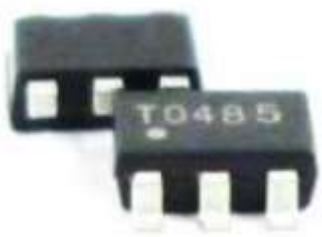
I²C-Bus Compatible Digital Temperature Sensor

MM3285 Datasheet

DESCRIPTION



The MM3285 is an I²C-bus compatible digital temperature sensor IC incorporating a temperature sensor and sigma-delta AD converter. The MM3285 offers I²C-bus compatible interface with low power consumption, making it ideal for a wide range of applications.

FEATURES

- Low voltage operation: 3.0V to 5.5V
- Low current consumption: 75μA typ.
- Fast data update time: 2ms typ.
- Accuracy: ±2.0°C (-25°C to +100°C)
- Resolution: 9 bits (0.5°C)
- Shutdown mode minimizing current consumption
- I²C-bus compatible interface
- Up to 4 ICs can be built into a bus

Contents

BLOCK DIAGRAM

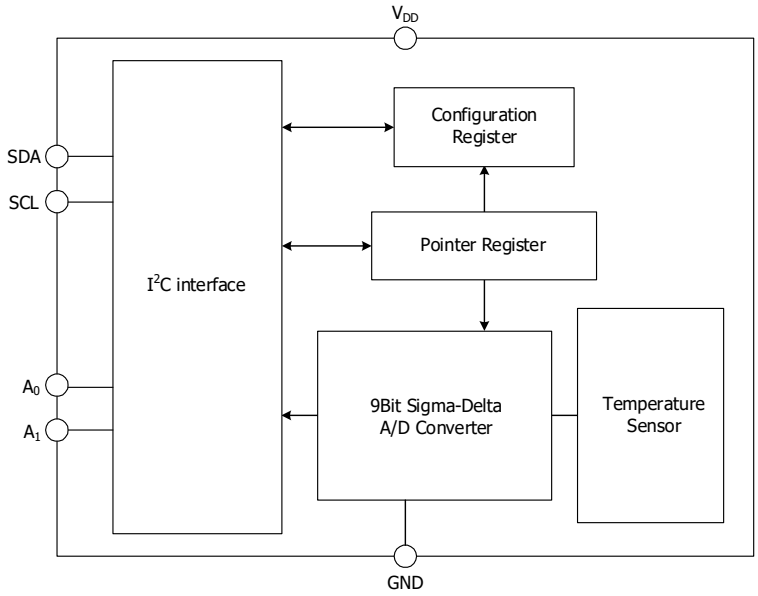


Fig. 1 Block Diagram

PIN CONFIGURATION

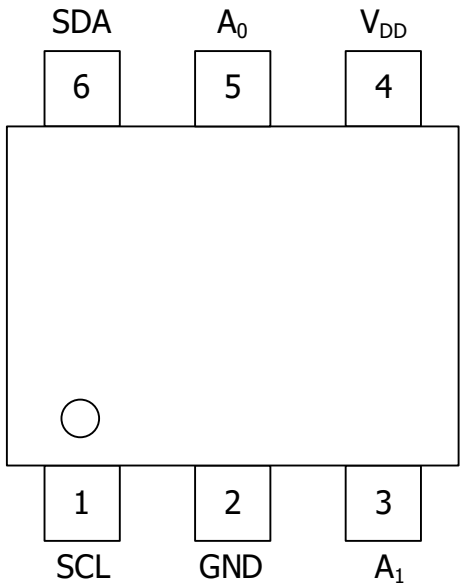
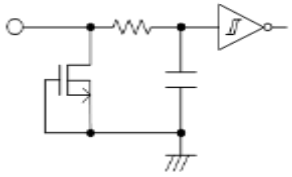
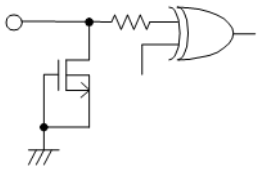
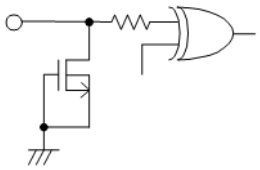
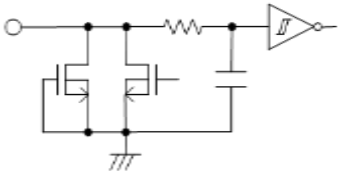


Fig. 2 Pin Configuration

PIN DESCRIPTION

Table 1 Pin Description

PIN No.	SYMBOL	FUNCTION	INTERNAL EQUIVALENT CIRCUIT
1	SCL	I²C-Bus Clock Input	
2	GND	Ground	-
3	A_1	Slave Address Set	
4	V_{DD}	Power Supply	-
5	A_0	Slave Address Set	
6	SDA	I²C-Bus Data I/O	

ABSOLUTE MAXIMUM RATINGS

(Unless otherwise specified, Ta=25°C.)

ITEM	SYMBOL	MIN.	MAX.	UNIT
Maximum Supply Voltage	V_{DDmax}	-0.3	6.0	V
Maximum Output Voltage	V_{OUT}	-0.3	VDD+0.3	V
Power Dissipation	Pd	-	300	mW
Storage Temperature	T_{stg}	-65	150	°C

RECOMMENDED OPERATING CONDITIONS

(Unless otherwise specified, Ta=25°C.)

ITEM	SYMBOL	MIN.	MAX.	UNIT
Operating Voltage	V_{DDopr}	3.0	5.5	V
Operating Ambient Temperature	T_{opr}	-40	125	°C

ELECTRICAL CHARACTERISTICS

TEMPERATURE-TO-DIGITAL CONVERTER CHARACTERISTICS

(Unless otherwise specified, Ta=25°C, VDD=3.3V.)

