

Features

- efficient, high fidelity 1 or 2-channel WDRC signal processing
- fully programmable via serial data interface
- one DLL operation
- four trimmer inputs plus volume control or programmer controlled
- flexible trimmer/parameter assignments
- three-terminal trimmers
- wideband level detection
- choice of two AGC-I parametric adjustment strategies
- 6, 12 or 24 dB/octave band split filter or configurable as single-channel compressor.
- in-channel, low level squelch control (1:2 expansion)
- output compression limiting (AGC-O)
- flexible pre- and post-emphasis filters
- three independent memories
- pulse-density-modulated output stage drives zero-bias 2-terminal receivers

Packaging

Hybrid typical dimensions:

0.150 x 0.250 x 0.035in

(3.81 x 6.35 x 0.89mm)

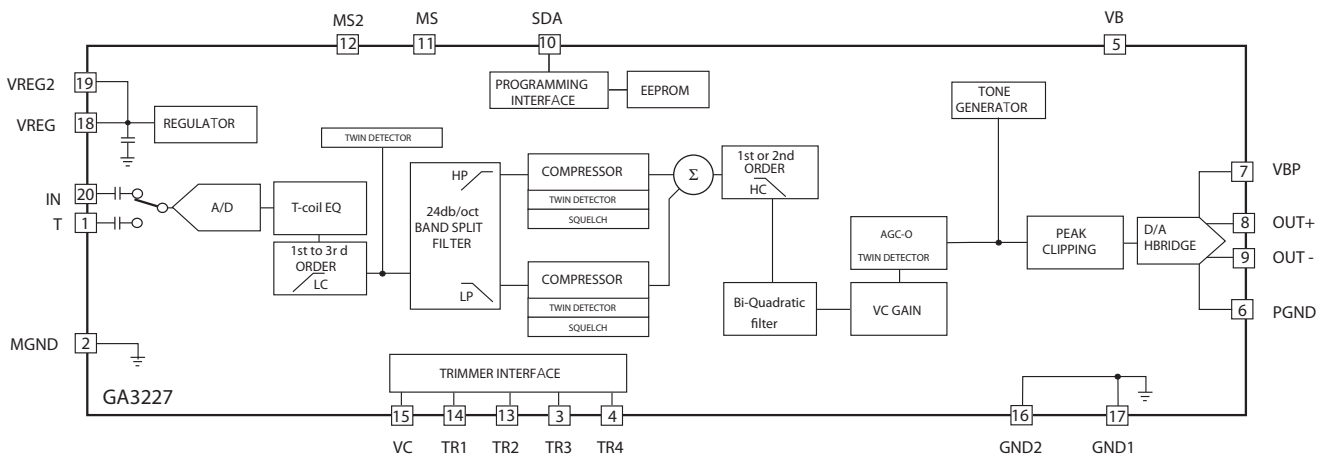
Description

The GA3227 hybrid is a DSP system based on a two-channel compression circuit. It can be configured as a single channel linear device or a single or dual channel WDRC device. It can efficiently replace traditional analog hear aid compression circuits without compromising fundamental performance requirements

The CONSOLIDATOR hybrid can be configured as a programmable circuit or a trimmer circuit supporting manual configuration. As a trimmer circuit, it continuously monitors trimmer positions and translates them into the hearing aid parameters of choice.

Also included in the GA3227 is an in channel squelch circuit to attenuate microphone and circuit noise in quiet environments. It includes low distortion compression limiting, programmable high and low cut filters as well as a fully accessible bi-quadratic filter.

The hybrid code programmed into the GA3227 controller chip is "2".



Block Diagram

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1. Pin Assignment

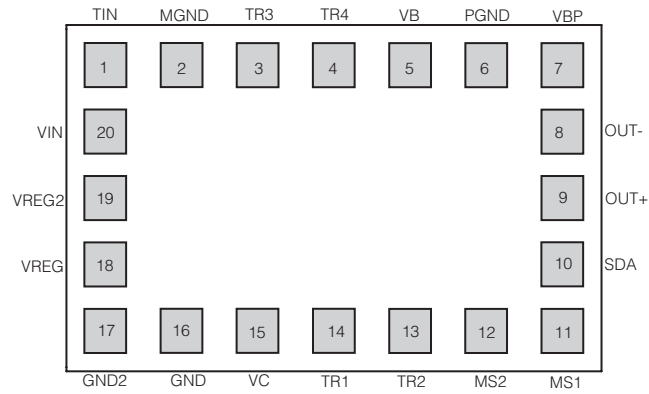


Figure 1-1: GA3227 Pin Assignment

2. Electrical Characteristics

Table 2-1: Absolute Maximum Rating

Parameter	Value Range
Operating Temperature Range	0°C to 40°C
Storage Temperature Range	-20°C to 70°C
Absolute Maximum Power Dissipation	25mW
Input ESD Voltage	2000V
Maximum Operating Supply Voltage	1.5V DC
Absolute Maximum Supply Voltage	2V DC

