LM100 Broadcast Loudness Meter User's Manual

Issue 3 Part Number 91846

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Part Number 91846
Issue 3
S06/14721/17486

Regulatory Notices

USA

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with this instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his or her own expense.

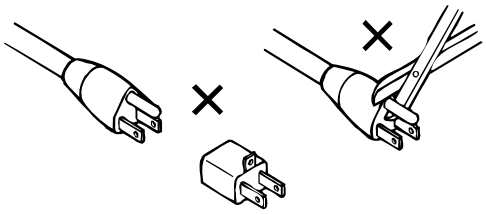
Warning: Troubleshooting must be performed by a trained technician. Do not attempt to service this equipment unless you are qualified to do so

Warning: Check that the correct fuses have been installed. To reduce the risk of fire, replace only with fuses of the same type and rating.

Exposed portions of the power supply assembly are electrically "hot." To reduce risk of electric shock, the power cord **must** be disconnected when the power supply assembly is removed.

Warning: Before applying power, check the main fuse, using the procedure on page vi.

The ground terminal of the power plug is connected directly to the chassis of the unit. For continued protection against electric shock, a correctly wired and grounded (earthed) three-pin power outlet must be used. Do not use a ground-lifting adapter and never cut the ground pin on the three-prong plug.



Canada

This Class A digital apparatus complies with Canadian ICES-003.

UK

The power cord supplied for use in Europe is not suitable for use in the UK. To use the cord in the UK, cut off the CEE7/7 plug and replace with an approved BS 1363 13A plug:

- The green and yellow core must be connected to the terminal in the plug identified by the letter E, or by the earth symbol ⏚, or colored green, or green and yellow.
- The blue core must be connected to the terminal marked with the letter N or colored black.
- The brown core must be connected to the terminal marked with the letter L or colored red.
- This apparatus must be earthed.

EU

This equipment complies with the EMC requirements of EN55103-1 and EN55103-2 when operated in an E2 environment in accordance with this manual.

IMPORTANT SAFETY NOTICE

This unit complies with the safety standard EN60065. The unit shall not be exposed to dripping or splashing and no objects filled with liquids, such as coffee cups, shall be placed on the equipment. To ensure safe operation and to guard against potential shock hazard or risk of fire, the following **must** be observed:

oEnsure that your mains supply is in the correct range for the input power requirement of the unit.
oEnsure **fuses** fitted are the **correct rating and type** as marked on the unit.
oThe unit **must be earthed** by connecting to a correctly wired and **earthed** power outlet.
oThe **power cord** supplied with this unit must be wired as follows:

GB

Live—Brown Neutral—Blue Earth—Green/Yellow

IMPORTANT – NOTE DE SECURITE

Ce materiel est conforme à la norme EN60065. Ne pas exposer cet appareil aux éclaboussures ou aux gouttes de liquide. Ne pas poser d'objets remplis de liquide, tels que des tasses de café, sur l'appareil. Pour vous assurer d'un fonctionnement sans danger et de prévenir tout choc électrique ou tout risque d'incendie, veillez à observer les recommandations suivantes.

F

oLe selecteur de tension doit être placé sur la valeur correspondante à votre alimentation réseau.
oLes fusibles doivent correspondre à la valeur indiquée sur le materiel.
oLe materiel doit être correctement relié à la terre.
oLe cordon secteur livré avec le materiel doit être cablé de la manière suivante:

Phase—Brun Neutre—Bleu Terre—Vert/Jaune

WICHTIGER SICHERHEITSHINWEIS

Dieses Gerät entspricht der Sicherheitsnorm EN60065. Das Gerät darf nicht mit Flüssigkeiten (Spritzwasser usw.) in Berührung kommen; stellen Sie keine Gefäße, z.B. Kaffeetassen, auf das Gerät. Für das sichere Funktionieren des Gerätes und zur Unfallverhütung (elektrischer Schlag, Feuer) sind die folgenden Regeln unbedingt einzuhalten:

oDer Spannungswähler muß auf Ihre Netzspannung eingestellt sein.
oDie Sicherungen müssen in Typ und Stromwert mit den Angaben auf dem Gerät übereinstimmen.
oDie Erdung des Gerätes muß über eine geerdete Steckdose gewährleistet sein.
oDas mitgelieferte Netzkabel muß wie folgt verdrahtet werden:

D

Phase—braun Nulleiter—blau Erde—grün/gelb

NORME DI SICUREZZA – IMPORTANTE

Questa apparecchiatura è stata costruita in accordo alle norme di sicurezza EN60065. Il prodotto non deve essere sottoposto a schizzi, spruzzi e gocciolamenti, e nessun tipo di oggetto riempito con liquidi, come ad esempio tazze di caffè, deve essere appoggiato sul dispositivo. Per una perfetta sicurezza ed al fine di evitare eventuali rischi di scossa êlettrica o d'incendio vanno osservate le seguenti misure di sicurezza:

oAssicurarsi che il selettore di cambio tensione sia posizionato sul valore corretto.
oAssicurarsi che la portata ed il tipo di fusibili siano quelli prescritti dalla casa costruttrice.
oL'apparecchiatura deve avere un collegamento di messa a terra ben eseguito; anche la connessione rete deve avere un collegamento a terra.
oIl cavo di alimentazione a corredo dell'apparecchiatura deve essere collegato come segue:

I

Filo tensione—Marrone Neutro—Blu Massa—Verde/Giallo

AVISO IMPORTANTE DE SEGURIDAD

Esta unidad cumple con la norma de seguridad EN60065. La unidad no debe ser expuesta a goteos o salpicaduras y no deben colocarse sobre el equipo recipientes con liquidos, como tazas de cafe. Para asegurarse un funcionamiento seguro y prevenir cualquier posible peligro de descarga o riesgo de incendio, se han de observar las siguientes precauciones:

oAsegúrese que el selector de tensión esté ajustado a la tensión correcta para su alimentación.
oAsegúrese que los fusibles colocados son del tipo y valor correctos, tal como se marca en la unidad.
oLa unidad debe ser puesta a tierra, conectándola a un conector de red correctamente cableado y puesto a tierra.
oEl cable de red suministrado con esta unidad, debe ser cableado como sigue:

E

Vivo—Marrón Neutro—Azul Tierra—Verde/Amarillo

VIKTIGA SÄKERHETSÅTGÄRDER

Denna enhet uppfyller säkerhetsstandard EN60065. Enheten får ej utsättas för yttre åverkan samt föremål innehållande vätska, såsom kaffemuggar, får ej placeras på utrustningen." För att garantera säkerheten och gardera mot eventuell elchock eller brandrisk, måste följande observeras:

oKontrollera att spänningsväljaren är inställd på korrekt nätspänning.
oKonrollera att säkringarna är av rätt typ och för rätt strömstyrka så som anvisningarna på enheten föreskriver.
oEnheten måste vara jordad genom anslutning till ett korrekt kopplat och jordat el-uttag.
oEl-sladden som medföljer denna enhet måste kopplas enligt foljande:

S

Fas—Brun Neutral—Blå Jord—Grön/Gul

BELANGRIJK VEILIGHEIDS-VOORSCHRIFT

Deze unit voldoet aan de EN60065 veiligheids-standaards. Dit apparaat mag niet worden blootgesteld aan vocht. Vanwege het risico dat er druppels in het apparaat vallen, dient u er geen vloeistoffen in bekers op te plaatsen. Voor een veilig gebruik en om het gevaar van electrische schokken en het risico van brand te vermijden, dienen de volgende regels in acht te worden genomen:

oControleer of de spanningscaroussel op het juiste Voltage staat.
oGebruik alleen zekeringen van de aangegeven typen en waarden.
oAansluiting van de unit alleen aan een geaarde wandcontactdoos.
oDe netkabel die met de unit wordt geleverd, moet als volgt worden aangesloten:

NL

Fase—Bruin Nul—Blauw Aarde—Groen/Geel

Fusing Information

Warning: To reduce the risk of fire, replace fuses only with the same type and rating.

The LM100 uses a universal switching power supply that handles the full range of nominal mains voltages between 90 and 264 VAC and any frequency between 50 and 60 Hz.

Main Fuse

The main fuse rating is:

T 1A L (1 amp, 250 V, 20 mm, time-lag, low breaking capacity) for all operating voltages.

The power cord must be removed from the rear-panel connection to inspect or replace the fuse.

To inspect or replace the main fuse:

Slide open the fuse compartment in the AC power input housing by placing the tip of a small screwdriver in the notch.

Carefully pull out the fuse carrier.

Either replace the fuse with a new one, or check that the current fuse has the correct rating.

Slide the fuse compartment back into place, then snap the fuse compartment closed.

Internal Fuse

The switching power supply contains a separate fuse. Most fault conditions should be protected by the main fuse.

