Р DР Н А ^Rн нм А3229

Description

The RHYTHM[™] SA3229 hybrid from ON Semiconductor is a trimmer–configurable DSP system based on a four–channel compression circuit featuring a feedback cancellation algorithm.

Based on a phase cancellation method, SA 3229's adaptive feedback reduction algorithm provides added stable gain to enable extra gain and user comfort. It features rapid adjustment for dynamic feedback situations and resistance to tonal inputs.

In addition to these adaptive algorithms, SA3229 also supports the following features: up to four channel WDRC, low-distortion compression limiting, cross fading between audio paths for click-free memory changes, eight-band graphic equalizer, eight configurable generic biquad filters, programming speed enhancements, in-channel squelch to attenuate microphone and circuit noise in quiet environments, optional peak clipping, flexible compression adjustments, volume control, rocker switch, noise generation for Tinnitus treatment, and industry-leading security features to avoid cloning and software piracy.

A trimmer interface supports manual circuit configuration. It continuously monitors trimmer positions and translates them into the hearing–aid parameters of choice. A Serial Data or I²C Interface provides full programmability at the factory and in the field.

RHYTHM SA3229 is a single-chip hybrid with a one-time programmable (OTP) memory intended for low cost applications requiring high gain.

Features

- Adaptive Feedback Cancellation
- WDRC Compression with Choice of 1, 2 or 4 Channels of Compression
- Auto Telecoil with Programmable Delay
- EVOKE Acoustic Indicators
- Noise Generator for Tinnitus Treatment or In-Situ Audiometry
- Frequency Response Shaping with Graphic EQ
- Trimmer Compatibility Four Three–Terminal Trimmers with Configurable Assignments of Control Parameters
- I²C and SDA Programming
- Rocker Switch Support for Memory Change and/or Volume Control Adjustment
- Support for Active High or Active Low Switching
- Analog or Digital Volume Control with Programmable Range
- High Quality 20-bit Audio Processing
- High Power/High Gain Capability
- Configurable Low Battery Indicator



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SIP25 HYBRID CASE 127DZ

PAD CONNECTION

MARKING DIAGRAM

SPECIFICATIONS

Table 1. ABSOLUTE MAXIMUM RATINGS

Parameter	Value	Units
Operating Temperature Range	0 to +40	°C
Storage Temperature Range	-20 to +70	°C
Absolute Maximum Power Dissipation	25	mW
Maximum Operating Supply Voltage	1.65	VDC
Absolute Maximum Supply Voltage	1.8	VDC

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

WARNING: Electrostatic Sensitive Device - Do not open packages or handle except at a static-free workstation.

WARNING: Moisture Sensitive Device - RoHS Compliant; Level 3 MSL. Do not open packages except under controlled conditions.

Table 2. ELECTRICAL CHARACTERISTICS (Supply Voltage V_B = 1.25 V; Temperature = 25° C)

Parameter	Symbol	Conditions	Min	Тур	Max	Units
Hybrid Current	I _{AMP}	All functions, 32 kHz sampling rate	-	640	-	μΑ
		All functions, 16 kHz sampling rate	-	535	-	
Minimum Operating Supply Voltage	VBOFF	Ramp down, audio path	0.93	0.95	0.97	V
		Ramp down, control logic	0.77	0.80	0.83	
Supply Voltage Turn On Threshold	V _{BON}	Ramp up	1.06	1.10	1.16	V
Low Frequency System Limit	-	-	-	125	-	Hz
High Frequency System Limit	-	-	-	16	-	kHz
Total Harmonic Distortion	THD	$V_{IN} = -40 \text{ dBV}$	-	-	1	%
THD at Maximum Input	THD					-

Fable 2. ELECTRICAL CHARACTERISTICS	(Supply Voltage V _B = 1.25 V; Temperature	$e = 25^{\circ}C)$ (continued)
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Parameter	Symbol	Conditions	Min	Тур	Мах	Units
OUTPUT						
D/A Dynamic Range	-	100 Hz – 8 kHz	-	88		

