English Manual

LM2n / LM6n

Product	LM2n / LM6n
Product version	1.0
Document	Manual
Document version/date	2014-04-24

Introduction

About this manual

This manual will help you learn understanding and operating your TC Electronic software.

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

You can print this manual, but we encourage you to use the PDF version, which has both internal and external hyperlinks. E.g., clicking the TC Electronic logo in the upper left corner of each page will take you to the table of contents.

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

To download the most current version of this manual, visit the web page

tcelectronic.com/support/manuals/

Getting support

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

tcelectronic.com/support/

System requirements and installation

System requirements

System requirements for Mac OS X

- Intel CPU (min. 2 GHz recommended)
- 2 GB RAM
- Mac OS 10.6.8 or higher
- Pro Tools 10 or higher or a VST/AU-compatible host
- Plug-in Formats
- VST2.4 32/64 bit
- VST3 32/64 bit
- Audio Units 32/64 bit
- AudioSuite 32 bit
- AAX Native 32 bit
- AAX Native 64 bit

System requirements for Microsoft Windows

- Intel-compatible CPU (min. 2 GHz recommended)
- 2 GB RAM
- Windows XP or higher
- Pro Tools 10 or higher or a VST-compatible host
- Plug-in Formats
- VST2.4 32/64 bit
- VST3 32/64 bit
- AudioSuite 32 bit
- AAX Native 32 bit
- AAX Native 64 bit

Hosts

You can use this plug-in with all host supporting the plug-in formats listed under System requirements. It has specifically been tested with:

- Avid Pro Tools 10 & 11 (Mac/PC)
- Apple Logic Pro X (Mac)
- Apple Final Cut Pro X (Mac)
- Steinberg Nuendo (Mac/PC)
- Steinberg Wavelab (PC)
- Steinberg Cubase (Mac/PC)
- Ableton Live (Mac/PC)
- Adobe Audition CC (Mac/PC)
- Adobe Premiere CC (Mac/PC)
- Reaper (Mac/PC)

Installation

You may be familiar with software licensing and authorization based on the iLok hardware. LM2n / LM6n uses a new license management concept/technology that allows you to authorize your plug-ins *without* a physical iLok key.

Instead of the iLok key, you can use your computer as a “key”. All you need is a (free) **iLok ID,** and the license(s) you purchase will be associated with this ID.

You then install the **iLok License Manager** software on your computer and use your iLok ID to activate the plug-in(s) you have purchased on this computer. Licenses can later be deactivated and then activated on another computer, allowing you to easily use your LM2n / LM6n wherever you need it. No key to lose – one less thing to worry about.

Of course, you can still use an iLok 2 device to store your licenses if this is what you prefer.

Obtaining an iLok ID

Please note that you will only need to create one account for all your PACE-based software licenses. If you already have an iLok ID, proceed with “Obtaining and installing the iLok License Manager” on page 5.

– Go to the iLok website: http://www.ilok.com/
– Click on “Create Free Account”.
– Fill the Free Account Setup form and click “Create Account”.

After finishing the registration process, a confirmation message will be sent to the e-mail account you specified when registering. You can now use this account to log into the iLok website and activate software licenses on your computer using the **iLok License Manager** application.

Obtaining and installing the iLok License Manager

– Go to the iLok License Manager download page on the iLok website: http://www.ilok.com/ilm.html
– Download the iLok License Manager installer for your operating system.

– After downloading the iLok License Manager installer, unZIP it and run it.
– Follow the iLok License Manager installer’s instructions.
– After the installer is finished, launch the iLok License Manager.

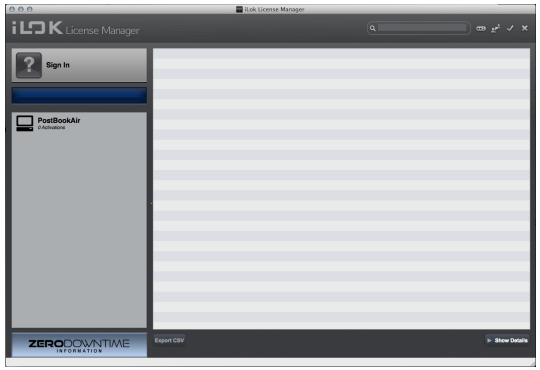


Fig. 1.: The iLok License Manager

– Click on “Sign in” and provide the credentials (your account name and your password) that you entered when you created your iLok ID.

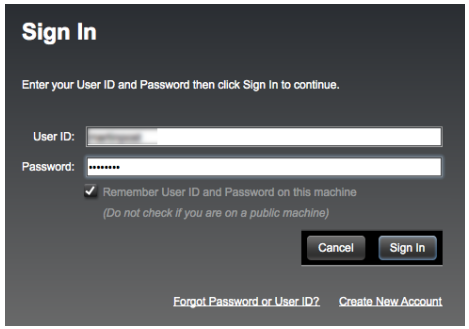


Fig. 2.: iLok License Manager: Sign In dialog

Managing plug-in activation

– After signing in, the plug-ins that were registered to your iLok ID will be available for activation and deactivation.
– Select a plug-in in the license list.
– Click on “Show Details” to display additional information, including options to Activate and Deactivate your plug-in(s).

Activating your plug-in from the iLok License Manager

If you want to activate a plug-in from the iLok License Manager, proceed as follows:

– Select a plug-in in the license list.
– Click on “Show Details”.
– Click on “Activate”.
– In the next dialog (“Select an activation location”), select the activation location (the computer or your iLok 2 device) and click “Next”.

