

SOUND  DEVICES

**302**



## **Compact Production Mixer User Guide and Technical Information**

**Sound Devices, LLC**

300 Wengel Drive

Reedsburg, WI 53959 USA

tel: +1 (608) 524-0625

fax: +1 (608) 524-0655

**[www.sounddevices.com](http://www.sounddevices.com)**

[info@sounddevices.com](mailto:info@sounddevices.com)

The 302 is the essential portable mixer for production companies and camera operators wanting to take control of their audio. The 302 is stunning in size, flexibility, control and performance; it is the most compact and cost-effective battery-powered professional audio mixer in its class.

With important features to accommodate nearly any over-the-shoulder production, the 302 can interface with any professional microphone, wireless system, or camera/recorder input. Its microphone inputs share the same superb circuitry of all Sound Devices field production tools.

With many of the controls of Sound Devices flagship 442 mixer, the 302 has a complete feature-set in a compact, functional design. All controls are accessible on its three main surfaces. Its high-efficiency power circuitry runs the mixer from either three internal AA batteries or external 5–18 VDC.

The 302 is part of Sound Devices family of field production audio tools, which includes mixers, preamplifiers, computer interfaces, recorders, and their accessories.

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## QUICK START CHECKLIST

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Proper setup of sound sources and input devices is quick and easy with the 302. Follow the steps outlined below for basic interconnection.

### Powering

1. Insert three AA-batteries with + side first into the mixer battery tube.
2. Switch on the mixer power by sliding the power switch to INT. The power LED will illuminate solid green with good batteries.

### Interconnection

1. Connect the output XLR connectors of the 302 to the destination recorder, camera, or other input.
2. Connect microphones, wireless receivers, or other signal sources to the input XLR connectors.
3. Switch phantom or T-power on, as need by microphone sources.

### Setting Output Gain Structure

1. Determine the required input level of the destination. If a line level connection is required, no further output level adjustment is needed on the 302. If the input level requires less than line level, such as microphone or a -10 dBu level, adjust the master output level accordingly (**see Output Level Control**).
2. Turn on the 302's tone oscillator. Adjust the input sensitivity on the destination device so that the 302 output is at an average level with sufficient headroom to accommodate signal peaks. For many digital cameras and recorders, this is often a range between -20 and -12 dBFS as read on the recorder or camera's peak meter. With analog devices, setting input sensitivities so that tone is near 0 VU is typical.

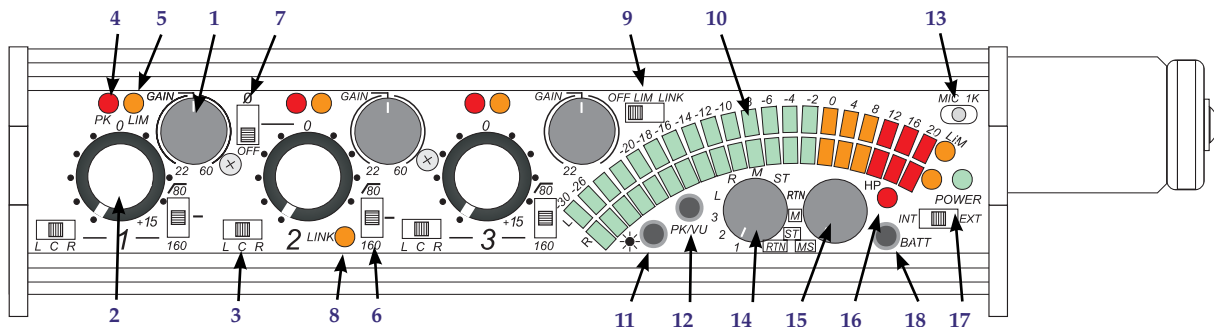
### Setting Input Levels

1. Select the overall level, mic or line, for the input channel.
2. Set the channel fader to the unity gain position.
3. Raise the gain control (push-up trim) while talk-testing inputs so that signal indicates on both the 302's level meter and the recorder/camera level meter.

### Monitoring

1. Connect headphones to the headphone connector located on the input panel.
2. Set the headphone source to ST to monitor stereo program. Raise the headphone volume level to the required level. **NOTE: The 302 headphone output is capable of producing ear-damaging levels. Turn down levels before switching headphone sources.**
3. Monitor individual sources by moving the headphone selection switch to the 1, 2, or 3 positions.

## FRONT PANEL DESCRIPTIONS



### 1. Gain (Trim)

The coarse gain control. Sets the input sensitivity so that the Fader can be used for fine gain control with the channel fader.

### 2. Fader

The primary control for input adjusting level during operation.

### 3. Pan Switch

Assigns the input channel to the output bus. Left-only, Center (equal left and right), or Right-only.

### 4. Peak LED

When illuminated, indicates that the channel is very near overload.

### 5. Limiter LED

When illuminated, indicates that the channel limiter is operating and reducing channel gain to prevent overload.

### 6. High-Pass Filter (Low Cut)

Three-position switch engages the high-pass filter. Used to reduce excessive low frequencies. 12 dB per octave at 80 Hz or 160 Hz. Center position is off.

### 7. Polarity Reverse Switch – Input 2

When engaged, the polarity of Input 2 is reverse (180° out-of-phase) with respect to inputs 1 and 3. Useful to flip the stereo image with MS stereo.

### 8. Stereo Link LED (Inputs 1 & 2)

Indicates that inputs 1 and 2 are linked as a stereo pair. Controlled in the Setup Menu. In L/R stereo link input 2 Fader controls overall stereo level. When in MS position input 1 Fader controls Mid, input 2 Fader controls the amount of stereo (Side) information.

### 9. Limiter Switch

Activates both input and output limiters. ON is dual-mono limiter operation, LINK is stereo operation. Output limiter threshold controlled in Setup Menu.

### 10. Output Meter

Sunlight-viewable, 20-segment LED meter. Calibrated in dBu when peak-reading.

### 11. Meter Brightness

Controls the brightness of the LED output meter. Each push selects among four brightness levels.

### 12. Meter Ballistics

Toggles among the available meter ballistic options: VU-only, peak-only, combo peak/VU, peak-hold/VU.

### 13. Slate Mic/Tone Switch

Two-position switch activates the slate microphone in the left (momentary) position, or the tone oscillator in the right (latched) position. Additional options available in the Setup Menu.

### 14. Headphone Selector Switch

Sets the signal source sent to headphones. Options include: input PFL 1, 2, 3; left output bus; right output bus; Mono (summed left and right); Stereo master; RTN - stereo monitor return; MS-mono; MS-stereo; RTN-MS.

### 15. Headphone Volume

Adjusts the overall volume of the headphones. NOTE: the headphone output is capable of ear-damaging levels. Take care when adjusting among signal sources.

### 16. Headphone LED

Indicates overload of the headphone circuit and RTN circuit.

