SGM4564
4-Bit Bidirectional Voltage-Level Translator with Auto Direction Sensing

GENERAL DESCRIPTION

The SGM4564 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 1.2V to 5.5V for A ports and 1.65V to 5.5V for B ports. The device provides a bidirectional translation function between the different voltage nodes (including 1.2V, 1.5V, 1.8V, 2.5V, 3.3V and 5V).

The SGM4564 has an output enable (OE) function, which controls the outputs states. When OE goes low, all outputs 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 SGM4564 features the OE input circuit which is referenced to V_{CCA}.

The SGM4564 is available in Green SOIC-14, UTQFN-1.8×1.8-12L and TQFN-2×2-12L packages. It operates over an ambient temperature range of -40℃ to +85℃.

FEATURES

- **Power Supply Voltage Range ($V_{CCA} \leq V_{CCB}$)**
  - **A Ports: 1.2V to 5.5V**
  - **B Ports: 1.65V to 5.5V**
- **Support V_{CCA} or V_{CCB} Isolation**
  - **When V_{CCA} or V_{CCB} is Low, Device Enters Power-Down Mode**
- **OE Input Circuit Referenced to V_{CCA}**
- **Support Partial-Power-Down Function**
- **Support Push-Pull Output**
- **Low Power Consumption**
- **-40℃ to +85℃ Operating Temperature Range**
- **Available in Green SOIC-14, UTQFN-1.8×1.8-12L and TQFN-2×2-12L Packages**

APPLICATIONS

Universal Asynchronous Receiver/Transmitter

General Purpose I/O (GPIO)

Smart Phones

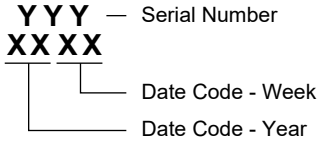
Portable Equipment

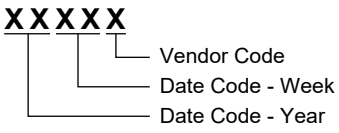
PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM4564	UTQFN-1.8×1.8-12L	-40℃ to +85℃	SGM4564YUQN12G/TR	4564 XXXX	Tape and Reel, 3000
	SOIC-14	-40℃ to +85℃	SGM4564YS14G/TR	SGM4564YS14 XXXXX	Tape and Reel, 2500
	TQFN-2×2-12L	-40℃ to +85℃	SGM4564YTQM12G/TR	4564 XXXX	Tape and Reel, 3000

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 in Absolute Maximum Ratings may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect reliability. Functional operation of the device at any conditions beyond those indicated in the Recommended Operating Conditions section is not implied.

DISCLAIMER

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

ESD SENSITIVITY CAUTION

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

ABSOLUTE MAXIMUM RATINGS

Supply Voltage Range
V_{CCA} ..... -0.3V to 6V
V_{CCB} ..... -0.3V to 6V
Input Voltage Range, V_I
A Ports ..... -0.3V to 6V
B Ports ..... -0.3V to 6V
Output Voltage Range for the High-Impedance or Power-Off State, V_O
A Ports ..... -0.3V to 6V
B Ports ..... -0.3V to 6V
Output Voltage Range for the High or Low State, V_O (1)
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 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

NOTE:
1. V_{CCA} and V_{CCB} values are shown in the recommended operating conditions table.

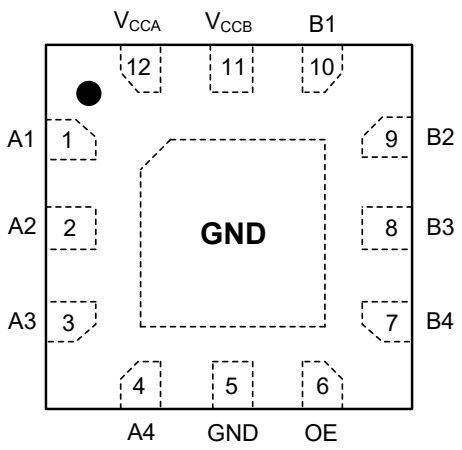
RECOMMENDED OPERATING CONDITIONS (2) (3)

Supply Voltage Range
V_{CCA} ..... 1.2V to 5.5V
V_{CCB} ..... 1.65V to 5.5V
High-Level Input Voltage, V_{IH}
Data Inputs ..... V_{CCI} × 0.85 (4) to V_{CCI}
OE Input ..... V_{CCA} × 0.85 to 5.5V
Low-Level Input Voltage, V_{IL}
Data Inputs ..... 0V to V_{CCI} × 0.2 (4)
OE Input ..... 0V to V_{CCA} × 0.2
Output Voltage Range for the High-Impedance or Power-Off State, V_O
..... 0V to 5.5V
B Ports ..... 0V to 5.5V
Input Transition Rise or Fall Rate, Δt/ΔV
A Port Inputs ..... 40ns/V (MAX)
B Port Inputs ..... 40ns/V (MAX)
Operating Temperature Range ..... -40℃ to +85℃

NOTES:
2. Ensure that the A side and B side of the unused data I/O pairs remain the same state, that is., both at V_{CCI} or both at GND.
3. Ensure that $V_{CCA} \le V_{CCB}$ and V_{CCA} must not exceed 5.5V.
4. V_{CCI} is the supply voltage associated with the input ports.

