Overview

The GM75176E is a 10Mbps high-speed, half-duplex transceiver for RS-485/RS-422 communication that contains one driver and one receiver. With ±15kV human body model ESD protection and fail-safe circuit, when the receiver input is open or shorted, it ensures that the receiver outputs a logic high level. This means that if all transmitters connected to the terminated bus are disabled (high impedance), the receiver will output a logic high level. The GM75176E driver does not limit the slew rate and can guarantee a communication rate of up to 10Mbps. The receiver of GM75176E has 1 unit load input impedance, and up to 32 transceivers can be connected to the bus. In addition, GM75176E also has a built-in over-temperature protection circuit to ensure that the chip is not damaged under high temperature conditions.

Features

- Low current shutdown mode
- Industry standard 8-pin SOP package
- Up to 32 transceivers can be connected to the bus
- The true fail-safe receiver is compatible with EIA/TIA-485
- Built-in over-temperature protection circuit to ensure that the chip is not damaged at high temperatures
- Provides enhanced ESD protection for RS-485/RS-422 A/B pins

A/B pin provides enhanced ESD protection

HBM human body model: ±15kV

IEC 61000-4-2:

Contact discharge ±12kV

Air discharge ±15kV

Pin logic diagram and description

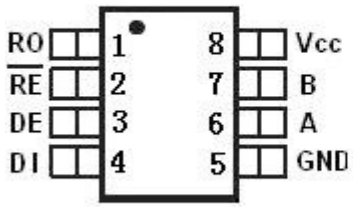


Figure 1: GM75176E pin diagram

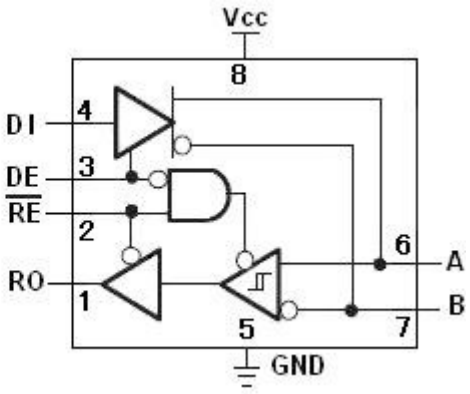


Figure 2: GM75176E logic diagram

Application

- Industrial control network
- Communication equipment
- Motor control system
- Security system
- Lighting system
- Instrumentation

Ordering information

Model	Transfer method	Rate	Number of nodes	Temperature range	Package	SPQ
GM75176E	Half duplex	10Mbps	32	-40℃～+85℃	SOP8	2500pcs
-						

Pin description

Pin	Name	Features
1	RO	Receiver output. When RE is low, if A-B ≧ -50mV, RO output is high; if A-B ≦ -200mV, RO output is low
2	RE	Receiver output enable. RO output is valid when RE is connected to low level; RO is in high impedance state when RE is connected to high level; When RE is connected to high level and DE is connected to low level, the device enters low-power shutdown mode
3	DE	Driver output enable. When DE is connected to high level, the driver output is valid, when DE is low level, the output is in high impedance state; When RE is connected to high level and DE is connected to low level, the device enters low-power shutdown mode
4	DI	Driver input. When DE is high, the low level on DI forces the non-inverting output low, and the inverting output high. Similarly, a high level on DI will force the non-inverting output to be high, and the inverting output to be low.
5	GND	Ground
6	A	Receiver non-inverting input and driver non-inverting output
7	B	Receiver inverting input and driver inverting output
8	V_{CC}	Power supply: 4.5 ≦ VCC ≦ 5.5V

Absolute maximum ratings

Parameter	Symbol	Value	Unit
Supply voltage	V_{CC}	+7	V
Control input voltage	/RE, DE	-0.3 to V_{CC}+0.3	V
Driver input voltage	DI	-0.3 to V_{CC}+0.3	V
Driver output voltage	A, B	±13	V
Receiver input voltage	A, B	±13	V
Receiver output voltage	RO	-0.3～V_{CC}+0.3	V
Continuous power consumption	SOP8	471	mW
Operating temperature range		-40～+85	℃
Storage temperature		-65～+150	℃
Welding temperature		300	℃

