

### GENERAL DESCRIPTION

SGM2526 is a programmable current limit switch with input voltage range selection and output voltage clamping. Extremely low  $R_{DS(ON)}$  of the integrated protection N-channel MOSFET helps to reduce power loss during the normal operation. Programmable soft-start time controls the slew rate of the output voltage during the start-up time. Independent enable control allows the complicated system sequencing control. It integrates the over-temperature protection shutdown and auto-recovery with hysteresis.

The SGM2526 is available in a Green TDFN-3×3-10L package and operates over a temperature range of -40°C to +85°C.

### FEATURES

- Wide Input Voltage Range from 4.5V to 22V with Surge up to 30V
- Extremely Low  $R_{DS(ON)}$  for the Integrated Protection Switch: 23mΩ
- Programmable Soft-Start Time
- Programmable Current Limit: 5A (MAX)
- Thermal Shutdown Protection & Auto-Recovery
- Selectable Input Range and Clamping Output Voltage Threshold
- Enable Interface Pin
- -40°C to +85°C Operating Temperature Range
- Available in a Green TDFN-3×3-10L Package

### APPLICATIONS

Notebook PC  
iPad Mini  
Server  
Service PC

### TYPICAL APPLICATION

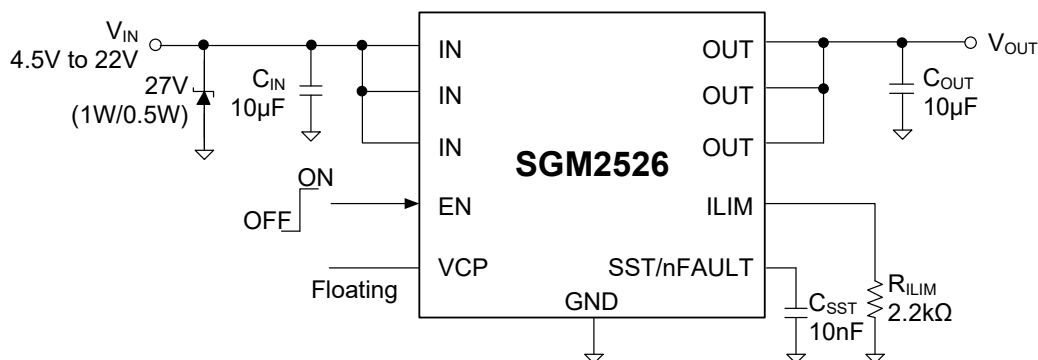


Figure 1. Typical Application Circuit

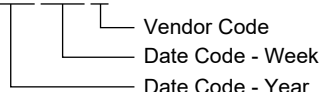
## PACKAGE/ORDERING INFORMATION

| MODEL   | PACKAGE DESCRIPTION | SPECIFIED TEMPERATURE RANGE | ORDERING NUMBER  | PACKAGE MARKING       | PACKING OPTION      |
|---------|---------------------|-----------------------------|------------------|-----------------------|---------------------|
| SGM2526 | TDFN-3×3-10L        | -40°C to +85°C              | SGM2526YTD10G/TR | SGM<br>2526D<br>XXXXX | Tape and Reel, 4000 |

## MARKING INFORMATION

NOTE: XXXXX = Date Code and Vendor Code.

**XXXXX**



Green (RoHS & HSF): SG Micro Corp defines "Green" to mean Pb-Free (RoHS compatible) and free of halogen substances. If you have additional comments or questions, please contact your SGMICRO representative directly.

## ABSOLUTE MAXIMUM RATINGS

|                                         |                 |
|-----------------------------------------|-----------------|
| IN, OUT, EN, VCP to GND .....           | -0.3V to 30V    |
| ILIM, SST/nFAULT to GND.....            | -0.3V to 6V     |
| Package Thermal Resistance              |                 |
| TDFN-3×3-10L, $\theta_{JA}$ .....       | 62°C/W          |
| Junction Temperature .....              | +150°C          |
| Storage Temperature Range.....          | -65°C to +150°C |
| Lead Temperature (Soldering, 10s) ..... | +260°C          |
| ESD Susceptibility                      |                 |
| HBM.....                                | 4000V           |
| MM.....                                 | 300V            |
| CDM .....                               | 1000V           |

## RECOMMENDED OPERATING CONDITIONS

|                                           |                 |
|-------------------------------------------|-----------------|
| Supply Input Voltage.....                 | 4.5V to 22V     |
| Ambient Temperature Range.....            | -40°C to +85°C  |
| Operating Junction Temperature Range..... | -40°C to +125°C |

## OVERSTRESS CAUTION

Stresses beyond those listed in Absolute Maximum Ratings may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect reliability. Functional operation of the device at any conditions beyond those indicated in the Recommended Operating Conditions section is not implied.