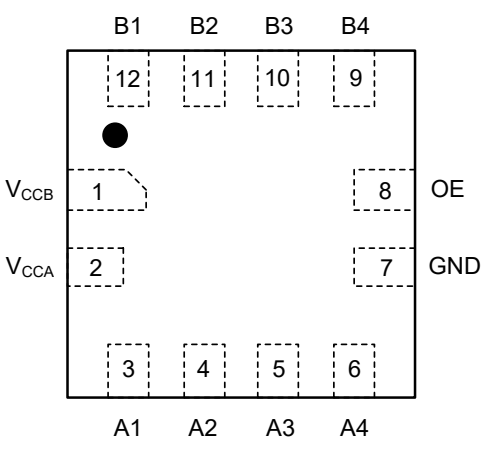
PIN CONFIGURATIONS

(TOP VIEW)



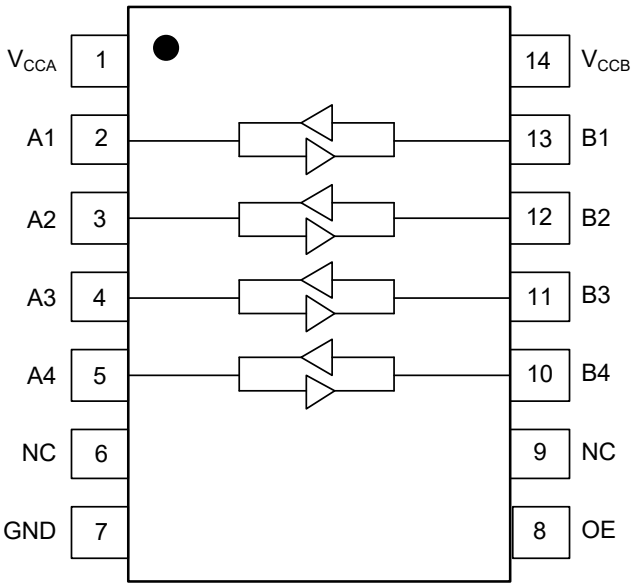
TQFN-2×2-12L

(TOP VIEW)



UTQFN-1.8×1.8-12L

(TOP VIEW)



SOIC-14

PIN DESCRIPTION

PIN			NAME	FUNCTION
SOIC-14	UTQFN-1.8×1.8-12L	TQFN-2×2-12L		
1	2	12	V_{CCA}	Supply Voltage on A Ports. It can be operated from 1.2V to 5.5V, and V_{CCA} is always ≤ V_{CCB}.
2	3	1	A1	Input/Output 1. It tracks the V_{CCA} supply.
3	4	2	A2	Input/Output 2. It tracks the V_{CCA} supply.
4	5	3	A3	Input/Output 3. It tracks the V_{CCA} supply.
5	6	4	A4	Input/Output 4. It tracks the V_{CCA} supply.
6, 9	—	—	NC	No Connection. Not internally connected.
7	7	5	GND	Ground.
8	8	6	OE	Output Enable Control Pin. Active high. When OE goes low, all outputs enter into the high-impedance state. It tracks the V_{CCA} supply.
10	9	7	B4	Input/Output 4. It tracks the V_{CCB} supply.
11	10	8	B3	Input/Output 3. It tracks the V_{CCB} supply.
12	11	9	B2	Input/Output 2. It tracks the V_{CCB} supply.
13	12	10	B1	Input/Output 1. It tracks the V_{CCB} supply.
14	1	11	V_{CCB}	Supply Voltage on B Ports. It can be operated from 1.65V to 5.5V.
—	—	Exposed Pad	GND	Exposed pad should be soldered to PCB board and connected to GND or left floating.

ELECTRICAL CHARACTERISTICS

(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_{CCA} = 1.2V	+25℃		1.05		V
				V_{CCA} = 1.4V to 5.5V	Full	V_{CCA} - 0.3			
A Ports Low-Level Output Voltage		V_{OLA}	I_{OL} = 20μA	V_{CCA} = 1.2V	+25℃		0.1		
				V_{CCA} = 1.4V to 5.5V	Full			0.3	
B Ports High-Level Output Voltage		V_{OHB}	I_{OH} = -20μA	V_{CCB} = 1.65V to 5.5V	Full	V_{CCB} - 0.3			
B Ports Low-Level Output Voltage		V_{OLB}	I_{OL} = 20μA	V_{CCB} = 1.65V to 5.5V	Full			0.3	
Input Leakage Current	OE Input	I_I	OE = V_{CCA} or GND, V_{CCA} = 1.2V to 5.5V, V_{CCB} = 1.65V to 5.5V		+25℃			±1	μA
					Full			±1.5	
Power-Off Leakage Current	A Ports	I_{OFF}	V_I or V_O = 0V to 5.5V, V_{CCA} = 0V, V_{CCB} = 0V to 5.5V		+25℃			±0.5	
					Full			±1	
	B Ports		V_I or V_O = 0V to 5.5V, V_{CCA} = 0V to 5.5V, V_{CCB} = 0V		+25℃			±0.5	
					Full			±1	
3-State Output Leakage	A or B Ports	I_{OZ}	OE = GND, V_{CCA} = 1.2V to 5.5V, V_{CCB} = 1.65V to 5.5V		+25℃			±0.5	
					Full			±1	
Quiescent Supply Current		I_{CCA}	V_I = V_{CCI} or GND, I_O = 0A, OE = V_{CCA}	V_{CCA} = 1.2V, V_{CCB} = 1.65V to 5.5V	+25℃		0.1		μA
				V_{CCA} = 1.4V to 5.5V, V_{CCB} = 1.65V to 5.5V	Full			12	
				V_{CCA} = 5.5V, V_{CCB} = 0V				12	
				V_{CCA} = 0V, V_{CCB} = 5.5V				-1	
		I_{CCB}	V_I = V_{CCI} or GND, I_O = 0A, OE = V_{CCA}	V_{CCA} = 1.2V, V_{CCB} = 1.65V to 5.5V	+25℃		1		μA
				V_{CCA} = 1.4V to 5.5V, V_{CCB} = 1.65V to 5.5V	Full			10	
				V_{CCA} = 5.5V, V_{CCB} = 0V				-1	
				V_{CCA} = 0V, V_{CCB} = 5.5V				9	
		I_{CCA} + I_{CCB}	V_I = V_{CCI} or GND, I_O = 0A, OE = V_{CCA}	V_{CCA} = 1.2V, V_{CCB} = 1.65V to 5.5V	+25℃		1		μA
				V_{CCA} = 1.4V to 5.5V, V_{CCB} = 1.65V to 5.5V	Full			19	
		I_{CCZA}	V_I = V_{CCI} or GND, I_O = 0A, OE = GND	V_{CCA} = 1.2V, V_{CCB} = 1.65V to 5.5V	+25℃		0.1		μA
				V_{CCA} = 1.4V to 5.5V, V_{CCB} = 1.65V to 5.5V	Full			12	
		I_{CCZB}	V_I = V_{CCI} or GND, I_O = 0A, OE = GND	V_{CCA} = 1.2V, V_{CCB} = 1.65V to 5.5V	+25℃		0.1		μA
				V_{CCA} = 1.4V to 5.5V, V_{CCB} = 1.65V to 5.5V	Full			9	
OE Input Capacitance		C_I	V_{CCA} = 1.2V to 5.5V, V_{CCB} = 1.65V to 5.5V		+25℃		5.2		pF
Input/Output Capacitance	A Ports	C_{IO}	V_{CCA} = 1.2V to 5.5V, V_{CCB} = 1.65V to 5.5V		+25℃		4.4		pF
	B Ports				+25℃		4.4		