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Temperature Detection Accuracy (*1)	Ac	-25°C≤Ta≤100°C	-	-	±2.0	°C
		-40°C≤Ta≤125°C	-	-	±3.0	
Temperature Data Update Time	T		-	2.0	-	ms
Supply Current	I_{DD}	Normal Operation	-	75	150	μA
		Shutdown Mode	-	1.0	-	
Start-up Reset Voltage	Reset		-	2.1	-	V
Reset Hysteresis (*2)	Rhys		-	0.3	-	V

*1 The specification values of temperature detection accuracy show values when supply voltage is 3.3V. Temperature data varies by +1°C/V (typ.) against supply voltage.

*2 Power-off Reset Voltage is 1.8V (typ.) due to hysteresis voltage of 0.3V (typ.).

LOGIC ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, Ta=25°C, VDD=3.3V.)

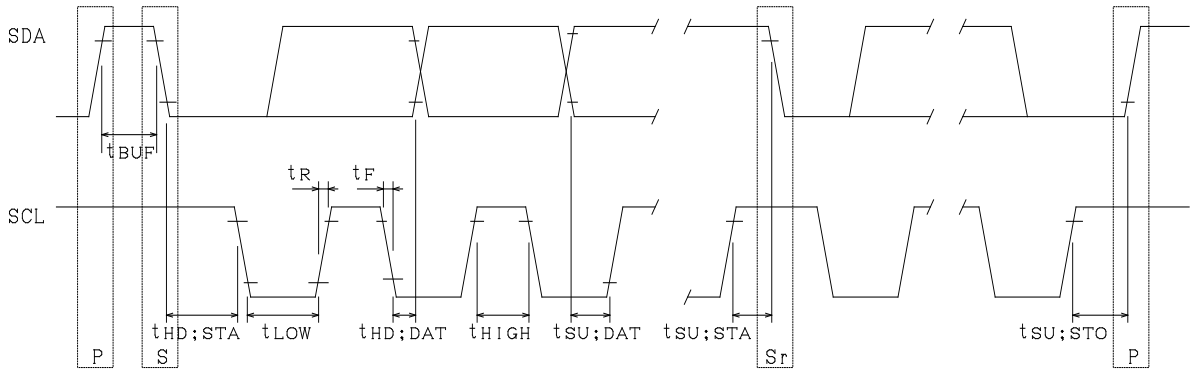
PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Input voltage L	V_{IL}		-0.3	-	V_{DD}×0.3	V
Input voltage H	V_{IH}		V_{DD}×0.7	-	V_{DD}+0.3	V
SDA low level output voltage	V_{OL}	SDA sink 3mA	0	-	0.4	V
High level input current	I_{IH}	SDA, SCL=3.3V	-10	-	10	μA
Low level input current	I_{IL}	SDA, SCL=0.4V	-10	-	10	μA

(Unless otherwise specified, Ta=25°C, VDD=3.3V, I²C-bus Mode = Standard Mode.)

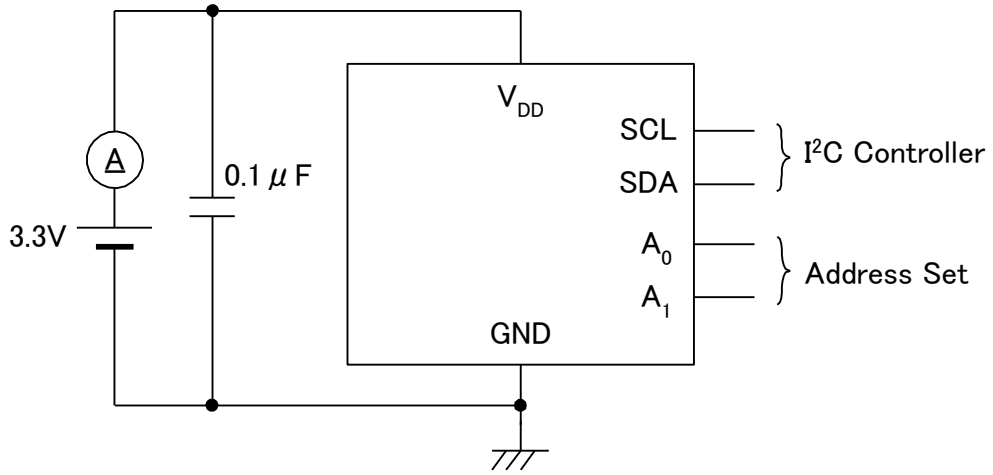
PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Clock frequency	f_{SCL}		-	-	100	kHz
Data transfer wait time	t_{BUF}		4.7	-	-	μs
SCL start hold time	$t_{HD;STA}$		4.0	-	-	μs
SCL low level hold time	t_{LOW}		4.7	-	-	μs
SCL high level hold time	t_{HIGH}		4.0	-	-	μs
Start condition setup time	$t_{SU;STA}$		4.7	-	-	μs
SDA data hold time	$t_{HD;DAT}$		0.0	-	-	μs
SDA data setup time	$t_{SU;DAT}$		250	-	-	ns
SDA,SCL rise time	t_R		-	-	1000	ns
SDA,SCL fall time	t_F		-	-	300	ns
Stop condition setup time	$t_{SU;STO}$		4.0	-	-	μs

(Unless otherwise specified, Ta=25°C, VDD=3.3V, I²C-bus Mode = Fast Mode.)