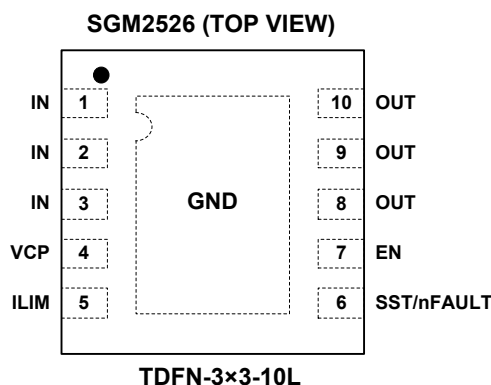
## ESD SENSITIVITY CAUTION

This integrated circuit can be damaged by ESD if you don't pay attention to ESD protection. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

## DISCLAIMER

SG Micro Corp reserves the right to make any change in circuit design, or specifications without prior notice.

## PIN CONFIGURATION



## PIN DESCRIPTION

| PIN         | NAME       | FUNCTION                                                                                                                                                                                                                                                         |
|-------------|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1, 2, 3     | IN         | Power Input Pin. Decouple high frequency noise by connecting at least 0.1μF MLCC to ground.                                                                                                                                                                      |
| 4           | VCP        | Output Clamp Voltage Selection Based on the Input Voltage. Pull VCP pin to high by connecting a resistor to IN pin, or float VCP pin to select different output clamping thresholds, as shown in Table 1. Recommend to decoupling this pin with 0.1μF capacitor. |
| 5           | ILIM       | Current Limit Program Pin. Program the current limit by connecting a resistor to ground.                                                                                                                                                                         |
| 6           | SST/nFAULT | Soft-Start Time Program and Fault Event Indicator Pin. Connect a capacitor to ground to program the soft-start time. nFAULT event indicator, goes low to indicate fault condition due to under-voltage or thermal shutdown event.                                |
| 7           | EN         | Enable Interface Pin. Pull it high to enable the IC.                                                                                                                                                                                                             |
| 8, 9, 10    | OUT        | Power Output Pin.                                                                                                                                                                                                                                                |
| Exposed Pad | GND        | Ground Pin.                                                                                                                                                                                                                                                      |

**Table 1. Output Clamp Voltage Selection**

| VCP      | $V_{IN}$ (V) |         | Clamping Threshold (V) |      |      |
|----------|--------------|---------|------------------------|------|------|
|          |              |         | MIN                    | TYP  | MAX  |
| High     | 5            | Over 6  | 5.5                    | 5.7  | 5.9  |
| Floating | 12           | Over 14 | 12.8                   | 13.3 | 13.6 |

## ELECTRICAL CHARACTERISTICS

(T<sub>A</sub> = +25°C, V<sub>IN</sub> = 5V, R<sub>LIM</sub> = 10kΩ, C<sub>SST</sub> = 10nF, C<sub>IN</sub> = 10μF and C<sub>OUT</sub> = 10μF, unless otherwise specified.)

| PARAMETER                                  | SYMBOL              | CONDITIONS                      | MIN  | TYP                   | MAX  | UNITS |
|--------------------------------------------|---------------------|---------------------------------|------|-----------------------|------|-------|
| Input Voltage Range                        | V <sub>IN</sub>     |                                 | 4.5  |                       | 22   | V     |
| Input UVLO Threshold Voltage               | V <sub>UVLO</sub>   | VCP = High                      | 3.4  | 3.6                   | 3.8  | V     |
|                                            |                     | VCP = Floating                  | 8.2  | 8.6                   | 9.0  | V     |
| UVLO Hysteresis                            | V <sub>UVHYS</sub>  | VCP = High                      |      | 0.1                   |      | V     |
|                                            |                     | VCP = Floating                  |      | 0.2                   |      | V     |
| Bias Current                               | I <sub>BIAS</sub>   |                                 |      | 170                   | 200  | μA    |
| Shutdown Current                           | I <sub>SHDN</sub>   | EN = 0V                         |      | 0.7                   | 1.2  | μA    |
| FET On-Resistance                          | R <sub>DS(ON)</sub> |                                 |      | 23                    | 29   | mΩ    |
| Clamping Output Voltage                    | V <sub>CLP</sub>    | VCP = High                      | 5.5  | 5.7                   | 5.9  | V     |
|                                            |                     | VCP = Floating                  | 12.8 | 13.2                  | 13.6 | V     |
| Soft-Start Time <sup>(1)</sup>             | t <sub>SST</sub>    | C <sub>SST</sub> = 0F           |      | 1.4                   |      | ms    |
|                                            |                     | C <sub>SST</sub> = 10nF         |      | 2.6                   |      | ms    |
| Soft-Start Time Accuracy <sup>(1)</sup>    |                     | C <sub>SST</sub> = 10nF         |      | ±30% t <sub>SST</sub> |      |       |
| Current Limit Accuracy                     |                     | R <sub>LIM</sub> = 11kΩ         | 0.92 | 1.0                   | 1.09 | A     |
| Current Limit Program Range <sup>(2)</sup> | I <sub>LIM</sub>    |                                 | 1    |                       | 5    | A     |
| EN Turn-On Threshold Voltage               | V <sub>EN_ON</sub>  | T <sub>A</sub> = -40°C to +85°C | 1.2  |                       |      | V     |
| EN Turn-Off Threshold Voltage              | V <sub>EN_OFF</sub> | T <sub>A</sub> = -40°C to +85°C |      |                       | 0.4  | V     |
| Thermal Shutdown Temperature               | T <sub>SD</sub>     |                                 |      | 150                   |      | °C    |
| Thermal Shutdown Hysteresis                | T <sub>HYS</sub>    |                                 |      | 20                    |      | °C    |

