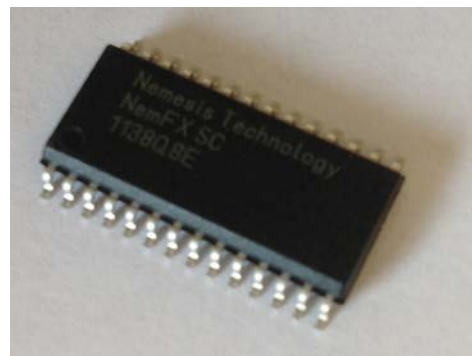


NemFX SC

Reverb, Delay, & Chorus

Features

- Very low cost, high performance Reverb, Delay, & Chorus
- Superior sound quality
- 16 great Programs so you can select the right sound for your application
 - 6 Reverb Types (Plate, Room, Ambience, Hall and a couple of Springs)
 - Adjustable Reverb Decay Time
 - 2 Delay Types (one with Modulation & one without) x 4 Tempo Subdivisions
 - Adjustable Delay Time (up to 600 ms!) & Feedback
 - Tap Tempo Switch Input with LED Output
 - 1 Chorus Program
 - Adjustable Chorus Rate & Depth
 - 1 Chorus->Reverb Program
 - Adjustable Chorus Rate & Reverb Decay Time
- Mono audio input, stereo audio output
 - Two Modes for getting audio in and out
 - Internal CODEC for lowest cost and smallest footprint
 - External CODEC for higher performance
- LED Outputs to indicate Signal Present and Clip
- Available in 28-Pin SOIC package
- Requires only a +3.3V Power Supply



RoHS Compliant, Pb-Free!

Applications

- Electric and Acoustic Guitar Amplifiers, Bass Amplifiers, Keyboard Amplifiers
- Portable PA Systems
- Mixing Consoles, Powered Audio Mixers, DJ Mixers
- Digital Pianos, Electric Pianos, Combo Organs, Karaoke Systems

Description

Nemesis Technology, Inc. is proud to offer the Reverb, Delay, & Chorus Version of our popular NemFX SC Series Digital Multi-Effects solutions. The NemFX SC is an extremely low cost unit that is designed for applications where price is a driving factor. When used in Internal CODEC Mode, this chip is ideally suited for entry-level products such as practice amplifiers. In External CODEC Mode, NemFX SC's sophisticated sound quality enables it to be used in higher applications. The NemFX SC features 16 high-quality Programs so you can choose the appropriate sound for your application, whether you need a modern sounding studio style reverb, a sweet-sounding spring reverb program, a highly responsive delay, or a creamy chorus. The NemFX SC has two Parameter Control inputs so you can adjust things like reverb tail length or delay time so the sound sits perfectly in your track. NemFX SC even provides for a Tap Tempo switch and LED for fast and accurate delay time setting during a performance. Tempo has 4 Subdivision options so you can set delay times that are way faster than you can tap. Lastly, the NemFX SC Reverb has LED outputs for showing Signal Present and Clip so you always know what's going on.

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Theory of Operation

The NemFX SC is a single chip Reverb, Delay, & Chorus solution which can be installed on main boards in products such as guitar amplifiers and portable PA systems. Connection to the NemFX SC is simple. First, you use a digital input pin to select the CODEC mode to be Internal or External. In Internal CODEC mode, NemFX SC has a differential analog audio input and a differential analog audio output for easy mono in and stereo out operation. In External CODEC mode, NemFX SC provides an interface for connecting an external Audio CODEC. Four digital input pins allow you to select which one of the sixteen great Programs to use. Two analog input pins let you set parameters like Reverb Decay Time, Delay Time & Feedback, and Chorus Rate & Depth. A digital input pin provides for connecting a Tap Tempo Switch so users can tap in their Delay Times. Three digital output pins can control Signal Present, Clip, and Tap Tempo LEDs.

Key Specifications*

Parameter	Typical
Internal CODEC Mode	
Differential Analog Audio Input Level	6.6 Vpp max
Differential Analog Audio Output Level	2.3 Vpp max
Power Supply	+3.3V, 60 mA

*since we are continuously improving our products, specifications are subject to change without notice