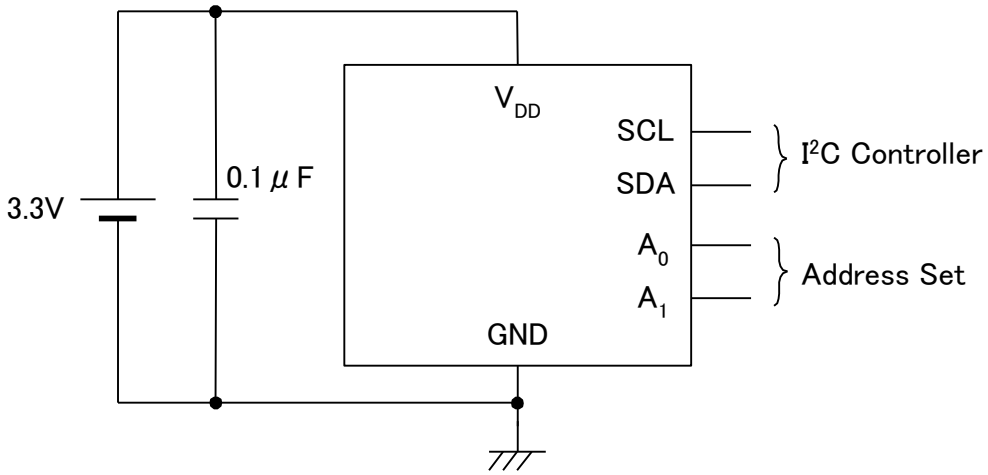
PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Clock frequency	f_{SCL}		-	-	400	kHz
Data transfer wait time	t_{BUF}		1.3	-	-	µs
SCL start hold time	$t_{HD;STA}$		0.6	-	-	µs
SCL low level hold time	t_{LOW}		1.3	-	-	µs
SCL high level hold time	t_{HIGH}		0.6	-	-	µs
Start condition setup time	$t_{SU;STA}$		0.6	-	-	µs
SDA data hold time	$t_{HD;DAT}$		0.0	-	-	µs
SDA data setup time	$t_{SU;DAT}$		100	-	-	ns
SDA, SCL rise time	t_R		-	-	300	ns
SDA, SCL fall time	t_F		-	-	300	ns
Stop condition setup time	$t_{SU;STO}$		0.6	-	-	µs



TEST CIRCUIT

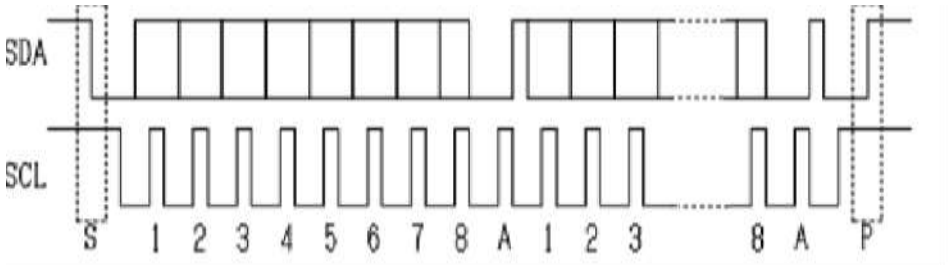


TYPICAL APPLICATION CIRCUIT



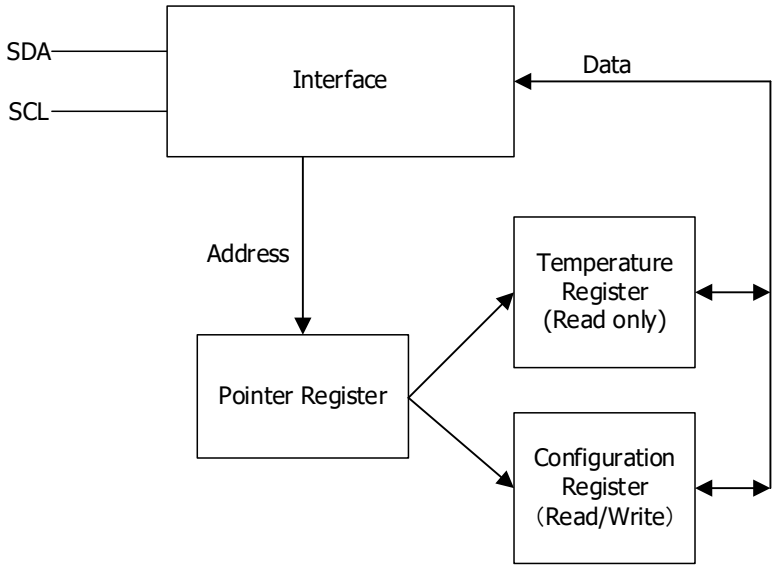
- Mitsumi shall not assume any liability for any accident or damage caused by use of this circuit.
- Mitsumi shall not assume any liability for any issues related to industrial property rights and/or other rights owned by third parties or shall not grant any license regarding use of this circuit.

I2C-BUS CONDITIONS



S: Start condition
P: Stop condition
A: Acknowledge

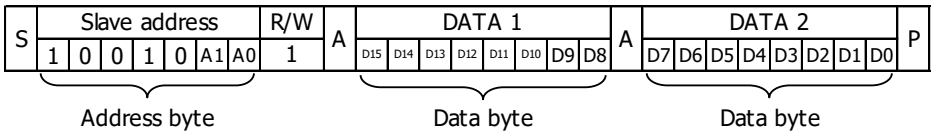
I²C-bus is inter-IC bus system to transfer data by 2 lines of SDA and SCL. Data transfer is performed by 1 byte, and acknowledgement is sent when each byte is complete. Data transfer takes place MSB first from a start condition. There are a pointer register and two data registers selected by the pointer register in MM3285.



I2C Data Format

Read Mode

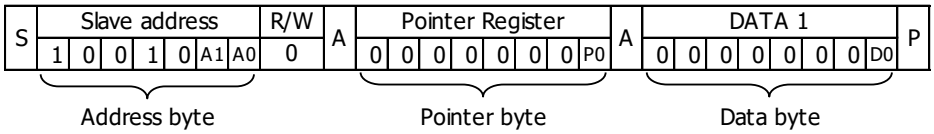
The data format for read mode is set in the temperature, configuration register as shown below.



* If a register selected with a pointer byte, data byte is 1 byte only.

Write Mode

The data format for write mode is set in the configuration register as shown below.



* If a register selected with a pointer byte, data byte is 1 byte only.

Register Structure

Pointer Register

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

(1) P0: Register select

P1	P0	Register
0	0	Temperature Register (Read only, Power-up default)
0	1	Configuration Register (Read/Write)
1	0	Test Mode Resister

(2) P1-P7: Must be kept to zero.
*The MM3285 enters the static test mode when 1 is input to P1. Please always input 0 to P1.

Temperature Register (Read only)

D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
MSB	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	LSB	X	X	X	X	X	X	X

(1) D0-D6: Undefined
(2) D7-D15: Temperature data. 1 LSB = 0.5°C. Two's complement format.