### NOTE 1:

$$t_{SST} = t_{SST\_DLT} \text{ (No External } C_{SST} \text{)} \quad (1)$$

$$t_{SST} = \frac{C_{SST}}{I_{INT}} \times 1.2 \quad (t_{SST} > t_{SST\_DLT}) \quad (2)$$

where t<sub>SST\_DLT</sub> is the internally fixed default soft-start time, about 1.4ms, which means there's no any external C<sub>SST</sub>; I<sub>INT</sub> is the internal current source, about 4.6μA. A capacitor (C<sub>SST</sub>) of less than 10nF is recommended.

### NOTE 2:

#### Recommended Current Limit Program Table:

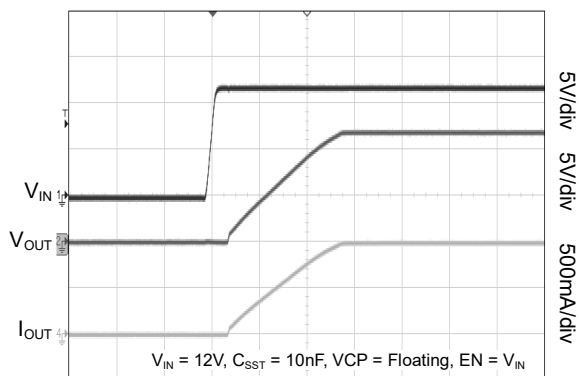
| R <sub>LIM</sub> (kΩ) | 11  | 5.5 | 4.4 | 3.7 | 3.1 | 2.8 | 2.4 | 2.2 |
|-----------------------|-----|-----|-----|-----|-----|-----|-----|-----|
| Current Limit (A)     | 1.0 | 2.0 | 2.5 | 3.0 | 3.5 | 4.0 | 4.5 | 5.0 |

#### Recommended Formula for R<sub>LIM</sub> & Current Limit Calculation:

$$R_{LIM} = \frac{11}{I_{LIM}} \text{ (kΩ)} \quad (3)$$

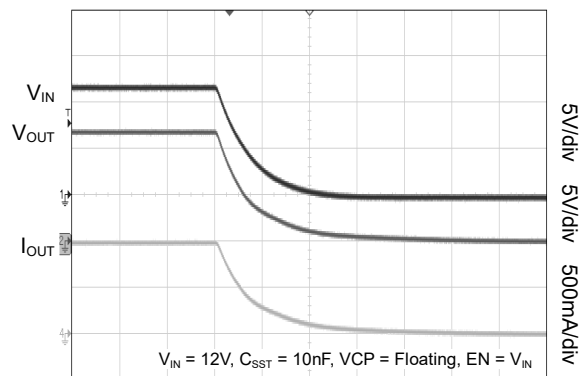
## TYPICAL PERFORMANCE CHARACTERISTICS

Programmable Soft-Start Time



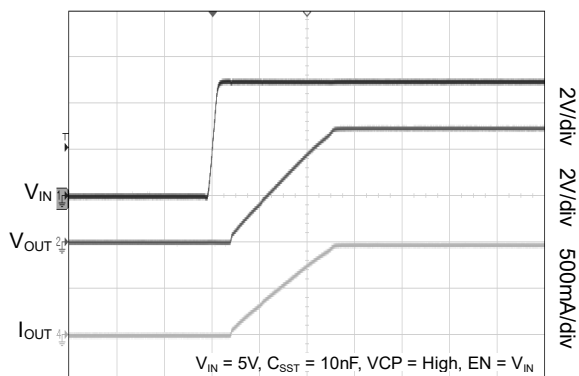
Time (1ms/div)

