SGM4556
2-Bit Bidirectional Voltage-Level Translator with Auto Direction Sensing

GENERAL DESCRIPTION

This 2-bit non-inverting 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 5.0V. The B ports are designed to track V_{CCB}. V_{CCB} accepts any supply voltage from 1.65 V 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. OE has an internal pull-down current source, as long as V_{CCB} is powered.

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.

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 SGM4556 is available in Green XTDFN-1.4×1-8L and SOT-23-8 packages. It operates over an ambient temperature range of -40℃ to +85℃.

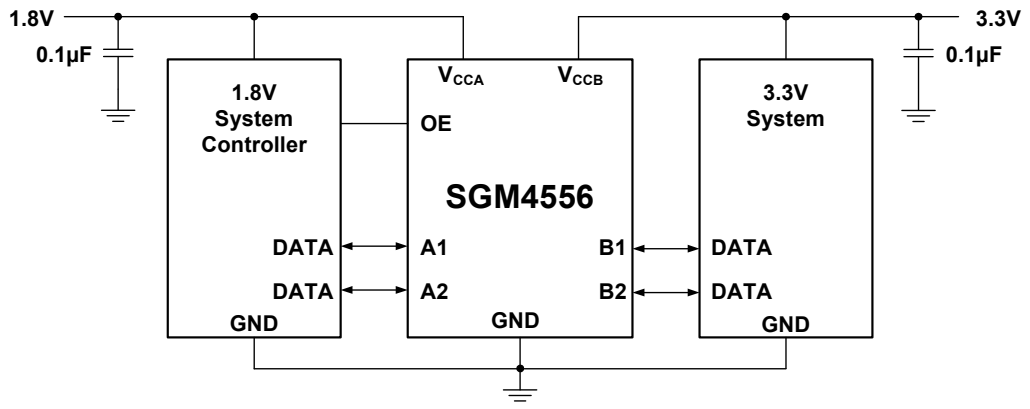
FEATURES

- **1.2V to 5.0V 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 XTDFN-1.4×1-8L and SOT-23-8 Packages**

APPLICATIONS

UART
GPIO

TYPICAL APPLICATION CIRCUIT



PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKAGE OPTION
SGM4556	SOT-23-8	-40℃ to +85℃	SGM4556YN8G/TR	SM2XX	Tape and Reel, 3000
	XTDFN-1.4×1-8L	-40℃ to +85℃	SGM4556YXDO8G/TR	N8X	Tape and Reel, 5000

NOTE: **X** = Date Code, **XX** = Date Code.

MARKING INFORMATION

SM2 X X

Date code - Month ("A" = Jan. "B" = Feb. ⋯ "L" = Dec.)
Date code - Year ("A" = 2010, "B" = 2011 ⋯)
Chip I.D.

For example: SM2DB (2013, February)

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 (2) ..... -0.3V to 6V
V_O, Voltage Range Applied to Any Output in the High-Impedance or Power-Off State (2)
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 (2) (3)
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) ..... -50mA
I_O, Continuous Output Current ..... ±50mA
Continuous Current through V_{CCA}, V_{CCB}, or GND ..... ±100mA
Operating Temperature Range ..... -40℃ to +85℃
Junction Temperature ..... 150℃
Storage Temperature Range ..... -65℃ to +150℃
Lead Temperature (Soldering, 10sec) ..... 260℃
ESD Susceptibility
HBM 4000V
MM 400V

NOTES:
1. Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

2. The input and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.

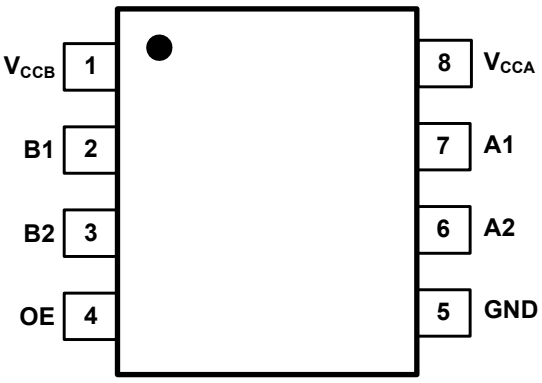
3. The value of V_{CCA} and V_{CCB} are provided in the recommended operating conditions table.