Block Diagram - Internal CODEC Mode

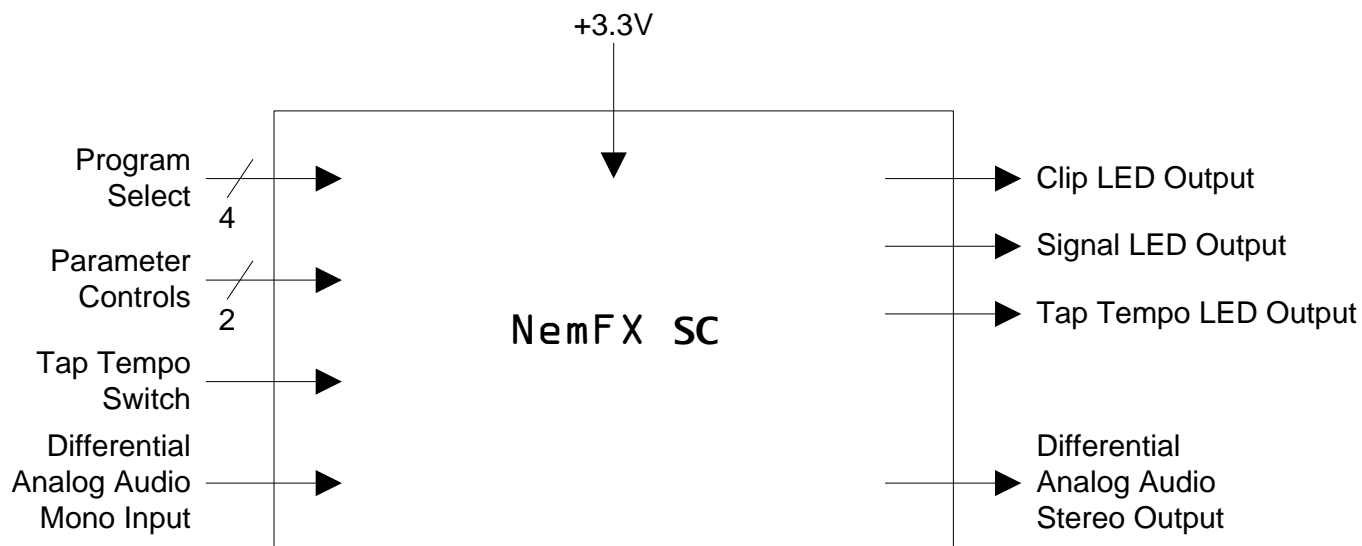


Figure 1a: Block Diagram - Internal CODEC Mode

Block Diagram - External CODEC Mode

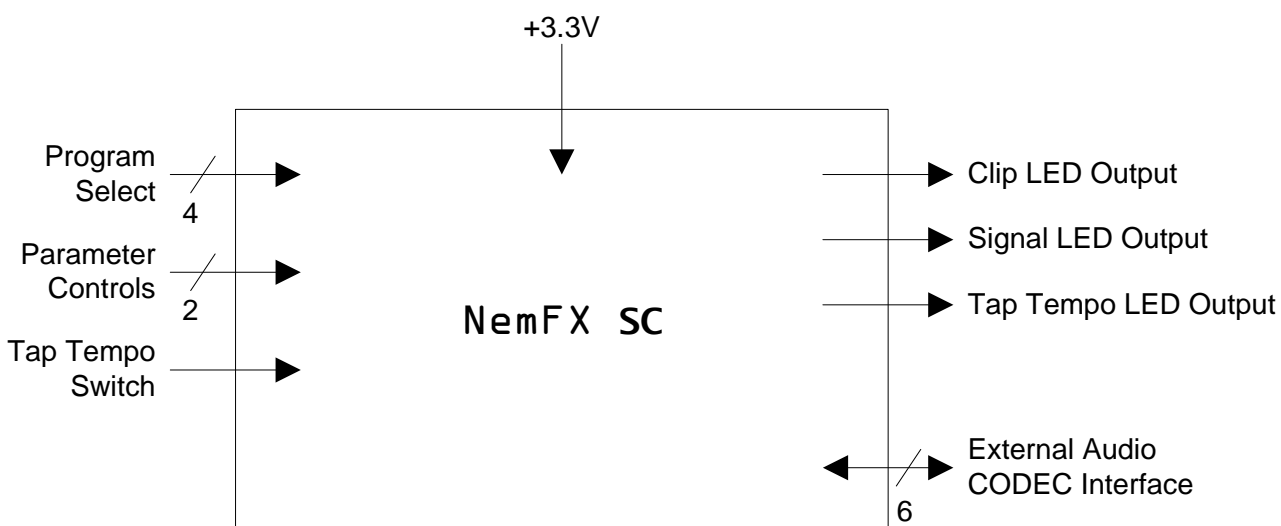


Figure 1b: Block Diagram - External CODEC Mode

Detailed Specifications

(Typical audio performance numbers at nominal supply voltages, 25°C operating temperature, with suggested I/O circuitry, unless otherwise specified. All DC voltages relative to ground.)

Audio Performance*

Parameter	Typical	Unit
Internal CODEC Mode		
Full Scale Differential Analog Audio Input Level	6.6	Vpp
Full Scale Differential Analog Audio Output Level	2.3	Vpp

Recommended Operating Conditions*

Parameter	Min	Typical	Max	Unit
Internal CODEC Mode				
Source Impedance	-	-	200	Ω
Load Impedance	1 k	10 k	-	Ω
Full Scale Differential Analog Audio Input Level	-	6.6	-	Vpp
Full Scale Differential Analog Audio Output Level	-	2.3	-	Vpp
Power Supply Voltage	3.0	3.3	3.6	V
Power Supply current	-	60	90	mA
Operating Ambient Temperature	-40	-	+85	°C

Absolute Maximum Ratings*

Parameter	Min	Max	Unit
Voltage on VDD with respect to GND	-0.3	+4.0	V
Analog Voltage Input Level	-0.3	VDD + 0.3	V
Digital Voltage Input Level	-0.3	VDD + 0.3	V
Ambient Temperature	-40	+125	°C

*since we are continuously improving our products, specifications are subject to change without notice

