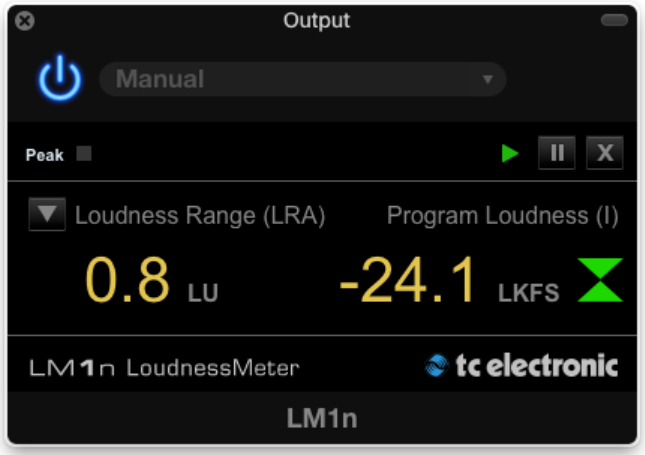
tc electronic®

English Manual

LM1n



Product	LM1n
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. LM1n 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 LM1n 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.

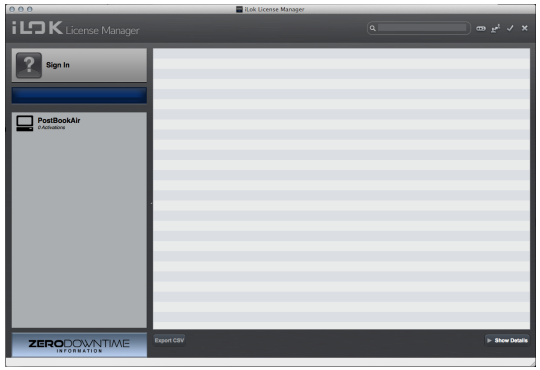


Fig. 1.: The iLok License Manager

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

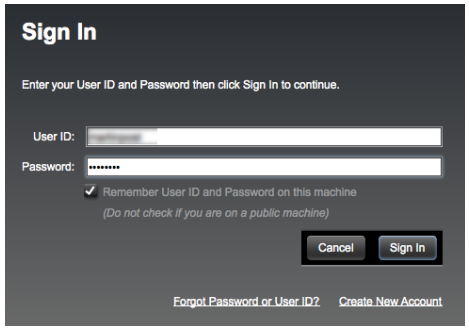


Fig. 2.: iLok License Manager: Sign In dialog

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”.

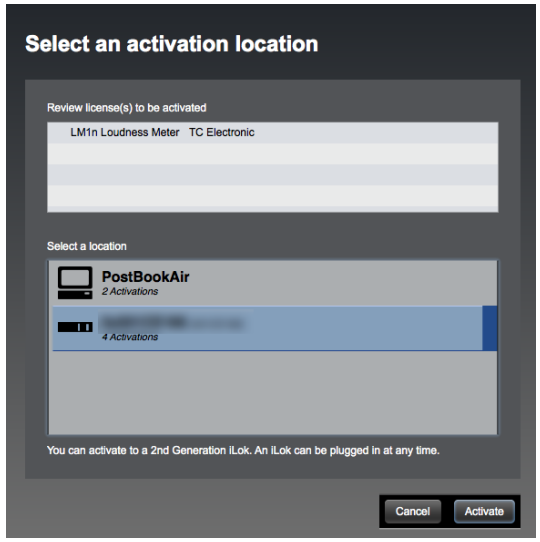


Fig. 3.: Plug-in activation from iLok License Manager

Installing LM1n

– Make sure your host software is not running.
– Run the installer for the LM1n plug-in. You may need an administrator account name and password to run the installer.