CAUTION

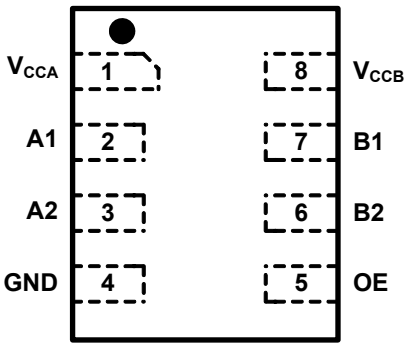
This integrated circuit can be damaged by ESD if you don't pay attention to ESD protection. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance 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.

SGMICRO reserves the right to make any change in circuit design, specification or other related things if necessary without notice at any time. Please contact SGMICRO sales office to get the latest datasheet.

PIN CONFIGURATIONS (TOP VIEW)



SOT-23-8



XTDFN-1.4×1-8L

PIN DESCRIPTION

PIN		NAME	FUNCTION
SOT-23-8	XTDFN-1.4×1-8L		
1	8	V_{CCB}	B Ports Supply Voltage. 1.65V ≤ V_{CCB} ≤ 5.5V.
2	7	B1	Input/Output B. Referenced to V_{CCB}.
3	6	B2	Input/Output B. Referenced to V_{CCB}.
4	5	OE	3-State Output Enable. Pull OE low to place all outputs in 3-state mode. Referenced to V_{CCA}.
5	4	GND	Ground.
6	3	A2	Input/Output A. Referenced to V_{CCA}.
7	2	A1	Input/Output A. Referenced to V_{CCA}.
8	1	V_{CCA}	A Ports Supply Voltage. 1.2V ≤ V_{CCA} ≤ 5.0V and V_{CCA} ≤ V_{CCB}.

ELECTRICAL CHARACTERISTICS

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

PARAMETER		CONDITIONS		TEMP	MIN	TYP	MAX	UNITS
RECOMMENDED OPERATING CONDITIONS (1)								
Supply Voltage	V_{CCA}				1.2		5.0	V
	V_{CCB}				1.65		5.5	
High-Level Input Voltage (V_{IH})	Data Inputs	V_{CCA} = 1.2V to 5.0V, V_{CCB} = 1.65V to 5.5V			V_{CCI} × 0.85		V_{CCI}	V
	OE Input	V_{CCA} = 1.2V to 5.0V, V_{CCB} = 1.65V to 5.5V			V_{CCA} × 0.85		5.5	
Low-Level Input Voltage (V_{IL})	Data Inputs	V_{CCA} = 1.2V to 5.0V, V_{CCB} = 1.65V to 5.5V			0		V_{CCI} × 0.2	V
	OE Input	V_{CCA} = 1.2V to 5.0V, V_{CCB} = 1.65V to 5.5V			0		V_{CCA} × 0.2	
Voltage Range Applied to Any Output in the High-Impedance or Power-Off State (V_O)	A Ports	V_{CCA} = 1.2V to 5.0V, V_{CCB} = 1.65V to 5.5V			0		5.0	V
	B Ports				0		5.5	
Input Transition Rise or Fall Rate (Δt/ΔV)	A Port Inputs	V_{CCA} = 1.2V to 5.0V, V_{CCB} = 1.65V to 5.5V					40	ns/V
	B Port Inputs	V_{CCA} = 1.2V to 5.0V, V_{CCB} = 1.65V to 5.5V					40	
ELECTRICAL CHARACTERISTICS (1) (2)								
A Ports High Level Output Voltage (V_{OHA})		I_{OH} = -20μA	V_{CCA} = 1.2V	+25℃		1.05		V
			V_{CCA} = 1.4V to 5.0V	Full	V_{CCA} - 0.4			
A Ports Low Level Output Voltage (V_{OLA})		I_{OL} = 20μA	V_{CCA} = 1.2V	+25℃		0.1		
			V_{CCA} = 1.4V to 5.0V	Full			0.4	
B Ports High Level Output Voltage (V_{OHB})		I_{OH} = -20μA	V_{CCB} = 1.65V to 5.5V	Full	V_{CCB} - 0.4			
B Ports Low Level Output Voltage (V_{OLB})		I_{OL} = 20μA	V_{CCB} = 1.65V to 5.5V	Full			0.4	
Input Leakage Current (I_I)	OE	V_{CCA} = 1.2V to 5.0V, 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 5.0V, 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 5.0V, 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 5.0V, 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	V_{CCA} = 1.2V, V_{CCB} = 1.65V to 5.5V	+25℃		0.1		μA
			V_{CCA} = 1.4V to 5V, V_{CCB} = 1.65V to 5.5V	Full			10	
			V_{CCA} = 5.0V, V_{CCB} = 0V				10	
			V_{CCA} = 0V, V_{CCB} = 5.5V				-1	
Quiescent Supply Current (I_{CCB})		V_I = V_{CCI} or GND, I_O = 0	V_{CCA} = 1.2V, V_{CCB} = 1.65V to 5.5V	+25℃		1		μA
			V_{CCA} = 1.4V to 5.0V, V_{CCB} = 1.65V to 5.5V	Full			10	
			V_{CCA} = 5V, V_{CCB} = 0V				-1	
			V_{CCA} = 0V, V_{CCB} = 5.5V				10	

