

### GENERAL DESCRIPTION

The SGM457 is a low power, low supply voltage, SOT package, serial control interface and digital output temperature sensor with an accuracy of  $\pm 0.5^{\circ}\text{C}$  (TYP) in the temperature range of  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ . I<sup>2</sup>C interface is used to communicate with SGM457. Multiple device access instruction is used in this serial bus, so multiple SGM457 devices (up to four) can share one serial bus. The micro-controller will communicate with these devices on the bus without sending separate instructions which increases the efficiency of software. In multiple hot points monitoring systems such as computing platform, the design can be realized by connecting one serial bus with multiple temperature sensors.

The SGM457 is available in a Green SOT-563-6 package and operates over an ambient temperature range of  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ .

### FEATURES

- 1.6V to 5.5V Supply Voltage Range
- Temperature Accuracy:  
-40°C to +125°C:  $\pm 2^{\circ}\text{C}$  (MAX)
- Operating Supply Current: 14 $\mu\text{A}$  (TYP)
- Shutdown Mode Current: 0.5 $\mu\text{A}$  (TYP)
- Resolution: 12 Bits
- Serial Control Bus is Compatible with Two-Wire, I<sup>2</sup>C
- Available in a Green SOT-563-6 Package

### APPLICATIONS

- Smart Phone
- Temperature Monitor in Computing Platform
- Industrial Control
- Temperature Monitor in Power System

### TYPICAL APPLICATION

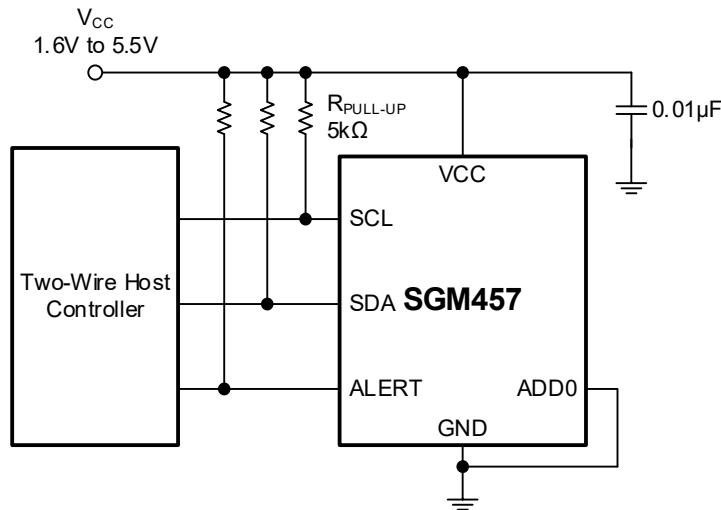
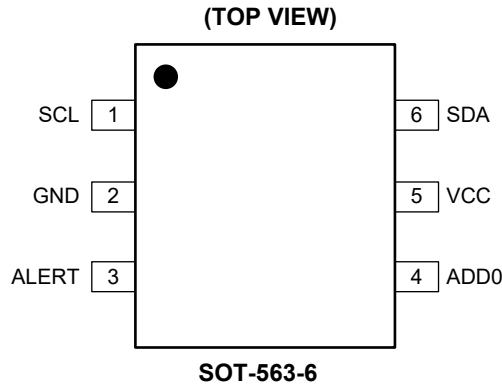


Figure 1. Typical Application Circuit



**PIN CONFIGURATION**



**PIN DESCRIPTION**

PIN	NAME	I/O	FUNCTION
1	SCL	I	Clock Input Pin. Open-drain output. Pull up a 5kΩ resistor to VCC.
2	GND	—	Ground.
3	ALERT	O	Over-Temperature Alert Pin. Open-drain output. Pull up a 5kΩ resistor to VCC.
4	ADD0	I	Address Selecting Pin. ADD0 has four connection ways, as shown in Table 3.
5	VCC	I	Power Supply Pin.
6	SDA	I/O	Data Input/Output Pin. Open-drain output. Pull up a 5kΩ resistor to VCC.

NOTE: I: Input; O: Output.

**FUNCTIONAL BLOCK DIAGRAM**

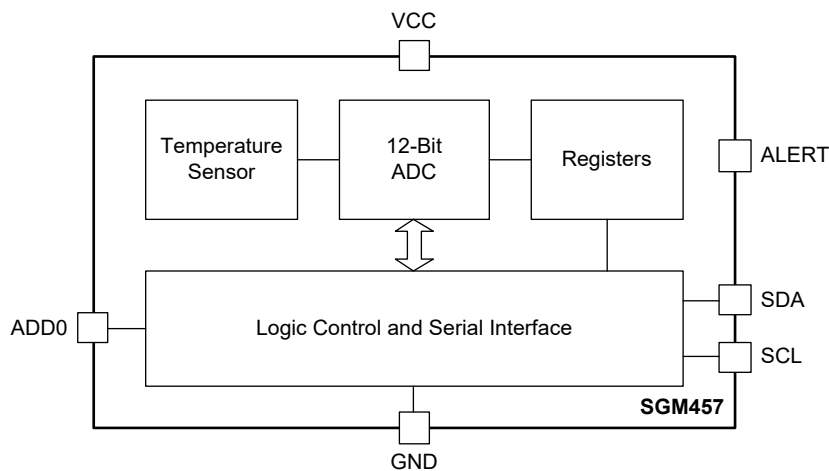


Figure 2. Functional Block Diagram

**ELECTRICAL CHARACTERISTICS**(V<sub>CC</sub> = 1.6V to 5.5V, T<sub>A</sub> = -40°C to +125°C, typical values are measured at T<sub>A</sub> = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
<b>Temperature Input</b>						
Range			-40		+125	°C
Accuracy (Temperature Error)		V <sub>CC</sub> = 3.3V	-2	±0.5	2	°C
vs. Supply				0.5	1	°C/V
Resolution				0.0625		°C
<b>Digital Input/Output</b>						
Input Capacitance				3		pF
Input Logic High	V <sub>IH</sub>		0.7 × V <sub>CC</sub>			V
Input Logic Low	V <sub>IL</sub>				0.3 × V <sub>CC</sub>	V
Input Current	I <sub>IN</sub>	0 < V <sub>IN</sub> < 5.5V	-1.0		1.0	μA
Output Logic	V <sub>OL</sub>	SDA, ALERT, I <sub>OL</sub> = 3mA		0.01	0.3	V
Resolution				12		Bits
Conversion Time				13	17	ms
Conversion Modes		CR1 = 0, CR0 = 0		0.25		Conv/s
		CR1 = 0, CR0 = 1		1		
		CR1 = 1, CR0 = 0 (default)		4		
		CR1 = 1, CR0 = 1		8		
Timeout Time		V <sub>CC</sub> = 3.3V		30	36	ms
<b>Power Supply</b>						
Operating Supply Range			1.6		5.5	V
Average Quiescent Current	I <sub>Q</sub>	Serial bus inactive, CR1 = 1, CR0 = 0 (default)		14	25	μA
Shutdown Current	I <sub>SD</sub>	Serial bus inactive		0.4	2.5	μA
<b>Temperature</b>						
Specified Range			-40		+125	°C
Operating Range			-55		+150	°C