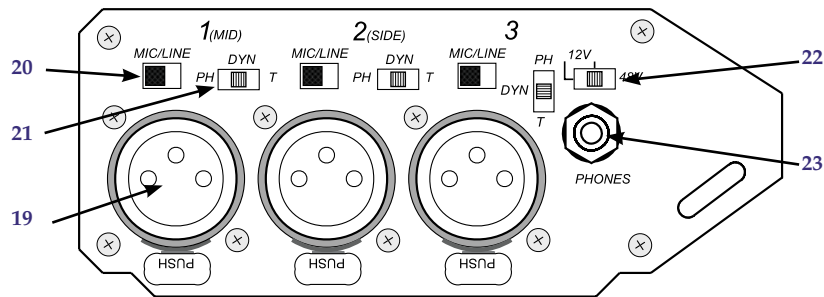
### 17. Power Switch/LED

Three-position switch selects between internal battery power or external DC sources. Power LED illuminates when power is on. LED flashes when voltage reaches low limit (see Powering).

### 18. Battery Check Button

Hold to show the internal and external battery levels on the output meter. Battery level remains for two seconds after button release.

## INPUT PANEL DESCRIPTIONS



### 19. Transformer-Balanced Inputs

Can be used unbalanced by grounding pin-3 to pin-1 of the XLR connector. Pin-1 = ground; pin-2 = 'hot'; pin-3 = 'cold'.

### 20. Mic/Line Channel Switch

Selects the input level of the adjacent connector. Mic level has 40 dB more gain than line level.

### 21. Phantom/DYNAMIC/T-Power Selection

Selects the microphone powering type of the adjacent input. DYN position turns off all microphone powering. Mic powering is selected per input.

**NOTE: Use T-Powering only for T-Powered microphones.**

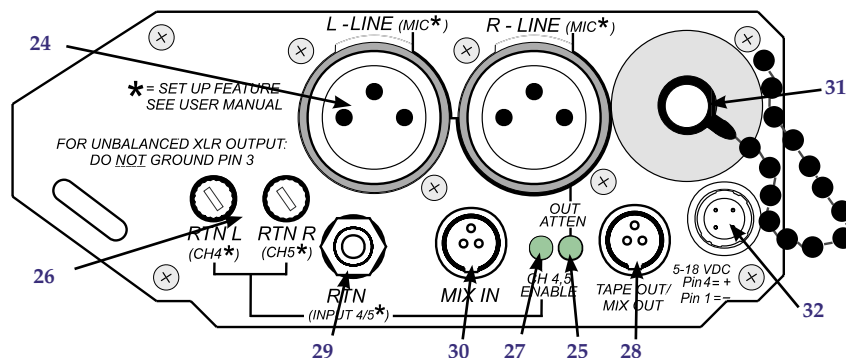
### 22. Phantom Voltage Selection

Selects between 48 V or 12 V phantom voltage for the input channels. The three-position switch uses two positions for 12 V—there is no difference between these positions.

### 23. Headphone Output

3.5 mm TRS stereo headphone output. Can drive headphones from 8 to 2000 ohms to required monitoring levels.

## OUTPUT PANEL DESCRIPTIONS



### 24. XLR Master Outputs

Active-balanced outputs. Pin-1 = ground; pin-2 = 'hot'; pin 3 = 'cold'. Can be unbalanced by using pin-2 for signal and pin-1 for ground.

### 25. Output Attenuation LED

When illuminated, indicates that the XLR output connectors are set for a level other than the factory default of line level. See Setup Menu to set XLR output levels.

### 26. Return Level (Channel 4/5 Level) Control

Adjusts the gain of the return feed to balance program and monitor signals in headphones.

### 27. Channel 4/5 Activation LED

When illuminated, indicates that the return connector is now set as an input 4 and 5 connections.

### 28. Tape Out / Mix Out

Unbalanced stereo output on TA3-type connector. Same program as master output. Pin-1 = ground, pin-2 = left, pin-3 = right. Also used to link to the Mix In of a 442 or 302.

### 29. Return (Channel 4/5) Input

Unbalanced stereo 3.5-mm input connector for return monitor audio. 3.5-mm wired tip = left,

ring = right, sleeve = ground. Connection used for inputs 4 & 5 when selected in Setup Menu.

### 30. Mix In

An input to the master bus designed exclusively to link the Tape Out/ Mix Out of 302, 442, MixPre, or MP-2 to the 302 for additional inputs. Pin-1 = ground, pin-2 = left, pin-3 = right. Shell of TA3 connector must be grounded to pin-1 to open connection.

### 31. Battery Tube

Holds three-AA batteries for internal powering.

Accepts alkaline, lithium, or NiHM rechargeable cells.

### 32. DC Input

Accepts DC voltages from 5–18 VDC for mixer powering. Four-pin Hirose connector wired pin-1 negative (-), pin-4 positive (+). Ext DC is completely isolated (floating) from the rest of the circuitry.

## INPUTS

The inputs of the 302 consist of three, full-featured microphone preamplifiers. Each input has a wide gain range to accommodate nearly all signal types. The 302 easily accepts signals from low-sensitivity ribbon and dynamic microphones, medium level wireless and condenser mic outputs, and “hot” line-level signals.

302 inputs are transformer-balanced. The isolation characteristics of transformers are superior to other balancing techniques for the hostile and uncontrolled environments of field production. Transformers provide galvanic isolation from the driving source, meaning there is no direct electrical connection. Signals are “transformed” magnetically. The input transformers in the 302 use premium magnetic core material to achieve high signal handling capability (especially at low frequencies) while keeping distortion to a minimum. Because of their inherently high common mode impedance, transformers are unrivaled by any other type of input for common-mode noise rejection.

The inputs of the 302 can be used balanced or unbalanced. When unbalancing, ground pin-3 to pin-1 of the XLR connector. There is no change in gain between unbalanced and balanced connections into the 302.

### Mic/Line Level Selection



The Mic/Line switch on the input panel is used to select the general level for each input. Taking into account all gain stages, the 302 has 75 dB of available gain from mic input to line output. When inputs are set to the LINE position, the input sensitivity is reduced by 40 dB.

### Gain (Trim)

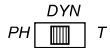


Like traditional mixing consoles, the 302's input sensitivity is set using the Gain (trim) control. The Gain control adjusts the input sensitivity so that the channel Fader can be used near its unity, or 0, position. Once set, the Gain is typically kept at the set level and all mixing is performed with the Fader control. The Gain control features a pop-up knob so that it can be adjusted easily and then hidden from the mixing surface.

### Fader

While both the Gain and the Fader control the level of an input, the Fader is the primary level control used during mixer operation. The Gain can be thought of as a “coarse” level adjustment to be adjusted during set up, and the Fader as a “fine” level adjustment to be adjusted during operation. With a properly set Gain, the Fader can be set to its unity gain position at 12 o'clock. With the Fader at unity, the dynamic range of the mixer is maximized. By setting both the Gain control and Fader inputs with varied sensitivities can be controlled with similar positions on the input Faders.

## Phantom and T- Microphone Powering



The 302 can provide either phantom power or T-power to each input and is selected individually. If neither phantom or T-power are required, for instance with dynamic microphones, it is good practice to turn off microphone powering (DYN position).

### Phantom Power

Phantom powering is a fixed DC voltage between 12 and 48 volts. This voltage is resistively applied to pin-2 and pin-3 of an XLR connector relative to pin-1. (Note that as there is no voltage difference between the signal pins-2 and -3—a dynamic mic can operate just fine in the presence of phantom powering.)