ELECTRICAL CHARACTERISTICS

(Typical values are at T_A = +25℃, unless otherwise specified.)

PARAMETER	CONDITIONS		TEMP	MIN	TYP	MAX	UNITS
Quiescent Supply Current (I_{CCA} + I_{CCB})	V_I = V_{CCI} or GND, I_O = 0	V_{CCA} = 1.2V, V_{CCB} = 1.65V to 5.5V	+25℃		1		μA
		V_{CCA} = 1.4V to 5.0V, V_{CCB} = 1.65V to 5.5V	Full			15	
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 5.0V, V_{CCB} = 1.65V to 5.5V	Full			10	
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 5.0V, V_{CCB} = 1.65V to 5.5V	Full			10	
OE Input Capacitance (C_I)	V_{CCA} = 1.2V to 5.0V, V_{CCB} = 1.65V to 5.5V		+25℃		4		pF
Input/Output Capacitance A Ports (C_{IO})	V_{CCA} = 1.2V to 5.0V, V_{CCB} = 1.65V to 5.5V		+25℃		4.5		pF
Input/Output Capacitance B Ports (C_{IO})					4.5		

NOTES:
1. V_{CCI} is the supply voltage associated with the input ports.
2. V_{CCO} is the supply voltage associated with the output 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	22.1	20.7	19.9	19.4	ns
	t_{PHL}			31.1	29.3	29.9	31.5	
	t_{PLH}	B	A	29.8	29.7	25.1	30.6	
	t_{PHL}			22.8	19.9	20.1	18.2	
t_{EN}	t_{PZH}	OE	A	66.9	67.3	66.7	65.8	ns
	t_{PZL}			48.2	47.6	47.2	46.2	
	t_{PZH}		B	32.6	28.8	28.5	29.6	
	t_{PZL}			62.7	60.5	61.5	63.7	
t_{DIS}	t_{PHZ}	OE	A	1161	1170	1165	1168	ns
	t_{PLZ}			521	524	528	529	
	t_{PHZ}		B	1135	1166	1180	1186	
	t_{PLZ}			532	567	578	563	
t_{rA}		A Ports Rise Time		21.9	21.6	20.0	18.8	ns
t_{fA}		A Ports Fall Time		5.9	6.3	5.2	3.9	ns
t_{rB}		B Ports Rise Time		3.9	2.3	1.9	1.6	ns
t_{fB}		B Ports Fall Time		2.3	1.9	1.7	1.6	ns
$t_{SK(O)}$		Channel-to-Channel		0.5	0.5	0.5	0.5	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	14.8	14.2	13.2	12.5	ns
	t_{PHL}			15.1	12.3	11.7	12.9	
	t_{PLH}	B	A	13.0	13.6	11.5	10.8	
	t_{PHL}			11.9	9.9	9.5	8.3	
t_{EN}	t_{PZH}	OE	A	28.9	29.0	28.8	28.6	ns
	t_{PZL}			27.6	23.3	22.2	21.7	
	t_{PZH}		B	22.8	18.4	17.4	17.1	
	t_{PZL}			31.2	26.8	26.5	26.6	
t_{DIS}	t_{PHZ}	OE	A	1141	1132	1139	1138	ns
	t_{PLZ}			536	531	535	534	
	t_{PHZ}		B	1112	1151	1165	1173	
	t_{PLZ}			530	558	568	553	
t_{rA}		A Ports Rise Time		7.7	7.9	8.4	8.2	ns
t_{fA}		A Ports Fall Time		3.1	2.9	3.0	2.4	ns
t_{rB}		B Ports Rise Time		4.0	2.3	1.8	1.5	ns
t_{fB}		B Ports Fall Time		2.3	2.0	1.8	1.6	ns