Temperature Data Format

Temperature data is represented by a 9-bit (8 bits plus a sign bit), two's complement word with an LSB equal to 0.5°C.

Temperature	Digital Output	
	Binary Code	Hex
125°C	0 1111 1010	0FAh
100°C	0 1100 1000	0C8h
80°C	0 1010 0000	0A0h
60°C	0 0111 1000	078h
40°C	0 0101 0000	050h
25°C	0 0011 0010	032h
0.5°C	0 0000 0001	001h
0°C	0 0000 0000	000h
-0.5°C	1 1111 1111	1FFh
-10°C	1 1110 1100	1ECh
-25°C	1 1100 1110	1CEh
-40°C	1 1011 0000	1B0h

Configuration Register (Read/Write)

D7	D6	D5	D4	D3	D2	D1	D0
0	0	0	0	0	0	0	Shutdown Mode Select

(1) D0: Shutdown mode select

D0	Shutdown Mode
0	Normal Operation
1	Shutdown

(2)D1-D7: Must be kept zero for normal operation.

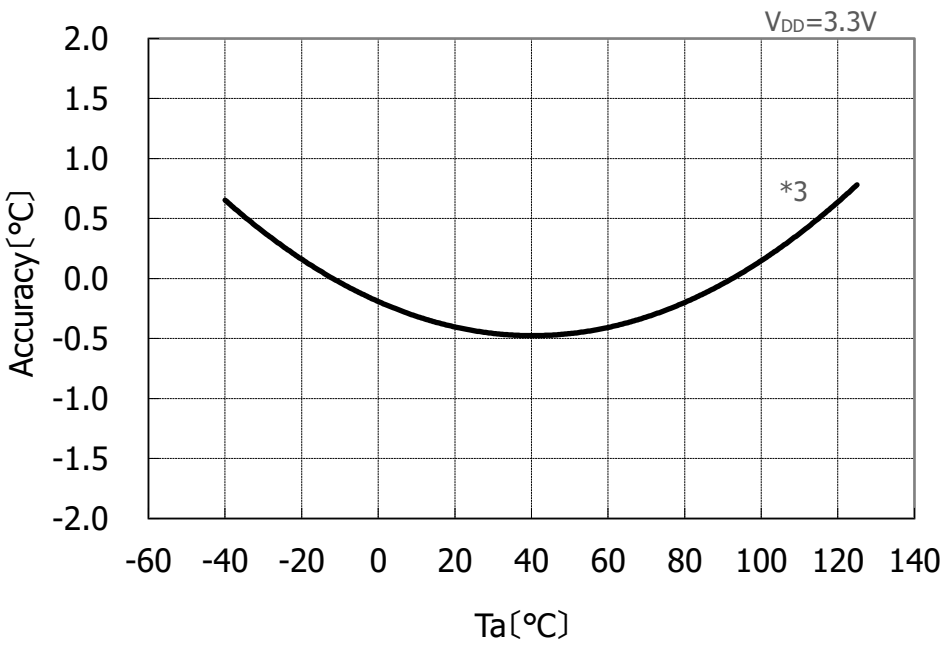
* Power-up default is with all bits (D0 to D7) "0" (zero).

Shutdown mode

Shutdown mode is enabled by setting the shutdown mode select bit in the configuration register. Current consumption during shutdown mode is 1μA typ., which achieves reduction in power consumption during standby mode.

