LEAMING AGC-100
AUTOMATIC GAIN CONTROL

INSTRUCTION BOOK
IB 173100-02 E

by

LEAMING INDUSTRIES
3972 BARRANCA PARKWAY J608
IRVINE, CA 92606
(949) 743-5233

AGC-100

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AGC-100

1.0. INTRODUCTION

The AGC-100 is an automatic gain control designed to maintain average audio program levels within a reasonable range without reducing the dynamic range to the extent that quiet passages are no longer quiet and loud passages are no longer loud.

The AGC-100 includes a gated-gain compressor/expander which operates in an adaptive-slope mode. With this method, the control makes a gradual transition from a 2:1 compression ratio at low input levels toward a constant-output at elevated input levels. A realistic dynamic range is thus preserved while over-modulation is avoided.

The AGC-100 may be used to process either a stereo (Left & Right) signal, or it may be used to process two monaural inputs.

Each AGC-100 is individually enclosed in an aluminum case and occupies 1/3 of an RM-1 or PMU401 panel mount (1-3/4" high, 19" wide). Each AGC-100 is powered by 115 V.A.C. (Or, it may be factory-configured for 230 V.A.C.)

2.0 CONFIGURATION

Refer to the Component Locator diagram at the rear of this manual to identify the configuration jumper jacks, which are accessed by removing the top cover of the AGC-100's chassis.

2.1 STEREO or DOUBLE MONO

The AGC-100 is normally shipped configured for stereo operation. If double-mono operation is desired, one jumper must be moved from its rear position to its front position on the circuit board. That jumper is located approx. 5" forward of the rear panel of the AGC-100, near the LM324 integrated circuit.
The purpose of the jumper is to couple the gain control signal between the two channels when in the stereo mode, so that stereo imaging remains correct. This coupling, if present with two mono programs in the AGC-100, would be detrimental to level optimization of the separate programs.

2.2 PRE-EMPHASIS & DE-EMPHASIS

The AGC-100 is normally shipped configured for flat frequency response, as measured externally. However, for optimum

characteristics when used with FM transmission systems, the AGC-100 uses standard 75 μS pre- & de-emphasis internally. Some applications may require either no internal pre- & de-emphasis, or internal pre-emphasis without de-emphasis, to feed an un-pre-emphasized FM transmitter.

Any combination of emphasis may be selected, for either channel, by repositioning internal jumper-jacks (one pre-emphasis/flat jumper & one de-emphasis/flat jumper for each of the two channels, total: four emphasis jumpers).
Emphasis is selected by placing the appropriate jumpers in their right-side positions. Emphasis is de-selected (flat) by placing the appropriate jumpers in their left-side positions. The pair of jumpers near the front of the circuit board activates pre-emphasis; the left jumper is for the left channel, and the right jumper is for the right channel. The pair of jumpers near the rear of the circuit board activates de-emphasis; again, the jumper on the left is for the left channel, and the jumper on the right is for the right channel.

Some applications may require the output to have the standard 75 μS pre-emphasis used in FM broadcasting; this is easily accomplished in the AGC-100 by activating pre-emphasis and de-activating de-emphasis.

3.0 INSTALLATION, CONNECTION

The AGC-100 is normally mounted on a PMU401 or RM-1 Panel Mount; use the four black #6-32 x 5/8" screws (supplied) to attach the AGC-100 to the mounting panel.

The connectors on the AGC-100 are screw-terminal type. To wire them, strip the insulation off the signal wires (approx. 3/8"), slip the wire under the head of the screw, and tighten the screw.

3.1 AUDIO INPUT

The input to the AGC-100 uses five of the ten screw terminals on the rear of the AGC-100:

#6, Right High In
#7, Right Low In
#8, Ground
#9, Left High In
#10, Left Low In

For optimum results, use twisted-pair cable with an overall shield. Connect the Right and Left shields together to the common ground terminal. When in the stereo mode, both channel inputs should be connected to the signal, even if the signal is mono. (Simply hook a short jumper wire from the Left High terminal to the Right High terminal, and another jumper from Left Low to Right Low.)

3.2 AUDIO OUTPUT

The audio output uses the other five screw terminals, with the same terminal sequence as the inputs:

#1, Right High Out
#2, Right Low Out
#3, Ground
#4, Left High Out
#5, Left Low Out

3.2.1 If driving an unbalanced load, the High terminal carries the signal and the Low terminal is to be connected to the shield, which should generally be grounded at the load end only, in order to minimize ground loops.

3.2.2 If driving a balanced load, the shield should generally be connected at one end only, that being at the load end, in order to minimize ground loops. Be sure that the chassis of the AGC-100 and the load are both grounded, which is usually done by the power cord safety ground and/or the mounting rack frame ground.