$t_{SK(O)}$		Channel-to-Channel		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	11.3	12.3	11.4	10.6	ns
	t_{PHL}			11.0	8.8	8.0	8.4	
	t_{PLH}	B	A	8.6	10.6	9.1	7.4	
	t_{PHL}			9.2	6.8	8.0	5.7	
t_{EN}	t_{PZH}	OE	A	19.0	19.0	19.0	19.1	ns
	t_{PZL}			21.7	17.9	16.5	15.8	
	t_{PZH}		B	20.1	15.6	14.6	14.0	
	t_{PZL}			22.6	19.2	18.7	18.5	
t_{DIS}	t_{PHZ}	OE	A	1170	1169	1170	1170	ns
	t_{PLZ}			541	540	541	542	
	t_{PHZ}		B	1099	1142	1157	1166	
	t_{PLZ}			533	560	566	554	
t_{rA}		A Ports Rise Time		4.8	4.6	4.4	3.9	ns
t_{fA}		A Ports Fall Time		2.3	2.6	2.5	2.3	ns
t_{rB}		B Ports Rise Time		4.3	2.3	1.8	1.6	ns
t_{fB}		B Ports Fall Time		2.3	2.1	1.8	2.2	ns
$t_{SK(O)}$		Channel-to-Channel		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	9.4	7.1	5.2	ns
	t_{PHL}			6.1	5.7	5.1	
	t_{PLH}	B	A	7.8	5.5	4.6	
	t_{PHL}			5.7	5.2	3.6	
t_{EN}	t_{PZH}	OE	A	13.0	12.7	13.0	ns
	t_{PZL}			14.4	13.0	12.2	
	t_{PZH}		B	13.7	12.5	12.1	
	t_{PZL}			14.5	14.1	13.4	
t_{DIS}	t_{PHZ}	OE	A	1188	1188	1189	ns
	t_{PLZ}			571	571	573	
	t_{PHZ}		B	1127	1151	1158	
	t_{PLZ}			566	570	553	
t_{rA}		A Ports Rise Time		2.6	3.2	3.7	ns
t_{fA}		A Ports Fall Time		2.4	2.6	2.7	ns
t_{rB}		B Ports Rise Time		2.2	2.2	2.3	ns
t_{fB}		B Ports Fall Time		1.8	2.2	1.8	ns
$t_{SK(O)}$		Channel-to-Channel		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	6.2	4.1	ns
	t_{PHL}			5.0	4.0	
	t_{PLH}	B	A	5.0	3.7	
	t_{PHL}			4.6	3.0	
t_{EN}	t_{PZH}	OE	A	11.5	11.0	ns
	t_{PZL}			12.3	11.3	
	t_{PZH}		B	11.8	11.5	
	t_{PZL}			12.4	11.7	
t_{DIS}	t_{PHZ}	OE	A	1196	1190	ns
	t_{PLZ}			583	584	
	t_{PHZ}		B	1139	1150	
	t_{PLZ}			578	557	
t_{rA}		A Ports Rise Time		5.8	2.8	ns
t_{fA}		A Ports Fall Time		4.4	2.3	ns
t_{rB}		B Ports Rise Time		1.9	1.7	ns
t_{fB}		B Ports Fall Time		2.0	2.1	ns
$t_{SK(O)}$		Channel-to-Channel		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	3.5	ns
	t_{PHL}			2.9	
	t_{PLH}	B	A	3.0	
	t_{PHL}			2.6	
t_{EN}	t_{PZH}	OE	A	11.5	ns
	t_{PZL}			11.7	
	t_{PZH}		B	11.3	
	t_{PZL}			10.7	
t_{DIS}	t_{PHZ}	OE	A	1196	ns
	t_{PLZ}			578	
	t_{PHZ}		B	1146	
	t_{PLZ}			559	
t_{rA}		A Ports Rise Time		3.4	ns
t_{fA}		A Ports Fall Time		3.1	ns
t_{rB}		B Ports Rise Time		1.7	ns
t_{fB}		B Ports Fall Time		1.7	ns
$t_{SK(O)}$		Channel-to-Channel		0.5	ns
Data Rate				100	Mbps

