SGM855
Nano-Power System Timer for Power Gating

GENERAL DESCRIPTION

The SGM855 is a nano-power system timer which only consumes 40nA (TYP) quiescent current. It has a programmable watchdog to interrupt the power MOSFET with the DRV pin. Hence, it is suitable for power gating in duty-cycled or battery-powered applications. Due to the power saving feature of SGM855, smaller battery can be adopted under power collection system or wireless sensor applications. The SGM855 can program the timer interval from 100ms to 8200s through the resistor placed between the DELAY/M_DRV pin and GND. Besides, the user can choose the timer to operate in timer mode or one-shot mode by the EN/ONE_SHOT pin.

The SGM855 is available a Green SOT-23-6 Package.

FEATURES

- **Supply Voltage Range: 1.8V to 5.5V**
- **Low Current Consumption: 40nA (TYP) at 2.5V**
- **Programmable Time Intervals: 100ms to 8200s**
- **Timer Accuracy: 1% (TYP)**
- **Resistor Selectable Time Interval**
- **Manual MOSFET Power-On**
- **One-Shot Feature**
- **Available in a Green SOT-23-6 Package**

APPLICATIONS

Battery-Powered Systems
Internet of Things (IoT)
Anti-Intrusion System
Anti-Tamper System
Home Automation Sensors
Temperature Regulating System
Consumer Electronics
Wireless Sensor
White Household Appliances
Industrial Applications

TYPICAL APPLICATION

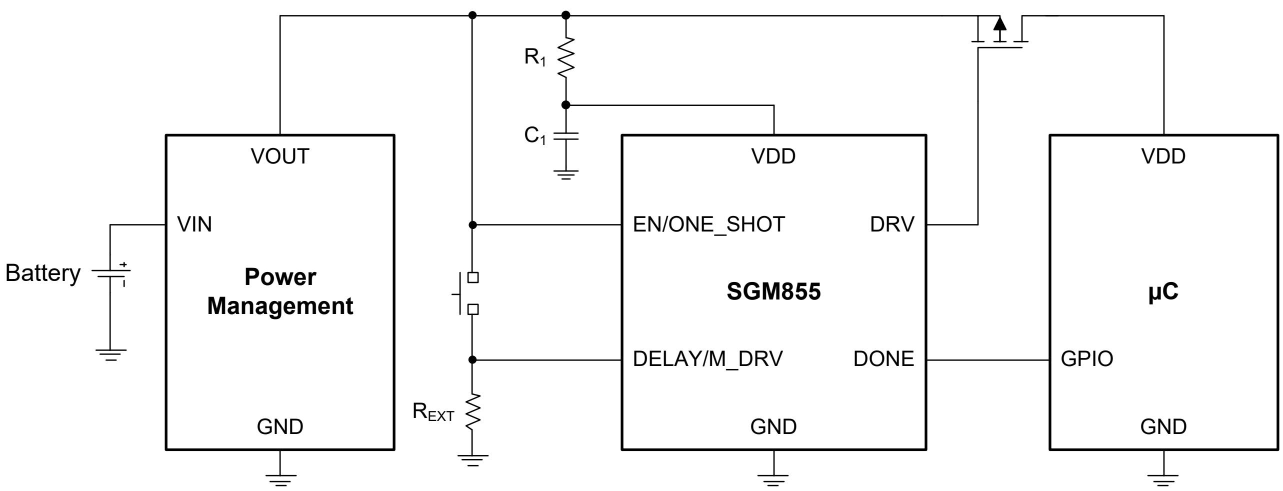


Figure 1. Typical Application Circuit

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM855	SOT-23-6	-40℃ to +105℃	SGM855GN6G/TR	1H5 XXXXX	Tape and Reel, 3000

MARKING INFORMATION

NOTE: XXXXX = Date Code, Trace Code and Vendor Code.

XXXXX
- Vendor Code
- Trace Code
- Date Code - Year

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

Supply Voltage, V_{DD} .... -0.3V to 6V
Input Voltage at Any Pin [1] ....-0.3V to V_{DD} + 0.3V
Package Thermal Resistance
SOT-23-6, θ_{JA} .... 131.9℃/W
SOT-23-6, θ_{JB} .... 31.2℃/W
SOT-23-6, θ_{JC} .... 61℃/W
Junction Temperature ....+150℃
Storage Temperature Range ....-65℃ to +150℃
Lead Temperature (Soldering, 10s) ....+260℃
ESD Susceptibility [2] [3]
HBM..±4000V
CDM ....±1000V

NOTES:

1. The voltage between any two pins should not exceed 6V.
2. For human body model (HBM), all pins comply with ANSI/ESDA/JEDEC JS-001 specifications.
3. For charged device model (CDM), all pins comply with ANSI/ESDA/JEDEC JS-002 specifications.

RECOMMENDED OPERATING CONDITIONS

Supply Voltage, V_{DD} ....1.8V to 5.5V
Operating Temperature Range ....-40℃ to +105℃

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

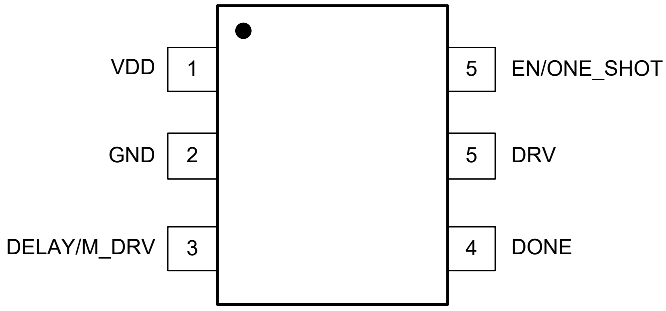
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because even small parametric changes could cause the device not to meet the published specifications.

DISCLAIMER

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

PIN CONFIGURATION

(TOP VIEW)



SOT-23-6

PIN DESCRIPTION

PIN	NAME	TYPE	FUNCTION
1	VDD	P	Supply Voltage Pin.
2	GND	G	Ground.
3	DELAY/M_DRV	I	Time Interval Set and Manual MOSFET Power-On. Putting a resistor between the DELAY/M_DRV pin and GND determines the time interval. It can also be used to turn on the MOSFET manually.
4	DONE	I	Watchdog Input Pin. Periodically logic high at this pin means correct operation of the microcontroller.
5	DRV	O	Power MOSFET Driving Pin. Connect this pin to the gate of the MOSFET. The power MOSFET is on when DRV goes low.
6	EN/ONE_SHOT	I	Mode Selection Pin. When EN/ONE_SHOT is logic high, the SGM855 works in timer mode. When EN/ONE_SHOT is logic low, the SGM855 works in one-shot mode and the power MOSFET will be turned on again until a new active DELAY/M_DRV occurs.