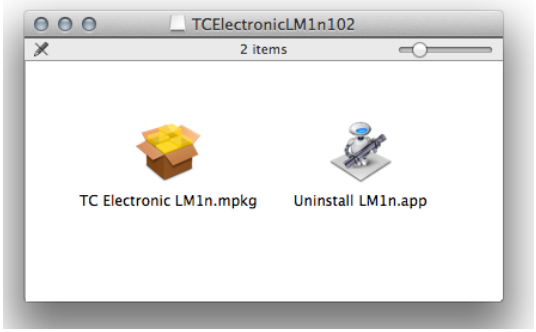
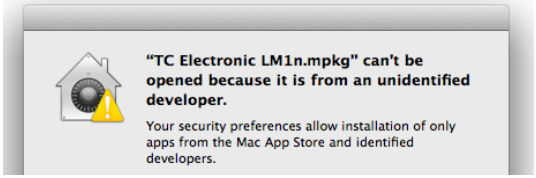


Fig. 4.: The LM1n installer

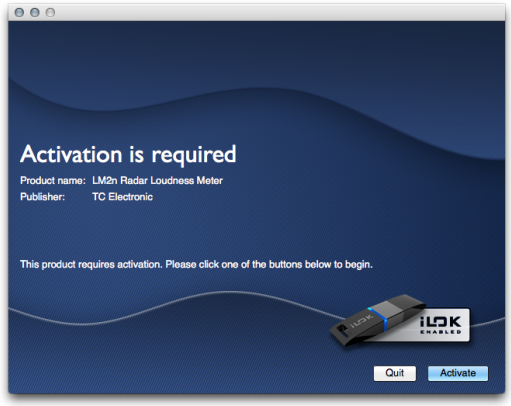
– On OS X, you may see the following dialog when you try to open the installer by double-clicking it:



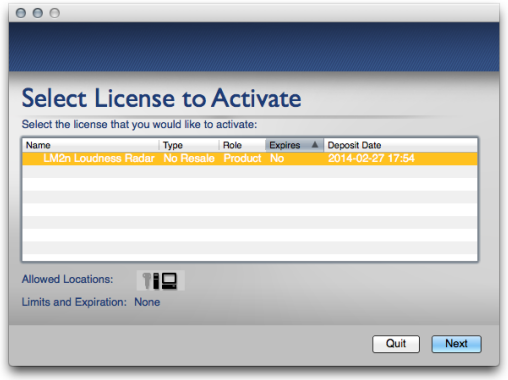
– If you see this dialog, close it, then, right-click the installer's icon and select "Open" from the context menu. This will open another dialog, allowing you to confirm that you want to install this plug-in and continue with the installation process.
– Read and accept the Software License Agreement presented by the installer.
– Finish the installation of the LM1n 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”.

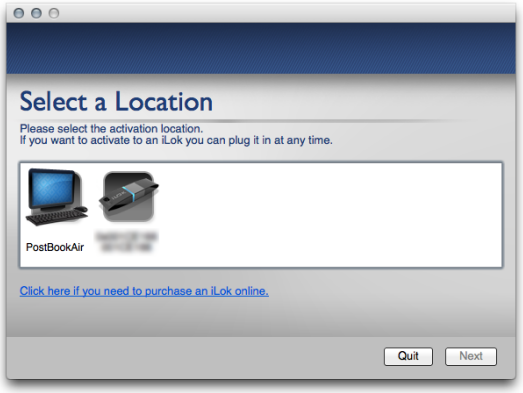


Fig. 5.: Plug-in activation during host software startup

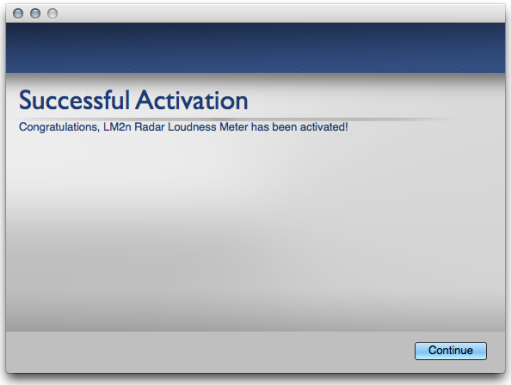


Fig. 6.: Plug-in Activation confirmation

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

Using LM1n

LM1n features

- Loudness meter fully compliant with
  - EBU R128
  - BS.1770-3
  - ATSC A/85 2013
  - ITU-R BS.1770
- Radar meter showing momentary and short-term loudness
- True-peak bar graph meters
- Universal Descriptors
- Presets for use in broadcast, music, post production and film
- Offline measurements
- Supports mono and stereo sources

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

LM1n 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 LM1n:

- Installation is possible without a physical iLok device (see “Installation” on page 4).
- Offline processing capabilities have been improved.
- There are now dedicated Max Momentary Loudness and Max Short Term Loudness descriptors.