Pin Diagram – Internal CODEC Mode

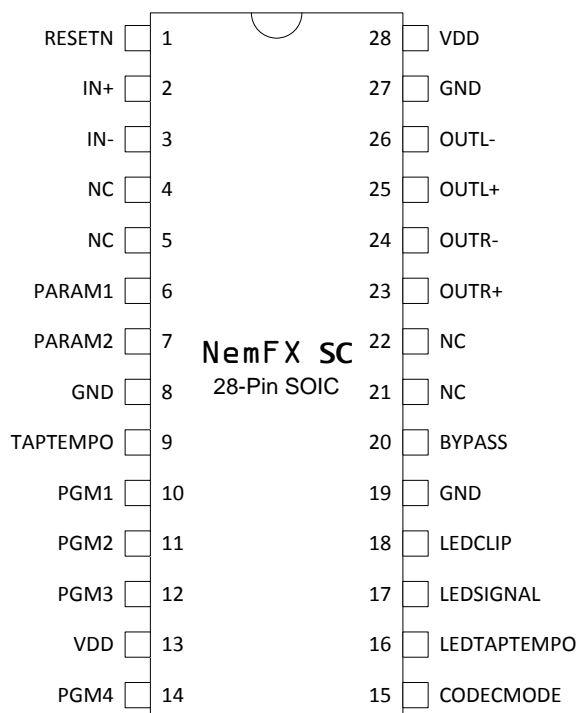


Figure 2a: Pin Diagram – Internal CODEC Mode

Pin Descriptions – Internal CODEC Mode

Pin	Name	Type	Description
1	RESETN	Input	Reset Input (active-low)
2	IN+	Input	Differential Analog Audio Input (non-inverting)
3	IN-	Input	Differential Analog Audio Input (inverting)
4-5, 21-22	NC		No Connect (do not connect anything to these pins)
6	PARAM1	Input	Parameter 1 Control Analog Input
7	PARAM2	Input	Parameter 2 Control Analog Input
8, 19, 27	GND	Input	Ground
9	TAPTEMPO	Input	Tap Tempo Switch Input
10	PGM1	Input	Program Select 1 Input
11	PGM2	Input	Program Select 2 Input
12	PGM3	Input	Program Select 3 Input
13, 28	VDD	Input	Power Supply (+3.3V)
14	PGM4	Input	Program Select 4 Input
15	CODECMODE	Input	CODEC Mode Select Input
16	LEDTAPTEMPO	Output	Tap Tempo LED Output
17	LEDSIGNAL	Output	Signal Present LED Output
18	LEDCLIP	Output	Clip LED Output
20	BYPASS	Input	Bypass Filter Capacitor Connection
23	OUTR+	Output	Right Differential Analog Audio Output (non-inverting)
24	OUTR-	Output	Right Differential Analog Audio Output (inverting)
25	OUTL+	Output	Left Differential Analog Audio Output (non-inverting)
26	OUTL-	Output	Left Differential Analog Audio Output (inverting)

Pin Diagram – External CODEC Mode

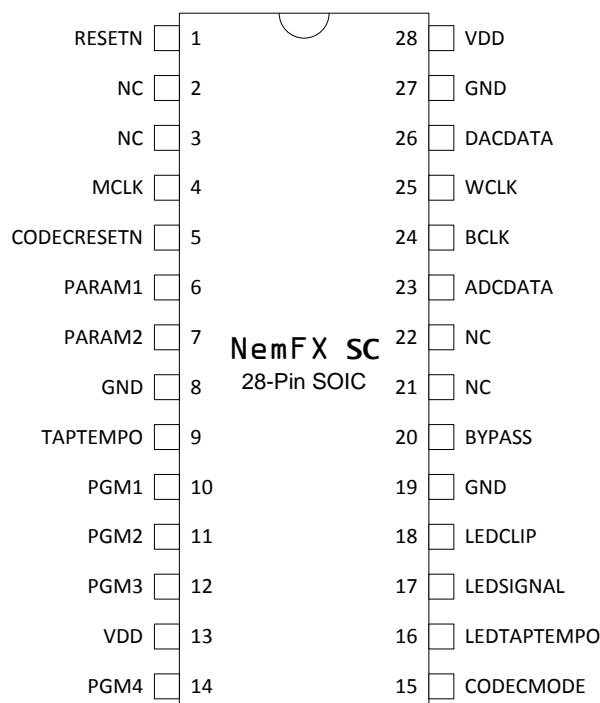


Figure 2b: Pin Diagram – External CODEC Mode

Pin Descriptions – External CODEC Mode

Pin	Name	Type	Description
1	RESETN	Input	Reset Input (active-low)
2-3, 21-22	NC		No Connect (do not connect anything to these pins)
4	MCLK	Output	Master Clock Output
5	CODECRESETN	Output	Reset Output for External CODEC (active-low)
6	PARAM1	Input	Parameter 1 Control Analog Input
7	PARAM2	Input	Parameter 2 Control Analog Input
8, 19, 27	GND	Input	Ground
9	TAPTEMPO	Input	Tap Tempo Switch Input
10	PGM1	Input	Program Select 1 Input
11	PGM2	Input	Program Select 2 Input
12	PGM3	Input	Program Select 3 Input
13, 28	VDD	Input	Power Supply (+3.3V)
14	PGM4	Input	Program Select 4 Input
15	CODECMODE	Input	CODEC Mode Select Input
16	LEDTAPTEMPO	Output	Tap Tempo LED Output
17	LEDSIGNAL	Output	Signal Present LED Output
18	LEDCLIP	Output	Clip LED Output
20	BYPASS	Input	Bypass Filter Capacitor Connection
23	ADCDATA	Input	ADC Data Input
24	BCLK	Output	Bit Clock Output
25	WCLK	Output	Word Clock Output
26	DACDATA	Output	DAC Data Output