4.0 OPERATION, CALIBRATION

In brief, when power is applied, and either OFF / SETUP or ON mode is selected, the AGC-100 is active. The gain setting (calibration) should be done in the Setup mode only, while listening to typical program material through the AGC-100. Following gain calibration, the unit may be switched to the Run mode, which will allow it to automatically correct the program level as necessary. The remainder of this section elaborates on this paragraph.

NOTE: The AGC-100 mode switch is a slide-type, recessed behind the front panel. To actuate the switch, insert a small flat-blade screwdriver through the access hole in the front panel, then gently move the slide to the desired position.

For Setup, it makes little difference whether you are operating in the double-mono mode, or the stereo mode. When in the stereo mode, the inputs of both channels should be connected to the signal, even if the signal is mono, for optimum functioning of the AGC-100.

4.1 PLACE THE OFF / SETUP / ON SWITCH in the Setup (left) position. The green MODE LED will illuminate dimly.

4.2 While listening to the program, when the program is peaking at or near its normal loudest, ADJUST THE INPUT LEVEL CONTROLS (Left and Right) on the AGC-100, so that the VU meter reads approximately 0 VU (yellow LED) and the red LED flashes only rarely, on very loud program material. It is important to listen to the program, so that you may determine whether the material is intended to be loud or soft, before attempting to set the levels. Otherwise, the AGC-100 may not be operating in the center of its range, which would produce less than optimum results.

4.3 PLACE THE OFF / SETUP / ON SWITCH in the ON (right) position. This completes the setup calibration procedure. The green MODE LED will illuminate fully if the program is not in a *very* quiet segment. If the program pauses, or the input level abruptly drops over 20 dB below its recent peak level, the AGC-100 will hold the gain at the last setting. If the program level remains at or below this level for 10 seconds, the MODE LED will dim and the relative gain setting will change to 0 VU, the same as in the Off / Setup mode. The unit will automatically be re-activated when the program returns.

NOTE: The operation of the AGC-100 is nearly transparent; consequently it is extremely difficult to detect, as over-modulation is quickly reduced substantially, and low levels are raised relatively slowly, in order to retain the apparent dynamic range of the program and to eliminate audible gain changes. To demonstrate that the unit is indeed functioning, intentionally apply a noticeably stronger than normal signal with the AGC-100 in the Off / Setup mode, then switch the AGC-100 to the ON mode. There should be a noticeable reduction in the audio level, obvious to the listener and visible on the LED meters of the AGC-100. When the AGC is switched to the Off / Setup mode, the audio level will recover. It is convenient to use an Input Level control of the AGC-100 to do this; just re-set this control as outlined above when the demonstration is completed, in order to set the AGC-100 into its optimum range.

5.10 SPECIFICATIONS, AGC-100

NOTE: All audio levels are in dB re 0.775 V & 1000 Hz (0 dBm_{600})

OVERALL PERFORMANCE

FREQUENCY RESPONSE:
20 Hz to 15 kHz, ±0.5 dB

DISTORTION:
0.3% maximum THD

NOISE (15 kHz BW):
-70 dB re PPL

CHANNEL SEPARATION:
70 dB minimum

AUDIO CONTROL
GAIN, NOMINAL:
0 dB (+5 dB in, +5 dB out),
may be changed by adjusting
Input (front panel) and/or Output (internal)
levels

COMPRESSION RATIO:
Adaptive-slope; 2:1 @ low
input level with gradual
transition to constant-output
@ high input level.

AUTOMATIC GAIN RANGE:
Output change from Nominal caused by
input changes:

Input	Output
-20	-9 dB
-10	-4 dB
0	0 dB
+10	+3 dB
+20	+4 dB

LIMITER:
Peak clipper at 3 dB above PPL

PEAK-TO-NOMINAL RATIO:
5 dB

PRE-EMPHASIS & DE-EMPHASIS:
75 microseconds
(Internal, flat thruput)

ATTACK TIME:
5 milliseconds nominal

HOLD TIME:
10 seconds nominal (gain holds after
level
drops 20 dB, then goes to bypass gain)

RELEASE TIME:
10 seconds per 10 dB nominal

AUDIO INPUT

INPUT LEVEL, PEAK:
+10 dB, ±10 dB
adjustable on front panel.