NOTE:

1. V_{CCI} is the supply voltage associated with the input ports.

TIMING REQUIREMENTS

(T_A = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	V_{CCB} = 1.8V	V_{CCB} = 2.5V	V_{CCB} = 3.3V	V_{CCB} = 5V	UNITS
		TYP	TYP	TYP	TYP	
(V_{CCA} = 1.2V)						
Data Rate		20	20	20	20	Mbps
Pulse Duration (Data Inputs)	t_W	50	50	50	50	ns
(V_{CCA} = 1.5V)						
Data Rate		40	40	40	40	Mbps
Pulse Duration (Data Inputs)	t_W	25	25	25	25	ns
(V_{CCA} = 1.8V)						
Data Rate		60	60	60	60	Mbps
Pulse Duration (Data Inputs)	t_W	17	17	17	17	ns
(V_{CCA} = 2.5V)						
Data Rate			100	100	100	Mbps
Pulse Duration (Data Inputs)	t_W		10	10	10	ns
(V_{CCA} = 3.3V)						
Data Rate				100	100	Mbps
Pulse Duration (Data Inputs)	t_W			10	10	ns
(V_{CCA} = 5V)						
Data Rate					100	Mbps
Pulse Duration (Data Inputs)	t_W				10	ns

SWITCHING CHARACTERISTICS

(V_{CCA} = 1.2V, T_A = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL		CONDITIONS	V_{CCB} = 1.8V	V_{CCB} = 2.5V	V_{CCB} = 3.3V	V_{CCB} = 5V	UNITS
				TYP	TYP	TYP	TYP	
Propagation Delay	t_{PD}	t_{PLH}	A to B	23.8	21.2	20.4	20.6	ns
		t_{PHL}		30.0	28.4	29.5	31.4	
		t_{PLH}	B to A	31.1	27.6	27.3	28.8	
		t_{PHL}		22.0	19.8	19.3	18.2	
Enable Time	t_{EN}	t_{PZH}	OE to A	70.1	68.8	67.6	64.5	ns
		t_{PZL}		58.9	55.8	56.3	56.1	
		t_{PZH}	OE to B	44.2	40.7	41.0	42.8	
		t_{PZL}		69.7	66.4	67.5	67.5	
Disable Time	t_{DIS}	t_{PHZ}	OE to A	1050	1070	1030	1040	ns
		t_{PLZ}		480	480	490	470	
		t_{PHZ}	OE to B	1080	1090	1080	1100	
		t_{PLZ}		510	560	570	560	
Rise Time	t_{rA}		A Ports	18.0	17.1	16.8	14.7	ns
	t_{rB}		B Ports	3.6	2.3	1.9	1.5	ns
Fall Time	t_{fA}		A Ports	7.2	6.1	5.2	2.5	ns
	t_{fB}		B Ports	2.4	1.9	1.8	1.5	ns
Channel-to-Channel Skew	t_{SKO}			1	1	1	1	ns
Data Rate				20	20	20	20	Mbps

SWITCHING CHARACTERISTICS (continued)