If you find it necessary to replace the internal fuse, be certain to replace it with a fuse of the same type and rating as printed on the switching power supply board.

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Introduction

Beset by loudness discrepancies—between programs or channels of television services—the broadcast, satellite, and cable TV industries have long required a simple method for quantifying perceived audio levels. These industries have traditionally controlled their program levels using either a PPM or VU meter, neither of which measures subjective loudness.

The Dolby® LM100 Broadcast Loudness Meter with Dialogue Intelligence™ features a revolutionary measurement technology capable of quantifying the subjective loudness of speech in broadcast programming. This technology has been specifically developed to analyze the input signal and make measurements only when dialogue is present.

Quantifying the dialogue level simplifies a crucial step in broadcasting. When switching between programs, most home listeners adjust their television volume controls in an effort to achieve consistency in dialogue levels between programs. By properly quantifying the level of dialogue, you can ensure that the Dolby `Dialogue Level` metadata parameter is accurate. Setting this parameter accurately standardizes the loudness for all programs, eliminating the need for home listeners to adjust the volume. For details on Dolby metadata, see *A Guide to Dolby Metadata*, available at: www.dolby.com/assets/pdf/tech_library/18_Metadata.Guide.pdf.

The LM100 measurement algorithm yields more consistent results with sources that primarily contain dialogue (considerably more so than PPM or VU meters); it is also compliant with the IEC 60804 specification and displays the results in an easy-to-understand numerical format.

You can use the LM100 in applications ranging from postproduction and quality control to final transmission and program turnaround.

The LM100 accepts stereo PCM, two-channel analog (baseband) audio, and multichannel Dolby E and Dolby Digital (AC-3) inputs. For a facility working with analog or two-channel PCM audio, the unit can accurately quantify the subjective loudness of dialogue (and therefore the overall program level), which is useful in almost any environment where audio levels must be assessed. For facilities working with Dolby Digital or Dolby E signals, the LM100 can also measure or validate the existing dialogue level (also known as dialogue normalization, or dialnorm) parameter value within a Dolby Digital or Dolby E program by making a direct, objective comparison to the actual measured dialogue level value.

In addition, the LM100 can determine the unweighted "true" peak and a range of other audio signal information. The unit includes a set of user-definable alarms and monitoring functions that can inform an operator of input loss, signal clipping, RF overmodulation, high or low signal levels, silence, phase errors, and incorrectly set dialogue level (dialnorm) values. A dedicated GPI/O port provides a tally of these alarm conditions, with more extensive monitoring available through the serial ports and an internal event log.

1.1 LM100 Front and Rear Panels

The front panel includes the following features:

- Controls to easily select the input source, program, and/or individual channels for measurement
- Dedicated controls to pause and reset the measurement function
- LEDs that indicate fault, error, and audio alarm conditions
- A headphone jack with volume control

For detailed information on the LM100 front panel, see Chapter 3.

The rear panel provides the following connectors:

- AES3 digital input with loop-through
- Two balanced analog inputs on combination XLR/quarter-inch TRS connectors
- A pair of RCA connectors for confidence and signal-presence monitoring of the selected source
- GPI/O status and alarm ports

For detailed information on the LM100 rear panel, see Chapter 2.

Note: The LM100 front- and rear-panel serial interfaces provide remote control, status logging, and a means for updating software.

1.2 LM100 Configurations

The unit is available in the following two configurations:

- The LM100-LTC includes a linear timecode input that allows signal-condition alarm events to be logged against an external timecode (LTC) input.
- The LM100-NTSC includes an RF input specifically for CATV and NTSC “off air” television measurement applications. The RF tuner also includes a composite video output. The RF input replaces the timecode input, therefore logging in this version is referenced to the internal clock.

Installation

This chapter describes the required LM100 physical connections.

2.1 Mounting

The LM100 is a 1-U rackmount unit that operates at ambient temperatures up to 50°C (122°F). It ventilates through the rear and side panels.

Caution: Do not mount the LM100 directly above heat-generating equipment. Ensure adequate ventilation. The temperature inside a poorly ventilated rack can be considerably higher than ambient room temperature.

2.2 Rear-Panel Connections

The rear-panel connections include an AES3 digital input with loop-through, analog inputs and outputs, serial ports, GPI/O ports, and the power supply. It is best to make all other connections before connecting the power supply.

Figure 2-1 shows the rear-panel audio and data connections. The upper image shows the **RF Input** and **Video Output** ports available on the LM100-NTSC, and the lower image shows the **Timecode Input** port available on the LM100-LTC. All other connectors are identical on both models.

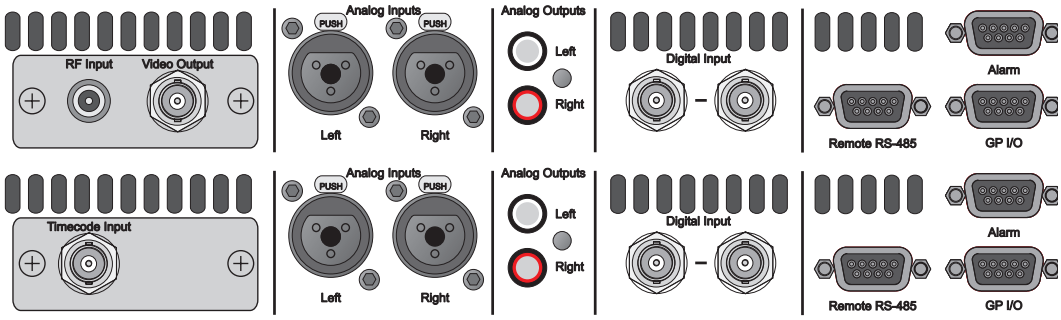


Figure 2-1 Rear-Panel Audio and Data Ports

2.2.1 Analog Inputs

Each analog audio input jack accepts either a male XLR connector or a quarter-inch TRS connector. The maximum input signal level is +22 dBu.

2.2.2 Analog Outputs

The **Left** and **Right Analog Outputs** are provided on standard RCA connectors. They carry a two-channel audio signal automatically downmixed from a multichannel signal if necessary, for confidence monitoring of the active audio program.

2.2.3 Digital Inputs

The **Digital Input** BNC connectors are AES3id compliant. The unit processes Dolby® E, Dolby Digital, and PCM audio streams, with up to 24-bit resolution. You can use the second BNC as a passive loop-through to connect to other equipment; otherwise it must be terminated using a standard 75 ohm termination.

2.2.4 Remote RS-485

You can use the **Remote RS-485** port for software upgrades, to connect to a custom-built remote-control software interface, or to send system log file entries to any device that can receive ASCII text strings using the RS-485 protocol. For details, see Section 5.6.

2.2.5 Alarm

Individual signal-condition alarms trigger pins on this port. You can connect this port to any device that can detect a TTL voltage level change. For details, see Section 5.5.

2.2.6 GPI/O

Specific LM100 status information and control inputs are provided through the **GP I/O** port. You can use a GPI/O device with the LM100 without setting it to Remote mode. For details, see Section 5.7.

2.2.7 NTSC Connections

The LM100-NTSC includes a standard **RF Input** port. Use a standard 75 RF cable to connect the LM100 to either a cable TV input or an antenna receiving off-air signals.

The LM100-NTSC **Video Output** is a standard composite video signal available on a female BNC connector. It allows confidence monitoring of the video for the active program.

2.2.8 LTC Connection

The LM100-LTC includes a **Timecode Input** port that can read linear timecode per the SMPTE 12M specification.

2.2.9 Power

The main fuse rating is:

T 1A L (1 amp, 250 V, 20 mm, time-lag, low breaking capacity) for all operating voltages.

Warning: Before applying power, check the main fuse using the procedure on page vi.

There is no power switch on the LM100. To apply power, connect the power cord to a live outlet.

Front-Panel Controls

This chapter describes the LM100 front-panel controls.

Figure 3-1 LM100 Front Panel

3.1 Button Functions

You use the LM100 front-panel buttons to navigate menus, for measurement related functions, and for special functions, such as hardware resets, factory resets, and firmware upgrades. Following is a description of each button.

3.1.1 Navigation Buttons

The front-panel buttons control the LM100. The front of each button is labeled with its primary function. Above or below some buttons are alternate functions. To enable an alternate function, press the LM100 **Shift** button, and then press the corresponding button. The **Shift** button lights when pressed, and remains lit until you press a button with an associated shift command, press **Shift** again, or press the LM100 **Esc** button.

Pressing ← scrolls through the status menus. In setup menus and the `Dolby E Metadata` and `Dolby Digital Metadata` status menus, when selecting an option, pressing ← returns the display to the next-higher menu level without activating your selection.

Pressing **Shift**, ← activates remote operation. The ← button is lit, and the unit remains in remote operation until the same combination is pressed again.

In the `Headphone Volume` or `Brightness` menu, pressing ← decreases the setting incrementally.

