SGM4574
4-Bit Bidirectional Voltage-Level Translator for Open-Drain and Push-Pull Applications

GENERAL DESCRIPTION

The SGM4574 is a 4-bit, non-inverting, bidirectional voltage-level translator which features two independent configurable power-supply lines. The A and B ports track the V_{CCA} supply and V_{CCB} supply respectively. The supply voltage range is 1.65V to 5.5V for A ports and 2.3V to 5.5V for B ports. The device provides a bidirectional translation function between the different voltage nodes (including 1.8V, 2.5V, 3.3V and 5V).

The SGM4574 has an output enable (OE) function, which controls the inputs and outputs states. When OE goes low, all I/Os enter into the high-impedance state. The OE should be connected to GND via a pull-down resistor, and the minimum resistor value is depended on the current source capability of the driver.

The SGM4574 features the OE input circuit which is referenced to V_{CCA}.

The SGM4574 is available in Green UTQFN-1.8×1.8-12L, TQFN-2×2-12L and SOIC-14 packages. It operates over an ambient temperature range of -40℃ to +85℃.

FEATURES

- **Power Supply Voltage Ranges ($V_{CCA} \leq V_{CCB}$)**
  - **A Ports: 1.65V to 5.5V**
  - **B Ports: 2.3V to 5.5V**
- **Direction-Control Signal is Not Required**
- **Data Rates**
  - **Push-Pull: 24Mbps**
  - **Open-Drain: 2Mbps**
- **No Specific Power Sequences Required for V_{CCA} and V_{CCB}**
- **-40℃ to +85℃ Operating Temperature Range**
- **Available in Green UTQFN-1.8×1.8-12L, TQFN-2×2-12L and SOIC-14 Packages**

APPLICATIONS

Smart Phones
Portable Devices
Handheld Devices
PC/Tablet

TYPICAL APPLICATION

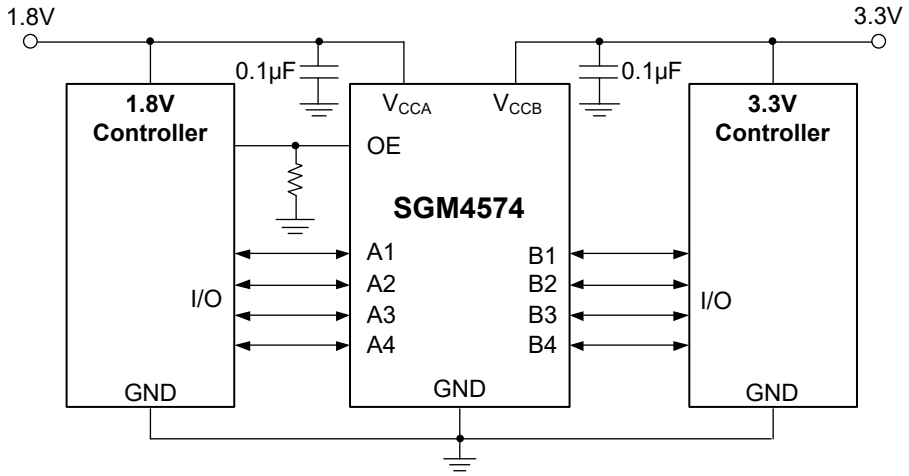


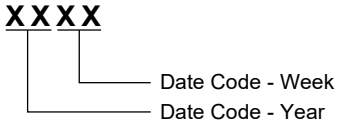
Figure 1. Typical Application Circuit

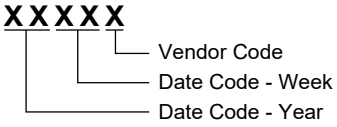
PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM4574	UTQFN-1.8×1.8-12L	-40℃ to +85℃	SGM4574YUQN12G/TR	4574 XXXX	Tape and Reel, 3000
	TQFN-2×2-12L	-40℃ to +85℃	SGM4574YTQM12G/TR	4574 XXXX	Tape and Reel, 3000
	SOIC-14	-40℃ to +85℃	SGM4574YS14G/TR	SGM4574YS14 XXXXX	Tape and Reel, 2500

MARKING INFORMATION

NOTE: XXXX = Date Code. XXXXX = Date Code and Vendor Code.





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.

OVERSTRESS CAUTION

Stresses beyond those listed may cause permanent damage to the device. Functional operation of the device at these or any other conditions beyond those indicated in the operational section of the specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

DISCLAIMER

SG Micro Corp reserves the right to make any change in circuit design, specification or other related things if necessary without notice at any time.

ESD SENSITIVITY CAUTION

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

ABSOLUTE MAXIMUM RATINGS

Supply Voltage Range
V_{CCA} ..... -0.3V to 6V
V_{CCB} ..... -0.3V to 6V
A Ports, B Ports, OE Input Voltage Range, V_I (1)
..... -0.3V to 6V
Output Voltage Range for the High-Impedance or Power-Off State, V_O (1)
A Ports ..... -0.3V to 6V
B Ports ..... -0.3V to 6V
Output Voltage Range for the High or Low State, V_O (1) (2)
A Ports ..... -0.3V to V_{CCA} + 0.3V
B Ports ..... -0.3V to V_{CCB} + 0.3V
Input Clamp Current, I_{IK} (V_I < 0) ..... -50mA
Output Clamp Current, I_{OK} (V_O < 0) ..... -25mA
Continuous Output Current, I_O ..... ±50mA
Continuous Current through V_{CCA}, V_{CCB}, or GND ..... ±100mA
Junction Temperature ..... +150℃
Storage Temperature Range ..... -65℃ to +150℃
Lead Temperature (Soldering, 10s) ..... +260℃
ESD Susceptibility
HBM 4000V
MM 300V
CDM 1000V

NOTES:
1. When the input and output current ratings are observed, the input and I/O negative voltage ratings may be exceeded.
2. V_{CCA} and V_{CCB} values are shown in the recommended operating conditions table.

