international bodies that impact your broadcast work.

Legislation on loudness in television is constantly evolving. However, with Loudness Pilot we will always help you remain compliant with the latest revision of the broadcast standards that impact your work.

Targeted On Your Tasks

We have focused this unit on the areas most relevant to regional and local broadcast stations working with stereo SDI.

This means that you now have a single, fit-for-purpose tool ready to delivering either two languages simultaneously or to two different platforms, such as TV and mobile.

Loudness Pilot – Basic concepts and operation

Operating Loudness Pilot

Loudness Pilot is equipped with one or more *signal processing cards*. Each card encompasses four so-called *engines*.

Two of these engines are running the **ALC2** Loudness Correction algorithm (see [“Loudness Wizard” on page 102](#)), while the other two can run the optional **LM2** metering algorithms (see [“LM2 \(optional\)” on page 96](#)).

As you can easily see, Loudness Pilot is a „head-less system“ – it has no front panel controls (with the exception of the Reset button).

Loudness Pilot is operated using the **TC Icon** software, which you can download from the TC Electronic website.

You can use the same version of the TC Icon software to operate Loudness Pilot and other professional broadcast products from TC Electronic (e.g. DB4 and DB8 MKII).

Accordingly, a significant part of this manual covers operating Loudness Pilot using TC Icon software running on a standard computer, and the screen shots you see are taken from the OS X or Windows versions of this software.

Loudness Pilot offers a variety of ways to engage or disengage audio processing. Processing may be invoked automatically, depending on format, level, physical inputs etc., while remote control can be achieved via Ethernet, GPI, SDI metadata etc. **When setting up the device, make sure to only engage the methods you wish to use.** For

example, if GPI inputs are not used, make sure to make sure to disable the respective input.

Please invest some time in learning TC Icon’s basic concepts – you will benefit from it when operating systems that may include many networked TC signal processors.

Hardware versions

Loudness Pilot is available in five different hardware versions: Loudness Pilot SDI with one, two or three dual-engine processing cards installed, and Loudness Pilot AES in balanced and unbalanced versions.

Expanding your Loudness Pilot

Loudness Pilot offers considerable flexibility in routing and processing audio signals. To benefit from this flexibility, you need to understand the basic concepts and building blocks of the device as outlined in this section.

The audio processing capabilities of your device depend on the number of **dual-engine cards/processors** (3G Transmission cards) installed.

Each 3G Transmission card...

- ▶ can **process one SDI audio stream**
- ▶ holds **two multichannel processors**
- ▶ is capable of running...

- **two ALC2** algorithms

as well as

- **two LM2 Loudness Radar Meters** (optional)

simultaneously.

Accordingly, a Loudness Pilot with three 3G Transmission cards can handle **three independent streams**.

Instructions on upgrading a base Loudness Pilot with one or two Transmission 3G cards are not part of this manual. They are provided in a separate document that comes with the 3G Transmission card.

Loudness Pilot SDI: The Serial Digital Interface

With regards to inputs and outputs, Loudness Pilot SDI is based on the Serial digital interface (SDI) – a family of audio and video interfaces standardized by the Society of Motion Picture and Television Engineers (SMPTE).

An SDI signal may contain up to sixteen audio channels (8 pairs) at 48 kHz sample rate and 24 bit resolution.

We assume that you have a good working knowledge of SDI. The standard as such is not discussed in this manual.

Loudness Pilot AES

For many years, TC Electronic has focused on developing highly intelligent clocking solutions. Loudness Pilot features one of the most complex and intelligent technologies we have ever made. It is based on the TC developed DICE™ core with its JET™ technology, which has been further refined to deliver important features specifically for broadcast use.

- ▶ Loudness Pilot locks really fast and artefact-free to clock sources.
- ▶ It sends as good an audio signal as possible through at all times.
- ▶ If the source is lost, Loudness Pilot keeps on running at the “last good sync source rate”.
- ▶ Loudness Pilot keeps outgoing clock inconsistencies (e.g. when the sync reference is lost or the sync source changes) to a minimum. This ensures that e.g. upstream source switching will affect downstream devices to the least possible extent.
- ▶ Loudness Pilot reduces incoming jitter to a nearly unmeasurable level.

SDI vs. AES

There are no versions of Loudness Pilot that provide SDI and AES inputs and outputs on the same unit.

Loudness Pilot presets

Loudness Pilot comes with ready-to-use presets based on international standards. More presets will be made available as part of software updates from the TC website. These presets are based on information from broadcasters around the world.

If you feel that an important preset is missing or that a given preset does not work as it should, please get in touch with TC Electronic technical support:

tcelectronic.com/support/

Loudness Pilot status indicators and ports

This section of the manual describes the device's status indicators and connectors.

Please note that the number of front panel status indicators and connectors on the device depends on the hardware version you have purchased.

Front panel indicators

Loudness Pilot has the following front panel status indicators:



Fig. 15.: Front panel indicators on Loudness Pilot with three SDI cards

Additional status information can be displayed using TC Icon software – see [“Obtaining Loudness Pilot status information”](#) on page 45.

PSU 1 and PSU 2 LEDs

The PSU 1 and PSU 2 LEDs indicate the status of the two built-in power supplies.

LED color / indication	Status
Green	An external power is connected and the power supply is fully functioning.
Red	There is a problem with the power supply. Either there is no external power connected, or there is a problem at certain checkpoints in the relevant power supply.

Please refer to the descriptions of the PSU connectors in the [“Back panel connectors”](#) on page 27 section for more information.

Sync LED(s) – SDI versions

Loudness Pilot has three Sync LEDs – one for each of the up to three cards/engines in the device. If only one card is installed, only the first LED will be used.

The Sync LEDs indicate if synchronization to the currently connected signal source has been achieved.

LED color/ indication	Status
Off	Startup – no lock achieved.
Green	An SDI stream has been detected at the corresponding input, and Loudness Pilot is locked to it.
Yellow	There is an SDI anomaly.
Red	Loudness Pilot cannot lock to the SDI audio stream.

Sync LED(s) – AES versions

The Sync LED of Loudness Pilot AES (balanced/unbalanced) indicates if synchronization to the signal source selected as Sync Source has been achieved.

For a description of all Sync states, see [“AES Input State indicators” on page 53](#).

LED color/ indication	Status
Off	Startup – no lock achieved/ lock status unknown.
Green	A clock signal has been detected at the corresponding AES input, and Loudness Pilot is locked to it.
Yellow	Loudness Pilot is following its internal clock or set to Bypass.
Red	No lock or Freewheel status

Alert LED

Loudness Pilot has three Alert LEDs – one for each of the up to three cards/engines in the device. If only one card is installed, only the first LED will be used.

The Alert LEDs indicate problems either within the device or with the signal being processed.

LED color/ indication	Status
Off	Loudness Pilot is not connected to a computer running the TC Icon software or a hardware TC Icon.
Green	Loudness Pilot is connected to a computer running the TC Icon software or a hardware TC Icon. Normal operation, no problems detected.
Green – blinking	Preset recall
Yellow	There has been silence for more than five seconds, or the LM2/LM6 algorithm has detected a “High Loudness” state.

Signal LED

The Signal LEDs indicate if audio streams are received and processed by Loudness Pilot.

Detection for the Signal LEDs and GPO occurs at the *input*.

LED color/ indication	Status
Off	No audio signal (above -70 dBFS) has been detected.
Green	An audio signal above -70 dBFS has been detected.
Yellow	An audio signal above -1 dBFS has been detected.

Front panel reset button

The Reset button on the front panel can be used to reset the IP address of a Loudness Pilot unit or to reset Ethernet communication between Loudness Pilot and a computer when a communication error has occurred.

Resetting the IP address of a Loudness Pilot unit

It may be necessary to reset the IP address of a Loudness Pilot unit. To do so, proceed as follows:

- ▶ Switch off Loudness Pilot by disconnecting both power supplies.
- ▶ Insert a straightened paper clip or a similar object into the “Reset” hole on the front panel until it touches the button behind the panel.
- ▶ Boot the Loudness Pilot by connecting one or both power supplies while still holding the straightened paper clip onto the Reset button.

Loudness Pilot **will boot using its default IP address**. The default IP address is 192.168.1.[xx], where [xx] is the last two digits of the device’s serial number as printed on its back.

Resetting Ethernet communication

It may be necessary to reset Ethernet communication between Loudness Pilot and a computer *during operation*. To do so, proceed as follows:

- ▶ During operation, insert a straightened paper clip or a similar object into the “Reset” hole on the front panel until it touches the button behind the panel, and press the button for approximately 5 seconds until the LEDs start blinking.

This will reset Ethernet communication without interrupting audio streams.

Back panel connectors



Fig. 16.: Loudness Pilot back panel connectors (SDI version)

PSU (2 x)

Loudness Pilot has two C13 type power inlet sockets. The dual power inlets provide extended operational security and stability. They accept 100 to 230 Volts AC at 50/60 Hz.

If possible, connect these two power sockets to two *independent* power sources to minimize the risk of power loss.

Due to the redundant design, Loudness Pilot will still be fully operational when one of the two power supplies fails. However, to ensure maximum security and stability, you should address the issue and investigate the cause of the error indication at the first given opportunity.

In case of *complete* power loss, the device is hardware-bypassed via relays, ensuring that no signal loss occurs.

Ethernet interface(s)

Loudness Pilot is equipped with 32 bit Ethernet interfaces fully compliant with the IEEE 802.3u standard, supporting 10 and 100 Mbit/s (100Base-TX ports).

Loudness Pilot has either two, four or six Ethernet ports – depending on the number of 3G Transmission cards installed.

Connect a computer running TC Icon software or a hardware TC Icon device to one of these ports using a “straight-through” cable with 8P8C modular connectors (“RJ45”). A “crossover” type cable is *not* required.

The Ethernet ports are used exclusively for connecting a controller (namely a computer running TC Icon software). No audio signals are transmitted for processing over Ethernet ports.

SDI In Port(s)

Loudness Pilot has either one, two or three SDI In ports, depending on the number of 3G Transmission cards installed.

The AES versions of Loudness Pilot (balanced/unbalanced) have *no* SDI In ports.

Connect the upstream SDI device to an SDI In socket on Loudness Pilot. Use a coaxial cable with BNC connectors with a nominal impedance of 75 Ohms.

Connecting multiple 3G cards

If you are using a Loudness Pilot with two or more 3G Transmission cards installed, daisy-chain the SDI cards as follows:

- ▶ Connect your signal source to the SDI In port of the first card.
- ▶ Connect the SDI Out port of the first card to the SDI In port of the second card.
- ▶ Connect the SDI Out port of the second card to the SDI In port of the third card (if applicable).
- ▶ Connect the SDI Out port of the third/last card to the next downstream device.

Connecting the Transmission cards as described here will have them show up as separate devices in TC Icon. Select and configure each card to assign and process SDI streams as required.

SDI Out Port(s)

Loudness Pilot has either one, two or three SDI Out ports, depending on the number of 3G Transmission cards installed.

The AES versions of Loudness Pilot (balanced/unbalanced) have *no* SDI In ports.

Connect the downstream SDI device to an SDI Out socket on Loudness Pilot. Use a coaxial cable with BNC connectors with a nominal impedance of 75 Ohms.

Unbalanced AES-3id In Ports

The *Unbalanced AES* version of Loudness Pilot has 8 AES-3id In ports on BNC connectors with one channel pair per connector.

The SDI versions of Loudness Pilot have *no* AES In ports.

Unbalanced AES-3id Out Ports

The *Unbalanced AES* version of Loudness Pilot has 8 AES-3id Out ports on BNC connectors with one channel pair per connector.

The SDI versions of Loudness Pilot have *no* AES Out ports.



Fig. 17.: Loudness Pilot AES (unbalanced version) back panel connectors

Balanced AES In/Out Ports

The *Balanced AES* version of Loudness Pilot has two Sub-D AES I/O connectors, with channels 1-8 on the upper connector and channels 9-16 on the lower connector.

The SDI versions of Loudness Pilot have *no* AES I/O ports.



Fig. 18.: Loudness Pilot AES (balanced version) back panel connectors

About AES channels

Loudness Pilot AES (balanced/unbalanced) comes fully loaded with 16 channels of unbalanced AES I/O, and by default the first 8 channels are active.

Should you need even more channels, you can purchase a separate license for activating channels 9-16. See [“Extending your product’s capabilities with optional licenses”](#) on page 121.

GPIO Port(s)

Connect a controller to this port to control various Loudness Pilot features remotely.

Setting up Loudness Pilot

Loudness Pilot can be used in a variety of configurations and setups. However, as all TC Broadcast processors in your system can be controlled from a single computer running TC Icon software, even large and complex setups are basically operated in the same manner as the basic setup described in this chapter.

Networking basics and troubleshooting

You may setup and operate your Loudness Pilot in a simple networking environment – where you can connect a computer and one Loudness Pilot directly using a standard Ethernet cable –, or your system may be more complex, involving several computers, several Loudness Pilot and other TC devices.

Either way, you are operating a system based on TCP/IP – the same protocol suite the Internet is built on. Accordingly, you need to follow basic networking procedures when setting up your system.

It is absolutely possible that a standard computer running the TC Icon software will detect a Loudness Pilot “out of the box” without problems. However, if it doesn’t, there is most likely a **subnet issue** or an **IP address conflict**. In this case, please refer to the following sections.

Subnet mask and TCP/IP addresses

The subnet mask is a number that defines a “group” of computers (or other devices) connected to a network. *All units in this group must have the same subnet mask.*

The **default subnet mask** of each Loudness Pilot is

255.255.255.0.

The TCP/IP address of each device connected to a network has to be unique. An IP address consists of four decimal numbers (ranging from 0 to 255) separated by dots, e.g. 192.168.1.1

The first three numbers (e.g. “192.168.1”) must be the same for each unit – *but the remaining number has to be unique in the subnet.* I.e., no two units in the subnet can have the same last number.

The **default IP address** of each Loudness Pilot is

192.168.1.[nn],

...where [nn] is identical to the last two digits in the Loudness Pilot’s serial number (you will find the serial number of Loudness Pilot on a label on the rear side of the device). This way, multiple Loudness Pilot’s can be setup directly out of the box without having to change their IP numbers.

If your computer is using the same IP address as a Loudness Pilot on the same network, you have two options:

- ▶ Alter the last octet (the last three numbers) of your computer's IP address *or*
- ▶ Alter the last octet of the Loudness Pilot's IP address.

Changing your computer's subnet mask and TCP/IP address

If and where you can change the subnet mask and IP address of your computer depends on...

- ▶ the *operating system* you are using and
- ▶ your *account privileges*.

In case of doubt, please consult your company's network administrator.

To find and change the TCP/IP address and the subnet mask on a computer running Windows:

- ▶ Go to Control Panel/Network Connections/Internet Protocol (TCP/IP).
- ▶ Set the TCP/IP address.

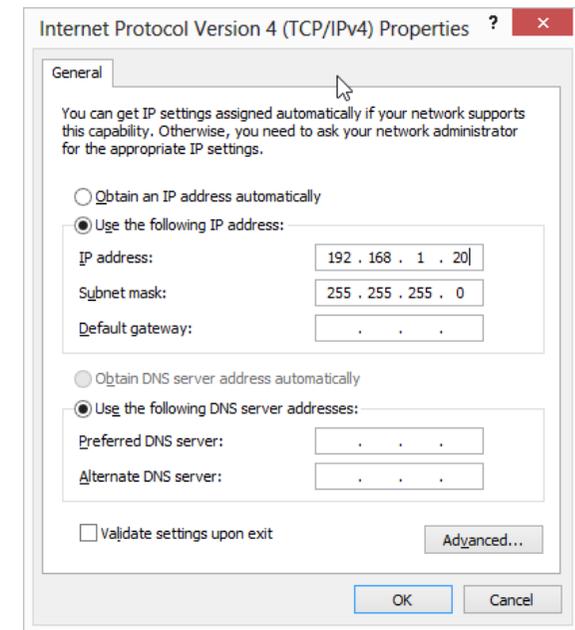


Fig. 19.: Windows Internet control panel

To find and change the TCP/IP address and the subnet mask on a computer running OS X:

- ▶ Go to System Preferences/Network.
- ▶ Select "Ethernet".
- ▶ Under "Configure IPv4", select "Manually".
- ▶ Set the TCP/IP address.

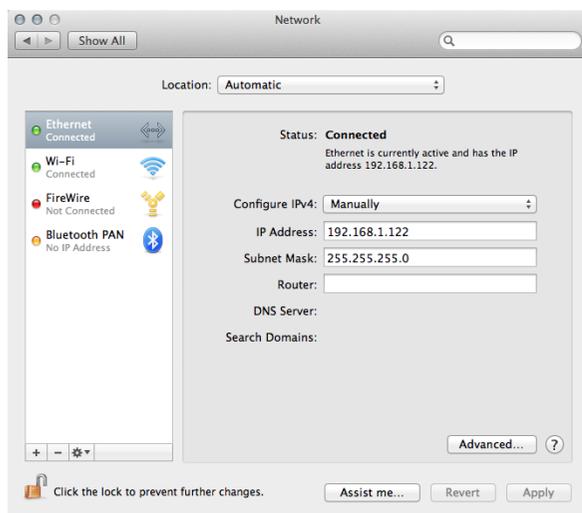


Fig. 20.: OS X Network preferences

For further information, please refer to your operating system's integrated help system.

Changing subnet mask and TCP/IP address of a Loudness Pilot

To change the subnet mask and TCP/IP address of a Loudness Pilot, you need to access it using a computer running the TC Icon software. This means that in case of an IP address conflict that keeps you from accessing Loudness Pilot in the first place, you need to change your *computer's* IP first as described in the previous section.

- ▶ Enter the new subnet mask.
 - ▶ Confirm by clicking Enter.
-
- ▶ Launch the TC Icon software on your computer.
 - ▶ Select the particular Loudness Pilot you want to access.
 - ▶ Click on the Frame tab.
 - ▶ Select the System page.
 - ▶ Select the Setup subpage.
 - ▶ Select Net.

To change the IP address:

- ▶ Select the IP address parameter.
- ▶ Enter the new IP address.
- ▶ Confirm by clicking Enter.

To change the subnet mask:

- ▶ Select the IP Subnet Mask parameter.

Resetting the IP address of a Loudness Pilot

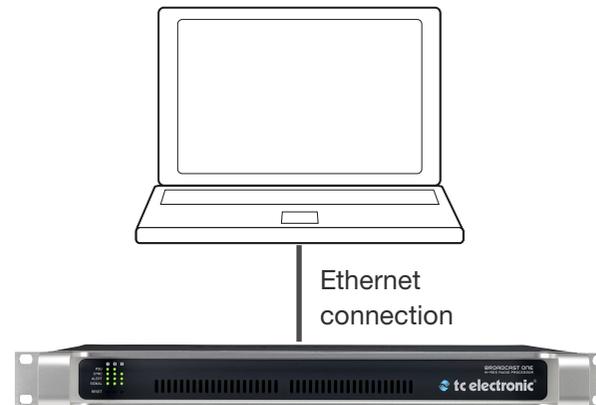
You may need to reset the IP address of a Loudness Pilot. This procedure is described in the section [“Front panel reset button”](#) on page 26.

If the serial number of a particular Loudness Pilot ends with “00”, the default IP address for this device will be 192.168.1.100, as “00” is not a valid IP number in all networks.

There is a small risk that two Loudness Pilot (or other TC signal processors) on a network have the same last two digits in the serial number and thus will conflict after a reset. To resolve this issue, reset one Loudness Pilot first and change its IP address before connecting the second Loudness Pilot.

Quick Setup

This guide applies for a simple setup as illustrated below.



Requirements for this setup are:

- ▶ A Loudness Pilot
- ▶ A CAT5 Ethernet cable
- ▶ A computer equipped with an Ethernet adapter, running Microsoft Windows or Mac OS X and the latest version of TC Icon software.