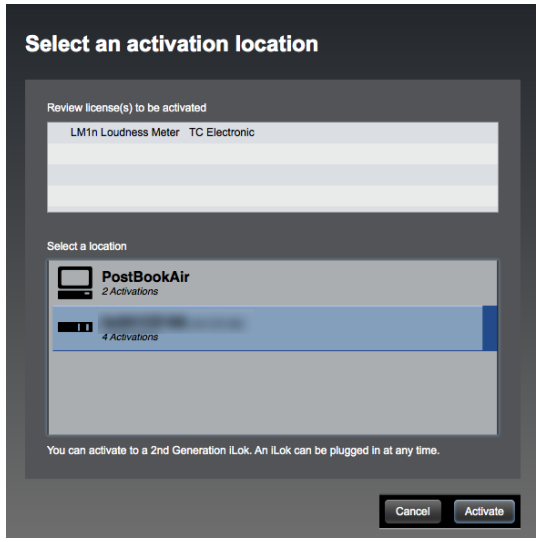


Fig. 3.: Plug-in activation from iLok License Manager

Installing LM2n / LM6n

- Make sure your host software is not running.
- Run the installer for the LM2n / LM6n plug-in. You may need an administrator account name and password to run the installer.

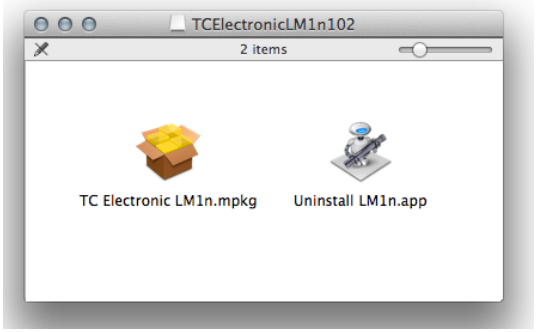
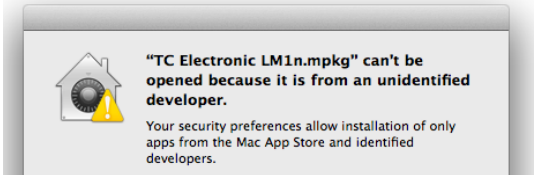


Fig. 4.: The LM1n installer

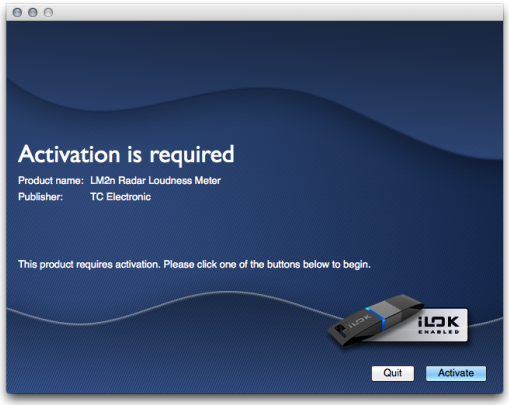
- On OS X, you may see the following dialog when you try to open the installer by double-clicking it:



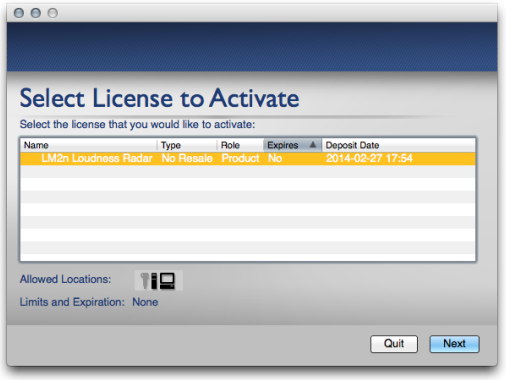
- If you see this dialog, close it, then, right-click the installer's icon and select "Open" from the context menu. This will open another dialog, allowing you to confirm that you want to install this plug-in and continue with the installation process.
- Read and accept the Software License Agreement presented by the installer.
- Finish the installation of the LM2n / LM6n plug-in and quit the installer.
- Launch your host software.

Activating your plug-in when launching the host application

- If you have not activated the recently installed plug-in as described in the previous section, you will now be presented with a dialog telling you that the plug-in needs to be activated.



- Review the plug-in name, make sure that this is the correct computer to activate and click on the "Activate" button.
- In the next dialog, select the plug-in you wish to activate and click "Next".



– In the next dialog, select the activation location (the computer or your iLok 2 device) and click “Next”.

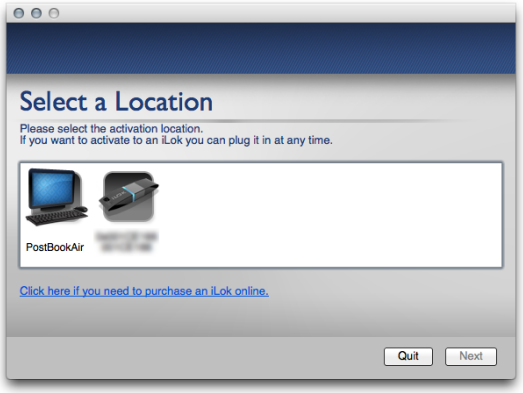


Fig. 5.: Plug-in activation during host software startup

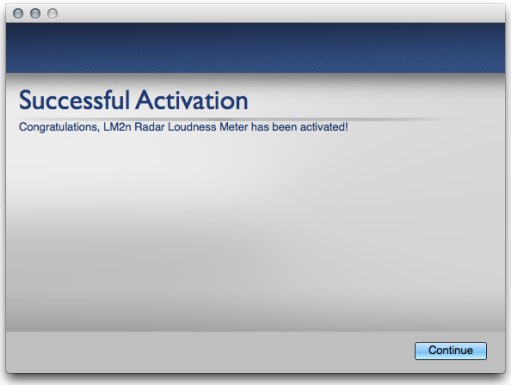


Fig. 6.: Plug-in Activation confirmation

– When your host software has finished launching, the newly activated plug-in(s) will be available.