NOTE: I = input, O = output, P = power, G = ground.

ELECTRICAL CHARACTERISTICS

(V_{DD} = 2.5V, T_J = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Power Supply							
Supply Current at Operation Mode	I_{DD_OP}				40	55	nA
Supply Current at Sense Mode (1)	I_{DD_SEN}	Digital conversion of external resistance (R_{EXT})			120	150	μA
Timer							
Time Interval Period	t_{IP}	1650 selectable time intervals	Minimum time interval		100		ms
			Maximum time interval		8200		s
Time Interval Setting Accuracy (2)		Excluding reliability test			±2.6		%
		Including reliability test			±3.5		
Resistance Detection Accuracy over Temperature		T_J = -40℃ to +105℃			90		ppm/℃
Time Interval Setting Accuracy over Supply Voltage		V_{DD} = 1.8V to 5.5V			±0.06		%/V
Oscillator Accuracy	t_{OSC}	Excluding reliability test			±1.0		%
		Including reliability test			±2.1		
Oscillator Accuracy over Temperature		T_J = -40℃ to +105℃			200		ppm/℃
Oscillator Accuracy over Supply Voltage		V_{DD} = 1.8V to 5.5V			±0.13		%/V
DONE Pulse Width	t_{DONE}			100			ns
DRV Pulse Width	t_{DRV}	DONE signal not received			320		ms
Time to Convert R_{EXT}	t_{R_EXT}				100	120	ms
Digital Logic Levels							
Logic High Threshold DONE Pin	V_{IH}			0.7 × V_{DD}			V
Logic Low Threshold DONE Pin	V_{IL}					0.3 × V_{DD}	V
Logic Output High Level DRV Pin	V_{OH}	I_{OUT} = 100μA		V_{DD} - 0.3			V
		I_{OUT} = 1mA		V_{DD} - 0.7			V
Logic Output Low Level DRV Pin	V_{OL}	I_{OUT} = -100μA				0.3	V
		I_{OUT} = -1mA				0.7	V
Logic High Threshold DELAY/M_DRV Pin	V_{IHM_DRV}			1.5			V

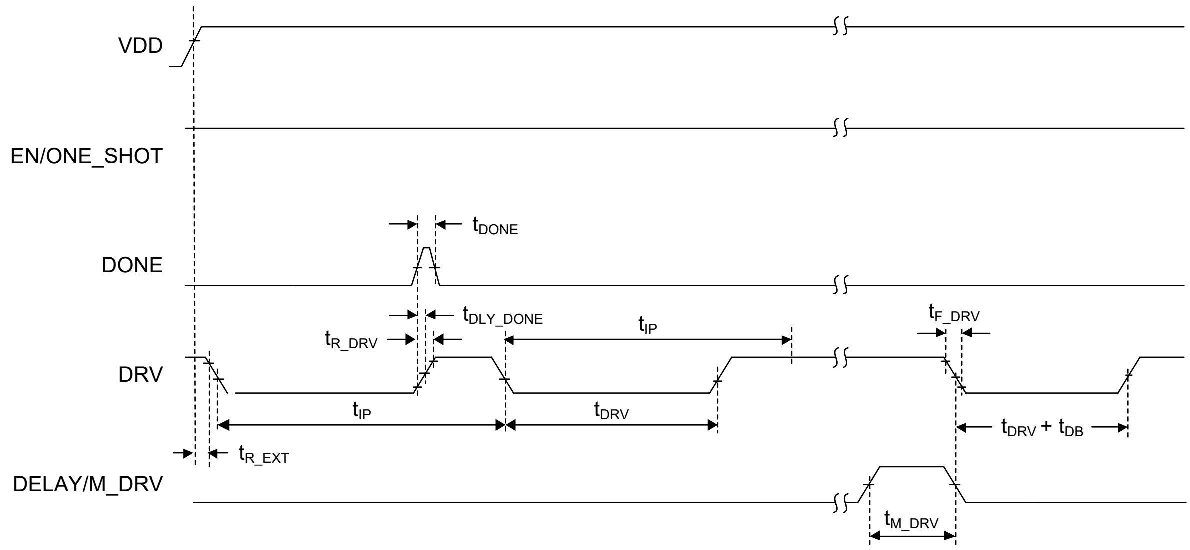
NOTES:

1. Current of load and pull-up resistor are not included.
2. This accuracy represents the error of different chip detection results when the external resistance is the same ideal resistance, excluding the error of the external resistance itself.

TIMING REQUIREMENTS

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Rise Time DRV [1]	t_{R_DRV}	Capacitive load 50pF		50		ns
Fall Time DRV [1]	t_{F_DRV}	Capacitive load 50pF		50		ns
DONE to DRV Delay [1]	t_{DLY_DONE}			100		ns
Valid Manual MOSFET Power-On	t_{M_DRV}	Observation time 30ms	20			ms
De-Bounce Manual MOSFET Power-On	t_{DB}			20		ms

NOTS:
1. Guaranteed by design.

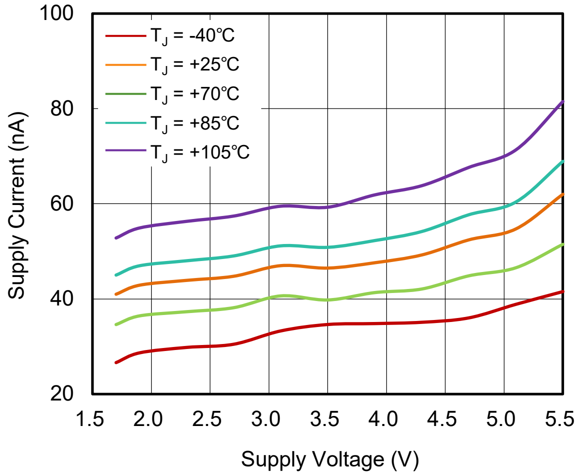


NOTE: It is recommended that the DONE signal must be given at least 200ns after the DRV falling edge to ensure the chip can correctly identify the DONE signal.