Proceed as follows:

- ▶ Unpack Loudness Pilot and install it in a stable, well-ventilated space.
- ▶ Connect Loudness Pilot and your computer using an Ethernet cable.
- ▶ Power up your computer and Loudness Pilot.

- ▶ If you have not already done so, download and install the latest version of the TC Icon software editor on your computer.
- ▶ Launch the TC Icon software on your computer.

The following screen will appear:



- ▶ Click “Assign”. The network is scanned, and all connected and operational devices will be listed on the next screen.
- ▶ Select the device you wish to access.
- ▶ To have TC Icon detect more devices and assign them to one of up to eight slots, see [“Assigning devices to the available slots”](#) on page 83.

- ▶ If you cannot access Loudness Pilot, please refer to [“Networking basics and troubleshooting”](#) on page 32.

That’s it – you are now ready to configure and operate your Loudness Pilot.

Updating Loudness Pilot software

The latest version of both the Loudness Pilot software and the TC Icon software editor available at the time of production are supplied with your Loudness Pilot.

However, from time to time, software updates are made available by TC, containing both bug fixes and new features.

Please download and install the most current version of the TC Icon software from:

tcelectronic.com/support/software/

The TC Icon software is available for

- ▶ Microsoft Windows and
- ▶ Mac OS X.

Using TC Icon software, you can access your Loudness Pilot and update its built-in software (the firmware), which is provided as a separate download.

Updating Loudness Pilot firmware is described in [“Updating Loudness Pilot firmware”](#) on page 75.

Basic operation

Introduction

This section of the manual is a general introduction to operating Loudness Pilot using the TC Icon software.

In the following chapters we assume that you have connected Loudness Pilot and your computer directly or as part of a network as described in [“Setting up Loudness Pilot” on page 31](#).

Several Loudness Pilot and other TC signal processors (e.g. DB4/DB8 MKII), and computers running the TC Icon software can be connected and operated at the same time as part of a standard Local Area Network (LAN). The TC Icon software is used to detect, configure and operate devices from your computer.

If you encounter communication errors or cannot detect or operate a device properly, please refer to [“Networking basics and troubleshooting” on page 32](#).

Basic TC Icon operation

The TC Icon software interface has been optimized for use in real-time situations in broadcast and post production environments (which usually are very different from standard desktop computing tasks and environments). Accordingly, **buttons** are very prominent and clearly labelled to ensure proper operation even in stressful situations. In addition, important parameters can be assigned to on-screen **faders**, allowing for precise control and immediate visual feedback.

The interface can be customized. Customizable parameters include fader positions and user interface colors. For more information, please refer to the chapters [““UI page” on page 85”](#) and [“Color page” on page 85](#) of this manual.

TC Icon interface: Tabs versus pages

- ▶ Use the *tab buttons* on the upper edge of the TC Icon window to select a primary group of functions.
- ▶ Use the *page buttons* on the left edge of the TC Icon window to select specific pages.

TC Icon modes: Base and Device operation

The TC Icon software has two operation modes: **Base** and **Device operation**.

- ▶ Use **Base mode** to select devices and configure the network and the TC Icon software itself.

In Base mode, you will see the Select, Auto and Setup tabs on the upper edge of the TC Icon window. Most Base mode functions are described in the chapter [“Icon Setup” on page 81](#).

- ▶ Use **Device operation** mode to operate the currently selected device.

In Device Mode, you will see the specific tabs for operating the currently selected TC device.

Switching between Base and Device operation modes:

- ▶ To switch between Base and Device operation modes, click the Icon symbol in the upper left corner of the window.



Faders

The TC Icon software has large on-screen faders. They have several features that will help you operate your Loudness Pilot efficiently.

- ▶ There are six on-screen faders.
- ▶ You can change the position of the faders or hide them completely – see [“UI page” on page 85](#).
- ▶ The name of the parameter that a fader is currently assigned to is displayed above the fader.
- ▶ When no label is shown above a fader, that fader is currently not assigned to a parameter.
- ▶ Fader assignments and values will always reflect the last Engine you have accessed.

Using Faders for fine adjustments

When a parameter is assigned to a fader, you can choose between **Normal** and **Fine adjustment** mode.

- ▶ In **Normal Adjustment** mode, the fader range will cover the full parameter range – e.g. -18 dB to 18 dB for the Center Trim parameter.
- ▶ In **Fine Adjustment** mode, the fader range will be smaller, allowing you to fine-tune around the current value – e.g. in 0.1 dB steps for a level parameter.

To switch a fader from Normal Adjustment mode to Fine Adjustment mode or back, click the label above that fader. Fine Adjust mode will be indicated by two triangles in the label field.

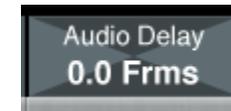


Fig. 21.: Fader label indicating Fine adjustment mode

Fader Groups

Loudness Pilot algorithms encompass many parameters on several pages. For efficient operation, the most important parameters can be assigned to the on-screen faders in **Fader Groups**. Fader Groups allow you to access the most important features immediately, no matter what particular page is currently being displayed.



Fig. 22.: Fader group 1 selected in the Fader Group selector

You can access *predefined* Fader Groups that cover typical applications, and you can define a *User Fader Group* with your own assignment for each fader.

You can select and customize Fader Groups per Engine – meaning that you can use one group of fader assignments for Engine 1, and another one for Engine 2.

To select a Fader Group:

- ▶ Select the tab of an Engine (on the top edge of the TC Icon software window).

- ▶ Use the arrow buttons on the Fader Group selector (on the left edge of the TC Icon software window) to select the desired Fader Group. The name of the currently selected Engine and Fader Group are displayed on the Fader Group selector. E.g., “E1 Group 1” means that you have selected the predefined Fader Group 1 for Engine 1.

To set up the User Fader Group:

- ▶ Select the tab of an Engine (on the top edge of the TC Icon software window).
- ▶ Use the arrow buttons on the Fader Group selector to select the “User” Fader Group.
- ▶ Click the “Fader Asgn” button (on the left edge of the TC Icon software window).
- ▶ Click the label of a fader that you want to assign to a parameter.
- ▶ Click the name of the parameter that you want to assign to the previously selected fader.
- ▶ Repeat the last two steps until you have made all desired assignments.
- ▶ Click the “Fader Asgn” button again.

Assigning Fader 6 on the fly

Even when using one of the predefined Fader Groups for an Engine, you can always assign the sixth Fader to whatever parameter you want to control in a given situation. Like all other Fader-related settings, this is an Engine-specific setting: You can assign Fader 6 to one parameter when Engine 1 is selected and to another parameter when Engine 2 is selected.

To assign a parameter to fader 6:

- ▶ To assign a parameter to the fader 6, simply click on a parameter field. That parameter will immediately be assigned to the sixth fader. If that parameter is also assigned to one of the other faders, you can now use both faders to control that parameter.

On-screen keyboard

Loudness Pilot allows you to store and rename presets, assign labels to inputs and outputs and perform other functions where text input is required. When you access one of these functions, an on-screen keyboard will be displayed.

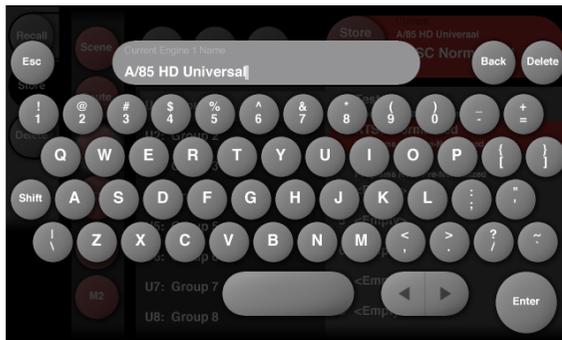


Fig. 23.: TC Icon software – On-screen keyboard

While the keyboard is being displayed, you can either click the letters shown on-screen or use your computer's keyboard for character input. When you are done, click the large Enter button or press your computer keyboard's Enter key.

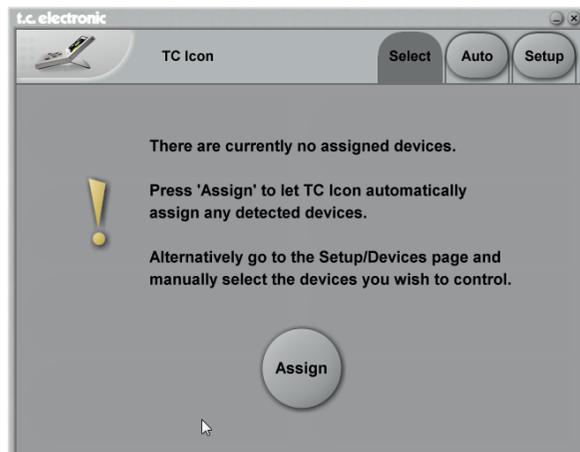
Accessing Loudness Pilot

- ▶ Connect your computer and Loudness Pilot as described in the [“Setting up Loudness Pilot”](#) chapter.
- ▶ Power up your computer and your Loudness Pilot.
- ▶ On your computer, launch the TC Icon software.
- ▶ When you do this for the first time or the system configuration has been changed, the following screen will appear:
- ▶ If a connected device is not detected, please refer to [“Networking basics and troubleshooting”](#) on page 32.
- ▶ Click the icon representing the Loudness Pilot to access it.

Operating multiple computers and / or TC HD devices in one network

In a more complex setup with multiple TC Icon hardware remote controls and/or several networked computers running TC Icon software, each of these TC Icon units and computers can be used to connect to TC HD devices (System 6000 MKII, DB6, Loudness Pilot, UpCon) on this network.

If your setup contains multiple TC HD devices, you should name these devices unambiguously so you don't accidentally edit the settings of the wrong device.



- ▶ Click “Assign”.
- ▶ All currently connected TC signal processors that are supported by the TC Icon software should be detected and assigned to one of the eight on-screen slots/locations.

Scanning/rescanning a network for devices

The scenario described above covers the first time you boot up your system or when no connected units are assigned.

When...

- ▶ you make changes to your setup,
- ▶ when devices are powered up or down, or
- ▶ if there are connection errors, these may not be detected immediately.

In this case, you should scan the network again.

To scan a network for devices:

- ▶ In the TC Icon software, go to Setup/Devices
- ▶ Click the Detect button.

For further information, see [“Devices page” on page 83](#).

In the following sections of this manual, we assume that you are operating a basic system with only one Loudness Pilot connected.

Obtaining Loudness Pilot status information

Please note that the LEDs on the front of a Loudness Pilot will display basic status information as long as the device is powered – see [“Front panel indicators”](#) on page 24.

Additional status information can be obtained using TC Icon, where you can also define how certain error states should be indicated on the device.

To display status information about Loudness Pilot, go to Frame/System/Status.

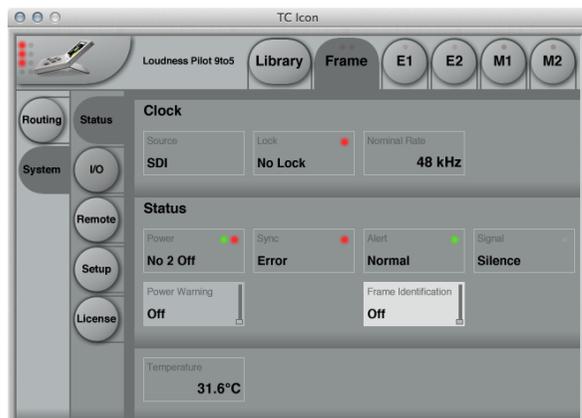


Fig. 24.: Loudness Pilot (SDI) Status page showing various issues (No Lock, Power supply 2 not connected, Sync error)

This page will display the following status information:

Clock section

Source indicator

Indicates the source of the clock signal Loudness Pilot is currently following.

Lock indicator

Indicates whether synchronization has been achieved. If no synchronization has been achieved, a red LED will be shown in this field.

Nominal Rate indicator

Shows the detected sample rate of the signal Loudness Pilot is synced to.

Status section

Power indicator

Displays the current state of the Loudness Pilot power supplies.

A power supply failure may be indicated as described under [“Power Warning parameter”](#) on page 46.

Power Warning parameter

A failing supply is *always* indicated by a red LED on the front panel of the device. TC Icon can also indicate a failing power supply, depending on the setting of the “Power Warning” parameter.

“Off” setting

A failing power supply is not reported in the Icon remote app.

“Warning” setting

A failing power supply is indicated by a *yellow* “Power” label in the respective Loudness Pilot Frame indicator, and a yellow LED will be shown on the Frame tab when it is selected.

“Error” setting

A failing power supply is indicated by a *red* “Power” label in the respective Loudness Pilot Frame indicator, and a red LED will be shown on the Frame tab when it is selected.

Sync indicator

The states and color codes shown here are the same as those shown by the respective Loudness Pilot Sync LED on the front panel of the device – see [“Sync LED\(s\) – SDI versions” on page 25](#).

Alert indicator

The states and color codes shown here are the same as those shown by the respective Loudness Pilot Alert LED on the front panel of the device– see [“Alert LED” on page 25](#).

Signal indicator

The states and color codes shown here are the same as those shown by the respective Loudness Pilot Signal LED on the front panel of the device– see [“Signal LED” on page 26](#).

Frame Identification parameter

If you are operating a complex system with multiple Loudness Pilot units, you may need to identify one specific unit quickly. To do so, select the respective Frame using TC Icon software and then use the Frame Identification parameter to have that Frame identify itself with blinking Alert LEDs as follows:

“Off” setting

This is the default setting. The Alert LED operates as described in [“Alert LED” on page 25](#).

“Green/Off”, “Yellow/Off”, “Red/Off”, “Green/Yellow”, “Green/Red”, “Yellow/Red”

The Alert LED on the front panel of the respective Frame will blink in the chosen color/color combination, while the Alert indicator field will read “LED blinking”.

Temperature indicator

Shows the current internal temperature of Loudness Pilot in degrees Celsius.

Setting up audio and syncing

I/O Setup – SDI

To set up audio, go to Frame/System/I/O/SDI. Use this page to...

- ▶ display information about incoming audio,
- ▶ select audio for processing and
- ▶ change Advanced SDI settings.



Fig. 25.: I/O setup – SDI page (Loudness Pilot SDI)

SDI Status indication section

Lock status indicator

The Lock status field shows the top-level lock status of an incoming SDI stream.

- ▶ When Loudness Pilot is locked to an acceptable SDI stream on the SDI input, “Lock” is shown.
- ▶ When no acceptable SDI stream is available on the SDI input, “No Lock” and a red LED will be shown in this field.

Format indicator

When the Loudness Pilot is locking to an incoming SDI stream, the Format indicator field will show the format – e.g. “1080i59.94 HD”. If the Loudness Pilot is not locking to any incoming SDI stream, the Format indicator field will read “N/A”.

Available Groups indicators

SDI with embedded audio carries up to 16 channels of audio, divided into four groups. Accordingly, each group carries four channels of audio. The four Available Groups indicators show which audio groups are available in the incoming SDI stream for metering and processing. The on-screen LED for each available group will light up in green. If the Loudness Pilot is not locking to an incoming SDI stream, all indicators are turned off.

Audio (In) Groups selector

Settings: “Groups 1+2”/“Groups 3+4”/“Groups 1+3”/“Groups 1+4”/“Groups 2+3”/“Groups 2+4”

Use the Audio Groups selector to select audio groups for metering and processing.

- ! Please note that Loudness Pilot always receives two of the audio groups in the incoming stream. The unprocessed audio groups are bypassed bit-transparently, as well as all related SDI packets such as video time code, close captions etc.

Advanced SDI Mode section

The Advanced SDI Mode section of the I/O SDI page contains SDI-related settings that you would normally not have to change.

Advanced settings switch

To change Advanced SDI settings, click the Advanced button in the Advanced SDI Mode section of this page.

! Please note that switching off access to Advanced SDI settings will reset all parameters in this section to their default values.

Clock Mode parameter

With SDI standards constantly evolving, chances are that upstream equipment treat audio and video sync differently – e.g., a device may only pay attention to one or the other. As this may cause occasional disruption of sound, picture or both, a problem may be difficult to trace without measurement equipment monitoring SDI traffic for weeks or months. To diagnose a potential problem, Loudness Pilot offers a diagnostic mode, which may be tried after consulting TC support. To activate diagnostic mode, set the Clock Mode parameter to Diagnostic.

In Diagnostic mode, the Loudness Pilot will disregard the audio clock information included in the audio packets in the SDI stream and embed the audio based on the video clock only.

! Use the Diagnostic setting for diagnostic purposes only.

Audio Out Groups parameter

Use the Audio Out Groups parameter to define if and how the group assignment of the processed audio signals should be changed.

Follow In Group setting

The processed audio signals will be assigned to the same audio channel groups at the SDI output that were selected using the Audio Groups selector. This is the default setting which is also used when Advanced SDI mode has not been activated.

Settings: “Groups 1+2”/“Groups 3+4”/“Groups 1+3”/“Groups 1+4”/“Groups 2+3”/“Groups 2+4”

The processed audio signals will be assigned to the selected audio channel groups at the SDI output.

If you are using this parameter to reassign audio channels to other groups, make sure that you are processing the right audio groups downstream.

Rate Detect Mode parameter

Use the Rate Detect Mode parameter to specify how Loudness Pilot should behave when receiving SD, HD and 3G signals. By narrowing the range of formats acceptable to the Loudness Pilot, lock-up time may be optimized.

Automatic setting

When you set the Rate Detect Mode parameter to Automatic, Loudness Pilot will accept all SDI formats: SD, HD and 3G. This is the default setting which is also used when Advanced SDI mode has not been activated.

SD only setting

When you set the Rate Detect Mode parameter to SD, Loudness Pilot will only accept the SD format and not consider locking to HD or 3G signals. This results in optimal lock-up time for SD signals.

HD only setting

When you set the Rate Detect Mode parameter to HD, Loudness Pilot will only accept the HD format and not consider locking to SD or 3G signals. This results in optimal lock-up time for HD signals.

3G only setting

When you set the Rate Detect Mode parameter to 3G, Loudness Pilot will only accept the 3G format and not consider locking to SD or HD signals. This results in optimal lock-up time for 3G signals.

Stream 3G LevelB selection parameter

With 3G Level B SDI (SMPTE424M), 32 audio channels in 8 audio groups are available via two streams. Use the Stream 3G LevelB parameter

to select the stream that Loudness Pilot should de-embed/embed audio from and to.

! Please note that when running 3G Level B, data stream 1 and data stream 2 need to have the same bit width so Loudness Pilot can de-embed and process audio. I.e., both data streams need to contain 8-bit data, or both data streams need contain 10-bit data). If the bit widths of the two data streams differ, Loudness Pilot will not be able to de-embed and process audio.

Stream 1 setting

The Loudness Pilot will de-embed and embed two of the up to four available audio groups in stream 1. This is the default setting which is also used when Advanced SDI mode has not been activated.

Stream 2 setting

The Loudness Pilot will de-embed and embed two of the up to four available audio groups in stream 2.

Bypass button

Settings: Enabled, Disabled

Use the Bypass button to immediately activate a hardware bypass of the SDI signal, allowing it to pass through Loudness Pilot unprocessed.

I/O Setup – Loudness Pilot AES

To set up audio, go to Frame/System/I/O/AES. Use this page to...

- ▶ display information about incoming audio,
- ▶ set the sync signal source
- ▶ change Advanced AES settings.