When phantom is selected, the 302 can provide up to 10 mA to each input at 48 V, sufficient for the most power-hungry condenser microphones. When acceptable, using 12 V phantom is recommended to extend battery runtime. Many microphones do not require 48 V phantom and can be properly powered from 12 V phantom power. The phantom voltage level is globally selected for all inputs—either 12 V or 48 V.

### T-Powering

T-powering is a microphone powering scheme used by several European condenser microphone manufacturers. Today, T-powered microphones are not as common as phantom powered microphones, but many are still in regular use. Unlike phantom power, T-power resistively applies 12 V between the signal pins -2 and -3. T-power can be selected for each input. The 302 provides positive T-power, where pin-2 on the three-pin XLR connector has +12 volts relative to pin-3. When using “red dot” T-powered microphones (reverse polarity T-power) use a polarity-reversing adapter on the input, otherwise damage to the microphone may occur.

**NOTE: Phantom and T-powering are not interchangeable. Use T-powering only for T-powered microphones.**

It is generally good practice to turn off phantom power when not using a phantom powered mic, as phantom power can capacitively couple noise into the mic inputs with poor mic cables. Also, turn phantom power off when using ribbon microphones since an improperly wired cable can permanently damage the microphone. The DYN (dynamic) position applies no voltage to the microphone input.

## High-Pass Filters



Each channel of the 302 has a two-position high-pass filter. High-pass (or low-cut/low roll-off) filters are useful for removing excess low frequency energy in audio signals. Wind noise is a common unwanted low frequency signal and a high-pass filter is effective for reducing wind noise. For most audio applications engaging the high-pass filter is beneficial, since little usable audio information exists below 80 Hz, especially for speech reproduction.

The 302's high-pass filters features a 12 dB/octave slope with either 80 Hz or 160 Hz corner (–3 dB) frequencies. The 160 Hz settings is used when aggressive filtering is required. The 302's high-pass circuit is unique because of its placement before any electronic amplification. Most mixer's high-pass circuits are placed after the mic preamp, where all of the high-energy low-frequency signals get amplified. Because the 302's circuit cuts low-frequency signals before amplifying, higher headroom is achieved in presence of signals with a lot of low-frequency energy.

Where possible, attempt to equalize at the sound source with microphone selection, use of windscreens, microphone placement, and on-board microphone filtering. Many microphones have on-board high pass filters, and the high-pass filters on the 302 can be used in conjunction with the microphone's filters to increase the filter's slope.

The high-pass filter are defeated when the switch in the center position.

## Pan Switches



The pan switches assign inputs to output buses. Inputs can be sent to the left, right, or both outputs equally. The 302 features excellent “off-attenuation” in the left and right positions. Using the pan switches a separate mix of sources can be sent to the left and right outputs. For instance, a summed mono mix of all three inputs can be sent to the right output while an isolated mix of one input can be sent to the left output.

## Input Limiters

The 302 input limiters act solely as “safety” limiters, and are enabled when the output limiters are enabled with the front-panel “LIM” switch (see **Setup Menu** to defeat Input Limiters entirely). In normal operation with properly set input levels, the threshold of the input limiter will rarely be reached. If extremely high input signal levels are approached, such as in high SPL environments or with misadjusted settings, the input limiter(s) will activate to prevent overload. Without this limiter, “hot” signals could overload the mixer and cause distortion. It is recommended that the input limiters be used at all times. Below the factory-set threshold (just below clipping), the limiter has no effect on audio. There is no user-adjustments to the input limiter threshold or its envelope.

When inputs 1 & 2 are linked as a stereo pair, their limiters also link to perform the same gain reduction to both inputs equally. Each input has an amber limiter LED which illuminates in proportion to the amount of limiting. If the orange LED for a channel comes on regularly, it is recommended to turn down the Gain.

## Peak and Limit LEDs



Each input has an indication of peak signal activity. When an input nears its clipping level (3 dB below), the red Peak LED illuminates. If the Peak LED comes on often, it is recommended to turn down the Gain. If limiters are active, the amber input limiter LED illuminates during limiting.

## Polarity Reverse - Input 2



Engaging the polarity reverse switch inverts the polarity of input 2. Polarity reversal is often used to quickly reverse the stereo field in MS recording. The normal position is OFF, with polarity reversal occurring when the switch is in the “Ø” position.

**NOTE: Be advised that an audible pop occurs when the polarity switch changes states.**

## Stereo Linking of Inputs 1 and 2

Stereo linking allows inputs 1 and 2 to be controlled as a single, stereo input. This is useful when stereo microphones or stereo line level signals are used with the 302 and the operator wants a single knob for controlling the overall signal.

There are two modes of operation for stereo linking, X/Y link and MS stereo. In both cases, inputs 1 and 2 are used for the inputs. Stereo linking is activated in the Setup Menu.

### X/Y Stereo Link

Inputs 1 and 2 can be linked as a stereo pair to simplify control with stereo microphones. X/Y stereo linking is set in the Setup Menu. When in X/Y stereo link operation, inputs 1 and 2 pan switches still control signal routing. Fader 2 controls the overall level of the pair. Each input Gain and high-pass controls still function on their respective inputs.

In X/Y Stereo linking, the limiters for inputs 1 and 2 are linked to operate identically on each signal.

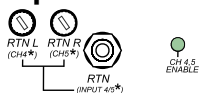
### MS Stereo Linking

When MS stereo linking is set in the Setup Menu, inputs 1 and 2 are linked as an MS (mid-side) stereo pair.

MS is a popular stereo configuration because of its good spatial placement, mono-compatibility, and surround compatibility.

The 302's MS matrix uses input 1 for the Mid signal and input 2 for the side signal. The input 2 Fader controls overall gain. Input 1 fader and input 2 pans are disabled. The Gain and high-pass filters still act individually. The Gain control for inputs 1 and 2 is used to vary the Mid and Side levels respectively. Using the input 2 Gain is an effective way to control stereo spread.

### Inputs 4 & 5



When additional inputs are needed, such as when multiple wireless receivers are used, the Return connector can be reassigned to act as an input connector for channels 4 and 5. This functionality is set in the Setup Menu (see Setup Menu).

Several options are available for inputs 4 and 5. Either or both inputs 4 and 5 can be sent to the left, right, or left and right output bus. The sensitivity of inputs 4 and 5 is controlled by the trim control adjacent to their 3.5-mm connector. **Note, this unbalanced input is suitable for tape or line level devices only. There are no microphone preamps on inputs 4 and 5.**

To indicate that the Return connector is now used for inputs 4 and 5, the 4/5 Channel Enabled LED (on the output panel) illuminates.

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## OUTPUTS

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The 302 is a two-bus mixer. Because each input can be “hard panned” between the left and right output bus the 302 is easily used in either stereo or dual-mono operation. With dialog often recorded in mono, each output connector can be used to feed a separate camera or recorder. XLR Outputs and Tape Outputs share the same program content.