**TIMING REQUIREMENTS**

PARAMETER	SYMBOL	FAST MODE			HIGH-SPEED MODE			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	
SCL Operating Frequency, VCC	$f_{SCL}$	0.001		0.4	0.001		2.85	MHz
Bus Free Time between STOP and START Condition	$t_{BUF}$	600			160			ns
Hold Time after Repeated START Condition (After this period, the first clock is generated.)	$t_{HDSTA}$	600			160			ns
Repeated START Condition Setup Time	$t_{SUSTA}$	600			160			ns
STOP Condition Setup Time	$t_{SUSTO}$	600			160			ns
Data Hold Time	$t_{HDDAT}$	100		900	25		105	ns
Data Setup Time	$t_{SUDAT}$	100			25			ns
SCL Clock Low Period, VCC	$t_{LOW}$	1300			210			ns
SCL Clock High Period	$t_{HIGH}$	600			60			ns
Data Fall Time	$t_{FD}$			300			80	ns
Data Rise Time	$t_{RD}$			300				ns
Data Rise Time, $SCLK \leq 100kHz$				1000				ns
Clock Fall Time	$t_{FC}$			300			40	ns
Clock Rise Time	$t_{RC}$			300			40	ns

NOTE:

1. The above values are measured with one time, which means that the maximum and minimum of the results are not provided.

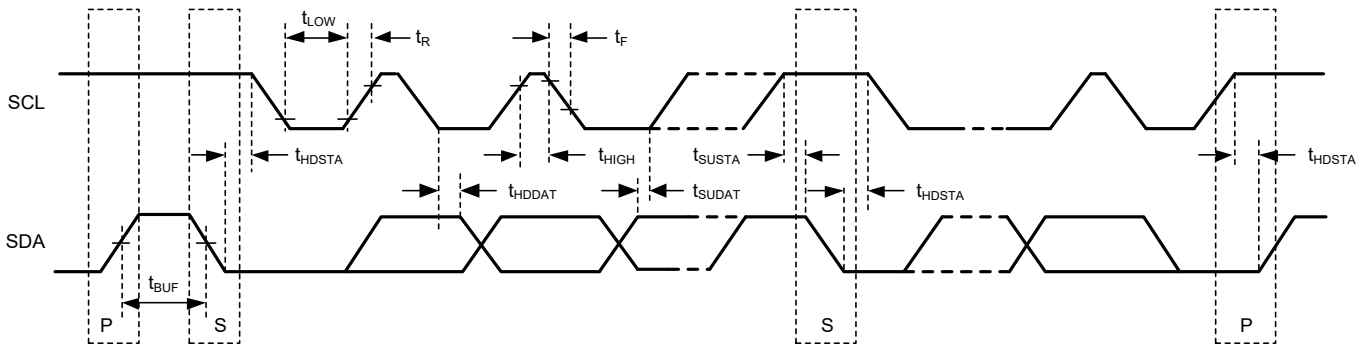


Figure 3. Two-Wire Timing Diagram

Figure 3 to Figure 5 illustrate how the I<sup>2</sup>C works for the digital output of SGM457. The bus definition of Figure 3 is shown as below:

**Bus Idle:** SDA and SCL are in high position in this mode.

**Start Data Transfer:** When SCL remains in high position and SDA changes from high to low, a START condition occurs. The transmission should always be launched with a START condition.

**Stop Data Transfer:** When SCL remains in high position and SDA changes from low to high, a STOP condition occurs. The transmission should always be finished with a STOP condition.

**Data Transfer:** The data bytes transferred between START and STOP condition are determined by the master device. The SGM457 can also update single byte. If users only update the MS byte, send a START or STOP signal on the bus to terminate the communication.

**Acknowledge:** The acknowledge signal should be generated to guarantee that the receiving device is addressed. The SDA should be pulled low for the entire clock pulse of SCL during the acknowledge time. Both the data hold time and data setup time should also be considered. If the master is a receiving in this case, the receiver can also send a not-acknowledge pulse on the last byte.