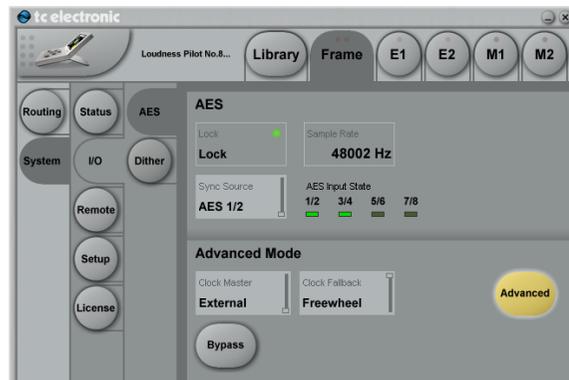


Fig. 26.: I/O setup – AES page (Loudness Pilot AES)

AES section

Lock status indicator

Lock status states: Lock, No lock, Freewheel, Internal, Bypassed

The Lock status indicator shows the overall reference clock status. The colors of the “LED” in this field represent the Icon application warning/error scheme, which is used for alarms on e.g. Icon, the Loudness Pilot front UI, GPO and SNMP.

- ▶ “Lock” (green LED/OK): Loudness Pilot has obtained lock to the reference signal set in the Sync Source field.
- ▶ “No Lock” (red LED/Error): “No Lock” is typically displayed when there is no signal present on the Input that Loudness Pilot is set to lock to, or if the incoming sample rate is outside the legal range (48 kHz +1.7 %/-1.3 %) and the Clock Fallback parameter is set to Halt.
- ▶ “Freewheel” (red LED/Error): “Freewheel” is displayed when there is no signal present on the Input that Loudness Pilot is set to lock to, or if the incoming sample rate is outside the legal range (48 kHz +1.7 %/-1.3 %) and the Clock Fallback is set to Freewheel.
- ▶ “Internal” (yellow LED/Warning): “Internal” is displayed when Loudness Pilot is set to sync to its internal referenced master clock at 48.000 kHz.

- ▶ “Bypassed” (yellow LED/Warning): “Bypassed” is displayed when the Loudness Pilot hardware bypass relay has been activated.

Sample Rate indicator

The Sample Rate indicator field displays the sample rate of the sync source Loudness Pilot is currently following. Sample rate is measured and displayed with 1 Hz precision (21 PPM @ 48 kHz).

AES Input State indicators

Indicator states: Green, yellow, grey

The AES Input State indicators show the status of the AES inputs. States are displayed as follows:

- ▶ **Green:** A green “LED” indicates that a signal is present and synchronous at the respective input.
- ▶ **Yellow:** A yellow “LED” indicates that a signal is present and running asynchronously relative to the sync source. This typically happens when the upstream device is running at an internal master clock rate and is not locked to the house clock.
- ▶ **Grey:** A grey “LED” indicates that no signal is present at the respective input or that the incoming sample rate is outside the legal range (48 kHz ±0.38 %).

Sync Source

Settings: AES 1/2, AES 3/4, AES 5/6, AES 7/8, AES 9/10, AES 11/12, AES 13/14, AES 15/16*

Use the Sync Source parameter to select the signal source that Loudness Pilot should sync to.

Please note that channel pairs from 9/10 to 15/16 are only available as Sync Sources when you have the optional AES 16ch license. For more information, see [“Extending your product’s capabilities with optional licenses”](#) on page 121.

When the Clock Master parameter is set to “Internal”, the Sync Source setting is irrelevant. However, you should be aware that you can use this parameter to pre-select a sync source that will be used when you switch Loudness Pilot AES directly from Internal to External Sync.

Advanced Mode section (AES)

The Advanced AES Mode section contains additional AES-related settings.

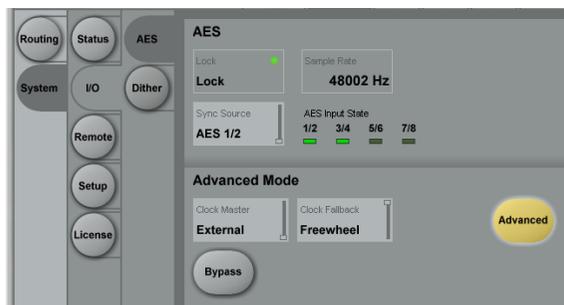


Fig. 27.: I/O setup – AES page (Loudness Pilot AES) with Advanced settings activated

Advanced settings switch

To change advanced AES settings, click the Advanced button in the Advanced Mode section of this page.

! Please note that switching off access to Advanced AES settings will reset all parameters in this section to their default values.

Clock Master parameter

Settings: External (default), Intern. 48 kHz

Use the Clock Master parameter to set whether Loudness Pilot should be referencing an incom-

ing external clock source or an internal crystal running at 48 kHz.

- ▶ External reference is mandatory in a broadcast installation and therefore the default setting.
- ▶ Internal is typically only for test and laboratory use.

Clock Fallback parameter

Settings: Freewheel (default), Halt

Use the Clock Fallback parameter to set how the internal clock of Loudness Pilot should be applied when the external sync source is not present.

- ▶ **Freewheel:** When sync is lost and the Clock Fallback parameter is set to Freewheel, the Loudness Pilot will continue running on the “last good rate”. If possible, Loudness Pilot will run on a 96 bit precision version of the last good sample rate that the Loudness Pilot received. This will only generate few sample slips downstream and on the inputs (which may still receive audio) so the audio quality is not significantly reduced. In some borderline cases it may not be possible to calculate the last good incoming sample rate. In such a situation, the Loudness Pilot will revert to the internal 48 kHz clock and audio will still be sent through. Expect more sample slips in such a situation.

- ▶ **Halt:** When the sync source is not present and the Clock Fallback parameter is set to Halt, all AES outputs are turned off – meaning no audio data and no AES carrier (no clock) are being sent out. Use this setting if you prefer to stop audio and clock output completely in a reference sync error situation. In this situation, the input signals are also turned off, and accordingly, meter activity will cease.

With both settings, Loudness Pilot will revert to the reference input signal (as set with the Sync source parameter) once it becomes available again. The changeover will be handled as smoothly as possible on both audio and clock.

Bypass button

Settings: Enabled, Disabled

Use the Bypass button to immediately activate a hardware bypass of the SDI signal, allowing it to pass through Loudness Pilot unprocessed.

Setting up audio dithering

To set up audio dithering, go to Frame/System/I/O/Dither.



Fig. 28.:System – I/O – Dither page

Use the Dither page to set up if and how audio signals should be dithered.

Dither out parameters

*Setting “Off” (no dithering applied),
24 bit, 20 bit, 18 bit, 16 bit*

Use the Dither out parameters to configure dithering for each pair of audio signals.

By default, the Dither Out parameters will be shown for channel pairs 1/2, 3/4, 5/6, and 7/8. Please note that channel pairs from 9/10 to 15/16 are only available as Sync Sources when you have the optional AES 16ch license. For more information, see [“Extending your product’s capabilities with optional licenses”](#) on page 121.

! If you are handling data-reduced formats, be sure to set these parameters to “Off”.

Loudness Pilot remote control

Loudness Pilot provides extensive remote control features. GPI and SDI metadata allow you to tailor remote control to your station's demands.

Please note that remote control based on SDI metadata requires an optional license. For more information, see [“Extending your product’s capabilities with optional licenses”](#) on page 121.

Remote – Master

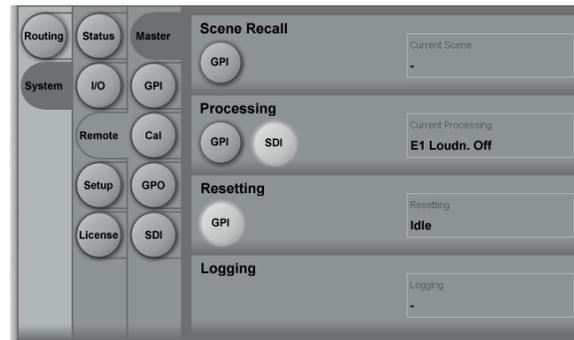


Fig. 29.: Loudness Pilot Remote Master page

The Remote Master page provides an overview of the current remote control setup. It also allows you to enable the remote control features (via GPI or SDI metadata) that you want to use.

Scene Recall section

GPI input 1 can be used for User Scene preset recall (see [“Library – Recall page”](#) on page 70).

Please note that the Icon user interface is locked when GPI is used for control.

GPI button

Use this button to enable GPI 1 input for User Scene Recall.

An “Enable” button that controls the same function can be found on the Remote – GPI page in the GPI 1 – Scene Recall section.

Current Scene status field

The Current Scene status field shows the name of the currently active Scene preset. The currently active Scene will be shown here whether it has been selected via GPI or not. The name shown here is identical to that shown on the Library – Recall – Scene page as “Current” and on top of the Frame – Routing page. When GPI is disabled, “-“ is shown.

Processing section

Audio processing in your Loudness Pilot can be controlled via GPI or SDI metadata.

When GPI or SDI metadata are being used to control the device, a blue LED on the respective Engine pages will indicate that their features are remote-controlled.

GPI and SDI buttons

Use these buttons to activate audio processing remote control via GPI 2 input or incoming SDI metadata.

Please note that this is a “radio button” set – only one of them can be active at a time.

SDI is only available with the SDI Metadata license loaded on a Loudness Pilot with SDI inputs and outputs. See [“Extending your product’s capabilities with optional licenses” on page 121.](#)

“Enable” buttons that control the same function can be found on the Remote – GPI page (in the GPI 2 – Processing Control section) and on the Remote – SDI page.

Current Processing status field

The Current Processing status field shows the current audio processing details no matter if GPI or SDI metadata is used for control.

“Normal” display

If “Normal” is displayed, audio-processing is not remote-controlled, and the unit works as specified by the current Engine preset.

“N/A” display

“N/A” (“not available”) indicates that the currently selected function is not available/applicable to the algorithm currently loaded in the Engine.

“N/A” also indicates that the device is not remote-controlled, and the unit works as specified by the current Engine preset.

Other displays

All other values shown in the Current Processing status field show which features are currently controlled via GPI or SDI. The possible values are a combination of the parameters Function, Engine and Status as set on the Remote – SDI or Remote – GPI page in the GPI 2 – Processing Control section.

When using SDI, the same information is shown on the Remote – SDI page in the Current Processing status field.

Resetting section

GPI can be used to reset audio processing history, meter history, or both.

When GPI is enabled, blue LEDs on the Engine and Meter pages’ Reset buttons will indicate that this feature is remote-controlled.

GPI button

Use this button to enable GPI 3 input for remote control of the Reset function.

An Enable button that activates the same feature can be found on the Remote – GPI page in the “GPI 3 – Resetting”.

Resetting status field

The Resetting status field shows the current Reset status, no matter whether it is controlled by GPI or not.

“Idle” display

The device is not remote-controlled, or it is waiting for a GPI pulse. See below for details regarding the control pulse.

“Resetting xx” display

When the device receives a GPI pulse, this status is shown for one second. The “xx” value is a combination of Function (audio processing and meter) and Engine.

Remote – GPI



Fig. 30.: Loudness Pilot Remote GPI page

GPI 1: Scene Recall section

Enable button

Use this button to enable GPI 1 input for User Scene Recall.

A “GPI” button that controls the same function can be found on the Remote – Master page in the Scene Recall section.

Please note that the Icon user interface is locked when GPI is used for control.

Function parameter

Use the Function parameter to define the scope of the GPI recall feature.

The available GPI recall modes that you can set using the Preset Recall Function parameter are:

Off setting

No Preset Recall using GPI.

2 Presets setting

Select one of two Presets using GPI1.

Select the Preset Bank using the Scene Bank parameter.

3 Presets setting

Select one of three Presets using GPI1.

Select the Preset Bank using the Scene Bank parameter.

For a description of the “Idle” state, see [“Idle state” on page 60.](#)

4 Presets setting

Select one of four Presets using GPI1.

Select the Preset Bank using the Scene Bank parameter.

7 Presets setting

Select one of seven Presets using GPI1.

Select the Preset Bank using the Scene Bank parameter.

For a description of the “Idle” state, see [“Idle state” on page 60.](#)

8 Presets setting

Select one of eight Presets using GPI1.

Select the Preset Bank using the Scene Bank parameter.

3 Presets DUAL setting

Select one of three Presets using GPI1 and GPI2.

This mode uses simple binary inputs on GPI1 and GPI2 – i.e. 00, 01, 10 and 11.

For a description of the “Idle” state, see [“Idle state” on page 60](#).

Select the Preset Bank using the Scene Bank parameter.

4 Presets DUAL setting

Select one of four Presets using GPI1 and GPI2.

This mode uses simple binary inputs on GPI1 and GPI2 – i.e. 00, 01, 10 and 11.

Select the Preset Bank using the Scene Bank parameter.

15 Presets DUAL setting

Select one of fifteen Presets using GPI1 and GPI2.

This mode uses 8-state on GPI1 and binary on GPI2.

For a description of the “Idle” state, see [“Idle state” on page 60](#).

In this mode, the Scene Presets are always recalled from two consecutive banks – e.g. Bank 1 and Bank 2.

Select the Preset Bank pairs (1+2, 3+4 etc.) using the Scene Bank parameter.

16 Presets DUAL setting

Select one of sixteen Presets using GPI1 and GPI2.

This mode uses 8-state on GPI1 and binary on GPI2.

In this mode, the Scene Presets are always recalled from two consecutive banks – e.g. Bank 1 and Bank 2.

Select the Preset Bank pairs (1+2, 3+4 etc.) using the Scene Bank parameter.

Idle state

“Idle” denotes GPI control being presently not active – i.e. the unit can still be controlled as normal, adjusting parameters and recalling presets via Icon. However, once a non-idle GPI state is chosen, the selected Scene preset is recalled, and normal functionality is blocked (which is also the case when GPI is engaged in general).

Scene Bank parameter

If you have set the previously described Function parameter to any value other than “Off”, you can select the Bank (or Banks) that Presets should be chosen from using the Scene Bank parameter. See the recall modes for a more thorough explanation.

Status field

The status field is intended for diagnostics during the setup of GPI control.

“-“ display

GPI 1 is not enabled, or the incoming voltage is outside of valid windows. Check the device’s GPI calibration, the incoming voltage and the general external GPI setup.

“Idle” display

GPI is not controlling. The incoming GPI voltage may be at maximum or not connected while the current setting for the Scene Bank parameter in the same section includes the “idle” option.

“1 (N/A)” display

No valid User preset is stored in that specific library location, and therefore GPI is not controlling. The behavior of the device is identical to Idle state.

“1”, “2” ... “8” displays

Incoming GPI voltage is within the valid window, and GPI is controlling Scene Recall. The TC Icon UI is locked.

Details regarding GPI signals

GPI 1 is receiving fixed-state, latching signals. A validation process is performed when receiving a new GPI voltage. The incoming voltage needs to be within the specific valid window for 500 ms before the preset change is initiated.

The time required for performing a change depends on the scope of that change – e.g., whether

it only involves parameters changes or the routing and algorithm change as well.

For information on voltage windows and GPI circuits, see [“Appendix 2: Loudness Pilot GPI/O page”](#) on page 122.

GPI 2 – Processing Control section

GPI (or SDI metadata) can be used to remote-control your Loudness Pilot’s audio processing feature.

When GPI (or SDI metadata) is used for remote control, blue “LEDs” on the respective Engine pages will highlight the affected signal processing parameters.

Enable button

Use this button to enable GPI 2 input for Processing Control.

A “GPI” button that controls the same function can be found on the Remote – Master page in the Processing section.

Note that SDI metadata can also control audio processing with the SDI Metadata license loaded on a Loudness Pilot with SDI input/output.

Function parameter

Use the Function parameter to define the parameters that should be remote-controlled.

Bypass Loudness

Loudness processing can be bypassed.

GPI can control if the loudness processing should be bypassed as follows:

- ▶ The signal is bypassed when the GPI input is min (0V)
- ▶ Normal operation (as specified by the Engine preset) when the GPI input is max (3V3) or not connected.

On the respective Engine page (Main), the Loudn. Correct parameter will be greyed out, and a blue LED indicates that it is being remote-controlled.

Engine parameter

Settings: E1, E2, E1+E2

Use the Engine parameter to specify which Engines should be remote-controlled.

Status field

The status field is intended for diagnostics during the setup of GPI control.

“Active” display

Displayed when the selected Function is active due to the GPI signal being at min. (0 V) and different from default/unconnected (3V3).

“Idle” display

Displayed when the selected Function is inactive due to the GPI signal being at max. (3V3) or unconnected. The device’s behavior is defined by the currently active Engine preset.

“(N/A)” display

Displayed when the algorithm currently loaded in the Engine does not support the selected Function and therefore GPI is not controlling it. The device’s behavior is defined by the currently active Engine preset.

Details regarding GPI 2 signals

GPI 2 is receiving fixed-state, latching signals. A validation process is performed when receiving a new GPI voltage. The incoming voltage needs to be at the new level for 40 ms before the processing change is initiated. The processing occurs nearly instantly.

For information on voltage windows and GPI circuits, see [“Appendix 2: Loudness Pilot GPI/O page”](#) on page 122.

GPI 3 – Resetting section

GPI can also be used to reset the *history* of the Loudness Pilot. When GPI is controlling the Loudness Pilot, blue LEDs on the affected Reset buttons on the respective Meter pages indicate that they are being remote-controlled.

As opposed to the GPI 1 and 2 inputs, the GPI 3 input is a “momentary type”, catching a pulse and not receiving fixed-state, latching signals.

Enable button

Use this button to enable GPI 3 input for resetting metering history.

A “GPI” button that controls the same function can be found on the Remote – Master page in the Resetting section.

Function parameter

Use the Function parameter to define the history files that should be reset when a Reset is triggered.

Off setting

No Reset will occur.

Metering setting

GPI will reset the Loudness meter history and log file.

Engines parameter

Settings: M1, M2, M1 & M2

Use the Engine parameter to specify the Engines whose meters should be affected when a Reset is being performed.

Status field

“-“ display

GPI 3 is disabled.

“Idle” display

Displayed when the device is waiting for a GPI reset pulse.

“Reset” display

“Reset” will be displayed for 1 second when a GPI pulse has been received. Simultaneously, the affected Reset buttons will light up yellow for 1 second on the respective Meters that are being remote-controlled.

Details regarding GPI 3 signals

Other than the GPI 1 and 2 inputs, the GPI 3 input is a “momentary type”, catching a pulse and not receiving fixed-state, latching signals.

- ▶ In Idle state (or when there is no connection to the GPI 3 input) the input will be at maximum voltage (3V3).

- ▶ When the input is pulled low to minimum voltage (0V), Loudness Pilot will catch the pulse and reset.
- ▶ Nothing will happen when the pulse returns from minimum to maximum.

The width of the incoming pulse should be at least 40 ms. It will take less than 200 ms from received reset pulse to the actual Reset.

For information on voltage windows and GPI circuits, see [“Appendix 2: Loudness Pilot GPI/O page”](#) on page 122.

GP Input Calibration

To calibrate GPI, go to the Frame/System/Remote/Cal page.



Fig. 31.: Loudness Pilot GPI calibration page

Each GPI may be used to switch between up to 8 states. GPI calibration should be performed when switching between more than two states (as it is required for preset recall).

Current section

The Current section of the GPI Calibration page provides live status information for the GP inputs. Here, “Vs” denotes positive terminal on the respective GP connector, typically 3.3 V.

Limits section

The Limits section of the GPI Calibration page shows the lower (“GPI Lo Threshold”) and upper (“GPI Hi Threshold”) limits of the voltage windows for the four GP inputs.

To calibrate a GPI input, click the respective Calibrate button and follow the on-screen instructions.

Setting up GPO

To set up GPO, go to the Frame/System/Remote/GPO page.



Fig. 32.: Loudness Pilot GPO page

Two relay-based general-purpose outputs are available. Use this page to configure them.

GPO 1 and GPO 2 parameters

Use the GPO 1 and GPO 2 parameters to specify which status information should be transmitted to the GPO pins. Available settings are “Off”, “Sync LED”, “Alert LED” and “Signal LED”. If you select one of the three LED options, the selected GPO pin pair will communicate the status of the respective Loudness Pilot front panel LED.