OPERATING CHARACTERISTICS

(T_A = +25℃, unless otherwise noted.)

PARAMETER		TEST 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)	61	56	13	6	7	7	8	8	9	pF
	B Port Inputs, A Port Outputs		9	9	9	9	9	9	9	9	10	pF
C_{PDB}	A Port Inputs, B Port Outputs		10	9	9	9	9	9	9	9	9	pF
	B Port Inputs, A Port Outputs		20	92	7	7	7	9	8	9	10	pF
C_{PDA}	A Port Inputs, B Port Outputs	C_L = 0, f = 10MHz, $t_r = t_f$ = 1ns, OE = GND (Outputs Disabled)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	pF
	B Port Inputs, A Port Outputs		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	pF
C_{PDB}	A Port Inputs, B Port Outputs		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	pF
	B Port Inputs, A Port Outputs		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	pF

APPLICATION INFORMATION

Applications

The SGM4556 can be used in level-translation applications for interfacing devices or systems operating at different interface voltages with one another.

Architecture

The SGM4556 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 SGM4556 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 140Ω 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.

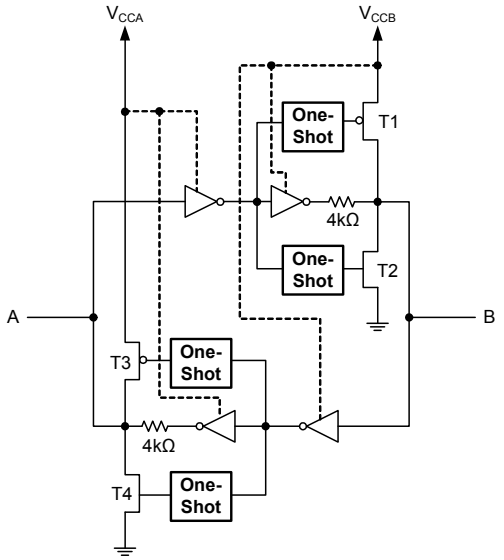
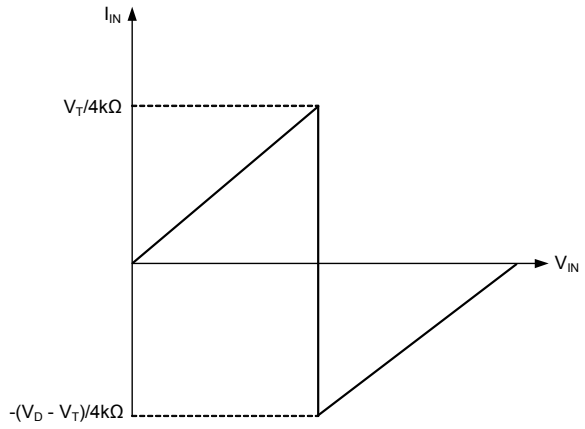


Figure 1. Architecture of an SGM4556 I/O Cell

Input Driver Requirements

Typical I_{IN} vs. V_{IN} characteristics of the SGM4556 are shown in Figure 2. For proper operation, the device driving the data I/Os of the SGM4556 must have drive strength of at least ±2mA.



A. V_T is the input threshold voltage of the SGM4556 (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, $V_{CCA} > V_{CCB}$ does not damage the device, so any power supply can be ramped up first. The SGM4556 has circuitry that disables all output ports when either V_{CC} is switched off ($V_{CCA/B}$ = 0V).