Power-Off



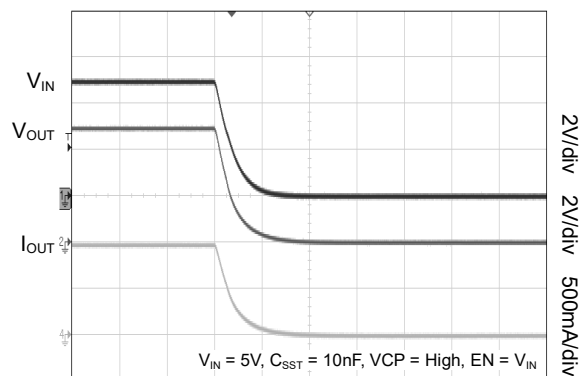
Time (50μs/div)

Programmable Soft-Start Time



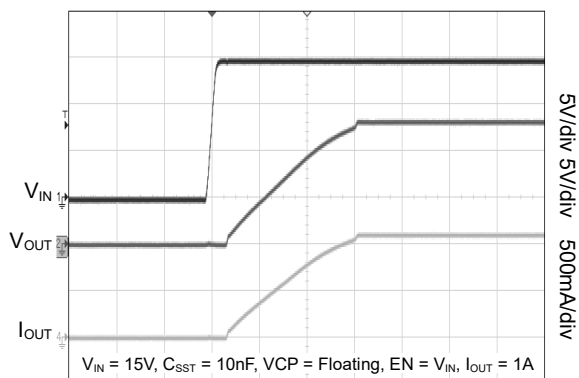
Time (1ms/div)

Power-Off



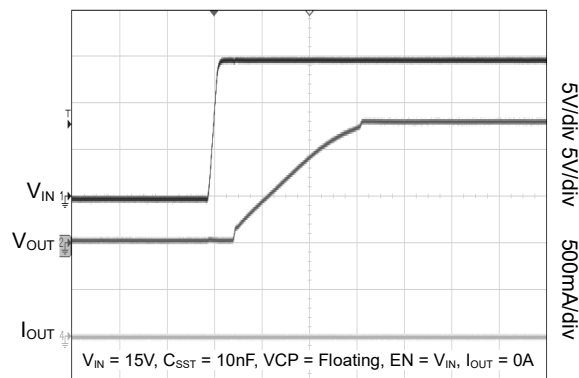
Time (100μs/div)

Output Voltage Clamping



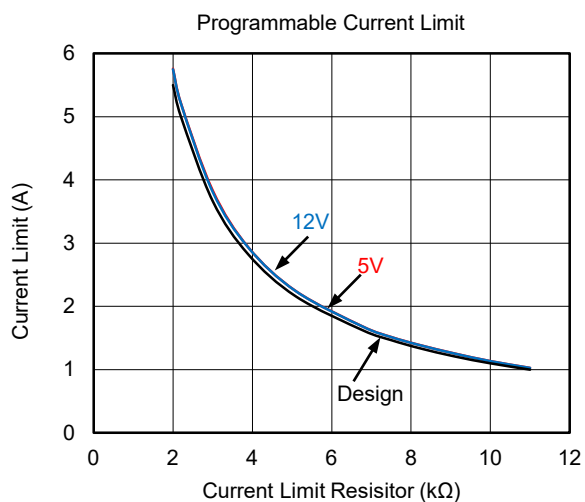
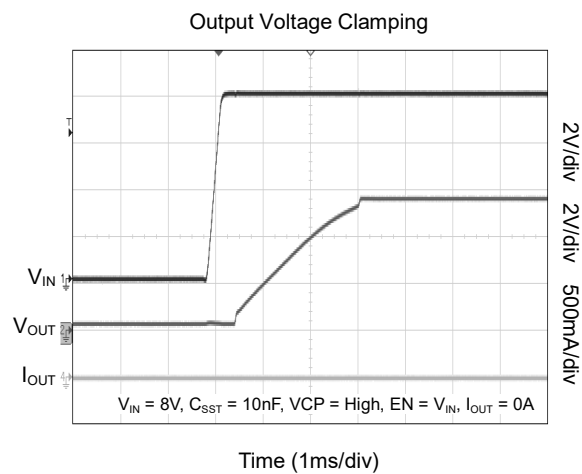
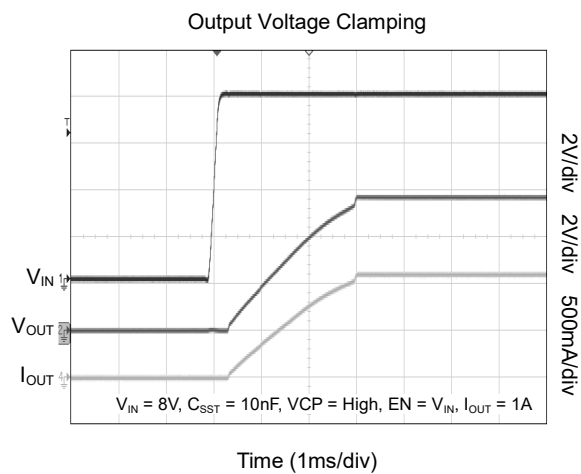
Time (1ms/div)