Conditions: Supply Voltage $V_B = 1.3V$; Temperature = 25°C

Table 2-2: System Parameters

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Hybrid Current	I_{AMP}		—	550	—	μA
Minimum Operating Supply Voltage	V_{BOFF}	Ramp down	0.95	—	0.980	V
Supply Voltage Turn on Threshold	V_{BON}	Ramp up	1.065	1.10	1.160	V
Supply Voltage Hysteresis		$V_{BON} - V_{BOFF}$	—	150	—	mV
Low Battery Warning Voltage		Ramp down	1.06	1.10	1.14	V
Supply Voltage During Communication	V_{BC}	During Communication	1.20	1.30	—	V
EEPROM Burn Cycles		Note 2	100k	—	—	cycles
Low Frequency System Bandwidth			—	130	—	Hz
High Frequency System Bandwidth			—	12	—	kHz
Total Maximum System Gain	A_V	$V_{IN} = -95dBV$ @3kHz; squelch disabled. See Note 1.	82	83	84	dB
Converter Gain	A_{CONV}	A/D + D/A gain.	28	29	30	dB
Total Harmonic Distortion	THD	$V_{IN} = -40$ dBV	—	—	1	%
THD at Maximum Input	THD _M	$V_{IN} = -14$ dBV, HRX - ON	—	—	3	%
Clock Frequency	f_{clk}		1.963	2.048	2.115	MHz

Table 2-2: System Parameters (Continued)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Regulator						
Regulator Voltage	V_{REG}		0.87	0.90	0.93	V
Regulator Supply Rejection	$PSRR_{REG}$		—	36	—	dB
Volume Control and Trimmers						
Volume Control or Trimmer Resistance	R_{VC}	Three-Terminal Trimmer. See Note 3.	0.1	—	1	$M\Omega$
Volume Control Range	ΔA		—	48	—	dB
Ms and MS2 Input						
Pull Down/Up Resistance			—	1	—	$M\Omega$
Logic 1 Voltage			—	V_{REG}	—	V
Logic 0 Voltage			—	0	—	V
Input						
Input Referred Noise	IRN	Bandwidth 100Hz - 8kHz	—	-109	-106	dBV
Input Impedance	Z_{IN}		13.5	16	18.5	$k\Omega$
Crosstalk		Between microphone and telecoil inputs	—	-60	—	dB
Maximum Input Level			—	-14	—	dBV
Input Dynamic Range		HRX - ON, Bandwidth 100Hz - 8kHz	—	95	—	dB
A/D Dynamic Range		Bandwidth 100Hz - 8kHz	—	86	—	dB
Output						
Maximum RMS Output Voltage		0dBFS $f = 1kHz$	—	-1	—	dBV
D/A Dynamic Range		Bandwidth 100Hz - 8kHz	—	83	—	dB
Output Impedance	Z_{OUT}		—	10	20	Ω
SDA Input						
Logic 0 Voltage		Note 2	0	—	0.3	V
Logic 1 Voltage		Note 2	1	—	1.3	V

Table 2-2: System Parameters (Continued)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
SDA Output						
Synchronization Time (Synchronization Pulse Width)	T_{SYNC}	Baud = 0	237	250	263	μs
		Baud = 1	118	125	132	μs
		Baud = 2	59	62.5	66	μs
		Baud = 3	29.76	31.25	32.81	μs
		Baud = 4	14.88	15.63	16.41	μs
		Baud = 5	7.44	7.81	8.20	μs
		Baud = 6	3.72	3.91	4.10	μs
		Baud = 7	1.86	1.95	2.05	μs

NOTE 1: Total System Gain consists of: *Wideband System Gain + High and Low Independent Channel Gains + Converter Gain*

Total System Gain is calibrated during Cal/Config process.

NOTE 2: Sample tested.

NOTE 3: Volume control is log taper, trimmers are linear taper.

Table 2-3: Processing Electrical Requirements

Parameter	Min	Max	Unit	Accuracy
Telecoil				
Telecoil Gain	-8	23	dB	type 3
Low Pass compensation Filter	0.5	1	kHz	type 1
Frequency Shaping				
Crossover Frequency	0.5	4.25	kHz	type 1, 2
High Cut Filter	1	12	kHz	type 1, 2
High Cut Filter Order	6 or 12		dB/Octave	N/A
Low Cut Filter	0.01	3	kHz	type 1, 2
Low Cut Filter Order	6, 12 or 18		dB/Octave	
Independent Channel Processing				
Bandsplit Filter Slopes	6, 12 or 24		dB/Octave	type 1, 2
Low Level Gain	-18	42	dB	type 3
High Level Gain	-18	42	dB	type 3
Lower Threshold	30	80	dB SPL	type 3
Upper Threshold	70	110	dB SPL	type 3

Table 2-3: Processing Electrical Requirements (Continued)