Using LM2n / LM6n

LM2n / LM6n features

- Loudness meter fully compliant with
  - EBU R128
  - BS.1770-3
  - ATSC A/85 2013
  - ITU-R BS.1770
- Universal Descriptors
- Presets for use in broadcast, music, post production and film
- Offline measurements
- Supports mono and stereo sources
- Supports 5.1 sources *(LM6n only)*
- Advanced logging functionality *(LM6n only).*

Differences between LM1n, LM2n and LM6n

This table shows the differences between the three versions of this product: LM1n, LM2n and LM6n.

Function	LM1n	LM2n	LM6n
Audio channels	1.0 and 2.0	1.0 and 2.0	1.0, 2.0 and 5.1
PPM Meter	No	1.0 and 2.0	1.0, 2.0 and 5.1
Interface size	Very small	Medium and big	Medium and big
Radar	No	Yes	Yes
Logfile	No	No	Yes

LM2n / LM6n vs. LM2 and LM6

If you have been using the original TC Electronic LM2 /LM6 plug-ins, you will find the following major differences between these plug-ins and LM2n / LM6n:

- Installation is possible without a physical iLok device (see “Installation” on page 4).
- The Radar display is available in two sizes (medium and big).
- Offline processing capabilities have been improved.
- There is a new “Surround channel order” feature.
- The interface colors can be desaturated.
- The log file format has been updated.
- There are now dedicated Max Momentary Loudness and Max Short Term Loudness descriptors.

Welcome!

LM2n / LM6n 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** – every day makes millions of people adjust the volume control over and over again.

LM2n / LM6n 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. LM2n / LM6n works coherently together with other TC equipment, or with equipment of other brands 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 CD's always emerging the loudest.

Understanding LM2n / LM6n

Since 1998, TC has performed listening tests and evaluation of loudness models and therefore holds an extensive **Universal Database of loudness,** based on ten 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.

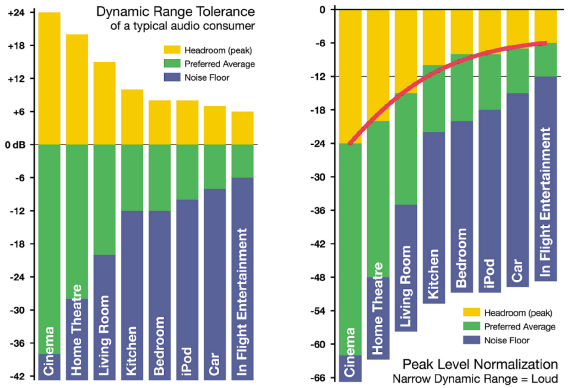


Fig. 7.: Left: Dynamic Range Tolerance (DRT) for consumers under different listening situations.
Right: Peak level normalization means that material targeted low dynamic range platforms gets loud.

The Universal Database is authoritative from an academic as well as a practical point of view. It has been indispensable when designing the LM2n / LM6n meters, because it provided the missing link between short-term and long-term loudness, and enabled the statistically founded Universal Descriptors of LM2n / LM6n.

The chart of Dynamic Range Tolerance in Fig. 7 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 DRT profile when mixing, but because level normalization in broadcast and music production is based on peak level measures, low dynamic range signatures end up the loudest as shown by the red line in Fig. 7. Audio production is therefore trapped in a downwards spiral, going for ever decreasing dynamic range. By now, the pop music industry is "right of" In Flight Entertainment in the illustration.

LM2n / LM6n offers a standardized option: The **visualization of loudness history and Dynamic Range Tolerance** in combination with long-term descriptors from production onwards is a transparent and well-sounding alternative to our current peak level obsession.

This is relevant not only for music, but also in production for broadcast or film. The 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.

LM2n / LM6n therefore color-codes loudness so it's easy to identify
- target level (green),
- below the noise floor level (blue), or
- loud events (yellow) – see Fig. 8.

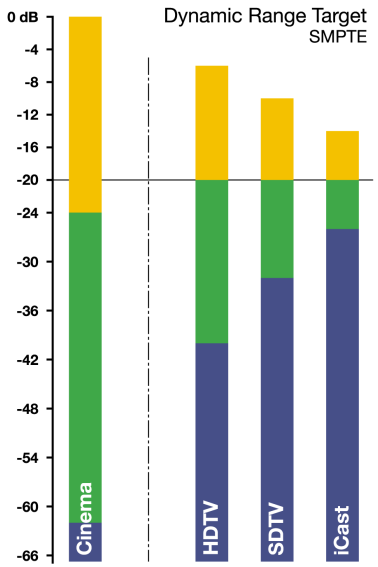


Fig. 8.: Color coding and target loudness for selected broadcast platforms based on a consumer's Dynamic Range Tolerance (DRT). The aim is to center dynamic range restriction around average loudness, in this case the -20 dB line, thereby automatically avoiding to wash out differences between foreground and background elements of a mix. Note how different 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 – thereby ensuring better audio quality not only in DTV audio, but across all broadcast platforms.

LM2n / LM6n and TC signal processing can coexist with PPM meters, VU meters or Dolby's LM100 meter. LM2n / LM6n 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.

Basic use of LM2n / LM6n

LM2n and LM6n make use of a unique way of visualizing short-term loudness, loudness history, and long-term statistical descriptors for any type of program material.

LM2n supports analysis of mono and stereo signals, while LM6n supports mono, stereo and 5.1.

Select LM2n or LM6n in your host to bring up the **Radar page.** This page will be used most of the time.

Fig. 9.: LM6n Radar page

Reading the Radar display

The parameter values shown in the left and right bottom corners of the Radar page in yellow are called **Descriptors.** The default descriptors are Loudness Range (left) and Program Loudness (right).

The Outer ring surrounding the actual Radar display shows **Momentary Loudness.** The value shown at the 12 o'clock position is the **Target Loudness**.