(V_{CCA} = 1.5V, T_A = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL		CONDITIONS	V_{CCB} = 1.8V	V_{CCB} = 2.5V	V_{CCB} = 3.3V	V_{CCB} = 5V	UNITS
				TYP	TYP	TYP	TYP	
Propagation Delay	t_{PD}	t_{PLH}	A to B	15.9	13.6	12.6	11.7	ns
		t_{PHL}		14.6	12.1	11.5	11.3	
		t_{PLH}	B to A	14.0	13.5	11.4	11.5	
		t_{PHL}		12.0	10.6	9.7	8.3	
Enable Time	t_{EN}	t_{PZH}	OE to A	31.2	31.4	31.7	30.9	ns
		t_{PZL}		32.4	27.9	26.8	26.2	
		t_{PZH}	OE to B	28.3	23.1	21.7	21.1	
		t_{PZL}		34.1	29.9	30.4	31.1	
Disable Time	t_{DIS}	t_{PHZ}	OE to A	1000	1030	1020	1010	ns
		t_{PLZ}		500	490	500	500	
		t_{PHZ}	OE to B	1080	1070	1070	1090	
		t_{PLZ}		510	550	550	550	
Rise Time	t_{rA}		A Ports	7.2	5.9	5.3	3.9	ns
	t_{rB}		B Ports	3.9	2.5	2.0	1.7	ns
Fall Time	t_{fA}		A Ports	2.5	2.8	3.2	2.6	ns
	t_{fB}		B Ports	3.2	1.9	1.7	1.6	ns
Channel-to-Channel Skew	t_{SKO}			0.5	0.5	0.5	0.5	ns
Data Rate				40	40	40	40	Mbps

SWITCHING CHARACTERISTICS (continued)

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

PARAMETER	SYMBOL		CONDITIONS	V_{CCB} = 1.8V	V_{CCB} = 2.5V	V_{CCB} = 3.3V	V_{CCB} = 5V	UNITS
				TYP	TYP	TYP	TYP	
Propagation Delay	t_{PD}	t_{PLH}	A to B	11.6	11.5	10.1	9.1	ns
		t_{PHL}		10.6	8.3	8.1	7.8	
		t_{PLH}	B to A	9.1	10.5	8.4	7.9	
		t_{PHL}		9.1	7.2	7.5	5.5	
Enable Time	t_{EN}	t_{PZH}	OE to A	21.9	21.6	21.8	22.0	ns
		t_{PZL}		25.9	21.1	19.8	19.4	
		t_{PZH}	OE to B	29.4	18.6	17.5	16.3	
		t_{PZL}		25.0	21.6	19.8	21.1	
Disable Time	t_{DIS}	t_{PHZ}	OE to A	1080	1050	1080	1060	ns
		t_{PLZ}		520	500	520	510	
		t_{PHZ}	OE to B	1040	1070	1060	1080	
		t_{PLZ}		520	540	540	540	
Rise Time	t_{rA}		A Ports	3.0	3.9	2.9	2.8	ns
	t_{rB}		B Ports	2.9	2.2	1.8	1.5	ns
Fall Time	t_{fA}		A Ports	2.2	2.4	2.2	2.5	ns
	t_{fB}		B Ports	2.1	2.2	2.1	1.5	ns
Channel-to-Channel Skew	t_{SKO}			0.5	0.5	0.5	0.5	ns
Data Rate				60	60	60	60	Mbps

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_{PD}	t_{PLH}	A to B	9.6	7.6	5.2	ns
		t_{PHL}		6.7	5.3	5.1	
		t_{PLH}	B to A	7.8	6.3	4.5	
		t_{PHL}		5.0	6.0	3.2	
Enable Time	t_{EN}	t_{PZH}	OE to A	14.4	14.5	14.3	ns
		t_{PZL}		15.9	13.8	13.6	
		t_{PZH}	OE to B	17.5	15.3	14.8	
		t_{PZL}		15.4	14.7	15.7	
Disable Time	t_{DIS}	t_{PHZ}	OE to A	1050	1070	1050	ns
		t_{PLZ}		550	550	530	
		t_{PHZ}	OE to B	1050	1070	1080	
		t_{PLZ}		550	550	540	
Rise Time	t_{rA}		A Ports	2.7	2.5	2.7	ns
	t_{rB}		B Ports	2.4	1.9	2.1	ns
Fall Time	t_{fA}		A Ports	2.9	2.0	2.1	ns
	t_{fB}		B Ports	2.6	1.8	1.5	ns
Channel-to-Channel Skew	t_{SKO}			0.5	0.5	0.5	ns
Data Rate				100	100	100	Mbps

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_{PD}	t_{PLH}	A to B	5.4	3.6	ns
		t_{PHL}		4.3	3.3	
		t_{PLH}	B to A	4.8	4.0	
		t_{PHL}		4.6	2.8	
Enable Time	t_{EN}	t_{PZH}	OE to A	12.5	12.0	ns
		t_{PZL}		13.5	11.4	
		t_{PZH}	OE to B	15.9	12.8	
		t_{PZL}		12.7	13.5	
Disable Time	t_{DIS}	t_{PHZ}	OE to A	1080	1080	ns
		t_{PLZ}		540	540	
		t_{PHZ}	OE to B	1060	1080	
		t_{PLZ}		550	540	
Rise Time	t_{rA}		A Ports	1.5	1.5	ns
	t_{rB}		B Ports	1.5	1.0	ns
Fall Time	t_{fA}		A Ports	1.6	1.6	ns
	t_{fB}		B Ports	1.5	1.0	ns
Channel-to-Channel Skew	t_{SKO}			0.5	0.5	ns
Data Rate				100	100	Mbps

SWITCHING CHARACTERISTICS (continued)

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

PARAMETER	SYMBOL		CONDITIONS	V_{CCB} = 5V	UNITS
				TYP	
Propagation Delay	t_{PD}	t_{PLH}	A to B	3.4	ns
		t_{PHL}		2.9	
		t_{PLH}	B to A	3.3	
		t_{PHL}		2.6	
Enable Time	t_{EN}	t_{PZH}	OE to A	11.7	ns
		t_{PZL}		12.3	
		t_{PZH}	OE to B	13.8	
		t_{PZL}		13.3	
Disable Time	t_{DIS}	t_{PHZ}	OE to A	1070	ns
		t_{PLZ}		530	
		t_{PHZ}	OE to B	1080	
		t_{PLZ}		540	
Rise Time	t_{rA}		A Ports	1.2	ns
	t_{rB}		B Ports	1.1	ns
Fall Time	t_{fA}		A Ports	1.3	ns
	t_{fB}		B Ports	1.3	ns
Channel-to-Channel Skew	t_{SKO}			0.5	ns
Data Rate				100	Mbps

OPERATING CHARACTERISTICS

(T_A = +25℃, unless otherwise noted.)