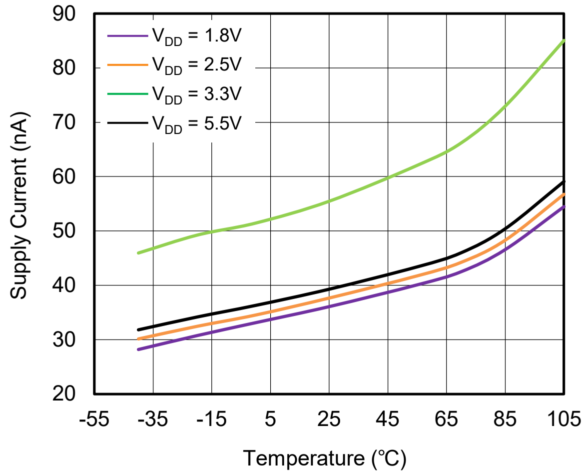
Figure 2. Timing Diagram

TYPICAL PERFORMANCE CHARACTERISTICS

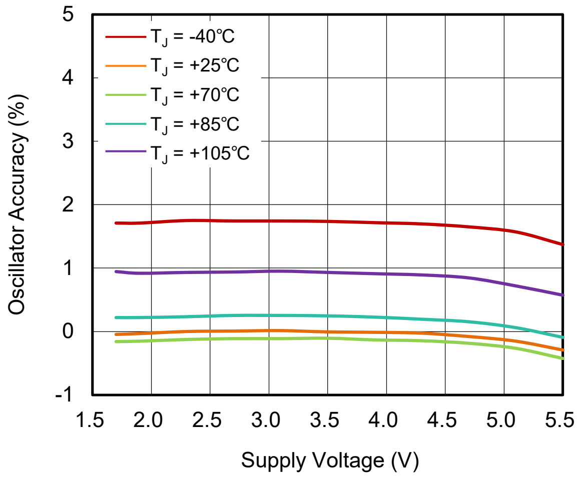
Supply Current vs. Supply Voltage



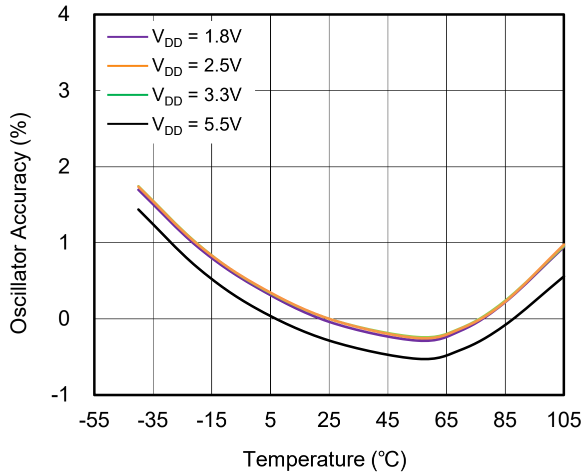
Supply Current vs. Temperature



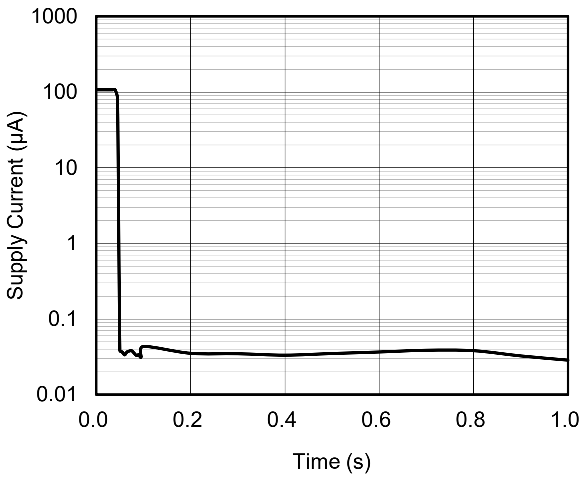
Oscillator Accuracy vs. Supply Voltage



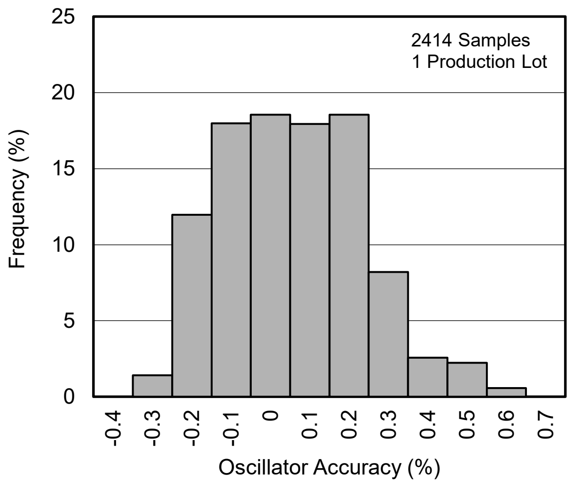
Oscillator Accuracy vs. Temperature



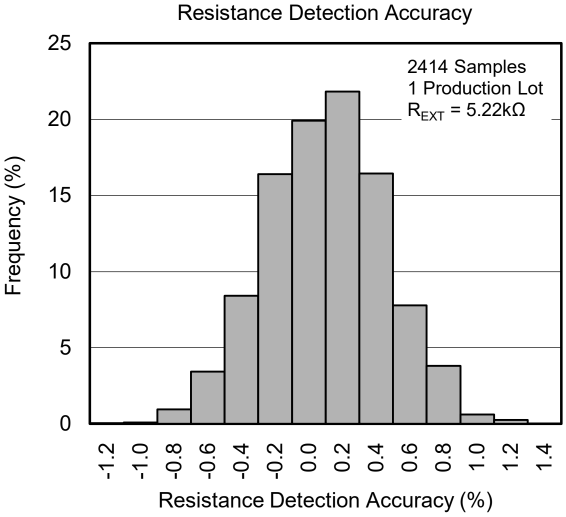
Supply Current vs. Time

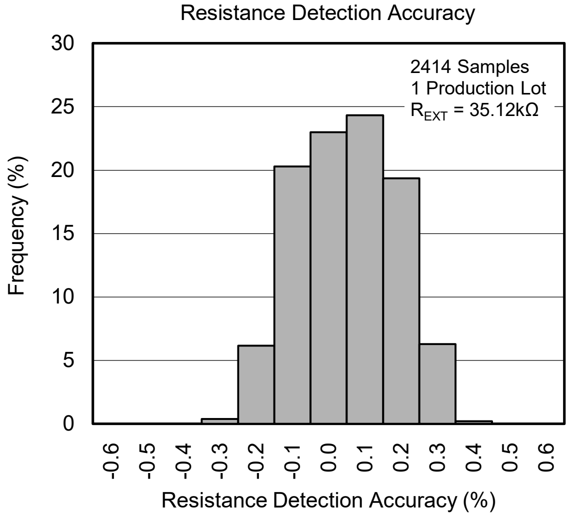


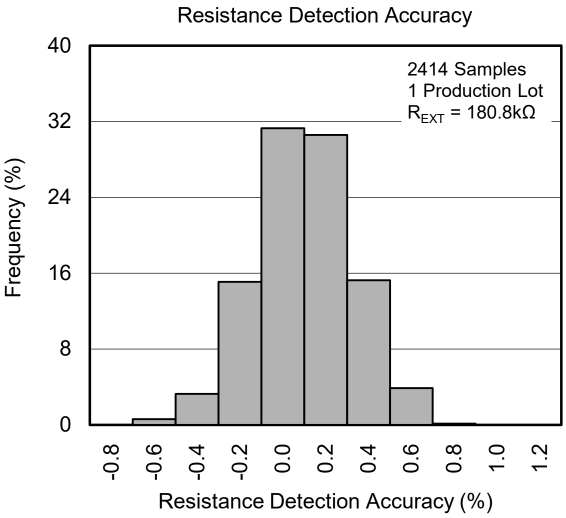
Oscillator Accuracy



TYPICAL PERFORMANCE CHARACTERISTICS







FUNCTIONAL BLOCK DIAGRAM

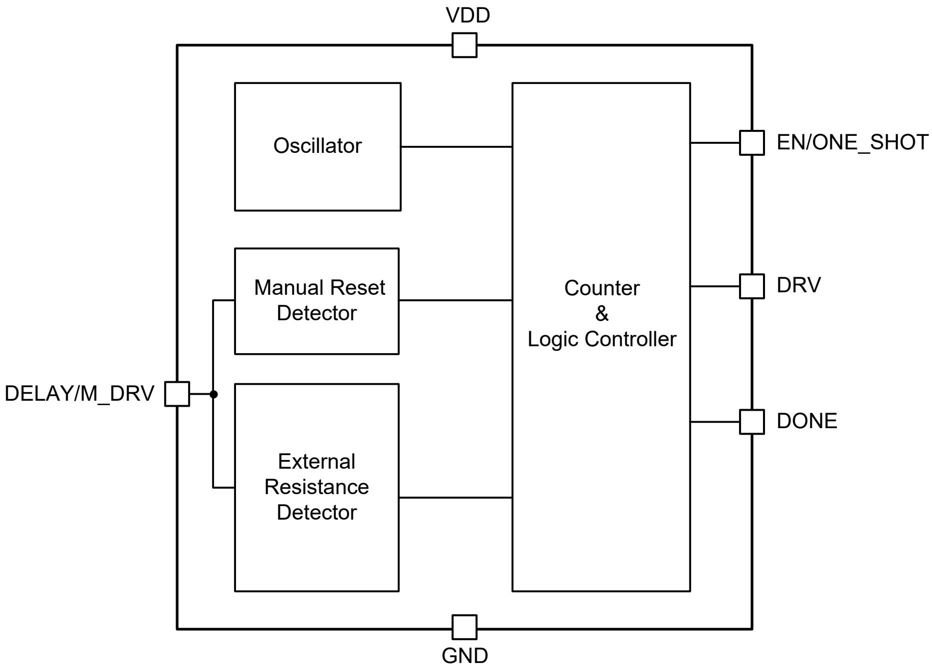


Figure 3. Block Diagram

DETAILED DESCRIPTION

Overview

The SGM855 is a nano-power system timer for power gating. It is designed for power-cycled applications with interval period varying from 100ms to 8200s.

When configured in timer mode (with EN/ONE_SHOT pin set to high), the SGM855 periodically outputs a DRV signal to drive a MOSFET, thereby activating the microcontroller (μC). The operation follows this logic:

- If the μC sends a DONE signal back within the programmed timing window (t_{DRV}), the SGM855 deactivates the μC immediately.
- If no valid DONE signal is received within t_{DRV}, the SGM855 keeps the μC powered for the full duration of t_{DRV}, ensuring sustained operation until the timeout.

When configured in one-shot mode (with EN/ONE_SHOT pin set to low), the SGM855 outputs a DRV signal to drive the MOSFET only once.

Feature Description

The SGM855 enters timer mode or one-shot mode with different EN/ONE_SHOT voltage. The DELAY/M_DRV pin is used to determine the timer interval period (t_{IP}) in the startup procedure and manually power on the MOSFET by pulling high this pin to VDD.

DRV