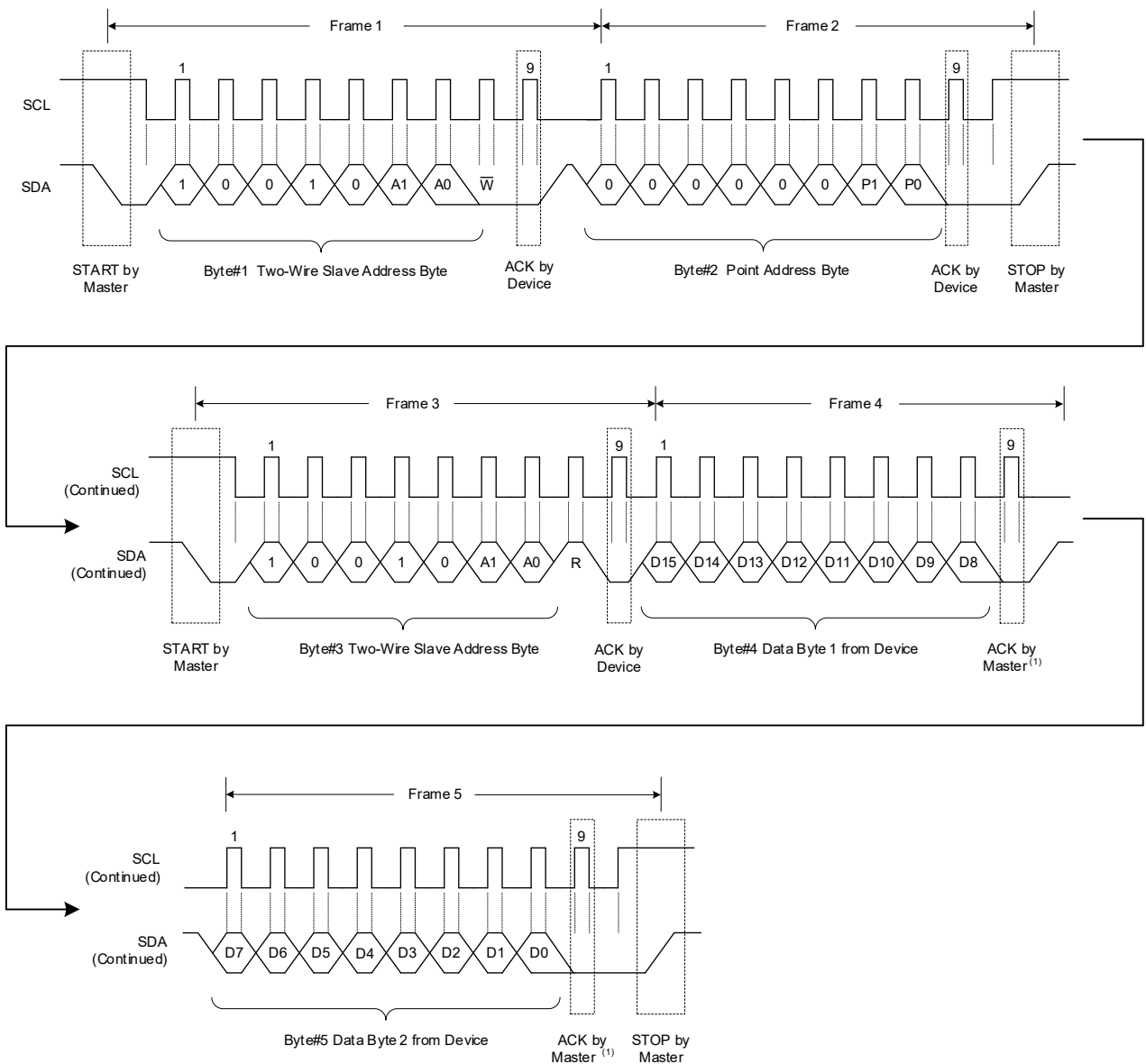
SERIAL INTERFACE

Table 1. The First Byte after START (Address of Slave Device)

MSB							LSB
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
1	0	0	1	0	A1	A0	R/ $\bar{W}$

NOTES:

1. R: read,  $\bar{W}$ : write.
2. ACK: acknowledge, NACK: not acknowledge.
3. The ADD0 pin determines the values of A0 and A1.



NOTE:

1. If master want to terminate a single-byte or two-byte read operation, leave SDA high.

Figure 4. Register Read Word Format

SERIAL INTERFACE (continued)