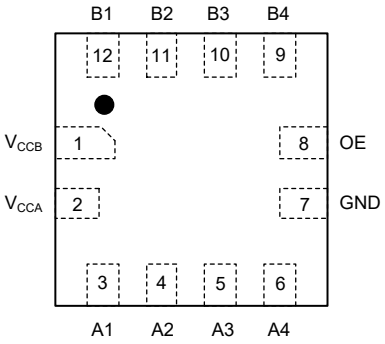
RECOMMENDED OPERATING CONDITIONS (3) (4)

Supply Voltage Range (5)
V_{CCA} ..... 1.65V to 5.5V
V_{CCB} ..... 2.3V to 5.5V
High-Level Input Voltage, V_{IH}
A Port I/Os (V_{CCA} = 1.65V, V_{CCB} = 2.3V to 5.5V)
..... V_{CCI} - 0.1V to V_{CCI}
A Port I/Os (V_{CCA} = 1.95V to 5.5V, V_{CCB} = 2.3V to 5.5V)
..... V_{CCI} - 0.4V to V_{CCI}
B Port I/Os ..... V_{CCI} - 0.4V to V_{CCI}
OE Input ..... V_{CCA} × 0.8V to 5.5V
Low-Level Input Voltage, V_{IL}
A Port I/Os ..... 0V to 0.15V
B Port I/Os ..... 0V to 0.15V
OE Input ..... 0V to V_{CCA} × 0.25V
Operating Temperature Range ..... -40℃ to +85℃

NOTES:
3. V_{CCI} is the supply voltage associated with the input ports.
4. V_{CCO} is the supply voltage associated with the output ports.
5. Ensure that $V_{CCA} \le V_{CCB}$ and V_{CCA} must not exceed 5.5V.

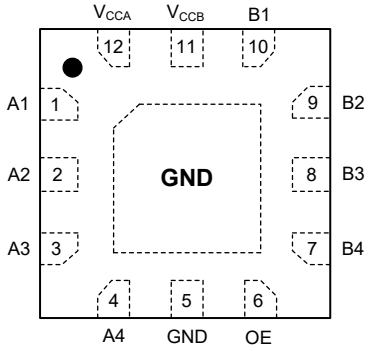
PIN CONFIGURATIONS

(TOP VIEW)



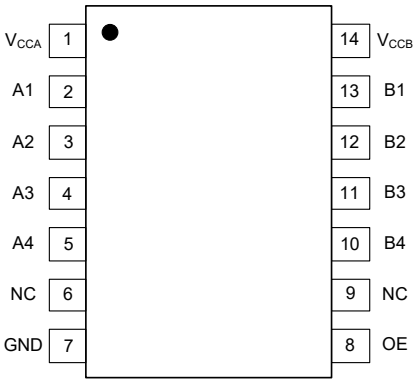
UTQFN-1.8×1.8-12L

(TOP VIEW)



TQFN-2×2-12L

(TOP VIEW)



SOIC-14

PIN DESCRIPTION

PIN			NAME	TYPE	FUNCTION
TQFN-2×2-12L	UTQFN-1.8×1.8-12L	SOIC-14			
1	3	2	A1	I/O	Input/Output 1. It tracks the V_{CCA} supply.
2	4	3	A2	I/O	Input/Output 2. It tracks the V_{CCA} supply.
3	5	4	A3	I/O	Input/Output 3. It tracks the V_{CCA} supply.
4	6	5	A4	I/O	Input/Output 4. It tracks the V_{CCA} supply.
–	–	6, 9	NC	–	No Connection. Not internally connected.
5	7	7	GND	S	Ground.
6	8	8	OE	I	Output Enable Control Pin. Active high. When OE goes low, all outputs enter into the high-impedance state. It tracks the V_{CCA} supply.
7	9	10	B4	I/O	Input/Output 4. It tracks the V_{CCB} supply.
8	10	11	B3	I/O	Input/Output 3. It tracks the V_{CCB} supply.
9	11	12	B2	I/O	Input/Output 2. It tracks the V_{CCB} supply.
10	12	13	B1	I/O	Input/Output 1. It tracks the V_{CCB} supply.
11	1	14	V_{CCB}	S	Supply Voltage on B Ports. It can be operated from 2.3V to 5.5V.
12	2	1	V_{CCA}	S	Supply Voltage on A Ports. It can be operated from 1.65V to 5.5V, and V_{CCA} is always ≤ V_{CCB}.
Exposed Pad	–	–	GND	–	Exposed pad should be soldered to PCB board and connected to GND or left floating.

ELECTRICAL CHARACTERISTICS

(V_{CCA} = 1.65V to 5.5V, V_{CCB} = 2.3V to 5.5V, Full = -40℃ to +85℃, typical values are at T_A = +25℃, unless otherwise noted.)