DC electrical characteristics

(If not otherwise stated, V_{CC}=+5V±5%, T_A=T_{MIN}～T_{MAX}, the typical value is V_{CC}=+5V, T_A=25℃) (Note 1)

Parameter	Symbol	Test conditions		Min	Typ	Max	Unit
Driver							
Supply voltage	V_{CC}			4.5		5.5	V
Differential driver output (no load)	V_{OD1}	Figure 4		1.5		5	V
Differential driver output	V_{OD2}	Figure 4, R=50Ω (RS-422)		2.0		5	V
		Figure 4, R=27Ω (RS-485)		1.5		5	
Amplitude change of differential output voltage (Note 2)	ΔV_{OD}	Figure 4, R=50Ω or R=27Ω				0.2	V
Driver common mode output voltage	V_{OC}	Figure 4, R=50Ω or R=27Ω		1		3	V
Amplitude change of common mode voltage (Note 2)	ΔV_{OC}	Figure 4, R=50Ω or R=27Ω				0.2	V
Input high voltage	V_{IH1}	DE, DI, /RE		2.0			V
Input low voltage	V_{IL1}	DE, DI, /RE				0.8	V
DI input hysteresis	V_{HYS}				100		mV
Input current (A, B) half duplex	I_{IN4}	DE=GND V_{CC}=GND or 5.5V	V_{IN}=12V			500	μA
			V_{IN}=-7V	-500			
Driver short-circuit output current	I_{OSD}	-7V≦V_{OUT}≦V_{CC}		-250			mA
		0V≦V_{OUT}≦12V				250	
		0V≦V_{OUT}≦V_{CC}		±25			
Receiver							
Receiver differential threshold voltage	V_{TH}	-7V≦V_{CM}≦12V		-200	-110	-50	mV
Receiver input hysteresis	ΔV_{TH}				30		mV
Receiver output high voltage	V_{OH}	I_O=-4mA, V_{ID}=-50mV		V_{CC}-0.4			V
Receiver output low voltage	V_{OL}	I_O=4mA, V_{ID}=-200mV				0.4	V
Three-state output current at receiver	I_{OZR}	0.4V≦V_O≦2.4V				±1	μA
Receiver input impedance	R_{IN}	-7V≦V_{CM}≦12V		12			kΩ
Receiver output short circuit current	I_{OSR}	0V≦V_{RO}≦V_{CC}		±7		±95	mA
Supply current							
Supply current	I_{CC}	No load, /RE=DI=V_{CC}, DE=V_{CC}			500	900	μA
		No load, /RE=DI=GND, DE=GND			400	600	μA
Shutdown mode current	I_{SHDN}	DE=GND, /RE=V_{CC}, DI=V_{CC} or GND			20	30	μA
Overheating protection							
Overheating protection temperature	T_{SHDN}	Chip junction temperature			120		°C
ESD Electrostatic protection							
Electrostatic protection (A/B pin)		HBM Human body model			±15		kV
		MM Machine mode			±800		V
		Contact discharge IEC 61000-4-2			±12		kV
		Air discharge IEC 61000-4-2			±15		kV

Note 1: All currents into device pins are positive; all currents out of device pins are negative; all voltages are without exception referenced to device ground

Note 2: When DI input changes state, $\triangle V_{OD}$ and $\triangle V_{OC}$ are V_{OD} and V_{OC} changes respectively.

Note 3: Maximum current level applies to peak current just prior to foldback-current limiting; minimum current level applies during current limiting.