Pressing ↑ moves the selection from the current menu option to the one above.

In the `Headphone Volume` or `Brightness` menu, pressing ↑ increases the setting incrementally.

In the main status screen, pressing **Shift**, ↑ increases the RF channel number when the `RF Input` is selected.

Pressing ↓ moves your selection from the current menu item to the one below.

In the `Headphone Volume` or `Brightness` menu, pressing ↓ decreases the setting incrementally.

In the main status screen, pressing **Shift**, ↓ decreases the `RF channel number` when `RF input` is selected.

Pressing ➜ scrolls through the status menus. In setup menus and the `Dolby E Metadata` and `Dolby Digital Metadata` status menus, when a menu option is selected, pressing ➜ displays the submenu for that option.

Pressing **Shift**, ➜ displays the `Brightness` menu.

When you select a menu option, pressing **Enter** displays the submenu for that option.

In the `Main Setup` menu, when a parameter setting is selected, pressing **Enter** activates the selected parameter and displays the next higher menu level.

In the main status screen, pressing **Enter** scrolls through the display options on the right side of the screen.

3.1.2 Measurement Buttons

In a status menu, pressing **Setup** displays the last setup menu viewed.

In a setup menu, pressing **Setup** displays the `Main Setup` menu.

In a setup menu, pressing the **Status** combination (**Shift**, **Setup**) displays the last status menu viewed.

In a status menu, pressing **Status** displays the main status screen.

Pressing **Esc** returns the display to the next-higher menu level without activating a selected parameter.

In the `Headphone Volume` or `Brightness` menu, pressing **Esc** returns the display to the last menu viewed.

Reset and **Pause** are dedicated controls for measuring loudness. For details on loudness measurement functions, see Section 5.1.

3.1.3 Special Buttons

In special cases, you may need to reset the LM100 or upgrade the firmware. Table 3-1 shows the button combinations to press for each of these special functions.

Table 3-1 Special Button Functions

Function	Action/Result
Hardware Reset	Press **Shift, Esc**, ➔ simultaneously; the LM100 reboots.
Firmware Upgrade	During reboot, press and hold **Setup**; the status display provides you with the option of upgrading the unit firmware or completing the boot sequence.
Factory Reset	During reboot, press and hold **Enter**; the status display provides you with the option of restoring factory defaults or completing the boot sequence. **Note:** Restoring factory defaults includes all presets and GPI/O configuration assignments.

3.2 LED Indicators

The **Audio Alarm** indicator is illuminated if a user-configurable signal-condition alarm is triggered, as described in Section 5.5.

The **Error** indicator is illuminated when an error prevents the unit from processing the selected input correctly (for example, if there is a loss of input signal or the input signal does not match the requirements for the selected input type). Error conditions are detailed in Table 3-2. When the **Error** indicator is triggered, the `Error Stats` status menu provides more information regarding the source of the error, as detailed in the table.

Note: The **Fault** indicator is illuminated if there is an LM100 hardware fault.

Table 3-2 Error Conditions

Menu Display	Error	Corrective Action
`Invld Frmt`	The input format does not match the selected decode format.	Check the input signal format or change the selected decode format.
`Invld Rate`	The input is a valid PCM signal, but the sampling rate is not 32 kHz, 44.1 kHz, or 48 kHz.	Use the correct sampling rate.
`Invld Prog`	The input is a valid Dolby® E signal, but the selected Dolby E program number is not present in the input stream.	Select a valid program number for the input stream.
`DE Frm Dsc`	The Dolby E frame count is not continuous, indicating a missing frame or edit.	Check the Dolby E stream.
`Invld AES Ch`	The input is a valid Dolby Digital signal, but the selected AES3 channel contains an invalid bitstream.	Select a valid AES3 channel setting.
`Invld Bstr`	The digital input is selected, but the unit is receiving a bitstream it does not understand (that is, not Dolby E or Dolby Digital).	Provide a valid bitstream.
`No Input`	Digital input is missing (when selected input is digital) or RF input is missing (when selected input is RF on LM100-NTSC).	Change the input selection or check the input source.
`Invld Ch Md`	The input is a valid Dolby E signal, but the metadata indicates more channels than exist in the selected program.	Check the Channel mode configuration parameter within the selected program in the Dolby E stream.
`RF Ov Prot`	The Dolby E metadata RF overmodulation protection parameter is enabled in one or more of the programs.	Check the Dolby E stream.
`No DD Md`	Dolby E metadata does not contain Dolby Digital metadata.	Check the Dolby E stream.
`Uncal`	Unit is uncalibrated.	Return the unit to the factory for calibration.

3.3 RS-232 Connection

The **Remote RS-232** port can be used for software upgrades, to connect to a custom-built remote-control software interface, or to send LM100 system log file entries to any device that can receive ASCII text strings using RS-232 protocol. For details, see Section 5.6.

Note: Connecting a cable to this port disables the rear-panel **Remote RS-485** port.

3.4 Headphone Connection

You can connect headphones to the LM100 for confidence monitoring of the active program. To adjust headphone volume, press the front-panel button combination **Shift**, **Enter.**

Menus

This chapter explains how to navigate through the LM100 menus. It also provides a detailed description of the status menus and the `Main Setup` menu.

4.1 Menu Basics

The LM100 front-panel screen displays status menus that show the current measurement and settings, and setup menus that control the LM100 functions.

The status menus and `Main Setup` menu are separate structures. To view the `Main Setup` menu when a status menu is displayed, press **Setup.** To view a status menu when a setup menu is displayed, press the **Status** button combination: **Shift**, **Setup**.

Note: If you do not press a front-panel button within the specified interval (shown in the `Screen Saver Timeout` setup menu), the LM100 displays a screen saver (which inverts the display). Pressing any front-panel button returns the screen to normal.

4.2 Status Menus

The status menus display the current measurement values and active settings for a selection of setup parameters and the condition and content of input signals.

The main status screen shows the current measured loudness value and information regarding the input stream status.

You can display additional input stream status information by pressing the ← and → buttons to scroll through the other status menus.

4.2.1 Main Status Screen

When you power on the LM100, the main status screen appears. It is the most important LM100 screen, as it shows the measured loudness values. This menu is usually divided into three sections, although one display option divides the screen into two sections. Examples of the main status screen with and without an input signal are shown in Figure 4-1 and Figure 4-2, respectively.

Figure 4-1 Main Status Screen when Receiving a Dolby Digital Stream

Figure 4-2 Main Status Screen with No Input Signal

Left Section

The input stream type is identified in the upper left section. When the source is Dolby® Digital, the Channel mode appears (3/2 in this example); if an LFE channel is included, it is indicated by an L to the right of the Channel mode. Immediately next to the channel mode, the data rate appears, expressed in kbps (448 in this example).

When the source is Dolby E, the screen displays the program configuration, the bit depth of the Dolby E stream, and the currently selected program, as shown in Figure 4-3.

Figure 4-3 Main Status Screen when Receiving a Dolby E Stream

When the source is PCM, the sample rate appears, as shown in Figure 4-4.

Figure 4-4 Main Status Screen when Receiving a PCM Signal

When the input is an analog signal, no additional information appears, as shown in Figure 4-5.

Figure 4-5 Main Status Screen when Receiving an Analog Signal

When the input is an RF signal, the channel number, tuning mode (`Cable`, `CableHRC`, `CableIRC`, `Off-Air`), and input audio type appear, as shown in Figure 4-6.

Figure 4-6 Main Status Screen when Receiving an RF Signal

When a measurement is in progress, in certain modes and conditions the lower left section displays a time counter, showing `hours:minutes:seconds`. If you pause the measurement, that area flashes `paused`, and the **Pause** button also flashes.

If the LM100 is in Infinite Measurement mode, a time counter appears in the lower left portion of the screen. This indicates the amount of time that has elapsed since the measurement was reset.

When the LM100 is in Short Term mode with `Dialogue Intelligence`™ enabled, the time counter appears only when dialogue has not been detected, thereby indicating the amount of time elapsed since dialogue was last detected. While dialogue remains undetected, the measurement value in the center section flashes and a second value appears at the bottom of the center section. That value shows the current non-dialogue-based measurement; the flashing value shows the last valid dialogue-based measurement, and the counter shows the time elapsed since the dialogue-based measurement stopped. When dialogue-based measurement resumes, the time counter and the second value no longer display.

Center and Right Sections

The right two-thirds of the screen displays information relative to the current measurements. The leftmost number (with the word `meter` below it) shows the measured loudness value, as shown in Figures 4-1 through 4-5. The letter at the top of this portion of the display indicates whether the measurement mode is Short Term (`s`) or Infinite (`i`). For more information regarding Short Term and Infinite modes, see Section 5.3. The channel(s) currently being measured appears in parentheses next to the word `meter`.