PARAMETER		SYMBOL	CONDITIONS		TEMP	MIN	TYP	MAX	UNITS
A Ports High-Level Output Voltage		V_{OHA}	I_{OH} = -20μA, V_{IB} ≥ V_{CCB} - 0.4V		Full	V_{CCA} × 0.67			V
A Ports Low-Level Output Voltage		V_{OLA}	I_{OL} = 1mA, V_{IB} ≤ 0.15V		Full			0.4	V
B Ports High-Level Output Voltage		V_{OHB}	I_{OH} = -20μA, V_{IA} ≥ V_{CCA} - 0.4V		Full	V_{CCB} × 0.67			V
B Ports Low-Level Output Voltage		V_{OLB}	I_{OL} = 1mA, V_{IA} ≤ 0.15V		Full			0.4	V
Input Leakage Current	OE Input	I_I			+25℃			±1	μA
					Full			±1.5	μA
Power Off Leakage Current	A Ports	I_{OFF}	V_{CCA} = 0V, V_{CCB} = 0V to 5.5V		+25℃			±0.5	μA
					Full			±1	μA
	B Ports		V_{CCA} = 0V to 5.5V, V_{CCB} = 0V		+25℃			±0.5	μA
					Full			±1	μA
3-State Output Leakage	A or B Ports	I_{OZ}	OE = 0V		+25℃			±0.5	μA
					Full			±1	μA
Quiescent Supply Current		I_{CCA}	V_I = V_O = OPEN, I_O = 0A	V_{CCA} = 1.65V to V_{CCB}, V_{CCB} = 2.3V to 5.5V	Full			13	μA
				V_{CCA} = 5.5V, V_{CCB} = 0V	Full			13	μA
				V_{CCA} = 0V, V_{CCB} = 5.5V	Full			-1	μA
		I_{CCB}	V_I = V_O = OPEN, I_O = 0A	V_{CCA} = 1.65V to V_{CCB}, V_{CCB} = 2.3V to 5.5V	Full			17	μA
				V_{CCA} = 5.5V, V_{CCB} = 0V	Full			-1	μA
				V_{CCA} = 0V, V_{CCB} = 5.5V	Full			8	μA
		I_{CCA} + I_{CCB}	V_I = V_O = OPEN, I_O = 0A	V_{CCA} = 1.65V to V_{CCB}, V_{CCB} = 2.3V to 5.5V	Full			21	μA
		I_{CCZA}	V_I = V_{CCI} or 0V, I_O = 0A, OE = 0V	V_{CCA} = 1.65V to V_{CCB}, V_{CCB} = 2.3V to 5.5V	Full			13	μA
		I_{CCZB}	V_I = V_{CCI} or 0V, I_O = 0A, OE = 0V	V_{CCA} = 1.65V to V_{CCB}, V_{CCB} = 2.3V to 5.5V	Full			8	μA
OE Input Capacitance		C_I	V_{CCA} = 3.3V, V_{CCB} = 3.3V		+25℃		6		pF
Input/Output Capacitance	A Ports	C_{IO}	V_{CCA} = 3.3V, V_{CCB} = 3.3V		+25℃		6		pF
	B Ports				+25℃		6		pF

TIMING REQUIREMENTS

(T_A = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	V_{CCB} = 2.5V	V_{CCB} = 3.3V	V_{CCB} = 5V	UNITS
			TYP	TYP	TYP	
(V_{CCA} = 1.8V)						
Data Rate		Push-pull driving	24	24	24	Mbps
		Open-drain driving	2	2	2	
Pulse Duration (Data Inputs)	t_W	Push-pull driving	41	41	41	ns
		Open-drain driving	500	500	500	
(V_{CCA} = 2.5V)						
Data Rate		Push-pull driving	24	24	24	Mbps
		Open-drain driving	2	2	2	
Pulse Duration (Data Inputs)	t_W	Push-pull driving	41	41	41	ns
		Open-drain driving	500	500	500	
(V_{CCA} = 3.3V)						
Data Rate		Push-pull driving		24	24	Mbps
		Open-drain driving		2	2	
Pulse Duration (Data Inputs)	t_W	Push-pull driving		41	41	ns
		Open-drain driving		500	500	
(V_{CCA} = 5V)						
Data Rate		Push-pull driving			24	Mbps
		Open-drain driving			2	
Pulse Duration (Data Inputs)	t_W	Push-pull driving			41	ns
		Open-drain driving			500	

SWITCHING CHARACTERISTICS

(V_{CCA} = 1.8V, T_A = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		V_{CCB} = 2.5V	V_{CCB} = 3.3V	V_{CCB} = 5V	UNITS
				TYP	TYP	TYP	
Propagation Delay	t_{PHL}	A to B	Push-pull driving	3.5	3.5	5.1	ns
			Open-drain driving	56.2	27.0	27.9	
	t_{PLH}		Push-pull driving	5.1	4.5	4.4	
			Open-drain driving	142.7	119.8	92.1	
	t_{PHL}	B to A	Push-pull driving	3.0	2.8	3.4	ns
			Open-drain driving	25.6	25.3	25.4	
	t_{PLH}		Push-pull driving	3.7	3.2	2.6	
			Open-drain driving	55.1	49.4	48.0	
Enable Time	t_{EN} (t_{PZH} & t_{PZL})	OE to A or B		28.4	24.6	22.5	ns
Disable Time	t_{DIS} (t_{PHZ} & t_{PLZ})	OE to A or B		674	677	671	
Rise Time	t_{rA}	A Ports	Push-pull driving	7.2	8.1	9.1	ns
			Open-drain driving	12.3	11.3	10.1	
	t_{rB}	B Ports	Push-pull driving	7.2	6.1	5.4	ns
			Open-drain driving	99.3	72.9	36.7	
Fall Time	t_{fA}	A Ports	Push-pull driving	5.7	5.9	6.9	ns
			Open-drain driving	3.8	3.6	3.6	
	t_{fB}	B Ports	Push-pull driving	7.9	7.8	8.4	ns
			Open-drain driving	3.5	8.4	5.0	
Data Rate		Push-pull driving		24	24	24	Mbps
		Open-drain driving		2	2	2	

SWITCHING CHARACTERISTICS (continued)

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

PARAMETER	SYMBOL	CONDITIONS		V_{CCB} = 2.5V	V_{CCB} = 3.3V	V_{CCB} = 5V	UNITS
				TYP	TYP	TYP	
Propagation Delay	t_{PHL}	A to B	Push-pull driving	4.5	4.5	5.0	ns
			Open-drain driving	26.2	27.1	26.2	
	t_{PLH}		Push-pull driving	3.8	3.3	3.1	
			Open-drain driving	111.0	95.6	76.0	
	t_{PHL}	B to A	Push-pull driving	4.2	4.0	4.1	ns
			Open-drain driving	25.8	25.5	25.6	
	t_{PLH}		Push-pull driving	3.7	3.5	3.6	
			Open-drain driving	52.7	50.6	49.8	
Enable Time	t_{EN} (t_{PZH} & t_{PZL})	OE to A or B		21.6	17.4	15.5	ns
Disable Time	t_{DIS} (t_{PHZ} & t_{PLZ})	OE to A or B		689	688	678	
Rise Time	t_{rA}	A Ports	Push-pull driving	6.4	6.7	6.9	ns
			Open-drain driving	10.5	7.7	7.8	
	t_{rB}	B Ports	Push-pull driving	6.2	5.4	4.9	ns
			Open-drain driving	67.0	50.9	30.5	
Fall Time	t_{fA}	A Ports	Push-pull driving	8.6	8.2	7.3	ns
			Open-drain driving	3.6	3.3	3.1	
	t_{fB}	B Ports	Push-pull driving	8.5	7.7	8.1	ns
			Open-drain driving	3.4	3.9	5.4	
Data Rate		Push-pull driving		24	24	24	Mbps
		Open-drain driving		2	2	2	