Switching characteristics

(If not otherwise stated, V_{CC}=+5V±5%, T_A=T_{MIN}～T_{MAX}, the typical value is V_{CC}=+5V, T_A=25℃) (Note 1)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Driver input to output	T_{DPLH}	Figure 6 and 8, R_{DIFF}=54Ω, C_{L1}=C_{L2}=100pF		20	40	ns
	T_{DPHL}			20	40	
Driver output skew $\|t_{DPLH} - t_{DPHL}\|$	T_{DSKEW}	Figure 6 and 8, R_{DIFF}=54Ω, C_{L1}=C_{L2}=100pF		-3	±10	ns
Driver rise or fall time	t_{DR}, t_{DF}	Figure 6 and 8, R_{DIFF}=54Ω, C_{L1}=C_{L2}=100pF		14	25	ns
Maximum data rate	F_{MAX}		10			Mbps
Driver enable to output high	T_{DZH}	Figure 7 and 9, C_L=100pF, S2 closed			150	ns
Driver enable to output low	T_{DZL}	Figure 7 and 9, C_L=100pF, S1 closed			150	ns
Driver disable time from low	T_{DLZ}	Figure 7 and 9, CL=15pF, S1 closed			100	ns
Driver disable time from high	T_{DHZ}	Figure 7 and 9, C_L=15pF, S2 closed			100	ns
Receiver input to output	T_{RPLH} T_{RPHL}	Figure 10 and 12, $\|V_{ID}\|$≥2.0V, V_{ID}≦15ns rise and fall time		50		ns
Differential receiver skew $\|t_{DPLH} - t_{DPHL}\|$	T_{RSKD}	Figure 10 and 12, $\|V_{ID}\|$≥2.0V, V_{ID}≦15ns rise and fall time		0	±10	ns
Receiver enable to output low	T_{RZL}	Figure 5 and 11, C_L=100pF, S1 closed		20	50	ns
Receiver enable to output high	T_{RZH}	Figure 5 and 11, C_L=100pF, S2 closed		20	50	ns
Receiver disable time from low	T_{RLZ}	Figure 5 and 11, C_L=100pF, S1 closed		20	50	ns
Receiver disable time from high	T_{RHZ}	Figure 5 and 11, C_L=100pF, S2 closed		20	50	ns
Time to shutdown	T_{SHDN}		50	200	600	ns
Driver enable from shutdown to output high	$T_{DZH(SHDN)}$	Figure 7 and 9, C_L=15pF, S2 closed			250	ns
Driver enable from shutdown to output low	$T_{DZL(SHDN)}$	Figure 7 and 9, C_L=15pF, S1 closed			250	ns
Receiver enable from shutdown to output high	$T_{RZH(SHDN)}$	Figure 5 and 11, C_L=100pF, S2 closed			3500	ns
Receiver enable from shutdown to output low	$T_{RZL(SHDN)}$	Figure 5 and 11, C_L=100pF, S1 closed			3500	ns

Function table

GM75176E

Driver				
Input			Output	
/RE	DE	DI	B	A
X	1	1	0	1
X	1	0	1	0
0	0	X	High-Z	High-Z
1	0	X	Shutdown	

GM75176E

Receiver			
Input		Output	
/RE	DE	A-B	RO
0	X	≥-0.05V	1
0	X	≤-0.2V	0
0	X	Open/shorted	1
1	1	X	High-Z
1	0	X	Shutdown