Table 3. I²C TIMING

		Standard Mode		Fast Mode		
Parameter	Symbol	Min	Max	Min	Max	Units
Clock Frequency	f _{PC_CLK}	0	100	0	400	kHz
Hold time (repeated) START condition. After this period, the first clock pulse is generated.	t _{HD;STA}	4.0	-	0.6	-	μsec
LOW Period of the PC_CLK Clock	t _{LOW}	4.7	-	-	-	μsec
HIGH Period of the PC_CLK Clock	t _{HIGH}	4.0	-	-	-	μsec
Set-up time for a repeated START condition	t _{SU;STA}	4.7	-	-	-	μsec

Data Hold Time: for CBUS Compatible Masters for I

TYPICAL APPLICATIONS



Note: All resistors in ohms and all capacitors in farads, unless otherwise stated.

Figure 2. Test Circuit



Figure 4. Independent Channel I/O Curve Flexibility

taper, which is selectable via software. It is possible to use a VC with up to 1 M Ω of resistance, but this could result in a slight decrease in the resolution of the taper.

Trimmers

The trimmer interface provides the ability to control up to 19 hearing aid parameters through up to four trimmers. A single trimmer parameter can have up to 16 values and a single trimmer can control multiple parameters (e.g., Trimmer 1 can control compression ratio in all four channels simultaneously). The trimmer must be three-terminal 100 k Ω to 360 k Ω variable resistors and have a linear taper.

Parameters that can be assigned to trimmers include Low Cut, High Cut, Compression Ratio, Wideband Gain, Tinnitus Noise Level, Crossover Frequency, Lower Threshold, Upper Threshold, EQ Gain, Squelch Threshold, High Level Gain, Low Level Gain, AGC–O Threshold, Static Volume Control and Peak Clipper Threshold.

Digital Volume Control

The digital volume control makes use of two pins for

In Momentary Memory Select mode, the rocker switch allows cycling through the memory profiles in both directions. An "up" switch closure indicates a program advance to the next *higher* numbered memory and "down" switch closures indicates a program retreat to the next *lower* numbered memory. In this mode, volume control is only available through software control.

In Mixed Mode, operation of the switch as a volume control or memory select is governed by the time duration of the switch closure: either short or long. The discrimination of short and long pulses is set by a programmable, time-threshold value, from 1 s to 5 s in 1 s increments. An additional programmable parameter determines whether the short pulses refer to volume-control operation or memory-select operation.

If long pulses control memory select operation, the memory change is initiated once the switch is held for the long pulse period without requiring the switch to be released. In Digital VC mode or Momentary Memory Select mode, the action takes place after the switch is released.

AGC-O

The AGC–O module is an output limiting circuit with a fixed compression ratio of ∞ : 1. The limiting level is programmable as a level measured in dB from full scale. The maximum output of the device is 0 dBFS.

The AGC–O module has its own level detector, with programmable attack and release time constants.

Graphic Equalizer

SA3229 has a 8-band graphic equalizer. Each band provides up to 24 dB of gain adjustment in 1 dB increments.

Biquadratic Filters

Additional frequency shaping can be achieved by configuring generic biquad filters. The transfer function for each of the biquad filters is as follows:

$$H(z) = \frac{b0 + b1 \times z^{-1} + b2 \times z^{-2}}{1 + a1 \times z^{-1} + a2 \times z^{-2}}$$

NOTE: The *a*0 coefficient is hard–wired to always be '1'. The coefficients are each 16 bits in length and formatted as one sign bit, one integer bit and 14 fractional bits. This maps onto a decimal range of -2.0 to 2.0 before quantization (-32767 to 32767 after quantization).