Output Voltage Clamping

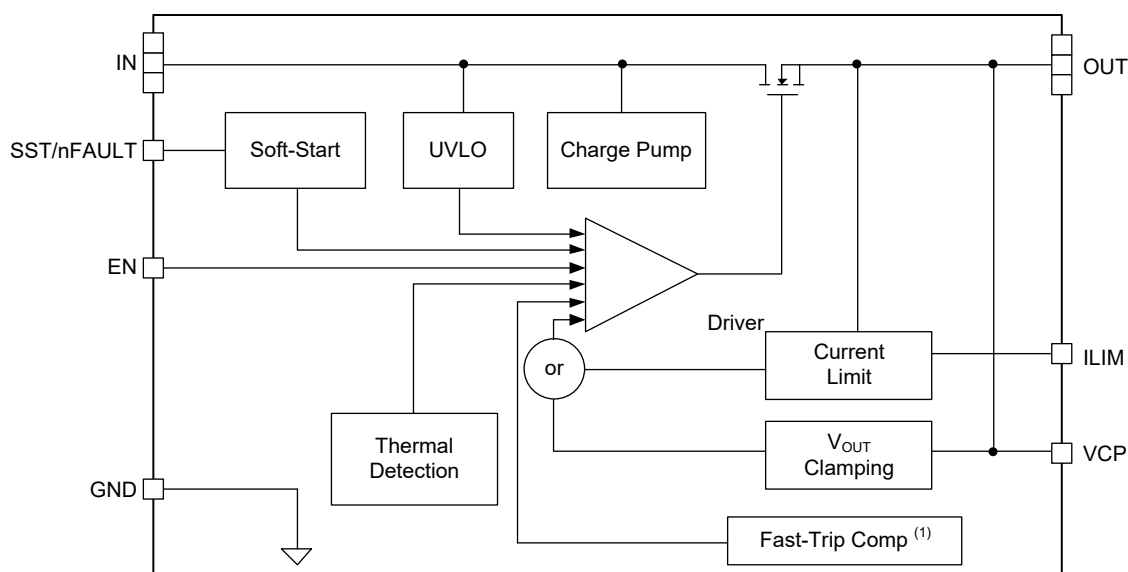


Time (1ms/div)

## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

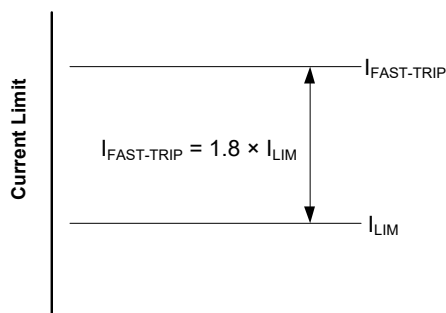


## FUNCTIONAL BLOCK DIAGRAM



### NOTES:

1. During a transient short-circuit event, the current through the device increases very rapidly. The current limit amplifier cannot respond very quickly to this event due to its limited bandwidth. Therefore, the SGM2526 incorporates a fast-trip comparator, which shuts down the pass device very quickly when  $I_{OUT} > I_{FAST-TRIP}$  ( $I_{FAST-TRIP} = 1.8 \times I_{LIM}$ ), and terminates the rapid short-circuit peak current. After the transient short-circuit peak current has been terminated by the fast-trip comparator, the current limit amplifier smoothly regulates the output current to  $I_{LIM}$ .
2. When the switching voltage of SGM2526 is more than 15V, customer should add a no more than 27V (> 0.5W) zener diode to prevent the input voltage spike from damaging the SGM2526.



## APPLICATION EXAMPLES

The SGM2526 provides simple solution for current limiting, in-rush current control and supervision of power rails for wide range of applications operating at 4.5V to 22V and delivering up to 5A.

### Protection and Current Limiting for Primary-Side Regulated Power Supplies

Primary-side regulated power supplies and adapters are dominant today in many of the applications such as LCD-TV, fast charger, set-top boxes and gaming consoles.

- No secondary-side protection for immediate termination of critical faults such as short-circuit and over-voltage.
- Do not provide precision current limiting for over-load transients.
- Have poor output voltage regulation for sudden change in AC input voltages, triggering output over-voltage condition.

Many of the above applications require precision output current limiting and secondary-side protection, driving the need for current sensing in the secondary-side. This needs additional circuit implementation using precision operational amplifiers. This increases the complexity of the solution and also results in sensing losses. The SGM2526 with its integrated low-ohmic N-channel MOSFET provides a simple and efficient solution.