Parameter	Min	Max	Unit	Accuracy
Compression Ratio	1:1	3 :1	Ratio	type 3
AGCi Attack Time Constant (Fast & Slow)	0.25	8192	ms	type 1, 3
AGCi Release Time Constant (Fast & Slow)	0.25	8192	ms	type 1, 3
Squelch Expansion Ratio		1:2	ratio	N/A
Squelch Threshold	20	60	dB SPL	type 3
Squelch Attack Time Constant	0.25	8192	ms	type 1, 3
Squelch Release Time Constant	0.25	8192	ms	type 1, 3
Wideband System Gain				
Wideband System Gain	-36	12	dB	type 3
Wideband Attack Time Constant (Fast & Slow)	0.25	8192	ms	type 1, 3
Wideband Release Time Constant (Fast & Slow)	0.25	8192	ms	type 1, 3
External VC	-48	0	dB	type 3
Internal VC Attenuator	-48	0	dB	type 3
Total System Gain				
Total System Gain	-19	83	dB	Note 1
AGCo				
AGCo Output Limiting	-30	-1	dBFS*	type 3
AGCo Compression Ratio		∞ :1	Ratio	N/A
AGCo Attack Time Constant (Fast & Slow)	0.25	8192	ms	type 1, 3
AGCo Release Time Constant (Fast & Slow)	0.25	8192	ms	type 1, 3
Peak Clipper				
PC Output Limiting	-40	0	dBFS	type 3

Table 2-3: Processing Electrical Requirements (Continued)

Parameter	Min	Max	Unit	Accuracy
Tone Generator				
Pure Tone Frequency (memory and low battery indicator)	0.25	12	kHz	type 1, 2
Pure Tone Amplitude (memory and low battery indicator)	-50	0	dBFS	type 3

* peak output is defined as largest sine wave possible at the resonant frequency of the receiver

NOTE 1: Total System Gain consists of *Wideband System Gain + High and Low Independent Channel Gains + Converter Gain* and accuracy of this parameter is dependent on accuracy of the components.

Accuracy definitions:

- type 1: accuracy is determined by the clock frequency deviation
- type 2: accuracy is determined by the quantization error of 16bit coefficient and 20bit or higher data word.
- type 3: accuracy is determined by the quantization error of a parameter word (see table 2 for word length) and 20bit or higher data word.

