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

GENERAL DESCRIPTION

This 4-bit non-inverting voltage-level translator uses two separate configurable power-supply rails. The A ports are designed to track V_{CCA}. V_{CCA} accepts any supply voltage from 1.2V to 5.5V. The B ports are designed to track V_{CCB}. V_{CCB} accepts any supply voltage from 1.65V to 5.5V. This allows for universal low-voltage bidirectional translation between any of the 1.2V, 1.5V, 1.8V, 2.5V, 3.3V, and 5V voltage nodes. V_{CCA} should not exceed V_{CCB}.

When the output-enable (OE) input is low, all outputs are placed in the high-impedance state. To ensure the high-impedance state during power up or power down, OE should be tied to GND through a pull-down resistor; the minimum value of the resistor is determined by the current-sourcing capability of the driver.

The SGM4564 is designed so that the OE input circuit is supplied by V_{CCA}.

This device is fully specified for partial-power-down applications using I_{OFF}. The I_{OFF} circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.

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

- **1.2V to 5.5V on A Ports and 1.65V to 5.5V on B Ports ($V_{CCA} \leq V_{CCB}$)**
- **V_{CC} Isolation: If Either V_{CC} is at GND, All Outputs are in the High-Impedance State**
- **OE Input Circuit Referenced to V_{CCA}**
- **Low Power Consumption**
- **Push-Pull Output**
- **I_{OFF}: Supports Partial-Power-Down Mode Operation**
- **-40℃ to +85℃ Operating Temperature Range**
- **Available in Green SOIC-14, UTQFN-1.8×1.8-12L and TQFN-2×2-12L Packages**

APPLICATIONS

Smart-Phone
Portable Equipments
UART
GPIO

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

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.

ABSOLUTE MAXIMUM RATINGS

V_{CCA}, Supply Voltage Range ..... -0.3V to 6V
V_{CCB}, Supply Voltage Range ..... -0.3V to 6V
V_I, Input Voltage Range
A Ports ..... -0.3V to 6V
B Ports ..... -0.3V to 6V
V_O, Voltage Range Applied to Any Output in the High-Impedance or Power-Off State
A Ports ..... -0.3V to 6V
B Ports ..... -0.3V to 6V
V_O, Voltage Range Applied to Any Output in the High or Low State (1)
A Ports ..... -0.3V to V_{CCA} + 0.3V
B Ports ..... -0.3V to V_{CCB} + 0.3V
I_{IK}, Input Clamp Current (V_I < 0) ..... -50mA
I_{OK}, Output Clamp Current (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, 10sec) ..... 260℃
ESD Susceptibility
HBM 4000V
MM 300V

NOTE: 1. The value of V_{CCA} and V_{CCB} are provided 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
Voltage Range Applied to Any Output in the High-Impedance or Power-Off State, V_O
A Ports ..... 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. The A and B sides of an unused data I/O pair must be held in the same state, i.e., both at V_{CCI} or both at GND.
3. V_{CCA} must be less than or equal to V_{CCB} and must not exceed 5.5V.
4. V_{CCI} is the supply voltage associated with the input ports.

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

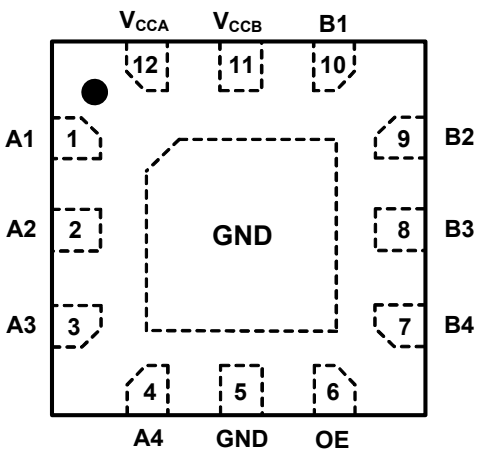
SG Micro Corp reserves the right to make any change in circuit design, specification or other related things if necessary without notice at any time.

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.