The Radar measures loudness over the time. The time represented by one Radar revolution is set using the Radar Speed parameter on the Settings page.

Resetting measurements

Click the Reset button (the "X" in the upper right corner of the interface) to reset the Radar display and the Descriptors.

Presets (storing/recalling settings)

Presets are handled via your host. Please refer to the description of the host software's features for storing and recalling plug-in settings.

Logging (LM6n only)

When logging has been activated (using the Create Log File parameter on the Settings page) and the plug-in is opened or reset, a log file is created in the log file folder specified on the Settings page.

This log file includes information such as:

- when LM6n was opened and closed
- how long LM6n has been measuring material since it was opened last
- Loudness Range and Program loudness data logged since LM6n was opened.

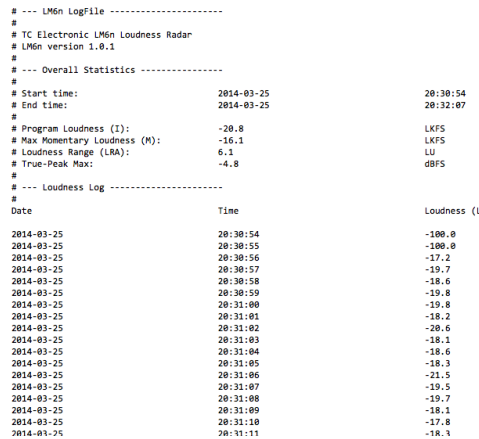
- Use the Create Log File parameter on the Settings page to activate logging functionality. See "Create Log File parameter" on page 24.
- Use the Log File Folder parameter on the Settings page to define the folder where log files should be stored. See "Log File Folder parameter (LM6n only)" on page 24.
- Use the Reset on Play parameter on the Settings page to specify wether measurements should be reset when activating Play mode. See "Reset on Play parameter" on page 25

Log file name and content

The format of the log file name is "LM6n-Log-YYYY-MM-DD-hh-mm-ss.log".

E.g.,"LM6n-Log-2014-04-02-14-23-00.log" means that this log file was created April 2nd, 2014 at 2:23 pm.

Each LM6n log file is a simple text document that can be opened in any text editor. You can easily copy and paste the information from a log file into other applications – e.g., into your e-mail client.



```
# --- LM6n LogFile ---------------------
#
# TC Electronic LM6n Loudness Radar
# LM6n version 1.0.1
#
# --- Overall Statistics ---------------
#
# Start time:                   2014-03-25                      20:30:54
# End time:                     2014-03-25                      20:32:07
#
# Program Loudness (I):         -20.8                           LKFS
# Max Momentary Loudness (M):   -16.1                           LKFS
# Loudness Range (LRA):         6.1                             LU
# True-Peak Max:                -4.8                            dBFS
#
# --- Loudness Log ---------------------
#
Date                            Time                            Loudness (LKFS)

2014-03-25                      20:30:54                        -100.0
2014-03-25                      20:30:55                        -100.0
2014-03-25                      20:30:56                        -17.2
2014-03-25                      20:30:57                        -19.7
2014-03-25                      20:30:58                        -18.6
2014-03-25                      20:30:59                        -19.8
2014-03-25                      20:31:00                        -19.8
2014-03-25                      20:31:01                        -18.2
2014-03-25                      20:31:02                        -20.6
2014-03-25                      20:31:03                        -18.1
2014-03-25                      20:31:04                        -18.6
2014-03-25                      20:31:05                        -18.3
2014-03-25                      20:31:06                        -21.5
2014-03-25                      20:31:07                        -19.5
2014-03-25                      20:31:08                        -19.7
2014-03-25                      20:31:09                        -18.1
2014-03-25                      20:31:10                        -17.8
2014-03-25                      20:31:11                        -18.3
```

Fig. 10.: A sample LM6 log file, opened in a text editor

An LM6n log file will contain…

- **plug-in version information** in the header section
- **overall statistics** (including start and end time and Descriptor data as seen on the Stats page)
- the actual **Loudness log** with one line per measurement in the following format, with data separated by tabs:
  - Date
  - Time
  - Loudness value.

Universal Descriptors and Dolby LM100

Unlike methods that measure dialog only, LM2n / LM6n may be used with any type of audio – which includes dialog, of course. If you wish to measure dialog, it is recommended to do a manual spot check of a program or a film. Find 10 to 30 seconds of regular dialog and measure it with LM2n / LM6n. 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 Center of Gravity in LM5 or Program Loudness in LM2n / LM6n . 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.

To measure dialog with LM2n / LM6n the same way Dolby LM100 is sometimes used, solo the Center channel during a spot check to momentarily disable the channel weighting specified in BS.1770, if you're working on a 5.1 stem.

Universal descriptors and AC3 Meta-data

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 LM2n / LM6n 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.

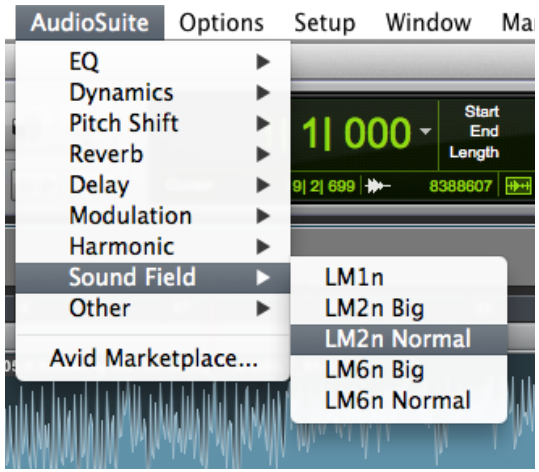
If your station is more music than speech, better inter-channel leveling may be obtained with dialnorm permanently set 1 or 2 LU lower than the Program Loudness target level.