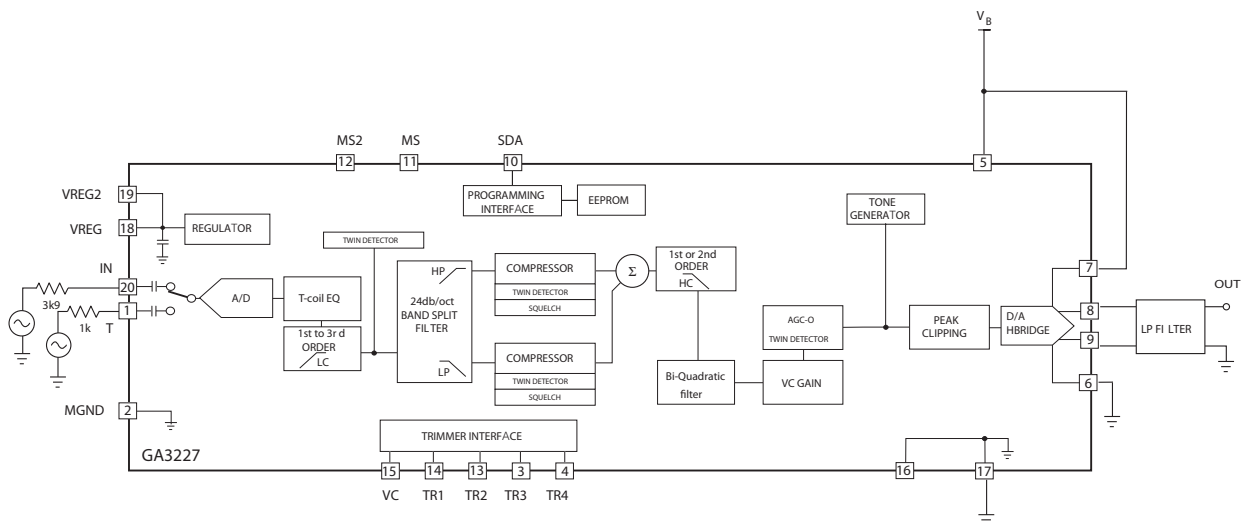


Figure 2-1: Test Circuit

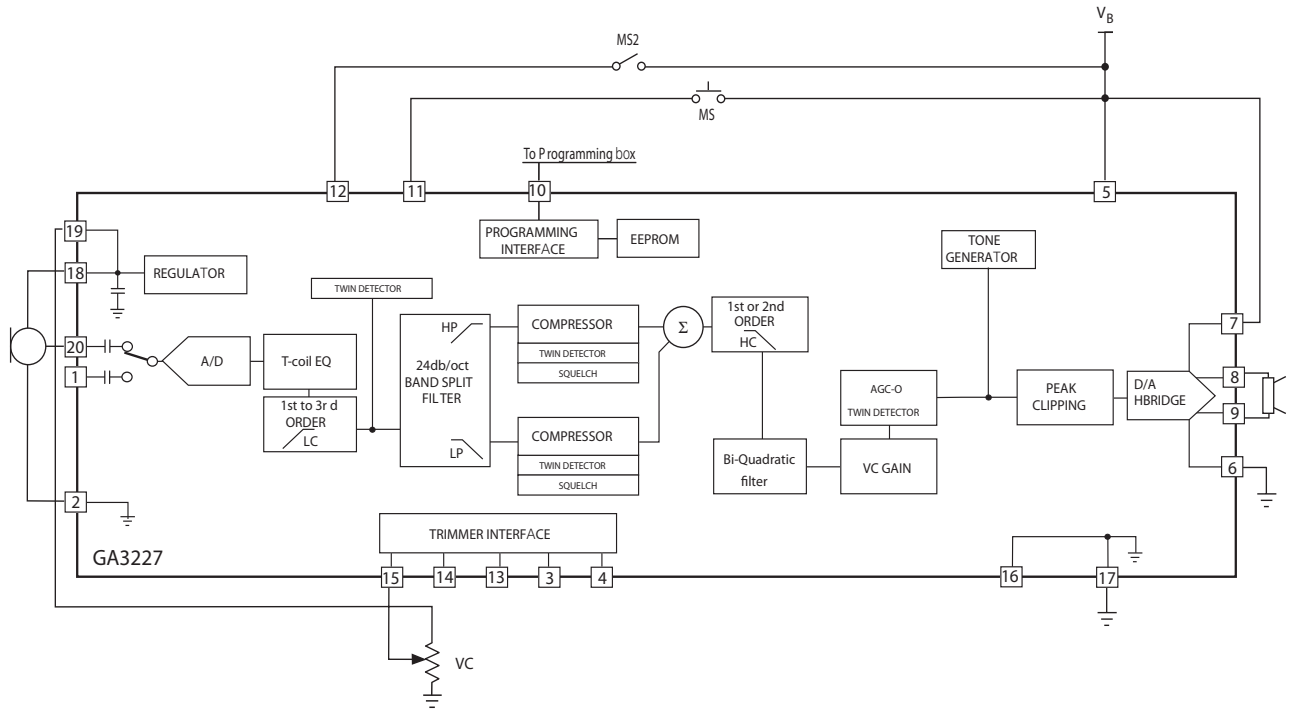


Figure 2-2: Example of Programmable Application Circuit

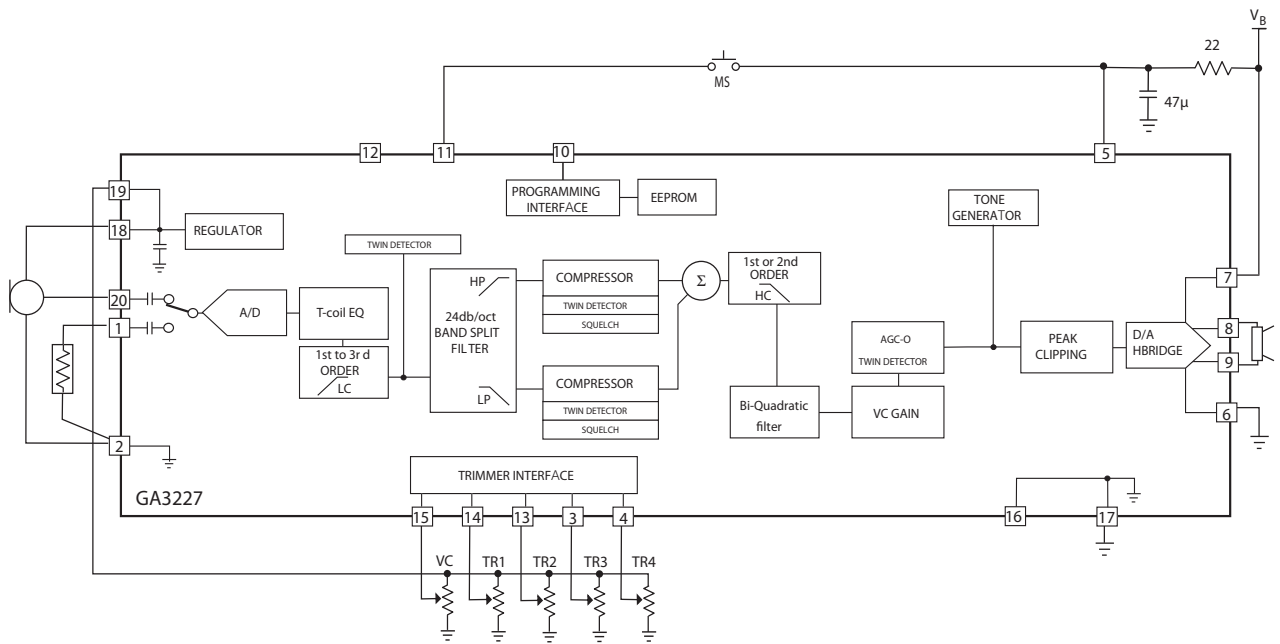


Figure 2-3: Example of Trimmer Application Circuit

3. Introduction

The GA3227 hybrid comprises a configurable two-channel compressor circuit with two methods of operation, programmable mode and trimmer mode. The device may be configured as a one or two channel device with linear or WDRC processing. Configuration data stored in non-volatile memory defines hearing-aid parameters. This data needs to be uploaded to the hybrid before the circuit becomes functional. The GA3227 hybrid is programmed via the SDA pin using industry-standard programming boxes.

Configuration data is generated by an ARK product component library (DLL). The GA3227 is fully supported by Gennum's software tools available from the Gennum ARK web site <http://ark.gennum.com>.

During normal trimmer mode operation, a low-speed A/D circuit monitors the positions of up to four manual trimmers and a VC potentiometer. Trimmer position changes are immediately interpreted and translated into new circuit parameter values, which are then used to update the signal path.

Gennum's Library Manager tool allows one to pre-define trimmer assignments for all common functions such as low-cut, high-cut, notch and resonant-peak-shift filtering, AGC parameters, wideband gain, and maximum power output (MPO).

3.1 Signal Path

There are two main audio input signal paths. The first path contains the Microphone and second path contains the Telecoil input as selected by a programmable MUX. The microphone input is intended as the main audio input for single-microphone applications. The two audio inputs are buffered, sampled and converted into digital form using an A/D converter. The digital output is then converted into a 24kHz 20-bit digital audio signal.

In Telecoil mode, gains are trimmed during the Cal/Config process to compensate for microphone/Telecoil mismatches. The Telecoil input may also be used as a second microphone input. In this case the Telecoil compensation should be disabled. This can be done via the ARKonline wizard.

The wideband detector circuit output is routed to a band-split filter that divides the signal into two frequency bands. There is an option to configure the hybrid as a single channel device that simply shuts down and bypasses the band-split filter. The gain in each channel is a function of the overall detected wide-band energy. The two frequency bands are then summed back into a wide-band signal.