The gate of the MOSFET is connected to the DRV pin. When DRV is set to low, the MOSFET is activated (turned on). The DRV pulse duration matches the programmed time interval minus a fixed 50ms. If a DONE signal is received from the μC before the remaining time (programmed interval minus 50ms) completes, the pulse ends early, immediately turning the MOSFET off. In the absence of a DONE signal within this adjusted timeframe, the DRV pin remains high for the final 50ms of the programmed interval, ensuring the MOSFET is fully turned off before the next cycle begins. The DRV pin defaults to high (MOSFET off) following resistance measurement in the beginning. The SGM855 initiates the DRV control signal at the start of each refreshed programmed time interval. Finally, manual power-on attempts are ignored while the DRV pin is low and the MOSFET is active.

DETAILED DESCRIPTION (continued)

DONE

The DONE is an input logic pin, and it is not allowed to be floating. And the SGM855 will recognize the rising edge of the DONE pulse. It is recommended to set the pulse width larger than 100ns. Besides, the SGM855 only recognizes the first DONE signal when multiple DONE signals are sent within one time interval of t_{IP}. Note that the DONE signal will not be recognized in the last 50ms of the current time interval. It is recommended that the DONE signal must be given at least 200ns after the DRV falling edge to ensure the chip can correctly identify the DONE signal.

If a valid DONE signal is recognized while the DRV is still asserted low, the DRV will go high as soon as possible.

Device Functional Modes

Startup

During startup, after power-on reset (POR), the SGM855 detects the resistance of the external resistor connected between DELAY/M_RST pin and GND only one time and convert it to time interval period (t_{IP}) within t_{R_EXT}. After the resistance reading procedure, the SGM855 enters the timer mode or one-shot mode by the EN/ONE_SHOT value. Wire EN/ONE_SHOT to either GND or VDD based on the desired mode of operation.