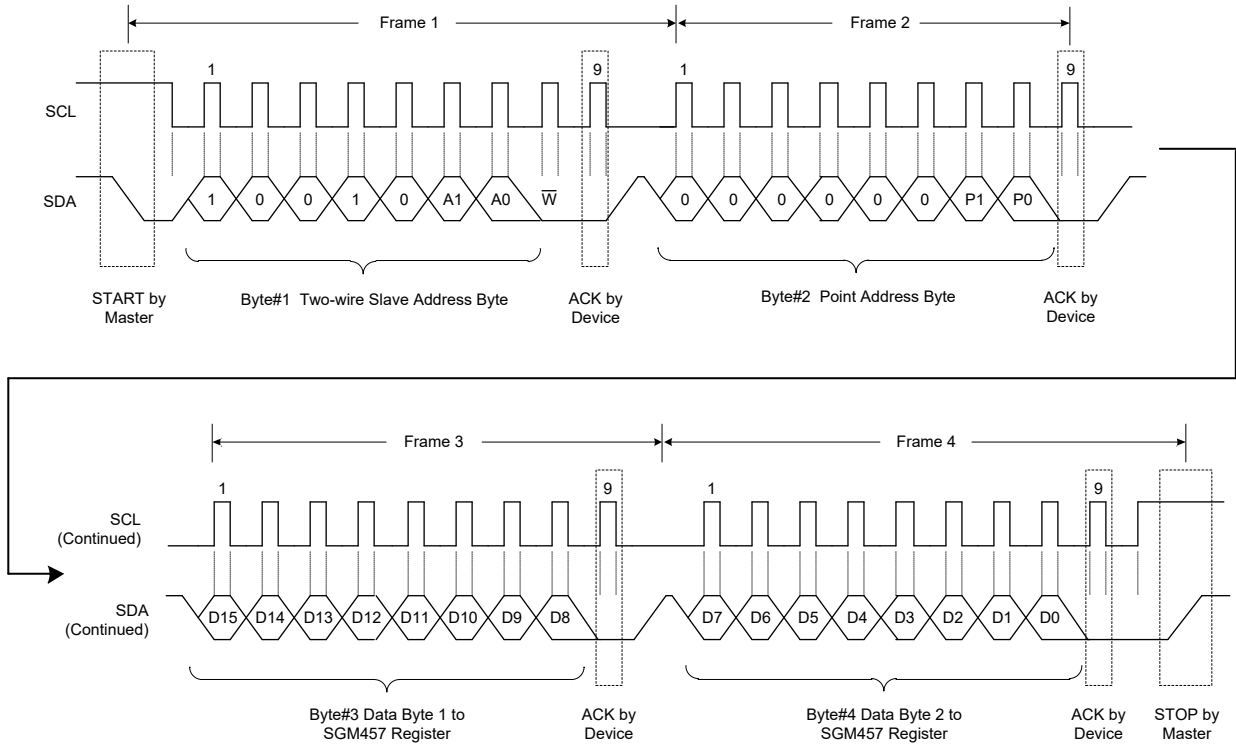
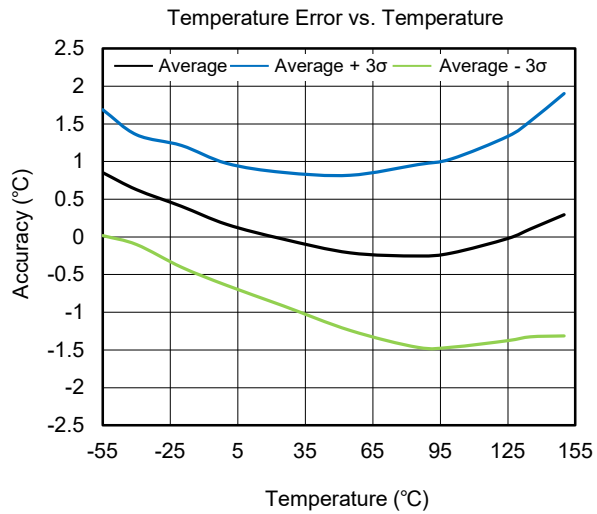
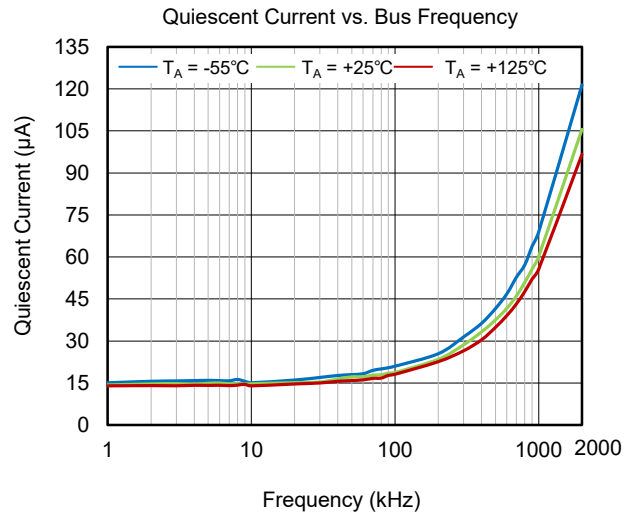
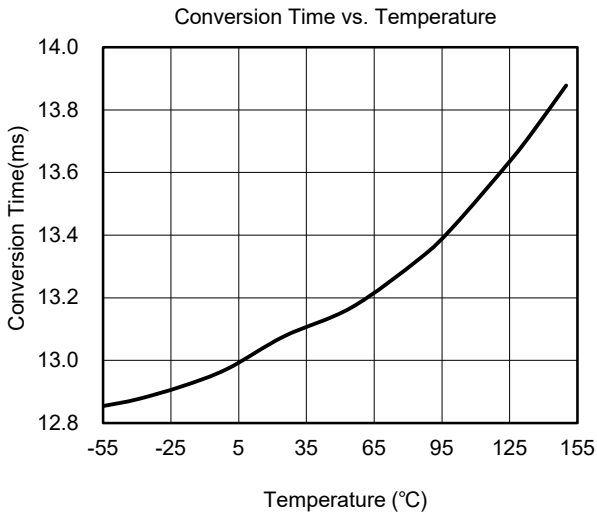
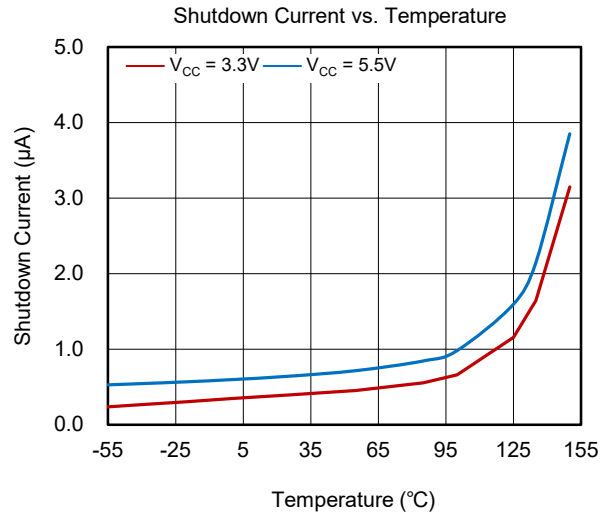
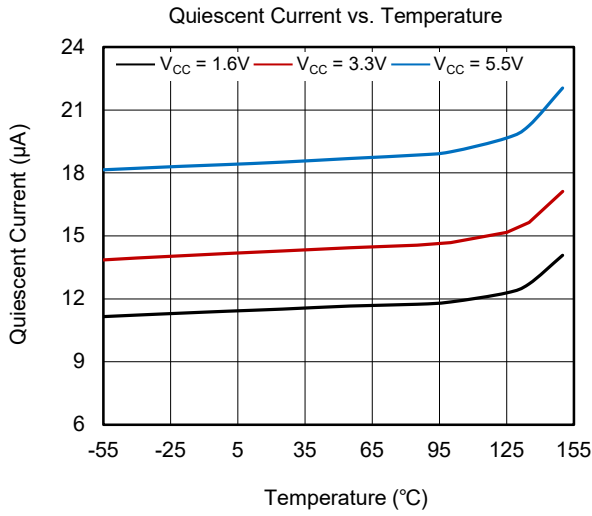


Figure 5. Register Write Word Format

TYPICAL PERFORMANCE CHARACTERISTICS





## DETAILED DESCRIPTION

### Overview

The SGM457 device is a digital temperature sensor that has excellent performance for thermal protection and control applications. The two-wire control interface of SGM457 is compatible with I<sup>2</sup>C bus. The operating temperature range of the SGM457 is from -40°C to +125°C.

The temperature diode sensor is integrated into the SGM457 device, and the thermal paths are provided by the package leads and the plastic package. Due to the low thermal resistance of metals, the package leads provide the main thermal path.

### Writing and Reading Operation

In order to access the specified pointer register of SGM457, it is necessary to send the values of the desired pointer register after addressing the slave device. As already illustrates in Figure 3, the values of pointer register are required after each write command. If the master device desires to read the information of the specified register, a write command must be sent by the master at first to indicate which pointer register is needed. First, the slave address should be sent with the low state of R/ $\bar{W}$ , followed by the address of the pointer address. Second, the STARhould be sent by the master (the slave address of the specified SGM457), and then followed with the high state of R/ $\bar{W}$  to indicate a read command (Figure 4). For the condition of repeated reading, it is not required for sending the bytes of pointer register again, unless the device is reset or the address of pointer register is altered by the write command. It is unnecessary to repeatedly send the Pointer Register values to the slave when the same register continuously reads. Because the Pointer Register will remain the previous value if there is no write command to Pointer Register.

### Slave Mode Operations

The SGM457 can also transmit or receive the data under read or write condition. The device cannot drive the SCL signal when used as a slave device.

#### Slave Receiver Mode

When the slave is desired to receive the data, the master will firstly send a slave address to the slave, followed by the R/ $\bar{W}$  bit low. After transmitting the

slave address, the slave (SGM457) will pull SDA low to indicate an acknowledgement. Then, the address of pointer register is sent by the master and an acknowledgement signal is also required for the slave device. In addition, the data is written to the addressing pointer register, and followed by the acknowledgement signal from the slave device. If the master wants to stop the transmission, a START or STOP command is required.

#### Slave Transmitter Mode

The R/ $\bar{W}$  is pulled high after the slave address is transmitted by the master device, followed by an acknowledgement of the slave. Then, the data is transmitted by the specified pointer register of the slave device, followed by the acknowledgement of the master. In addition, if the master wants to stop the transmission, it can generate a not-acknowledge command or generate a START or STOP command to terminate the transmission.