SWITCHING CHARACTERISTICS (continued)

(V_{CCA} = 3.3V, T_A = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		V_{CCB} = 3.3V	V_{CCB} = 5V	UNITS
				TYP	TYP	
Propagation Delay	t_{PHL}	A to B	Push-pull driving	4.4	5.0	ns
			Open-drain driving	25.5	27.5	
	t_{PLH}		Push-pull driving	3.5	2.7	
			Open-drain driving	52.4	51.4	
	t_{PHL}	B to A	Push-pull driving	4.1	4.4	ns
			Open-drain driving	25.8	54.3	
	t_{PLH}		Push-pull driving	3.1	2.8	
			Open-drain driving	50.3	49.4	
Enable Time	t_{EN} (t_{PZH} & t_{PZL})	OE to A or B		15.9	13.8	ns
Disable Time	t_{DIS} (t_{PHZ} & t_{PLZ})	OE to A or B		699	678	
Rise Time	t_{rA}	A Ports	Push-pull driving	5.2	6.2	ns
			Open-drain driving	6.3	6.2	
	t_{rB}	B Ports	Push-pull driving	5.3	4.7	ns
			Open-drain driving	8.3	6.8	
Fall Time	t_{fA}	A Ports	Push-pull driving	7.3	7.6	ns
			Open-drain driving	3.1	3.0	
	t_{fB}	B Ports	Push-pull driving	7.7	7.3	ns
			Open-drain driving	3.8	4.6	
Data Rate		Push-pull driving		24	24	Mbps
		Open-drain driving		2	2	

SWITCHING CHARACTERISTICS (continued)

(V_{CCA} = 5V, T_A = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		V_{CCB} = 5V	UNITS
				TYP	
Propagation Delay	t_{PHL}	A to B	Push-pull driving	5.3	ns
			Open-drain driving	27.4	
	t_{PLH}		Push-pull driving	2.4	
			Open-drain driving	50.6	
	t_{PHL}	B to A	Push-pull driving	5.0	ns
			Open-drain driving	26.3	
	t_{PLH}		Push-pull driving	2.2	
			Open-drain driving	49.3	
Enable Time	t_{EN} (t_{PZH} & t_{PZL})	OE to A or B		22.6	ns
Disable Time	t_{DIS} (t_{PHZ} & t_{PLZ})	OE to A or B		665	
Rise Time	t_{rA}	A Ports	Push-pull driving	5.3	ns
			Open-drain driving	5.0	
	t_{rB}	B Ports	Push-pull driving	4.9	ns
			Open-drain driving	6.5	
Fall Time	t_{fA}	A Ports	Push-pull driving	8.5	ns
			Open-drain driving	2.8	
	t_{fB}	B Ports	Push-pull driving	7.7	ns
			Open-drain driving	4.2	
Data Rate		Push-pull driving		24	Mbps
		Open-drain driving		2	