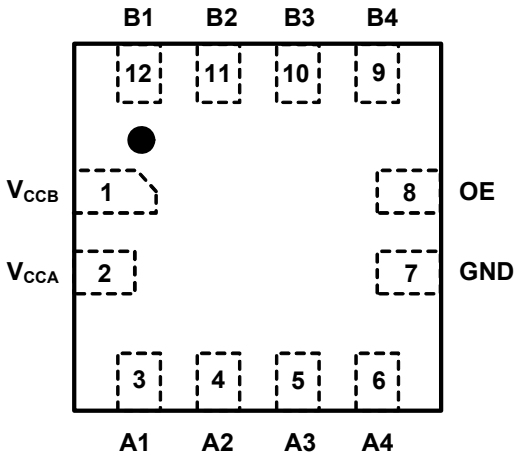
PIN CONFIGURATIONS

(TOP VIEW)



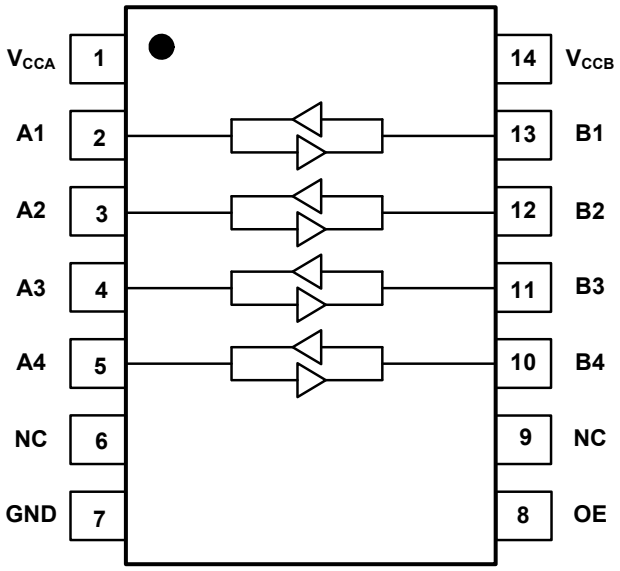
TQFN-2×2-12L

(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}	A Ports Supply Voltage. 1.2V ≤ V_{CCA} ≤ 5.5V and V_{CCA} ≤ V_{CCB}.
2	3	1	A1	Input/Output 1. Referenced to V_{CCA}.
3	4	2	A2	Input/Output 2. Referenced to V_{CCA}.
4	5	3	A3	Input/Output 3. Referenced to V_{CCA}.
5	6	4	A4	Input/Output 4. Referenced to V_{CCA}.
6	—	—	NC	No Connection. Not internally connected.
7	7	5	GND	Ground.
8	8	6	OE	3-State Output-Mode Enable. Pull OE low to place all outputs in 3-state mode. Referenced to V_{CCA}.
9	—	—	NC	No Connection. Not internally connected.
10	9	7	B4	Input/Output 4. Referenced to V_{CCB}.
11	10	8	B3	Input/Output 3. Referenced to V_{CCB}.
12	11	9	B2	Input/Output 2. Referenced to V_{CCB}.
13	12	10	B1	Input/Output 1. Referenced to V_{CCB}.
14	1	11	V_{CCB}	B Ports Supply Voltage. 1.65V ≤ V_{CCB} ≤ 5.5V.
—	—	Exposed Pad	GND	Exposed pad should be soldered to PCB board and connected to GND or left floating.

ELECTRICAL CHARACTERISTICS (1)

(Full = -40℃ to +85℃, typical values are at T_A = +25℃, unless otherwise noted.)

PARAMETER		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 (I_I)	OE	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 (I_{OFF})	A Ports	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 (I_{OZ})	A or B Ports	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 = 0, 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	
Quiescent Supply Current (I_{CCB})		V_I = V_{CCI} or GND, I_O = 0, 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	
Quiescent Supply Current (I_{CCA} + I_{CCB})		V_I = V_{CCI} or GND, I_O = 0, 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	
Quiescent Supply Current (I_{CCZA})		V_I = V_{CCI} or GND, I_O = 0, 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	
Quiescent Supply Current (I_{CCZB})		V_I = V_{CCI} or GND, I_O = 0, 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 (C_{IO})	A Ports	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