Offline measurements

In Avid Pro Tools, LM2n / LM6n cannot only be used for real-time loudness measurements, but also for offline processing. This means that you can select a track or the section of a recording and measure loudness parameters without having to run this track in real-time.

To perform offline measurements in Avid Pro Tools, proceed as follows:

– Select the track or audio part that you want to measure.
– From the Pro Tools AudioSuite menu, select Sound Field / LM2n or Sound Field / LM6n – depending on the plug-in license(s) you have purchased and activated and the track(s) you need to measure.



– Click the “Analyze” button in the lower right corner of the plug-in window.

LM2n / LM6n will measure the loudness of the selected track or audio part and present you with the results.

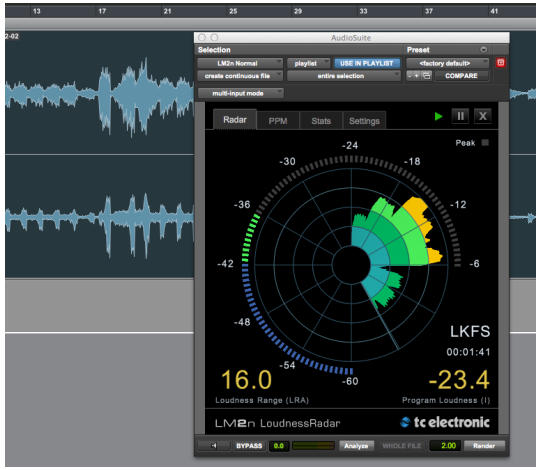


Fig. 11.: LM2n after measuring an audio signal offline.

Interface and feature reference

LM2n / LM6n tabs / screens: Radar, PPM, Stats, Settings

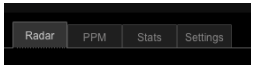


Fig. 12.: Tabs

Use the four tabs on top of the LM2n / LM6n interface to navigate to the four pages that make up the plug-in's interface:

– **Radar:** Main Radar display.
See "Radar page" on page 17

– **PPM:** PPM page, also displaying a smaller version of the Radar.
See "PPM page" on page 21.

– **Stats:** Statistical information.
See "Stats page" on page 22.

– **Settings:** Units and other basic settings affecting the Radar display, and access to logging features.
See "Settings page" on page 23.

If you should also use the LM1n plug-in, please note that the LM1n interface has no tabs.

Main controls

Fig. 13.: Status indicator, Pause button, Reset button

Reset button

To clear all current measurements and restart meter revolution from the 12 o'clock position, click the Reset button.

Make it a habit to click the Reset button before a new measurement. This resets the Descriptors, the Radar and the true-peak meters. Run the audio, and watch the radar and descriptor fields update accordingly. It is normal that the descriptors wait five seconds into the program before showing the first readings, while the radar updates instantly. The first five seconds of a program *are* included in the descriptor calculations, even though they are not shown instantly.

In LM6n, resetting measurements will also create a new log file when the Create Log File parameter on the Settings page has been set to On.

Pausing measurements

Click the Pause button to the left of the Reset button to temporarily pause metering and measurements.

Radar page

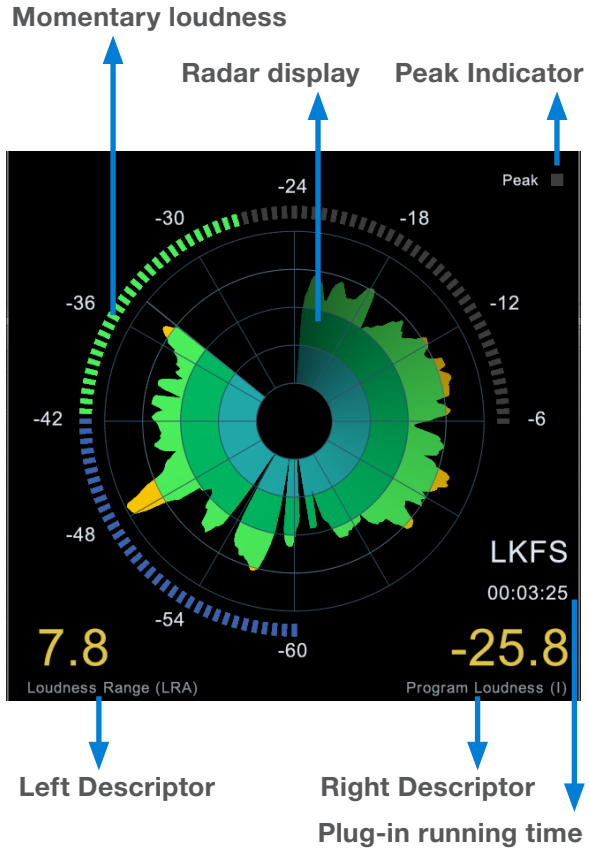


Fig. 14.: The LM2n / LM6n Radar page

The LM2n / LM6n Radar measures loudness over time.

The Radar display is a visualization of Short Term Loudness. The time represented by one Radar revolution is set using the Radar Speed parameter on the Settings page.

In the **Radar display,** Target Loudness is represented by the border between green and yellow, while the Low Level point is marked by the border between green and blue.

You should keep the outer ring in the green area, and around 12 o'clock 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 (LUFS selected), or have a zero point set at the 12 o'clock position (LU selected). Set the Loudness Unit parameter on the Settings page to "LUFS" or "LU/LUFS" accordingly. 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.

For the Loudness Unit parameter and the difference between "LUFS" and "LKFS", see "Loudness Unit parameter" on page 24.

The Outer ring surrounding the actual Radar display shows **Momentary Loudness.** The value shown at the 12 o'clock position is the **Target Loudness**. The range is defined using the Momentary Range parameter on the Settings page.