Typical Application Diagram - Internal CODEC Mode

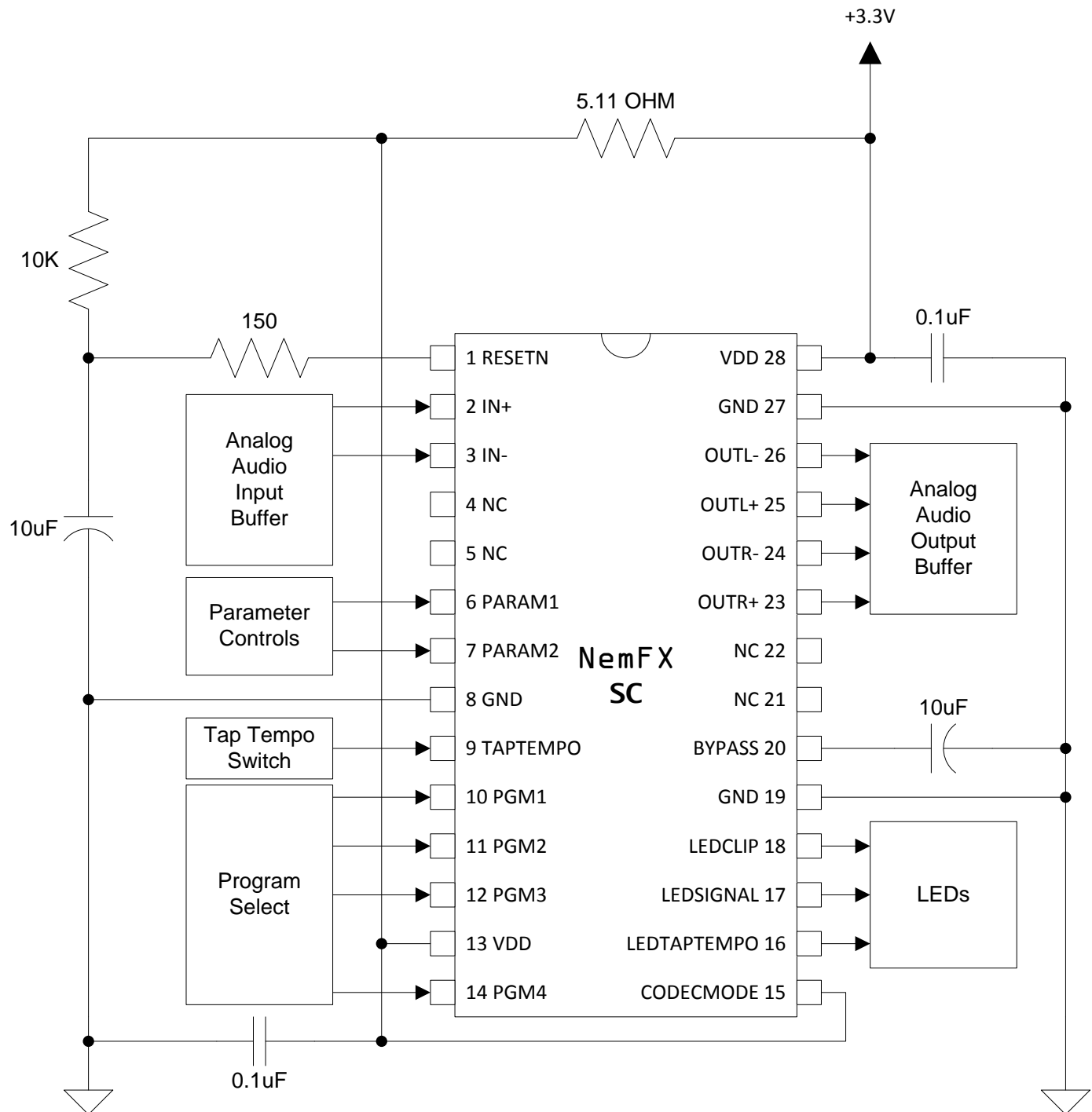


Figure 3a: Application Diagram - Internal CODEC Mode

Typical Application Diagram - External CODEC Mode

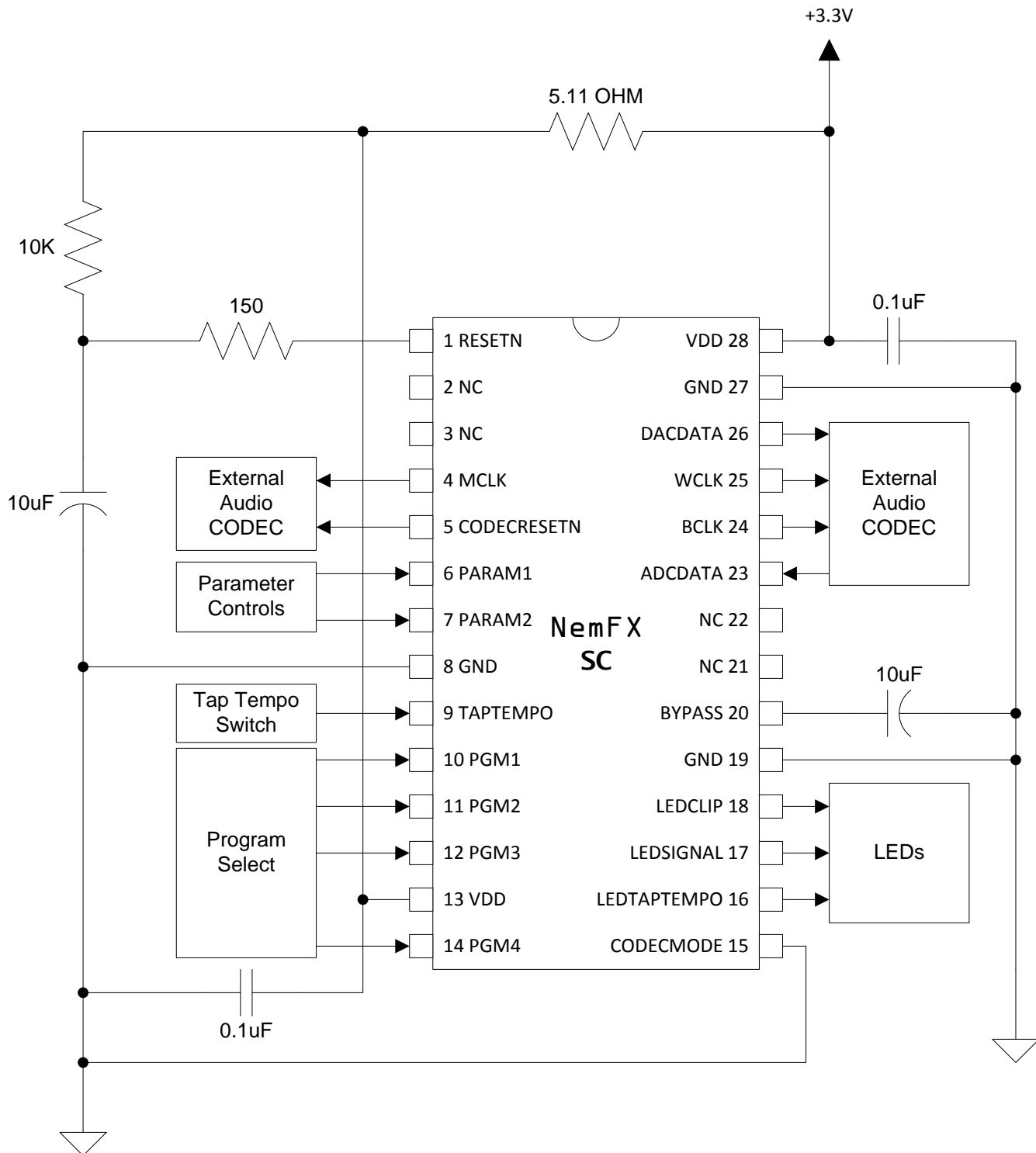


Figure 3b: Application Diagram - External CODEC Mode

Application Information

CODEC Modes

NemFX SC provides two options for getting audio to and from it. This gives flexibility for managing tradeoffs between cost and performance. For cost-sensitive designs, select Internal CODEC Mode to use the NemFX SC's built-in CODEC. For designs which require higher audio performance, select External CODEC Mode and use NemFX SC's External Audio CODEC Interface to connect an external CODEC.

