SGM4542
2-Bit Bidirectional Voltage-Level Translator for Open-Drain and Push-Pull Applications

GENERAL DESCRIPTION

The SGM4542 is a 2-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 0.9V to 3.6V for both A and B ports. The device provides a bidirectional translation function between the different voltage nodes (including 1.2V, 1.8V, 2.5V, and 3.6V).

The SGM4542 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. It is beneficial for reducing quiescent current consumption.

The SGM4542 is available in a Green XTDFN-1.35×1-8L package. It operates over an ambient temperature range of -40℃ to +125℃.

FEATURES

- **Power Supply Voltage Range ($V_{CCA} \leq V_{CCB}$)**
  - **A Ports and B Ports: 0.9V to 3.6V**
- **Supports V_{CCA} or V_{CCB} Isolation**
  - **When V_{CCA} or V_{CCB} is Low, Device Enters Power-Down Mode**
- **Direction-Control Signal is Not Required**
- **No Specific Power Sequences Required for V_{CCA} and V_{CCB}**
- **Supports Power-Down Mode**
- **Available in a Green XTDFN-1.35×1-8L Package**

APPLICATIONS

Universal Asynchronous Receiver/Transmitter
I^2C/SMBus Interfaces
General Purpose I/O (GPIO)

TYPICAL APPLICATION

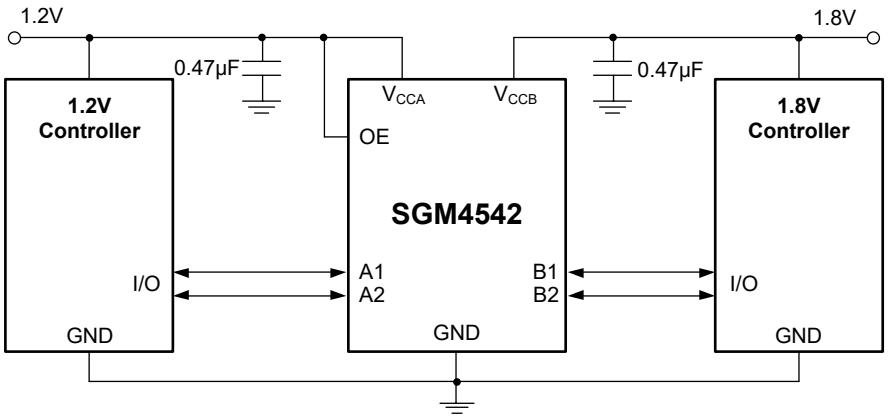


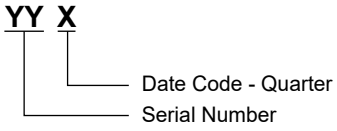
Figure 1. Typical Application Circuit

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM4542	XTDFN-1.35×1-8L	-40℃ to +125℃	SGM4542XXET8G/TR	XSX	Tape and Reel, 5000

MARKING INFORMATION

NOTE: X = Date 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

Supply Voltage Range
V_{CCA} ..... -0.5V to 4.6V
V_{CCB} ..... -0.5V to 4.6V
Input Voltage Range, V_I
A Ports ..... -0.5V to 4.6V
B Ports ..... -0.5V to 4.6V
OE ..... -0.5V to 4.6V
Output Voltage Range for the High-Impedance or Power-Off State, V_O
A Ports ..... -0.5V to 4.6V
B Ports ..... -0.5V to 4.6V
Output Voltage Range for the High or Low State, V_O
A Ports ..... -0.5V to V_{CCA} + 0.5V
B Ports ..... -0.5V to V_{CCB} + 0.5V
Input Clamp Current, I_{IK}, (V_I < 0) ..... -50mA
Output Clamp Current, I_{OK}, (V_O < 0) ..... -50mA
Package Thermal Resistance
XTDFN-1.35×1-8L, θ_{JA} ..... 240℃/W
Junction Temperature ..... +150℃
Storage Temperature Range ..... -65℃ to +150℃
Lead Temperature (Soldering, 10s) ..... +260℃
ESD Susceptibility
HBM 3000V
CDM 1000V

RECOMMENDED OPERATING CONDITIONS

Operating Temperature Range ..... -40℃ to +125℃

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.