PARAMETER		CONDITIONS	V_{CCA}								UNITS
			1.2V	1.2V	1.5V	1.8V	2.5V	2.5V	3.3V	3.3V	5V	
			V_{CCB}									
			5V	1.8V	1.8V	1.8V	2.5V	5V	3.3V	5V	5V	
			TYP	TYP	TYP	TYP	TYP	TYP	TYP	TYP	TYP	
C_{PDA}	A Port Inputs, B Port Outputs	C_L = 0, f = 10MHz, t_r = t_f = 1ns, OE = V_{CCA} (Outputs Enabled)	75	71	37	10	11	12	12	13	14	pF
	B Port Inputs, A Port Outputs		6	6	6	6	6	6	6	6	6	
C_{PDB}	A Port Inputs, B Port Outputs		7	6	6	6	6	6	6	6	6	
	B Port Inputs, A Port Outputs		18	105	11	10	10	12	12	13	14	
C_{PDA}	A Port Inputs, B Port Outputs	C_L = 0, f = 10MHz, t_r = t_f = 1ns, OE = GND (Outputs Disabled)	0.005	0.005	0.004	0.003	0.003	0.003	0.002	0.002	0.002	pF
	B Port Inputs, A Port Outputs		0.011	0.007	0.018	0.010	0.011	0.004	0.006	0.004	0.006	
C_{PDB}	A Port Inputs, B Port Outputs		0.001	0.003	0.003	0.003	0.003	0.002	0.002	0.002	0.002	
	B Port Inputs, A Port Outputs		0.003	0.004	0.010	0.003	0.007	0.002	0.003	0.002	0.001	

WAVEFORMS

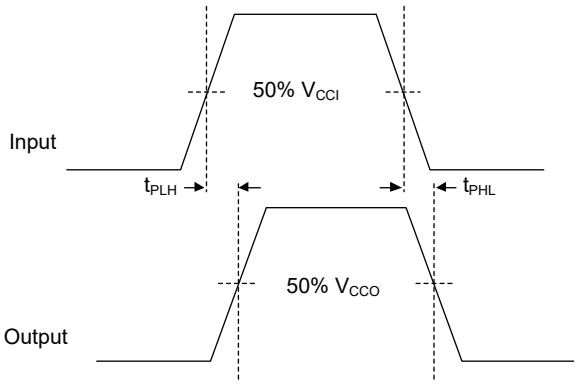


Figure 1. Propagation Delay

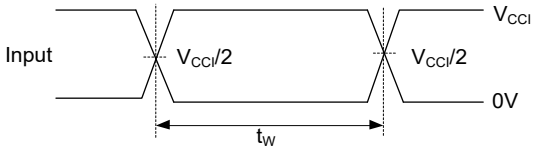


Figure 2. Pulse Duration

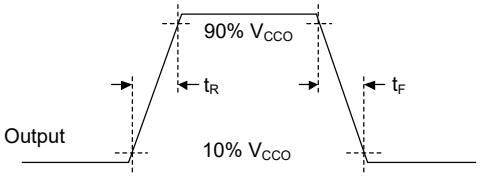
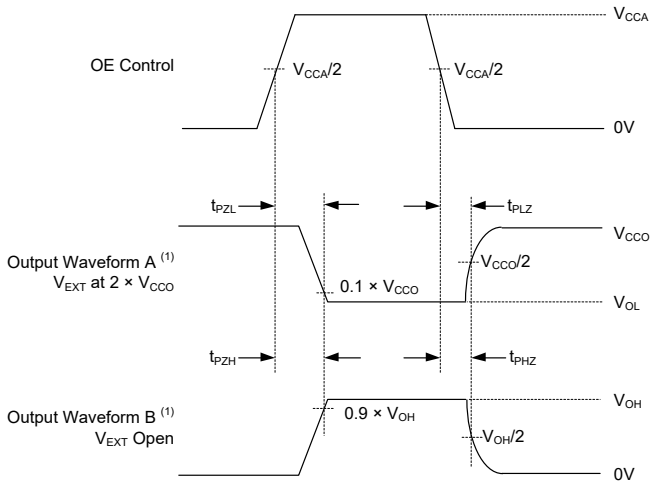


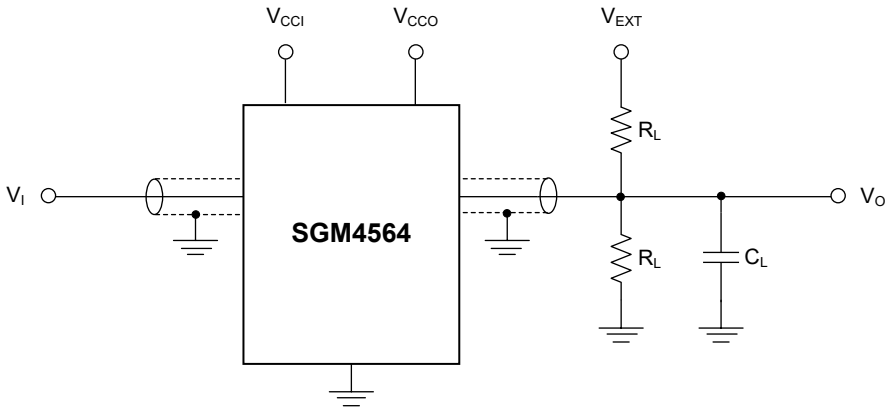
Figure 3. Rise Time and Fall Time of Data Output



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 4. 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 5. Test Circuit for Measuring Switching Times

APPLICATION INFORMATION

Applications

For the application of the SGM4564, it is often used in the voltage-level translation system.