Further processing capabilities include a 1st to 3rd order low cut filter before the band-split filter. After the two channels are summed together there is a 1st or 2nd order high cut filter, one biquadratic filter followed by volume control, and low-distortion AGCo.

All AGC loops use a feed-forward topology to ensure system stability. Detectors in the AGCi path and AGCo path are twin fast/slow detectors with independently adjustable attack and release time constants. The squelch detector (which resides in the AGCi path) is implemented as a single fast/slow detector.

3.2 Functional Block Descriptions

3.2.1 A/D and D/A Converter

The system's A/D converter is a 2nd-order sigma-delta modulator, which operates at a 2.048MHz sample rate. The system's input is pre-conditioned with anti-alias filtering and a programmable gain pre-amplifier. The analog output is over-sampled and modulated to produce a 1-bit pulse density modulated (PDM) data stream. The digital PDM data is then decimated down to pulse-code modulated (PCM) digital words at the system's sampling rate of 24kHz.

The D/A is comprised of a digital 3rd-order sigma-delta modulator and an H-bridge. The modulator accepts PCM audio data from the DSP path and converts it into a 32-times over-sampled, 1-bit PDM data stream, which is then supplied to the H-bridge. The H-bridge is a specialized CMOS output driver used to convert the 1-bit data stream into a low-impedance, differential output voltage waveform suitable for driving zero-biased hearing aid receivers.

3.2.2 Channel Processing

Figure 1 represents the I/O characteristic of the AGC channel processing.

- low input level expansion (squelch) region
- low input level linear region
- compression region
- high input level linear region (return to linear)

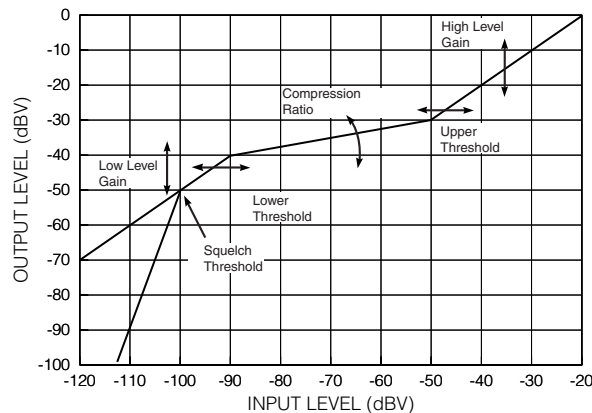


Figure 3-1: Channel I/O Curve Flexibility

The I/O characteristic of the AGC channel processing can be adjusted in six ways:

- squelch threshold (SQUELCHTH)
- low level gain (LLGAIN)
- lower threshold (LTH)
- high level gain (HLGAIN)
- upper threshold (UTH)
- compression ratio (CR)

During Parameter Map creation, constraints are applied to the compression parameters to ensure that the I/O characteristics are continuous. In both Programmable mode and Trimmer mode predefined parameter adjustments support two popular styles of compression ratio adjustment:

- The compression region of the I/O curve pivots about the upper threshold. As the compression ratio trimmer is adjusted, high-level gain remains constant while the low-level gain changes.
- The compression region of the I/O curve pivots about the lower threshold. Low-level gain remains constant as the compression ratio trimmer is adjusted.