Welcome!

LM1n 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.

LM1n 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. LM1n 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 LM1n

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.

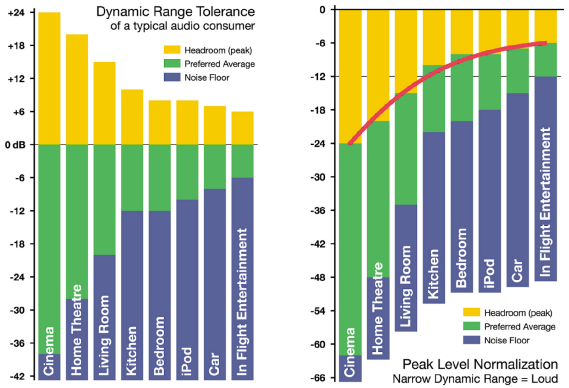


Fig. 7.: Left: Dynamic Range Tolerance (DRT) for consumers under different listening situations.
Right: Peak level normalization means that material targeted low dynamic range platforms gets loud.

The Universal Database is authoritative from an academic as well as a practical point of view. It has been indispensable when designing the LM1n meters, because it provided the missing link between short-term and long-term loudness, and enabled the statistically founded Universal Descriptors of LM1n.

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.

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.

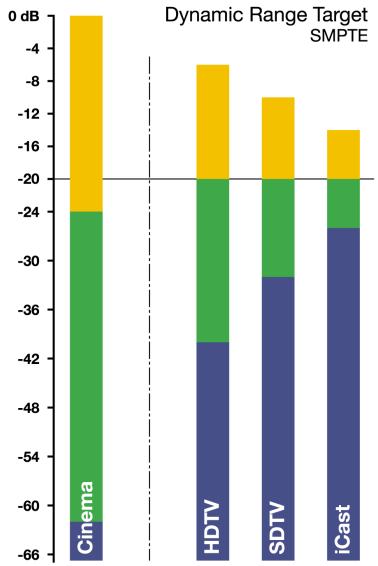


Fig. 8.: Color coding and target loudness for selected broadcast platforms based on a consumer's Dynamic Range Tolerance (DRT). The aim is to center dynamic range restriction around average loudness, in this case the -20 dB line, thereby automatically avoiding to wash out differences between foreground 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.

LM1n and TC signal processing can coexist with PPM meters, VU meters or Dolby's LM100 meter. LM1n 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.

Universal Descriptors and Dolby LM100

Unlike methods that measure dialog only, LM1n 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 LM1n. 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 LM1n . 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 LM1n 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 LM1n 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.

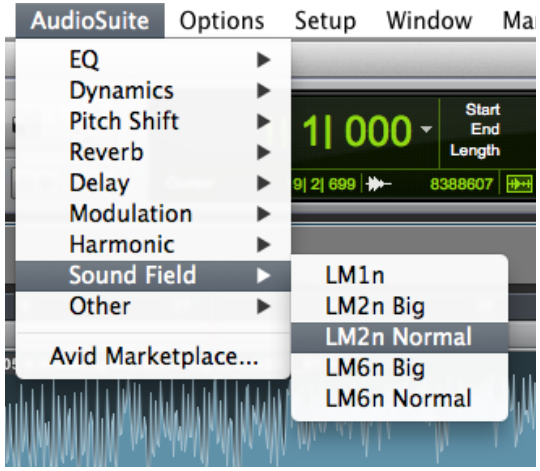
If your station is more music than speech, better inter-channel leveling may be obtained with dialnorm permanently set 1 or 2 LU lower than the Program Loudness target level.

Offline measurements

In Avid Pro Tools, LM1n 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 / LM1n.



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

LM1n will measure the loudness of the selected track or audio part and present you with the results.