FUNCTIONAL BLOCK DIAGRAM

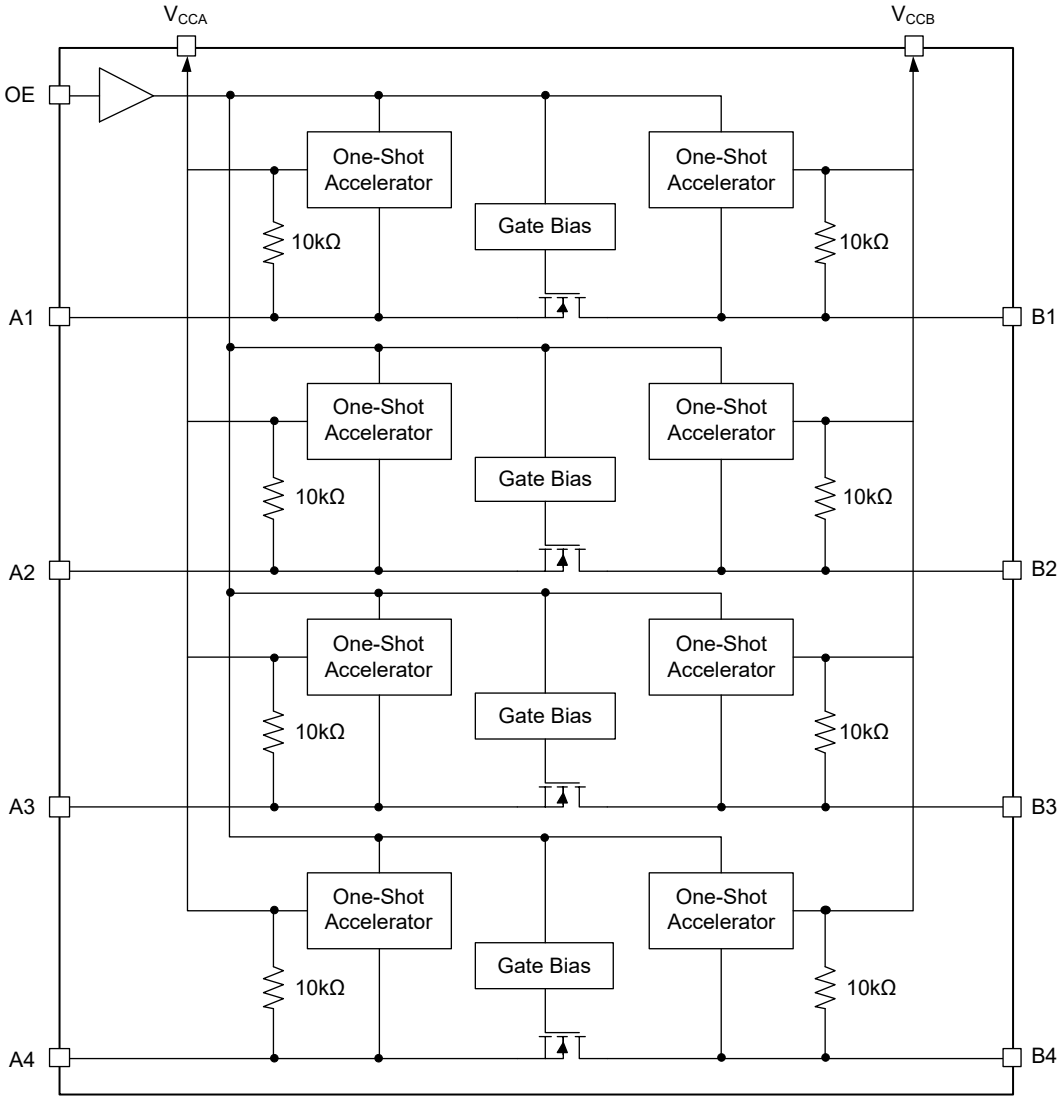


Figure 2. Block Diagram

WAVEFORMS

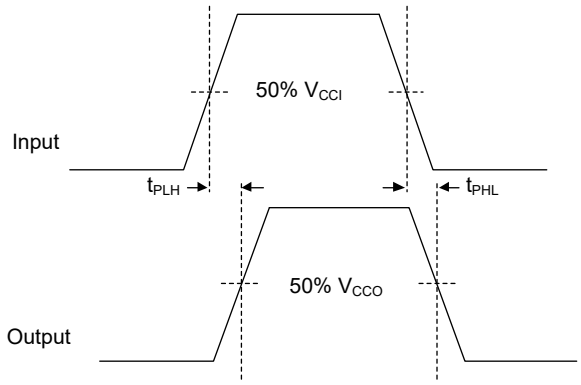


Figure 3. Propagation Delay

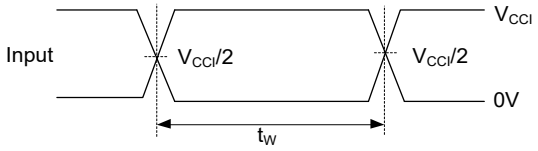


Figure 4. Pulse Duration

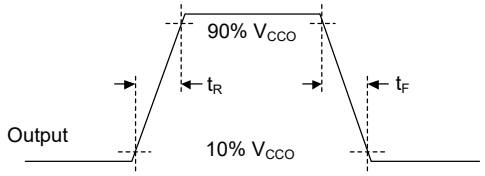
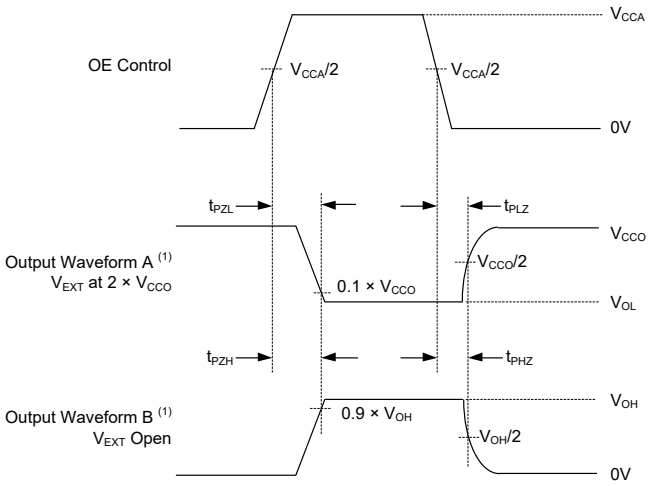


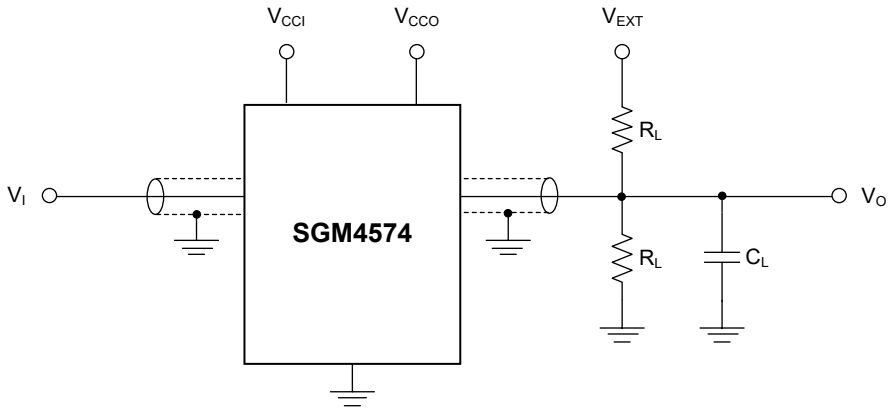
Figure 5. Rise Time and Fall Time of Data Output



NOTE:
1. Waveform A indicates an output that is high except for OE is high. Waveform B indicates an output that is low except for OE is high.

Figure 6. Enable and Disable Times

TEST CIRCUIT



Definitions for test circuit:
R_L = Load resistance.
C_L = Load capacitance includes jig and probe capacitance.
V_{EXT} = External voltage for measuring switching times.
V_{CCI} = Supply voltage associated with the input.
V_{CCO} = Supply voltage associated with the output.

Figure 7. Test Circuit for Measuring Switching Times

DETAILED DESCRIPTION

Overview

The SGM4574 can transmit the logic waveform from port A to port B and port B to port A. The acceptable voltage range for port A is from 1.65V to 5.5V while the acceptable voltage range for port B is from 2.3V to 5.5V. In order to enhance the data rate of the transmission, the one-shot accelerators are taken into account. Also, the main structure of the SGM4574 is pass gate. For the operation of the device, the external resistor is not needed as there is a pull-up resistor at each open-drain output of the device. On top of this, the device is also supported the output of push-pull CMOS logic.