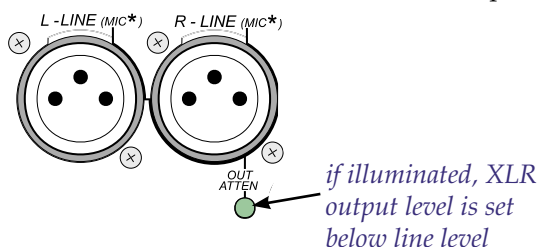
The 302 has no master level control. The master is factory-set to unity gain, or “0” dB.

### XLR Outputs

The two XLR outputs are active-balanced connections, each capable of driving long lines. These connections can be used either balanced or unbalanced. When unbalancing, use pin-2 for (+) and pin-1 for ground; float (leave open) pin-3.

### XLR Output Level

With no external mic/line level switch the 302 output level is adjusted in the Setup Menu (see Setup Menu for details). From the factory, the 302 is set for Line Level outputs. Adjacent to the XLR outputs, the Output Attenuation LED indicates if the XLR outputs are at a level other than Line Level.



### Line-Level or Mic-Level (or somewhere in between)

By adjusting the attenuation level in the setup menu (see Setup Menu for adjustment) the output level of

the 302 can be adjusted from line level down to mic level. Both left and right XLR outputs are adjusted at the same time—there is no ability to adjust left/right independently. Additionally, operating levels between mic and line level can be set. Attenuation is set from 0 to 16 dB in 2 dB increments, and 40 to 56 dB in 2 dB increments. The common attenuation levels of -10 (aux level) and -40 (hot mic-level) and -56 (low mic-level) are available.

When setting the output attenuation, determine how much attenuation is applied by adding the values shown of the solid LEDs. For instance, to set 40 dB of attenuation the values of -30 (right meter) and -10 (left) meter will be indicated.

Output levels are set depending on the device (camera, recorder, transmitter, etc.) that the outputs are connected. This unique control is ideal since the gain structure can be precisely set for any given piece of equipment.

**To change the mixer from line level to mic level perform the following steps:**

1. Turn off the mixer, if already on.
2. Press and hold the Peak/VU selection button while switching power on. Continue to hold down the PK/VU button until the -30 LED begins flashing at the left meter.
3. The Setup Menu is now entered and Output Attenuation is the first setup (the -30 left LED is flashing and the 0 LEDs are lit).
4. Use the brightness (down) button to apply attenuation. Successively press the down button until the -30 LED (right meter) and the -10 LED (left meter) are illuminated.
5. Step through all setups using the PK/VU button until the meters “dance”.

The setting is now saved and the Output Attenuation LED should now be lit.

## Tape Out (Mix Output)



TAPE OUT/  
MIX OUT

The 302 has an unbalanced, two-channel tape level output on a single, locking Switchcraft TA3M-type connector. Tape output program is the same as the XLR Output. The Tape Out level is fixed at its -15 dBu nominal level and is electrically isolated from the XLR Outputs.

The 302 Tape Out is used to connect the 302 to numerous inputs, including: MiniDiscs, DATs, compact cassette recorders, and wireless transmitters. Additionally, the Tape Output functions as the Mix Out to link multiple Sound Devices mixer (see **Mixer Linking**).

## Output Limiters

OFF LIM LINK



In addition to the limiters on each input channel, the 302 has a software-controlled Output Limiter. Output limiters are used to prevent overloading of recorders, cameras, and wireless transmitters connected to the 302. The Output Limiters on the 302 use an optoisolator-based peak limiting circuit. The Output Limiter threshold is set in the Setup Menu. The Output Limiter can be set in one of two positions, Link or LIM.

### Link (Stereo Operation)

When set in the link position, the Output Limiter acts identically on each (left/right) output bus. If one output causes the limiter to engage, the other bus will follow suit. This is useful when using the 302 in stereo—limiter operation will not affect the stereo image.

### LIM (Dual-Mono)

When using each output bus separately the output limiter should be set to the ON position. This position

engages each Output Limiter separately. They will act on each respective output bus independently of the other.

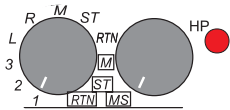
*While all dynamics processing “distorts” the audio signal, overloading a circuit is usually far more objectionable. For most applications the limiters are a significant benefit and should be enabled.*

## HEADPHONE MONITORING

The 302 has a flexible headphone circuit capable of selecting a variety of audio signals for listening in headphones. Most professional headphones ranging in impedance from 8 ohms to 1000 ohms can be used with the 302.

**NOTE: THE 302 IS CAPABLE OF PRODUCING EAR-DAMAGING LEVELS IN HEADPHONES. TURN DOWN THE HEADPHONE VOLUME BEFORE SELECTING A MONITORING SOURCE.**

The headphone level control adjusts the overall volume sent to the headphones. The level control adjusts both the left and right headphone outputs simultaneously.



### HP Monitor Selection

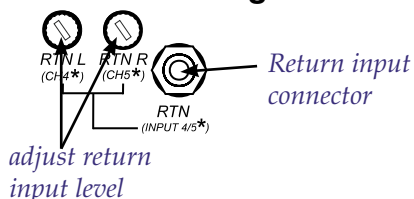
Several signal sources can be sent to the headphones. The front panel rotary switch selects the signal.

<b>(PFL) 1</b>	PFL solo monitoring of the channel one input signal. Channel is monitored in mono. Pre-fade, post limiter, post high-pass. Useful for setting the channel gain.
<b>(PFL) 2</b>	same as above, but for channel 2 input
<b>(PFL) 3</b>	same as above, but for channel 3 input
<b>L</b>	left output bus, monitored dual-mono
<b>R</b>	right output bus, monitored dual-mono
<b>M</b>	summed mono of left and right output bus
<b>ST</b>	stereo monitoring of master output bus. This is the primary monitoring path
<b>RTN</b>	stereo return from the RTN monitor input path
<b>M-MS</b>	monitoring of the mono signal of an MS stereo signal
<b>ST-MS</b>	monitoring of discrete MS signals in headphones as decoded stereo signal
<b>RTN-MS</b>	monitoring of discrete MS return signal in headphones as decoded stereo signal

### Headphone Level and Overload LED

The headphone level knob controls overall headphone level to the phones. The adjacent LED indicates that the headphone circuit is overloading. The LED will also illuminate with an overloaded RTN signal.

### Return Monitoring



Indicated by the RTN positions on the rotary switch, audio sources connected to the mixers 3.5-mm jack labeled RTN can be monitored in headphones. Return, or “confidence monitoring,” is useful to monitor audio from a camera or recorder. Typically, camera headphone outputs are used as the Return Monitor source. Return levels are controlled by the headphone level, while the return level sensitivity can be adjusted with the return input level controls.

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## tone oscillator/slate microphone

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A single 3-position switch controls the tone oscillator and slate microphone. The tone/slate switch is located in the upper right corner, protected from inadvertent engagement by the end panel. When the tone oscillator or slate microphone is engaged inputs are muted.

MIC 1K



### Tone Oscillator

Tone is used to set gain levels between the 302 and the next device in the signal path. The tone oscillator uses the locking position of the switch. NOTE: this switch can be reassigned in the Setup Menu.