The value at the far right is the largest peak value currently being measured from any individual channel within the program. This peak meter has an instant attack, a peak hold of .75 seconds, and a constant decay of 12 dB per second following the peak hold.

The peak level is measured in dBu or dBr (if the analog input calibration is non-zero) when the analog input is selected; dBr (relative to 100 percent modulation) when the RF input is selected; and dBFS when any digital source is selected and present.

The main status screen also provides different display modes. Press **Enter** to scroll through these different modes on the right side of the screen.

When measuring Dolby Digital or Dolby E signals, the far right section of the default screen shows the setting for the `dialnorm` value contained in the metadata stream. If you press **Enter,** this section of the display shows the largest peak value. If you press **Enter** again, the screen displays only a single, larger magnification of the loudness measurement. Pressing **Enter** one more time displays the default screen where the `dialnorm` value appears on the far right.

If the LM100 is in Infinite mode with `Dialogue Intelligence` enabled and dialogue is not detected, the measurement value holds and begins to "flash" until the unit detects dialogue once again.

In Short Term mode with `Dialogue Intelligence` enabled, if dialogue is not detected, the measurement value flashes and a second value appears at the bottom of the center section, as previously discussed. That value shows the current non-dialogue-based measurement; the flashing value shows the last valid dialogue-based measurement, and the time counter in the lower left section shows the time elapsed since the dialogue-based measurement stopped. When dialogue-based measurement resumes, the time counter and the second value no longer appear. When you select the `Analog` input, an additional display mode is now available. This additional mode displays the recommended value for setting the dialogue level parameter in downstream Dolby Digital or Dolby E encoding equipment; this recommended value allows the operator to simply calculate a dialnorm value when measuring analog sources. Figure 4-7 shows an example of this display.

Figure 4-7 Main Status Screen Displaying a Recommended Dialnorm Setting for an Analog Input

Note: The valid range for the dialnorm value[1] is from –1 to –31 dBFS. However, the derived analog dialnorm feature on the LM100 can, in some cases, display measured values below –31, indicating that the input levels are too low to be properly set through the `dialnorm` parameter in downstream Dolby Digital or Dolby E equipment.

[1] ATSC: *Digital Audio Compression Standard (AC-3),* Advanced Television Systems Committee, Washington, DC, Doc. A/52, Dec. 20, 1995.

Units of Measurement

Measurements in the digital domain are made referenced to digital full-scale, expressed in dBFS. Analog measurements, by default, are based on the dBu scale, or on a relative scale (expressed as dBr) if the analog calibration setting is not 0 dBu. RF measurements are based on a relative scale (expressed as dBr) referenced to 100 percent modulation of the monophonic sound carrier (25 kHz peak deviation).

4.2.2 Level Meters

Figure 4-8 shows a sample level meter display. This display provides a more familiar PPM-style meter for each input channel. The meters have an instant attack time and a constant decay of 12 dB per second. Each channel signal is identified at the bottom of the screen. The scale is displayed on the left side and represents dBFS, dBu, or dBr, depending on the input signal type.

Figure 4-8 Level Meter Displaying a Dolby E 7.1 Input

Press **Enter** to zoom in on the upper portion of the scale.

4.2.3 Metadata Status

The `Metadata Status` menu enables you to check the settings of key metadata parameters in either a Dolby E or Dolby Digital input stream.

4.2.4 Digital Input Status

The `Digital Input Status` menu indicates whether a digital input signal is locked. If it is, the menu also displays the sample rate, validity bit status, and individual channel-status parameter values.

4.2.5 Error Statistics

The `Error Stats` menu provides error-related information for the LM100, its input signals, or a digital input stream.

The `Error Condition` display provides information regarding current errors that are preventing the unit from processing the selected input correctly. Two common error conditions are a loss of input signal and an input signal that does not match the requirements for the selected input type. Press **Enter** to view details when an error appears. More information on specific errors is available in Table 3-2.

The other items in the `Error Stats` menu provide a historical count of the following error types: Dolby E CRC (cyclic redundancy code), Dolby Digital CRC, AES3 Coding, AES3 Confidence, AES3 Parity, AES3 CCRC, and Dolby E Discontinuity.

To reset the error count on a single error type, press **Enter** to view the `Error detail` menu, then press **Enter** again to reset the count to zero.

To reset all error counts, select `Clear All Errors` and press **Enter.** A confirmation prompt appears. Press **Enter** to confirm the global reset, or **Esc** to exit the prompt without resetting the counts.

4.2.6 Alarm Statistics

You can define the configuration of each audio alarm. For details, see Section 5.5.

When an alarm is triggered:

- The **Audio Alarm** LED indicator flashes.
- A pulse is sent to the global alarm pin on the **GP I/O** port.
- A pulse is sent to the corresponding pin on the **Alarm** port.
- An entry is generated in the system log.
- The appropriate alarm statistic is incremented.

There are six different signal condition alarms: `Input Clipping, Over Level, Under Level, Dialnorm, Phase Error,` and `Digital Input Loss.` For the LM100-NTSC, there are two additional alarms: `RF Overmodulation` and `RF Input Loss`.

To reset the alarm count on a single alarm type, press **Enter** to view the `Alarm Detail` menu, then **Enter** again to reset the count to zero.

To reset all alarm counts, select `Clear All Alarms` and press **Enter.** A confirmation prompt appears. Press **Enter** to confirm the global reset, or **Esc** to exit the prompt without resetting the counts.

Alarm statistics can also be sent as a text log to a device connected to a serial port. For details, see Section 5.5.

4.2.7 System Log

The `System Log` menu displays up to 480 logged events. Events such as signal-condition alarms and errors are automatically added to the log; you can add and remove other indications through the `System Log` setup menu.

To view the most recently logged event, press **Shift**, ↑. To view the earliest logged event in the LM100 memory, press **Shift**, ↓.

To view any event in more detail, select the event and press **Enter.** If the event log is full and another event occurs, the system log discards the oldest event and registers the current event. You can clear the system log using the `System Log Control` menu.

Each event is logged against either the time of day or (optionally) a timecode value in the LM100-LTC. When logging against time of day, an event registered in the last 24 hours displays the time in the `System Log` menu; events beyond 24 hours display the date.

System log entries can also be sent as ASCII text strings to a device, such as a PC running a terminal emulation application, connected to either the front- or rear-panel serial port. For details, see Section 5.5.

4.2.8 System Status

The `System Status` menu shows the current LM100 hardware and software versions and indicates whether an option card is installed. To receive LM100 software upgrade notifications, please register your unit on the Dolby support page at www.dolbysupport.com.

The `Latency` menu displays the time it takes for audio to pass from the input connector to the analog output connectors, and is specific to the type of input stream. You can adjust `PCM Latency` in the `Monitor Control` setup menu.

4.3 Main Setup Menu

In the `Main Setup` menu, you can configure the LM100 to suit your needs. When viewing a status menu, or any setup menu, pressing **Setup** displays the `Main Setup` menu. If any setup menu display is unchanged for five minutes, the display reverts to the `Main Setup` menu.

4.3.1 Measurement Control

The `Measurement Control` menus allow you to configure the LM100 to provide the most suitable measurement characteristics for the current application. Proper settings depend on factors such as whether the LM100 is being used in a live or postproduction environment, for multichannel or stereo material, for quality control or off-air monitoring, or for aligning the loudness of multiple services. It is important that you read Chapter 5 to understand how to set these parameters.

The menus allow you to select the channel or channels to use for loudness measurement, the measurement method (Short Term or Infinite), and whether the `Dialogue Intelligence` feature is enabled. For more information on Dialogue Intelligence, see Section 5.2.

4.3.2 Input Control

In the `Input Control` menu, you can configure the following:

- `Input Source`
- `Decode Format`
- `Dolby E Program`
- `AES3 Channel Select` mode
- `Analog input Cal` (calibration) settings

Input Source

In the `Input Source` menu, you can select the input (`Digital`, `Analog`, or `RF`, if present) to use for a measurement.

A special mode (`RF/Digital`) uses the **RF Input** by default, but automatically switches to the **Digital Input** if a valid Dolby E or Dolby Digital signal is present on the **Digital Input** connector. This mode is used when the LM100-NTSC is simultaneously connected to the digital audio and the channel 3/4 remodulated outputs of a digital cable set-top box. Thus, when the set-top box is tuned to an analog tiered service, the unit measures the signal directly from the RF tuner; when the set-top box is tuned to a digitally tiered service, the

unit autodetects the presence of a Dolby Digital stream (from the S/PDIF output on the digital set-top box) and measures the digital audio bitstream.

Decode Format

Use the `Decode Format` menu to select the bitstream type you want the LM100 to decode. This parameter is normally set to `Autodetect`. However, if required, you can override this setting and specify that the LM100 decodes only one bitstream type.