Architecture

The SGM4574 can switch the direction of the transmission for port A and port B automatically without any external control.

There is no need to add an external direction control for the application of the SGM4574. Also, each I/O pin can be an input or output of the voltage translator.

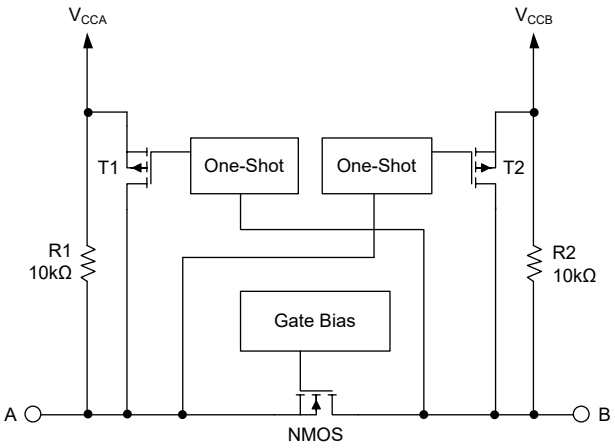


Figure 8. Architecture of an SGM4574 Cell

The explanation of two main parts of the internal circuit for the SGM4574 is shown as below:

- There is an NMOS between port A and port B to switch on or off the transmission.
- The one-shot accelerator can be used to accelerate the rising edges of the signal for port A and port B automatically.

Input Driver Requirements

The falling time of port A and port B and t_{PHL} depend on the output impedance of the connected device. The values of parameters which are t_{fA}, t_{fB}, t_{PHL} and data rates are specified when the resistance of external driver is less than 50Ω.

Power-Up

For the application of the SGM4574, the V_{CCA} should be less than V_{CCB}. However, it does not matter if the power supply voltage is ramping, and the sequence of power-up for both V_{CCA} and V_{CCB} is not defined.

Enable and Disable

The function of OE is used to disable SGM4574 by setting the transmitting I/O pins to high-impedance mode. The definition of disable time (t_{DIS}) is the time period between OE goes low and when all of the I/O pins are in high-impedance mode. The enable time (t_{EN}) is defined as the time period between OE goes to high position and one-shot part starts to operate.

Pull-Up or Pull-Down Resistors on I/O Lines

For the I/O pin of A and B sides, there is a 10kΩ pull-up resistor to provide a high position for each I/O pin. However, if a smaller pull-up resistor is required, the users can add an external resistor which is parallel with the 10kΩ resistor.

Device Functional Modes

The SGM4574 contains two functional modes: enabled and disabled. When the OE input goes to low, all I/Os are set in HIZ state, the device will be disabled; when the OE input goes to high, the device will be enabled.

APPLICATION INFORMATION

The SGM4574 can be used in the application between two different voltage interfaces or systems. The SGM4574 can be used in the situation where the open-drain or push-pull driver connected to its data I/Os, while the SGM4574 is beneficial in the application of push-pull.

Design Requirements

The values in Table 1 are considered for the following design.

Table 1. Design Parameters

Design Parameter	Example Value
Input Voltage Range	1.65V to 5.5V
Output Voltage Range	2.3V to 5.5V

Detailed Design Procedure

The following parameters should be determined:

• Input voltage range

The input voltage range of each side of the SGM4574 is determined by the associated power supply voltage. For logic high, the input signal should be higher than its V_{IH}. Also, for logic low, the input signal should be lower than its V_{IL} for logic low.

• Output voltage range

The associated supply voltage at the output side determines the range of the output logic waveform.

There is a 10kΩ pull-up resistor integrated inside the SGM4574. Also, if the small RC is required, an external pull-up resistor is required to be parallel with the internal resistor.

• The V_{OH} and V_{OL} are decreased because of the influence of the external pull-down resistor. The following equation illustrates how to calculate the V_{OH} with the given pull-down resistor.

$$V_{OH} = V_{CCX} \times R_{PD}/(R_{PD} + 10k\Omega) \quad (1)$$

where,

V_{CCX} illustrates the supply voltage for ports A or B.

R_{PD} illustrates the selected value of the external pull-down resistor.

Power-Supply Recommendations

There are two separate power supplies for the operation of SGM4574. The supply range of V_{CCB} is from 2.3V to 5.5V while the supply voltage for V_{CCA} is from 1.65V to 5.5V. The nodes of ports A and B can be set any voltage stages within the supply voltage, which are 1.8V, 2.5V, 3.3V and 5V. Also, the output signal will track the selected supply voltage as well.

There is no rule about the power-up sequence of the power supply for ports A and B. The device will not be damaged if $V_{CCA} \geq V_{CCB}$; however, for normal operation, the users need to make sure that $V_{CCA} \leq V_{CCB}$.

The Output Enable (OE) is powered by V_{CCA} and all of the input I/O pins are in high-impedance state if OE = GND. For the period of powering up, if the users desire high-impedance state of the I/Os, a pull-down resistor is required to tie the voltage of OE pin to GND. The ability of sourcing current can determine selected value of the pull-down resistor.

Layout Guidelines

The following recommendations of PCB layout should be allowed:

• Use bypass capacitor at the power supply pins.

• To decrease the external loading, short traces should be taken into account.

• The length of the PCB trace should be short so that the round-trip delay of the reflection is below the one-shot period (30ns). Also, the reflection can meet low impedance at the source.

• Sometimes, the external pull-up resistors and loading capacitance is required for different systems, so that it is recommended that the pads at the signal trace is necessary.