Parameters such as low level gain, lower threshold and compression ratio can be combined and controlled by a single trimmer.

The squelch region within each channel implements a low level noise reduction scheme (1:2 expansion) for listener comfort. This scheme operates in quiet listening environments (programmable threshold) to reduce the gain at very low levels.

Single-channel compressor operation is supported by disabling the band split filter and one of the channel compressors. The remaining compressor can be configured as a wide-dynamic-range compressor (WDRC), or as an input compression limiter (ICL).

3.3 HRX Head Room Expander

The GA3227 has an enhanced Head Room Expander (HRX) circuit, which increases the input dynamic range of the CONSOLIDATOR Digital without any unwanted audible artifacts. This is accomplished by dynamically adjusting the preamplifier's gain and the post-A/D attenuation depending on the input level.

3.4 Telecoil Path

The telecoil input is calibrated during the Cal/Config process. To compensate for the telecoil/microphone frequency response mismatch, a first order filter with 500Hz corner frequency is implemented. Through ARKonline it is possible to implement a telecoil compensation filter with an adjustable corner frequency. To accommodate for the gain mismatch, the telecoil gain is adjusted to match the microphone gain at 500Hz or 1kHz (default) and is selectable in ARKonline. There is also a telecoil gain adjustment parameter, which can be enabled in ARKonline and set in IDS that will allow for manual adjustment of the telecoil gain compensation.

3.4.1 Volume Control & Trimmers

All parameters can be controlled via the SDA or assigned to the trimmers. The four trimmers have flexible parameter assignments so any of the four trimmers can be assigned to any available parameters (A complete list of parameters is available on ARKonline).

Both the external VC and trimmers are configured to work with a three-terminal $0.1M\Omega - 1M\Omega$ variable resistor. The volume control should have a log taper, while the trimmers should have a linear taper. Hysteresis is built into the circuitry to prevent unintentional level toggling

3.4.2 Bi-Quadratic Filter

The bi-quadratic filter allows for additional frequency shaping. The filter coefficients can be entered in IDS.

3.4.3 AGCo

The AGCo module is an output limiting circuit with a fixed compression ratio infinity:1. The limiting level is programmable as a level measured as dB from full scale. 0 dBFS is the maximum output of the device. The AGCo module has its own twin level detector, with programmable attack and release time constants.

3.5 MS and MS2 Switches

There are two, two-pole Memory Select switches available on the GA3227, which allows the user flexibility in switching between configurations. MS switch may be either momentary or static as set up in ARKonline and are configurable to be either pull-up or pull-down through the setting tab in IDS. In programmable mode the switch must be set to pull-down. MS2 is a static switch and is used to select the third memory (Memory C).

Up to three memories can be configured in programmable mode, or one memory in trimmer mode. All memory select options are selectable via the ARKonline wizard.

In simple trimmer mode there is one method for memory select. In this mode, when the telecoil is enabled, MS switches the GA3227's input between the microphone and the telecoil using either a momentary or static switch which is selectable using ARKonline.

There are four memory select modes available in programmable and multi-memory trimmer mode:

3.5.1 Momentary Switch on MS

This mode uses a single momentary switch on MS to change memories. Using this mode will cause the part to toggle between Memory's A, B and C.

3.5.2 Momentary Switch on MS, Static Switch on MS2 (jump to Memory C)

This mode uses a static switch on MS2 and a momentary switch on MS to change memories. If the static switch is OPEN, the part will start in memory A and toggle between memory A and B. If the static switch on MS2 is set to HIGH, the part will automatically jump to the memory C (this will happen on startup or during normal operation). In this setup, the momentary switch's state is ignored. This prevents memory select beeps from occurring. When MS2 is set to OPEN, the part will load in the last select memory.

The table assumes the following conditions:

- T = momentary switch is toggled
- 0 = OPEN
- 1 = HIGH

Table 3-1: Dynamic example with 3 valid memories

MS2	0	0	0	1	1	1	0	0	0	1	0	0	0	0	0	0
MS	0	T	T	0	T	T	0	T	T	0	0	T	T	T	T	T
Memory	A	B	A	C	C	C	A	B	A	C	A	B	A	B	A	B

3.5.3 Static Switch on MS and MS2

This mode uses two static switches to change memories.

The following table describes which memory is selected depending on the state of the switches.