Dolby E Program

Use the `Dolby E Program` menu to identify which program to measure in a Dolby E stream.

Note: When the input source is a valid Dolby E signal, the selected Dolby E program number must be present in the input stream, or no measurement can be made.

AES3 Channel Select

Use the `AES3 Channel Select` menu to specify how the unit recognizes a Dolby Digital signal from the digital input.

Selecting `Channel 1` or `Channel 2` specifies that the Dolby Digital input must be contained within that channel. Selecting `Channel 1+2` requires a Dolby Digital stream in both channels. When you select `Autodetect`, the LM100 locks onto the first signal it recognizes. We recommend `Autodetect` unless there are signals present in just one channel.

Analog Input Calibration

Use the `Analog Input Cal` menu to match the LM100 to the standard operating level for your facility. For example, if 0 VU = +4 dBu (1.23 V_{RMS}), set the analog input calibration to +4 dBu. This allows a 1 kHz line-up level at 0 VU to display 0 dBr on the LM100.

You also use this parameter to calculate the recommended dialnorm value when measuring an analog input signal.

Note: When the `Analog Ref Level` setting is not zero, measurement for the analog input is expressed in dBr. When the setting is zero, the measurement is expressed in dBu, reflecting that 0 dBu = 0.775 $V_{RMS.}$

Table 4-1 Common Reference Levels

Reference	Analog Ref Level	Volts	Digital Ref Level
SMPTE RP155	+4 dBu	1.23 V_{RMS}	–20 dBFS
EBU R68	0 dBu	0.775 V_{RMS}	–18 dBFS

RF Tuning Mode

This feature, and menu, is available only on the LM100-NTSC.

Use the `RF Tuning Mode` menu to select the frequency plan (`Off-Air`, `Cable STD`, `Cable HRC`, or `Cable IRC`) used for tuning RF signals.

RF Channel

This feature, and menu, is available only on the LM100-NTSC.

Use the `RF Channel` menu to select the channel number used for tuning RF signals.

Note: The channel number can also be selected from the main status screen, by pressing **Shift**, ↑ or ↓.

RF Second Language

This feature, and menu, is available only on the LM100-NTSC.

Use the `RF Second Language` menu to specify whether you want to measure the second language channel (if available) when receiving RF signals.

4.3.3 Monitor Control

Use the `Monitor Control` menu to configure the **Analog Outputs** (headphone and rear-panel line outputs).

DAC on Non Audio

The `DAC on Non Audio` menu controls whether a digital input signal flagged as non-audio (via the AES3 Channel Status Byte 0 bit 1) is muted or sent to the headphone and **Analog Outputs**.

PCM Latency

The `PCM Latency` menu allows the user to set the latency from the **Digital Input** to the **Analog Outputs** for a PCM signal.

4.3.4 Alarm Control

The LM100 alarm capabilities are among its most useful and versatile functions, as described in Section 5.5. Use the `Alarm Control` menu to set the parameters that trigger alarms.

Input Clipping

Use the `Input Clipping` menu to configure the parameters of the input clipping alarm. Table 4-2 defines those parameters.

Table 4-2 Input Clipping Alarm Parameters

Menu Item	Controls	Increment	Range
`Alarm`	Enables or disables the alarm.	NA	Enabled/Disabled
`Length`	The number of samples by which the input must exceed the clip threshold to trigger the alarm.	10	10 to 200 samples
`Digital Threshold`	The amplitude threshold for the alarm when the input is digital.	0.1	0 to –20 dBFS
`Analog Threshold`	The amplitude threshold for the alarm when the input is analog.	0.1	+22 to –20 dBr or dBu*
`RF Threshold`	The amplitude threshold for the alarm when the input is RF†.	0.1	+10 to –20 dBr

*When the `Analog Ref Level` setting is not zero, the analog threshold is expressed in dBr. When the setting is zero, it is expressed in dBu.

† Only on the LM100-NTSC.

RF Overmodulation

This feature, and menu, is available only on the LM100-NTSC.

Use the `RF Overmodulation` menu to enable or disable the overmodulation alarm for RF input signals. When enabled, any signal that modulates the aural carrier by more than 101 percent triggers the alarm.

Digital Loudness Reference

Use the `Digital Loudness Ref` menu to set the reference loudness level for digital input signals. This reference level is used by the over/under threshold alarms.

Analog Loudness Reference

Use the `Analog Loudness Ref` menu to set the reference loudness level for analog input signals. This reference level is used by the over/under threshold alarms.

Note: When the `Analog Ref Level` setting is not zero, measurement for the analog input is expressed in dBr. When the setting is zero, the measurement is expressed in dBu, reflecting that 0 dBu = 0.775 $V_{RMS.}$

RF Loudness Reference

This feature, and menu, is available only on the LM100-NTSC.

Use the `RF Loudness Ref` menu to set the reference loudness level for RF sources. This reference level is used by the over/under threshold alarms.

Over Level

The over-level alarm is triggered when the input signal loudness level exceeds the chosen threshold relative to the selected digital or analog loudness reference level.

The `Over-Level` menu allows you to set the parameters for triggering the alarm, as shown in Table 4-3.

Table 4-3 Over-Level Alarm Parameters

Menu Item	Controls	Range
`Alarm`	Enables or disables the alarm.	Enabled/Disabled
`Threshold`	The loudness threshold for the alarm. The alarm triggers if the measured loudness value exceeds the loudness reference plus the threshold for the duration specified in `Time`.	1 to 31 dB
`Time`	The duration of the over-level condition required to trigger the alarm.	0 to 300 seconds

Under Level

The under-level alarm is triggered when the input signal loudness level falls below the chosen threshold relative to the selected digital or analog loudness reference level. This alarm is useful for identifying silence and/or near-silent conditions.

The `Under-Level` menu allows you to set the parameters for triggering the alarm, as shown in Table 4-4.

Table 4-4 Under-Level Alarm Parameters

Menu Item	Controls	Range
`Alarm`	Enables or disables the alarm.	Enabled/Disabled
`Threshold`	The loudness threshold for the alarm. The alarm triggers if the measured loudness value falls below the loudness reference minus the threshold for the duration specified in `Time`.	1 to 31 dB
`Time`	The duration of the under-level condition required to trigger the alarm.	0 to 300 seconds

Dialnorm Threshold

The dialnorm threshold alarm is triggered when the measured loudness value of the input signal deviates from the dialnorm value already carried within the Dolby E or Dolby Digital input stream. This alarm is useful for identifying Dolby E and Dolby Digital bitstreams with incorrect dialogue level (dialnorm) metadata values.

The `Dialnorm Threshold` menu allows you to set the parameters for triggering the alarm, as shown in Table 4-5.

Table 4-5 Dialnorm Threshold Alarm Parameters

Menu Item	Controls	Range
`Alarm`	Enables or disables the alarm.	Enabled/Disabled
`Threshold`	The threshold for the alarm. The alarm triggers if the measured loudness value deviates by more than this value either above or below the dialogue level value carried in the metadata for the duration specified in `Time`.	1 to 20 dB
`Time`	The duration of the dialnorm threshold condition required to trigger the alarm.	0 to 300 seconds

Digital Input Loss

The digital input loss alarm is triggered if the digital input becomes invalid or disappears. Use the `Digital Input Loss` alarm to enable or disable the alarm. This alarm is applicable only when using digital input.

RF Input Loss

This feature, and menu, is available only on the LM100-NTSC.

The RF input loss alarm is triggered if the RF Input becomes invalid or disappears. Use the `RF Input Loss` menu to enable or disable the alarm. This alarm is applicable only when using the **RF Input**.

Phase Error

The phase error alarm is triggered when a stereo signal's Left and Right channels are out of phase. Use the `Phase Error` menu to enable or disable the phase error alarm.

DE RF Overmod Protect

The DE RF overmod protect alarm is triggered when a Dolby E signal is detected with the `RF Overmod metadata` field enabled. Use the `DE RF Ov Protect` menu to enable or disable the DE RF overmod protect alarm.

Track Measurement

You can control all the alarm counters using the front-panel **Reset** button or the **GP I/O** port.

If you set `Track Measurement` to `Enabled`, pressing the **Reset** button clears all the alarm counters simultaneously, as well as resetting the measurement. If you disable this setting, pressing **Reset** has no effect on the alarm counters.

Alarm Output Polarity

When an alarm is triggered, the LM100 generates a pulse on the associated **Alarm** port pin, as shown in Table 5-3, as well as on the Alarm pin on the **GP I/O** port. Use the `Alarm Output Polarity` menu to set the polarity for the alarm outputs to either positive or negative.

4.3.5 User Presets

The LM100 can use up to four presets. When you save a preset, the LM100 stores the complete memory of all active settings. Saving a preset writes over any preset previously stored to that preset number. Use the `User Presets` menu to save or recall a preset.