From the factory, the tone oscillator is set to output a 1 kHz tone at 0 dBu to the outputs (when the outputs are set to Line level). **If you are interconnecting primarily with analog video cameras, you may want to modify to the tone output level to +4 dBu in the Setup Menu.** In the Setup Menu, the tone frequency and output level can be adjusted or tone can be defeated altogether.

When engaged, the 302 tone oscillator attenuates the headphone output by 20 dB to protect the operator’s ears. This feature can be defeated in the Setup Menu.

### Left/Right Verification

Pressing the battery check button when the tone oscillator is active sets the left output level to cycle between 0 and –20 dB. This is helpful to verify proper left and right channel connection. Turning off the tone oscillator or pressing the battery check button again stops the output cycling.

### Slate Microphone

The slate microphone is used to audibly notate scenes at the mixer location. Its audio performance is not suitable for critical recording applications; it should only be used for documenting scenes to tape. The slate mic uses the momentary switch position.

In the Setup Menu, a one second 400 Hz tone can be set to precede the slate microphone. The slate microphone signal is sent to all outputs. In the Setup Menu, the slate microphone can be disabled altogether to prevent unintended activation. Additionally, the switch assignments of slate and tone can be reversed for user convenience.

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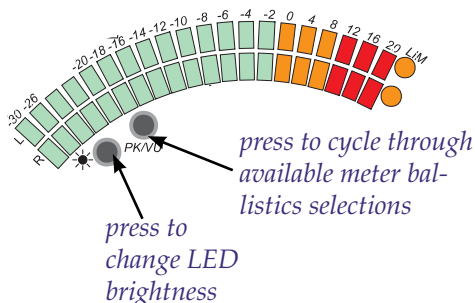
## THE METER

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The meter on the 302 provides a great deal of audio signal information for the operator. The ability to view peak level (PPM), average levels (VU), or a combination of both is unique to Sound Devices LED-based meters. In addition to the flexibility to provide multiple meter ballistics, the meter does not have the inherent limitations of LCD and mechanical meters—sluggish indications in cold temperature with LCD’s and fragility with mechanical meters. The 302 meters share the same technology and software programmability used in Sound Devices larger 442 field mixer and on the 7-Series digital recorders.

## Source

The meter can display levels of the output buses, the PFL levels or levels from the RTN inputs. Default operation is always the output bus except when PFL's are selected from the Headphone Selection Switch. This operation can be modified in the Setup Menu.



## Scale

When viewing peak information on the meter, its scale is calibrated in peak-reading dBu. When viewing VU information, its scale corresponds to VU units. **NOTE: Unlike other analog mixers, the 302 is calibrated with its 0 VU reference at 0 dBu, not +4 dBu. If you primarily interconnect with analog video cameras, set the 0 VU reference to +4 dBu by making the change in the Setup Menu.** The 302's scale is designed for digital recording devices, providing maximum information between -30 dBu to 0 dBu where typical peaks occur (-50 to -20 dBFS). This allows the user to record with a full 12 to 20 dB of headroom while in the fine-resolution green-colored part of the meter. Additionally, the meter color changes to orange at 0 dBu and then red at +8 dBu. These color changes correspond to -20 dBFS and -12 dBFS respectively, which are commonly used recording levels for today's digital recording devices.

## Ballistics

The 302 output meter can indicate several different selections of ballistics. The available choices that are selected with the front panel meter ballistics button can be selected in the Setup Menu. To move from one setting to the next depress the meter ballistics button. Settings include:

**Peak** - important setting used to know the absolute peak signal level to prevent overload of downstream devices. Peak-only is commonly used in Europe, but is being replaced by the PPM/VU combination metering.

**VU** - calibrated to show average loudness of audio signals. Useful when connecting to analog recorders or in combination with peak readings. VU meters are too slow to be used as the sole metering with digital devices. **Note that the 302 factory default has its 0 VU reference at 0 dBu.**

**Peak with VU combination** - a very informative setting which for many users is the default used with the 302. Indicates the absolute peak level as well as the "loudness" of the signal.

**Peak-Hold with VU** - similar to Peak/VU combination, but with the peak level being held for 1500 ms.

Useful when a peak signal is encountered while the operator is not viewing the meters - peak held long enough to know if signal exceeded desired levels.

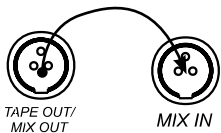
## Illumination Intensity

The output meter can be set for comfortable viewing in all lighting conditions. Four levels of brightness are available by depressing the meter brightness button.

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## MIXER LINKING

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*make the connection between  
Tape Out and Mix In*

To add inputs to the 302, an additional mixer can be connected (linked) into its Mix In connection. The unbalanced Mix In connection is directly compatible with Sound Devices MixPre, 302, and 442 mixers. A simple connection between those mixer Mix Out/Tape Out and the 302 Mix In adds their input channel to the 302's output bus. The unit connected via the Mix In will contain all inputs.

When linking with a 442 a system of seven microphone inputs is achieved. Generally when linking to a 442, the 442 is used as the master, linking with the 302's Mix Out to the 442's Mix In. At the 442 outputs, all seven inputs appear.

Sound Device XL-1 accessory cable can be used to link multiple 302 mixers or 302 and 442 mixers. Sound Devices XL-3 accessory cable can be used to link a MixPre to the 302 for a system of five inputs. **Note: link cables must be wired to short pin-1 to connector shell in order to open the Mix In connection.**

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## POWERING

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The 302 can be powered from either internal batteries or from external DC. The power-efficient 302 can operate from three AA alkaline batteries for nearly a production day (less with phantom powering). While many users prefer external DC sources to power both their mixer and wireless receivers, the use of internal batteries is perfectly feasible for both primary and backup powering of the 302.

### Power Switch and LED

The 3-position power switch selects between internal batteries, external DC, or power off. Because of the power supply design of the 302, the unit takes approximately 10 seconds to fully stabilize its power supply after power-up. Additionally, there is sufficient capacitance in the circuit to toggle between internal and external without disruption in audio.

The power LED illuminates solid green to indicate good power. When the power source falls below the threshold voltage (see chart on next page) the power LED begins to flash. Once flashing changing the power source is recommended.

### Internal Batteries

The 302 uses a unique battery tube to hold 3-AA batteries. This robust tube is sealed to prevent potential battery leakage from ruining internal circuitry. The threaded-nickel cap extends beyond the panel to make battery changes easy and quick. The battery tube extends no farther than adjacent XLR connectors.

**Note: Remove batteries when the unit is stored for extended periods.**

### External DC Sources

For extended mixer runtime use an external DC source. The 302 can be powered from any DC source with a voltage range of 5 volts to 18 volts. If using an AC-to-DC transformer, such as a Sound Devices XL-WPH, make certain its output voltage falls in the 5–18 V range and can supply at least 4 watts. If an over voltage is applied to the mixer, an internal poly fuse is opened to prevent mixer damage. The fuse is reset when the voltage is removed.

The external DC supply is isolated (floating) from the circuitry to minimize ground loop and interaction among devices sharing the same DC source. The external DC connector is a Hirose 4-pin female. This locking connector mates to Hirose P/N HR10-7P-4P (Sound Devices P/N XL-H). Pin-1 is negative and pin-4 is the positive voltage.