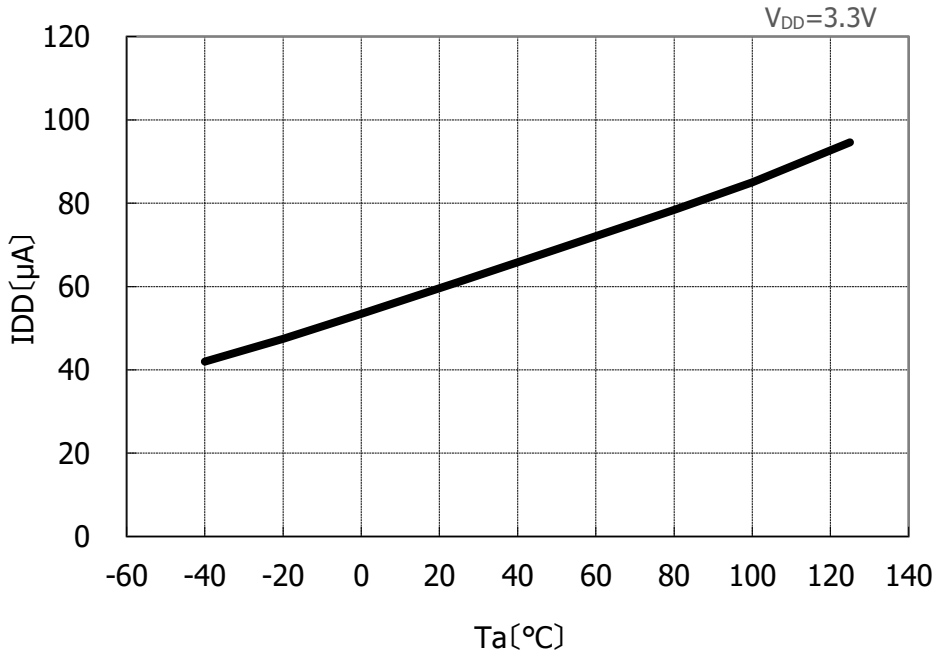
TYPICAL PERFORMANCE CHARACTERISTICS

Ambient Temperature – Accuracy



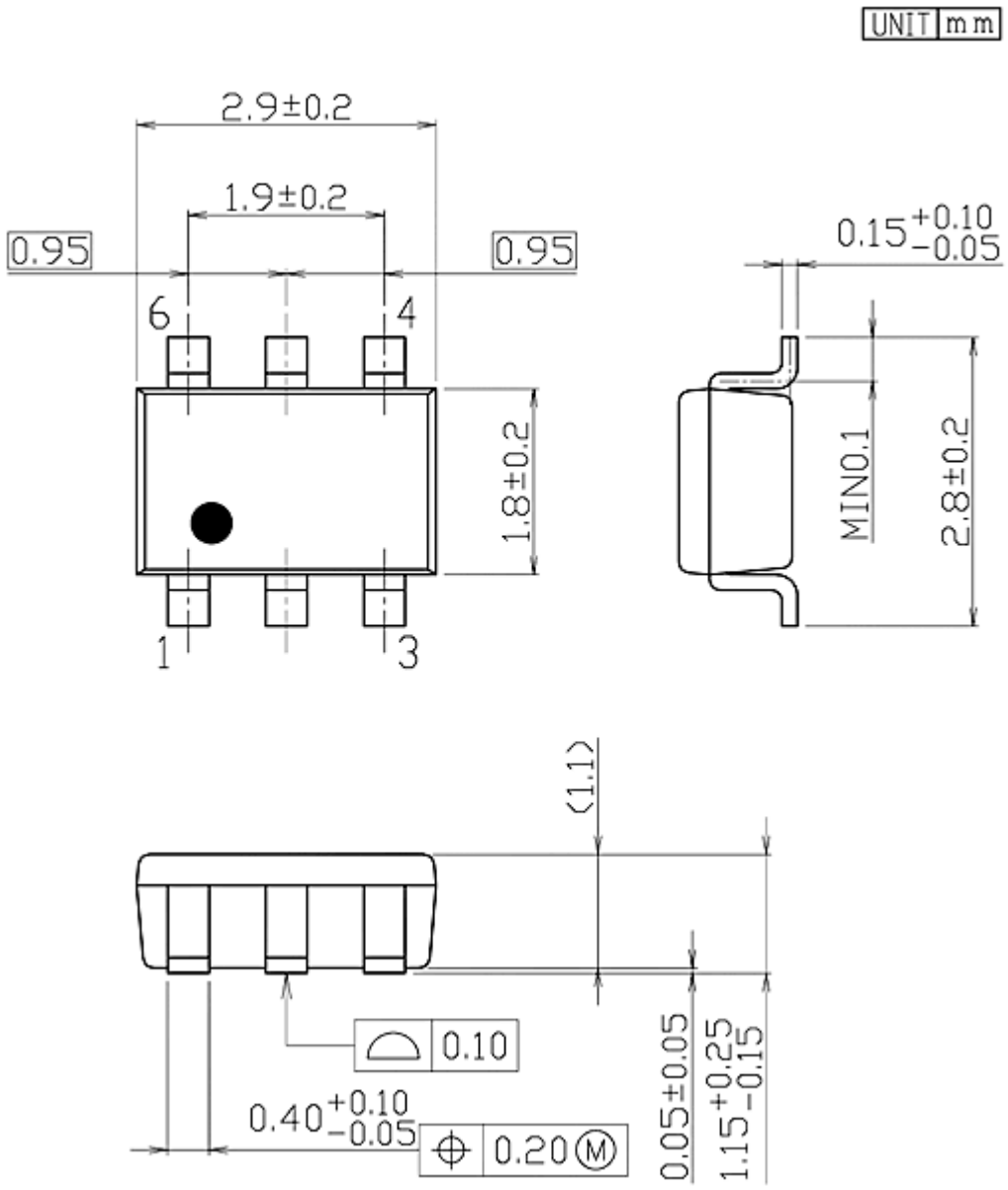
*3 The characteristic graph shows an approximate curve.

Ambient Temperature – Supply Current

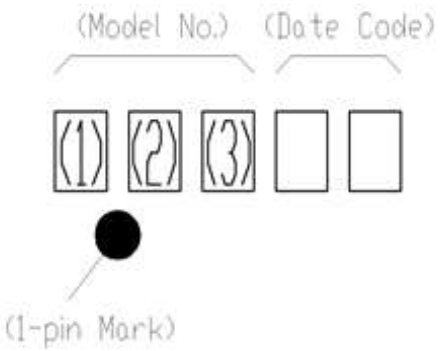


DIMENSIONS

PACKAGE: SOT-26A

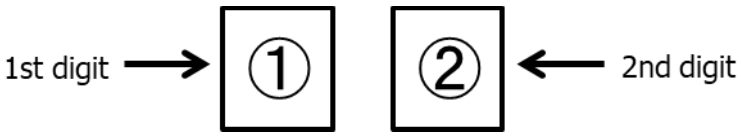


MARKING CONTENTS



Model name	Model No.		
	(1)	(2)	(3)
M M 3 2 8 5 C N R E	T	0	4

How to identify 2 characteristic lot numbers.



(1) The 1st digit (①) shows the first half of the year or the second half.

(2) The 2nd digit (②) shows a production week of mass production.

【How to indicate a production year】

First half of the year

The 1st digit (①)	
the last digit of a production year	mark
xxx1	1
xxx2	2
xxx3	3
xxx4	4
xxx5	5
xxx6	6
xxx7	7
xxx8	8
xxx9	9
xxx0	0

The 2nd digit (②)			
production week	mark	production week	mark
1	1	14	E
2	2	15	F
3	3	16	G
4	4	17	H
5	5	18	J
6	6	19	K
7	7	20	L
8	8	21	M
9	9	22	N
10	A	23	P
11	B	24	Q
12	C	25	R
13	D	26	S

Second half of the year

The 1st digit (①)	
the last digit of a production year	mark
xxx1	A
xxx2	B
xxx3	C
xxx4	D
xxx5	E
xxx6	F
xxx7	G
xxx8	H
xxx9	J
xxx0	K

The 2nd digit (②)			
production week	mark	production week	mark
27	1	40	E
28	2	41	F
29	3	42	G
30	4	43	H
31	5	44	J
32	6	45	K
33	7	46	L
34	8	47	M
35	9	48	N
36	A	49	P
37	B	50	Q
38	C	51	R
39	D	52	S
		53	T