Please note that LM2n / LM6n incorporates an intelligent gate, which discriminates between foreground and background material of a program. Consequently, a measure doesn't start before audio has been identified. It also pauses the measurement during periods of only background noise, and in the fade-out of a music track.

Peak Indicator

In the upper right corner of the page is a Peak indicator. Use the Peak indicator parameter on the Settings page to define at which level the peak indicator should light up.

Plug-in running time

The **plug-in running time** displayed on the right edge will be reset when you click the Reset button.

Descriptors

The parameter values shown in the left and right bottom corners of the LM2n /LM6n Radar page in yellow are called **Descriptors.**

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.

The default descriptors are **Loudness Range** (left) and **Program Loudness** (right).

Use the Settings page to select Descriptors. See “Settings page” on page 23.

Prog. Loudness (I) descriptor

Program Loudness (I) 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 they are identical: 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 LM2n / LM6n are all rooted in ITU-R BS.1770. However, subtle differences exist between different regions of the world. Therefore LM2n / LM6n 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, especially when taking the measurement differences into account. Target numbers range between -24 and -22 LUFS.

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

Sliding Loudness descriptor

Sliding Loudness – unlike Program Loudness, Loudness Range and Loudness Max – 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.

LM2n / LM6n makes use of optimized statistics processing in order to display a sliding loudness value (a prognosis) as quickly as possible after a reset.

Loudness Range (LRA) descriptor

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.

Max Momentary (M) descriptor

Max Momentary is the maximum momentary value through the entire program. This is the same descriptor that is also displayed by the Outer ring of the Radar display in LM2n and LM6n (see “Radar page” on page 17.

While Program Loudness concerns the entire, full-length program, Momentary loudness is measured in a window of 400 ms.

Max Short Term (S) descriptor

Max Short Term is the maximum momentary value through the entire program. This is the same descriptor that is also displayed by the Radar display in LM2n and LM6n (see “Radar page” on page 17.

While Program Loudness concerns the entire, full-length program, Max Short Term is measured in a window of 3 seconds.

Max True Peak (TP) descriptor

Max True-peak is the maximum true-peak value seen over the entire program.

Peak/Loudness Ratio (PLR) descriptor

Peak/Loudness Ratio is the distance between Program Loudness (see “Prog. Loudness (I) descriptor” on page 18) and Max True-Peak (see “Max True Peak (TP) descriptor” on page 20).

Loudness Range (LRA) quantifies loudness variations inside a program or a music track. But LRA isn’t very sensitive to transient-limiting and clipping happening as a result of the loudness war in commercials and music production.

Peak to Loudness Ratio (PLR) is a more appropriate measure of such squashing, which has an adverse effect on clarity, intelligibility and audio quality at large. In addition to its “educational” value, PLR is also relevant when tailoring a track or a program to a certain amount of downstream headroom. For instance, ATSC A/85 and EBU R128 provide 23 dB of headroom, while Sound Check in iTunes offers 16 dB of headroom.

Lowering PLR further only destroys audio quality without gaining loudness on any modern platform. Accordingly, keeping an eye on this crucial reading can save your next recording for generations to come.

PPM page

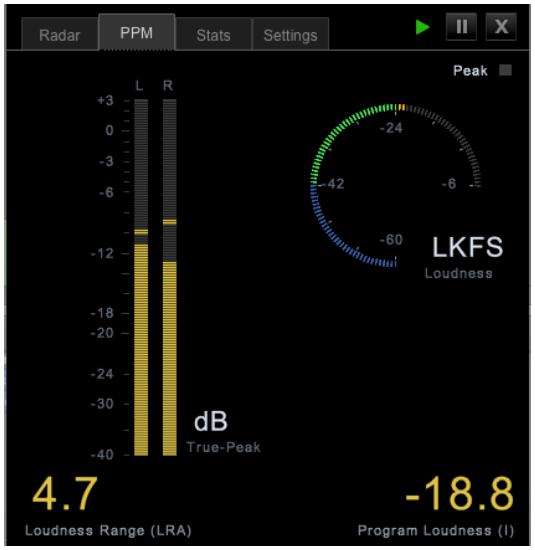


Fig. 15.: LM2n PPM page

The PPM page shows…

- a **peak programme meter** (PPM) for the signal currently being measured by the plug-in
- a smaller version of the **Radar display** as seen on the plug-in's Radar page and
- the two **Descriptors** selected on the Settings page using the Left Descriptor and Right Descriptor parameters.

The peak meters of LM2n and LM6n 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 guideline of the headroom.

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.

Stats page

Fig. 16.: LM6n Stats page

The Stats page gives an overview of essential descriptors, as described in this section.

Please note that clicking the Reset button will reset the meters and the log file. See “Reset button” on page 16.

Statistics

This is the time (given in days, hours, minutes and seconds) since the plug-in has been instantiated or since the Reset button has been clicked for the last time.

Program Loudness (I)

This is the Program Loudness. Use the Loudness Units parameter on the Settings page to define the unit for this display.

Max Momentary Loudness (M) or Max Short Term Loudness (S)

The parameter displayed in this line depends on the setting of the **Max Loud. Time** parameter on the Settings page.

– If you set the Max Loud. Time parameter on the Settings page to “0.4 sec (M)”, the parameter is displayed as “Max Momentary Loudness (M)”.
– If you set the Max Loud. Time parameter on the Settings page to “3 sec (S)”, the parameter is displayed as “Max Short Term Loudness (S)”.

Use the Loudness Units parameter on the Settings page to define the unit for this display.

Loudness Range (LRA)

This is the Loudness Range, measured in LU.

True-Peak Max

This is the True-peak Max parameter, measured in dBFS.

Sliding Loudness [n] seconds

Use the Sliding Loudness Time parameter on the Settings page to define [n].

Use the Loudness Units parameter on the Settings page to define the unit for this display.