		V_{CCB} = 1.8V	V_{CCB} = 2.5V	V_{CCB} = 3.3V	V_{CCB} = 5V	UNITS
		TYP	TYP	TYP	TYP	
(T_A = +25℃, V_{CCA} = 1.2V, unless otherwise noted.)						
Data Rate		20	20	20	20	Mbps
Pulse Duration (t_W)	Data Inputs	50	50	50	50	ns
(T_A = +25℃, V_{CCA} = 1.5V, unless otherwise noted.)						
Data Rate		40	40	40	40	Mbps
Pulse Duration (t_W)	Data Inputs	25	25	25	25	ns
(T_A = +25℃, V_{CCA} = 1.8V, unless otherwise noted.)						
Data Rate		60	60	60	60	Mbps
Pulse Duration (t_W)	Data Inputs	17	17	17	17	ns
(T_A = +25℃, V_{CCA} = 2.5V, unless otherwise noted.)						
Data Rate			100	100	100	Mbps
Pulse Duration (t_W)	Data Inputs		10	10	10	ns
(T_A = +25℃, V_{CCA} = 3.3V, unless otherwise noted.)						
Data Rate				100	100	Mbps
Pulse Duration (t_W)	Data Inputs			10	10	ns
(T_A = +25℃, V_{CCA} = 5V, unless otherwise noted.)						
Data Rate					100	Mbps
Pulse Duration (t_W)	Data Inputs				10	ns

SWITCHING CHARACTERISTICS

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

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

SWITCHING CHARACTERISTICS

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

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

SWITCHING CHARACTERISTICS

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

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

SWITCHING CHARACTERISTICS

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

PARAMETER		FROM (INPUT)	TO (OUTPUT)	V_{CCB} = 2.5V	V_{CCB} = 3.3V	V_{CCB} = 5V	UNITS
				TYP	TYP	TYP	
t_{PD}	t_{PLH}	A	B	9.6	7.6	5.2	ns
	t_{PHL}			6.7	5.3	5.1	
	t_{PLH}	B	A	7.8	6.3	4.5	
	t_{PHL}			5.0	6.0	3.2	
t_{EN}	t_{PZH}	OE	A	14.4	14.5	14.3	ns
	t_{PZL}			15.9	13.8	13.6	
	t_{PZH}		B	17.5	15.3	14.8	
	t_{PZL}			15.4	14.7	15.7	
t_{DIS}	t_{PHZ}	OE	A	1050	1070	1050	ns
	t_{PLZ}			550	550	530	
	t_{PHZ}		B	1050	1070	1080	
	t_{PLZ}			550	550	540	
t_{rA}		A Ports Rise Time		2.7	2.5	2.7	ns
t_{fA}		A Ports Fall Time		2.9	2.0	2.1	ns
t_{rB}		B Ports Rise Time		2.4	1.9	2.1	ns
t_{fB}		B Ports Fall Time		2.6	1.8	1.5	ns
$t_{SK(O)}$		Channel-to-Channel Skew		0.5	0.5	0.5	ns
Data Rate				100	100	100	Mbps

SWITCHING CHARACTERISTICS

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

PARAMETER		FROM (INPUT)	TO (OUTPUT)	V_{CCB} = 3.3V	V_{CCB} = 5V	UNITS
				TYP	TYP	
t_{PD}	t_{PLH}	A	B	5.4	3.6	ns
	t_{PHL}			4.3	3.3	
	t_{PLH}	B	A	4.8	4.0	
	t_{PHL}			4.6	2.8	
t_{EN}	t_{PZH}	OE	A	12.5	12.0	ns
	t_{PZL}			13.5	11.4	
	t_{PZH}		B	15.9	12.8	
	t_{PZL}			12.7	13.5	
t_{DIS}	t_{PHZ}	OE	A	1080	1080	ns
	t_{PLZ}			540	540	
	t_{PHZ}		B	1060	1080	
	t_{PLZ}			550	540	
t_{rA}		A Ports Rise Time		1.5	1.5	ns
t_{fA}		A Ports Fall Time		1.6	1.6	ns
t_{rB}		B Ports Rise Time		1.5	1.0	ns
t_{fB}		B Ports Fall Time		1.5	1.0	ns
$t_{SK(O)}$		Channel-to-Channel Skew		0.5	0.5	ns
Data Rate				100	100	Mbps