Idle State 1 and Idle State 2 parameters

Use the Idle State 1 and Idle State 2 parameters to specify which state of the respective GPO re-

lay (1 or 2) should represent the *inactive* state of the assigned LED/status information. Available settings are “Open” and “Closed”.

GPO setup example

- ▶ To signal Loudness Pilot Synchronization Status on GPO relay 1 – see [“Sync LED\(s\) – SDI versions”](#) on page 25 –, set the GPO 1 parameter to “Sync LED”.
- ▶ If you set Idle State 1 to “Open”, the GPO 1 relay...
 - will be *open* as long as no synchronization has been achieved and
 - will *close* when synchronization has been achieved.

Remote – SDI



Fig. 33.: Loudness Pilot Remote SDI page

Loudness Pilot can process SMPTE2020 metadata in the incoming SDI stream.

The “Any SMPTE2020” setting is a straightforward way to control how Loudness Pilot should process audio using SDI metadata.

If any SMPTE2020 package is received, Loudness Pilot can be set to bypass specific parts of the audio processing. As an example: If the incoming program audio content is already Loudness-normalized, using the “Any SMPTE2020” approach is a good way of bypassing unnecessary audio processing during transmission.

Enable button

Use this button to enable device control using metadata from the SDI input.

An SDI button that controls the same function can be found on the Remote – Master page in the Processing section.

Detecting parameter

Use this parameter to enable remote control of features using SDI metadata.

Off setting

SDI remote control is disabled.

Any SMPTE2020 setting

If a SMPTE2020 package is received, Loudness Pilot can be set to bypass specific parts of the processing algorithm as defined by the Processing Control parameter.

Processing Control parameter

Use this parameter to specify how Loudness Pilot should process audio when SDI metadata are detected according to the Detecting parameter's setting.

Off setting

No audio processing based on SDI metadata occurs.

Bypass Loudn. setting

This setting is only available when the Detecting parameter is set to Any SMPTE2020. When a SMPTE2020 package is present in the incoming

SDI stream, Loudness Pilot will bypass the Loudness processing specified by the Engine preset.

Engines parameter

Settings: E1, E2, E1+E2

Use this parameter to specify the Engines that should be remote-controlled.

SDID (DID:0x45) parameter

Settings: 0x01, 0x02 (Channels 1/2), 0x03 (Channels 3/4) 0x04 (Channels 5/6) ... 0x09 (Channels 15/16)

Use this parameter to specify the audio channel pair in the SDI stream from which metadata should be read.

SDID background information

SMPTE2020 metadata are divided into audio programs that e.g. can consist of stereo and 5.1 audio signals. Only the first audio pair of an audio program carries metadata, and this will be the audio pair that the SDID parameter should be set to – e.g. 0x04 for the channel pair on audio channels 5/6 (i.e., the first two channels in SDI Audio Group 2) in the SDI stream. Loudness Pilot only receives metadata from the *first* audio program in an SDI stream.

The SDID value of 0x01 is defined by the standard to be used when there is only one audio program associated with the SDI stream, and there is no intended association between VANC

packets with an SDID value of 0x01 and a specific audio channel pair.

Note that only data ID DID 0x45 is defined for SMPTE2020 metadata, and that is also the only one valid for Loudness Pilot.

Extraction Line parameter

Settings: Line 9..20

Use this parameter to specify the line in the incoming SDI stream where Loudness Pilot should look for a SMPTE2020 package. All other lines are ignored.

Input status display

This field displays the SDI signal and its metadata.

“License required” display

Displayed when no SDI Metadata license is available.

To learn where to receive a demo or buy a permanent license, go to tcelectronic.com/where-to-buy

“N/A” display

Displayed when no valid metadata is received. Please check if the Extraction Line and SDID is set up as expected in both Loudness Pilot and the upstream products.

“SMPTE2020 Detected” display

Can only be displayed when the Detecting parameter is set to Any SMPTE2020. Indicates that Loudness Pilot is receiving valid SMPTE2020 metadata packages.

Current Processing display

This field display the status of the current audio processing in the Loudness Pilot. Remote/metadata-triggered behavior is described here.

In the messages listed below, “Ex” specifies what Engines are affected by the remote control, and this relates to the Engines parameter – see [“Engines parameter” on page 65](#).

“Normal” display

Loudness Pilot is processing audio according to the Engine preset.

“Ex Loudn. Off” display

Can only be displayed when the Detecting parameter is set to Any SMPTE2020. Indicates that valid metadata are being detected and have instructed Loudness Pilot to bypass Loudness processing specified by the Engine preset.

SDI metadata on the SDI output

The Loudness Pilot does not change any metadata on its output – so incoming SDI metadata are bypassed to the SDI output.

More information about the SDI standard and how metadata are formatted can be found in standard SMPTE 2020.

Recalling, storing and deleting settings

Scenes, Routings, Engines

To use Loudness Pilot effectively, you should make all required settings as described in this manual and then store them, so they can later be recalled. You may also want to *name* the settings you store and *delete* settings that are no longer required. All these features are described in this chapter.

You first need to understand the hierarchical structure of your Loudness Pilot.

Scenes

A **Scene** is the most extensive selection you can make when recalling, storing or deleting settings. A Scene includes...

- ▶ all settings for both Engines on a processor/card
- ▶ signal routings to and from these Engines.

Recalling a Scene is equivalent to a “total recall.”

All the settings that make up a Scene are called a *Scene preset*.

Recalling (Loading), storing (saving) and deleting Scene Presets is covered in the [“Recalling, storing and deleting settings” on page 67](#) section of this manual.

Engines

Instead of recalling or storing a full Scene as described in the previous section, you may want to edit, store or recall the settings for one particular **Engine**.

All the settings for one particular Engine are called an *Engine preset*.

Recalling (Loading), storing (saving) and deleting Engine Presets is covered in the [“Recalling, storing and deleting settings” on page 67](#) section of this manual.

Routings

All the settings that define how signals are routed to and from the Engines on a processor/card are called a *Routing preset*.

Recalling (Loading), storing (saving) and deleting Routing Presets is covered in the [“Recalling, storing and deleting settings” on page 67](#) section of this manual.

The Library concept

The Library gives you access to all settings of all parameters of the currently selected Loudness Pilot.

The highest organizational level of the Library is a Bank. A Bank will hold either...

- ▶ 50 Scene presets or
- ▶ 50 Routing presets or
- ▶ 100 Engine presets or
- ▶ 100 Meter presets
- ▶ **Factory presets vs. user presets**

When recalling presets, you will see that there are two categories of presets: **Factory** presets and **User** presets.

- ▶ Factory presets can only be recalled, but *not overwritten or deleted*. If you change a Factory preset and you want to keep it, you have to store it as a User preset.
- ▶ User presets can be recalled, edited and stored, thereby overwriting the previous version.

Library – Recall page



Fig. 34.: Library – Recall Scene page

Use the Library Recall page of the TC Icon software to recall (load) previously stored settings into the memory of the currently selected device.

All colored buttons and selected items on the Recall page are colored in green.

To access the Library Recall page:

- ▶ If it isn't already, select the device you want to control using the Select page – see [“TC Icon modes: Base and Device operation”](#) on [page 39](#).
- ▶ Select the “Library” tab.
- ▶ Select the “Recall” page.
- ▶ Select the subpage for the setting type you want to access:
 - **Scene** – to recall a Scene preset

- **Route** – to recall a Routing preset.
- **E(engine) 1 or E(engine) 2** – to recall an Engine preset and use it for the currently selected Engine.
- **M(eter) 1 or M(eter) 2** – to recall a Meter preset and use it for the currently selected Loudness Meter.

- ▶ Select between Factory and User preset groups by clicking the Factory or User button.

There are 8 Factory and 8 User preset groups, with each group holding up to 8 presets.

- ▶ Select a preset you want to use.
- ▶ Click the large “Recall (Scene / Route / Engine) Preset” button in the upper right corner to recall (activate) the selected preset.

The selected preset will be recalled.

Preset information

For many presets, additional information is stored as part of the preset. When you select such a preset, an inverted “Info” tag will appear at the bottom of the large Preset Recall button.



Fig. 35.: Info tag in the Preset Recall button

Library – Store page

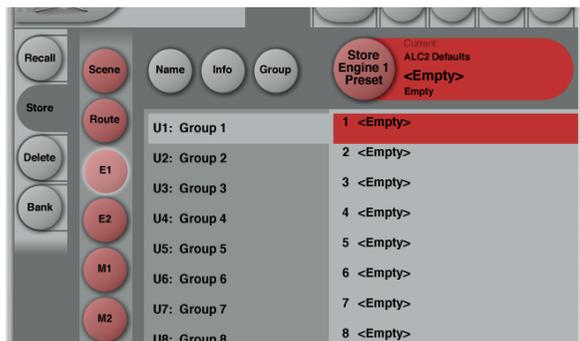


Fig. 36.: Library – Scene Store page

Use the Library Store page of the TC Icon software to store (save) settings to a memory bank. You can only store settings as User presets. Factory presets cannot be overwritten.

All colored buttons and selected items on the Store page are colored in red.

To access the Library Store page:

- ▶ Select the “Library” tab.
- ▶ Select the “Store” page.
- ▶ Select the subpage for the setting type you want to store:
 - Scene – to store all settings (including Routing and all algorithm settings) as a Scene.
 - Route – to store the current Routing.

- E(engine) 1 or E(engine) 2 – to store the settings of either Engine 1 or 2 as an Engine preset.

- ▶ Select a User preset group.

There are 8 User preset groups, with each group holding up to 8 presets.

- ▶ Select a preset slot in the currently selected group that you want to use.
- ▶ Click the large “Store (Scene / Route / Engine) Preset” button to store (save) your settings as a preset.

The selected data type will be stored as a preset. You can then recall this preset – see [“Library – Recall page” on page 70.](#)

Naming Presets

All user preset types can be (re)named.

To rename a preset:

- ▶ On the Store page, select the preset that you want to rename.
- ▶ Click the “Name” button.
- ▶ An on-screen keyboard will be shown.
- ▶ Use the on-screen keys or the physical keyboard of your computer to edit the name.

- ▶ Click the large Enter button to confirm the new name.

! Please note that the preset itself is **not** stored when you click the Enter button! To store the preset with its new name, click the large “Store (Scene / Route / Engine) Preset” button.

Adding Preset Information

You can add information to presets you have created or modified. When recalling such a preset later, an inverted “Info” tag will appear at the bottom of the large Preset Recall button, allowing the user to access this additional information – see [“Preset information” on page 70.](#)

To add information to a preset:

- ▶ On the Store page, select the preset that you want to add information to.
- ▶ Click the “Info” button.
- ▶ An on-screen keyboard will be shown.
- ▶ Use the on-screen keys or the physical keyboard of your computer to edit the name.
- ▶ Click Enter to confirm.

! Please note that the preset itself is **not** stored when you click the Enter button! To store the preset with the newly added information, click the large “Store (Scene / Route / Engine) Preset” button.

Operating the unit while renaming presets

Please note that even when renaming presets or adding information as described above, the faders for the previously accessed page are still available and operational. This means you can continue operating the faders even when the keyboard is shown on screen.

Library – Delete page

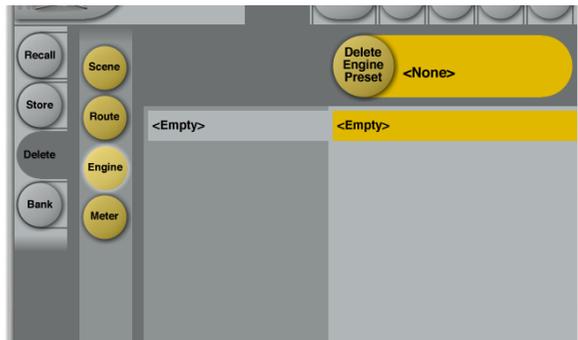


Fig. 37.: Library – Engine Delete page

Use the Library Delete page of the TC Icon software to delete settings from a memory bank. You can only delete User presets. Factory presets cannot be deleted.

Please note that all colored buttons and selected items on the Delete page are colored in yellow.

To access the Library Delete page:

- ▶ Select the “Library” tab.
- ▶ Select the “Delete” page.
- ▶ Select the subpage for the setting type you want to delete:
 - Scene
 - Route
 - E(engine) 1 or E(engine) 2

- M(eter) 1 or M(eter) 2

- ▶ Select a User preset group.

There are 8 User preset groups, with each group holding up to 8 presets.

- ▶ Select a preset in the currently selected group that you want to delete.
- ▶ Click the large “Delete (Scene/Route/Engine/Meter) Preset” button to delete the selected preset.
- ▶ You will be asked to confirm this operation before the preset is actually deleted.

Operating the unit while deleting presets

Please note that even when deleting presets, the faders for the previously accessed page are still available and operational. This means you can continue operating the faders even when the keyboard is shown on screen.

Library – Bank page

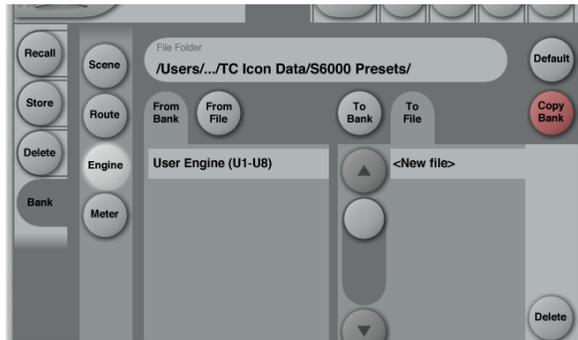


Fig. 38.: Library – Engine Bank page

Use the Library Bank page of the TC Icon software to copy Scene/Routing/Engine/Meter Presets from one location to another.

You can copy Presets from and to *Banks* and *files*.

Files can be transferred to other computers, allowing you to easily reuse your presets.

To access the Library Bank page:

- ▶ If it isn't already selected, select the device you want to control using the Select page – see [“TC Icon modes: Base and Device operation” on page 39.](#)
- ▶ Select the “Library” tab.
- ▶ Select the “Bank” page.

- ▶ Select the subpage for the setting type you want to copy:
 - Scene – to copy Scene presets.
 - Route – to copy Routing presets.
 - Engine – to copy Engine presets.
 - Meter – to copy Meter presets.

To copy from a Bank to a file on disk

- ▶ Select “From Bank” in the first column. The second column will switch to “To File” accordingly.
- ▶ Specify the folder where the file should be written in the “File Folder” field.
- ▶ If you want to overwrite an existing file, select it in the right column.

If you select “New file” instead, you will be prompted to specify the file name.

- ▶ Click the “Copy Bank” button.

To copy from a file on disk to a Bank

- ▶ Select “From File” in the first column. The second column will switch to “To Bank” accordingly.
- ▶ Specify the folder from where the file should be read in the “File Folder” field.

- ▶ Click the “Copy Bank” button.

Updating Loudness Pilot firmware

You should keep both the TC Icon software running on your computer and the software of your Loudness Pilot (the firmware) up to date. Using up-to-date software versions ensures you benefit from bug fixes and the latest features.

Updating the firmware of your Loudness Pilot requires a computer with the TC Icon software installed.

In TC Icon, you can select a previously downloaded Loudness Pilot firmware file (with a “.tca” suffix) and apply it to the currently selected Loudness Pilot.

For downloading, installing and updating *TC Icon* software, please refer to

- ▶ [“Finding and installing TC Icon software – Microsoft Windows” on page 13](#) or
- ▶ [“Finding and installing TC Icon software – OS X” on page 15.](#)

This section describes downloading and installing the Loudness Pilot firmware.

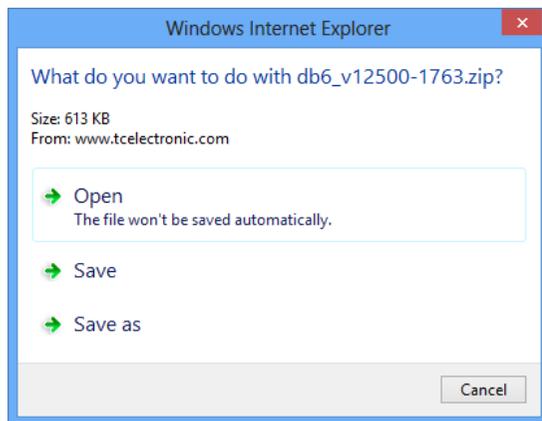
Finding and installing Loudness Pilot firmware – Microsoft Windows

You can download the latest version of the Loudness Pilot firmware from:

tcelectronic.com/support/software/

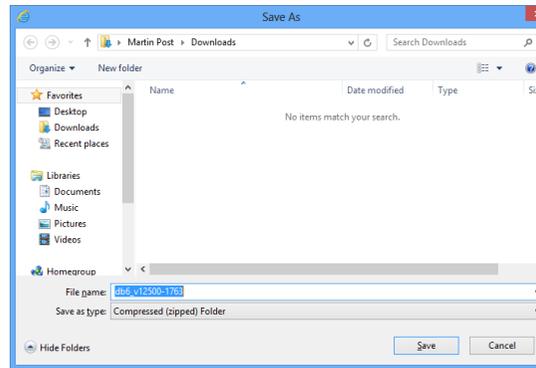
- ▶ On this page, locate the “Loudness Pilot” section.
- ▶ In this section of the support page, look for “Firmware” and click the button representing the latest version of the Loudness Pilot firmware.

Depending on your browser type and configuration, a dialog may be shown asking you what you want to do with this file.

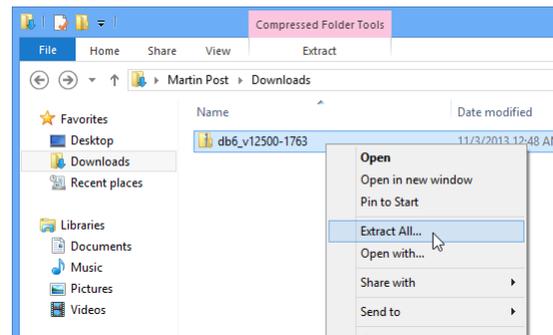


Choose “Save”.

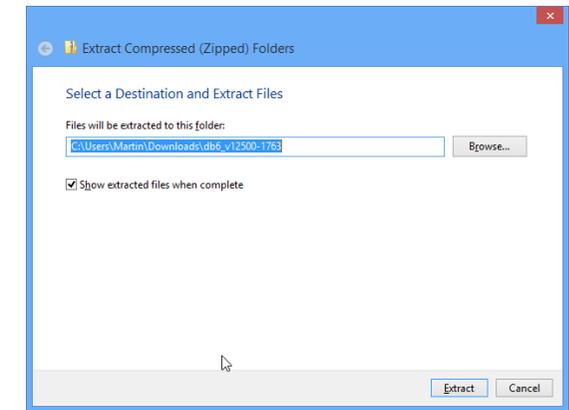
The software will be downloaded to your browser’s default download location. Usually, this is the “Downloads” folder for your user account.



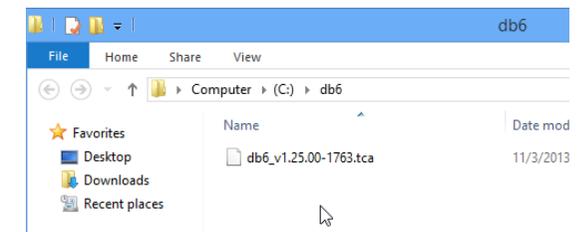
- ▶ In Windows Explorer, navigate to the folder containing the ZIP file you just downloaded.
- ▶ Right-click the ZIP file and choose “Extract All...” from the context menu.



A dialog box will allow you to specify where the extracted files should be stored.