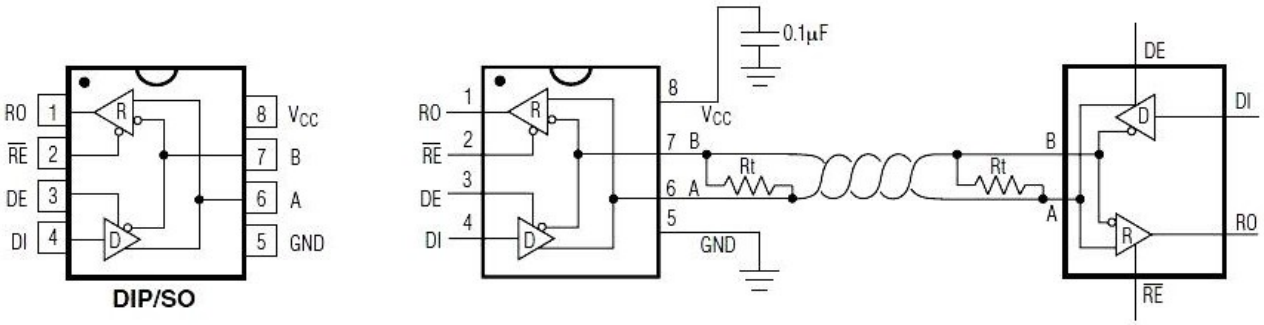


Figure 3: GM75176E typical half-duplex application circuit

1. Description

The GM75176E high-speed transceiver for RS-485/RS-422 communication contains a driver and a receiver. It has a fail-safe circuit to ensure that the receiver outputs a logic high level when the receiver input is open or shorted. This means that if all transmitters connected to the terminated bus are disabled (high impedance), the receiver will output a logic high level. The GM75176E driver does not limit the slew rate and can achieve error-free high-speed data transmission up to 10Mbps. GM75176E is a half-duplex transceiver, designed in CMOS process, and has lower static power consumption under the same performance compared with bipolar process.

2. Over temperature protection

GM75176E has built-in over-temperature protection function. When the chip temperature is greater than 120°C, the chip enters the over-temperature protection mode, in which the driver output of the chip is turned off. When the temperature is less than 100°C, the chip will automatically restart. This protection function can effectively prevent the driver stage from being damaged under high temperature conditions.

3. Fail-safe

When the receiver input is short-circuited or open, or when all drivers connected to the terminated transmission line are disabled, GM75176E can ensure that the receiver outputs a logic high level. This is achieved by setting the receiver input threshold to -50mV and -200mV respectively. If the differential receiver input voltage (A-B) is greater than or equal to -50mV, RO is logic-high; if the voltage (A-B) is less than or equal to -200mV, RO is logic-low.

When all transmitters connected to the terminated bus are disabled, the receiver differential input voltage will be pulled to 0V by the termination resistor. Depending on the receiver threshold, a logic high level with a minimum noise margin of 50mV can be achieved. Unlike previous fail-safe devices, the -50mV to -200mV threshold voltage complies with the ±200 mV EIA/TIA-485 standard.

4. 32 transceivers on the bus

The receiver of the GM75176E transceiver has 1 unit load input impedance (12kΩ), allowing up to 32 transceivers to be connected in parallel on the same communication bus. These devices can be combined arbitrarily, or combined with other RS-485 transceivers, as long as the total load does not exceed 32 unit loads that can be connected to the same bus.