### General Call

The SGM457 also supports a general call address (0000000) when the eighth bit is low. After receiving an acknowledgement signal from the slave device, the master prepares to send a second byte to the device. In this case, if the second byte is 00000110, the slave device (SGM457) will go into power-up mode and reset all registers. However, the SGM457 cannot acquire an address for general call from the master device.

### High-Speed (HS) Mode

If the transmission frequency is greater than 400kHz, in order to make the SGM457 work in high-speed mode, the byte that is 00001xxx must be transmitted after the START condition by the master. However, the SGM457 does not need to generate an acknowledge byte, but the input and output filters can be adjusted accordingly (up to 2.85MHz) to make SGM457 operate in high-speed mode. After the high-speed byte is transmitted, the master will transmit a START command, followed by the slave address to the SGM457. In addition, the high-speed mode will stop once the STOP command is transmitted from the master, and the input and output filters of SGM457 will be switched to the default mode.

**DETAILED DESCRIPTION (continued)**

**Timeout Function**

If the SCL line is pulled low by 30ms, it means that the SGM457 will perform reset mode. Under this condition, the bus is released by SGM457 and then another START function is required for operation. To prevent the device goes into the timeout function, the operation frequency of the SCL should be greater than or equal to 1kHz.

**Programming**

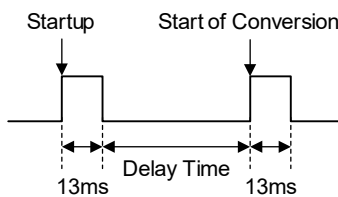
**Conversion Rate (CR)**

The value of CR1 and CR0 that are located in the corresponding register to adjust the SGM457 device conversion rates of 0.25Hz, 1Hz, 4Hz, or 8Hz. The default rate is 4Hz. For more details on the conversion rate bits, refer to Table 2.

**Table 2. Conversion Rate Settings**

CR1	CR0	Conversion Rate
0	0	0.25Hz
0	1	1Hz
1	0	4Hz (default)
1	1	8Hz

The startup conversion is taken placed immediately as the power-up or general-call reset. For the first result of the conversion, it should be after 13ms. For the active mode, the quiescent current for the conversion is 200µA (typical at +25°C, V<sub>CC</sub> = 3.3V). For the delay mode, the quiescent current in this period is just 3.2µA (typical at +25°C, V<sub>CC</sub> = 3.3V).



**Figure 6. Conversion Start**

**Shutdown Mode (SD)**

Low power shutdown mode is activated when the SD bit is 1 in the configuration register. This mode saves power obviously by shutting down most of the circuitry of SGM457. When SD is set to 0, the SGM457 will enter a continuous mode.

**One-Shot/Conversion Ready (OS)**

The SGM457 device can be configured to one-shot mode, which is used to minimize the power consumption when continuous temperature detection is unnecessary. When the SGM457 is in shutdown mode, users can configure the OS bit to 1 to start a one-shot temperature measurement. The OS bit remains 0 until the conversion is completed. After the single measurement, the OS bit will read 1 and the device will enter to shutdown mode. The OS bit is also a flag to indicate whether this conversion is completed.

The single conversion time is 13ms in normal operation and the time for a single temperature reading will not exceed 20µs, which means that a higher conversion rate can be obtained because there is no additional delay. The conversion rate can reach 60Hz or more in this mode.

**Continuous-Conversion Mode**

The continues-conversion mode is that the sigma-delta ADC of the SGM457 device converts the analog data to digital data and with a constant conversion rate. If the default value of SD bit in configuration register is 0, the SGM457 will enter a continuous mode. Users can set the value of CR1 and CR0 that are located in the corresponding register to achieve different conversion rates. Typically, the conversion rate for SGM457 is 4Hz. If the users desire to set a different conversion rate, the single conversion will be achieved first, and then the device will be powered down to wait the appropriate CR1 and CR0.

**Extended Mode (EM)**

The extended-mode bit can be set to obtain different work mode in SGM457. The default mode is normal mode (EM = 0), in which the data of the temperature register and high-limit and low-limit registers are 12-bit data format. Users can replace the SGM457 with the SGM452 in normal mode.

The Extended mode (EM = 1) is used for applications with temperatures exceeding +128°C. In this mode, the data format for related temperature register is 13 bits.

**DETAILED DESCRIPTION (continued)****Thermostat Mode (TM)**

The thermostat-mode bit can be set to two different modes, the comparator mode (TM = 0) or interrupt mode (TM = 1). For detail description, refer to the High-Limit and Low-Limit Registers section.

**Comparator Mode (TM = 0):**

For the comparator mode (TM = 0), the ALERT pin is pulled to active if the measured temperature equals to or higher than  $T_{HIGH}$  value. The ALERT pin is changed to inactive status when temperature is lower than  $T_{LOW}$  value.

**Interrupt Mode (TM = 1):**

For the interrupt mode (TM = 1), the ALERT pin will change to an active state if the measured temperature is higher than  $T_{HIGH}$ , or lower than  $T_{LOW}$ , and the active status will be cleared when any register is read.

**Bus Overview**

The device which can send the command to the target register is called master and the device which can be controlled by the master is called slave. The master device can generate the clock signal to the slave in order to control it with SCL and SDA lines.

Send a specific address to start the slave, the SDA signal will be pulled from high to low while SCL is still in high state. For the slaves connected to the bus, at the CLK rising edge, the slaves start to be addressed by the master, and followed by a READ or WRITE bit. For the ninth bit of the transmission signal, if SDA is pulled low, the slave acknowledges the transmission, in which case the slave is being addressed.

In one word, for the data transfer process, the initial signal will indicate a start state, and then followed by eight clock pulsed and an acknowledge signal. However, the stability of SDA signal should be guaranteed when SCL is high, otherwise it will be

mistaken for START or STOP mode. After the transmission completes, the signal of SDA will change from low to high when SCL is high.

**Serial Interface**

On the two-wire bus, the SGM457 can work as a slave device, which is controlled by the master. When connecting to the bus, both SDA and SCL pins are connected through the topology of open-drain. In addition, in order to improve the performance of slave devices under the condition of input peak value and noise bus, filter and Schmitt flip-flop are adopted. There are two modes of transmission protocol: fast mode (1kHz to 400kHz) and high-speed mode (1kHz to 2.85MHz). MSB is the first bit to be transferred when transmitting a byte.

**Serial Bus Address**

For the definition of I<sup>2</sup>C communication, before sending data, the master device should address the specified slave device. There are seven bits for the address of the slave device and another one bit is for the command of reading or writing.