INPUT IMPEDANCE:
100 k-ohms, balanced

AUDIO OUTPUT

OUTPUT LEVEL, NOMINAL:
+10 dB +8/-10 dB
adjustable internally

OUTPUT IMPEDANCE:
60 ohms, balanced
30 ohms, unbalanced

LOAD IMPEDANCE:
600 ohms minimum

FRONT PANEL

INDICATORS:
Left LED bargraph,
Right LED bargraph,
peak-reading,
4-segments each
(Green, Green, Amber, Red)
Mode LED
Dim: Setup/Enable
Bright: Active

CONTROLS:
OFF (SETUP)/ON Switch
Left Level Potentiometer
Right Level Potentiometer

REAR PANEL

CONNECTORS, screw-terminal

Audio Input:
Right High
Right Low
Ground
Left High
Left Low

Audio Output
Right High
Right Low
Ground
Left High
Left Low

POWER AND MECHANICAL

POWER:
105-125 V 50-60 Hz, 10 VA

SIZE:
1.6" H x 5.6" W x 16" D
Mounts on 1/3 of RM-1 or PMU413 19"
panel mount

6.0 **THEORY OF OPERATION**

The AGC-100 can proportionately change its gain setting in response to program level. The AGC-100 operates in an adaptive-slope mode, which approaches 2:1 (dB) correction at lower signal input levels, and approaches constant-level output (infinite correction) at higher input levels, thus preserving good dynamic range at normal levels, but preventing significant over-modulation if the input levels exceed normal.

The basic action of the AGC-100 is quick attack (gain reduction), with delayed, gradual release (gain increase).

Quick attack reduces the gain rapidly enough that the human ear does not perceive any excessive levels from too-strong signals. Supplementing gain reduction is instantaneous hard-limiting to prevent any sudden transients from causing severe overmodulation. (This limiting is seldom active, due to the fast attack of the AGC.)

Delayed, slow release preserves nearly all the normal dynamic range of program material, while effectively reducing undesired increases of background sounds ("pumping") during lulls in the foreground program.

More detail of the action of the AGC-100 is presented in the following paragraphs.

When operating in the ON mode, signal input levels which would normally result in an output above 0 VU cause a rapid gain reduction (approx. 5 mS) to normal output levels. Clean gain reduction to prevent over-modulation is limited only by the dynamic range of the AGC-100's input stage, which can handle over +20 dBm.

Following any automatic gain reduction, there is a ten-second period during which the gain will not increase. The delay applies to gain increases only; any program peak above normal will rapidly reduce the gain to nearly 0 VU at any time, and will re-initiate the 10-second delay. This delay significantly improves the smoothness of the program level by maintaining constant gain between speech syllables and paragraphs, music rests, and downbeats.

Following this delay, if the signal level drops from its earlier peak, and remains somewhat low, the gain will gradually increase, at a rate of approximately 1 dB per second, until a new program peak at 0 VU halts the increase. In order to prevent excessive increases in background noise during sustained relatively-quiet passages, the maximum upward correction is limited to 12 dB gain increase above the Setup level.

The AGC-100 also pauses when the program pauses. This process avoids increases of background sounds during program pauses (sudden level drops over 20 dB) by holding the gain constant at the last setting prior to the pause. If the program returns within 10 seconds, the AGC action resumes where it left off. However, if the pause exceeds 10 seconds, the AGC silently returns to the Setup gain setting (no relative correction). The AGC then waits for the program to return, at which time the AGC automatically returns to the active mode, rapidly adjusting the gain upward or downward as appropriate.

A brief exception to the slow release occurs whenever the AGC-100 first enters the active mode, whether manually switched to ON from OFF / SETUP, or, if already in the ON switch position, automatically, when the program returns following an extended pause. The release

rate then is accelerated considerably for a few milliseconds, to facilitate rapid acquisition of the optimum gain setting when a program first appears.

As mentioned earlier, adaptive-slope control preserves most of the dynamic range by slowly increasing the gain, and only by a factor of 2 (dB) when the level drops below normal. However, if the input level rises above normal, the gain is decreased by a considerably greater factor, such that over-modulation is held to only a few dB even with an input greater than 20 dB above normal.

For a table of the input-output level relationship, see the specifications section of this manual. Note that 0 dB (0 VU on the AGC's LED bar) is the nominal match-level. That is the point at which a steady-state single tone level is unaffected when switching to or from Off / Setup and Run modes.