Timer Mode

In timer mode (EN/ONE_SHOT = high), the SGM855 generates periodic DRV pulses based on the programmed time interval. The duration of these DRV pulses is determined by receiving a DONE pulse from the µC. See Figure 4.

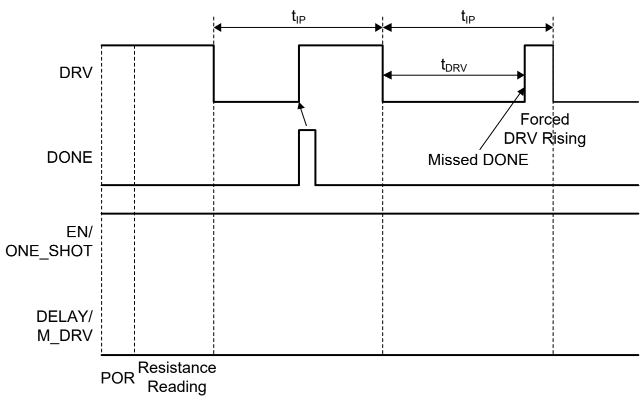


Figure 4. Startup Timer Mode

One-Shot Mode

During one-shot mode (EN/ONE_SHOT = low), the SGM855 pulls down the DRV pin only once. The pulse length is determined by when the DONE pulse is released from the µC (See Figure 5). If no DONE pulse is received, the DRV pin is released at the final 50ms (See Figure 6).

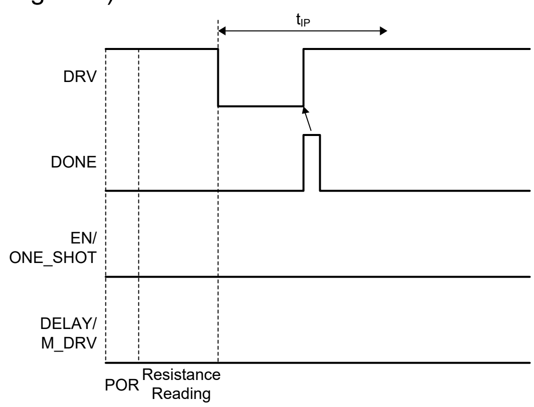


Figure 5. Startup One-Shot Mode (DONE Received within t_{IP})

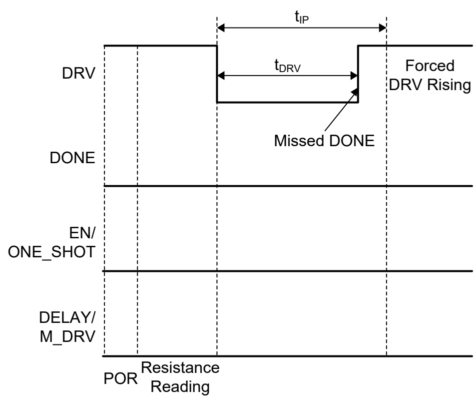


Figure 6. Startup One-Shot Mode (No DONE Received within t_{IP})

Programming

Configuring the Time Interval with the DELAY/M_DRV Pin

The time interval between two adjacent DRV pulses (measured at their falling edges in timer mode) is determined by an external resistance (R_{EXT}) connected between the DELAY/M_DRV pin and ground. This resistance must be selected within the range of 500Ω to 180kΩ, and a minimum 1% precision resistor is recommended for accuracy. It is not allowed to connect a capacitor to DELAY/M_RST pin. And it is also recommended that the trace between the resistor on DELAY/M_RST pin and GND is as short as possible.

DETAILED DESCRIPTION (continued)

Besides, other interfering signals should be kept far away for good detection. For detailed guidance on calculating and setting the time interval using R_{EXT}, refer to the Time Interval Period Programming through External Resistance section.

Manual MOSFET Power-On Applied to the DELAY/M_DRV Pin

When the DELAY/M_DRV pin is connected to VDD, the SGM855 detects this action as a manual MOSFET power-on condition, which bypasses the programmed time interval setting. If a manual power-on signal is applied during POR or during the resistance-reading procedure, the ongoing reading process is immediately abandoned and will restart only after the DELAY/M_DRV is released. A pulse on the DELAY/M_DRV pin is recognized as a valid manual power-on command only if it persists for a minimum of 20ms (with a 30ms observation window to confirm the validity of the signal). The manual power-on function can be implemented using a momentary-action switch for tactile or mechanical control.

If the DRV is already low (MOSFET on), the manual MOSFET power-on is ignored.

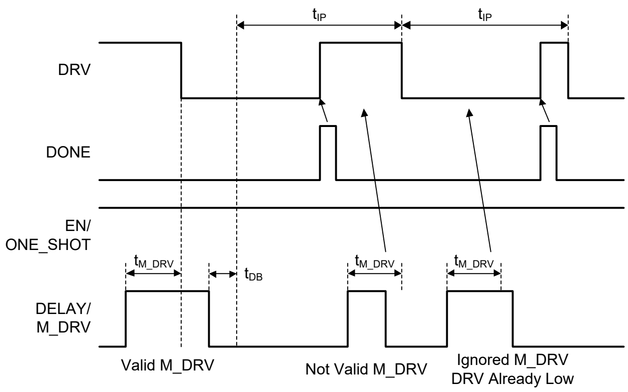


Figure 7. Manual MOSFET Power-On in Timer Mode

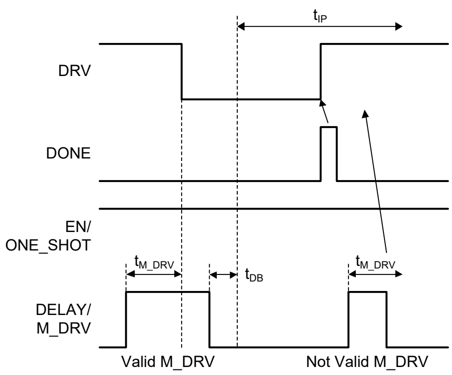


Figure 8. Manual MOSFET Power-On in One-Shot Mode

DELAY/M_DRV

Usually, R_{EXT} ranging from 500Ω to 180kΩ is recommended for the DELAY/M_DRV pin to configure t_{IP}. In the POR and resistance reading procedure, the DELAY/M_DRV pin is connected to an analog circuit by a mux. After that, the DELAY/M_DRV pin is cut off to a digital circuit.