To save a preset, follow these steps:

1. Enter the `Save Preset` menu.
2. Select a preset number to save, then press **Enter**.

   The `Save Preset` menu appears, as shown in Figure 4-9.

Figure 4-9 Save Preset Menu

3. Press ➔ to highlight `Clear`, then press **Enter.**

   The old preset name disappears.

4. Use the arrow buttons to highlight each character in the new preset name, pressing **Enter** after highlighting each character.
5. When the name is complete, highlight `OK`, then press **Enter.**

The confirmation prompt in Figure 4-10 appears.

Figure 4-10 Save Preset Prompt

6. If the new preset name is correct, press **Enter** to save the preset with that name. If not, press **Esc,** and return to Step 1.

   When the new name is saved, the display reverts to the main status screen, briefly showing the message in Figure 4-11.

Figure 4-11 Preset Confirmation Message

You can recall a preset as follows:

1. Enter the `Recall Preset` menu.
2. Select a preset to recall, then press **Enter.**

4.3.6 System Log

Use the `System Log` menu to control the characteristics of the internal system log**.**

Time Stamp Mode

When using the LM100-LTC with a valid timecode input, the system log can use either the time of day or linear timecode as the log entry time stamp. Use the `Time Stamp Mode` menu to change this setting.

Periodic Loudness

The system log can store the current measured loudness value at regular (that is, periodic) time intervals, as set in the `Periodic Loudness` menu. This allows you to use the LM100 to simultaneously track and log the changes in the loudness of programs or services over many hours or days.

Note: When measuring in Infinite mode, additional settings appear in the `Periodic Loudness` menu, which enables the measurement to automatically reset at the same time interval as the periodic measurement itself logs. For example, if you select `30 Seconds with Reset`, the LM100 generates a "periodic loudness" system log entry based on the integrated level for the past 30 seconds, and then resets the infinite measurement before continuing.

Metadata Log

If enabled, the metadata parameters shown in Table 4-6 within a Dolby E or Dolby Digital bitstream are added to the system log. This is done whenever a Dolby E or Dolby Digital bitstream is first detected, and subsequently when any of these parameters change value.

Table 4-6 Metadata Parameters Noted in System Log

Dolby Digital Channel Mode
Dolby Digital LFE Channel
Dolby Digital Data Rate
Dolby Digital Dialogue Level
Dolby E Program Configuration
Dolby E Bit Depth
Dolby E Frame Rate
Dolby E P*x* Channel Mode
Dolby E P*x* LFE Channel
Dolby E P*x* Dialnorm

Bitstream CRC Log

If enabled, any CRC errors in Dolby E or Dolby Digital bitstreams are logged. You can use this log to monitor and ensure that Dolby Digital or Dolby E bitstreams are not corrupted and/or do not contain errors.

System OK Log

If enabled, a `System OK` message is logged at hourly intervals. You can use this log to verify ongoing correct operation of the LM100 within the system log.

Track Measurement

You can control the system to follow the **Reset** and **Pause** controls provided on the front-panel buttons or through the **GPI/O** port.

If you set `Track Measurement` to `Enabled`, pressing the **Reset** button clears the system log and resets the measurement; pressing **Pause** stops new entries from generating in the system log as well as pausing the measurement. If you disable this setting, the Reset and Pause controls have no effect on the system log.

Clear System Log

Allows you to manually delete all entries in the system log.

4.3.7 System Settings

The `System Settings` menus allow you to configure the serial ports, the real-time clock, and the screen saver.

Remote Baud Rate

This setting controls the speed (baud rate) of the RS-232 and RS-485 serial ports.

Remote Mode

When you select `Remote`, the LM100 can be controlled from a remote-control application or device over the serial ports. When you select `Logging`, the serial ports output each system log entry as an ASCII text string as it is generated. This output can be displayed and stored by any standard terminal application.

Unit Name

You can name your unit using up to 12 characters. This is useful for identifying the LM100 from remote-control applications. To enter a name, go to the `Unit Name` menu and use the procedure for text entry, as described in Section 4.3.5.

Unit Address

The unit address allows each LM100 to be uniquely identified when using a software remote-control application over the serial connection, using either the **RS-232** or the **RS-485** connection. You can connect more than one LM100 to the same RS-485 link, provided that each unit is assigned a unique address.

Time/Date

Use the `Time/Date` menu to set the internal real-time clock.

Screensaver Timeout

After a defined period of inactivity, the LM100 applies a screen saver to prolong the life of the display screen. Use the `Screensaver Timeout` menu to set this period of inactivity.

Features

The LM100 provides several unique features. This chapter focuses on the unit's primary functions, and the best uses for each of those functions.

5.1 Measuring Equivalent Loudness

For years, the audio industry has quantified the level of its programming using peak program meters (PPM) and volume unit (VU) meters. It is important to note that both were developed and are used to read signal voltages, and therefore make no attempt to measure subjective loudness. Thus, several different voices, adjusted in level so that they all deflect meters to the same mark, may sound somewhat different in level to the listener at home. This problem is often compounded by the rapid response of the meter, which requires all operators to perform their own individual visual integration or averaging of the meter movement itself.

The equivalent-loudness method standardized by the IEC (IEC 60804) is an A-weighted integrated measure, and is often abbreviated Leq(A). Leq itself is defined as the level of a constant sound that, in a given time period, has the same energy as a time-varying sound. A-weighting is used in an effort to approximate the frequency sensitivity of human hearing at lower listening levels; its standardization and inclusion in many measurement devices is largely based on Fletcher and Munson's 1930s research on equal-loudness contours. The core measurement algorithm used in the LM100, Leq(A), is also recognized and recommended in Advanced Television Systems Committee (ATSC) standards and in CEA Bulletin CEB11: *NTSC/ATSC Loudness Matching*.

In comparison to the PPM and VU meter example, evidence has shown that matching the levels of different voices so that they yield the same Leq(A) measurement value delivers more accurate subjective loudness than using either PPMs or VU meters.

PPMs and VU meters are frequently used to measure and/or align content to a predetermined "house" reference level, and thus have only an arbitrary relationship to the loudness (more specifically, the dialogue level) within a given program. For example, if a VU meter and a PPM are calibrated to display a reference tone equally, and dialogue that averages 0 VU is applied to both, the PPM will indicate levels considerably above its reference level and possibly above the maximum permitted level. On the other hand, dialogue that averages at the PPM reference will most likely indicate many dB below 0 VU. This simple example demonstrates the importance of understanding that the reference level (or line-up level) is not the same as the dialogue level of a program. This can be seen when listening to a broadcast that suffers from loudness variations. All the content may well have been produced to the same reference level, but the perceived loudness level is clearly different.

Within broadcast programming the dialogue (or speech) levels of a program are especially important when considering how to determine the subjective loudness of a program. Research shows that most listeners at home use their volume controls in an effort to keep the dialogue levels uniform as they switch through multiple channels and as they listen through program-to-program and/or program-to-commercial transitions. It therefore follows that if listeners at home base their loudness judgment on the level of dialogue, then a loudness meter would certainly benefit from an algorithm that mirrors this behavior. Dialogue Intelligence™ in the LM100 provides exactly that feature, as described in Section 5.2.

5.1.1 Measuring Digital Sources

When the **Digital Input** is selected and receiving a two-channel linear PCM digital audio signal, the default main status screen indicates the measured loudness value side by side with the unweighted peak level value. The unweighted peak value indicates the largest peak value detected from all channels present on the input.

When the **Digital Input** is selected and receiving a Dolby® Digital or Dolby E stream, the default main status screen indicates the measured loudness value side by side with the dialnorm value contained within the input stream. Ideally, these values are nearly the same, thereby confirming the accuracy of this extremely important metadata parameter (value). If the measured loudness value is significantly different from the dialnorm value, when the program broadcasts, it will sound either louder or softer than programs with accurate dialnorm settings. You can use the loudness measurement information to make adjustments, either to the dialogue level parameter value within the Dolby Digital or Dolby E stream, or to the source audio levels.

Measurements in the digital domain are referenced to digital full-scale, and are expressed in dBFS.

5.1.2 Measuring Analog Source Audio

When the selected input is analog, the LM100 can also provide a suggested value for dialnorm (by pressing **Enter** twice from the main status screen). This can be useful when setting the dialnorm parameter value prior to encoding the program for digital distribution via Dolby E or Dolby Digital. This recommended value automates the process of calculating a dialnorm value when measuring analog sources. The calculated (that is, derived) value is based on the analog input calibration. An example is provided in Chapter 4, following Figure 4-7.

Analog measurements, by default, are based on the dBu scale, or on a relative scale (expressed as dBr) if the analog calibration setting is not 0 dBu.

5.1.3 Measuring RF Modulated Sources

When the **RF Input** is selected and a particular channel is tuned, the default main status screen indicates the measured loudness value side by side with the unweighted peak value.

