8-channel programmable current pulse generator

General description

The integrated circuit MS1031 is an 8-channel programmable current pulse generator. The current amplitude of each channel is individually programmable in the range of 10µA to 2.55mA with a resolution of 10µA. Monophasic (current flow only in one direction) or biphasic mode (current alternating) is supported. Each channel can be individually enabled or disabled. The pulse parameters are programmable. The parameters include pulse timing, number of consecutive pulses and pulse sets and the master pulse sequence. The pulses are applied in parallel or in series to the 8 channels. Cascading of multiple MS1031 is possible. With this profile only a minimum intervention from a microcontroller is necessary. An input pin allows for immediate shut-down of the current generation if necessary. Programming from the microcontroller is done via an SPI interface.

Applications

- Programmable current sources
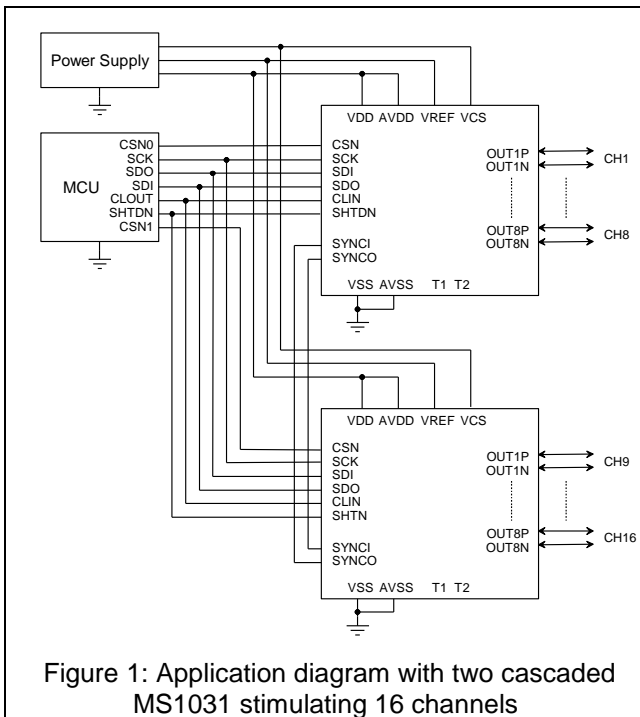- Neuromuscular electrical stimulation

Typical application

Figure 1: Application diagram with two cascaded MS1031 stimulating 16 channels

Features

- 8-channel current generator
- Monophasic or biphasic mode
- Each channel can be enabled or disabled
- Current value individually programmable from 10µA to 2.55mA with a resolution of 10µA
- Programmable pulse timing
- Programmable pulse sequence
- Serial or parallel pulse generation
- Anodic or cathodic generation in bipolar mode
- Cascading and synchronization of multiple circuits
- Shut-down input to immediately interrupt current pulse generation
- Internal (RC oscillator) or external 100kHz clock
- Internal or external 1.25V reference voltage
- 10 MHz SPI slave interface
- Operating voltage range 1.8V to 4.5V
- Current source voltage max. 8V
- Temperature operating range 10 to 50°C
- Semi-custom array MD500
- Die dimension: 1.96mm x 2.14mm after saw
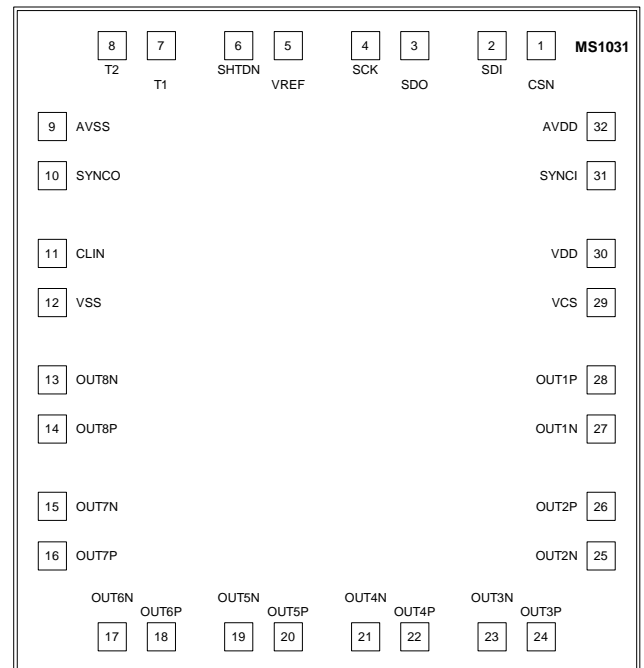- Various packaging options (die, flip-chip, packaged)

Pinout

Figure 2: Pinout (die)