Enable and Disable

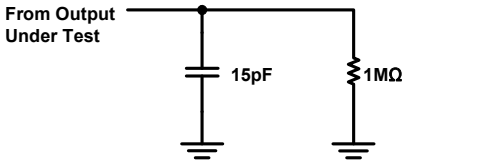
The SGM4556 has an OE input that is used to disable the device by setting OE = low, which places all I/Os in the high-impedance (Hi-Z) state. OE has an internal pull-down current source, as long as V_{CCB} is powered. The disable time indicates the delay between when OE goes low and when the outputs 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

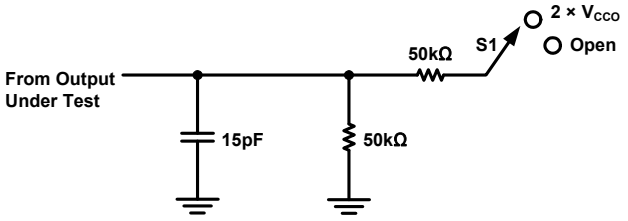
The SGM4556 is designed to drive capacitive loads of up to 70pF. The output drivers of the SGM4556 have low DC drive strength. If pull-up or pull-down resistors are connected externally to the data I/Os, their values must be kept higher than 50kΩ to ensure that they do not contend with the output drivers of the SGM4556.

For the same reason, the SGM4556 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. For these applications, please use the open-drain output SGM4553 which is pin-compatible with the SGM4556.

PARAMETER MEASUREMENT INFORMATION

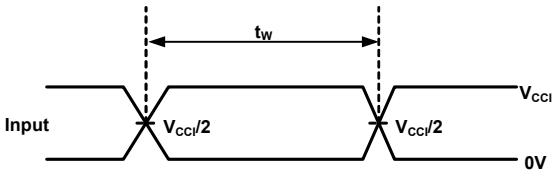


LOAD CIRCUIT FOR MAX DATA RATE, PULSE DURATION PROPAGATION DELAY OUTPUT RISE AND FALL TIME MEASUREMENT

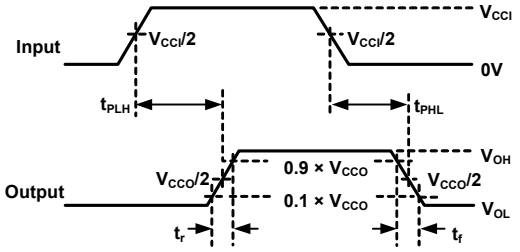


LOAD CIRCUIT FOR ENABLE/DISABLE TIME MEASUREMENT

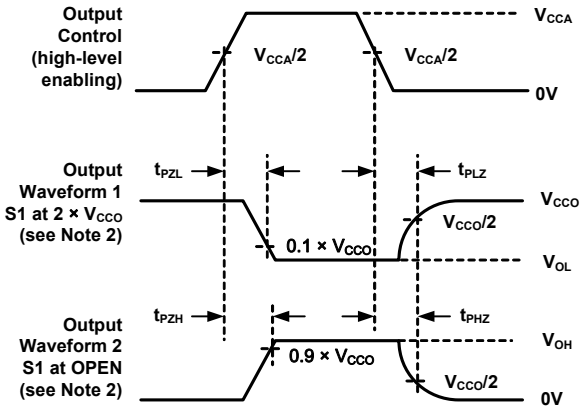
TEST	S1
t_{PZL}/t_{PLZ}	2 × V_{CCO}
t_{PHZ}/t_{PZH}	Open



VOLTAGE WAVEFORMS PULSE DURATION



VOLTAGE WAVEFORMS PROPAGATION DELAY TIMES



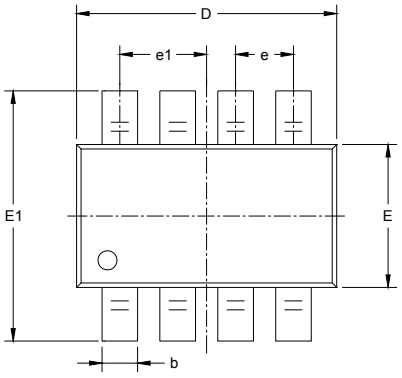
VOLTAGE WAVEFORMS ENABLE AND DISABLE TIMES