REVISION HISTORY

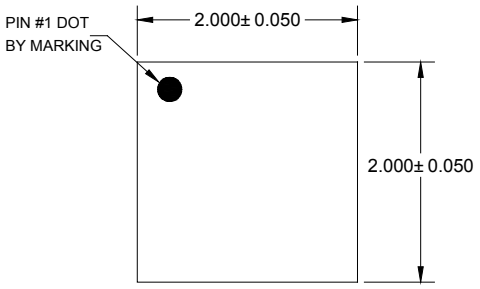
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Original (JUNE 2018) to REV.A

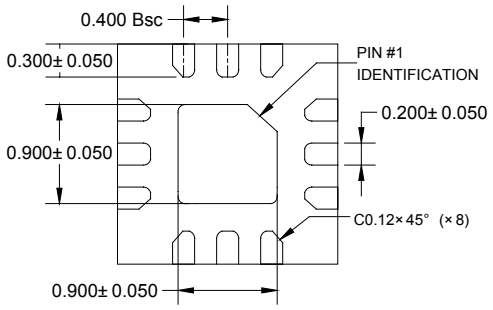
Changed from product preview to production data	All

PACKAGE OUTLINE DIMENSIONS

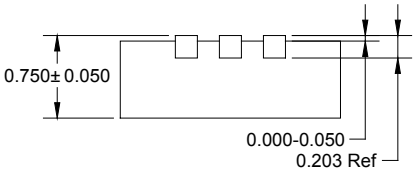
TQFN-2×2-12L



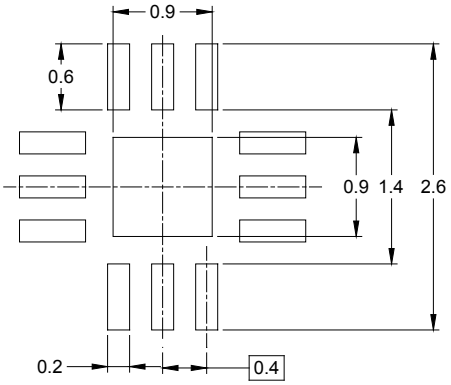
TOP VIEW



BOTTOM VIEW



SIDE VIEW

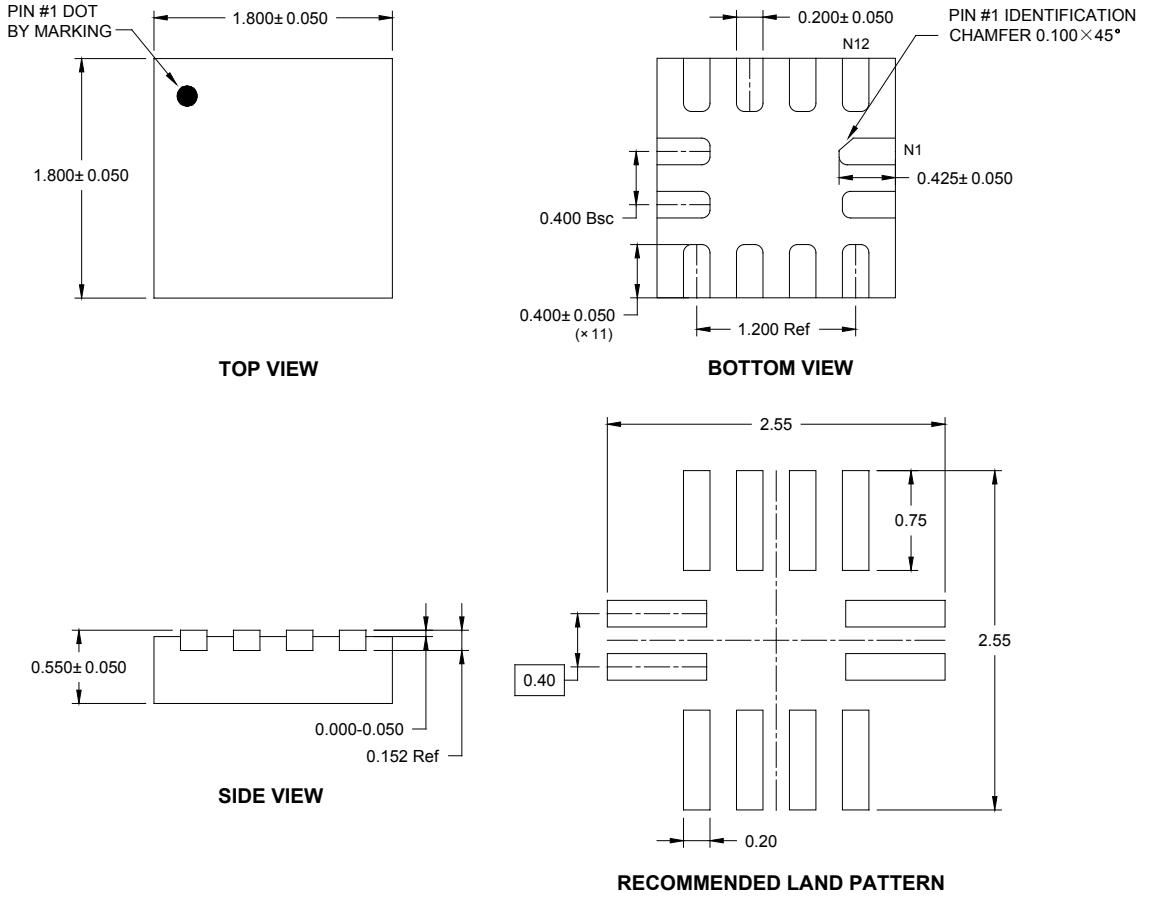


RECOMMENDED LAND PATTERN

NOTE: All linear dimensions are in millimeters.