SWITCHING CHARACTERISTICS

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

PARAMETER		FROM (INPUT)	TO (OUTPUT)	V_{CCB} = 5V	UNITS
				TYP	
t_{PD}	t_{PLH}	A	B	3.4	ns
	t_{PHL}			2.9	
	t_{PLH}	B	A	3.3	
	t_{PHL}			2.6	
t_{EN}	t_{PZH}	OE	A	11.7	ns
	t_{PZL}			12.3	
	t_{PZH}		B	13.8	
	t_{PZL}			13.3	
t_{DIS}	t_{PHZ}	OE	A	1070	ns
	t_{PLZ}			530	
	t_{PHZ}		B	1080	
	t_{PLZ}			540	
t_{rA}		A Ports Rise Time		1.2	ns
t_{fA}		A Ports Fall Time		1.3	ns
t_{rB}		B Ports Rise Time		1.1	ns
t_{fB}		B Ports Fall Time		1.3	ns
$t_{SK(O)}$		Channel-to-Channel Skew		0.5	ns
Data Rate				100	Mbps

OPERATING CHARACTERISTICS

(T_A = 25℃, unless otherwise noted.)

PARAMETER		TEST CONDITIONS	V_{CCA}								UNIT
			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	

APPLICATION INFORMATION

Applications

The SGM4564 can be used in level-translation applications for interfacing devices or systems operating at different interface voltages with one another.

Architecture

The SGM4564 architecture (see Figure 1) does not require a direction-control signal to control the direction of data flow from A to B or from B to A. In a DC state, the output drivers of the SGM4564 can maintain a high or low, but are designed to be weak, so that they can be overdriven by an external driver when data on the bus starts flowing the opposite direction.

The output one-shots detect rising or falling edges on the A or B ports. During a rising edge, the one-shot turns on the PMOS transistors (T1, T3) for a short duration, which speeds up the low-to-high transition. Similarly, during a falling edge, the one-shot turns on the NMOS transistors (T2, T4) for a short duration, which speeds up the high-to-low transition. The typical output impedance during output transition is 70Ω at V_{CCO} = 1.2V to 1.8V, 50Ω at V_{CCO} = 1.8V to 3.3V, and 40Ω at V_{CCO} = 3.3V to 5V.

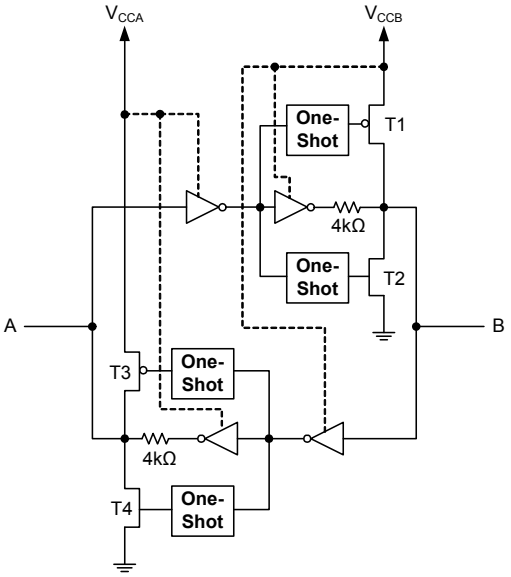
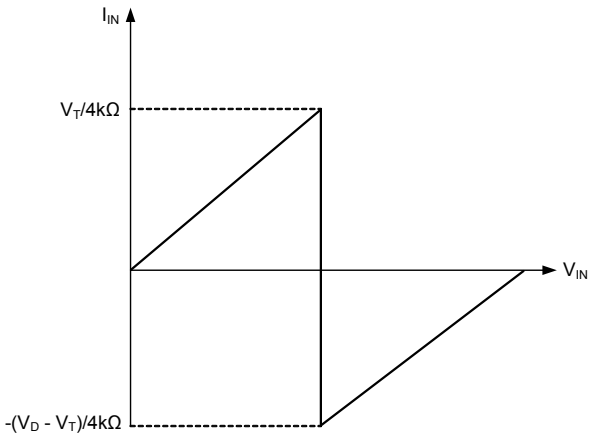


Figure 1. Architecture of SGM4564 I/O Cell

Input Driver Requirements

Typical I_{IN} vs. V_{IN} characteristics of the SGM4564 are shown in Figure 2. For proper operation, the device driving the data I/Os of the SGM4564 must have drive strength of at least ±2mA.