- ▶ Accept the defaults or change the path. We suggest changing the path to “C:\LP\”. This will allow you to locate the file in TC Icon software more easily.
- ▶ After extracting the ZIP file, you will see a .tca file in Windows Explorer.



In the next steps, you will select this .tca file in the TC Icon software to transfer it to Loudness

Pilot. **We will assume that you have extracted the content of the ZIP archive to C:\LP\.** If you have extracted it to another location, you will have to specify this in the “Common Software Update Folder” field accordingly (see below).

- ▶ Connect your PC to the Loudness Pilot that you want to update using an Ethernet cable.
- ▶ Launch the TC Icon software on your PC.
- ▶ In the TC Icon software, select the Loudness Pilot that you want to update.
- ▶ Go to the Frame/System/Setup/Version page.

Here, you will find the current software version of your Loudness Pilot (shown as “Loudness Pilot SW Version”). Note this version number.

- ▶ Go to the Frame/System/Setup/Update page.
- ▶ Click into the “Common Software Update Folder” field.
- ▶ Enter the path to the folder where the downloaded .tca file is located.

Example:

Assuming that...

- your hard disk drive has the letter c:\

- you extracted the downloaded .tca file to the folder “LP” on the drive root (see previous steps)

...the correct path would be:

C:\LP

- ▶ Click Enter. You will be returned to the previous screen.

The name of the .tca file you downloaded should now be displayed right under the “Common Software Update Folder” field.

- ▶ If you want to make sure you have selected the correct file before applying the update, you can select the downloaded software file and click the “File Info” button to display additional information.
- ▶ To apply the update, select the downloaded .tca file and click the “Update SW” button.
- ▶ Confirm that you want to perform the update by clicking the “Yes” button.
- ▶ A confirmation message will be shown once the update has been applied.

Click “OK”.

- ▶ Go to the Frame/System/Setup/Version page and note the updated software version.

! Please note that a folder may contain *multiple* .tca files, which will be shown on the

Frame/System/Setup/Update page when that folder is selected. Be sure to select the correct file – usually, the most current one.

! If you experience technical problems during software download or installation, please ask a person with administrator privileges on this PC for assistance.

Finding and installing Loudness Pilot firmware – OS X

You can download the latest version of the Loudness Pilot firmware from:

tcelectronic.com/support/software/

- ▶ On this page, locate the “Loudness Pilot” section.
- ▶ In this section of the support page, look for “Firmware” and click the button representing the latest version of the Loudness Pilot firmware.

Depending on your browser type and configuration, a dialog may be shown asking you what you want to do with this file. Choose “Save”.

The software will be downloaded to your browser’s default download location. Usually, this is the “Downloads” folder for your user account.

- ▶ Go to the folder containing the file you just downloaded.
- ▶ If you are seeing a .ZIP file, double-click it to extract its contents. However, your browser may already have extracted the contents from the .ZIP file automatically.
- ▶ After the ZIP file has been extracted, you will see a .tca file in the Finder.

In the next steps, you will select this .tca file in the TC Icon software to transfer it to Loudness Pilot.

For the first example, we will assume that you have left the file at its default position (the “Downloads” folder).

If you have moved the downloaded .tca file somewhere else, or if you intend to use a .tca file on a network or USB drive, you will have to specify the correct path in the “Common Software Update Folder” field of TC Icon software accordingly (see [“Locating the Loudness Pilot firmware file – example 2” on page 80](#)).

- ▶ Connect your Mac to the Loudness Pilot that you want to update using an Ethernet cable.
- ▶ Launch the TC Icon software on your Mac.
- ▶ In the TC Icon software, select the Loudness Pilot that you want to update.
- ▶ Go to the Frame/System/Setup/Version page.

Here, you will find the current software version of your Loudness Pilot (shown as “Loudness Pilot SW Version”). Note this version number.
- ▶ Go to the Frame/System/Setup/Update page.
- ▶ Click into the “Common Software Update Folder” field.

- ▶ Enter the path to the folder where the downloaded .tca file is located.

Locating and transferring the Loudness Pilot firmware file – example 1

This is a simple default scenario where we assume that...

- your hard disk drive is called “Macintosh HD”
- your (short) user account name in OS X is “joe” and
- you have not moved the .tca file from its download location.

In this case, the correct path to enter in the “Common Software Update Folder” field is:

`/users/joe/downloads/`

- ▶ Click Enter. You will be returned to the previous screen.

The name of the .tca file you downloaded should now be displayed right under the “Common Software Update Folder” field.

- ▶ If you want to make sure you have selected the correct file before applying the update, you can select the downloaded software file and click the “File Info” button to display additional information.

To apply the update, select the downloaded .tca file and click the “Update SW” button.

- ▶ Confirm that you want to perform the update by clicking the “Yes” button.
- ▶ A confirmation message will be shown once the update has been applied.

Click “OK”.

- ▶ Go to the Frame/System/Setup/Version page and note the updated software version.

Locating the Loudness Pilot firmware file – example 2

If you have moved the .tca file to a folder called “Loudness_Pilot_updates” on an external hard disk called “DAW2”, the correct path to enter in “Common Software Update Folder” would be:

`//Volumes/DAW2/Loudness_Pilot_updates/`

For the remaining steps, see Example 1.

- ! Please note that a folder may contain multiple .tca files, which will be shown on the Frame/System/Setup/Update page when that folder is selected. Be sure to select the correct file – usually, the most current one.
- ! If you experience technical problems during software download or installation, please ask a person with administrator privileges on this Mac for assistance.

Icon Setup

This chapter covers screens and parameters of the TC Icon software not directly related to the day-to-day operation of your Loudness Pilot.

Accessing the Icon Setup pages

- ▶ If it isn't already, switch the TC Icon software to Base mode by clicking the Icon symbol in the upper left corner of the window – see [“TC Icon modes: Base and Device operation” on page 39](#).

In Base Mode, you will see the Select, Auto and Setup tabs on the upper edge of the TC Icon window.



- ▶ Select Setup.
- ▶ Select one of the pages described in the following sections of this manual.

Info page

On this page, the version number of the currently installed TC Icon software is displayed.

To update the TC Icon software, please refer to the [“Updating Loudness Pilot software” on page 36](#) section of this manual.

Devices page

Use this page to detect, control and assign the devices in your local network.



Detect button

Click the “Detect” button to scan the network for connected devices. All detected devices will appear in the list.

If you encounter problems when detecting connected devices, please refer to [“Networking basics and troubleshooting”](#) on page 32.

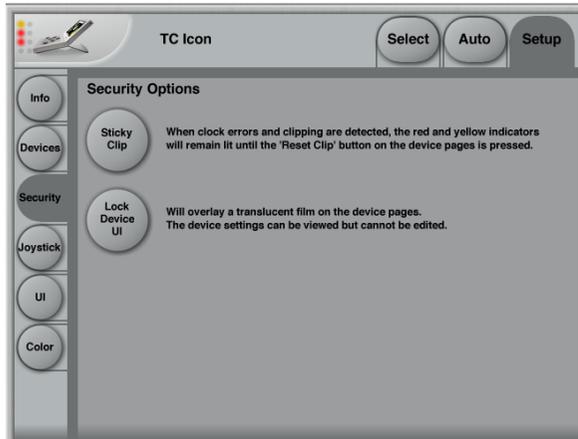
Assigning devices to the available slots

You need to assign a device to a slot of the TC Icon software to control it. Each instance of the TC Icon software can control up to eight different devices.

- ▶ Select a device from the list on the left side of the screen.
- ▶ Click one of the eight slots on the right side of the screen to assign the selected device to this slot.

Security page

On the security page, you can set several features regarding device readouts and operation.



Sticky Clip button

Click the Sticky Clip button to activate or deactivate the Sticky Clip feature.

When the Sticky Clip feature is activated (button highlighted) and clock errors or clippings are detected in a device, the red and yellow warning indicators will remain lit until the user presses “Reset Clip” button. This feature ensures that clock errors or clippings do not go unnoticed.

Lock Device UI button

Click the Lock Device UI button to lock or unlock the user interfaces of the devices controlled by the TC Icon software.

When the Lock Device UI feature is activated (button highlighted), the user will be able to see the settings of the currently selected device, but he cannot *change* them. This will be indicated by a semi-transparent overlay and a “Device UI is locked” message on all device-related screens.



Joystick page

The MIDI Joystick setup page of the TC Icon software is not required for operating Loudness Pilot and not described in this manual.

UI page



Fig. 39.:TC Icon software – UI page

TC Icon Window parameter

Use the TC Icon Window parameter to specify if and where faders should be shown. Three options are available. Changes on this page will take effect next time you open the TC Icon software.

Faders at bottom setting

Faders will be positioned right below the main interface. This is the default setting.

Fader at right side setting

One fader will be positioned to the right of the main interface.

No faders setting

No faders will be shown on screen.

Color page

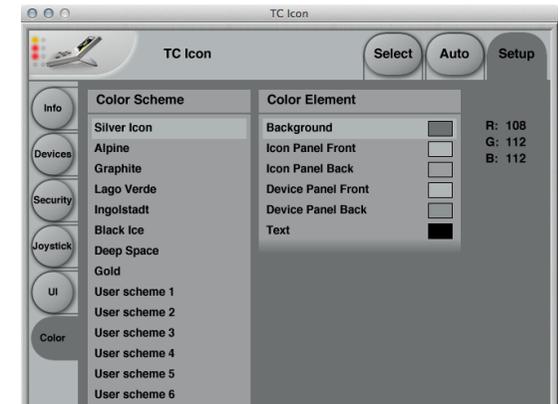


Fig. 40.:TC Icon software – Color page

Use the parameters on the Color page to define the TC Icon software's interface colors.

Color Scheme parameter

Use the Color Scheme parameter to select a predefined color scheme. You can select a predefined color scheme from the list or define your own color scheme using one of the “User scheme” slots.

Color Element parameters

Use the Color Element parameters to customize the colors of the currently selected User scheme. You can change the colors used for:

- ▶ Background
- ▶ Icon Panel Front
- ▶ Icon Panel Back
- ▶ Device Panel Front
- ▶ Device Panel Back
- ▶ User Interface Text.

We suggest changing these colors under realistic/typical lighting conditions to make sure the interface is readable during day-to-day use.

Changing User scheme colors

- ▶ To change the color, select a user interface component in the Color Element list (e.g. Background) and set the three R(ed) G(reen) B(lue) faders to the desired values.
- ▶ To apply the new color scheme, click the “Apply User Scheme” button.

ALC2

An introduction to ALC2

Subtle corrections to loudness can make a significant difference to your viewers/listeners. ALC2 is capable of doing just that: Apply substantial corrections when needed, make subtle adjustments when appropriate – and leave your audio absolutely untouched when it is already normalized.

ALC2 is the “heart and soul” of Loudness Pilot. Each signal processing card in a Loudness Pilot unit has two Engines capable of running the ALC2 algorithm; meaning one signal processing card can process two audio streams independently. You can also use two Engines to process the same (stereo or dual mono) signal and deliver e.g. one stereo signal for HDTV and another one for mobile applications in real-time.

Main page

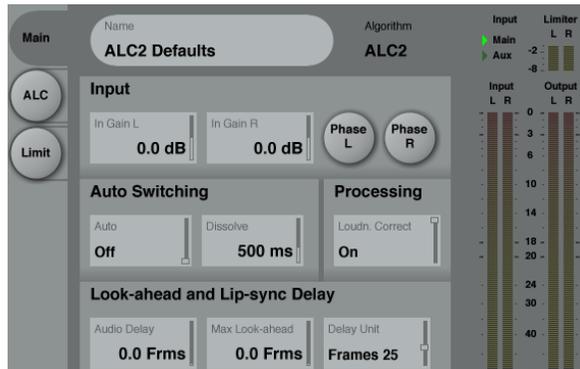


Fig. 41.: Loudness Pilot Engine
– ALC2 Main page

Input section

In Gain parameters

Use the In Gain parameters to apply a static gain to the currently processed signal. Parameter range is from -18 dB to +18 dB.

If Loudness Pilot is used for ingest, better results may be obtained by using the In Gain parameter to get the program roughly on Target before processing.

As Loudness Pilot has a high internal headroom, there is no risk of clipping when positive gain is applied.

Phase L + Phase R buttons

Use the two Phase buttons to switch the phase of the left and or the right channel of the incoming Stereo signal.

Auto Switching section

Introduction to Auto Switching

Loudness Pilot features Auto Input Switching, enabling seamless fallback switching to another signal source if the primary source is not available.

This feature has several applications. It can be used to switch back to the primary language if a second language stream is not available anymore. It could also be used to switch to an emergency channel as soon as a signal is present on the respective input.

To configure and use this feature, connect the respective signal sources to an Engine's input on the Frame – Routing page.

- ▶ Connect your **Main** (*primary*) signal source to channels 1 and 2 of the respective Loudness Pilot Engine.
- ▶ Connect your **Auxiliary** (*secondary*) signal source to channels 3 and 4 of the respective engine.



Fig. 42.: Routing page, with channels 1 and 2 connected to Engine 1's Main inputs and channels 5 and 6 connected to Engine 1's Aux inputs

The basic assumption for Auto Switching is that your Main (primary) signal is the default. As long as this signal is available and valid as defined by the Auto parameter's setting, it will be processed and sent to the Engine's Stereo output as defined on the Frame – Routing page.

As soon as the Main (primary) signal is not available/valid anymore, the Engine should process the signal from the Auxiliary (secondary) input instead and send this signal to the Engine's Stereo output.

The signal that is currently being processed and sent to the Engine's output is indicated in the upper right corner of the ALC2 window.



Fig. 43.: Input indicator for the currently selected Engine, with the Main (primary) input active/highlighted.

Auto parameter

Use the Auto parameter to configure the condition that will trigger a fallback from the Main to the Aux input as described above.

Off setting

When the Auto parameter is set to off, no input switching/fallback will occur. Loudness Pilot will always process the Main signal.

-60 dB / -50 dB settings

Use these settings to base Main signal availability detection on the Main signal's *level*.

If the Main signal's level falls below this level (-50 dB or -60 dB), the Engine will switch from the Main (primary) to the Auxiliary (secondary) input, process it and send it to the Engine's output.

24 / 20 / 16 Bit settings

Use these settings to base Main signal availability detection on the Main signal's *dithering*.

For example, if you set the Auto parameter to 16 Bit, Loudness Pilot will monitor the signal on the Main (primary) signal input for a dither noise level at approximately -96 dBFS. If the noise level in a silent period for the Main channels is below -96 dBFS, the Engine will switch from the Main (primary) to the Auxiliary (secondary) input, process it and send it to the Engine's output.

Dissolve parameter

Range: 25 ms to 3 seconds

Signal switching between Main and Aux signals occurs in a power-compensated fashion. Use the Dissolve parameter to set the cross-fade engage and disengage time.

Processing section

Loudness Correct parameter

Use the Loudness Correct parameter to specify if Loudness adjustment should be applied.

On

To switch on Loudness adjustment of the input signal, set the Loudness Correct parameter to On.

Off

To switch off Loudness adjustment of the input signal, set the Loudness Correct parameter to Off.

Look-ahead and Lip-sync Delay section

Audio Delay parameter

Use the Audio Delay parameter to adjust AV sync. You can change this parameter in real-time without introducing clicks or pitch changes.

Setting the Audio Delay parameter to “0” results in minimum latency (around 1 ms). The maximum value for the Audio Delay parameter is 10 seconds delay for each channel in a stereo stem.

If Audio Delay is enabled, some or all of it may also serve as loudness control look-ahead.

Max Look-ahead parameter

The loudness correction module of the Loudness Wizard algorithm may “look ahead” to evaluate the input signal – thereby allowing adjustment to start e.g. before a loud commercial.

The actual “look-ahead” section can never be longer than the setting of the Audio Delay parameter. However, you can use the Max Look-ahead parameter to use an even shorter section. This is useful if you don’t want loudness adjustment to set in too early, even with a high Audio Delay setting (e.g. for Lip-Sync or for Profanity prevention).

Delay Unit parameter

Use the Delay Unit parameter to set the display unit for the Audio Delay and Delay Unit parameters.

ms setting

To display the Audio Delay and Max Look-ahead parameters in milliseconds, set the Delay Unit parameter to ms.

Frames 24 setting

To display the Audio Delay and Max Look-ahead parameters in frames based on 24 frames per second, set the Delay Unit parameter to Frames 24.

Frames 25 setting

To display the Audio Delay and Max Look-ahead parameters in frames based on 25 frames per second, set the Delay Unit parameter to Frames 25.

Frames 30 setting

To display the Audio Delay and Max Look-ahead parameters in frames based on 30 frames per second, set the Delay Unit parameter to Frames 30.

ALC page

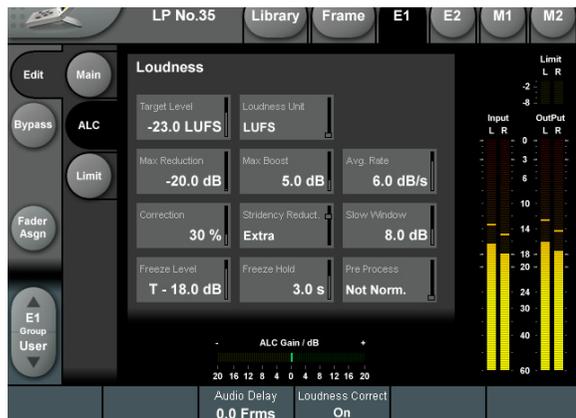


Fig. 44.:ALC page

Loudness section

Target Level parameter

Use the Target level parameter to set the target level for Loudness adjustment. The unit is shown as “LFS”, which denotes “LKFS” as well as “LUFS” (the two are identical).

For normal broadcast, the value should typically be between -18 and -24 LFS. Note that the distance between this value and Limit Threshold on the Limit page is a quality-defining factor – i.e. the standard headroom of the station. To ensure decent audio quality, headroom should be 16 dB or higher.

In broadcast environments working with a fixed Dialnorm value, Target Level can be set 1 to 3 dB higher than the static Dialnorm value in order to prevent level jumps between channels, and to have the Dolby DRC system sound better, if invoked.

Loudness Unit parameter

LUFS setting

Use this settings to show all parameters in units of LUFS – that is, in Loudness Units on the absolute scale. This is the normal setting for the Loudness Unit parameter, which we recommend for most applications.

LU setting

Use this settings to show all parameters in units of LU – that is, in Loudness Units on a relative scale.

Max Reduction parameter

Use the Max Reduction to set the maximum number of dBs the processor is allowed to attenuate the signal.

If this parameter is set to 0.0 dB, level reduction is disabled regardless of other settings such as Correction.

Max Boost parameter

Use the Max Boost parameter to set the maximum number of dBs the processor is allowed to boost the signal. If this parameter is set to 0.0 dB, level boost is disabled regardless of other settings such as Correction.

Avg. Rate parameter

Use the Avg. Rate parameter to set the speed by which gain changes as a result of loudness variations.

The rate adapts to the signal, and it takes the Slow Window and Pre Process parameter settings into account, so this parameter indicates an average number.

Correction parameter

Use the Correction parameter to set how much correction is applied when the actual loudness is different from the Target Level. For instance, if Correction is set at 40%, and loudness is 6 dB away from the Target Level, the processor will apply a correction of 2.4 dB.

Be careful when setting this parameter, as it may take a little “time testing” to arrive at the best value, especially if you wish to cover within program level jumps and inter-program level jumps using one preset. Note that Stridency Reduction overrides the Corrections parameter when the input level is higher than Target.

Stridency Reduct. parameter

Stridency Reduction is an adaptive loudness control that only has effect for loud signal above Target Level.

As consumers, once we have adjusted the gain for a suitable sound pressure level, we are more tolerant of loudness dropping than of loudness going up – see “Loudness Descriptors to Characterize Wide Loudness-Range Material” from the 127th AES conference, 2009.