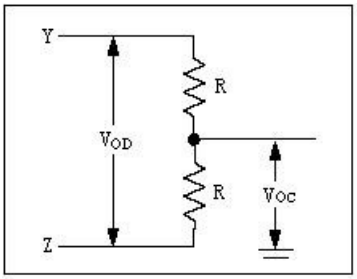


Figure 4: Driver DC test load

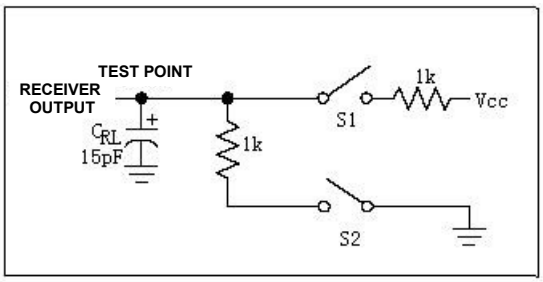


Figure 5: Receiver enable/disable timing test load

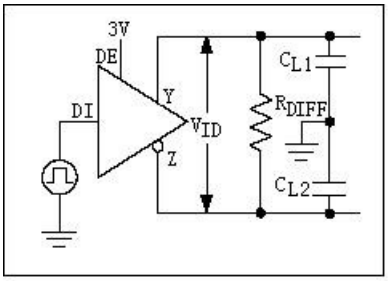


Figure 6: Driver timing test circuit

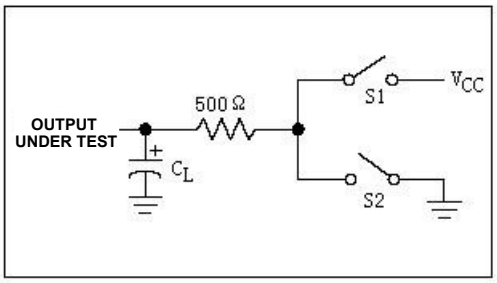


Figure 7: Driver enable/disable timing test load

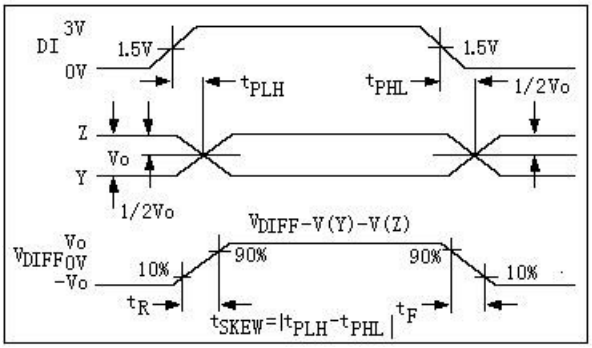


Figure 8: Driver propagation delays

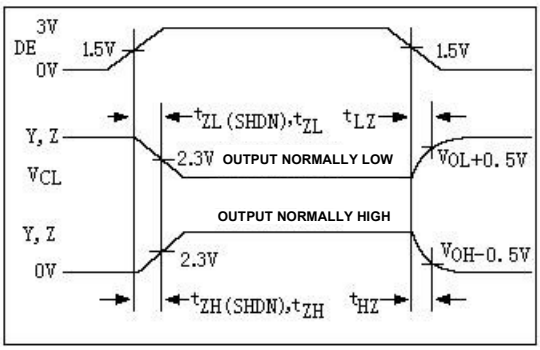


Figure 9: Driver enable and disable times

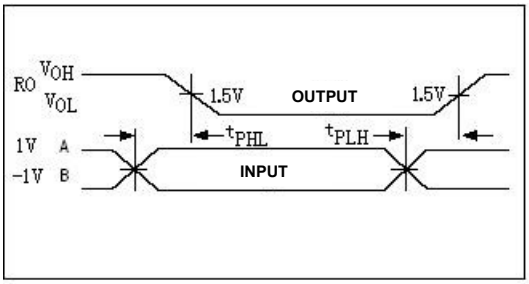


Figure 10: Receiver propagation delays

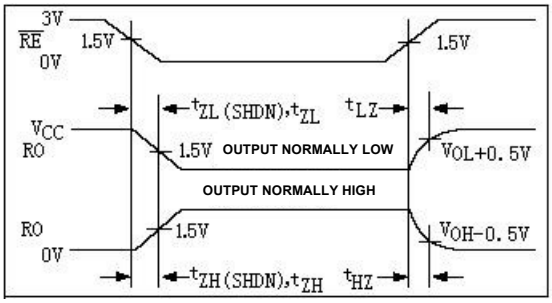


Figure 11: Receiver enable and disable times

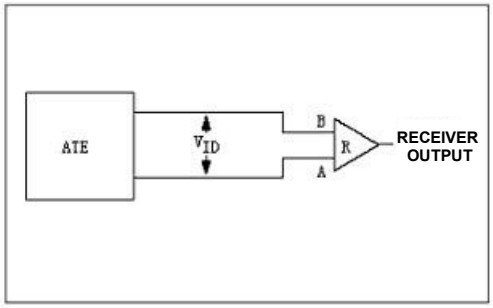


Figure 12: Receiver propagation delay test circuit

Typical application

The GM75176E transceiver is designed for two-way data communication on a multipoint bus transmission line. Figure 13 shows a typical network application circuit. Under low-speed conditions, these devices can be used as linear transponders with cables longer than 4000 feet, but under high-speed conditions of 10Mbps, the transmission line length needs to be controlled within 100 feet. At the same time, in order to reduce the reflection of the transmission line under certain application conditions, terminal matching should be performed at both ends of the transmission line with the characteristic impedance of the wire used, and the length of the branch wires outside the main line should be as short as possible.