Measurements in the RF domain are referenced to 100 percent modulation of the monophonic sound carrier (25 kHz peak deviation) and are expressed in dBr.

5.2 Dialogue Intelligence

Dialogue Intelligence allows the LM100 to automatically base its measurement on the portions of the input signal that contain the characteristics of dialogue. This powerful feature provides users at all skill levels with the capability to easily quantify the level of dialogue within broadcast programs. By combining Dialogue Intelligence with extensive logging and alarm capabilities, the LM100 opens up the possibility of automated measurement, QC, and control.

Note: The dialnorm parameter within a Dolby Digital bitstream is, after all, also known as dialogue level, and the term dialnorm is an abbreviation of "dialogue normalization." Thus, when the dialnorm value is properly implemented across multiple programs, the home listener can switch between programs and perceive the dialogue in each program at the same level.

When you first enable `Dialogue Intelligence`, the LM100 takes a few moments to analyze the input signal before confirming that dialogue is or is not present. During this analysis, a "listening" icon appears, as shown in Figure 5-1. When the analysis is complete, either `No Dialogue` or a dialogue-based measurement value appears.

Figure 5-1 Listening Icon Display before Dialogue Intelligence Computes

When you enable `Dialogue Intelligence`, the measurement is based solely on the portions of the input signal recognized as having the characteristics of speech. Portions of the input signal that do not primarily contain the characteristics of dialogue are not included in the measurement value.

Note: The Dialogue Intelligence algorithm is designed to return a dialogue-based measurement value only when this input signal primarily contains the characteristics of dialogue. Therefore, on rare occasions, the algorithm may ignore a section of the program that contains dialogue but may also be coincident with other types of signals and spectra, such as music or effects. This behavior increases the accuracy and confidence of the dialogue-based measurement value.

5.3 Measurement Modes: Short Term vs. Infinite

The LM100 has two measurement modes of operation relating to the measurement period itself, Infinite mode and Short Term mode. This section describes the behavior of both.

Infinite Mode

Infinite mode (without `Dialogue Intelligence` enabled) conforms to the specifications of IEC 60804 (2000-10): *Integrating-Averaging Sound Level Meters*. In this mode, the measurement value is the long-term A-weighted level, Leq(A), for the entire period since the measurement was reset.

Enabling `Dialogue Intelligence` allows you to simply quantify all the sections of the program that contain only dialogue and use the ending measurement value for analysis and/or normalization purposes. This value is also commonly used to set the dialogue normalization parameter within Dolby Digital and Dolby E bitstreams.

Infinite mode is typically used when it is possible to measure the entire duration of the program (for example, all 30 seconds of a commercial or the whole two hours of a movie). It provides the most accurate measurement, as it is able to average over the complete program length. This mode is most often used in ingest, QC, and postproduction applications where audio metadata is being authored and levels can, in most cases, be controlled and/or adjusted.

It is also possible to use Infinite mode to measure shorter individual sections of a program rather than the entire duration. With this method, you may find a measurement value much more quickly. However, you must be sure that the loudness level of the sections being measured represents the entire program.

Short Term Mode

Short Term mode displays the Leq(A) measurement value for the previous ten-second period as a "sliding-window" type of function. For example, the first measurement value displayed corresponds to the 0–10 seconds time interval, the next to the 1–11 seconds time interval, the next to the 2–12 seconds time interval, and so forth.

As the Short Term measurement only considers the last ten seconds of program material, the measurement value has the potential (depending on the program) to be much more dynamic than that measured in Infinite mode. (Highly processed channels and programming will most likely not exhibit this type of behavior.)

The benefit of measurements performed in Short Term mode is that it allows the operator to see Short Term variations in loudness level (or Short Term variations in dialogue level when `Dialogue Intelligence` is enabled) within a program. Many skilled audio operators prefer to use the Short Term measurement, as they find the information on near-term dynamics to be very useful when mixing or producing a program and they are capable of managing overall program loudness by reading the Short Term measurement.

Short Term mode is also very useful for measuring and logging the "dynamic" loudness history of a given program during the QC, postproduction process, or particular television service/channel in a cable head-end facility (see the example in Figure 5-2). In this example, an LM100 with Dialogue Intelligence enabled (and in Logging mode, using a PC to capture the periodic loudness values) was used to help a broadcaster determine the speech level values for programs and commercials from 5:30 p.m. through midnight.

Analysis of Figure 5-2 clearly reveals that during the 8 o'clock hour, the speech levels were elevated (~5 dB on average), whereas the programming that preceded and followed this particular program clearly had lower speech levels.

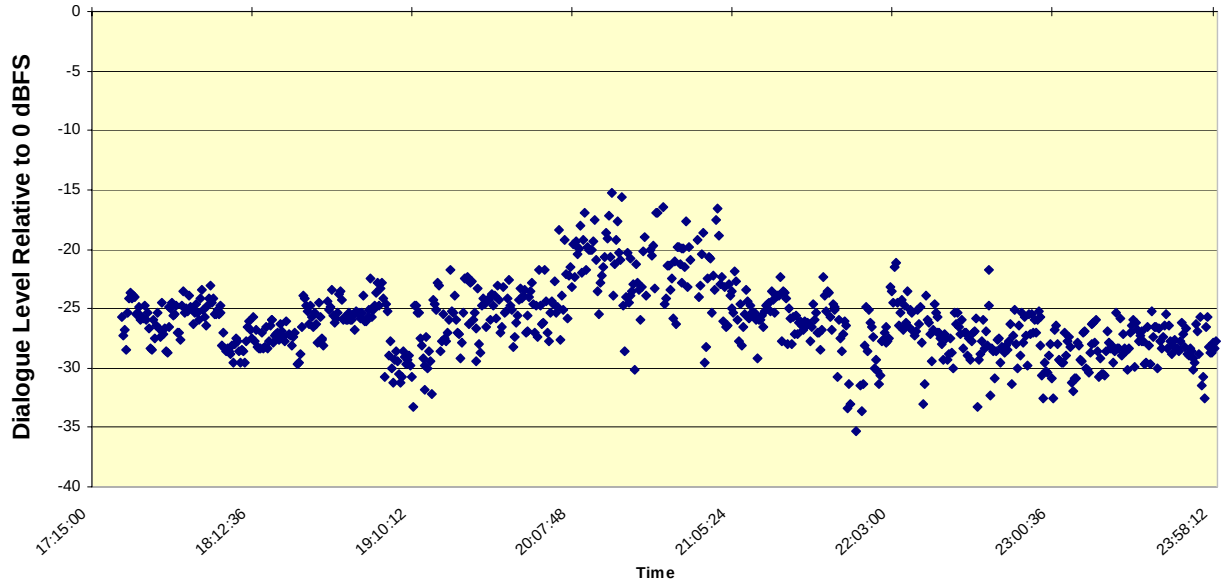


Figure 5-2 Short Term Dialogue Level History Example Utilizing LM100 Logging Features

Each data point represents an individual speech measurement.

Table 5-1 shows application examples that best utilize Short Term and Infinite modes.

Table 5-1 Application Examples for Short Term and Infinite Modes

Short Term	Infinite
Live broadcast event	Program ingest
Postproduction and/or mixing with audio engineer	Postproduction to check conformance with delivery requirements, including dialnorm
Quality control: measuring Short Term program dynamics (or the Short Term dynamics in dialogue level when Dialogue Intelligence is enabled)	Quality control: measuring overall program for normalization and/or dialnorm provisioning purposes (dialogue-based measurement when Dialogue Intelligence is enabled)
Logging Short Term periodic loudness history	Logging infinite (long-term) loudness history
Analog cable services: audio modulator deviation adjustments for cable head-ends (dialogue-based measurement when Dialogue Intelligence is enabled)	

5.4 Channels for Measurement

The LM100 can base its loudness measurement on one (`Left`, `Center`, or `Right`), two (`Stereo`), or all (`All`) input channels.

Because dialogue is almost always mixed primarily to the Center channel, the default is `Center`, making it ideal for a 5.1-channel program with dialogue. If a program without a Center channel is present on the input, the unit automatically measures the Left and Right channels by summing the individual channel powers. The channels actually being measured (as opposed to the `Channel Select` setting) display in parentheses next to the word `meter` on the main status screen.

The other selections are available if you need to quantify loudness on specific channels. `All` measures the signal by combining the individual channel powers from each channel present on the input.

Note: A two-channel 1 kHz sine wave with a `Channel Select` setting of `Stereo`, `All`, or `Center` displays +3 dB over the peak level, assuming both channels contain identical signals (that is, they are highly correlated).

5.5 Alarms and System Log

The alarm setup system provides a high level of flexibility, so you can configure alarms to trigger only for conditions that you consider important. LM100 alarm types are defined in Table 5-2.