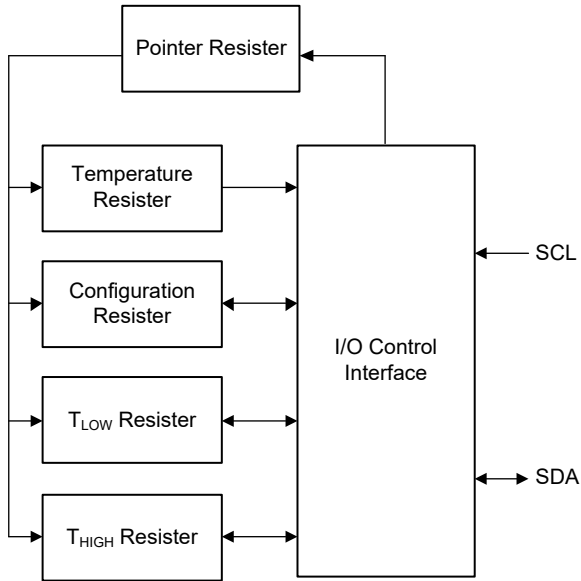
The SGM457 has four different slave addresses as shown in Table 3. For the function of the address, it can use to indicate the location or designator of temperature for four different connected slave SGM457s.

**Table 3. Different Slave Addresses of Address Pin**

Slave Address	ADD0 Pin Connection
1001000	Ground
1001001	VCC
1001010	SDA
1001011	SCL

**REGISTER DESCRIPTION**

Figure 7 shows the register structure of the SGM457 device. The SGM457 contains four data registers and an extra pointer register. The point register can be set to different value (shown in Table 7) to select internal register for communication. Table 6 indicates the bits of the pointer register byte. The power-up default value of P0, P1 is 00, which means that SGM457 can also read the temperature register after the device power-up.



**Figure 7. Internal Register Structure**

**Temperature Register**

The digital output of each temperature measurement is stored in the read-only temperature register. The temperature register of the SGM457 device can be set to two modes, 12-bit resolution mode (configuration register EM bit = 0, refer to the Extended Mode (EM) section) or 13-bit resolution mode (configuration register EM bit = 1). The digital output data consists of two bytes as shown in Table 8 and Table 9. Byte 1 is the most significant byte, followed by byte 2, the least significant byte. The first 12 bits (13 bits in EM) are read to acquire temperature data. The LSB data can be ignored in those applications with low temperature accuracy. The temperature data format is indicated in Table 4.

**Table 4. 12-Bit Temperature Data Format**

Temperature (°C)	Digital Output (Binary)	Hex
+128	011111111111	7FF
+127.9375	011111111111	7FF
+100	011001000000	640
+80	010100000000	500
+75	010010110000	4B0
+50	001100100000	320
+25	000110010000	190
+0.25	00000000100	004
0	000000000000	000
-0.25	11111111100	FFC
-25	111001110000	E70
-55	110010010000	C90

One LSB equals to 0.0625°C. Negative numbers are expressed by binary complement format. The power-up or reset default value of temperature register is 0x00 until the first conversion is completed. In normal mode (EM bit = 0), the first 12 bits are used to store temperature data, the last 4 bits are 0. In extended mode (EM bit = 1), the first 13 bits are used to store temperature data, the last 3 bits are 0, and this is the difference between the two modes.

For converting the positive temperature to the corresponding digital data:

1. The result of the temperature should be divided by the LSB of the temperature.
2. Convert the decimal value to binary value.

For example:  $(50^{\circ}\text{C}) / (0.0625^{\circ}\text{C}/\text{LSB}) = 800 = 320\text{h} = 001100100000$

For converting the digital value to the corresponding temperature:

1. Convert the 12-bit digital signal to the corresponding decimal value, and MSB = 0 means that the corresponding temperature is a positive value.
2. The result of decimal value should be multiplied by the LSB to get the corresponding temperature.

For example:  $001100100000 = 320\text{h} = 800 \times (0.0625^{\circ}\text{C}/\text{LSB}) = 50^{\circ}\text{C}$

**REGISTER DESCRIPTION (continued)**

For converting the negative temperature to the corresponding digital data:

1. The result of the absolute temperature should be divided by the LSB of the temperature.
2. The value of two's complement format can be obtained by obtaining the complementary of the result digital value and adding 1. Note that a negative number with MSB = 1.

For example:  $(|-25^{\circ}\text{C}|)/(0.0625^{\circ}\text{C}/\text{LSB}) = 400 = 190\text{h} = 000110010000$

Two's complement format:  $111001101111 + 1 = 111001110000$ .

For converting the negative digital value to the corresponding temperature:

1. Convert data to complement format (by reversing the digital value then adding 1)
2. Convert the complement format binary data to decimal number and multiply by the LSB ( $0.0625^{\circ}\text{C}$ ), then the decimal number should be multiplied by -1.

For example:  $111001110000$  has two's compliment of  $000110010000 = 000110001111 + 1$

Convert to temperature:  $000110010000 = 190\text{h} = 400$ ;  
 $400 \times (0.0625^{\circ}\text{C}/\text{LSB}) = 25^{\circ}\text{C} = (|-25^{\circ}\text{C}|); (|-25^{\circ}\text{C}|) \times (-1) = -25^{\circ}\text{C}$

**Table 5. 13-Bit Temperature Data Format**

Temperature (°C)	Digital Output (Binary)	Hex
+150	0100101100000	0960
+128	0100000000000	0800
+127.9375	0011111111111	07FF
+100	0011001000000	0640
+80	0010100000000	0500
+75	0010010110000	04B0
+50	0001100100000	0320
+25	0000110010000	0190
+0.25	000000000100	0004
0	0000000000000	0000
-0.25	1111111111100	1FFC
-25	1111001110000	1E70
-55	1110010010000	1C90

**Configuration Register**

The configuration register is composed of two bytes as indicated in Table 10 and Table 11. The bits D[3:0] of byte 2 remain 0. The bits D[7:4] and the byte 1 are functional bits to control the working mode of the SGM457 device. Due to the the same format for Configuration Register, the SGM457 are compatible with the SGM452. All registers are updated based on MSB first and then LSB.

**Converter Resolution (R1/R0)**

The read-only bits, R1 and R0, are used to indicate the converter resolution. After power-up or reset of the device, R1 = 1, R0 = 1, represents that the resolution is 12 bits.