### Power Metering

The battery check button indicates battery voltages of internal and external power supplies on the output meter. The left meter shows the internal battery voltage and the right meter shows the external battery voltage. Since many different battery types are available for external use, the external DC metering can be customized for a given battery in the Setup Menu. The power meter is read from left to right, with the highest voltage indicated with LED's lit all the way to the left (green).

### Power Consumption

The 302 can vary in the amount of current it draws. Several functions of the 302 directly affect current draw in different ways. The following list highlights the larger current drawing functions (listed from highest to lowest current draw).

<b>Microphone powering</b>	the main source of current beyond the idle current draw. (See Phantom and T-Microphon Powering) 48 V phantom can draw copious amounts of current out of the batteries depending on what model microphone is used. Two phantom powered microphones draw twice as much current as one. Microphones vary widely in their current draw depending on type and phantom voltage applied
<b>Output drive level</b>	higher output drive levels into multiple, low-impedance inputs increases current draw
<b>Headphone output</b>	high headphone output levels increase current draw
<b>Meter brightness</b>	current draw is slightly increased with higher illumination intensities

Experimentation is recommended to determine battery life for each individual setup and application.

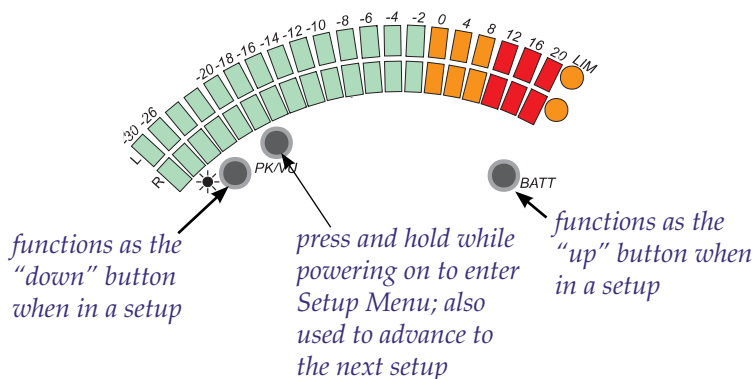
## THE SETUP MENU

The 302 has 18 available setup features (see Setup Chart for all available options). Setups, typically set-and-forget features, are infrequently changed. With the Setup Menu, these features are easily accessed directly on mixer's the front panel.

### Entering the Setup Menu

To access the Setup Menu perform the following steps:

1. Turn off the mixer, if already on.
2. Press and hold the Peak/VU selection switch while switching power on.
3. The Setup Menu is now entered.



The mixer will not pass audio when in the Setup Menu. When in the Setup Menu the flashing LED on the left meter (L) position indicates the selected setup feature. The right meter (R) position indicates the values selected for the setup. Use the PK/VU button advance from one setup to another. If the intended setup is passed, setup mode must be re-entered since you can only step forward through the Setup Menu.

To adjust values, the meter brightness button (down) and the battery check button (up) allow selection among setup values. Some setups have multiple values while others have only two values.

## Setup Example

The following steps show how to change the tone frequency from the factory default of 1 kHz to 100 Hz.

1. Enter the setup menu by pressing and holding down the PK/VU button while powering the mixer. Hold the button until the -30 LED begins flashing.
2. Press the PK/VU button six times until the left meter LED flashes at the -16 position (see Setup Chart for a list of all setups).
3. To move among parameter values, press the brightness button (down) and battery check button (up) until the 100 Hz position is selected (-24 LED will illuminate solid).
4. Press the PK/VU button multiple times until the meters perform their scrolling dance. This saves the new setting into memory.

To save new values to memory, the PK/VU button must be repeatedly pressed until the last setup is reached. At that point the meters will “dance” and the new values will be saved to memory.

## User Default

A memory location is available to store user-defined default settings. The user default is helpful to save a baseline of settings different than the factory default settings. To save a user default perform the following:

1. Hold down both the meter brightness button and battery check button while powering the mixer.
2. The current settings will be saved as the user default.

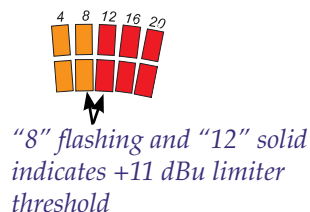
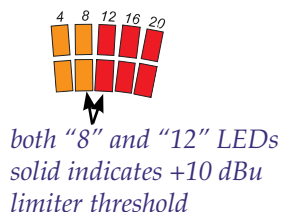
The user default settings can be recalled from the setup menu by applying the user default restore (see Setup Chart).

## Output Limiter Adjustment

Output limiter thresholds are adjustable between +4 dBu and +20 dBu in 1 dB increments. The threshold level is shown on the lower (right) meter string by illuminating LEDs. Because LEDs are spaced every 4 dB, a combination of flashing and solid adjacent LEDs indicate limiter levels between the numbered LEDs. Factory default is 20 dBu. Each press of the battery button or meter brightness control changes the threshold by 1 dB. Three possible LED indications show threshold value:

- **Single solid LED** - actual value indicates threshold.
- **Flashing LED next to a solid LED** - indicates that the threshold is one dB above or below the solid LED value.
- **Two solid LEDs** - threshold value is even number value between the two indicated values.

Two examples are shown below, a setting of +10 dBu and +11 dBu thresholds.



## SPECIFICATIONS

**Measurement settings** (unless otherwise specified): Gain controls for the channel being measured at mid point, all other channels gains fully down; pan switches centered; high-pass off; inputs in 'mic' position; outputs in 'line' position. Mic input driven with 150 ohm source. Outputs measured with 100k ohm load. Temperature at 25° C.

**Maximum Gain**, typical (trim, fader, master, phones RTN fully up):

	XLR Input Mic Setting	XLR Input Line Setting	RTN / ch 4/5
XLR Output @ factory (line) setting	75 dB	35 dB	20 dB
XLR Output attenuated	0–16 dB 2 dB steps	40–56 dB, 2 dB steps	25–41 dB, 2 dB steps
Tape Output TA3-type	61 dB	21 dB	6 dB
Headphones, 1/4-in and 3.5 mm	95 dB	55 dB	30 dB

### Inputs

	Impedance: (Ohms Actual)	Type:	For use with:	Max Input Level:
XLR, mic setting	2.5k	transformer-balanced	< 600 ohm mics	0 dBu (0.78 Vrms)
XLR, line setting	16k	transformer-balanced	< 2k ohm outputs	+40 dBu (80 Vrms)
Mix In	4.2k	unbalanced, stereo	302, 442 Mix Out (1.8k)	+6 dBu (1.5 Vrms)
Return & ch 4/5	10k	unbalanced	< 2k ohm outputs	+30 dBu

### Outputs

	Impedance: (Ohms Actual)	Type:	For use with:	Max Output Level:
XLR, factory Line setting	150	active-balanced	>= 600 ohm mics	+20 dBu (7.8 Vrms)
XLR, mic (lowest) setting	150	active-balanced	<2k ohm outputs	-36 dBu
Tape Out / Mix Out TA3	1.8k	unbalanced, stereo	>6k ohm inputs	+6 dBu (1.5 Vrms)
Headphones - 3.5 mm	200	unbalanced, stereo	8–2k ohm phones	+20 dBu (7.8 Vrms)