Thus, before quantization, the floating–point coefficients must be in the range $-2.0 \le x < 2.0$ and quantized with the function:

round($x \times 2^{14}$)

After designing a filter, the quantized coefficients can be entered into the PreBiquads or PostBiquads tab in the Interactive Data Sheet. The coefficients b0, b1, b2, a1, and a2 are as defined in the transfer function above. The parameters meta0 and meta1 do not have any effect on the signal processing, but can be used to store additional information related to the associated biquad. The underlying code in the product components automatically checks all of the filters in the system for stability (i.e., the poles have to be within the unit circle) before updating the graphs on the screen or programming the coefficients into the hybrid. If the Interactive Data Sheet receives an exception from the underlying stability checking code, it automatically disables the biquad being modified and displays a warning message. When the filter is made stable again, it can be re-enabled.

Also note that in some configurations, some of these filters may be used by the product component for microphone/telecoil compensation, low-frequency EQ, etc. If this is the case, the coefficients entered by the user into IDS are ignored and the filter designed by the software is programmed instead. For more information on filter design refer to the Biquad Filters In PARAGON Digital Hybrid information note.

Tinnitus Treatment Noise

The Tinnitus Treatment noise is generated using white noise generator hardware and shaping the generated noise using four 2nd order biquadratic filters. The filter parameters are the same coefficients as those presented in the Biquadratic Filters section.

The Tinnitus Treatment noise can be added into the signal path at two possible locations: before the VC (before the AGC–O, but compensated for the Wideband Gain) or after the VC (between the last generic biquad and the Cross Fader).

If the noise is injected before the VC then the level of the noise will change along with the rest of the audio through the device when the VC is adjusted. If the noise is injected after the VC it is not affected by VC changes.

EVOKE Acoustic Indicators

Ten Acoustic Indicators are available for indicating events. Each indicator is fixed to a particular event. Any event can have its assigned indicator enabled or disabled although not always independently. Individual enable/ disable control is provided for the following event or group of events:

- Power on reset (POR)
- Four memory selects
- Volume Up and Volume Down
- Volume Max and Volume Min
- Low Battery

Each Acoustic Indicator is made up of up to four faded tones. A faded tone exhibits a 64 ms fade–in and fade–out transition time. The duration of an Acoustic Indicator is configurable, with a maximum value of 6.35 seconds.

Power Management

SA3229 has three user-selectable power management schemes to ensure the hearing aid dies gracefully at the end of battery life. Shallow reset, Deep reset and Advanced

Reset mode. It also contains a programmable power on reset delay function.

Power On Reset Delay

standard programming boxes. I²C mode is a two-wire interface which uses the SDA pin for bidirectional data and CLK as the interface clock input. I²C programming support is available on the HiPro (serial or USB versions) and ON Semiconductor's DSP Programmer 3.0.

Input Connection and Layout Considerations

It is recommended to connect unused audio input pins directly to MGND to minimize the possibility of noise pickup. Inputs are internally AC coupled, so there is no additional leakage current when inputs are connected directly to ground.

In order to further minimize noise at the inputs the following guidelines are recommended:

- MGND is used as reference ground plane for input signals. All input components should be grounded to MGND. This ground plane should be isolated from all other ground connections in the system.
- Keep the input traces as short as possible and avoid routing traces near high noise sources such as the OUT+ and OUT- pins
- Star ground input component grounds to the MGND connection.

Unused trimmer inputs should also be connected to GND.

ORDERING INFORMATION

Device	Package	Shipping [†]		
SA3229–E1	25 Pad Hybrid Case 127DZ	25 Units / Bubble Pack		
SA3229–E1–T	25 Pad Hybrid Case 127DZ	250 Units / Tape & Reel		

+For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

Hybrid Jig Ordering Information

To order a Hybrid Jig Evaluation Board for SA3229 contact your Sales Account Manager or FAE and use part number SA3404GEVB.

PAD LOCATIONS

Table 8. PAD POSITION AND DIMENSIONS

mil					m	m			
Pad No	Pin Name	Х	Y	Xdim	Ydim	Х	Y	Xdim	Ydim
1									





RECOMMENDED MOUNTING FOOTPRINT

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