On power-up, NemFX SC reads the CODECMODE pin. If CODECMODE is tied to VDD (+3.3V), then Internal CODEC Mode is selected and NemFX SC configures its pins as shown in Figure 2a to use the built-in CODEC. Note that the CODECMODE pin has an internal weak pull-up to VDD so the pin can be left no-connected and NemFX SC will default to Internal CODEC Mode.

If CODECMODE is tied to GND (0V), then on power-up External CODEC Mode is selected and NemFX SC configures its pins as shown in Figure 2b to use the External Audio CODEC Interface.

Internal CODEC Mode

Analog Audio Input Circuit

The analog audio input pins require a low impedance drive directly from the output of an op-amp. Any resistance on the input connection to the NemFX SC will cause distortion on the input signal. The signal at the input pins can be up to a maximum of 6.6 Vpp differential before clipping occurs. Analog input signals must stay within the voltage range listed under 'Absolute Maximum Ratings' in the specifications section of the datasheet; otherwise, damage to the NemFX SC can occur.

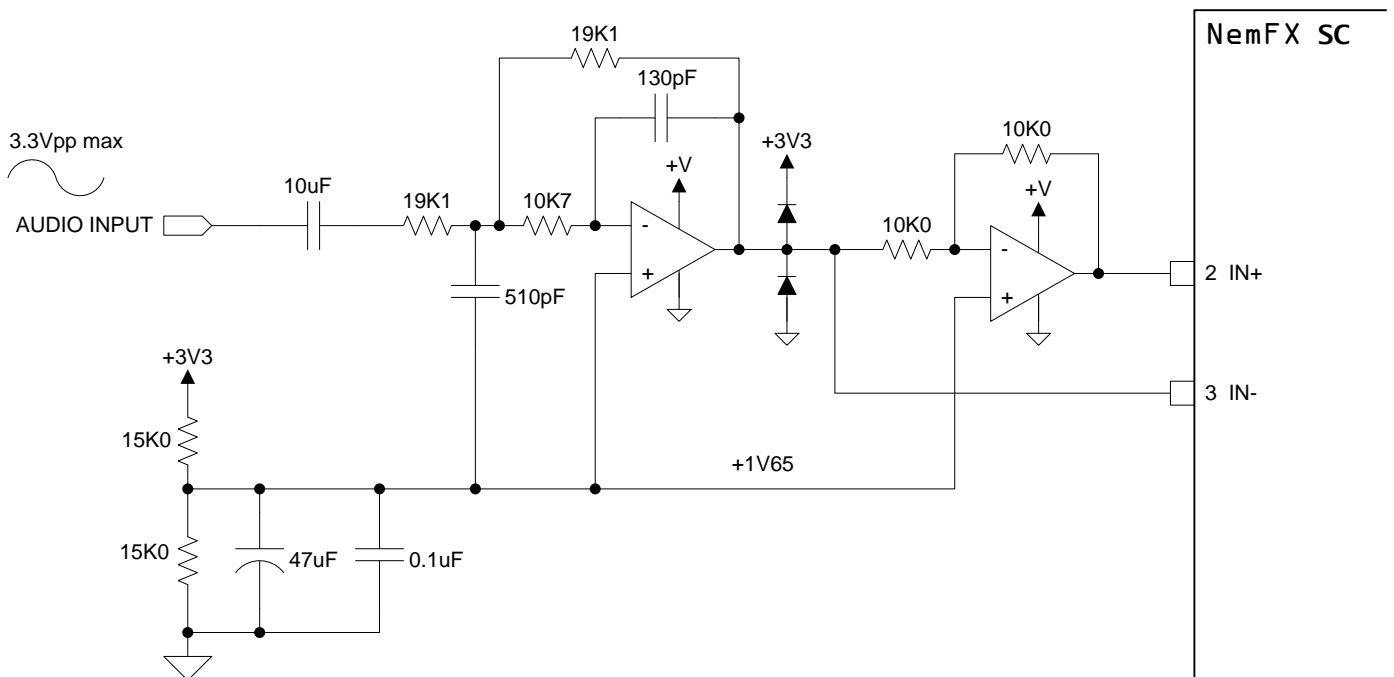
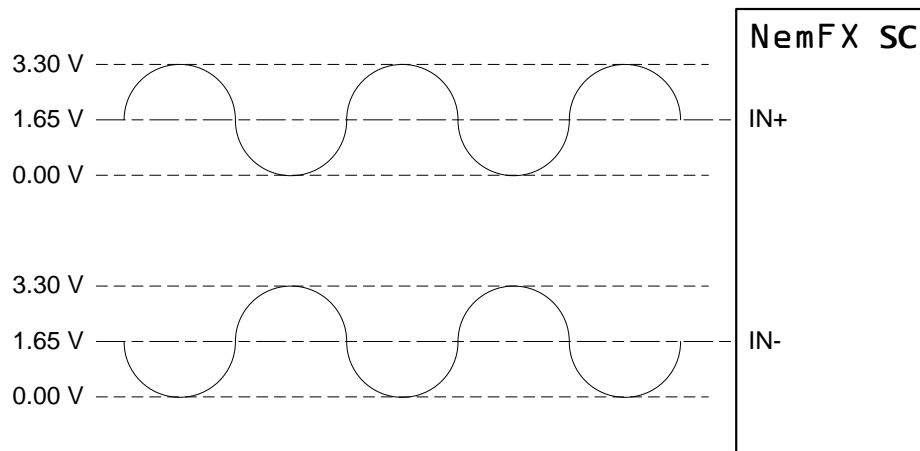


Figure 4: Recommended Analog Audio Input Buffer



Full-Scale Input Level = (IN+) - (IN-) = 6.6 Vpp

Figure 5: Full-Scale Analog Audio Input

Analog Audio Output Circuit

Interfacing to the analog audio output of the NemFX SC is also very simple. Each output pin must drive a load greater than 1 kΩ. NOTE: Additional filtering of signals above 60 kHz may be necessary on systems that are sensitive to high frequency noise.