When a logic high signal is applied to the DELAY/M_DRV pin, the SGM855 interprets this as a manual power-on command. The internal de-bounce circuitry, which is active on both rising and falling edges, ensures immunity to signal glitches on the DELAY/M_DRV input.

To be a valid DELAY/M_DRV, the high state must persist for over 20ms (with a 30ms observation window for validation). Once recognized, the DRV signal is asserted within the next 10ms, its duration determined by the programmed time interval minus 50ms, or truncated earlier if a DONE signal is received.

A valid manual power-on resets all internal counters, which restart only after the DELAY/M_DRV transitions back to low. However, due to the asynchronous nature of the manual input and its variable duration, the low state for DRV may exhibit ±5ms uncertainty. Prolonged assertion of high on DELAY/M_DRV forces the MOSFET on duration beyond the programmed interval. During this period, incoming DONE signals are ignored. Additionally, if the DRV is already low (indicating MOSFET active), subsequent manual power-on commands are suppressed until DRV returns to high.

Circuitry

The manual power-on is usually finished by a mechanical switch. There are two approaches to implement and the main difference is the current consumption.

When power efficiency is not the primary concern, a single-pole single-throw (SPST) switch configuration reduces costs. Here, the DELAY/M_DRV pin connects to VDD with a resistor R_{EXT}. The resulting power-on current sourced from VDD can be determined by dividing VDD by R_{EXT} (See Figure 9).

When the lower current consumption is more significant, take a single-pole double-throw (SPDT) switch is more suitable (See Figure 10).

DETAILED DESCRIPTION (continued)

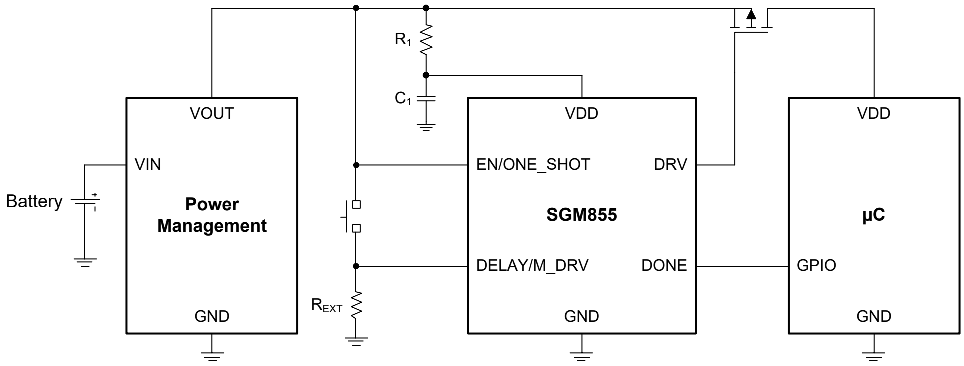


Figure 9. Manual MOSFET Power-On with SPST Switch

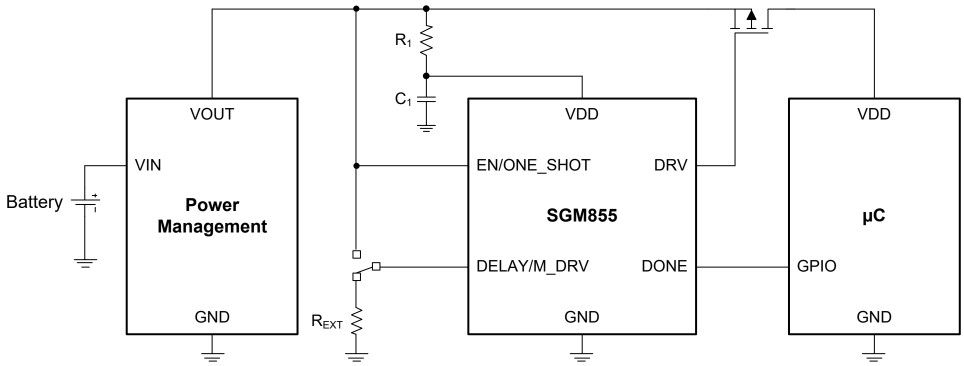


Figure 10. Manual MOSFET Power-On with SPDT Switch

Time Interval Period Programming through External Resistance

To set the time interval below 1 second, the external resistance R_{EXT} is selected according to Table 1.

Table 1. First 9 Time Intervals

t_{IP} (ms)	Resistance (kΩ)
100	0.5
200	1
300	1.5
400	2
500	2.5
600	3
700	3.5
800	4
900	4.5

To set the time interval over 1 second, the external resistance R_{EXT} is selected according to Equation 1.

$$R_{EXT} = 5.2 \times T^{0.3932} \quad (1)$$

Users can also calculate the time interval period through Equation 2 (the inverse function of Equation 1).

$$T = 0.0153 \times R_{EXT}^{\ 2.543} \quad (2)$$

where:

T is the desired time interval in seconds,

R_{EXT} is the resistance value in kΩ.

Figure 11 is provided to facilitate customers to estimate the R_{EXT}.

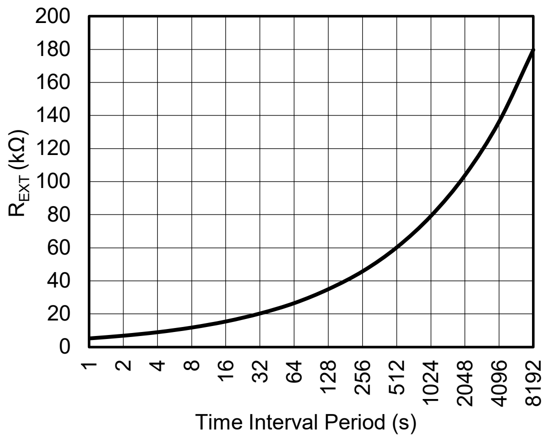


Figure 11. R_{EXT} vs. Time Interval Period

DETAILED DESCRIPTION (continued)

Time Interval Period Setting Error

The error of time interval period mainly consists of the following two parts: internal oscillator accuracy error and resistance detection error. It should be pointed out that this interval period setting error caused by the chip is discussed here, excluding the error caused by the external resistance. In order to reduce the error caused by external resistance, users should use high-precision resistance as much as possible. The examples below illustrate the procedure.

Example 1:

V_{DD} = 2.5V, T_J = +25℃, and the target time interval $t_{TARGET1}$ is 500ms. The required R_{EXT} is selected as 2.5kΩ according to Table 1.