Architecture

The SGM4564 can switch the direction of the transmission for port A and port B automatically without any external control. The output drivers can keep high or low in a DC state, however, they are designed to be weak so that they can be overdriven by external drivers when the data on the bus starts flowing in the opposite direction.

Figure 6 shows the architecture of an SGM4564 cell. The main explanation of the internal circuit for the SGM4564 is shown as below:

- The one-shot circuitry can be used to detect the rising edges or the falling edges of the signal for port A and port B automatically.
- When in the rising edge, two PMOSFETs (T1 and T3) are turned on by one-shot in a short time. The feature speeds up the transition from low to high.
- When in the falling edge, two NMOSFETs (T2 and T4) are turned on by one-shot in a short time. The feature speeds up the transition from high to low.
- The output impedance is 70Ω (TYP) when V_{CCO} voltage range is from 1.2V to 1.8V, it is 50Ω (TYP) when V_{CCO} voltage range is from 1.8V to 3.3V and 40Ω (TYP) when V_{CCO} voltage range is from 3.3V to 5V.

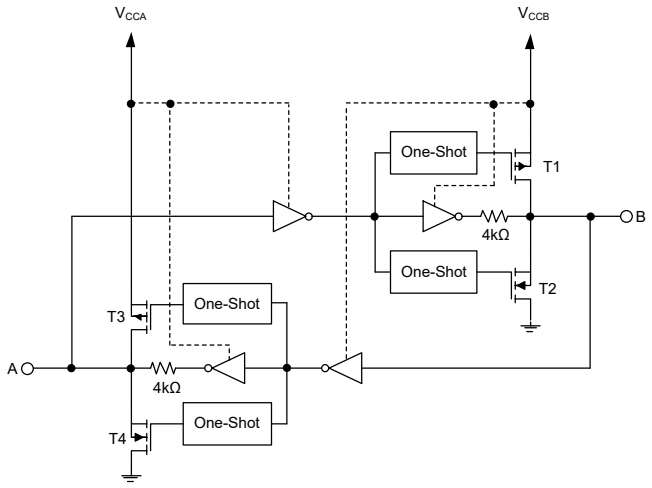
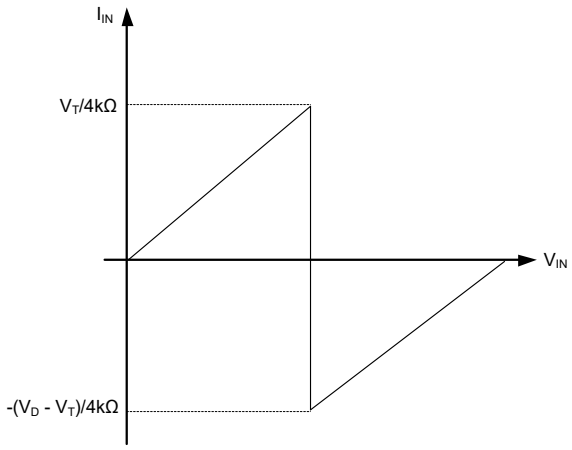


Figure 6. Architecture of an SGM4564 Cell

Input Driver Requirements

Figure 7 shows a typical V_{IN} vs. I_{IN} curve. To ensure proper operation, the SGM4564 data I/Os must be driven by a device with a drive strength of at least ±2mA.



NOTES:
1. V_T = Input threshold voltage (typically $V_{CCI}/2$).
2. V_D = External driver supply voltage.

Figure 7. Typical V_{IN} vs. I_{IN} Curve

Power-Up

For the application of the SGM4564, 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. The SGM4564 has a circuitry that disables all output ports when either V_{CC} is switched off (V_{CCA}/V_{CCB} = 0V).

Enable and Disable

The function of OE is used to disable SGM4564 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

The SGM4564 features the drive capability that is designed to drive up to 70pF capacitive loads. The output drivers have the low DC drive strength. When the data I/Os are externally connected to the pull-up or pull-down resistors, the values must be greater than 50kΩ to ensure that they don't conflict with the output driver. Therefore, the SGM4564 is not used in one-wire or I^2C applications. For the bidirectional data I/Os, an open-drain driver is connected.