A. V_T is the input threshold voltage of the SGM4564 (typically V_{CCI}/2).
B. V_D is the supply voltage of the external driver.

Figure 2. Typical I_{IN} vs. V_{IN} Curve

Power Up

During operation, ensure that $V_{CCA} \leq V_{CCB}$ at all times. During power-up sequencing, $V_{CCA} \geq V_{CCB}$ does not damage the device, so any power supply can be ramped up first. The SGM4564 has circuitry that disables all output ports when either V_{CC} is switched off ($V_{CCA/B}$ = 0V).

Enable and Disable

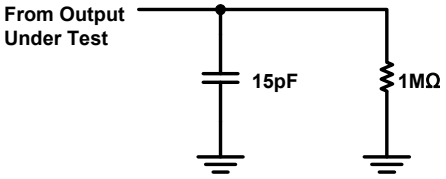
The SGM4564 has an OE input that is used to disable the device by setting OE = low, which places all I/Os in the high-impedance (Hi-Z) state. The disable time (t_{DIS}) indicates the delay between when OE goes low and when the outputs are actually disabled (Hi-Z). The enable time (t_{EN}) indicates the amount of time the user must allow for the one-shot circuitry to become operational after OE is taken high.

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

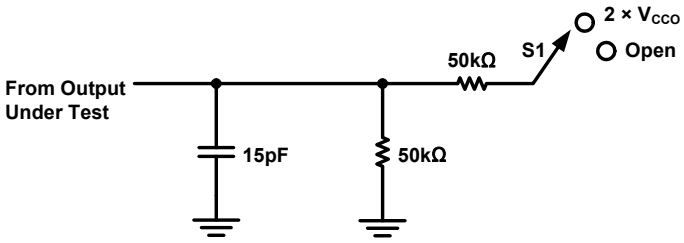
The SGM4564 is designed to drive capacitive loads of up to 70pF. The output drivers of the SGM4564 have low DC drive strength. If pull-up or pull-down resistors are connected externally to the data I/Os, their values must be kept higher than 50kΩ to ensure that they do not contend with the output drivers of the SGM4564.

For the same reason, the SGM4564 should not be used in applications such as I^2C or 1-wire where an open-drain driver is connected on the bidirectional data I/O.