Because the first 9 intervals are discrete intervals by multiples of 100ms, the resistance detecting tolerance is wide and can be neglected. The oscillator accuracy is ±1% (If reliability drift is included, the accuracy is 2.1%), therefore, when R_{EXT} is 0.5kΩ, the actual time interval is:

$$500 \times (1-1\%) \le t_{IP}(ms) \le 500 \times (1+1\%)$$

$$495 \le t_{IP}(ms) \le 505 \tag{3}$$

Example 2:

V_{DD} = 2.5V, T_J = +25℃, and the target time interval $t_{TARGET2}$ is 120s. The required R_{EXT} is calculated as 34kΩ according to Equation 1.

The resistance detection accuracy according to the Electrical Characteristics table is ±2.6% approximately (If reliability drift is included, the accuracy is 3.5%), the approximate t_{IP} range excluding oscillator accuracy is:

$$0.0153 \times \left[34 \times (1-2.6\%)\right]^{2.543} \le t_{IP}(s)$$

$$\le 0.0153 \times \left[34 \times (1+2.6\%)\right]^{2.543}$$

$$112.2 \le t_{IP}(s) \le 128.1 \tag{4}$$

The oscillator accuracy is ±1%, so the final approximate t_{IP} range is:

$$112.2 \times (1-1\%) \le t_{IP}(s) \le 128.1 \times (1+1.1\%)$$

$$111.1 \le t_{IP}(s) \le 129.4 \tag{5}$$

APPLICATION INFORMATION

In battery-powered systems, minimizing current consumption is critical. The SGM855 is specifically designed for periodic environmental monitoring applications. In these applications, conventional solutions often rely on a μC's watchdog or internal timers for wake-up functions, where those components typically exhibit suboptimal power efficiency. By implementing periodic power gating of the μC or the entire system via the SGM855, the overall supply current can be reduced to mere tens of nA during inactive periods.

Typical Application

The SGM855 is ideal for low-power sensor nodes (e.g., humidity and temperature monitoring) requiring infrequent data transmission. In home environments, where temperature changes slowly, measurements and data transfers can be executed at very low rates (e.g., every 30 seconds). The SGM855 enables full shutdown of the RF microcontroller during inactive periods, dramatically extending battery life compared to traditional designs.

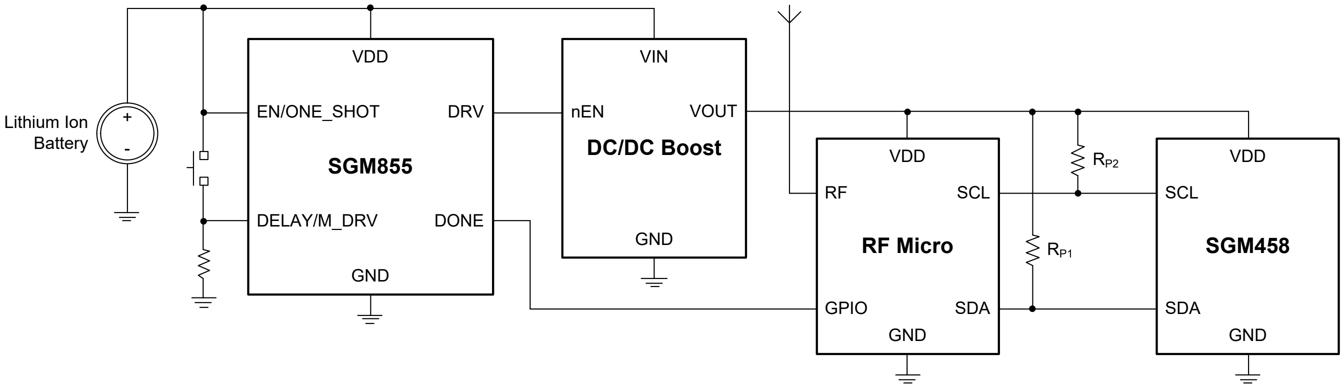


Figure 12. Sensor Node

Design Requirements

The primary focus for design is minimizing power consumption to extend battery life to years, leveraging the capability of SGM855 to fully shut down the RF microcontroller during inactive periods. Since environmental data (e.g., temperature/humidity) only requires 30s to 60s sampling intervals, this "deep-off" mode eliminates standby currents, making the SGM855 indispensable for ultra-low power IoT applications.

Detailed Design Procedure

Under strict battery-life constraints, the design mandates the use of ultra-low power voltage regulators and low-leakage MOSFETs to enable precise μC power gating. The initial design phase requires a detailed power-consumption analysis across all operational modes of each component. For instance, the sensor measurement mode activates the RF microcontroller for normal operation and data transmission. By strategically selecting the duration of each operational mode and balancing measurement or transmission intervals (e.g., 30s to 60s) with extended low-power states, the system can adhere to application requirements while maximizing battery longevity.

Application Curve

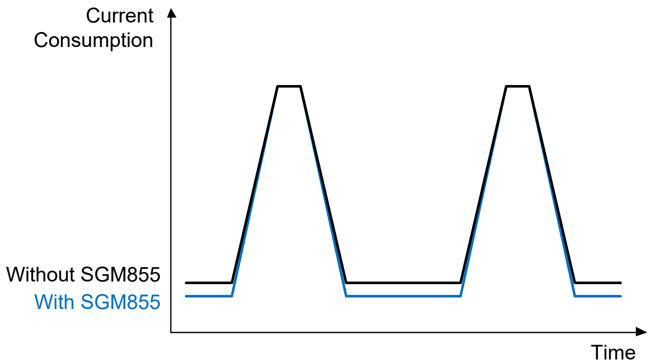


Figure 13. Effect of SGM855 on Current Consumption

Power Supply Recommendations

The SGM855 requires a voltage supply within 1.8V and 5.5V. To immune the power supply noise, an RC low-pass filter is strongly recommended as Figure 1 shows. The recommended resistance value is 10Ω, and the ceramic X7R capacitor value is 1μF.

APPLICATION INFORMATION (continued)

Layout

It is not allowed to connect a capacitor to DELAY/M_RST pin. Because of the DELAY/M_DRV pin is sensitive to parasitic capacitance when detecting the resistance, it is recommended that the trace between the external resistor on this pin and GND track is as short as possible.

Make sure that the DRV pin of SGM855 is close to the gate of the MOSFET in order to reduce the parasitic capacitance and improve the signal integrity.

Keep EN/ONE_SHOT trace as close as possible to VDD or GND.