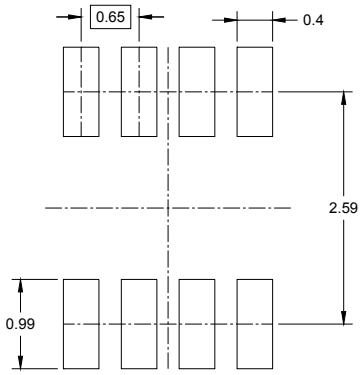
NOTES:
1. C_L includes probe and jig capacitance.
2. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.
3. All input pulses are supplied by generators having the following characteristics: PRR ≤ 10MHz, Z_O = 50Ω, dv/dt ≥ 1V/ns.
4. The outputs are measured one at a time, with one transition per measurement.
5. t_{PLZ} and t_{PHZ} are the same as t_{DIS}.
6. t_{PZL} and t_{PZH} are the same as t_{EN}.
7. t_{PLH} and t_{PHL} are the same as t_{PD}.
8. V_{CCI} is the V_{CC} associated with the input ports.
9. V_{CCO} is the V_{CC} associated with the output ports.
10. All parameters and waveforms are not applicable to all devices.

Figure 3. Load Circuits and Voltage Waveforms

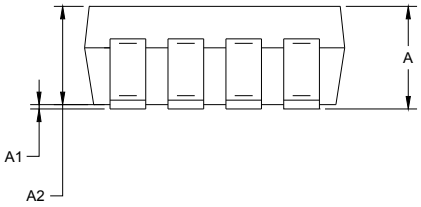
PACKAGE OUTLINE DIMENSIONS

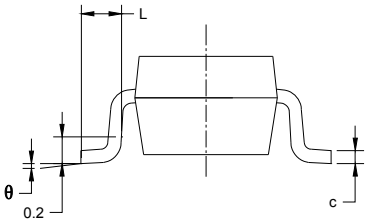
SOT-23-8





RECOMMENDED LAND PATTERN (Unit: mm)

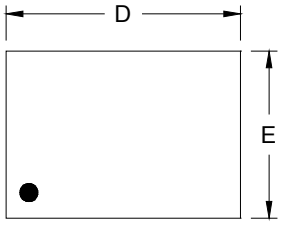




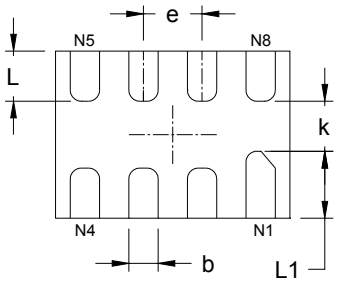
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.650 BSC		0.026 BSC	
e1	0.975 BSC		0.038 BSC	
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