**Frequency Response:**

20 Hz to 30 kHz, +0.2, -0.5 dB,  
-1 dB @ 5 Hz and 50 kHz typical

**Equivalent Input Noise:**

-126 dBu (-128 dBV) maximum (22 Hz to 22 kHz bandwidth, flat filter, trim control fully up)

**Input Clipping Level:**

0 dBu minimum (trim control fully down)

**Line Output Clipping Level (1% THD):**

20 dBu minimum  
18 dBu minimum with 600 ohm load

**Dynamic Range:**

115 dB minimum (trim fully down)

**THD + Noise:**

0.007% typical (1 kHz, +4 dBu at Line out)  
0.009 max (50 Hz to 20 kHz, +18 dBu at Line out, fader fully up)

**Output Noise:**

-100 dBu (-102 dBV) maximum (22 Hz to 22 kHz bandwidth, flat filter, master gain fully up, faders fully down)

**Common Mode Rejection Ratio:**

120 dB minimum at 80 Hz, mic input  
100 dB minimum at 10 kHz, mic input

**L/R Gain Matching, Mic In to Line Out:**

±0.1 dB

**High-Pass Filters:**

Switchable 80 Hz or 160 Hz, 12 dB/oct

**Mic Powering** (each mic selectable):

Dynamic (no power applied),  
12 V Phantom - through 680 ohm resistors, 10 mA per mic available,  
48 V Phantom - through 6.8k resistors, 10 mA per mic available,  
12 V T-Power - through 180 ohm resistors, 10 mA per mic available.

**Input Limiters:**

+18 dBu threshold, 20:1 limiting ratio, 1 mS attack time, 200 mS release time.

**Temperature:**

Operating: -20°C to 60°C, 0 to 95% relative humidity; (non-condensing); Storage: -40°C to 85°C

**Output Limiters:**

affects the Line Output and Tape Out, threshold selectable from +4 dBu to +20 dBu, 1 dB steps, 20:1 limiting ratio, 1 mS attack time, 200 mS release time

**Power supply:**

Internal ±16 V (bi-polar) regulated audio rails, 2.4–6 V range internal batteries; isolated (floating) external DC input jack, 5–18 V locking 4-pin Hirose connector, pin-4 = (+), pin-1 = (-), use Hirose #HR10-7P-4P (DigiKey# HR100-ND) for locking mating DC connector.

**Power Consumption:**

130 mA @ 4.5 V, internal batteries, idle, no phantom  
55 mA @ 12 V external DC, idle, no phantom

**Metering:**

40-segment (2 x 20), sunlight-viewable  
Selectable Peak, VU, or Peak (with or without peak hold) + VU ballistics

**Weight:**

0.85 kg, (1.8 lbs) unpackaged with three alkaline AA batteries

**Dimensions:**

47 mm x 214 mm x 114 mm (H x W x D)  
1.8" x 8.4" x 4.5"

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## ACCESSORIES

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Several high-value accessories are available for the 302 mixer, including a carry-case, cables, and power accessories. For a full list of Sound Devices products and accessories, visit our web site [www.sounddevices.com/products](http://www.sounddevices.com/products).

**CS-302**

Carry case designed exclusively for the 302 mixer. Features a bottom-side pouch that accepts an NP-type battery and leather shoulder strap. Accepts Portabrace RM-multi and RM-deluxe accessories and AH-2 harness (not included). Shown at left with RM-multi, not included.

**XL-1**

TA3-F to TA3-F link cable for 302-to-302 and 302-to-442 linking; 6-inch.

**XL-3**

3.5 mm to TA3-F link cable for MixPre/MP-2 Tape Output to 302 Mix In; 12-inch.

**XL-4**

Bag of four (4) TA3-F-type connectors.

**XL-H**

Bare Hirose connector, (Hirose p/n HR10-7P-4P) to mate with locking 4-pin DC power jack.

**XL-NPH**

NP-type battery cup with 12-inch cable with Hirose 4-pin locking power jack at equipment end. For use with 302, 442N, 442, and MixPre.

**XL-WPH**

Universal AC-to-DC power supply with Hirose 4-pin connector; 100–240 VAC, 50/60 Hz

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## WARRANTY & APPROVALS

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### Warranty

Sound Devices, LLC warrants the 302 Production Mixer against defects in materials and workmanship for a period of ONE (1) year from date of original retail purchase. This is a non-transferable warranty that extends only to the original purchaser. Sound Devices, LLC will repair or replace the product at its discretion at no charge. Warranty claims due to severe service conditions will be addressed on an individual basis. THE WARRANTY AND REMEDIES SET FORTH ABOVE ARE EXCLUSIVE. SOUND DEVICES, LLC DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. SOUND DEVICES, LLC IS NOT RESPONSIBLE FOR SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES ARISING FROM ANY BREACH OF WARRANTY OR UNDER ANY OTHER LEGAL THEORY. Because some jurisdictions do not permit the exclusion or limitations set forth above, they may not apply in all cases.

For all service, including warranty repair, please contact Sound Devices for an RMA number and send the 302, along with proof of purchase date to:

**Sound Devices, LLC**  
Service Repair RMA # XXXX  
300 Wengel Drive  
Reedsburg, WI 53959 USA

### FCC Statement

This device has been tested and found to comply with the limits for a class B digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

### CE Conformity Statement

Declaration of Conformity

According to ISO/IEC Guide 22

Manufacturer's Name: Sound Devices, LLC  
Manufacturer's Address: Sound Devices, LLC  
300 Wengel Drive  
Reedsburg, WI 53959 USA

declares that the product: 302 Production Mixer  
is in conformity with:

Document No.	Description
EN55103-1 (1997)	Emissions standard for product family audio devices for professional use
EN55103-2 (1997)	Immunity standard for product family audio devices for professional use
EN55022 (1995)/ CISPR 22 (1997)	Radiated and Conducted emissions, Class B
EN61000-4-2 (1995)/ IEC1000-4-2 (1995)	ESD - 6kV contact, 8kV air-discharge
EN61000-4-3 (1995)/ IEC1000-4-3 (1995)	Radiated RF Immunity, 3 V/m, 80% 1 kHz amplitude modulation
EN61000-4-4 (1995)/ IEC1000-4-4 (1995)	EFT/Burst, I/O lines, $\pm 0.25$ kV to $\pm 1.0$ kV
EN61000-4-6 (1996)/ IEC1000-4-6 (1996)	Conducted RF Immunity, 3 V, 80% 1 kHz amplitude modulation

Tested by: L. S. Compliance, Inc. Cedarburg, Wisconsin  
March 26, 2003

Matthew Anderson  
Director of Engineering

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## ADVANCED GAIN STRUCTURE AND INTERCONNECTION

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The 302's unique output attenuator circuit is adjusted in the Setup Menu. This can be thought of as a master gain control which comes after the 302's output meter. This circuit allows the user to match the 302's output level to any recording device. When properly set, the dynamic range of the system is maximized and the 302's meters will "match" the recorder's meters.