PACKAGE OUTLINE DIMENSIONS

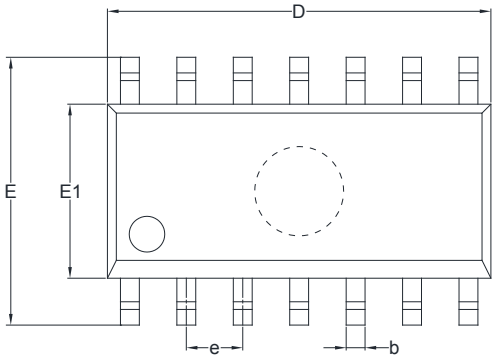
UTQFN-1.8×1.8-12L

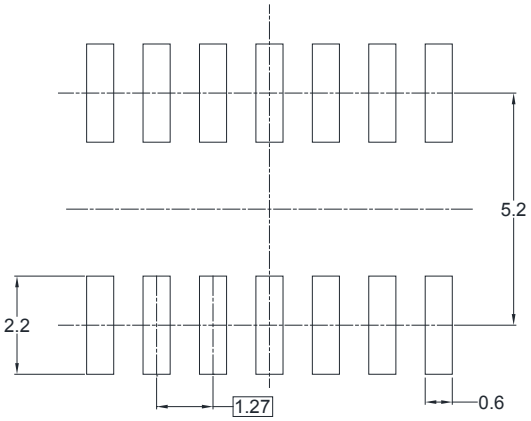


NOTE: All linear dimensions are in millimeters.

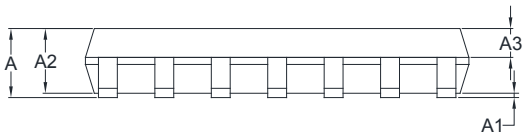
PACKAGE OUTLINE DIMENSIONS

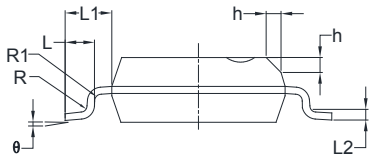
SOIC-14





RECOMMENDED LAND PATTERN (Unit: mm)

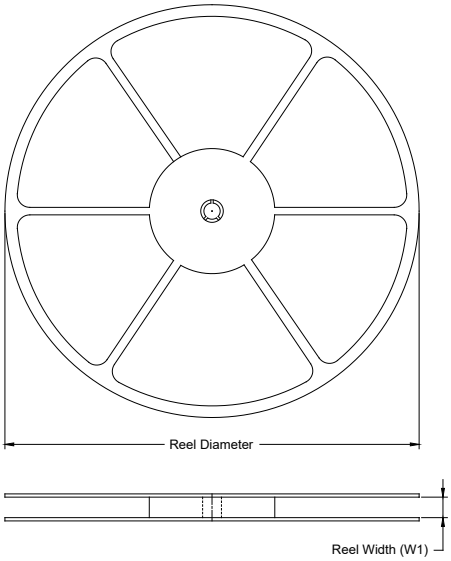




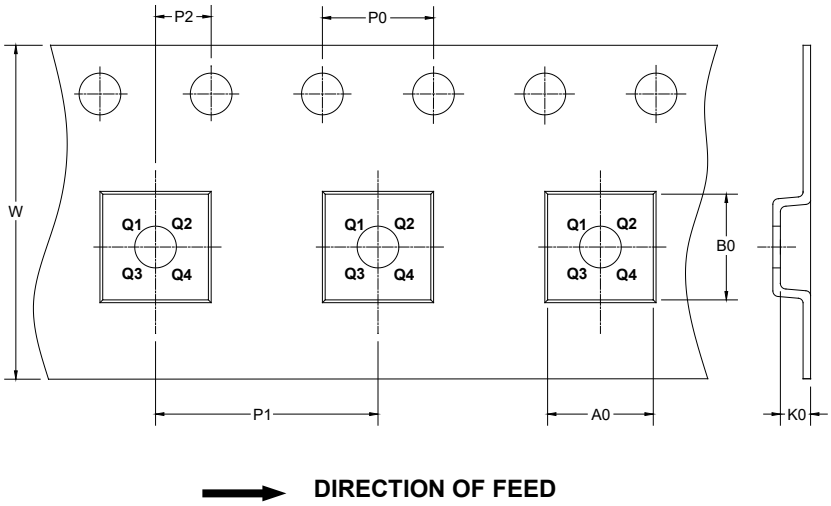
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.35	1.75	0.053	0.069
A1	0.10	0.25	0.004	0.010
A2	1.25	1.65	0.049	0.065
A3	0.55	0.75	0.022	0.030
b	0.36	0.49	0.014	0.019
D	8.53	8.73	0.336	0.344
E	5.80	6.20	0.228	0.244
E1	3.80	4.00	0.150	0.157
e	1.27 BSC		0.050 BSC	
L	0.45	0.80	0.018	0.032
L1	1.04 REF		0.040 REF	
L2	0.25 BSC		0.01 BSC	
R	0.07		0.003	
R1	0.07		0.003	
h	0.30	0.50	0.012	0.020
θ	0°	8°	0°	8°

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



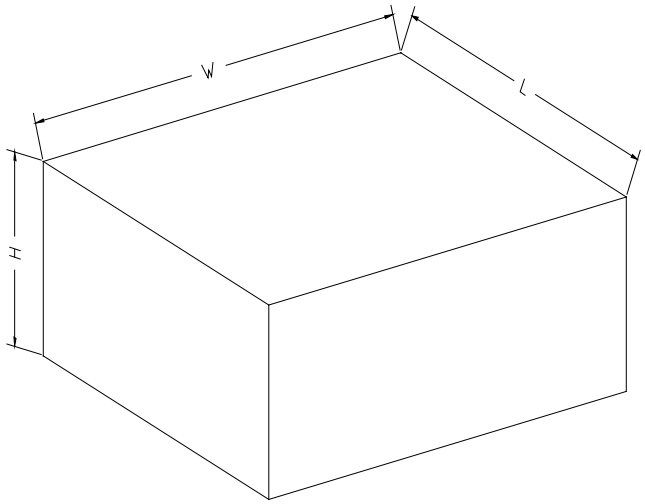
NOTE: The picture is only for reference. Please make the object as the standard.

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
TQFN-2×2-12L	7″	9.5	2.30	2.30	0.90	4.0	4.0	2.0	8.0	Q2
UTQFN-1.8×1.8-12L	7″	9.0	2.10	2.10	0.80	4.0	4.0	2.0	8.0	Q2
SOIC-14	13″	16.4	6.60	9.30	2.10	4.0	8.0	2.0	16.0	Q1

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
13″	386	280	370	5

DD0002