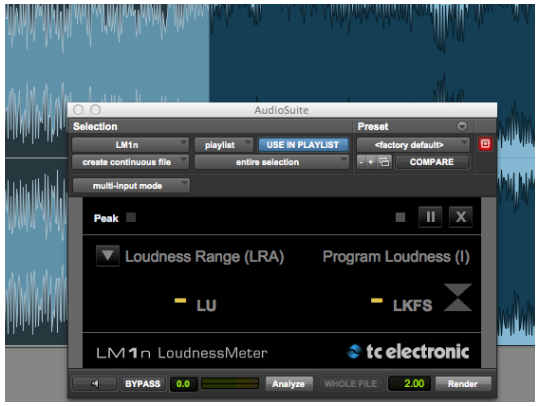


Fig. 9.: LM1n selected for offline measurements. Click the “Analyze” button to perform measurements.

Interface and feature reference

Main controls

Fig. 10.: Status indicator, Pause button, Reset button

Reset button

To clear all current measurements, click the Reset button.

Make it a habit to click the Reset button before a new measurement. This resets the Descriptors. Run the audio, and watch 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.

Pausing measurements

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

The LM1n interface

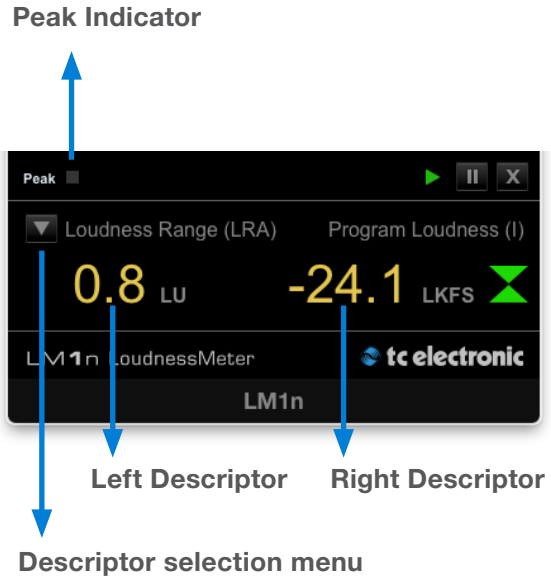


Fig. 11.: The LM1n interface

Peak Indicator

In the upper left corner of the page is a Peak indicator.

Descriptors

The parameter values shown in the LM1n's interface 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 left descriptor is **Loudness Range (LRA).** The right descriptor is always **Program Loudness (I)**.

Use the Descriptor selection drop-down menu to change the left Descriptor.

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 LM1n are all rooted in ITU-R BS.1770.

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 (10 sec) 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.

LM1n makes use of optimized statistics processing in order to display a sliding loudness value (a prognosis) as quickly as possible after a reset.

In LM1n, Sliding Loudness is based on a 10 second analysis “window”.

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.

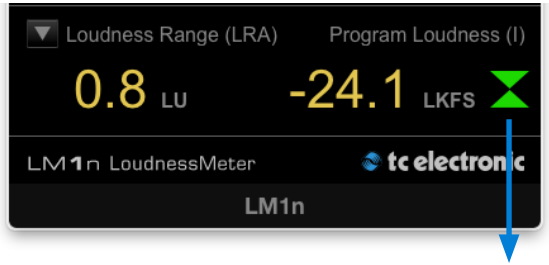
While Program Loudness concerns the entire, full-length program, Momentary loudness is measured in a window of 400 ms.

Max Short Term (S) descriptor

Max Short Term is the maximum momentary value through the entire program.

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

Descriptor arrows



Descriptor arrows

The LM1n’s Descriptor Arrows will help you adjusting Gain correctly. They are especially helpful if the user doesn’t have a lot of experience. Red

and yellow arrows indicate that the user should adjust gain.

Colors indicate plug-in measurements as follows:

- **Both arrows gray:**
  No measurements have been made yet, or the plug-in has been reset.
- **Bottom arrow red:**
  Below target, and far away.
  Increase gain.
- **Top arrow red:**
  Above target, and far away.
  Decrease gain.
- **Bottom arrow yellow:**
  Below target, but close.
  Increase gain slightly.
- **Top arrow yellow:**
  Above target, but close.
  Decrease gain slightly.

Presets

LM1n **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
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 LM1n follows the standard precisely. Possible updates to the ITU standard may be released as updates to LM1n (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 LM1n 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

LM1n 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 LM1n helps correct that situation.

LM1n 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:
LM1n 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.