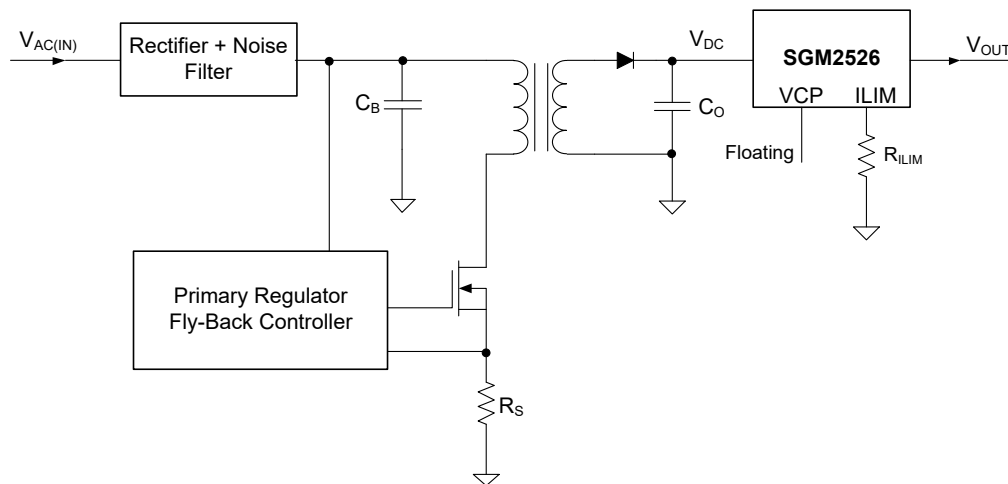


Figure 2. Current Limiting and Protection for AC-DC Power Supplies

## APPLICATION EXAMPLES (continued)

### Precision Current Limiting in Intrinsic Safety Applications

Intrinsic Safety (IS) is becoming prominent need for safe operation of electrical and electronic equipment in hazardous areas. Intrinsic Safety requires that equipment is designed such that the total amount of energy available in the apparatus is simply not enough to ignite an explosive atmosphere. The energy can be electrical, in the form of a spark, or thermal, in the form of a hot surface.

This calls for precision current limiting and precision shutdown of the circuit for over-voltage conditions ensuring that set voltage and current limits are not exceeded for wide operating temperature range and variable environmental conditions. Applications such as gas analyzers, medical equipment (such as electrocardiographs), portal industrial equipment, cabled power distribution systems and hand-held motor operated tools need to meet these critical safety standards.

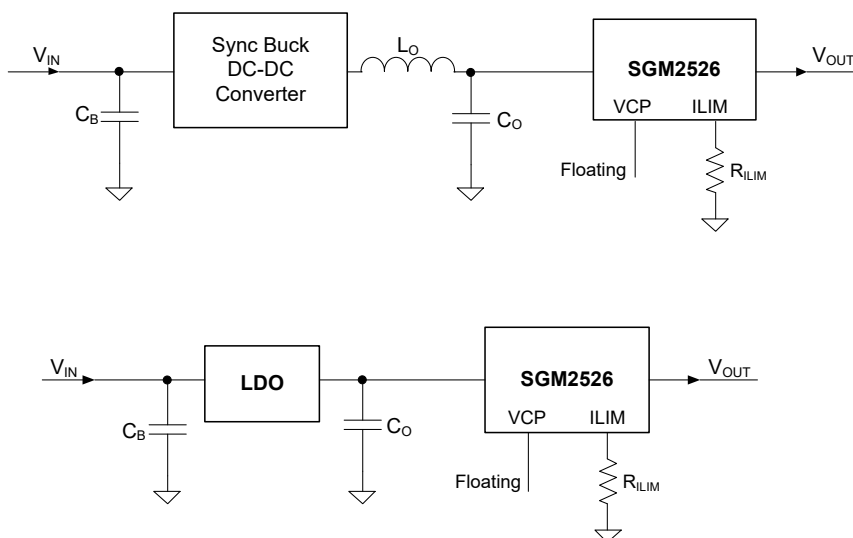


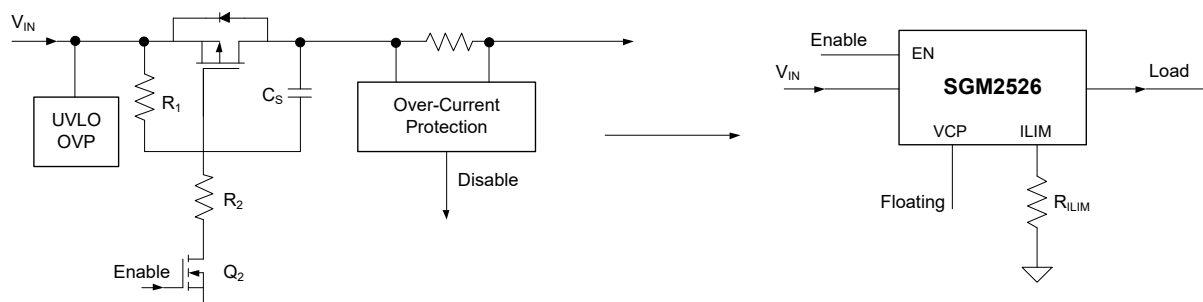
Figure 3. Precision Current Limiting and Protection of Internal Rails

## APPLICATION EXAMPLES (continued)

### Smart Load Switch

A smart load switch is a series MOSFET used for switching of the load (resistive or inductive). It also provides protection during fault conditions. Typical discrete implementation is shown in Figure 4. Discrete solutions have higher component count and require complex circuitry to implement each of the protection fault needs.