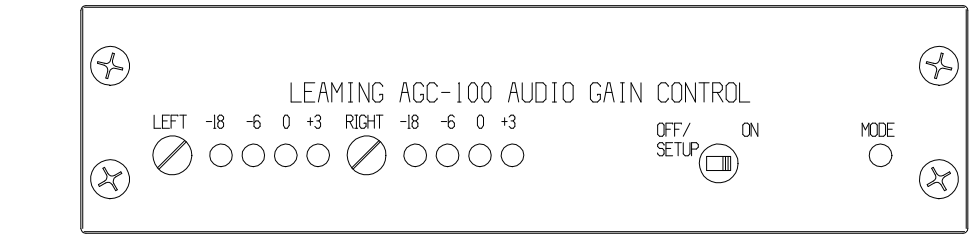
The difference between stereo and double-mono modes is slight, but significant. In the double-mono mode, the levels of the two channels are totally independent. However, in the stereo mode, both the left and the right channels have an effect on the output level of both channels; in general, the louder channel takes control and adjusts the gain accordingly, and the gain of the other channel tracks it to maintain good stereo imaging.

The MODE LED on the front panel provides an indication of the status of the AGC-100:

If the MODE LED is not illuminated at all, power is not applied to the AGC-100.

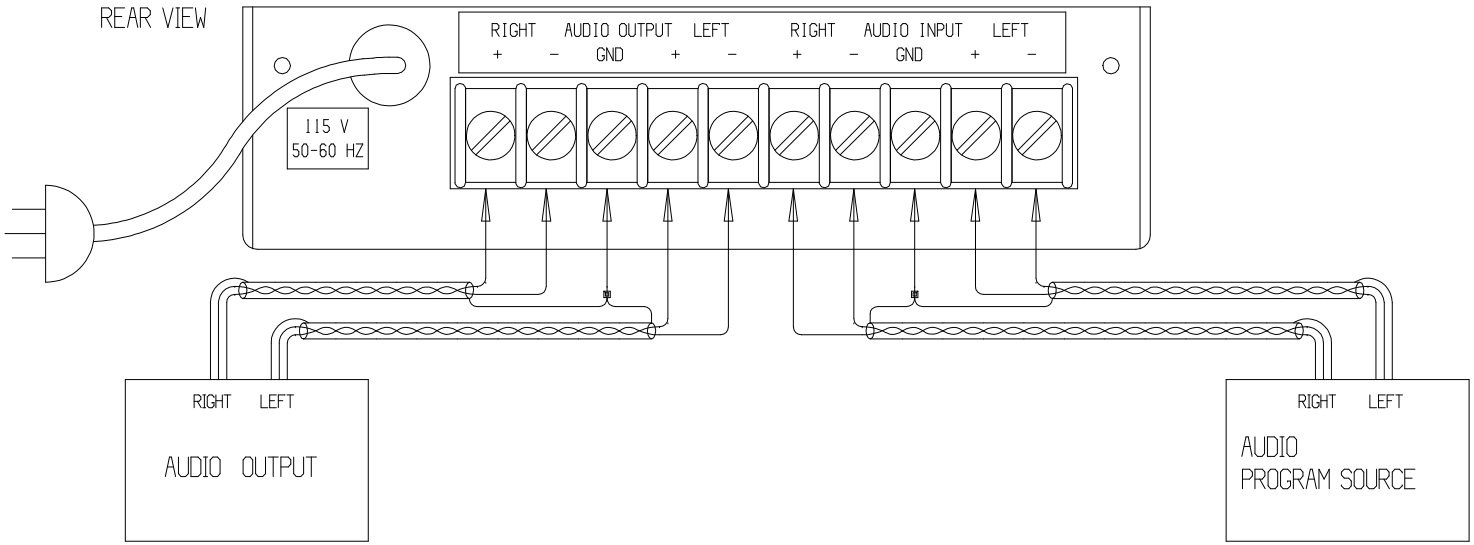
If the MODE LED is fully illuminated, the AGC is in its active mode, with normal program level present within the last ten seconds. The OFF/SETUP / ON switch must be in the ON position for this to occur.

If the MODE LED is dimly illuminated, either of two conditions may exist, depending on the setting of the OFF/SETUP / ON switch: If in OFF/SETUP, that is it. However, if in dim when in the ON position, the AGC has exceeded the 10-second gain-hold period at a program pause, and proceeded to the Setup gain setting, from which it will automatically return to the active mode when the program returns.



FRONT VIEW

REAR VIEW



CONNECTIONS, AUDIO GAIN CONTROL, AGC-100

LEAMING INDUSTRIES, INC.