For simple interconnection the following three settings are identical to setting the output switch on the 442 mixer to "Line", "Tape", or "Mic.". 0 dB – Line , 10 dB – Tape , 40 dB – Mic .

However, to tailor the 302's outputs exactly to the recording device, the 302's output can be attenuated from full line-level in 2 dB steps from 0 to 16 dB (line/tape levels), then in 2 dB steps from 40 to 56 dB (mic levels). So if 40 dB of attenuation is "too hot" for a given device's mic input, the attenuator could be set to 50 dB or more.

When interconnecting the 302 to any recording device, the best way to set the level between them is to match the 302's output clipping level with the recorder's input clipping level. When this is done and the recording device's input gain controls are kept fixed, two things will happen: (1) The dynamic range of the recording is maximized. (2) All level metering can be done via the 302's meter.

The recorder's level meter can be ignored since the only way for the recorder to clip is for the 302 to clip. The 302's meters match the recorder's meters in that the clip points match. Because most recorder's meter ballistics and scale are different, it is impossible to make the 302 meter exactly match a given recorder's meter. However, this is irrelevant if the clip levels match.

*The following information is intended for users with advanced knowledge of interconnection and gain structure only.*

### Full Scale Tone

To facilitate matching the clipping levels of the 302's output to the recorder's clip level, the 302 includes a full-scale tone output function. "Full scale" is the same as "clipping level." To activate this full scale tone, turn on the tone switch while in the Setup Menu –30 position. Be extremely careful when doing this, as a full-scale tone is extremely loud and can hurt the operator's ears. Make sure to turn down the headphone level and the level going to any amplifiers, etc. from the 302.

The advanced way to set gain structure is as follows:

1. Connect 302's XLR outputs to recording device.
2. Enter setup mode #1 (see "Setup Mode" section).
3. Turn down headphones and any amplifiers connected to the 302's other outputs.
4. Turn on the tone oscillator via its switch.
5. Turn the recording device's input gain control to its detented point (or half-way if no detent).
6. Adjust the 302's output level via the up/down buttons until the recorder is just shy of clipping as indicated on its meter.
7. If the 302's Output level is at 0 dB and the recorder is not to its clip level, increase the recorder's gain control until it is to the clip level.
8. Fix the recorder's gain controls with tape so that they do not get bumped.
9. Exit the 302's setup menu by pressing the PK/VU switch until the startup sequence happens. Note: The Setup Menu must be exited in this manner or else the setting will not be saved.
10. It is recommended that the 302's limiters be turned on at all times, as they will not activate until just before clipping.

## SETUP MENU (v 1.0.3)

Below is the chart of setups for the 302. See Setup Menu on page 15 for instructions on how to enter and navigate the setup menu.

Meter Pos.	Setup	Setting (value on R meter) [factory default bold/underlined]	Description
-30	XLR Attenuation Level	<u>Line-level (0)</u> , add the indicated values on left and right meter for attenuation amount	Selects the amount of attenuation from Line level on the XLR Outputs.
-26	Output Limiter Threshold Adjustment	1 dB increments from +4 to <b>+20 dBu</b> , level shown on meter	Sets the Output Limiter threshold in dBu. see page 12 in User Guide for more details.
-24	Stereo Link, Channels 1/2	<u>OFF (-30)</u> , Stereo Link (-26), MS Link (-24)	Links inputs 1 and 2 as a stereo pair, either X/Y or MS stereo
-22	Input Limiter Defeat	<u>OFF (-30)</u> , ON (-26)	When ON, input limiters remain OFF at all times
-20	RTN L to Channel 4 Input	<u>OFF (-30)</u> , L-only (-26), R-only (-24), L+R (-22)	Routes RTN-Left signal to the master bus with the set pan assignment.
-18	RTN R to Channel 5 Input	<u>OFF (-30)</u> , L-only (-26), R-only (-24), L+R (-22)	Routes RTN-Right signal to the master bus with the set pan assignment.
-16	Tone Oscillator Frequency	<u>1000 (-30)</u> , 400 (-26), 100 (-24), Hz	Selects the frequency of the sine wave tone oscillator
-14	Tone Oscillator Level	OFF (-30), -20 dBu (-26) -10 dBu (-24), 1 dB increments to +8, <b>0 dBu is default</b>	Selects the output level of the tone oscillator in dBu at LINE level
-12	Slate Mic ON/OFF	<u>ON (-30)</u> , Tone + Slate (-26), OFF (-24)	Activates the slate mic. Tone and slate offers a 400 Hz tone preceding the slate mic.
-10	Metering Source	<u>ST &amp; PFL (-30)</u> , Follows headphone switch position (-26), STereo only (-24)	Selects the metering source. PFL levels are show on the left meter
-8	VU Reference Level	<b>0 dBu (-30)</b> , +4 dBu (-26), +8 dBu (-24)	Selects 0 VU-to-dBu reference level
-6	Split-Ear Monitor	<u>OFF (-30)</u> , ON (-26), Program Mix (-24)	Assigns summed-mono RTN signal to left headphone output and R program to right headphone output. Active in RTN position.
-4	Headphone Attenuation w/Tone	<u>ON (-30)</u> , OFF (-26)	Reduces the headphone level by 20 dB when tone oscillator is activated
-2	External Battery Voltage Reference	<b>1 (-30)</b> , 2 (-26), 3 (-24), 4 (-22), 5 (-20), 6 (-18), see voltage metering chart below	Selects the external DC range of the voltage check function and power LED flash point
0	Meter Ballistics Select	<u>VU   PPM   VU-PPMHold   VU-PPM (-30)</u> , PPM   VU-PPMHold   VU-PPM (-26), VU   VU-PPM-Hold   VU-PPM (-24), PPM   VU-PPM (-22), VU   VU-PPM (-20)	Selects meter ballistics choices selected when toggling the front panel meter ballistics switch
4	Master Peak LED Threshold Adjust	1 dB increments from +4 to <b>+20 dBu</b> , level shown on meter	Sets the signal level where the "20" LED illuminates. Used to set an alternate peak level
8	Slate/Tone Switch	<u>Normal (-30)</u> , reversed (-26), tone only (-24), slate only (-22)	Changes the functionality of the slate / tone switch. Switch can be defeated by engaging setup -14 and setup -12
12	Default Restore	<u>OFF (-30)</u> , User Default (-26) Factory (-24)	Resets setup menu to either the stored default or the factory values

Setting	High Voltage	LED Flash Point	Low Voltage	Power Source
	4.5	3.4	3.0	Internal batteries
<b>1</b>	13.0	11.5	11.0	12 V NiCad, NiMH, Li, etc.
<b>2</b>	17.0	11.5	11.0	Expanded range of setting #1
<b>3</b>	8.5	5.75	5.5	6 V NiMH, Li, etc.
<b>4</b>	14.0	11.4	10	12 V Lead Acid
<b>5</b>	7.0	5.7	5.0	6 V Lead Acid
<b>6</b>	17.0	11.5	5.0	Full range of DC input, with cutoff for 12 V NiCad, etc.

← factory setting