Use the Stridency Reduct. parameter to determine how programs are dealt with. This parameter is influenced by the Pre Process parameter.

The Stridency Reduct. parameter is limited by the setting of the Max Reduction parameter on this page. Available settings are „Off“, „Soft“, „Universal“ and „Extra“. When set to anything

but “Off”, Stridency Reduction overrides the general Correction setting for loud content.

Slow Window parameter

The „slow window“ is an area around the set Target Level. Within the slow window, loudness is controlled only gently. When the signal exceeds the limits of the slow window, Loudness is treated more radically. Use the Slow Window parameter to define the size of this window.

Use the Slow Window parameter in combination with the Avg. Rate parameter. E.g., a setting of 10 dB means that the slow window is a range of ± 5 dB around the current setting of the Target parameter.

Freeze Level parameter

Use the Freeze Level parameter to set a level below which a Gain Boost is gradually revoked. This parameter can be used to avoid boosting signals meant to remain below the noise floor of a certain broadcast platform. The Freeze Level parameter relates to the Target Level parameter on the ALC page. For instance, if Target Level is set at -21 LFS, and Freeze Level is set at -15 dB, positive gain (if enabled) will be gradually nulled when level falls below -36 LFS.

Freeze Hold parameter

Use the Freeze Hold parameter to set the time (in seconds) before the processor resets to 0 dB gain change once the level falls below Freeze Level.

Pre Process parameter

Use the Pre Process parameter to indicate the condition of the input program – i.e., if it has already been normalized to Target level or not.

As procedures in production and on the servers moves towards programs already having been normalized prior to transmission, the amount of processing should gradually be backed off.

Avoid quality-hampering “sausage processing” by setting this parameter to indicate the correct state of the input signal. The Pre Process parameter is included with Presets, so it may consequently be altered based on GPI or SNMP commands.

Limit page

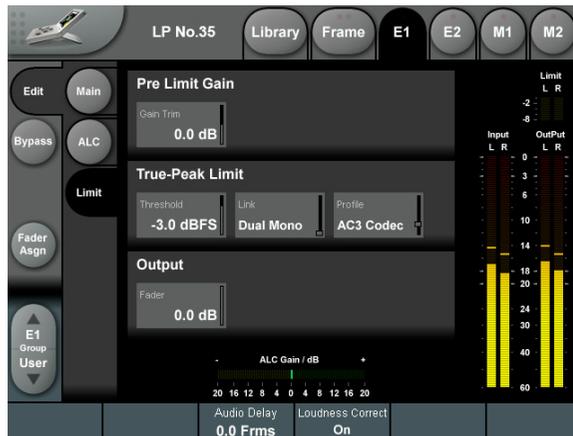


Fig. 45.:Loudness Pilot Limit page

The Limiter uses true-peak detection exceeding the oversampling requirements of BS.1770.

Loudness normalization based on “perceived loudness” can lead to peaks that might overload. That’s why Loudness Pilot employs True-Peak limiting. Your signal gets upsampled so that even inter-sample peaks are detected. True-Peak limiting handles these transient peaks seamlessly, keeping your audio at its finest.

Pre Limit Gain section

Gain Trim parameter

Range: -18 to +18 dB (Default: 0 dB)

Use the Gain Trim parameter to gain trim for the left and right channels. This parameter can be used for true-peak protected level conversion.

True-Peak Limit section

Threshold parameter

Threshold

Use the Threshold parameter to set the true-peak Limit Threshold for all limiters.

True-peak detection makes overload of downstream devices, such as data reduction codecs, sample rate converters and DA converters, less likely. Though digital samples may go to full scale, it is recommended to use a conservative Limit Threshold, even in digital transmission. Reserve the top of the digital scale for occasional peaks in wide range material (feature films, classical music), so don’t go above -6 dBFS in HDTV for normal broadcast programming. This way, down-mixing or bass management at the consumer will also not generate unexpected distortion.

The distance between the Target Level of the ALC section and the Limit Threshold is an important audio quality defining factor – the so-called headroom. Analog TV only had around 10 dB of headroom, but DTV should have at least 15-16 dB of headroom for a chance of conveying audio of a decent quality.

Raising the headroom can be accomplished by moving down the Target Level and/or raising the Limit Threshold. The headroom in BS.1770-based standards is typically 22 dB – significantly more than broadcast ever had before.

Link parameter

The Link parameter defines how limiters work together.

Dual Mono setting

- ▶ If a threshold is exceeded in one channel, only that specific channel is limited.

Stereo setting

- ▶ If the threshold is exceeded in one of the channels, both channels are limited. This way, the stereo perspective of your signal is preserved.

Profile parameter

Use the Profile parameter to optimize the adaptive true-peak limiter based on content, or based on the output platform.

The available settings are:

- ▶ Dynamic
- ▶ AC3 Codec
- ▶ Universal
- ▶ Loud
- ▶ Voice

For linear (baseband) delivery, and for most other codecs including AAC, use “Dynamic” for sensi-

tive content, “Voice” for predominantly speech or “Universal” for all-round adaptive settings.

For AC3 delivery, use the “AC3 Codec” Profile setting.

For all settings except for “AC3 Codec”, the true-peak threshold is the same for all channels. For “AC3 Codec”, however, AC3 downmix headroom is protected, while the dynamic properties are the same as “Universal”.

Output section

Output Fader parameter

The Output Fader parameter is a post-limiter fader. Parameter range is from -100 dB to 12 dB.

LM2 (optional)

LM2 – Introduction

The LM2 Loudness Radar Meter algorithm can measure loudness at the input stage as well as the output stage of Loudness Pilot.

It shows the user the essence of the “loudness landscape” at a glance for a complete and instant overview, including:

- ▶ Loudness History
 - ▶ Momentary Loudness
 - ▶ True-peak Level
 - ▶ Program Loudness and
 - ▶ Loudness Range
- all this *in a single view*.

LM2 also features a detailed 24/7 logging function that will generate a text file which you can use to document adherence to a specific broadcast standard. In fact, you get two independent sets of log files – one for each LM2 instance.

LM2 is an optional license. For more information, see [“Extending your product’s capabilities with optional licenses”](#) on page 121.

What is LM2?

LM2 represents a quantum leap away from simply measuring audio level to measuring **perceived loudness**.

The old level method is responsible for unacceptable level jumps in television, for music CDs getting increasingly distorted, and for different audio formats and program genres becoming incompatible: Pristine music tracks from the past don’t coexist with new recordings, TV commercials don’t fit drama, classical music or film and broadcast don’t match. The most fundamental audio issue of all – control of loudness – makes millions of people adjust the volume control over and over again, every day.

LM2 is part of a universal and ITU standardized loudness control concept, whereby audio may easily and consistently be measured and controlled at various stages of production and distribution. LM2 works coherently together with other TC equipment, or with third-party equipment adhering to the same global standard. Follow the guidelines given to allow audio produced for different purposes to be mixed – without low dynamic range material (such as commercials or pop CDs) always emerging as the loudest.

LM2 core features

- ▶ Real-time loudness meter compliant with
 - EBU R128,
 - ATSC A/85,
 - TR-B32 and ITU-R BS.1770-3.
- For legacy purposes, LM2 can also be switched to the ungated, original BS.1770 measure of Program Loudness.
- ▶ Loudness History Radar display
 - ▶ True-peak bar graph display
 - ▶ Supports mono and stereo
 - ▶ Presets for use in broadcast, music, film and post production.

TC's Universal Database of Loudness

Since 1998, TC has performed listening tests and evaluation of loudness models. From these tests, TC has built an extensive Universal Database of loudness, based on tens of thousands of assessments. This database covers all sorts of broadcast material, music, commercials, feature film and experimental sounds, and is verified against other independent studies.

The Universal Database is authoritative from an academic as well as a practical point of view. It has been indispensable when designing the LM2 meter, because it provided the missing link between short-term and long-term loudness, and enabled the statistically founded Universal Descriptors of LM2.

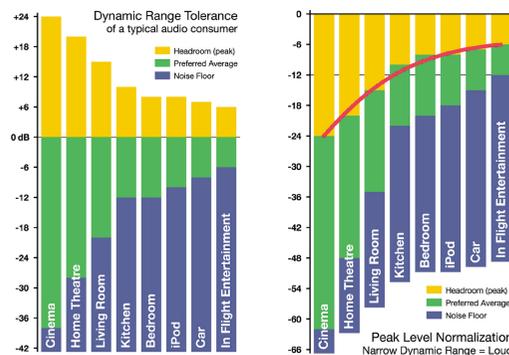


Fig. 46.: Fig. 1

Left: Dynamic Range Tolerance (DRT) for consumers in different listening situations

Right: Peak level normalization means that material targeted at low dynamic ranges gets loud.

The chart of Dynamic Range Tolerance in Figure 1 is a side-effect of the studies mentioned: Consumers were found to have a distinct Dynamic Range Tolerance (DRT) specific to their listening environment. The DRT is defined as a Preferred Average window with a certain peak level Headroom above it. The average sound pressure level (which obviously is different from one listening condition to another) has to be kept within certain boundaries in order to maintain speech intelligibility, and to avoid music or effects from getting annoyingly loud or soft.

Audio engineers instinctively target a certain Dynamic Range Tolerance profile when mixing. But because level normalization in broadcast and music production is based on *peak level mea-*

asures, low dynamic range signatures end up the loudest as shown by the red line in Fig 1.

Audio production is therefore trapped in a downward spiral, going for ever decreasing dynamic range. By now, the pop music industry is to the right of In-flight entertainment as shown in the illustration.

LM2 offers a standardized option. The visualization of loudness history and DRT – in combination with long-term descriptors from production onwards – is a transparent and well-sounding alternative to our current peak level obsession; not only for music, but also in production for broadcast or film.

An engineer – who may not be an audio expert – should be able to identify and consciously work with loudness developments within the limits of a target distribution platform – and with predictable results when the program is transcoded to another platform.

LM2 therefore color-codes loudness, making it easy to identify...

- ▶ target level (green),
- ▶ below-the-noise-floor level (blue) and
- ▶ loud events (yellow).

See Fig 2:

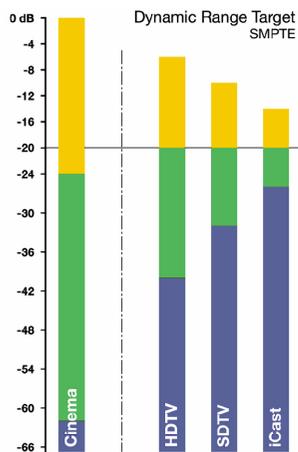


Fig. 47.: Fig. 2: Target loudness based on a consumer's Dynamic Range Tolerance

Fig. 2 shows target loudness for selected broadcast platforms based on a consumer's Dynamic Range Tolerance (DRT). The aim is to center dynamic range restriction around average loudness (in this case the -20 dB line), thereby avoiding washing out differences between foreground and background elements of a mix. Please note how different the broadcast requirements are from those of cinema.

When production engineers realize the boundaries they should generally stay within, less dynamics processing is automatically needed during distribution, and the requirement for maintaining time-consuming metadata at a broadcast station is minimized.

In broadcast, the goal is to use the same loudness measure for...

- ▶ Production,
- ▶ Ingest,
- ▶ Linking,
- ▶ Master Control Processing and
- ▶ Logging.

Using the same loudness measure for all these purposes ensures better audio quality – not only in DTV audio, but across *all* broadcast platforms.

LM2 and TC processing can coexist with PPM meters, VU meters or Dolby's LM100 meter. LM2 greatly increases the usability of LM100 in production environments because it provides running status, and gives a standardized and intuitive indication of both dialog and non-dialog program.

LM2 – Basic Use

LM2 can be used with mono and stereo material for any type of program material.

It visualizes...

- ▶ short-term loudness,
- ▶ loudness history and
- ▶ long-term statistical descriptors.

To bring up the Radar display:

- ▶ Select the M1 (Meter 1) or the M2 (Meter 2) tab depending on which of the two Loudness meters you want to display.
- ▶ Select the Edit page.
- ▶ Select the Radar subpage.

During normal operation, you will be using this page most of the time. The basic functionality of the LM2 Radar page is shown in Fig 3.

Reading the Radar display

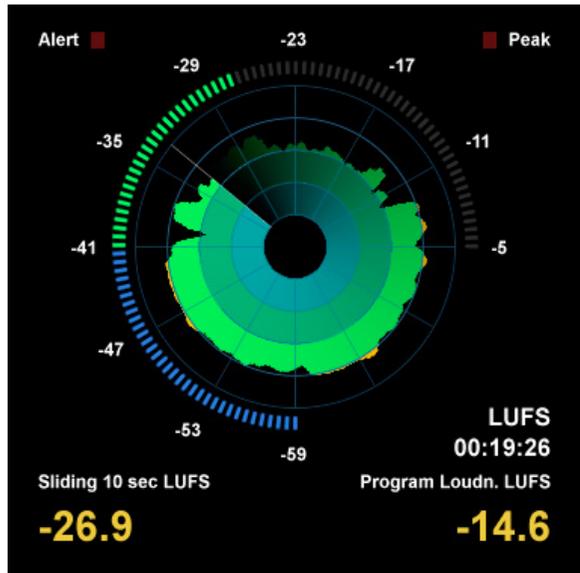


Fig. 48.:Fig 3.: The LM2 Radar

Target Loudness is displayed at the “12 o’clock” position of the outer LED ring, and at the radar circle marking the transition from green to yellow.

The yellow numbers in the lower part of the display are the two descriptors **Loudness Range** and **Program Loudness**.

Pausing and resetting the Radar display

The Pause and Reset buttons to the left of the display are the “transport controls” of LM2. They are used to make the radar and descriptor measurements run, pause and reset.

Click the Reset button to reset the Radar display and the descriptors.

Setting up LM2

To change the current LM2 preset’s name and adjust basic parameters, click the “Main” button.

To configure what information is displayed, click the “Setup” button.

Working with LM2 presets

LM2 presets define parameters such as target loudness, noise floor, and overload conditions. You can use TC Icon's Library functions to re-name, store and recall presets – see [“Recalling, storing and deleting settings”](#) on page 67.

LM2 – Radar Page



Fig. 49.:Fig 3.: The LM2 Radar page

Outer Ring: Current Loudness

The segmented outer ring of the Radar page displays Momentary loudness. The “12 o’clock” position represents the 0 LU point (i.e. Target Loudness). Values above this point are shown in yellow. The “LU Reference” parameter can be found on the LM2 Main page.

The Low Level point is marked by the transition from green to blue. The “Low Level Below” parameter can be found on the Setup page.

The user should be instructed to keep the outer ring in the green area, and around the “12 o’clock” position on the average. Excursions into the blue or the yellow area should be balanced, and not only go in one direction.

The numbers associated with the outer ring may be referenced at either maximum loudness or have a zero point set at Target Level. You can set this on the LM2 Main page using the “Loudness Unit” parameter. Either way of looking at loudness is valid.

LUFS reading is in line with how peak level is typically measured in a digital system, and compatible with Dolby AC3 and E metadata, while the *LU* approach calls for a certain Target Loudness to have been predetermined, like e.g. a VU meter.

Long-term measurements

Universal descriptors may be used to make program-duration measurements, or you may “spot-check” regular dialog or individual scenes as required. It is recommended not to measure programs of a shorter duration than approximately 10 seconds, while the maximum duration may be 24 hours or longer.

Reset button

Before a new measurement, click the Reset button. This will reset the descriptors, the radar and the true-peak meters.

Run the audio, and watch the Radar and the descriptor fields update accordingly.

While the Radar will update instantly, the descriptors will wait five seconds into the program before showing the first readings. This is normal. Even though the first five seconds of a program are not shown instantly, they are included in the descriptor calculations.

LM2 incorporates an intelligent gate which discriminates between foreground and background material of a program. Consequently, measuring won't start before audio has been identified. The intelligent gate also pauses measurements during periods that only contain background noise, and during fade-outs of music tracks.

Universal Descriptors and Dolby LM100

Unlike methods that measure dialog only, LM2 may be used with any type of audio, including dialog.

If you wish to measure dialog, it is recommended to do a manual spot check of a program or a film. Find 10-30 seconds of regular dialog and measure it with LM2. Where dialog may be soft, regular or loud, and shift by more than 15 dB inside a film, regular dialog tends to be less ambiguous and more consistent across a program.

For compatibility with a proprietary measure such as Dolby LM100, only some of these meters are updated to use ITU-R BS.1770 and Leq(K) while others are locked at Leq(A). The software version of LM100 should be 1.3.1.5 or higher in order for it to comply with BS.1770, and to have its average loudness reading be compatible with Program Loudness in LM2.

Even used just on speech, Leq(A) is not a precise approximation to perceived loudness, so please update the unit to BS.1770 to obtain similar readings and predictable results.

Universal Descriptors and AC3 Metadata

The “Dialnorm” parameter in AC3 metadata should indicate the average loudness of a program. Basic dynamic range and level control that rely on this parameter may take place in the consumer’s receiver. Therefore, its value should not be far off target, or the consumer results become highly unpredictable.

Program Loudness in LM2 is directly compatible with dialnorm in AC3. Most broadcast stations work with a fixed dialnorm setting, for instance -23 LUFS. This would be the Program Loudness target level for any program.

If your station is more music- than speech-oriented, better inter-channel leveling may be obtained with dialnorm permanently set 1 or 2 LU below the Program Loudness target level.

True-peak meters

The peak meters of LM2 display true-peak as specified in ITU-R BS.1770. True-peak meters give a better indication of headroom and risk of distortion in downstream equipment such as sample rate converters, data reduction systems and consumer electronics than digital sample meters used e.g. in CD mastering. Note that the standard level meters in most digital workstations and mixers are only sample peak (Final Cut, Avid, ProTools, Yamaha etc.) and should only be used as a rough headroom guideline.

Note that the meter scale is extended above 0 dBFS. Most consumer equipment distorts if you see readings above 0. It’s not a problem to have true-peak level going to -1 dBFS in production, but legacy platforms (analog, NICAM etc.) and some data-reduction codecs may distort unless true-peak level is kept lower.

With Dolby AC3 and with low bit rate codecs, -3 dBFS should be considered the limit, while legacy platforms requiring emphasis may need even further restriction. As described in EBU R128, it is recommended to make full use of the headroom with true-peaks going to -1 dBFS in production, and to only restrict peak level further during distribution/transmission.

LM2 – Main page

Descriptors section

Descriptor 1 / Descriptor 2 parameters

Range setting

Loudness Range (standardized in EBU R128 and abbreviated “LRA”) displays the loudness range of a program, a film or a music track. The unit is LU, which can be thought of as “dB on the average”.

The Loudness Range descriptor quantifies the variation of the loudness measurement of a program. It is based on the statistical distribution of loudness within a program, thereby excluding the extremes. Thus, for example, a single gunshot is not able to bias the LRA number.

EBU R128 does not specify a maximum permitted LRA. R128 does, however, strongly encourage the use of LRA to determine if dynamic treatment of an audio signal is needed and to match the signal with the requirements of a particular transmission channel or platform.

Consequently, if a program has LRA measured at 10 LU, you would need to move the master fader ± 5 dB to make loudness stay generally the same over the duration of the program (not that you would want that).

In production, Loudness Range may serve as a guide to how well balancing has been performed, and if too much or too little compression has been applied. If a journalist or video editor isn't capable of arriving at a suitable LRA,

he could be instructed to call an audio expert for help.

The following may be regarded as initial production guidelines:

- ▶ HDTV and digital radio:
Stay below LRA of 20 LU.
- ▶ SDTV:
Stay below LRA of 12 LU.
- ▶ Mobile TV and car radio:
Stay below LRA of 8 LU.

Remember to use LRA the other way around, too: If there is an ideal for a certain genre, check its LRA measure, and don't try go below it. LRA should not be used for Limbo.