**One-Shot (OS)**

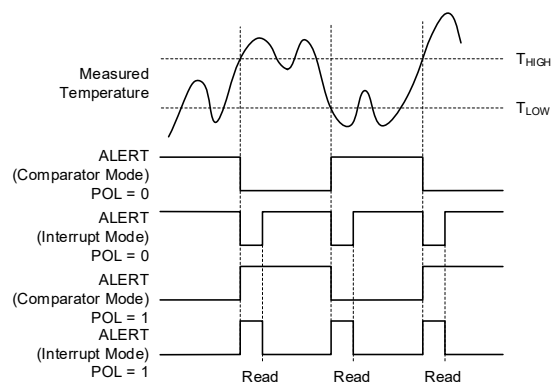
Refer to the One-Shot/Conversion Ready (OS) section for more details.

**EM Bit**

Refer to the Extended Mode (EM) section for more details.

**Alert (AL Bit)**

The AL bit is read only. The comparator mode status can be obtained by accessing the AL bit. The POL bit can control the data polarity of the AL bit. When the POL bit value is 0, the AL bit value is changed from 1 to 0 once the temperature equals to or is higher than  $T_{\text{HIGH}}$  for the serial number of programmed faults. The AL bit keeps 0 until the temperature is lower than  $T_{\text{LOW}}$  for the serial number of programmed faults, when its value is 1 again. The status of the TM bit has no influence on the status of the AL bit.



**Figure 8. Output Transfer Function Diagrams**

**REGISTER DESCRIPTION (continued)**

**High-Limit and Low-Limit Registers**

The upper threshold or lower threshold of temperature is saved in  $T_{HIGH}$  and  $T_{LOW}$  registers. After measuring the temperature, the device will compare the result value with two thresholds to check if it exceeds the limitation. The result will affect configuration register TM bit to operate ALERT pin as a comparator output or interrupt.

For the compared mode ( $TM = 0$ ), the ALERT pin is set to active if the measured temperature equals to or higher than  $T_{HIGH}$ . And it also produces a serial number of faults based on status of F1 and F0 fault bits. The ALERT pin is changed to inactive status when temperature is lower than  $T_{LOW}$  value for the same number of faults.

For the interrupt mode ( $TM = 1$ ), the ALERT pin is set to active (as presented in Table 2) if the measured temperature equals to or higher than  $T_{HIGH}$  or a serial

number of faults are produced. The ALERT pin is changed to inactive status when register is read. The ALERT pin is reset for the shutdown mode. After the ALERT pin is reset, pin status is active again only when temperature is lower than  $T_{LOW}$  value, but pin status is changed to inactive once register is read. When the ALERT pin is reset, the above cycle repeats, with the ALERT pin is set to active if the measured temperature equals to or higher than  $T_{HIGH}$ . General call reset command also can reset the ALERT pin and clear all the internal registers, changing the device mode to comparator mode ( $TM = 0$ ).

Table 12 to Table 15 indicate the format for the  $T_{HIGH}$  and  $T_{LOW}$  registers. Significantly, the most significant byte is sent first, then the least significant byte is sent later.  $T_{HIGH} = +80^{\circ}C$  and  $T_{LOW} = +75^{\circ}C$  are two default values for power-up.  $T_{HIGH}$ ,  $T_{LOW}$  and Temperature share the same format in register.

**Register Maps**

**Table 6. Pointer Register Byte**

P7	P6	P5	P4	P3	P2	P1	P0
0	0	0	0	0	0	Register Bits	

**Table 7. Pointer Addresses**

P1	P0	P5
0	0	Temperature Register (Read Only)
0	1	Configuration Register (Read/Write)
1	0	$T_{LOW}$ Register (Read/Write)
1	1	$T_{HIGH}$ Register (Read/Write)

**Table 8. Byte 1 of Temperature Register<sup>(1)</sup>**

D7	D6	D5	D4	D3	D2	D1	D0
T11 (T12)	T10 (T11)	T9 (T10)	T8 (T9)	T7 (T8)	T6 (T7)	T5 (T6)	T4 (T5)

NOTE:

1. Extended mode 13-bit configuration shown in parenthesis.

**Table 9. Byte 2 of Temperature Register<sup>(1)</sup>**

D7	D6	D5	D4	D3	D2	D1	D0
T3 (T4)	T2 (T3)	T1 (T2)	T8 (T1)	0 (T0)	0 (0)	0 (0)	0 (1)

NOTE:

1. Extended mode 13-bit configuration shown in parenthesis.

**REGISTER DESCRIPTION (continued)****Table 10. Byte 1 of Configuration and Power-Up or Reset Format**

D7	D6	D5	D4	D3	D2	D1	D0
OS	R1	R0	F1	F0	POL	TM	SD
0	1	1	0	0	0	0	0

**Table 11. Byte 2 of Configuration and Power-Up or Reset Format**

D7	D6	D5	D4	D3	D2	D1	D0
CR1	CR0	AL	EM	0	0	0	0
1	0	1	0	0	0	0	0

**Table 12. Byte 1 Temperature Register T<sub>HIGH</sub> <sup>(1)</sup>**

D7	D6	D5	D4	D3	D2	D1	D0
H11 (H12)	H10 (H11)	H9 (H10)	H8 (H9)	H7 (H8)	H6 (H7)	H5 (H6)	H4 (H5)

NOTE:

1. Extended mode 13-bit configuration shown in parenthesis.

**Table 13. Byte 2 Temperature Register T<sub>HIGH</sub>**

D7	D6	D5	D4	D3	D2	D1	D0
H3 (H4)	H2 (H3)	H1 (H2)	H8 (H1)	0 (H0)	0 (0)	0 (0)	0 (1)

**Table 14. Byte 1 Temperature Register T<sub>LOW</sub> <sup>(1)</sup>**

D7	D6	D5	D4	D3	D2	D1	D0
L11 (L12)	L10 (L11)	L9 (L10)	L8 (L9)	L7 (L8)	L6 (L7)	L5 (L6)	L4 (L5)

NOTE:

1. Extended mode 13-bit configuration shown in parenthesis.

**Table 15. Byte 2 Temperature Register T<sub>LOW</sub>**

D7	D6	D5	D4	D3	D2	D1	D0
L3 (L4)	L2 (L3)	L1 (L2)	L0 (L1)	0 (L0)	0 (0)	0 (0)	0 (1)

**APPLICATION INFORMATION**

The SGM457 is designed for the purpose of measuring the temperature of the PCB at the specific location where it is installed. By utilizing the programmable address options, it is possible to monitor up to four different locations on the board using a single serial bus.