PLR

This is the Peak-to-Loudness Range (PLR), measured in dB.

Settings page

Fig. 17.: LM6n Settings page

Left Descriptor parameter

Parameter settings:

- Off
- Program Loudness (I)
- Sliding Loudness
- Loudness Range (LRA)
- Max Momentary (M)
- Max Short Term (S)
- Max True Peak (TP)
- Peak/Loudness Ratio (PLR)

Use this parameter to define what Descriptor should be shown in the lower left corner of the Radar page and the Stats page. See “Descriptors” on page 18.

Selecting Max Momentary (M) or Max Short Term (S) will automatically set the Max Loudness Time parameter to 0.4 sec or 3 sec.

Right Descriptor parameter

Parameter settings:

- Off
- Program Loudness (I)
- Sliding Loudness Sliding L.
- Loudness Range (LRA)
- Max True Peak (TP)
- Peak/Loudness Ratio (PLR)

Use this parameter to define what Descriptor should be shown in the lower right corner of the Radar page and the Stats page. See “Descriptors” on page 18.

Target Loudness parameter

Parameter range: -6 to -36 LUFS (or LKFS, depending on name setting) in 0.5 steps

The Target Loudness parameter specifies the loudness level to generally aim at. It affects a number of functions and displays in LM2n / LM6n, and must be set according to the standard you need to comply with.

Current broadcast standards require Target Loudness to be in the range between -26 and -20 LUFS. For instance, EBU R128 calls for -23 LUFS while ATSC A/85 specifies -24 LUFS.

The Target Loudness parameter affects these functions and displays:

- It sets the **reference point for loudness measurements** in LU. If the Loudness Unit parameter is set to LU, Program Loudness, Sliding Loudness and Loudness Max will be shown in LU relative to LU Reference. Consequently, measurements that a on precisely on target will consequently read “0.0 LU”.
- It defines the **“12 o’clock” value of the Radar meter.**

Radar Speed parameter

Parameter settings: 1, 4, 12, 30 min,1, 2, 4, 12, 24 hours

Radar Speed controls how long each radar revolution takes. Select from 1 minute to 24 hours. You may “zoom” between the settings without loosing data as long as the history isn’t reset. The radar remembers up to 24 hours. Clicking

the Reset button will reset the meter and descriptor history.

Radar Resolution parameter

Parameter settings: 3, 4, 6, 8, 10, 12 dB/div

Use the Radar Resolution parameter to set the difference in loudness between each concentric circle in the Radar between 3 and 12 dB.

Choose low numbers when targeting a platform with a low dynamic range tolerance. You may "zoom" between the settings, as long as the history isn't reset.

Momentary Range parameter

Parameter settings: EBU +9, EBU +18

Use the Momentary Range parameter to set the range of the radar meter.

EBU mode meters can to display two different momentary displays: One with a narrow loudness range intended for normal broadcast and denoted "EBU +9", and one with a wide loudness range intended for film, drama and wide range music denoted "EBU +18".

- The "EBU +9" setting gives a momentary meter range from -18 to +9 LU.
- The "EBU +18" setting gives a momentary range from -36 to 18 LU.

Low Level Below parameter

Parameter settings: -6 LU to -30 LU in 1 LU steps

Use the Low Level Below parameter to set the transition between the colors blue and green on the momentary ring. It indicates that the level is at the risk of being below the noise floor.

Create Log File parameter

Parameter settings: On, Off

Set the Create Log File parameter to On to start creating log files in the folder defined with the Log File Folder parameter.

Log File Folder parameter (LM6n only)

Use the Log file folder parameter to set the folder on your computer's hard disk where LM6n log files should be stored.

- Click the Choose button.
- Select a folder.
- Click OK to confirm.

The selected folder will be displayed at the bottom of the Settings page.

Reveal in Windows Explorer / Reveal in Finder (LM6n only)

Click this button to reveal (open) the folder defined with the Log file folder parameter.

Loudness Unit parameter

Parameter settings: LUFS / LKFS / LU/LUFS / LU/LKFS

Use the Loudness Unit parameter to choose between LKFS and LUFS depending on preference and region.

- LKFS is the unit for loudness according to the International Telecommunication Union (ITU).
- LUFS is the unit for loudness according to the European Broadcasting Union (EBU).
- LU is the unit for loudness relative to the target value according to the ITU and the EBU.

If you use the LU/LUFS or the LU/LKFS setting, the Radar will show LU values, while for instance Target Loudness will be displayed as LUFS or LKFS respectively.

Loud(ness) Standard parameter

Parameter settings: BS.1770-3, Leq(K)

Use the Loud(ness) Standard parameter to set the loudness standard that measurements should adhere to.

Sliding Loudness Time (Slid. Loud. Time) parameter

Parameter settings: 3, 6, 10, 15, 30 sec, 1, 2, 4, 8 min

When Sliding Loudness is selected as Descriptor 1 or 2, use the Sliding Loudness Time parameter to set the window for analysis. E.g. if 6 seconds

is selected, the loudness range for the past 6 seconds is displayed.

Max Loudness Time (Max Loud. Time) parameter

Parameter settings:
0.4 sec – Momentary (M),
3 sec – Short Term (S)

Use the Max Loudness Time parameter to set the time window used for measuring Maximum Loudness.

This parameter can only be edited if the Left Descriptor parameter is set to another value than Max Momentary or Max Short Term.

If Left Descriptor is set to Max Momentary, this value is set to 0.4, and this setting is grayed out. If Left Descriptor is set to Max Short Term, this value is set to 3 sec., and this setting is grayed out.

Peak Indicator parameter

Parameter range: -12 to +3 dBTP in 0.5 dBTP steps

Use the Peak indicator parameter to define at which level the red peak indicator in the top right corner of the Radar page and the PPM page should light up.