PACKING SPECIFICATIONS

1. APPLICATION LIMIT
   IT APPLIES TO THE PACKING SPECIFICATION OF SOT-26A

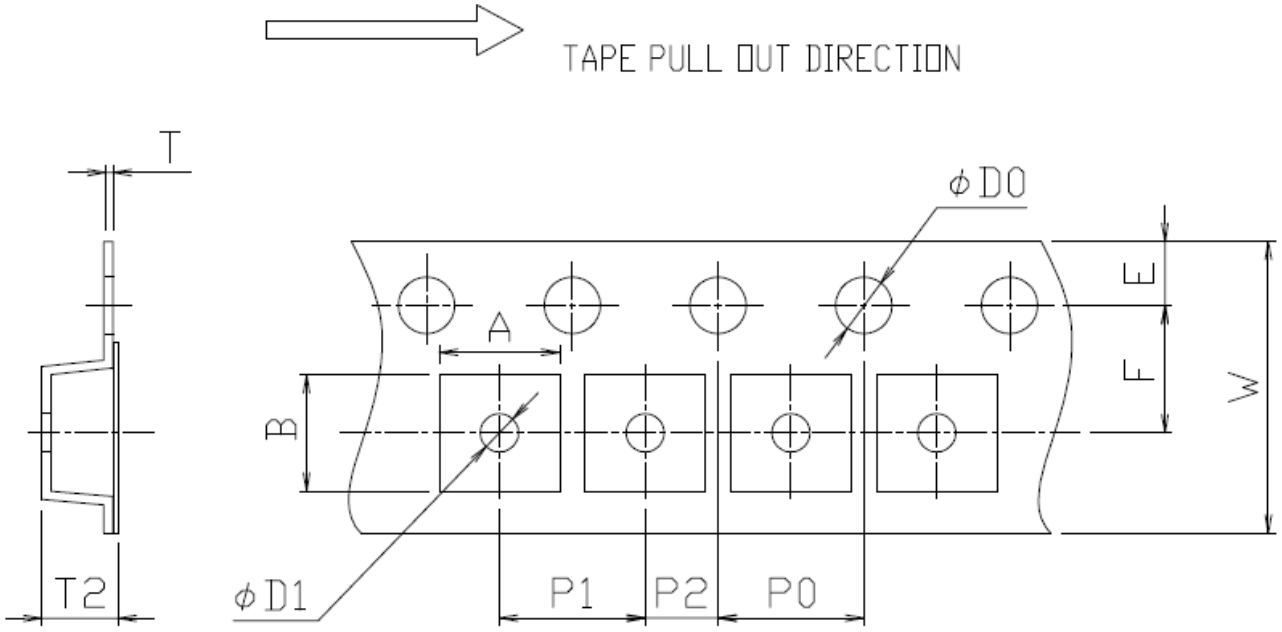
2. QUANTITY

(1) REEK PACKING	3000 pcs / REEL
(2) BOX PACKING	MAX 3000 pcs / BOX（5REEL）
	THE QUANTITY IS FILLED IN THE PACKING SLIP

3. PACKING SPECIFICATIONS

(1) HOUSING SPECTICATION	REFER TO DRAWING
(2) REEL DIMENSIONS	REFER TO DRAWING
(3) BOX DIMENSIONS	REFER TO DRAWING

EMBOSS TAPE HOUSING SPECIFICATION



記号 SYS.	A	B	W	F	E	P1	P2	P0	φD0	T	T2	φD1
UNIT mm	3.3	3.2	8.0	3.5	1.75	4.0	2.0	4.0	1.5	0.25	1.7	1.0
	±0.1	±0.1	±0.3	±0.05	±0.1	±0.1	±0.05	±0.1	$^{+0.1}_{-0}$	±0.05	±0.1	$^{+0.2}_{-0}$

NOTE

1. IC PULL DUT DIRECTION

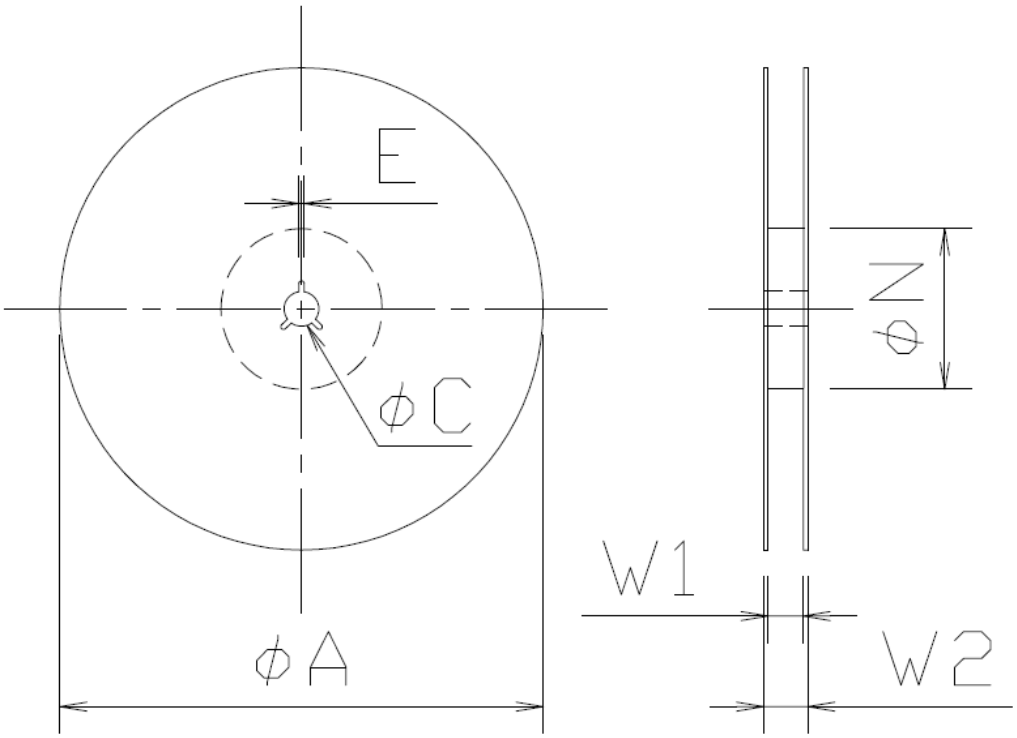
2. CARRIER TAPE MATERIAL: DISPOSED ELECTRICATION PREVENTION.