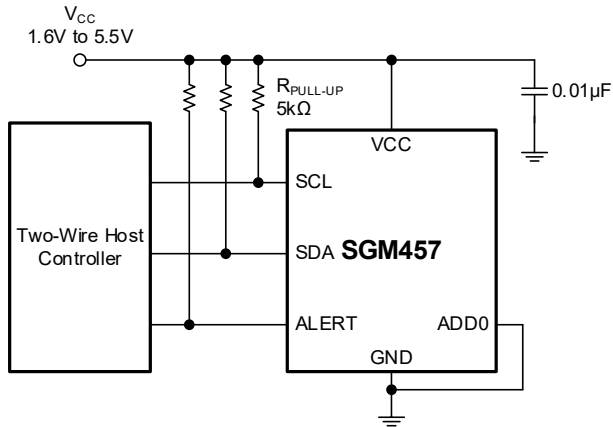


Figure 9. Typical Connections

**Design Requirements**

The pull-up resistors of recommended value of 5kΩ on the SCL, SDA, and ALERT pins of SGM457 are necessary. In some devices, the values of pull-up resistor can be closed to 5kΩ but the current of any pins should not be higher than 3mA. A 0.01µF bypass capacitor shown in Figure 9 is also required to reduce the interface from power supply noise. Using pull-up resistors can help SCL and SDA lines pull up to VCC or higher power supply. Connection between ADD0 pin to any of the GND, VCC, SDA, or SCL pin can set required address on the bus.

**Detailed Design Procedure**

When measuring the heat source, the SGM457 must be placed as close to the measured source as possible, and a good layout is also required for the coupling of heat. Furthermore, this kind of placement can make sure that changes in the measured temperature can be detected as quickly as possible. In addition, the

accuracy of the measurement for surface or air environment will be enhanced by isolating the SGM457 from the ambient temperature.

Due to the low power consumption characteristics of SGM457, the noise level generated by the SGM457 is low. To further reduce the noise issue from SGM457 and ensure that it does not affect other devices connected to the same power supply, an RC filter can be taken into account, and the value of resistor  $R_F$  in Figure 10 should be lower than 5kΩ and the value of capacitor  $C_F$  should be greater than 10nF.

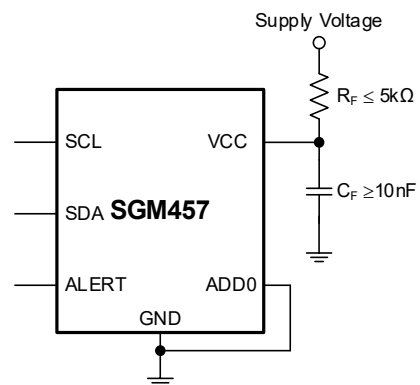


Figure 10. Noise Reduction Techniques

**Power Supply Recommendations**

The SGM457 has a power supply voltage range of 1.6V to 5.5V. Power supply between 1.8V and 3.3V is optimized for temperature accuracy in the whole range of supply.

**Layout Guidelines**

Suggest using 0.01µF bypass capacitor and putting it at nearest place of supply and ground pins. And for the noisy power supply case, another capacitor should be added to reject the noise of the power supply. Two 5kΩ resistors are also required for SDA and SCL pins for their open-drain topology.

**REVISION HISTORY**

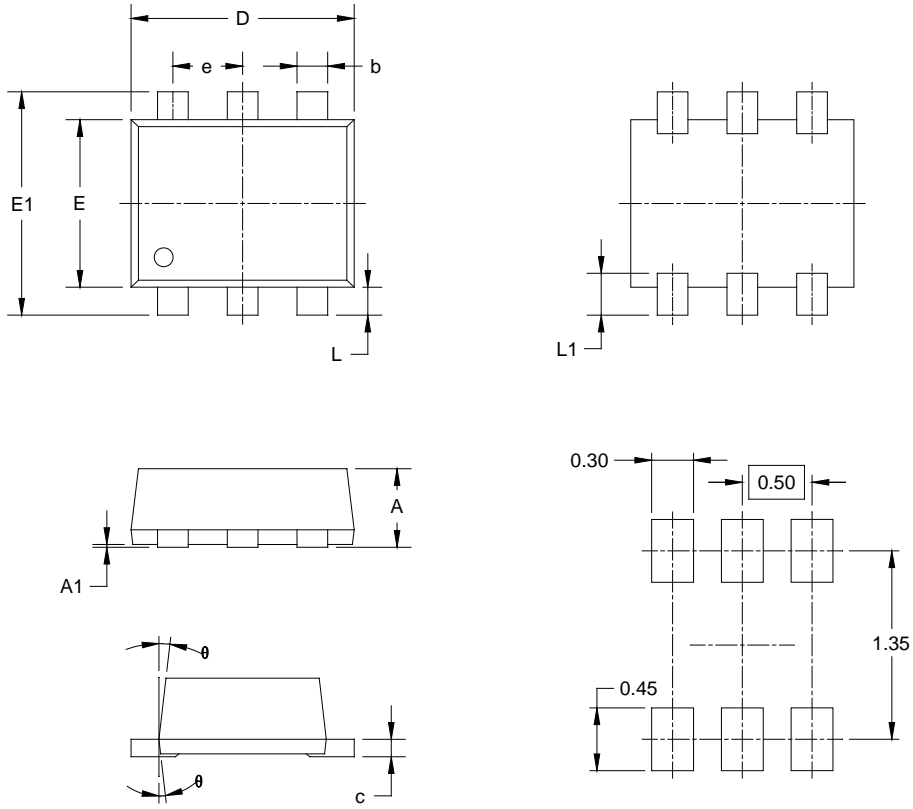
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Original (MAY 2023) to REV.A	Page
Changed from product preview to production data.....	All



PACKAGE OUTLINE DIMENSIONS

SOT-563-6



RECOMMENDED LAND PATTERN (Unit: mm)

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.525	0.600	0.021	0.024
A1	0.000	0.050	0.000	0.002
b	0.170	0.270	0.007	0.011
c	0.090	0.180	0.004	0.007
D	1.500	1.700	0.059	0.067
E	1.100	1.300	0.043	0.051
E1	1.500	1.700	0.059	0.067
e	0.450	0.550	0.018	0.022
L	0.100	0.300	0.004	0.012
L1	0.200	0.400	0.008	0.016
$\theta$	9° REF		9° REF	

NOTES:

1. Body dimensions do not include mode flash or protrusion.
2. This drawing is subject to change without notice.

# 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
SOT-563-6	7"	9.5	1.78	1.78	0.69	4.0	4.0	2.0	8.0	Q3

000001

# 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
7" (Option)	368	227	224	8
7"	442	410	224	18

DD0002