In this mode it is possible to jump from any memory to any other memory simply by changing the state of both switches. If both switches are changed simultaneously then the transition will be smooth, otherwise, if one switch is changed and then the other, the part will transition to an intermediate memory before reaching the final memory.

The part will start in whatever memory the switches are selecting. If a memory is invalid the part will default to memory A.

Table 3-2: Switch for MS an MS2

MS	MS2	Memory
OPEN	OPEN	A
HIGH	OPEN	B (if valid otherwise A)
OPEN	HIGH	A
HIGH	HIGH	C (if valid otherwise A)

3.5.4 Static Switch on MS, Static Switch on MS2 (Jump to Memory C)

This mode uses two static switches to change memories.

Unlike in the previous example, this mode will switch to the last valid memory when the static switch on MS2 is HIGH. This means that this mode will only use a maximum of three memories (even if four valid memories are programmed). The following table describes which memory is selected depending on the state of the switches.

Table 3-3:

MS	MS2	Memory
OPEN	OPEN	A
HIGH	OPEN	B (if valid otherwise A)
OPEN	HIGH	C
HIGH	HIGH	C

In this mode it is possible to jump from any memory to any other memory simply by changing the state of both switches. If both switches are changed simultaneously then the transition will be smooth, otherwise, if one switch is changed and then the other, the part will transition to an intermediate memory before reaching the final memory.

When MS2 is set HIGH, the state of the switch on MS is ignored. This prevents memory select beeps from occurring when switching MS when MS2 is HIGH.

The part will start in whatever memory the switches are selecting. If the device starts up in a memory other than A, and the memory beep tones are enabled, the device will emit the corresponding tones for that memory. If a memory is invalid, the part will default to memory A.

3.5.5 Audible Memory Change Indicator

The CONSOLIDATOR Digital can be configured to produce tones to indicate a memory change.

Through ARKonline the GA3227 can be configured to either enable or disable the Memory Change Indicator. When the Memory Change Indicator is enabled, there is an option to have a single beep for each memory change or multiple-beeps.

The amplitude and frequency of the memory change tone can be selected independent of the Tone Generator settings and can be individually selected for each memory.

When the memory change multiple beep is enabled and the memory change tone is enabled, then during a memory change operation the selected tone will beep a code to indicate which memory has been selected. The beep sequence will be 150ms ON followed by a 150ms OFF time between the beeps. The memory change beeping code is deciphered in the table below.

Table 3-4:

Selected Memory	# of Beeps
A	1
B	2
C	3

3.6 Tone Generator

The tone generator is capable of producing programmable tones. When the Tone Generator is enabled, the CONSOLIDATOR Digital connects the output of the tone generator to the input of the D/A converter. The programmed tone is the output until the Tone Generator is disabled. When disabled, the normal audio signal path is again connected. The tone generator will produce a beep to indicate a memory select change, a microphone/telecoil selection change or to warn the user of low battery voltage.

3.7 Low Battery Indicator (Power-On/Power-Off)

During power-on the CONSOLIDATOR Digital is held in a reset state until V_b reaches a turn-on threshold, and the hybrid's internal control logic determines that the supply is stable. When this occurs the hybrid begins its power-on sequence.

When a low battery condition (below turn on threshold) is detected, the CONSOLIDATOR Digital sends out a series of 3 beeps (225ms ON, 225ms OFF, 225ms ON, 225ms OFF, 225ms ON) to indicate the battery is low. This will repeat every 5 minutes until the device reaches the turn-off threshold.

If V_b drops below the turn-off threshold then the CONSOLIDATOR Digital is returned to its reset state and the audio output is muted.

The device starts up in shallow-reset mode which, during the power-ON sequence circuit starts when the supply voltage rises above the turn-ON threshold after shutdown. The device will function until the supply voltage drops below the turn-OFF threshold but will recover when the supply voltage rises above the turn-ON threshold. After 5 minutes, the device will switch to deep-reset mode. This begins when the supply voltage rises above the turn-ON threshold after shutdown. Once the supply voltage drops below the turn-OFF threshold the GA3227 will shut down and remain there until the supply voltage drops below approximately 0.3V and subsequently rises above the turn-ON threshold after shutdown.

An additional option configurable via ARKonline is to have the gain reduced as the battery voltage drops. When the supply falls below the low battery threshold the low battery tones will be emitted and the wideband gain will be reduced by 3dB. As the battery voltage continues to drop, the low battery tones will continue and the wideband gain will continue to be reduced until the turn-OFF threshold is reached when the device will shut down.

3.7.1 Current Consumption

Typical current consumption of the CONSOLIDATOR Digital, as stated in the Electrical Characteristics section, is measured at a specific configuration and settings.

3.7.2 Software

Full software support is provided for every stage of development from design to manufacturing to fitting.