REVISION HISTORY

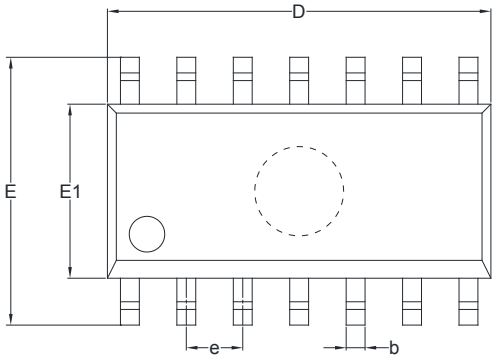
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

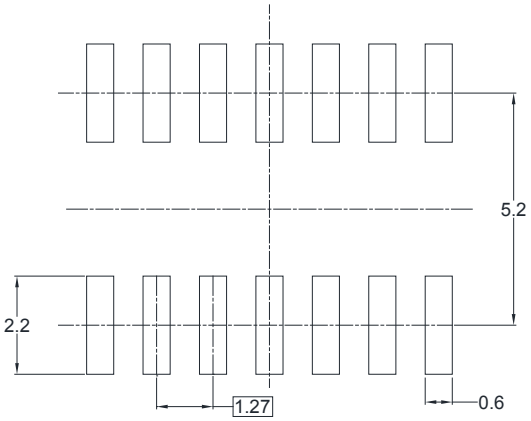
SEPTEMBER 2015 – REV.A to REV.A.1	Page
Add TQFN-2×2-12L package	All

Changes from Original (JANUARY 2015) to REV.A	Page
Changed from product preview to production data	All

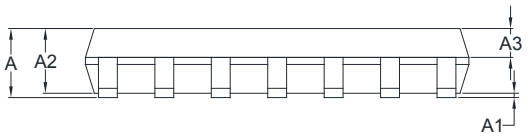
PACKAGE OUTLINE DIMENSIONS

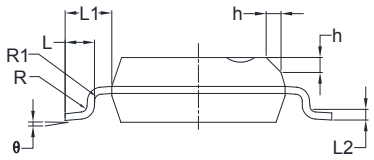
SOIC-14





RECOMMENDED LAND PATTERN (Unit: mm)

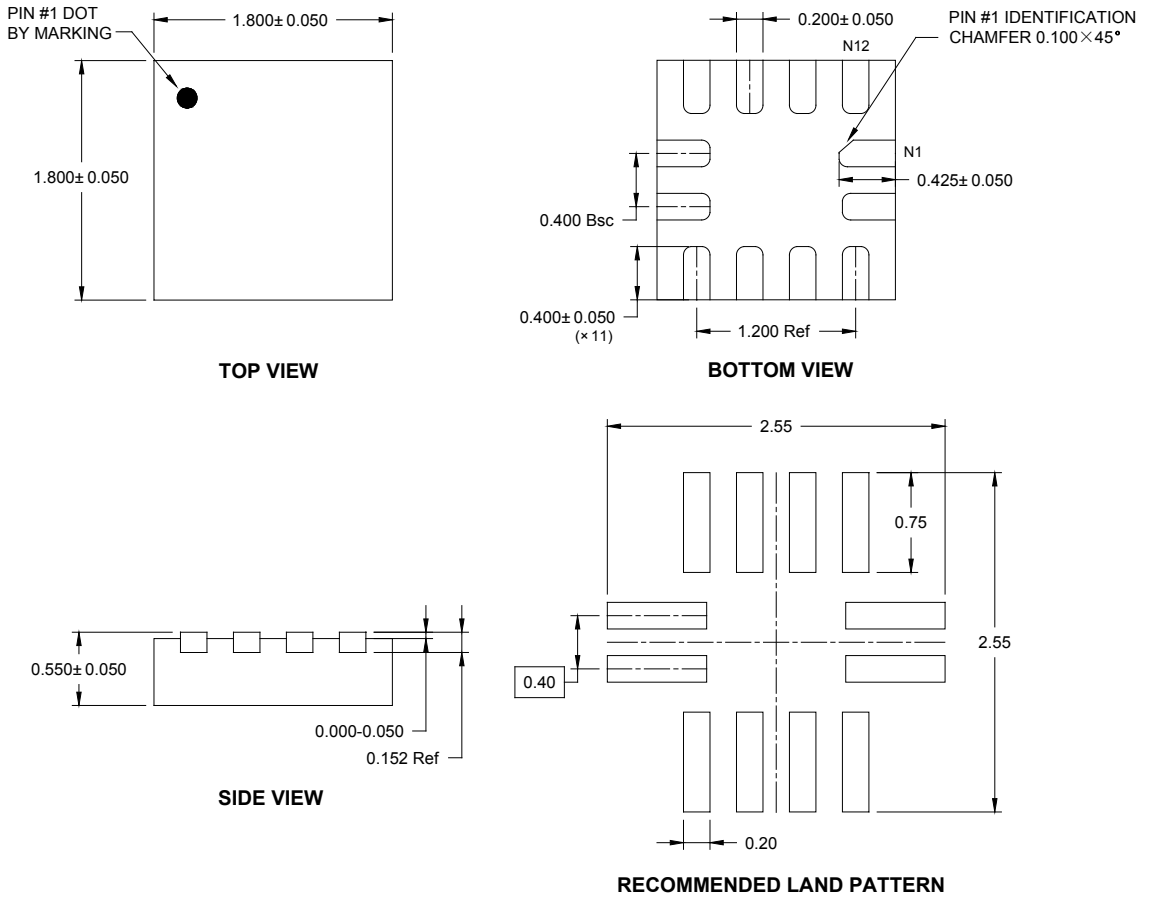




Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.35	1.75	0.053	0.069
A1	0.10	0.25	0.004	0.010
A2	1.25	1.65	0.049	0.065
A3	0.55	0.75	0.022	0.030
b	0.36	0.49	0.014	0.019
D	8.53	8.73	0.336	0.344
E	5.80	6.20	0.228	0.244
E1	3.80	4.00	0.150	0.157
e	1.27 BSC		0.050 BSC	
L	0.45	0.80	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°