Allow programs or music tracks the loudness range they need, but not more than they need.

Loudness Range may also be measured on a broadcast server to predict if a program is suitable for broadcast without further processing. LRA is even a fingerprint of a program and stays the same downstream of production if no dynamics processing has been applied. You may even check the number out of a consumer's set-top box to verify that distribution processing and Dolby DRC has been disabled.

As with Program Loudness and Loudness Max, the meter should be reset before measuring LRA.

Prog. Loudn. setting

Program Loudness returns one loudness number for an entire program, film or music track. Its unit is LUFS. Some vendors and countries use the unit “LKFS” or “LUFS”, but all three designate the same: An absolute measure of loudness in the digital domain, where the region around “0” is overly loud and not relevant for measuring anything but test signals. Expect readings of broadcast programs in the range between -28 and -20 LUFS.

Program Loudness is used as a production guideline, for transparent normalizing of programs and commercials, and to set loudness metadata in delivery if so required.

For delivery or transmission of AC3 format, the metadata parameter “dialnorm” should reflect Program Loudness.

The easiest way to handle multiple broadcast platforms is to normalize programs at the station to a certain value, thereby being able to take advantage of the normalization benefits across platforms, at the same time enabling static metadata.

Loudness measurements in LM2 are all rooted in ITU-R BS.1770. However, subtle differences exist between different regions of the world. Therefore LM2 also includes the “Loudness Standard” parameter. Be sure to set this parameter correctly for compliance in your region.

The Program Loudness target is more or less the same for broadcasters around the world, espe-

cially when taking the measurement differences into account. Target numbers range between -24 and -22 LUFS.

Like with Loudness Range and Loudness Max, the meter should be reset before measuring Program Loudness.

Sliding Loudn. setting

Unlike Loudness Range, Program Loudness and Loudness Max, Sliding Loudness is a continuously updated measure that doesn’t need to be reset. This type of descriptor is especially useful when “mixing by numbers” – i.e. when there is no access to the extremely informative radar display.

When mixing by numbers, having Program Loudness as one descriptor and Sliding Loudness as the other displays simultaneous information about the full program side by side with the most recent loudness history.

Because the Sliding Loudness measurement is completely ungated, it may also be used to spot-check sections of a program complying to “raw” ITU-R BS.1770 and the first revision of ATSC A/85.

LM2 makes use of optimized statistics processing in order to display a sliding loudness value (a prognosis) as quickly as possible after a reset.

Loudness Max setting

Loudness Max displays the maximum loudness registered since the meter was last reset. Loudness Max is an especially useful parameter when checking and normalizing short duration programs such as promos and commercials.

BCAP rules from the UK is an example of using Loudness Max as an efficient instrument to reduce listener complaints regarding loud commercials. While Program Loudness is adequate to normalize a consistent mix, Loudness Max may be used as a second line of transparent defense against overly short and loud event.

Loudness section

Loudness Std. parameter

The Program Loudness measure is always rooted in the ITU-R BS.1770 loudness model. This parameter sets measurement gating. Note that the parameter only influences *Program Loudness*, and not Sliding Loudness or Loudness Max.

ITU BS.1770-3 setting

This setting reflects the latest revision of ITU-R BS.1770. Relative gate at -10 LU, safety gate at -70 LUFS.

Leq(K) setting

This setting reflects the original version of ITU-R BS.1770. No measurement gate besides from at safety gate at -70 LUFS, so the user doesn't need to precisely start and stop a measurement in order to avoid bias from complete silence.

Cnt of Grav. setting

The standard setting from early versions of TC radar meters. Relative gate at -20 LU, safety gate at -70 LUFS.

LU Reference parameter

The LU Reference parameter defines the loudness required to obtain a “12 o'clock” reading on the outer ring of the Radar display, which is the

same as the border between green and yellow on the Radar.

Loudness Unit parameter

LUFS setting

All measurements of program loudness and sliding loudness are shown in units of LUFS – that is, in Loudness Units on the *absolute* scale. This is the normal setting for the Loudness Unit parameter, which we recommend for most applications.

Loudness Range is always shown in units of LU, because it is basically a measurement of ‘range’ or of the distance between a high and a low loudness level.

LU setting

With this setting, measurements of program loudness and sliding loudness are shown in units of LU – that is, in Loudness Units on a *relative* scale. The 0 LU is by definition the target loudness level, such as -23.0 LUFS. So by selecting “LU”, one can immediately see if a loudness level is above the target level (e.g. +1.2 LU) or below (e.g. -3.4 LU).

LM2 – Setup page

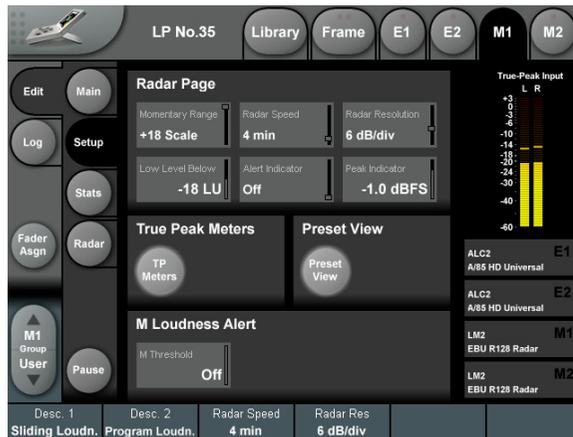


Fig. 50.:LM2 Setup page

Radar page section

Momentary Range parameter

Settings: “+9 Scale” or “+18 Scale”

EBU mode meters can display two different momentary displays:

+9 Scale setting

The +9 Scale setting provides a narrow loudness range intended for normal broadcast. It gives a momentary meter range from -18 to +9 LU.

+18 Scale setting

The +18 Scale setting provides a wide loudness range intended for film, drama and wide range music. The It gives a momentary range from -36 to 18 LU.

Radar Speed parameter

Range: 1 minute to 24 hours

The Radar Speed parameter controls how long each revolution of the Radar display takes. You may “zoom” between the settings during run-time, as long as the history isn’t reset.

Pressing the Reset button on the Radar page will reset meter and descriptor history.

Radar Resolution parameter

Range: 3 to 12 dB/div

The Radar Resolution parameter sets the difference in loudness between each concentric circle in the Radar display. Choose a low value when targeting a platform with a low dynamic range tolerance. You may “zoom” between the settings, as long as the history isn’t reset.

Low Level Below parameter

Range: -30 to -6 LU

The Low Level Below parameter determines where the transition between the green and blue range occurs in the outer ring. It indicates to the engineer that the signal level is now at risk of being below the noise floor.

Alert Indicator parameter

M Over only setting

When the Alert Indicator parameter is set to M Over only, the red Alert indicator on the Radar page will indicate when the signal level surpasses the value set with the M Threshold parameter in the Loudness Alert section.

Stereo Integrity setting

When the Alert Indicator parameter is set to Stereo Integrity, the red Alert indicator on the Radar page will indicate a lack of stereo integrity based on measuring the difference of left/right inputs. If there is a consistent difference between left and right over a prolonged time, the LED is lit.

Peak Indicator parameter

Range: -12 to +3 dBFS

Use the Peak Indicator parameter to specify the value that should trigger the Peak indicator in the upper right corner of the Radar display. E.g., if you set Peak Indicator to -1 dBFS, the PEAK indicator on the Radar page will be lit when the signal is -1 dBFS or above.

True Peak Meters section

TP Meters button

Use the TP Meters button to switch the stereo True Peak meters on the right edge of the LM2 on or off.

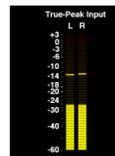


Fig. 51.: True Peak Input meters

Preset View section

Preset View button

Click the Preset View button to turn the Engine View display on the right hand side of the display on or off.

When Preset View is on, the two signal processing engines and the two LM2 instances are displayed on the right hand of the display with the currently active presets. When Preset View is off, a larger part of the interface is available for the True Peak Meters.

M Loudness Alert section

M Threshold parameter

Range: -30 to 0 LUFS / "Off"

Use the M Threshold parameter to specify the value that should trigger a High Loudness alarm. This alarm will be sent through the GPO and shown on the LM2 Alert LED.

LM2 – Stat(istic)s page

The Statistics page gives an overview of essential descriptors:

- ▶ Program Loudness
- ▶ Loudness Max
- ▶ Loudness Range
- ▶ True-Peak Max
- ▶ Sliding Loudness
- ▶ PLR (Peak to Loudness Ratio)

About PLR (Peak to Loudness Ratio)

PLR (Peak to Loudness Ratio) measurements often correlate with audio quality – be careful not to force it too low. Programs and tracks should be allowed to live.

- ! Important: Clicking the Reset button will reset the meters and the log file.

Level versus loudness

When level normalization in audio distribution is based on a peak level measure, it favors low dynamic range signatures as shown in Fig 1. This is what has happened to CD.

Quasi-peak level meters have this effect. They tell little about loudness and also require a headroom in order to stay clear of distortion. Using IEC 268-18 meters, the required headroom is typically 8-9 dB.

Sample-based meters are also widely used, but tell even less about loudness. Max sample detection is the general rule in digital mixers and DAWs. The side effect of using such a simplistic measure has become clear over the last decade, and CD music production stands as a monument over its deficiency. In numerous TC papers, it has been demonstrated how sample-based peak meters require a headroom of at least 3 dB in order to prevent distortion and listener fatigue.

The only type of standard level instrument that does not display some sort of peak level is the VU meter. Although it has been developed for another era, this kind of meter is arguably better at presenting an audio segment's center of gravity.

However, a VU meter is not perceptually optimized, or ideal for looking at audio with markedly different dynamic range signatures.

Unlike electrical level, loudness is *subjective*, and listeners weigh its most important aspects (SPL, frequency contents and duration) different-

ly. In search of an “objective” loudness measure, a certain **Between Listener Variability (BLV)** and **Within Listener Variability (WLV)** must be accepted – meaning that even loudness assessments by the same person are only consistent to some extent, and depend on the time of day, the listener's mood etc. BLV adds ambiguity as culture, age and other parameters are introduced as variables.

Because of the variations, a generic loudness measure is only meaningful when it is based on large subjective reference tests and solid statistics. Together with McGill University in Montreal, TC Electronic has undertaken extensive loudness model investigation and evaluation.

The results denounce a couple of Leq measures, namely A and M weighted, as generic loudness measures. In fact, a quasi-peak meter showed better judgement of loudness than Leq(A) or Leq(M). Even when used just for speech, Leq(A) is a poor choice, and it performs worse on music and effects.

An appropriate choice for a low complexity, generic measurement algorithm, which works for listening levels used domestically, has been known as Leq(RLB).

Combined loudness and peak level meters exist already, for instance the ones from Dorrroughs, but BS.1770 now offers a standardized way of measuring these parameters.

In 2006, ITU-R Working Party 6J drafted a new loudness and peak level measure, BS.1770, and

the standard has subsequently come into effect. It has been debated if the loudness part is robust enough, because it will obviously get exploited where possible. However, with a variety of program material, Leq(RLB) has been verified in independent studies to be a relatively accurate measure, and correlate well with human test panels. It therefore seems justified to use Leq(RLB) as a baseline measure for loudness, especially because room for improvement is also built into the standard. The final BS.1770 standard included a multichannel annex with a revised weighting filter, R2LB – now known as “K” weighting - and a channel weighting scheme. These two later additions have been less verified than the basic Leq(RLB) frequency weighting.

The other aspect of BS.1770, the algorithm to measure true-peak, is built on solid ground. Inconsistent peak meter readings, unexpected overloads, distortion in data reduced delivery and conversion etc. have been extensively described, so in liaison with AES SC-02-01, an over-sampled true-peak level measure was included with BS.1770.

In conclusion, BS.1770 is an honorable attempt at specifying loudness and peak level separately, instead of the simplistic (sample peak) and mixed up measures (quasi-peak) in use today. The loudness and peak level measurement engine of LM2 follows the standard precisely.

Possible updates to the ITU standard may be released as LM2 updates, provided that processing requirements doesn't exhaust the system.

Technical papers from AES, SMPTE, NAB and DAFX conferences with more information about loudness measurement, evaluation of loudness models, true-peak detection, consequences of 0 dBFS+ signals etc., are available from the TC website. Visit the Tech Library at tcelectronic.com/tech-library/ for details.

Meter Calibration

Because of the frequency and channel weighting, and of the way channels sum, only specific tones and input channels should be used for calibration.

The most transparent results are obtained using a 1 kHz sine tone for calibration. Other frequencies or types of signal may be used (square wave, noise etc.), but don't expect similar results. The beauty of the system lies in its RMS foundation, so this is a feature, not an error. The same feature enables the loudness measure to identify overly hot CDs or commercials, and to take out-of-phase signals into account just as much as signals that are in phase.

If we stick to standard methods for measuring peak audio level in a digital system, where a sine wave (asynchronous of the sample rate) with digital peaks at 0 dBFS, is regarded a 0 dBFS tone, BS.1770 and LM2 output these results:

- ▶ One front channel fed with a -20 dBFS, 1 kHz sine tone: Reading of -23,0 LUFS.
- ▶ Two front channels fed with a -20 dBFS, 1 kHz sine tone: Reading of -20,0 LUFS.

Display

LM2 may use either the measurement unit of LU (Loudness Units) or LUFS (Loudness Units Full Scale).

LU and LUFS are measurements in dB, reflecting the estimated gain offset to arrive at a certain Reference Loudness (LU) or Maximum Loudness (LUFS) as defined in BS.1770. Since a common reference point for LU has not been agreed on at the time of writing, LUFS (or “LKFS”, pointing specifically to the Leq(R2LB) weighting of BS.1770), might be favored initially to avoid ambiguous use of the term LU.

The effectiveness of any loudness meter depends on both the graphical appearance and dynamic behavior of its display, as well as on its underlying measurement algorithms. A short-term loudness meter also relies on the measurement algorithm’s ability to output pertinent loudness information using different analysis windows, for instance, 200-800 ms for running real-time updates.

It should be noted how the optimum size of this window varies from study to study, possibly because the objective of a running display hasn’t been fully agreed upon.

Formal evaluation of a visualization system is challenging. First of all, one or more metrics must be defined by which the display should be evaluated. The correspondence between the sound heard and the picture seen is one aspect

to be evaluated. Another metric could characterize the speed of reading the meter reliably.

In TC Electronic LM2, LM5 and LM6, short-term, mid-term and long-term of loudness measurements are tied together coherently, and displayed in novel ways (angular reading and radar) that were preferred in its development and test phases. However, we remain open to suggestions for further improvement of the visualization of loudness.

Postscript

Control of loudness is probably the only audio issue that has made it to the political agenda. Political regulation is currently being put into effect in Europe to prevent hearing damage and disturbances from PA systems, and to avoid annoying level jumps during commercial breaks in television. In Australia, something similar may happen.

Many years of research into loudness of not only dialog, but also of loudness relating to any type of audio programming, has brought TC to the forefront of companies in the world to perform real-time loudness measurement and control. Therefore, TC has taken active part in loudness standardization efforts in Japan, the United States, Europe and other areas.

In broadcast, digitization is driving the number of AV channels and platforms up, while the total number of viewers remains roughly the same. On the sound production side, it is therefore important that delivery criteria can be easily specified and met, even by people not primarily concerned with audio: Journalists, musicians, video editors, marketing professionals etc.

Using only dialog based audio measurements in digital broadcast, has led to ambiguous level management, more level jumps between programs, and extra time spent on audio production and management in general. Non-dialog based level jumps are currently creating havoc in digital TV, and LM2 helps correct that situation. The LM2 Loudness Meter can be used to control level and improve sound, not only in Dol-

by AC3 based transmissions, but also on other broadcast platforms, such as analog TV, mobile TV and IPTV.

In summary:

LM2 is part of a holistic and universal approach to loudness control, starting at with the production or live engineer. When she realizes the dynamic range at her disposal, less processing is needed at later stages of a distribution chain. The chain ends with the capability of quality controlling everything upstream by applying the same loudness measure for logging purposes: a closed loop.

Welcome to a new, standardized world of audio leveling – across genres, across formats, across the globe.

LM2 log files

Loudness meter data is stored in the device’s internal memory and can be transferred to a computer using the TC Icon application (but not with the hardware TC Icon).

Log file resets

The meter log file is reset (along with the actual Loudness Meter)...

- ▶ when you turn off the device
- ▶ when the Meter is reset manually
- ▶ when the Meter is reset via GPI remote control.

The log file is also reset along with the Loudness Meter if the measurement standard is changed manually, or by loading a preset based on a different standard.

Log page

To access the log file-related functions, select your TC HD device/Frame in TC Icon software, switch to the tab of the respective loudness meter and select the “Log” page button on the left side of the main window.

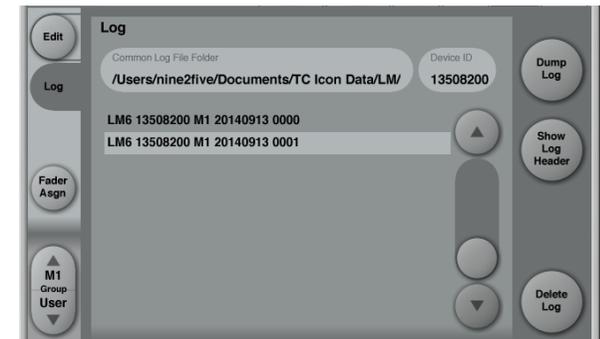


Fig. 52.: Log page with two log files

Common Log File Folder

Use the Common Log File Folder field to specify a folder on your computer where retrieved log files should be stored.

The folder you set here is a *common* folder for all the products controlled from this particular TC Icon software.

Log File folder defaults

- ▶ The default log file folder for **Microsoft Windows** is:
[C:] \users\ [your user name] \Documents\LM
- ▶ The default log file folder for **Apple OS X** is:
[Root] /users/ [your user name] / Documents/TC Electronic/

To specify the folder path, click in this field and type the path to the folder you want to use. Press the Enter key to confirm.

Dump log button

This button is not available when Auto Logging has been enabled – see [“Auto Logging” on page 115](#).

Click this button to manually retrieve the log file from the selected device and Engine and store it on your computer in the Common Log File Folder.

You will be asked to confirm this operation, as the TC Icon software user interface will not be available during log file retrieval.

Show Log Header button

This button is not available when Auto Logging has been enabled – see [“Auto Logging” on page 115](#).

Select a log file from the log file list and click this button to show its header information (see [“Log file header” on page 115](#)).

Delete Log button

This button is not available when Auto Logging has been enabled – see [“Auto Logging” on page 115](#).

To delete a log file from your computer’s hard disk, select the respective log file from the log file list and click the Delete Log button. You will be asked to confirm this operation.

Device ID field

The Device ID is used for naming log files. This applies to both manually and automatically retrieved log files.

If you operate several TC HD devices, use the Device ID field to give each device a unique name. This might be the name of the TV channel being measured with this device. By default, the Device ID corresponds to the product serial number.

Additional information when Auto Logging is enabled

To learn how to set up Auto Logging, see [“Auto Logging” on page 115](#).

When Auto Logging is enabled for this Engine, the following information will be displayed on the Log page:

Next log retrieval

This field will display a countdown to the next log file retrieval (e.g. as “35 min. 54 sec.”) or show “Now” while retrieving a log file.

Last log

After successful log file retrieval, the path to the file is shown plus the file header with statistics summary.