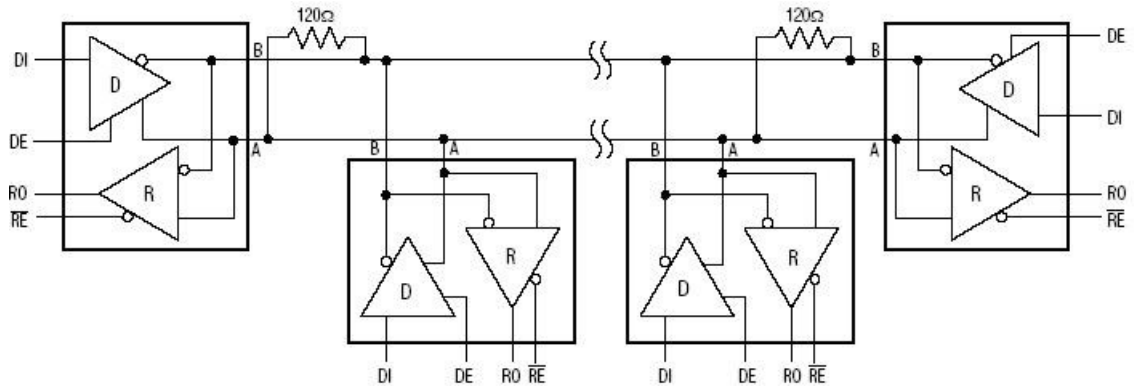


Figure 13: Typical half-duplex RS-485 network

Product information

1. Internal structure and materials

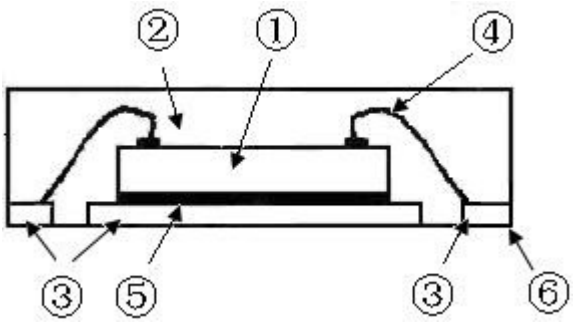


Figure 14: Typical IC internal structure diagram

NO	Item	Materials
1	Die	Silicon
2	Molding	Silica Fused
3	Lead frame	Cu-Alloy
4	Wire	Au or Cu
5	Die attach	Ag paste
6	Plating	Sn

2. Storage conditions

Operating temperature range: -40℃～+85℃
Storage temperature range: -65℃～+150℃
The recommended storage conditions are as follows:
——Temperature: +5℃～+30℃
——Humidity: 40%～70%RH