3972 Barranca Parkway J608, Irvine, Calif. 92606 (949) 743-5233

SYM	REVISION DESCRIPTION	REV/CKD BY	DATE

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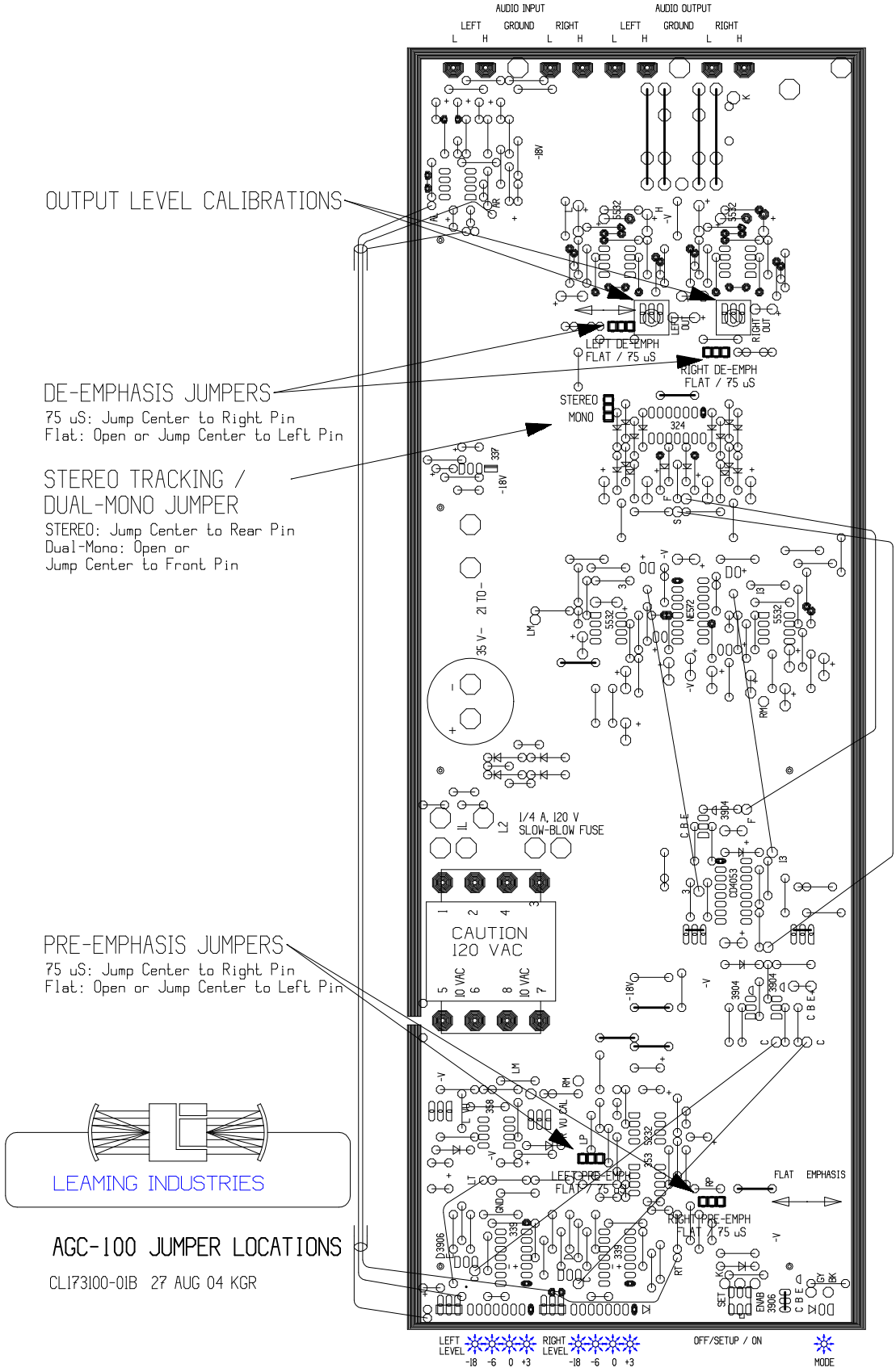
OUTPUT LEVEL CALIBRATIONS
DE-EMPHASIS JUMPERS
75 uS: Jump Center to Right Pin
Flat: Open or Jump Center to Left Pin
STEREO TRACKING /
DUAL-MONO JUMPER
STEREO: Jump Center to Rear Pin
Dual-Mono: Open or
Jump Center to Front Pin
PRE-EMPHASIS JUMPERS
75 uS: Jump Center to Right Pin
Flat: Open or Jump Center to Left Pin
LEAMING INDUSTRIES
AGC-100 JUMPER LOCATIONS
CL173100-01B 27 AUG 04 KGR
AUDIO INPUT
AUDIO OUTPUT
LEFT
GROUND
RIGHT
LEFT DE-EMPH
FLAT / 75 uS
RIGHT DE-EMPH
FLAT / 75 uS
STEREO
MONO
1/4 A, 120 V
SLOW-BLOW FUSE
CAUTION
120 VAC
FLAT
EMPHASIS
OFF/SETUP / ON
MODE