SGM2526 can be used as a smart power switch for applications ranging from 4.5V to 22V. SGM2526 provides programmable soft-start, programmable current limits, over-temperature protection, a fault flag and under-voltage lockout.



**Figure 4. Smart Load Switch Implementation**

Figure 4 shows typical implementation and usage as load switch. This configuration can be used for driving a solenoid and fan control. It is recommended to use a freewheeling diode across the load when load is highly inductive.

## REVISION HISTORY

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

### MAY 2019 – REV.A to REV.A.1

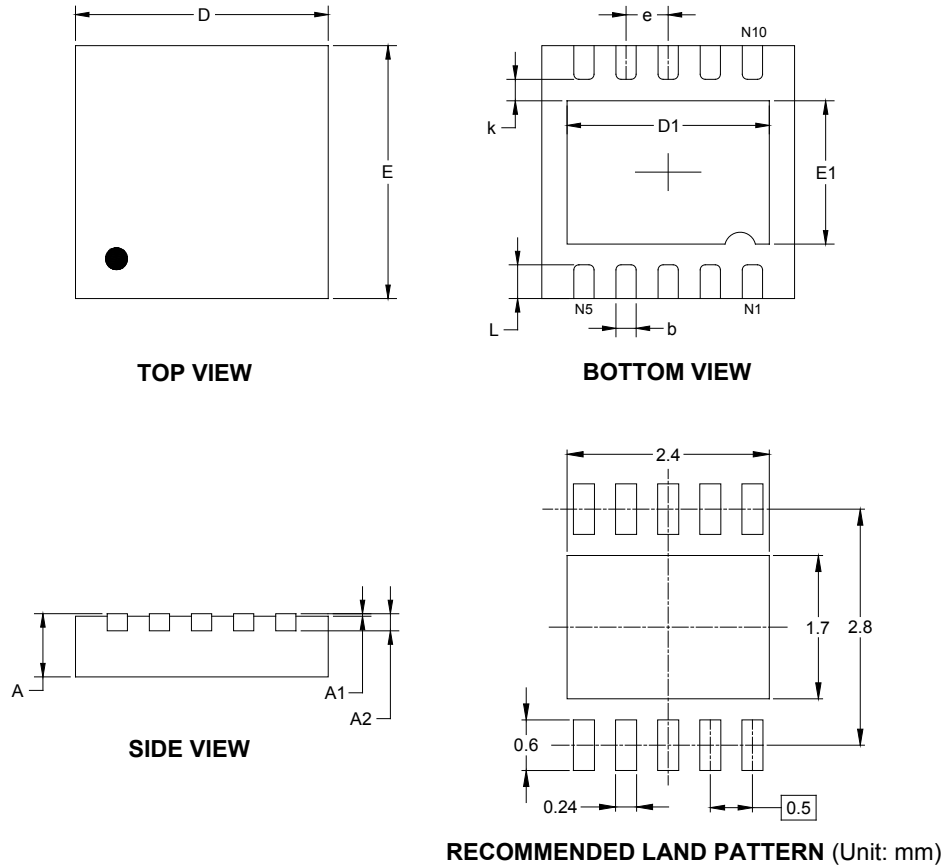
|                                                   | Page        |
|---------------------------------------------------|-------------|
| Updated Figure 1, Figure 2, Figure 3 and Figure 4 | 1, 8, 9, 10 |

### Changes from Original (DECEMBER 2018) to REV.A

|                                                 | Page |
|-------------------------------------------------|------|
| Changed from product preview to production data | All  |