Table 5-2 Available Alarm Types

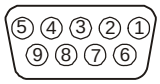
Alarm	Definition
Input Clipping	The input signal exceeds a user-defined clip level for a minimum number of user-defined samples.
RF Overmodulation (LM100-NTSC only)	The “tuned” RF input signal is greater than or equal to 101 percent modulation of the monophonic audio RF carrier.
RF Input Loss (LM100-NTSC only)	The “tuned” RF input carrier is absent.
Loudness Above Threshold	The measured loudness level exceeds the user-defined threshold for a user-defined duration.
Loudness Below Threshold	The measured loudness level falls below the user-defined threshold for a user-defined duration. This can be used as a silence alarm.
Digital Input Loss	Digital AES3 input is required but missing.
Dialnorm Threshold	The dialnorm (dialogue level) value carried within the Dolby E or Dolby Digital bitstream input differs from the user-defined threshold for a user-defined duration.
Phase Error	The stereo signal’s Left and Right channels are out of phase.
Dolby E RF Overmod Protect	The Dolby E RF Overmod metadata field is enabled.

Use the `Alarm Control` setup menu to control the alarm parameters, as described in Section 4.3.4.

Any alarm condition triggers the **Audio Alarm** LED, increments the associated counter in the `Alarm Stats` menu, triggers the global alarm GP I/O pin, and triggers the appropriate GPI/O on the **Alarm** port, as shown in Table 5-3.

You can use the **Alarm** port to create a notification method in your studio or control room. This can alert you to specific alarms (see Table 5-3), while recording alarms you define as less urgent in the `Alarm Stats` menu and the system log.

Table 5-3 Alarm Output Port

Connector Map	Pin	Status Parameter or Function
	1	Input Clip detection counter
	2	RF Overmodulation counter (LM100-NTSC only)
	3	Loudness Above Threshold counter
	4	Loudness Below Threshold counter
	5	Digital Input loss counter
	6	Dialnorm Threshold counter
	7	Asserted during an error condition
	8	Asserted when hardware is faulty
	9	Signal ground

The system log is capable of storing 480 individual time-stamped events. If you connect a remote interface cable to either the front- or rear-panel serial ports described in Section 5.6, you can store a record of every logged event.

Each alarm condition is stored in the internal system log in the following format:

```
Date Time | Alarm ID | Description | Count
```

The description field contains information about the alarm type, as well as the associated signal measurement when the alarm triggered. Here is a sample text log from the LM100:

```
19 Feb 2003 13:49:50 | 1001 | RF Overmodulation | Count: 1

19 Feb 2003 13:50:04 | 1002 | Loudness Above Threshold | Count: 5, Meter: -26.5 dB

19 Feb 2003 13:50:23 | 2001 | Input Format | Dolby Digital

19 Feb 2003 13:50:30 | 2002 | Measurement Pause | Peak: -3.0 dB

19 Feb 2003 13:50:32 | 2003 | Measurement Resume |

19 Feb 2003 13:51:10 | 3000 | Short Loudness Measurement | C: -26.5 dB

19 Feb 2003 13:51:19 | 3002 | LM100 OK |

19 Feb 2003 13:51:34 | 4000 | Dolby Digital Channel Mode | 3/2
```

Logged events also display on the `System Log` status menu. Figure 5-3 shows a sample display of the system log.

In the `System Log` menu, to view the most recently logged event, press **Shift**, ↑. To view the earliest logged event in the LM100 memory, press **Shift**, ↓.

Figure 5-3 System Log Status Menu

To view details of an event on the `System Log` status menu, highlight that event and press **Enter.** Figure 5-4 shows an entry detail display.

Figure 5-4 System Log Entry Detail Display

5.6 Serial Ports

You can use the rear-panel **Remote RS-485** port or the front-panel **Remote RS-232** port for software upgrades, to connect to a custom-built remote-control software interface, or to send system log events to any device that can receive ASCII text strings through the remote interface cable you connect to the LM100.

Note: The **Remote RS-485** port is deactivated if a cable is connected to the **Remote RS-232** port.

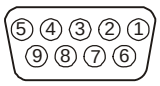
For any use, the settings on the `System Settings` menu must match the connected computer, as described in Section 4.3.7.

To generate a text-based error log to a remote device, set `Remote Mode` to `Logging`.

5.7 GP I/O Port

The **GP I/O** port provides the dedicated functions shown in Table 5-4. You don't have to be in remote mode to use a GPI/O device with the LM100; thus you can maintain full access to all front-panel control functions and display information.

Table 5-4 GP I/O Port

Connector Map	Pin	Direction	Connection	Note
	1	Input	Source Select	0 = Next source, *open*—no action
	2	Input	Channel Up	0 = Increment channel, *open*—no action
	3	Input	Channel Down	0 = Decrement channel, *open*—no action
	4	Input	Pause	0 = Toggle pause/run, *open*—no action
	5	Input	Reset	0 = Reset, *open*—no action
	6	Output	Alarm	Programmable polarity (for details on alarm control, see Section 4.3.4)
	7	Output	Compressed Input	0 = Not compressed 1 = Compressed
	8	Output	Measurement Running	0 = Paused 1 = Running
	9	—	Signal Ground	

To be recognized, input signals must be asserted for at least 50 ms.

The pin 2 and pin 3 functions are provided only on the LM100-NTSC. Each time either of these pins is grounded, the RF channel number increases incrementally (pin 2) or decreases incrementally (pin 3) by one. If the input remains grounded for more than 500 ms, the RF channel number increases or decreases continuously until the pin is released.

Pins 4, 5, and 6 duplicate the functions of the front-panel **Pause** and **Reset** buttons and the **Alarm** LED, respectively.

5.8 NTSC Model

The LM100-NTSC enables you to monitor program audio from either cable or off-air sources using the **RF Input.** This allows you to use the LM100 on program material in its final delivery format.

5.9 LTC Model

The LM100-LTC receives linear timecode at rates of 23.98, 24, 25, 29.97, and 30 Hz, and supports drop- and non-drop-frame modes. You can set up the system log to record events by time of day or by timecode stamp by using the `System Log` setup menu.

LM100 Specifications

Core Measurement Algorithm
Leq(A) (IEC 60804)

Dialogue Intelligence™ Algorithm
Proprietary; patent pending

Audio Sampling Rates
32, 44.1, and 48 kHz

Digital Audio Input
BNC female connector with loop-through, 75, unbalanced, AES-3ID-1995 (SMPTE 276M)

Formats supported: PCM data up to 24 bits; Dolby® E data supported in 16-, 20-, and 24-bit modes at 48 kHz; Dolby Digital (AC-3) data at 32, 44.1, and 48 kHz sample rates

Analog Audio Inputs
Two Neutrik® combination XLR/quarter-inch TRS connectors, electronically balanced

Maximum input level: ~ +22 dBu

Input impedance: 10 kΩ

User-definable nominal operating levels

Analog Audio Output
Two RCA-type connectors, unbalanced, stereo

Maximum output level: 2 V_{RMS} into a 10 kΩ load per IEC 61938

RF Input
This feature is available only on the LM100-NTSC.
F-type female connector with internal 75Ω termination

Tuner frequency range: 55.25 to 801.25 MHz

Supports BTSC-encoded stereo signals

Selectable CATV or "off-air" modes

CATV mode supports the Cable Television Channel Identification Plan per EIA 542 (User-selectable: Standard, HRC, or IRC channel identification plans)

Video output: composite, BNC female

Headphone Output
Quarter-inch standard stereo headphone jack, level adjustable

Timecode Input

This feature is available only on the LM100-LTC.
BNC female, unbalanced per SMPTE 12M-1999
Supports 23.98, 24, 25, 29.97 and 30 Hz frame rates, including drop and non-drop frame modes

Serial Remote Control Input

Front: 8-pin female mini-DIN connector, RS-232

Rear: 9-pin female D-connector, RS-485 (SMPTE 207M)

Alarm Port

9-pin female D-connector, 0–5 V TTL level

User-definable alarms: input clip detection, modulation overload, loudness above threshold, loudness below threshold (silence), dialnorm threshold, and AES input loss

General Purpose Input/Output (GP I/O) Port

9-pin female D-connector, 0–5 V TTL level

Measurement/Analysis System Log

480 events stored in internal nonvolatile RAM

(Unlimited event storage and retrieval via serial ports)

Power Requirements

90–264 VAC, 50–60 Hz, auto-sensing, 15 W maximum; unit designed to operate from a centrally switched power source

Dimensions and Weight

1-U rackmount: 44 × 483 × 375 mm (1.75 × 19 × 14.75 inches)

Net: 2.5 kg (5.5 lb)

Environmental Conditions

Operating: 0° to 50°C (32° to 122°F), natural convection cooling, 0 to 98 percent relative humidity (non-condensing)

Non-operating: –20° to +70°C (–4° to +158°F)