ESD SENSITIVITY CAUTION

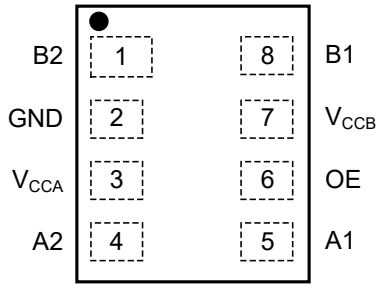
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance 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.

DISCLAIMER

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

PIN CONFIGURATION

(TOP VIEW)



XTDFN-1.35×1-8L

PIN DESCRIPTION

PIN	NAME	FUNCTION
1	B2	Channel 2 Input/Output B. It tracks the V_{CCB} supply.
2	GND	Ground.
3	V_{CCA}	Supply Voltage on A Port. It can be operated from 0.9V to 3.6V, and V_{CCA} is always ≤ V_{CCB}.
4	A2	Channel 2 Input/Output A. It tracks the V_{CCA} supply.
5	A1	Channel 1 Input/Output A. It tracks the V_{CCA} supply.
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.
7	V_{CCB}	Supply Voltage on B Port. It can be operated from 0.9V to 3.6V.
8	B1	Channel 1 Input/Output B. It tracks the V_{CCB} supply.

FUNCTIONAL DESCRIPTION

Table 1. Functional Table

V_{CCA} (1)	V_{CCB} (1)	OE (4)	An	Bn
1.08V to 1.98V	1.08V to 1.98V	L	Z (3)	Z
1.08V to 1.98V	1.08V to 1.98V	H (3)	Input/Output	Output/Input
L (2)	L	X (3)	Z	Z

NOTES:
1. No specific power sequences required for V_{CCA} and V_{CCB}. V_{CCA} is always ≤ V_{CCB}.
2. When either V_{CCA} or V_{CCB} is low, the device enters into power-down mode, An and Bn are in high-impedance state.
3. H = high voltage level; L = low voltage level; X = don't care; Z = high impedance state.
4. OE can withstand voltage up to V_{CCB}, but its V_{IL} and V_{IH} are referenced to V_{CCA}.

Table 2. Truth Table when OE = H

Input	Output
Transition Rising Edge	Follow Input Signal
H	H (Once reaches steady-state high, it can respond to signal driven in the opposite direction)
Transition Falling Edge	Follow Input Signal
L	L (Once reaches steady-state low, it can respond to signal driven in the opposite direction)

ELECTRICAL CHARACTERISTICS

(V_{CCA} = 1.08V to 3.6V, V_{CCB} = 1.08V to 3.6V, Full = -40℃ to +125℃, typical values are at T_A = +25℃, unless otherwise noted.)

PARAMETER		SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
Recommended Operating Conditions								
Supply Voltage (1)		V_{CCA}		Full	1.08		3.6	V
		V_{CCB}		Full	1.08		3.6	
High-Level Input Voltage	A Port I/Os	V_{IH}		Full	0.7 × V_{CCA}			V
	B Port I/Os			Full	0.7 × V_{CCB}			
	OE Input			Full	0.7 × V_{CCA}			
Low-Level Input Voltage	A Port I/Os	V_{IL}		Full			0.25	V
	B Port I/Os			Full			0.25	
	OE Input			Full			0.3 × V_{CCA}	
Hysteresis Voltage	OE Input	V_{HYS}		Full	0.03		0.3	V
Electrical Characteristics								
A Ports High-Level Output Voltage		V_{OHA}	I_{OH} = -20μA	Full	0.7 × V_{CCA}			V
A Ports Low-Level Output Voltage		V_{OLA}	I_{OL} = 1mA, V_{IB} ≤ 0.25V	Full			0.4	V
B Ports High-Level Output Voltage		V_{OHB}	I_{OH} = -20μA	Full	0.7 × V_{CCB}			V
B Ports Low-Level Output Voltage		V_{OLB}	I_{OL} = 1mA, V_{IA} ≤ 0.25V	Full			0.4	V
Input Leakage Current	OE Input	I_I		Full			±4	μA
Power-Off Leakage Current	A Ports	I_{OFF}	V_{CCA} = 0V, V_{CCB} = 0V to 3.6V	Full			±10	μA
	B Ports		V_{CCA} = 0V to 3.6V, V_{CCB} = 0V	Full			±10	
Off-State Output Leakage	A or B Ports	I_{OZ}	OE = 0V	Full			±8	μA
Quiescent Supply Current		I_{CCA} + I_{CCB}	V_{CCA} = 1.08V to V_{CCB}, V_{CCB} = 1.08V to 3.6V, V_I = 0V or V_{CCI} (2), I_O = 0A	Full			50	μA
OE Input Capacitance		C_I		+25℃		10		pF
Input/Output Capacitance	A Ports	C_{IO}	Enabled	+25℃		18		pF
			Disabled	+25℃		15		
	B Ports		Enabled	+25℃		18		
			Disabled	+25℃		15		