3. LENGTH OF LEADER TAPE: MORE THAN 400mm INCLUDING 40 OR MORE ENBOSSES IN WHICH NO COMPONENT IS PLACED.

4. LENGTH LEADER TAPE: MORE THAN 40mm INCLUDING ENBOSSES IN WHICH NO COMPONENT IS PLACED

REEL DIMENSIONS

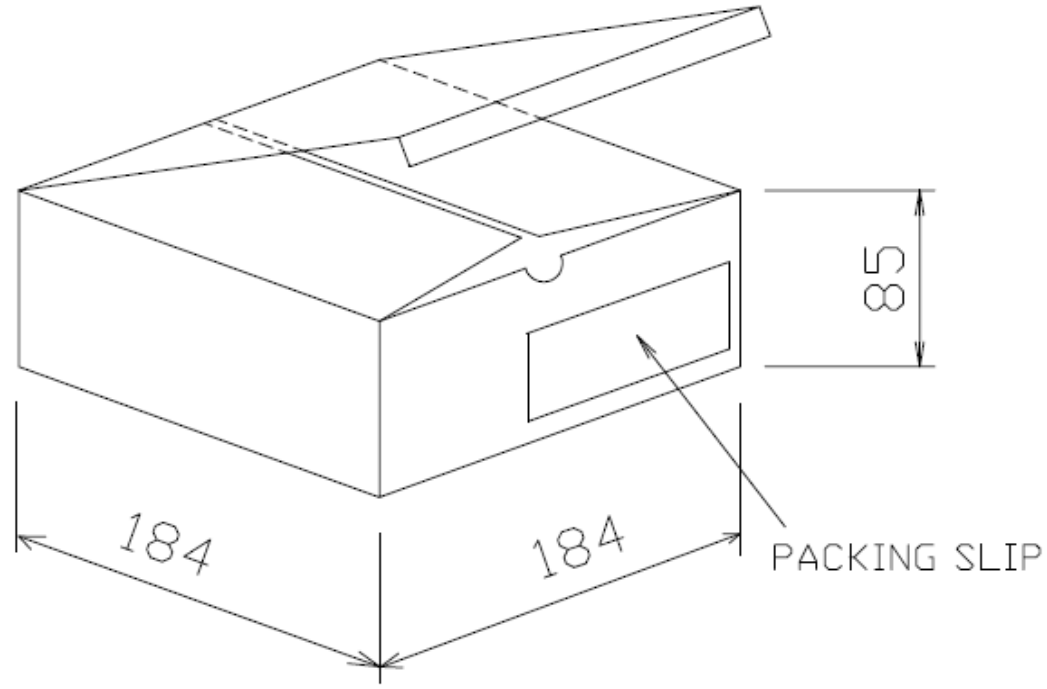
UNIT mm



SYM.	ϕA	ϕC	ϕN	E	W1	W2
UNIT mm	180	13.0	60.0	2.0	9.0	13.0
	+0 −3	±0.2	+1 −0	±0.5	±0.3	±1.4

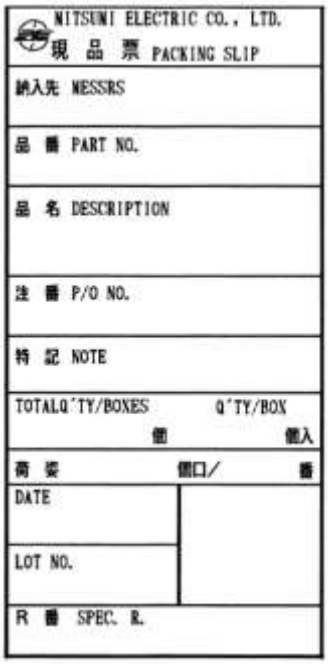
BOX DIMENSIONS

UNIT	mm



※BOX SIZE VARIES WITH DEPENDS ON THE QUANTITY.