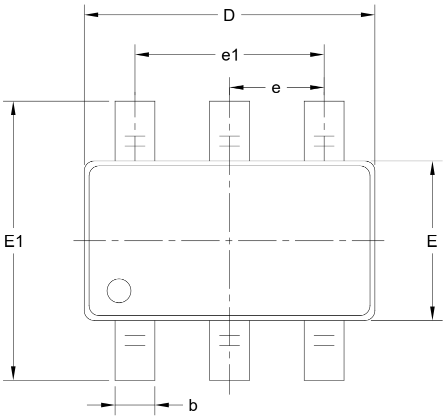
REVISION HISTORY

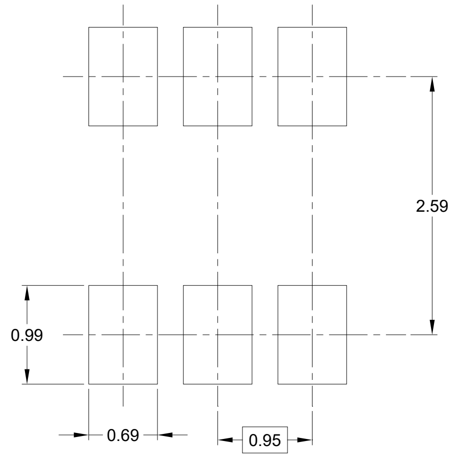
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Original (APRIL 2025) to REV.A	Page
Changed from product preview to production data	All

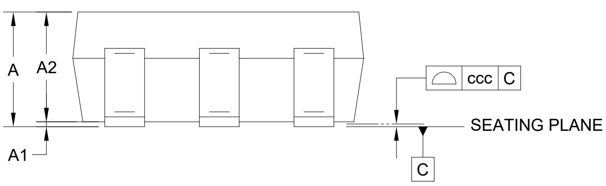
PACKAGE OUTLINE DIMENSIONS

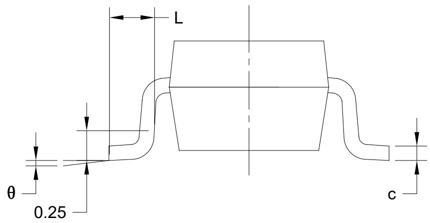
SOT-23-6





RECOMMENDED LAND PATTERN (Unit: mm)



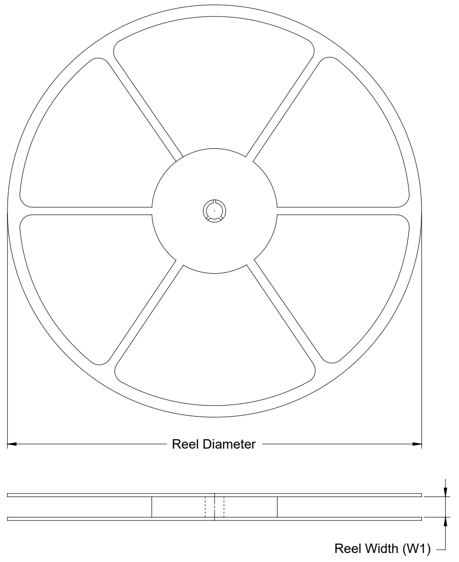


Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	-	-	1.450
A1	0.000	-	0.150
A2	0.900	-	1.300
b	0.300	-	0.500
c	0.080	-	0.220
D	2.750	-	3.050
E	1.450	-	1.750
E1	2.600	-	3.000
e	0.950 BSC		
e1	1.900 BSC		
L	0.300	-	0.600
θ	0°	-	8°
ccc	0.100		

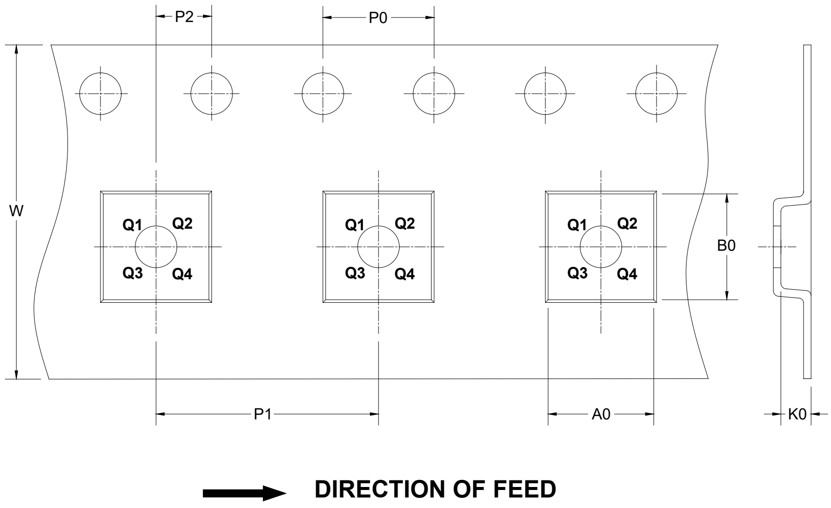
NOTES:
1. This drawing is subject to change without notice.
2. The dimensions do not include mold flashes, protrusions or gate burrs.
3. Reference JEDEC MO-178.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



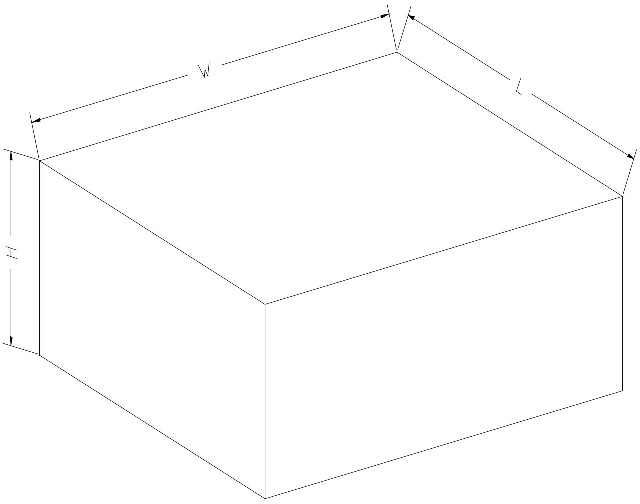
NOTE: The picture is only for reference. Please make the object as the standard.

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
SOT-23-6	7"	9.5	3.23	3.17	1.37	4.0	4.0	2.0	8.0	Q3

DD0001

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
7″ (Option)	368	227	224	8
7″	442	410	224	18

DD0002