3. Welding temperature

3.1 Recommended reflow soldering temperature

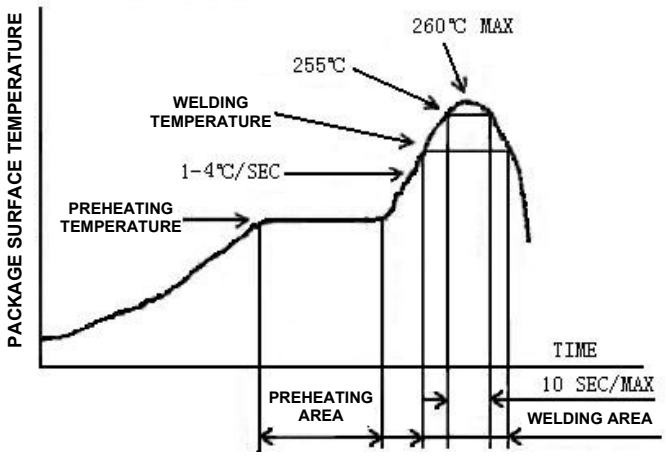


Figure 17: IC reflow soldering temperature curve

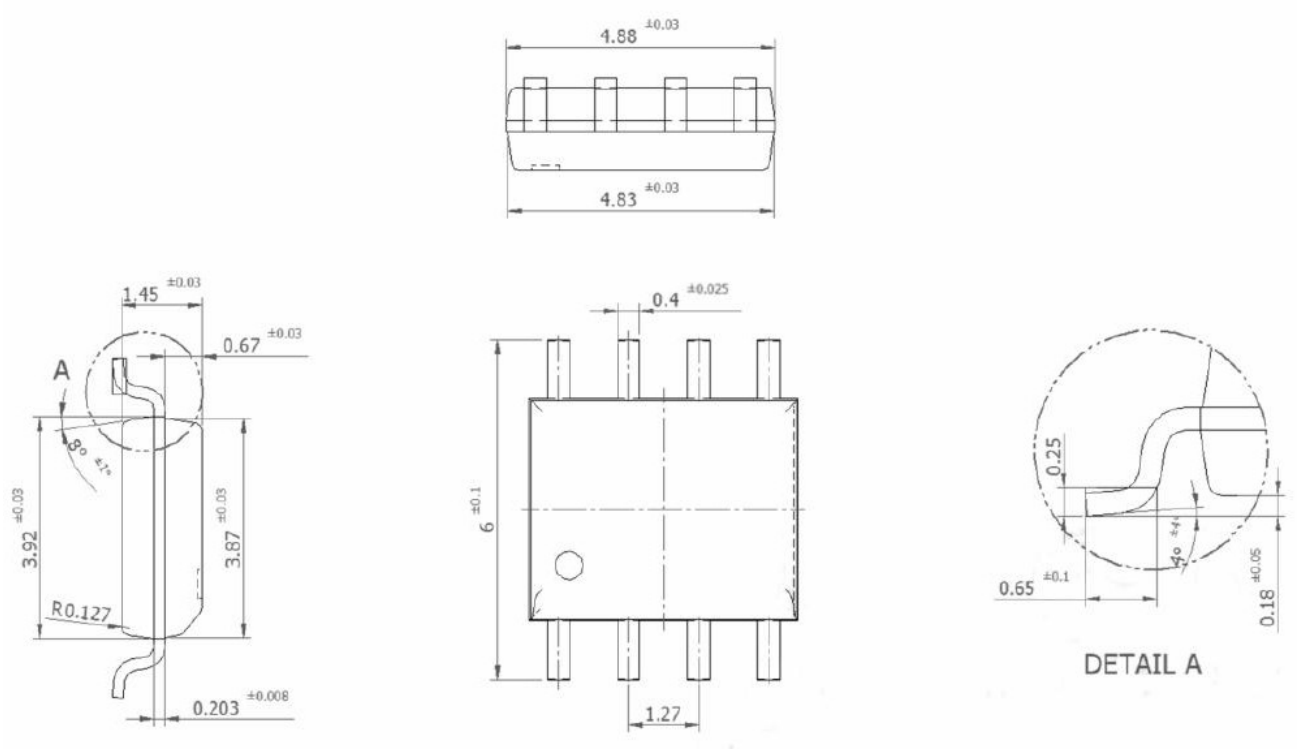
Preheating temperature: 130℃～190℃
Preheating area: 120sec max
Welding temperature: 200℃～230℃
Welding area: 60sec max

(Note) Number of maximum reflow cycles: twice

3.2 DIP8 products are suitable for wave soldering, and the soldering temperature is 235℃ ～260℃

Package information

8-pin plastic SOIC8, package code: SOP8



Note: All dimensions are in millimeters.