PARAMETER MEASUREMENT INFORMATION

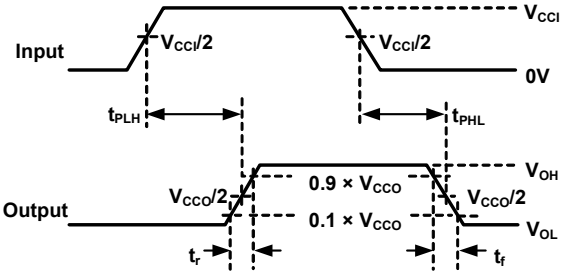


LOAD CIRCUIT FOR MAX DATA RATE, PULSE DURATION PROPAGATION DELAY OUTPUT RISE AND FALL TIME MEASUREMENT

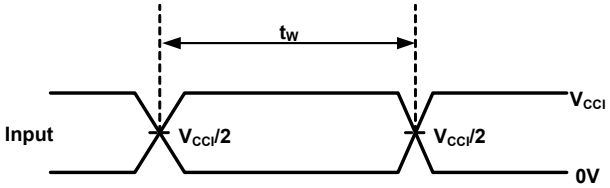


LOAD CIRCUIT FOR ENABLE/DISABLE TIME MEASUREMENT

TEST	S1
t_{PZL}/t_{PLZ}	2 × V_{CCO}
t_{PHZ}/t_{PZH}	Open



VOLTAGE WAVEFORMS PROPAGATION DELAY TIMES



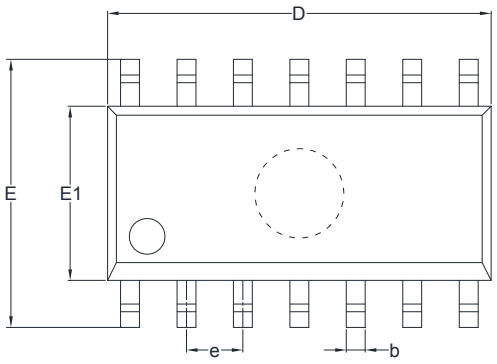
VOLTAGE WAVEFORMS PULSE DURATION

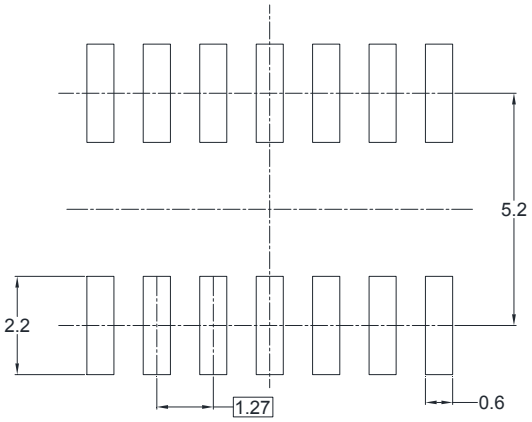
NOTES:
1. C_L includes probe and jig capacitance.
2. All input pulses are supplied by generators having the following characteristics: PRR ≤ 10MHz, Z_O = 50Ω, dv/dt ≥ 1V/ns.
3. The outputs are measured one at a time, with one transition per measurement.
4. t_{PLH} and t_{PHL} are the same as t_{PD}.
5. V_{CCI} is the V_{CC} associated with the input ports.
6. V_{CCO} is the V_{CC} associated with the output ports.
7. All parameters and waveforms are not applicable to all devices.

Figure 3. Load Circuits and Voltage Waveforms

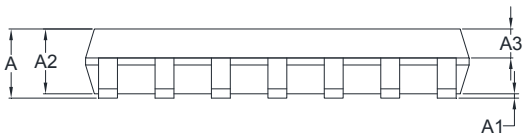
PACKAGE OUTLINE DIMENSIONS

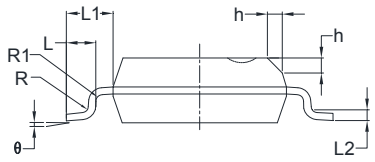
SOIC-14





RECOMMENDED LAND PATTERN (Unit: mm)