PACKAGE OUTLINE DIMENSIONS

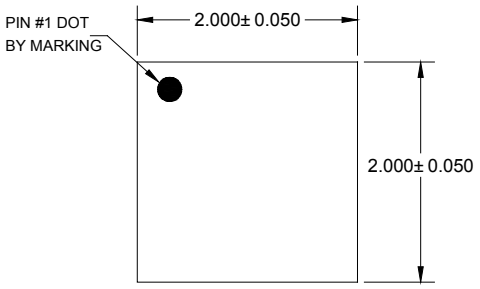
UTQFN-1.8×1.8-12L



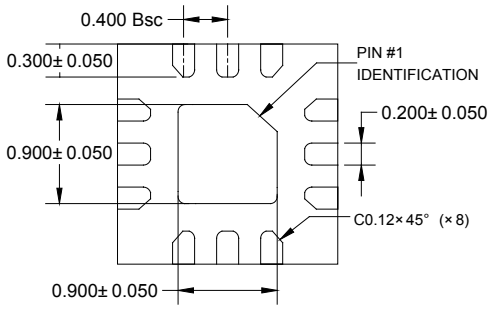
NOTE: All linear dimensions are in millimeters.

PACKAGE OUTLINE DIMENSIONS

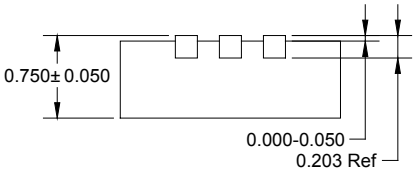
TQFN-2×2-12L



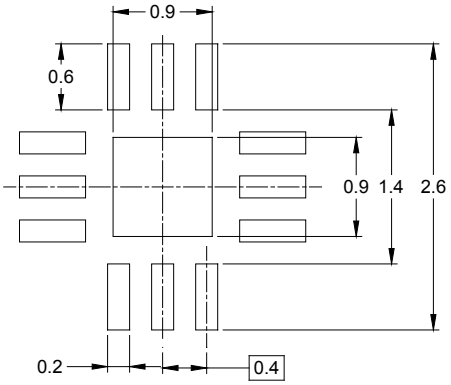
TOP VIEW



BOTTOM VIEW



SIDE VIEW

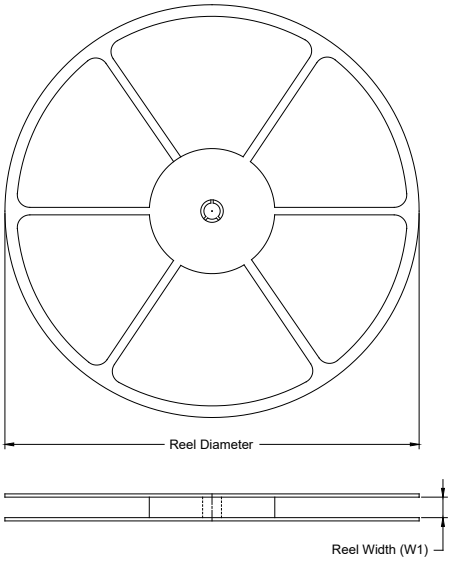


RECOMMENDED LAND PATTERN

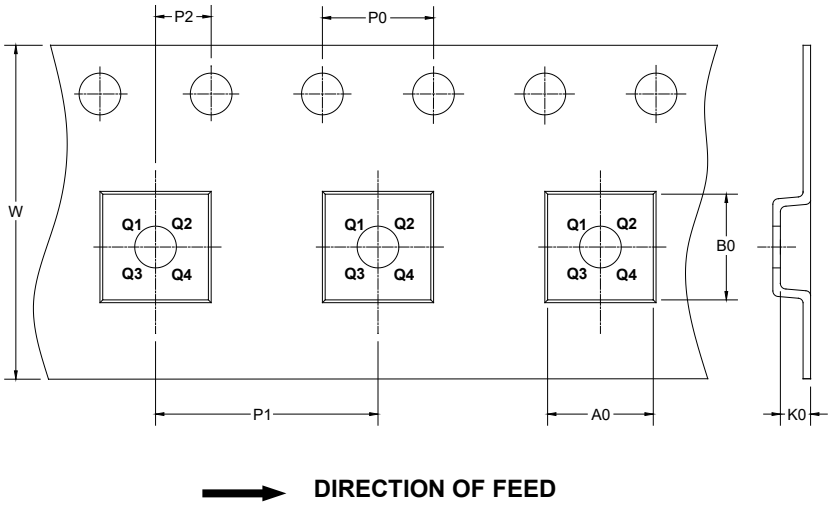
NOTE: All linear dimensions are in millimeters.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



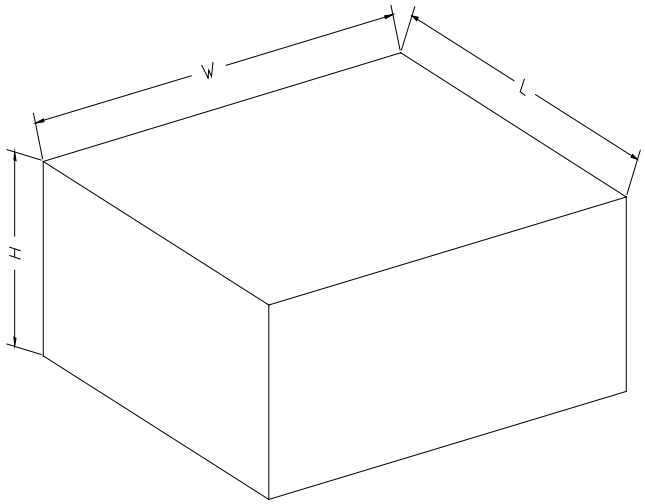
NOTE: The picture is only for reference. Please make the object as the standard.

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