3.7.3 SDA Communication

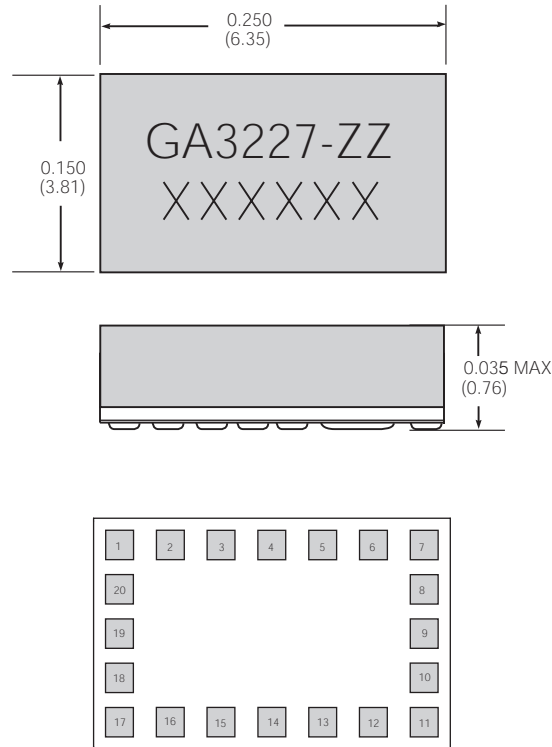
The CONSOLIDATOR Digital is programmed via the SDA pin using industry standard programming boxes. During parameter changes the main audio signal path of the hybrid is temporarily disabled and replaced with a low gain "bypass path" to avoid the generation of disturbing audio transients. Once the changes are complete, the main audio path is re-activated.

Any changes made during programming will be lost at power-off unless they are explicitly burned to EEPROM memory.

3.7.4 Power Management

The CONSOLIDATOR Digital was designed to accommodate high power applications. AC ripple on the supply can cause instantaneous reduction of the battery's voltage, potentially disruption the circuit's function. The GA3227 has a separate power supply and ground connection for the output stage. This allows hearing instrument designers to accommodate external RC filters in order to minimize any AC ripple from the supply line. Reducing this AC ripple greatly improves the stability of the circuit and prevents unwanted reset of the circuit caused by spikes on the supply line. For more information on properly designing a filter to reduce supply ripple, please refer to information note "[Using Gennum DSP Hybrid's in High Power Applications Initial Design Tips](#)" document #24561.

4. Package Dimensions



Dimension units are in inches.

Dimensions in parentheses are in millimetres, converted from inches and include minor rounding errors.

1.000 inches = 25.4mm

Dimension tolerances: ±0.004 (±0.10) unless otherwise stated.

Work order number: XXXXXX

ZZ is defined as: E1 : RoHS compliant hybrid, MSL#4, 240°C peak reflow, SAC305

Missing ZZ is defined as: Non-RoHS compliant hybrid, MSL#3, 218°C peak reflow, 60Sn/40Pb for external solder conditions

This Hybrid is designed for either point-to-point manual soldering or for reflow according to Gennum's reflow process (Information Note 521-45).

Figure 4-1: Package dimensions

Table 4-1: Pad Locations

Pad No.	Pad Position		Pad Dimensions	
	X	Y	Xdim	Ydim
1	0	0	20	20
2	36.67	0	20	20
3	73.33	0	20	20
4	110	0	20	20
5	146.67	0	20	20
6	183.33	0	20	20
7	220	0	20	20
8	220	-29.9	20	20
9	220	-59.8	20	20
10	220	-89.67	20	20
11	220	-119.61	20	20
12	183.33	-119.61	20	20
13	146.67	-119.61	20	20
14	110	-119.61	20	20
15	73.33	-119.61	20	20
16	36.67	-119.61	20	20
17	0	-119.61	20	20
18	0	-89.67	20	20
19	0	-59.8	20	20
20	0	-29.9	20	20
1	0	0	0.508	0.508
2	0.9314	0	0.508	0.508
3	1.8626	0	0.508	0.508
4	2.7940	0	0.508	0.508
5	3.7254	0	0.508	0.508
6	4.6566	0	0.508	0.508
7	5.5880	0	0.508	0.508
8	5.5880	-0.7595	0.508	0.508
9	5.5880	-1.5189	0.508	0.508

Table 4-1: Pad Locations (Continued)

Pad No.	Pad Position		Pad Dimensions	
	X	Y	Xdim	Ydim
10	5.5880	-2.2776	0.508	0.508
11	5.5880	-3.0381	0.508	0.508
12	4.6566	-3.0381	0.508	0.508
13	3.7254	-3.0381	0.508	0.508
14	2.7940	-3.0381	0.508	0.508
15	1.8626	-3.0381	0.508	0.508
16	0.9314	-3.0381	0.508	0.508
17	0	-3.0381	0.508	0.508
18	0	-2.2776	0.508	0.508
19	0	-1.5189	0.508	0.508
20	0	-0.7595	0.508	0.508

5. Revision History

Version	ECR	Date	Changes
A	14395	October 2006	New Document
B	143615	January 2007	Updates
C	144696	March 2007	Updates- Minor