PACKAGE OUTLINE DIMENSIONS

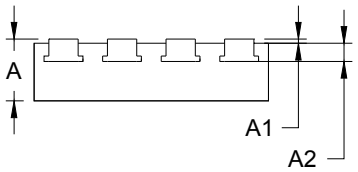
XTDFN-1.4×1-8L



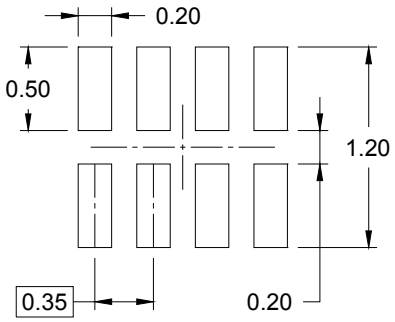
TOP VIEW



BOTTOM VIEW



SIDE VIEW

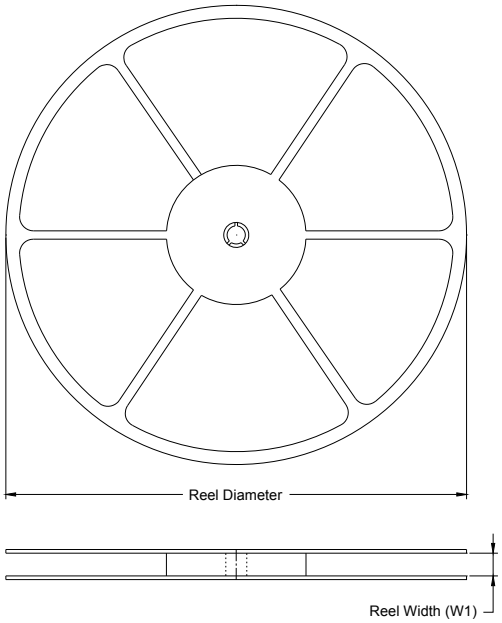


RECOMMENDED LAND PATTERN (Unit: mm)

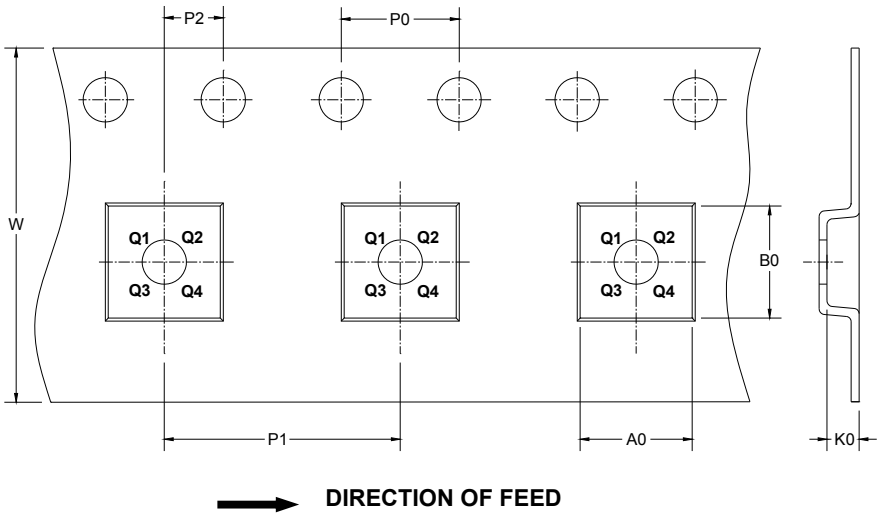
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.340	0.400	0.013	0.016
A1	0.000	0.050	0.000	0.002
A2	0.110 REF		0.004 REF	
D	1.350	1.450	0.053	0.057
E	0.950	1.050	0.037	0.041
k	0.200 MIN		0.008 MIN	
b	0.150	0.200	0.006	0.008
e	0.350 TYP		0.014 TYP	
L	0.250	0.350	0.010	0.014
L1	0.350	0.450	0.014	0.018

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS

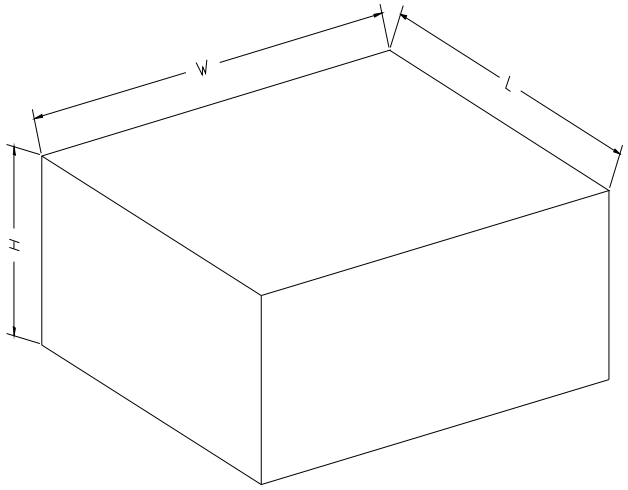


NOTE: The picture is only for reference. Please make the object as the standard.

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
SOT-23-8	7″	9.5	3.17	3.23	1.37	4.0	4.0	2.0	8.0	Q3
XTDFN-1.4×1-8L	7″	9.5	1.15	1.6	0.5	4.0	4.0	2.0	8.0	Q1

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