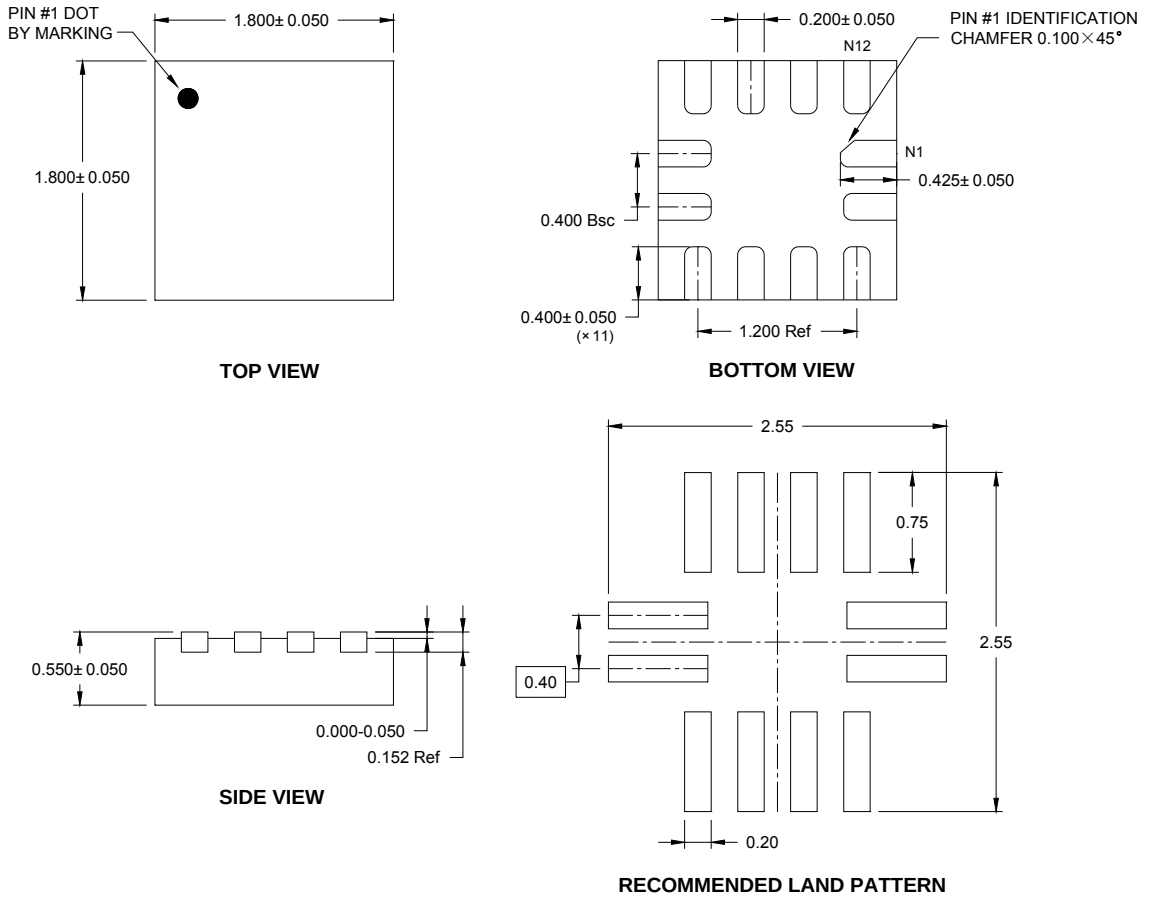




Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.35	1.75	0.053	0.069
A1	0.10	0.25	0.004	0.010
A2	1.25	1.65	0.049	0.065
A3	0.55	0.75	0.022	0.030
b	0.36	0.49	0.014	0.019
D	8.53	8.73	0.336	0.344
E	5.80	6.20	0.228	0.244
E1	3.80	4.00	0.150	0.157
e	1.27 BSC		0.050 BSC	
L	0.45	0.80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

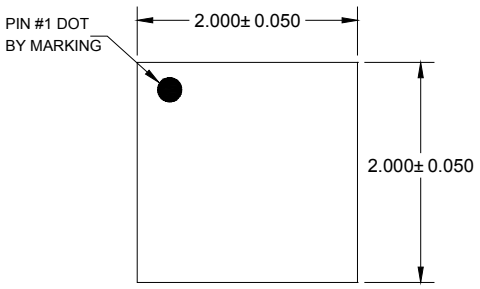
UTQFN-1.8×1.8-12L



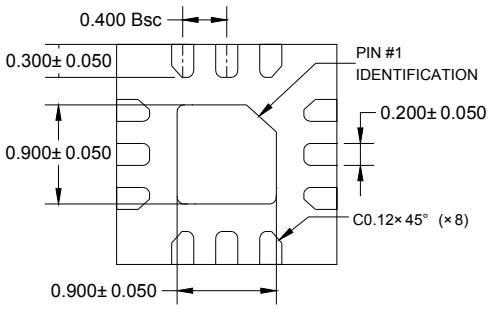
NOTE: All linear dimensions are in millimeters.