## PACKAGE OUTLINE DIMENSIONS

### TDFN-3×3-10L

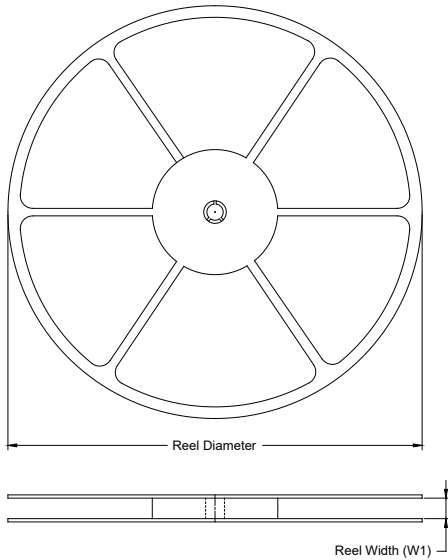


| Symbol | Dimensions<br>In Millimeters |       | Dimensions<br>In Inches |       |
|--------|------------------------------|-------|-------------------------|-------|
|        | MIN                          | MAX   | MIN                     | MAX   |
| A      | 0.700                        | 0.800 | 0.028                   | 0.031 |
| A1     | 0.000                        | 0.050 | 0.000                   | 0.002 |
| A2     | 0.203 REF                    |       | 0.008 REF               |       |
| D      | 2.900                        | 3.100 | 0.114                   | 0.122 |
| D1     | 2.300                        | 2.600 | 0.091                   | 0.103 |
| E      | 2.900                        | 3.100 | 0.114                   | 0.122 |
| E1     | 1.500                        | 1.800 | 0.059                   | 0.071 |
| k      | 0.200 MIN                    |       | 0.008 MIN               |       |
| b      | 0.180                        | 0.300 | 0.007                   | 0.012 |
| e      | 0.500 TYP                    |       | 0.020 TYP               |       |
| L      | 0.300                        | 0.500 | 0.012                   | 0.020 |

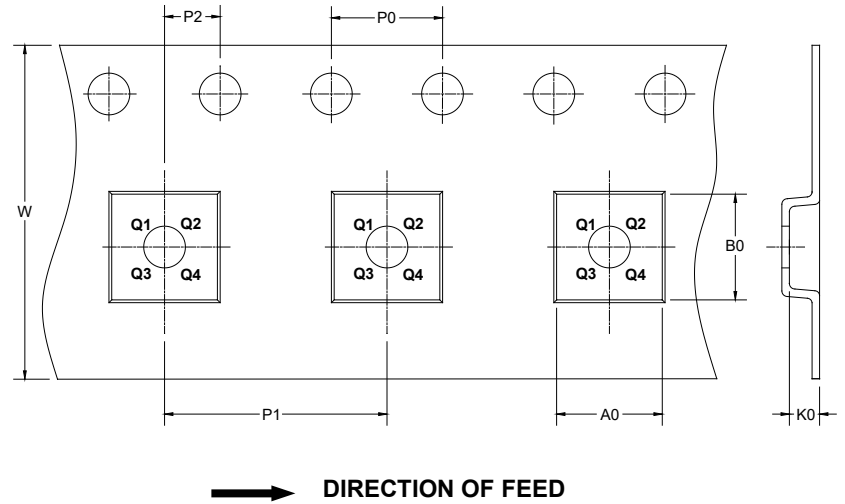
## PACKAGE INFORMATION

### TAPE AND REEL INFORMATION

#### REEL DIMENSIONS



#### TAPE DIMENSIONS



NOTE: The picture is only for reference. Please make the object as the standard.

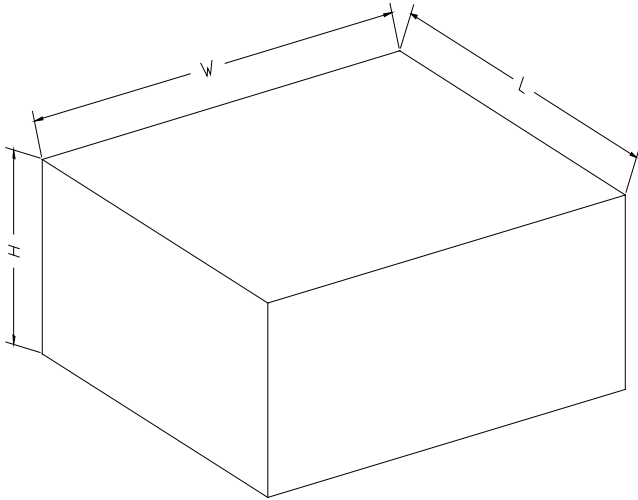
#### KEY PARAMETER LIST OF TAPE AND REEL

| Package Type | Reel Diameter | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P0 (mm) | P1 (mm) | P2 (mm) | W (mm) | Pin1 Quadrant |
|--------------|---------------|--------------------|---------|---------|---------|---------|---------|---------|--------|---------------|
| TDFN-3×3-10L | 13"           | 12.4               | 3.35    | 3.35    | 1.13    | 4.0     | 8.0     | 2.0     | 12.0   | Q1            |

DD00001

## PACKAGE INFORMATION

### CARTON BOX DIMENSIONS



NOTE: The picture is only for reference. Please make the object as the standard.

### KEY PARAMETER LIST OF CARTON BOX

| Reel Type | Length (mm) | Width (mm) | Height (mm) | Pizza/Carton |
|-----------|-------------|------------|-------------|--------------|
| 13"       | 386         | 280        | 370         | 5            |

DD0002