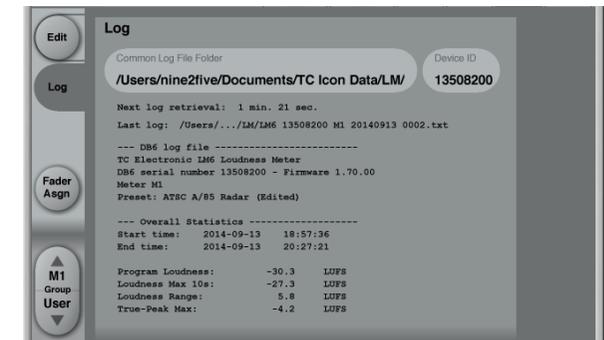


Fig. 53.: Log page with Auto Logging enabled

Log file format and structure

Each log file is a plain text file with the structure shown below. The header shows a summary of the log, followed by the actual, time-stamped values in tab-separated values format.

This file format can easily be imported into spreadsheet applications such as Microsoft Excel or Apple Numbers for further analysis.

Log file header

If the Loudness Meter preset being used has been edited, the Preset Name is followed by “Edited”. The serial number, preset name and software version information for the logged device is also available.

The summary includes statistics, and the measurements are stored every second.

Time and date is added while dumping the log file. This information is derived from the computer that the TC Icon software is running on. Accordingly, you need to ensure that the computer’s clock is set correctly.

Log file name

The log file’s name is composed from the Algorithm, the Device ID, the Meter Engine, the date (coming from the computer running the TC Icon software), plus a number starting with 0000 and increased for each log file retrieval on the same date.

Log file example

Header lines are indicated by a leading hash character.

```
# --- LM6 log file -----
#
# TC Electronic LM6 Loudness Meter
# DB6 serial number 13508233 - Firmware 1.25.00
# Meter M1
# Preset: EBU R128 Radar (Edited)
#
# --- Overall Statistics -----
#
# Start time:          2014-01-27 13:58:39
# End time:            2014-01-27 14:06:25
#
# Program Loudness:   -27.1 LUFS
# Loudness Max 10s:   -20.7LUFS
# Loudness Range:     17.1 LUFS
# True-Peak Max:      -4.0 LUFS
# --- Loudness log -----
#
Date           Time           Loudness (LUFS)
2014-07-27     13:58:39     -23.15
2014-07-27     13:58:40     -23.48
2014-07-27     13:58:41     -23.73
etc.
```

Working with log files

You can delete, move and rename log files as required using Windows Explorer in Microsoft Windows, the Finder in OS X or a third-party file manager.

Auto Logging

Using the free TC Icon software application (but not the hardware TC Icon), it is possible to specify a fixed interval at which the computer will collect Loudness Meter log files from the Frames controlled by the Icon software.

Log file retrieval can be activated for a wide range of TC Electronic devices from TC Icon software.

Log Select page

To activate Auto Logging,

- ▶ switch TC Icon software to Base mode by clicking the Icon symbol in the upper left corner of the window,
- ▶ click the Auto tab on top of the window
- ▶ click the Log Select page button on the left side of the window.



Fig. 54.: Auto Logging
– Log Select page

Use this page to select the Frame(s) and Engines in that Frame from which you want to collect log files.

Loudness Pilot meter log file retrieval

On a Loudness Pilot, the Meter Engines M1 and M2 are always available. Enable Auto Logging from them by clicking the M1 and/or M2 buttons on the Log Select page.

Button “LED” states

Grey

Indicates that this Engine holds a valid LM2 algorithm, but no log file has been retrieved yet.

Green

Indicates that at least one log file has been retrieved from this Engine.

Yellow

Indicates that this Engine does not hold an LM2 algorithm.

Red

Indicates that there was a problem retrieving the log file. Check that the connection to the Frame is working.

Blue – blinking

Indicates that the log file is currently being retrieved from the specific Frame and Engine.

“Auto log is not available from this device”

If a product controlled by the Icon application does not feature a Loudness Meter.

Log Setup page

To configure Auto Logging,

- ▶ switch TC Icon software to Base mode by clicking the Icon symbol in the upper left corner of the window,
- ▶ click the Auto tab on top of the window
- ▶ click the Log Setup page button on the left side of the window.

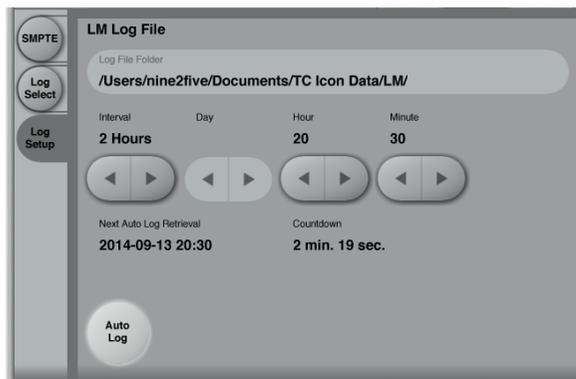


Fig. 55.: Auto Logging
– Log Setup page

Use the parameters on this page to set up log file retrieval.

Auto log button

Click this button to enable Auto Logging for all devices/Engines that have the respective Meter

button enabled on the Log Select page – see [“Log Select page”](#) on page 116.

Log File Folder

Use the Log File Folder field to specify a folder on your computer where retrieved log files should be stored.

The folder you set here is a *common* folder for all the products controlled from this particular TC Icon software.

Log File folder defaults

- ▶ The default log file folder for **Microsoft Windows** is:
[C:] \users\ [your user name] \Documents\LM
- ▶ The default log file folder for **Apple OS X** is:
[Root] /users/ [your user name] / Documents/TC Electronic/

Interval field

Settings: 1 / 2 / 4 / 12 hours, 1 day, 1 week

Use the arrow buttons in this section to define the interval for log file retrieval.

Day / Hour / Minute fields

Use the Hour and Minute fields to set a specific time of day when the next log file should be retrieved. The clock is set in 24 hours format.

Additional log files will be retrieved in the intervals specified using the Interval field.

E.g., if you set the Hour and Minute fields to 2 hours and 10 minutes and set the Interval field to 4 hours, log files will be retrieved at 2:10 am, 6:10 am, 10:10 am etc.

When you have set the Interval field to “1 Week”, you can also set the day of the week when the log file should be retrieved.

For devices running 24/7, you would usually chose a time when log file retrieval does not interfere with other activities.

E.g., you could retrieve the log file every Monday at 01:05.

Further info

When you have activated Auto Logging, additional information is displayed on the Log Setup page:

Next Auto Log Retrieval display

This is the time when the next log file retrieval will occur.

E.g., “2014-09-15 15:57” means that the next log file retrieval will occur on September 15, 2014, at 3:57 pm.

Countdown display

This field shows a countdown to the next log file retrieval in hours, minutes and seconds.

Retrieving Log From display

The name of the device and the Engine from which a log file is currently being retrieved, e.g. “7: Loudness Pilot No.87 – M2”

Appendix 1: Links and additional information

Support resources

- ▶ **TC Electronic service and warranty:**
tcelectronic.com/support/service-warranty/
- ▶ **TC Electronic Support:**
tcelectronic.com/support/
- ▶ **TC Electronic – product software:**
tcelectronic.com/support/software/
- ▶ **TC Electronic – all product manuals:**
tcelectronic.com/support/manuals/
- ▶ **TC Electronic user forum:**
forum.tcelectronic.com/

TC Electronic on...

- ▶ **the web:**
tcelectronic.com/
- ▶ **Facebook:**
facebook.com/tcelectronic
- ▶ **Google Plus:**
plus.google.com/+tcelectronic/
- ▶ **Twitter:**
twitter.com/tcelectronic
- ▶ **YouTube:**
youtube.com/user/tcelectronic

TC HD resources

- ▶ **TC Electronic | Production:**
tcelectronic.com/production/
- ▶ **TC Electronic | Broadcast:**
tcelectronic.com/broadcast/
- ▶ **TC HD products on YouTube:**
youtube.com/user/tcelectronicHDAudio/

Product-related information

- ▶ Loudness Pilot **support page:**
tcelectronic.com/loudness-pilot/support/

Extending your product's capabilities with optional licenses

The capabilities of your Loudness Pilot can be extended by purchasing optional licenses listed below.

To learn where to obtain demo versions or buy licenses to extend your TC HD product, please go to

tcelectronic.com/where-to-buy

16 Channel AES

Extends the number of audio channels that can be processed with an AES version (balanced or unbalanced) of your device from 8 to 16.

LM2 Loudness Radar Meter for Loudness Pilot

LM2 gives you instant overview of Loudness History, Momentary Loudness, True-peak Level, Program Loudness and Loudness Range. For more information, see "[LM2 \(optional\)](#)" on page [96](#).

SDI Metadata

Allows signal processing control based on SDI Metadata. For more information, see "[Remote – SDI](#)" on page [64](#).

SNMP Monitoring

Send out SNMP alerts (Silence Detector, PSU Error, Clock Errors etc.).

Appendix 2: Loudness Pilot GPI/O page

GPIO Technical specifications

The General Purpose Input/Output (GPIO) connector on the Loudness Pilot back panel is configured as follows:



Fig. 56.: Fig. 1: GPIO D-SUB connector

Pin No	Function
1	GPO 1, contact 1
2	GPO 2, contact 1
3	GPI 2
4	GPI 4
5	3V3 output, 100 mA max
6	GPO 1, contact 2
7	GPO 2, contact 2
8	GPI 1
9	GPI 3
10	3V3 output, 100 mA max
11	Ground
12	Reserved
13	Ground
14	Ground
15	Reserved

Fig. 57.: Table 1: GPIO pin assignments

The 3V3 output (presented on 2 pins) can be used for external GPIO network as described below. It is currently limited to 100 mA.

Each of the two GPOs consist of a floating internal relay than can either be set open (this is the default setting) or closed. Each relay can handle 200 mA / 24 V AC/DC max.

The four GPI inputs are DC coupled 0 to +3V3 inputs. Inside the processor, 100 kOhm resistors connect the GPI inputs to +3V3 power supply. When nothing is connected to the GPI input, the input voltage therefore is +3V3V. A resistor network can be used to pull down the voltage as suggested in Fig 3-4.

GPIO installation

Selection between up to 8 presets is achieved by feeding the processor a DC voltage to the GPIO D-SUB connector. The input voltage is compared against voltage windows that correspond to certain presets.

Between the valid voltage windows, invalid windows have been inserted to protect against erratic operation. The processor constantly monitors the GPI input, and only if several consecutive measurements point to the same, valid voltage window, a recall is performed.

The voltage windows are chosen to enable easy “binary relay encoding” as shown in fig. 3-4. If long cable runs are required, HF decoupling using a ceramic capacitor across the D-SUB GPI and GROUND pins may be needed.

For maximum detection precision and maximum tolerance against cable induced noise/hum please use the calibration tool in the TC Icon application to set the “HI” and “LO” thresholds of the GPI voltage range.

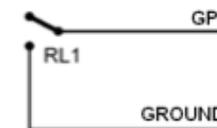


Fig. 58.: Fig. 2: Setup: “1 of 2”

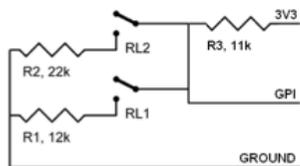


Fig. 59.:Fig. 3: Setup “1 of 4”.
Use 1% precision resistors

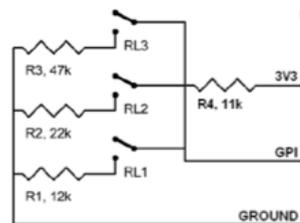


Fig. 60.:Fig. 4: Setup “1 of 8”.
Use 1% precision resistors

In Table 2, voltages outside the limits mentioned are to be considered invalid. No action is taken if invalid measurements are made. GPI recall action resumes when a stable, valid measurement is detected again.

Mode	User Preset No	Scaled Target / Vs	Min typ / V	Target typ / V	Max typ / V	RL3	RL2	RL1
1 of 2	1	1.000 (idle)	2.67	3.30	3.30			open
	2	0.000	0.00	0.00	0.51			clos.
1 of 4	1	1.000 (idle)	3.20	3.30	3.30		open	open
	2	0.689	2.18	2.28	2.38		clos.	open
	3	0.548	1.71	1.81	1.91		open	clos.
	4	0.439	0.00	1.45	1.55		clos.	clos.
1 of 8	1	1.000 (idle)	3.20	3.30	3.30	open	open	open
	2	0.826	2.63	2.73	2.83	clos.	open	open
	3	0.689	2.18	2.28	2.38	open	clos.	open
	4	0.602	1.93	1.99	2.05	clos.	clos.	open
	5	0.548	1.75	1.81	1.87	open	open	clos.
	6	0.491	1.56	1.62	1.68	clos.	open	clos.
	7	0.439	1.40	1.45	1.50	open	clos.	clos.
	8	0.402	0.00	1.33	1.38	clos.	clos.	clos.

Table 2: GPI voltage windows

Notes:

- ▶ “Idle” refers to the state when no input is connected, or when the input is left floating.
- ▶ Rather than absolute voltage measurements, the windows are defined as a fraction of the supply voltage. This voltage can be measured with a high impedance DMM on the D-SUB pin 5 or 10.
- ▶ The table shows values as a fraction of the supply voltage, and, as a guideline, typi-

cal voltages when the supply is 3.30 V. (If the supply voltage is e.g. 3.315 V, the table should be corrected by multiplying these values by 3.315/3.3).

Technical specifications

Loudness Pilot Frame

General	
Frame configuration	
Front indicators	Status for: PSU 1, PSU 2, Sync, Alert, Signal
Finish	anodized aluminum face plate. Plated steel chassis
Dimensions:	19 x 1.75 x 13.2 inches (483 x 44 x 334 mm), 1 RU
Weight	
Mains voltage:	100 to 240 VAC, 50-60 Hz auto-select
Power supply function:	Dual Power Supply Redundancy
Fan:	Dual Fan Redundancy
Power consumption:	
Warranty, parts and labor:	2 years (Extended Warranty program available)
EMC	
Complies with:	EN 55103-1 and EN 55103-2, FCC part 15 class B, CIS-PR 22 class B
Safety	
Certified to:	IEC 60065, EN 60065, UL 6500 and CSA E65
Environment	
Operating temperature:	32° F to 122° F (0° C to 50° C)
Storage temperature:	-22° F to 167° F (-30° C to 70° C)
Humidity:	Max. 90 % non-condensing

Transmission 3G Card

General

Number of Processors	
Number of audio channels processed	8 in, 8 out (per card) 16 in, 16 out optional for AES
Audio format configuration	2, 5.1, 2+2, 5.1+2, 2+5.1, 5.1+5.1
Audio processing delay	0.15 ms
Adjustable online delay	0-10 sec per audio channel
Delay Resolution	32 bit
Frequency Response DIO	DC to 23.9 kHz +/- 0.01 dB
Audio sample rate	48 kHz, fully synchronous
Audio processing resolution	32 bit, bit-transparent

Inputs and outputs – Loudness Pilot SDI

Connectors	1 BNC In, 1 BNC Out. 75 Ohm
Bypass relay	Input to output while powered off and during boot-up
Function	Audio de-embed/embed, video thru
SDI formats support – SD	525i59.94, 625i50
SDI formats support – HD	720p23.98, 24, 25, 29.97, 30, 50, 59.94, 60 1080p23.98, 24, 25, 29.97, 30 1080i50, 59.94, 60
SDI formats support – 3GA	720p23.98, 24, 25, 29.97, 30, 50, 59.94, 60 1080i50, 59.94, 60 1080p23.98, 24, 25, 29.97, 30, 50, 59.94, 60
SDI formats support – 3GB (2 streams)	720p23.98, 24, 25, 29.97, 30, 50, 59.94, 60 1080i50, 59.94, 60 1080p23.98, 24, 25, 29.97, 30, 50, 59.94, 60
Complies with standards	SMPTE 259M, 292M, 424M, 425M
Audio input/output selection	SDI group 1-2, 3-4, 3G stream 1, 3G stream 2
Interface function (de-embed/embed)	Synchronous, bit transparent
Input return loss	Typ. 17 dB, < 1.5 GHz, typ. 12 dB, 1.5 to 3 GHz
Output return loss	Typ. 18 dB, < 1.5 GHz, typ. 12 dB, 1.5 to 3 GHz
Relay bypass return loss	Typ. 19 dB, < 1.5 GHz, typ. 14 dB, 1.5 to 3 GHz
Adaptive cable equalization (input)	480 m @ SD, 250 m @ HD, 150 m @ 3G, Belden 1694A
Jitter tolerance (input) – timing	> 10 UI
Jitter tolerance (input) – alignment	> 0.7 UI
Output jitter @ SD – timing	< 0.25 UI
Output jitter @ SD – alignment	< 0.22 UI
Output jitter @ HD – timing	< 0.5 UI
Output jitter @ HD – alignment	< 0.1 UI
Output jitter @ 3G – timing	< 1.0 UI
Output jitter @ 3G – alignment	< 0.25 UI
Signal Level (output)	800 mV +/- 5%
DC offset (output)	0 V +/- 0.5 V
Rise/fall time (output)	< 700 ps @ SD, < 130 ps @ HD, < 120 ps @ 3G
Overshoot (output)	< 5% of amplitude

Inputs and outputs – Loudness Pilot AES unbalanced

Connectors	BNC, 75 Ohm
Bypass Relay	Input to output while powered off and during boot-up
Formats supported	AES/EBU (24 bit), AES3-id in/out
Status bits	In: Accepts all, Out: Pro-status bits
Complies with standards	AES3-2009, SMPTE 276M
Digital IO Engine	TC developed DICE™ core
Internal Sample Rates	48 kHz
Internal Clock Precision	±30 PPM
External Sample Rates	48 kHz +1.7 % / -1.3 %
Audio in-to-out delay	0.85 ms
Number of audio channels processed	8 in, 8 out (16 in, 16 out)
Interface function	Synchronous, bit transparent
Jitter Rejection Engine	TC developed JET™ technology
Jitter tolerance (input)	> AES3-2009 (master and slave input)
Jitter Rejection Filter	< -3 dB @ 10 Hz, < -100 dB @ 600 Hz, 4th order
Jitter gain (in-to-out)	< 1 dB
Output jitter (output @ clean source)	< 1 ns peak, BW : 700 Hz to 100 kHz
Digital output phase	< 0.5 % of sample period
Input variation before sample slip	±49.9 % of sample period
Input signal tolerance	0.2 to 5 Vpp
Output signal Level	1 V ±20%, terminated

Inputs and outputs – Loudness Pilot AES balanced

Connectors	DSUB incl. cable for XLR, 110 Ohm
Bypass Relay	Input to output while powered off and during boot-up
Formats supported	AES/EBU (24 bit), AES3
Status bits	In: Accepts all, Out: Pro-status bits
Complies with standards	AES3-2009
Digital IO Engine	TC developed DICE™ core
Internal Sample Rates	48 kHz
Internal Clock Precision	±30 PPM
External Sample Rates	48 kHz +1.7 % / -1.3 %
Audio in-to-out delay	0.85 ms
Number of audio channels processed	8 in, 8 out (16 in, 16 out)
Interface function	Synchronous, bit transparent
Jitter Rejection Engine	TC developed JET™ technology
Jitter tolerance (input)	> AES3-2009 (master and slave input)
Jitter Rejection Filter	< -3 dB @ 10 Hz, < -100 dB @ 600 Hz, 4th order
Jitter gain (in-to-out)	< 1 dB
Output jitter (output @ clean source)	< 1 ns peak, BW : 700 Hz to 100 kHz
Digital output phase	< 0.5 % of sample period
Input variation before sample slip	±49.9 % of sample period
Input signal tolerance	0.2 to 7 Vpp
Output signal Level	3.3 Vpp ±20%, terminated

Control Interface

GPI, control inputs (D-SUB)	4 multi-state, multi-function. 0 V to 3.3 V DC sensing
GPO output (D-SUB)	2 relays, floating, 200 mA / 24 V AC/DC max
Output voltage (D-SUB)	3.3 V DC, 100 mA current limited
Ethernet and remote control	2 ports, 10/100 Mbits/s, Base-T, SNMP-enabled