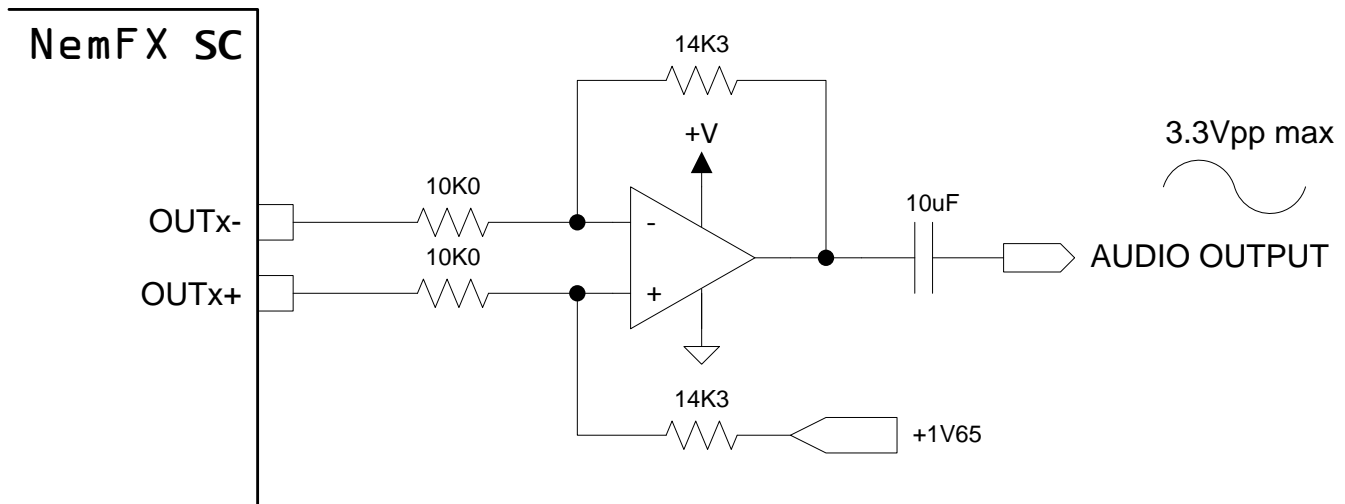
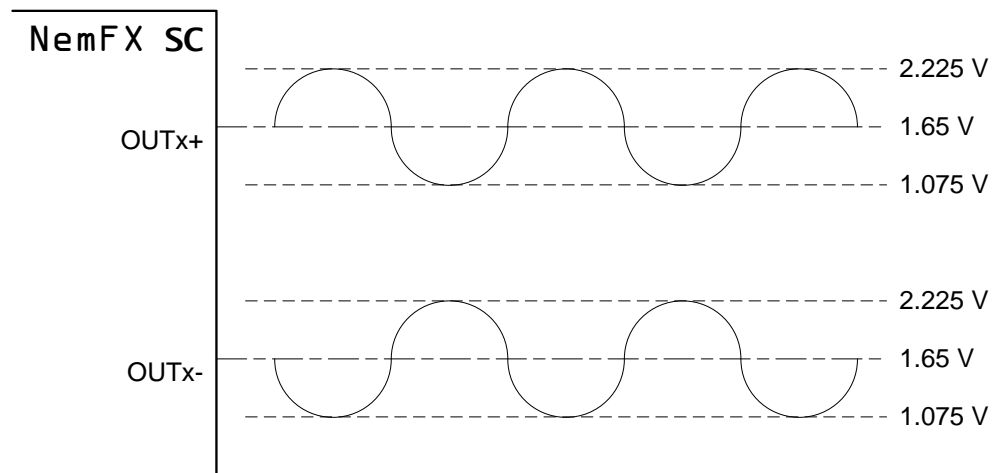


Figure 6: Recommended Analog Audio Output Buffer

A full scale signal will drive the analog audio outputs to a maximum of 2.3 Vpp.



$$\text{Full-Scale Output Level} = (\text{OUTx+}) - (\text{OUTx-}) = 2.3 \text{ Vpp}$$

Figure 7: Full-Scale Analog Audio Output

For applications which require only a mono output, Nemesis recommends summing the Left and Right Audio Outputs for improved signal-to-noise performance.

External CODEC Mode

External Audio CODEC Interface

The NemFX SC provides an interface for connecting an external Audio CODEC. The interface consists of three clock output pins (MCLK, BCLK, and WCLK), a digital audio data output pin (DACDATA), a digital audio data input pin (ADCDATA), and a CODEC reset output pin (CODECRESETN). The NemFX SC acts as the clock master and the external Audio CODEC acts as the clock slave. MCLK is the Master Clock for the system and runs at $256 \times F_s$. BCLK is the Bit Clock for synchronizing the digital audio interface and runs at $64 \times F_s$. WCLK is the Word Clock for synchronizing the words in the audio frame and runs at F_s . The interface uses the I2S digital audio format for connecting to 24-bit stereo audio CODECs. On some External CODECs, CODECRESETN is necessary to hold the External CODEC in reset until the clocks are stable.

The NemFX SC is compatible with any stereo audio CODEC that supports the I2S format at sample rates from 25 kHz to 100 kHz. For price sensitive applications, Nemesis recommends the following Audio CODECs: NXP Semiconductor UDA1345TS or Cirrus Logic CS4270. These yield good audio performance that is acceptable for many applications, while being low-cost parts that require minimal additional components for low system cost. Nemesis can provide reference schematics to show how to connect to these CODECs.

Note that the NemFX SC is a mono-in, stereo-out processor while I2S CODECs are stereo-in, stereo-out devices. As such, NemFX SC uses the External CODEC's left channel as its input and sends its output to both the left and right channel on the External CODEC.

Program Select

The NemFX SC offers sixteen great programs: six Reverbs, two Delays with four Tempo Subdivision options each, one Chorus, and one Chorus->Reverb. Four of Reverb Types are more Modern Reverbs for applications which require more of a studio reverb sound. The other two are Spring Reverb Types which emulate the classic sweet sound of a mechanical spring reverb can.