NOTES:

1. Ensure that V_{CCA} ≤ V_{CCB}.
2. V_{CCI} is the supply voltage associated with the input ports.

SWITCHING CHARACTERISTICS

(V_{CCA} = 1.08V to 3.6V, V_{CCB} = 1.08V to 3.6V, Full = -40℃ to +125℃, typical values are at T_A = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
Propagation Delay	t_{PD}	An to Bn, or Bn to An, push-pull driving	Full			22	ns
Rise Time	t_R	An or Bn, push-pull driving	Full	1		26.5	ns
Fall Time	t_F	An or Bn, push-pull driving	Full	1		26.5	ns
Enable Time	t_{EN}	OE to An or Bn	Full			285	ns
Disable Time	t_{DIS}	OE to An or Bn	Full			100	ns
Channel-to-Channel Skew	t_{SKO}	Push-pull driving	Full	0		5	ns

WAVEFORMS

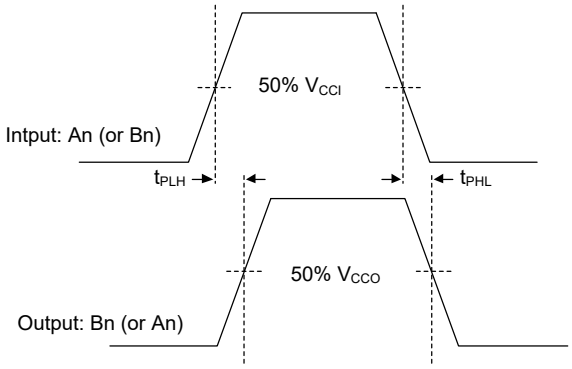


Figure 2. Propagation Delay (Data Input to Data Output)

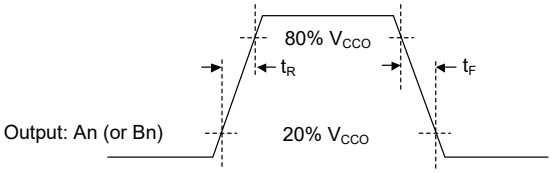
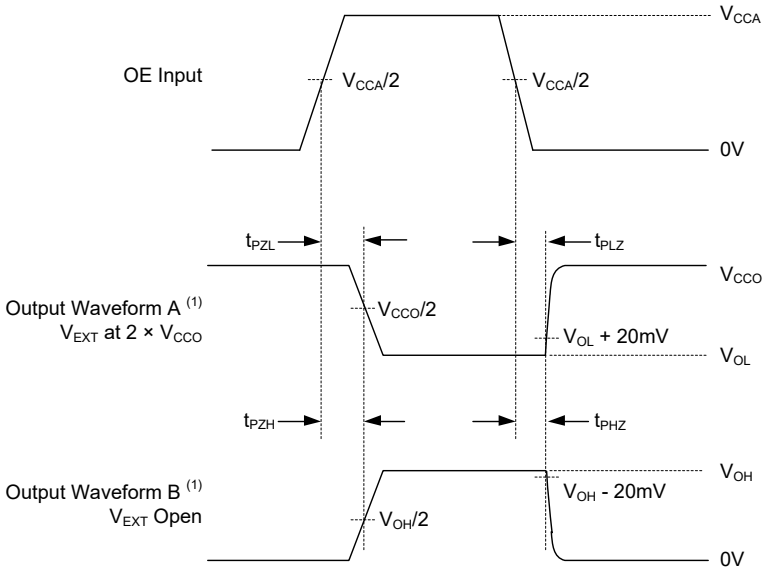