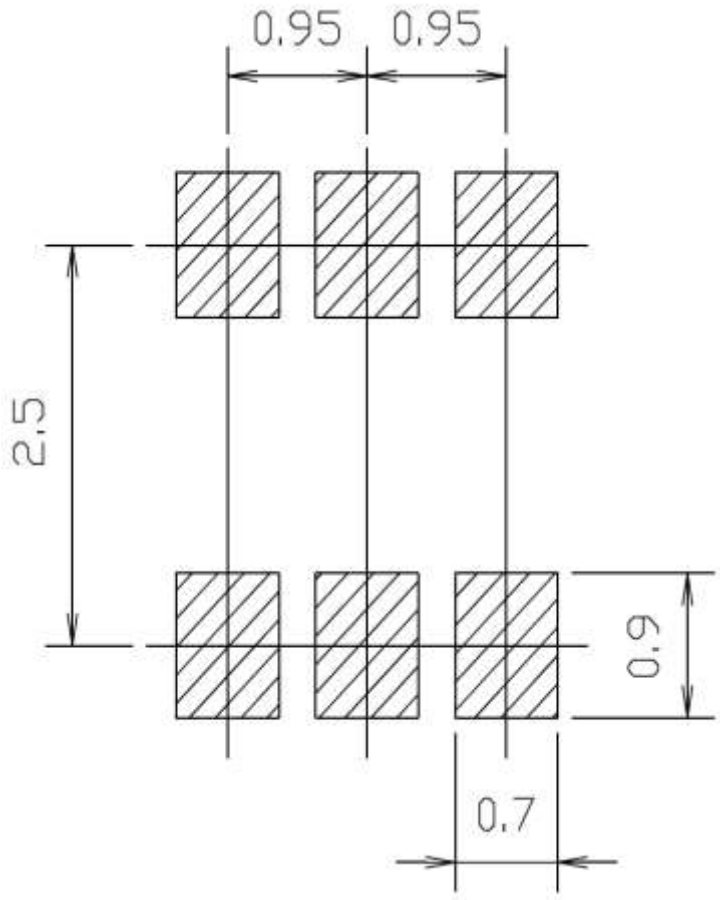
PACKING SLIP



CONDITION FOR PACKAGE MOUNTING

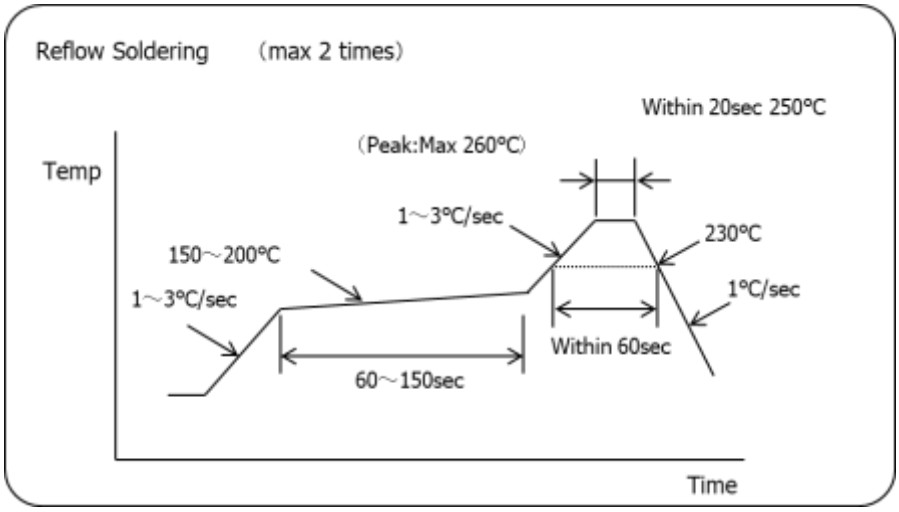
Design example of mount pad
Package: SOT-26A

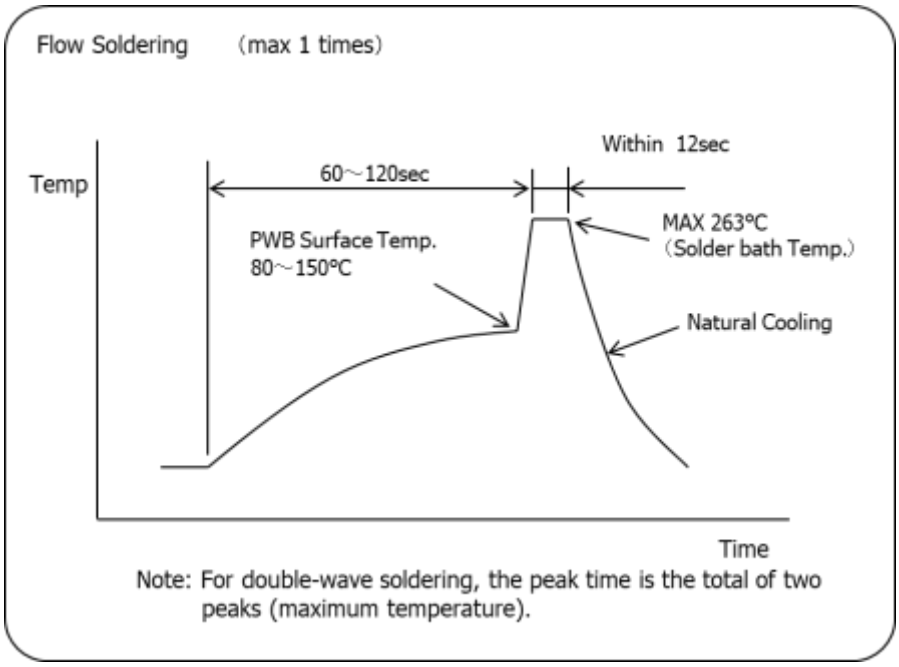
UNIT	mm



The dimension are for reference only and not guaranteed by design.
To design practically, correction should be made for optimized dimensions considering the effects of the board type to be mounted, mount (soldering) method, type and coating thickness of cream solder.

Pb-Free recommended profile condition





Manual Soldering

Iron tip temp./time	times
max 400°C/within 3s	max2

This profile gives recommended values, which are not guaranteed.
For mounting the package, evaluate the profile with the equipment, conditions, and materials to be used.

Storage method

Storage condition
Store the device under the following conditions.
Temperature: 5～30℃
Humidity: 40～70%RH
Storage life: 1 year
For the product in the moisture-proof packaging, follow these conditions after unpacking.
Temperature: 5～30℃
Humidity: 40～70%RH
Storage life: 168hours
Do not store this device where a large amount of dust or harmful volatile gas exists, electrostatic is easily charged, condensation is generated, or changes in temperature and humidity are wide, or under the direct sunlight.

Baking
If the storage time specified above has passed, mounting by soldering may cause cracks on the moisture absorbed package.
Before mounting, the package should be baked under the following conditions.
Temperature: 125℃
Treating time: 16 to 24 hours
Embossing tapes and reels are not heat-resistant type.
Before baking, the device should be placed in a heat-resistant container.
In consideration of the time-consuming baking process and the possibility of deformed terminal, the device should be mounted promptly within the time observing the storage conditions.
If a long-term storage is needed, a desiccator or a dry box should be used.

Handling instructions
Shipping boxes must be handled with care because any drop or shock may damage the device.
Additionally, the device must be handled in the place with the protection against electrostatic charge and without extreme changes of temperature/humidity.

MITSUMI ELECTRIC CO., LTD.
Strategy Engineering Department Semiconductor Business Division
Tel: +81-46-230-3470 / https://www.mitsumi.co.jp/profile/contact.html

Notes:
Any products mentioned this datasheet are subject to any modification in their appearance and others for improvements without prior notification. The details listed here are not a guarantee of the individual products at the time of ordering. When using the products, you will be asked to check their specifications.