Surround Channel Order (Surr.Ch. Order) parameter (LM6n only)

Parameter settings:
– L C R – Ls Rs – LFE (Film)
– L R – C – LFE – Ls Rs (SMPTE/ITU)
– L R – Ls Rs – C LFE (DTS)

Use the Surround Channel Order parameter to choose in which order the surround channels should be shown in the PPM view.

Radar Color parameter

Parameter settings: Normal, Desaturated

Use the Radar Color parameter to set the color scheme for the Radar.

The desaturated color scheme is particularly useful for users working in film applications (who usually don't want a colorful interface to distract them from the film they are working on).

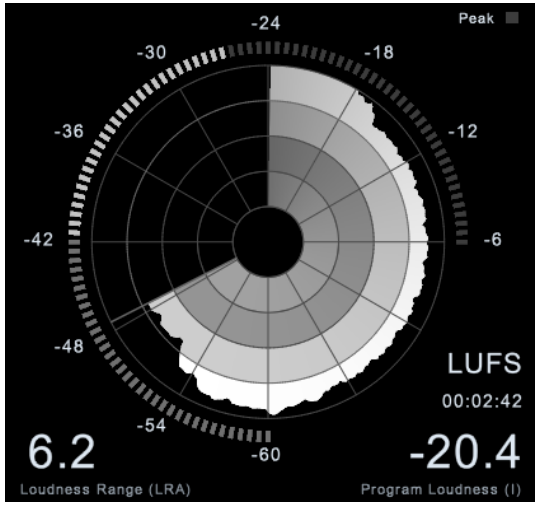


Fig. 18.: LM2n Radar in desaturated mode

Follow Transport parameter

Parameter settings: On, Off

Use the Follow Transport parameter to define if measurements should follow the transport controls (Start / Stop / Pause) of your host application, or run continuously.

– Off setting: The Radar runs all the time, except if manually set to PAUSE mode.
– On: The Radar runs depending on the state of the host applications transport controls.

Reset on Play parameter

Parameter settings: On, Off

When you set this parameter to On, measurements will be reset when going into Play mode.

Presets

LM2n / LM6n Preset name and target loudness Parameter	Default	ATSC A/85 LU (-24)	ATSC A/85 LKFS (-24)	ARIB TR-B32 LU (-24)	ARIB TR-B32 LKFS (-24)	EBU R128 LU (-23)	EBU R128 LUFS (-23)	OP-59 LU (-24)	OP-59 LKFS (-24)	CD Master (-15)	Film (-24)	Film (-27)	Film (-31)	Mobile (-16)
Target Loudness	-24	-24	-24	-24	-24	-23	-23	-24	-24	-15	-24	-27	-31	-16
Radar Speed	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Radar Resolution	6	6	6	6	6	6	6	6	6	6	10	10	10	6
Momentary range	EBU +18	EBU +18	EBU +18	EBU +18	EBU +18	EBU +9	EBU +9	EBU +18	EBU +18	EBU +18	EBU +18	EBU +18	EBU +18	EBU +9
Low Level below	-9	-18	-18	-18	-18	-9	-9	-18	-18	-18	-18	-18	-18	-9
Loudness Unit	LKFS	LKFS/LU	LKFS	LKFS/LU	LKFS	LUFS/LU	LUFS	LKFS/LU	LKFS	LKFS	LKFS	LKFS	LKFS	LKFS
Loudness Standard	BS.1770-3	BS.1770-3	BS.1770-3	BS.1770-3	BS.1770-3	BS.1770-3	BS.1770-3	BS.1770-3	BS.1770-3	BS.1770-3	BS.1770-3	BS.1770-3	BS.1770-3	BS.1770-3
Sliding Loudness Time	10 sec	10 sec	10 sec	10 sec	10 sec	10 sec	10 sec	10 sec	10 sec	10 sec	10 sec	10 sec	10 sec	10 sec
Peak Indicator	-2	-2	-2	-2	-2	-1	-1	-2	-2	0	0	0	0	0
Follow Transport	On	On	On	On	On	On	On	On	On	On	On	On	On	On
Yellow Upper Limit	+1	+1	+1	+1	+1	+0.5	+0.5	+1	+1	+2	+3	+3	+3	+1
Yellow Lower Limit	-1	-1	-1	-1	-1	-0.5	-0.5	-1	-1	-2	-3	-3	-3	-1
Red Upper Limit	+2	+2	+2	+2	+2	+1	+1	+2	+2	+4	+7	+7	+7	+2
Red Lower Limit	-2	-2	-2	-2	-2	-1	-1	-2	-2	-4	-7	-7	-7	-2

Appendix: Level versus loudness

The path to BS.1770

When level normalization in audio distribution is based on a peak level measures, it favors low dynamic range signatures as shown in Fig. 7. This is what has happened to the CD format.

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 headroom needed 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.** Though 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 factors – **SPL, frequency contents and duration** – differently. 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 depends on the time of day, her mood etc. BLV adds further to the blur, when sex, culture, age etc. 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 pick, 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 Dorroughs, 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 LM2n / LM6n follows the standard precisely. Possible updates to the ITU standard may be released as updates to LM2n / LM6n (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.

For details, visit the TC Tech Library at tcelectronic.com/tech-library/

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 LM2n / LM6n 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.
– All 5.1 channels fed with a -20 dBFS, 1 kHz sine tone: Reading of -15.4 LUFS.

Display

LM2n / LM6n 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 LM2n and LM6n, 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 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 LM2n / LM6n helps correct that situation.

LM2n / LM6n can be used to control level and improve sound – not only in Dolby AC3-based transmissions, but also on other broadcast platforms, such as analog TV, mobile TV and IPTV.

To summarize:
LM2n / LM6n is part of a holistic and universal approach to loudness control, starting at 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.