PGM4	PGM3	PGM2	PGM1	Description	PARAM1	PARAM2	TAPTEMPO
+3.3V	+3.3V	+3.3V	+3.3V	Plate Reverb	Reverb Decay Time	-	No
+3.3V	+3.3V	+3.3V	0V	Room Reverb	Reverb Decay Time	-	No
+3.3V	+3.3V	0V	0V	Spring Reverb Type 4	Reverb Decay Time	-	No
+3.3V	+3.3V	0V	+3.3V	Spring Reverb Type 9	Reverb Decay Time	-	No
+3.3V	0V	0V	+3.3V	Hall Reverb	Reverb Decay Time	-	No
+3.3V	0V	0V	0V	Ambience Reverb	Reverb Decay Time	-	No
+3.3V	0V	+3.3V	0V	Chorus	Chorus Depth	Chorus Rate	No
+3.3V	0V	+3.3V	+3.3V	Chorus->Reverb	Reverb Decay Time	Chorus Rate	No
0V	0V	+3.3V	+3.3V	Delay Quarter Note (1/1)	Delay Time	Feedback	Yes
0V	0V	+3.3V	0V	Delay Dotted Eighth Note (3/4)	Delay Time	Feedback	Yes
0V	0V	0V	0V	Delay Quarter Note Triplet (2/3)	Delay Time	Feedback	Yes
0V	0V	0V	+3.3V	Delay Eighth Note (1/2)	Delay Time	Feedback	Yes
0V	+3.3V	0V	+3.3V	Delay w/Modulation Eighth Note (1/2)	Delay Time	Feedback	Yes
0V	+3.3V	0V	0V	Delay w/Modulation Quarter Note Triplet (2/3)	Delay Time	Feedback	Yes
0V	+3.3V	+3.3V	0V	Delay w/Modulation Dotted Eighth Note (3/4)	Delay Time	Feedback	Yes
0V	+3.3V	+3.3V	+3.3V	Delay w/Modulation Quarter Note (1/1)	Delay Time	Feedback	Yes

Parameter Controls

The NemFX SC has two analog input pins, PARAM1 and PARAM2, for controlling parameters of the sound (see table above). Note: If your application does not require variable parameters, use a simple resistor voltage divider to set the voltages on Pins 6 and 7 to select an appropriate setting.

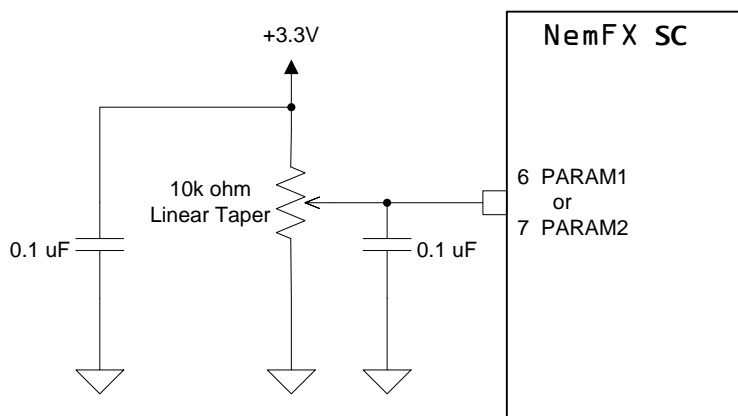


Figure 8: Parameter Controls

Tap Tempo Switch

The NemFX SC has a digital input pin for connecting a Tap Tempo Switch. This allows users to tap in the tempo of their song and the NemFX SC will set the Delay Time accordingly.

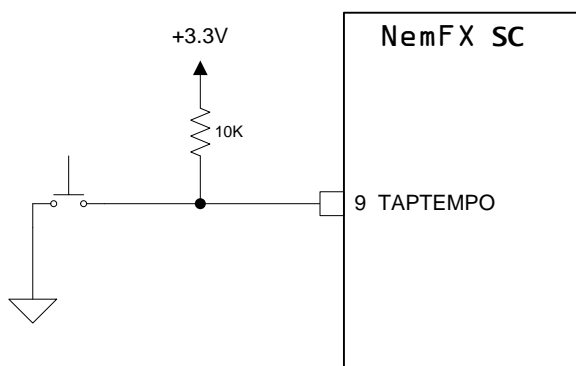


Figure 9: Tap Tempo Switch

LED Drive Circuit

The NemFX SC has three digital output pins for controlling Signal Present, Clip, and Tap Tempo LEDs.

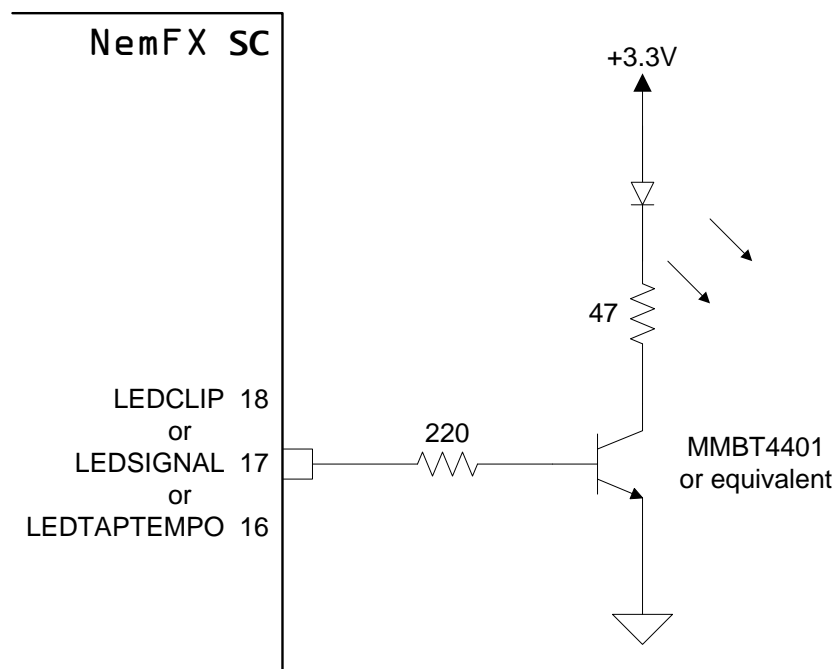


Figure 10: LED Drive Circuit

Power Supply

The NemFX SC requires a clean, regulated +3.3V power supply to achieve rated performance. The NemFX SC draws about 60 mA typical during steady-state operation. During power-up, the current draw will be higher as the capacitors charge up.