Pin description

Pin	Symbol	Description
1	CSN	SPI chip select
2	SDI	SPI data input
3	SDO	SPI data output
4	SCK	SPI clock
5	VREF	1.25V reference voltage
6	SHTDN	Shut down
7	T1	Test pin 1
8	T2	Test pin 2
9	AVSS	Negative analog supply voltage
10	SYNCO	Synchronization output
11	CLIN	100kHz clock input
12	VSS	Negative digital supply voltage
13	OUT8N	Current source/sink channel 8N
14	OUT8P	Current source/sink channel 8P
15	OUT7N	Current source/sink channel 7N
16	OUT7P	Current source/sink channel 7P
17	OUT6N	Current source/sink channel 6N
18	OUT6P	Current source/sink channel 6P
19	OUT5N	Current source/sink channel 5N
20	OUT5P	Current source/sink channel 5P
21	OUT4N	Current source/sink channel 4N
22	OUT4P	Current source/sink channel 4P
23	OUT3N	Current source/sink channel 3N
24	OUT3P	Current source/sink channel 3P
25	OUT2N	Current source/sink channel 2N
26	OUT2P	Current source/sink channel 2P
27	OUT1N	Current source/sink channel 1N
28	OUT1P	Current source/sink channel 1P
29	VCS	Current source supply
30	VDD	Positive digital supply voltage
31	SYNCI	Synchronization input
32	AVDD	Positive analog supply voltage

Table 1: Pin description

Pulse modes

The MS1031 supports two pulse modes: (a) monophasic (a) or biphasic (b). The difference in the pulse shapes and the wiring of the outputs is shown in Figure 3.
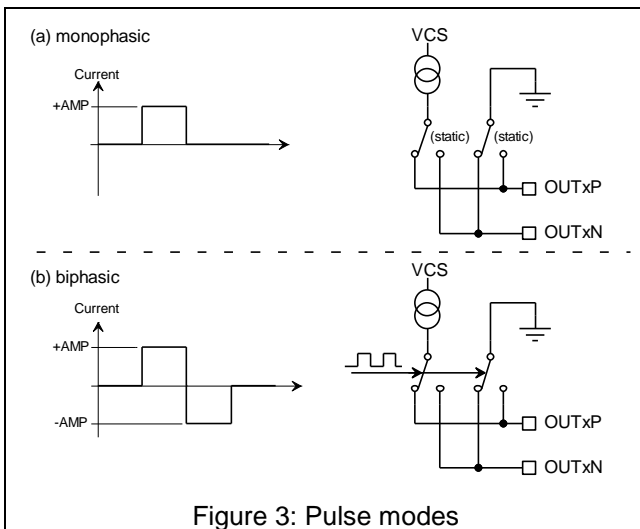

Figure 3: Pulse modes

Pulse specification

A pulse is specified by the amplitude of the current source (AMP), the pulse width (PW) and the delay zone (D0).
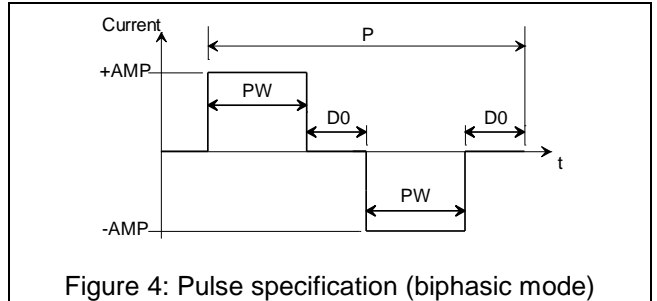

Figure 4: Pulse specification (biphasic mode)

Pulse set

N represents the number of consecutive pulses separated by the delay D1. X represents the number of successive sets of P pulses (=CP) each separated by the delay D2.
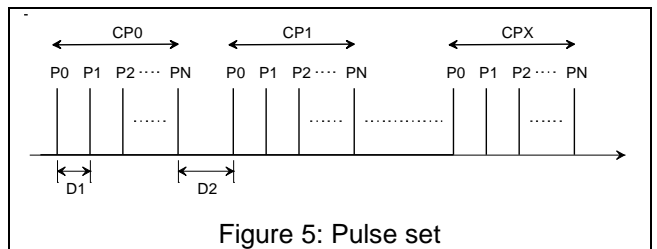

Figure 5: Pulse set

Master pulse sequence

The master pulse sequence consists of M pulse sets each separated by the delay D3. The pulse generation is completed when the specified number of pulse sets is finished.
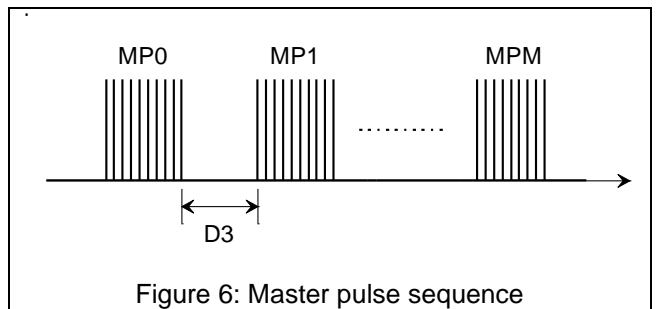

Figure 6: Master pulse sequence