PACKAGE OUTLINE DIMENSIONS

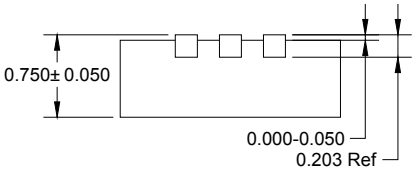
TQFN-2×2-12L



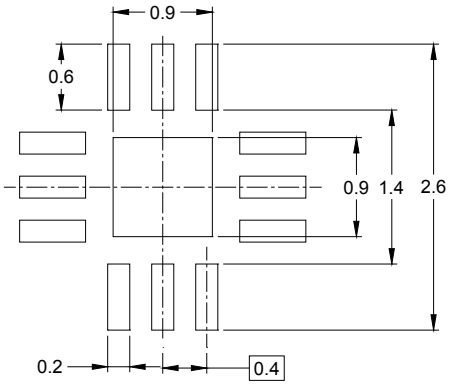
TOP VIEW



BOTTOM VIEW



SIDE VIEW

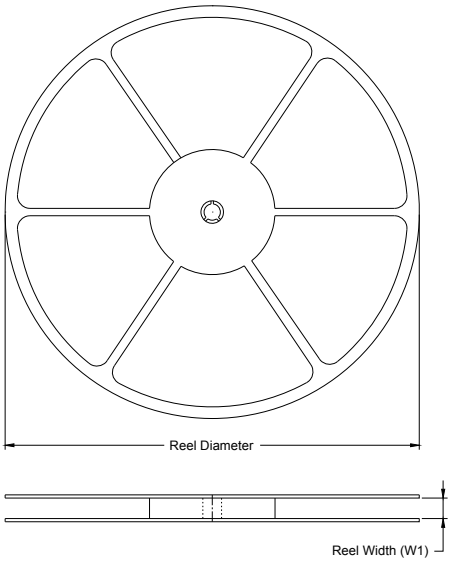


RECOMMENDED LAND PATTERN

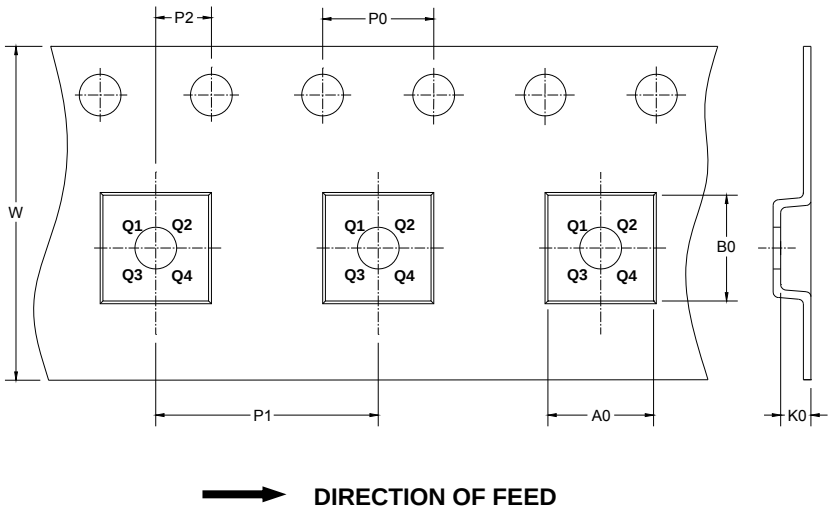
NOTE: All linear dimensions are in millimeters.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



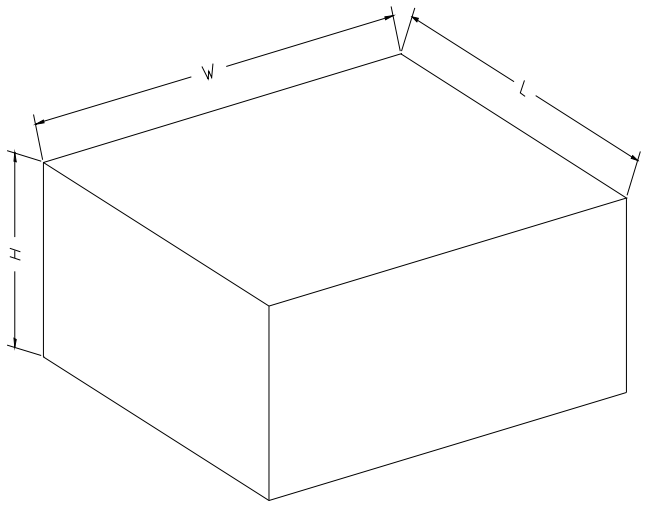
NOTE: The picture is only for reference. Please make the object as the standard.

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	6.6	9.3	2.1	4.0	8.0	2.0	16.0	Q1
UTQFN-1.8×1.8-12L	7″	9.0	2.1	2.1	0.8	4.0	4.0	2.0	8.0	Q1
TQFN-2×2-12L	7″	9.5	2.3	2.3	0.9	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