Capacitor on BYPASS Pin

Pin 20 (BYPASS) requires a capacitor to GND to stabilize the output of the internal voltage regulator. The capacitance should be around 10 μ F. If the voltage ripple on the BYPASS pin is too high, the part may malfunction and spuriously reset. To prevent this, Nemesis recommends using a low-ESR (< 5 Ohms) capacitor such as a ceramic or tantalum. Place this capacitor as close as possible to the BYPASS pin and keep the trace length as short as possible to minimize trace inductance.

Test Mode

For convenience, NemFX SC provides a Test Mode which puts the chip into an audio pass-through mode where the input audio is passed through un-modified to both outputs. This is handy during product development for testing the performance of the audio signal paths.

To enter Test Mode, ground the TAPTEMPO pin (for example, by holding down the TAP TEMPO switch) while powering up the NemFX SC. The Tap Tempo LED will turn on solid to indicate that the chip is in Test Mode.

To exit Test Mode, simply change the state of any of the Program Select pins (for example, by turning the PROGRAM SELECT Knob). Audio processing and the Tap Tempo LED will resume normal operation.

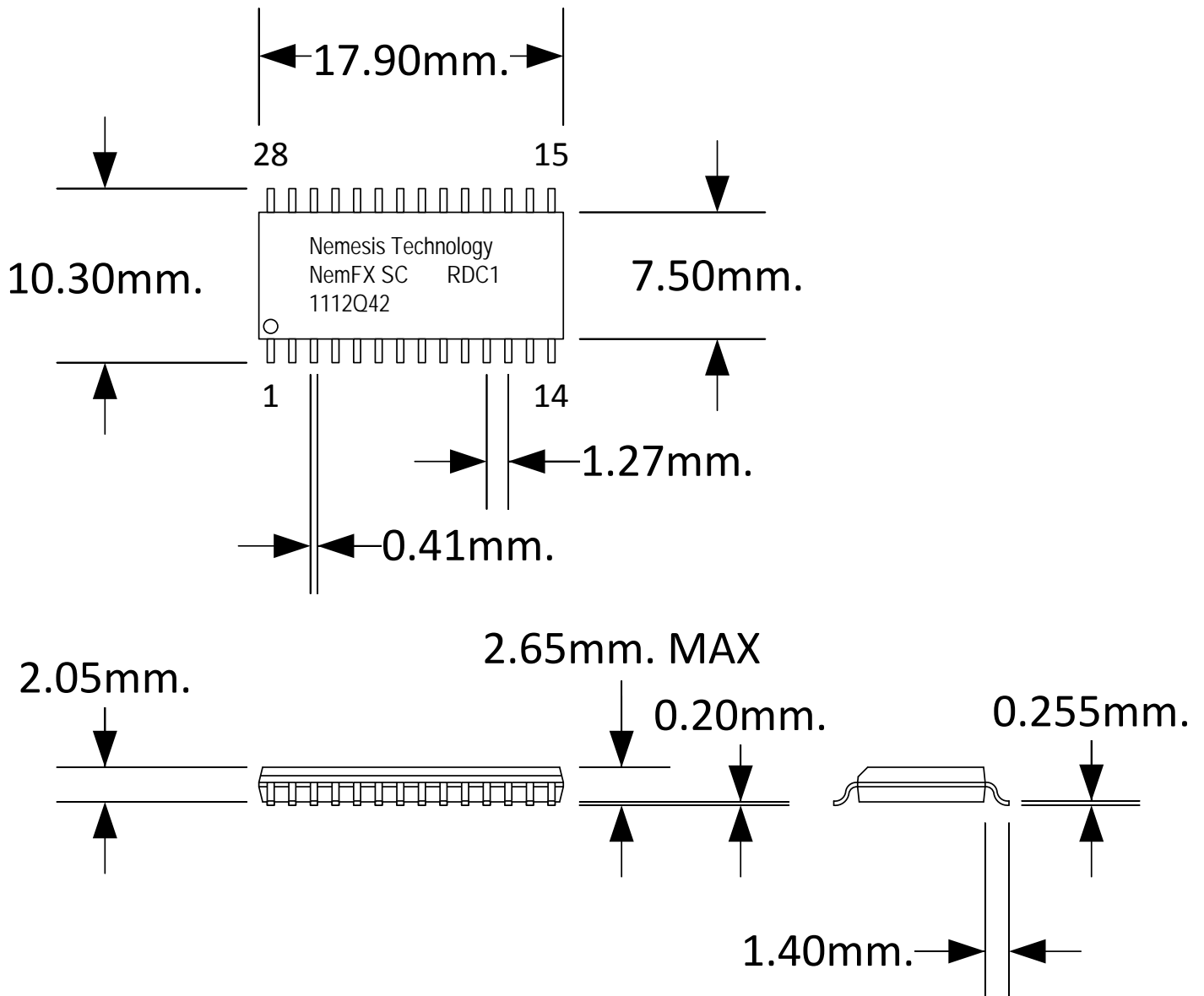
Ordering Options

NemFXSC-RDC1- _
Package _____
S0 - Plastic Small Outline - Wide - 300 mil body (SOIC)

Contact Nemesis Technology, Inc. for more information.

Package Details

28-Pin Plastic Small Outline - Wide - 300 mil Body (SOIC)



Important Information

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NemFX SC Reverb's are electronic devices and should be handled in static safe and otherwise appropriate manner. Nemesis Technology, Inc. will not be held responsible for any mishandling of NemFX SC Reverb's.

Nemesis Technology, Inc. will, however, accept responsibility for adding the sweet sounds of reverb and other effects to your audio products.

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