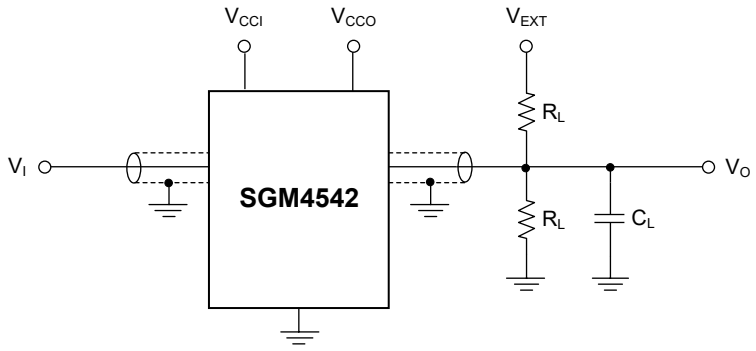
Figure 3. Rise Time and Fall Time of Data Output



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



Test conditions are given in Table 3.

Definitions for test circuit:

R_L = Load resistance.

C_L = Load capacitance including jig and probe capacitance.

V_{EXT} = External voltage for measuring switching times.

Figure 5. Test Circuit for Measuring Switching Times

Table 3. Test Conditions

Supply Voltage		Input		Load		V_{EXT}		
V_{CCA}	V_{CCB}	V_I	$\Delta t/\Delta V$	C_L	R_L (2)	t_{PLH}, t_{PHL} (3)	t_{PLZ}, t_{PZL} (4)(5)	t_{PHZ}, t_{PZH} (4)(5)
1.08V to 3.6V	1.08V to 3.6V	V_{CCI} (1)	≤ 2ns/V	15pF	50kΩ, 1MΩ	Open	2 × V_{CCO} (1)	Open

NOTES:

1. V_{CCI} is the supply voltage associated with the input, and V_{CCO} is the supply voltage associated with the output.
2. For measuring propagation delay and output rise and fall measurements, R_L = 1MΩ; for measuring enable and disable times, R_L = 50kΩ.
3. t_{PLH} and t_{PHL} are the same as t_{PD}.
4. t_{PLZ} and t_{PHZ} are the same as t_{DIS}.
5. t_{PZL} and t_{PZH} are the same as t_{EN}.

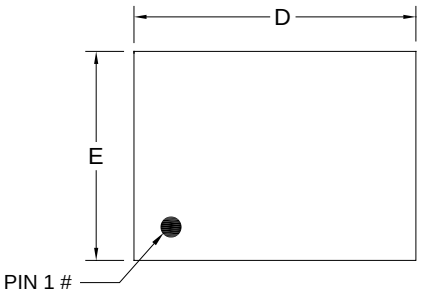
REVISION HISTORY

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

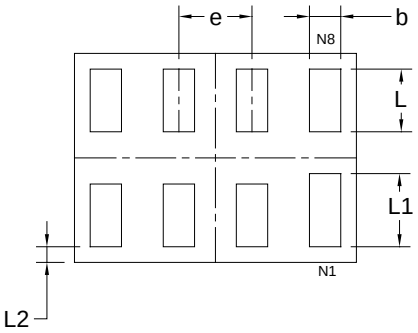
Changes from Original (DECEMBER 2021) to REV.A	Page
Changed from product preview to production data	All

PACKAGE OUTLINE DIMENSIONS

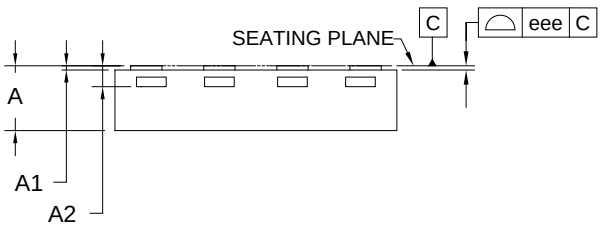
XTDFN-1.35×1-8L



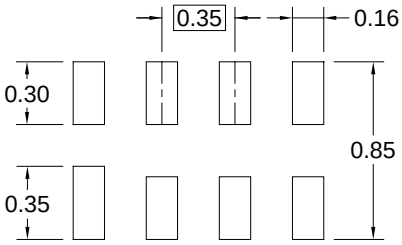
TOP VIEW



BOTTOM VIEW



SIDE VIEW



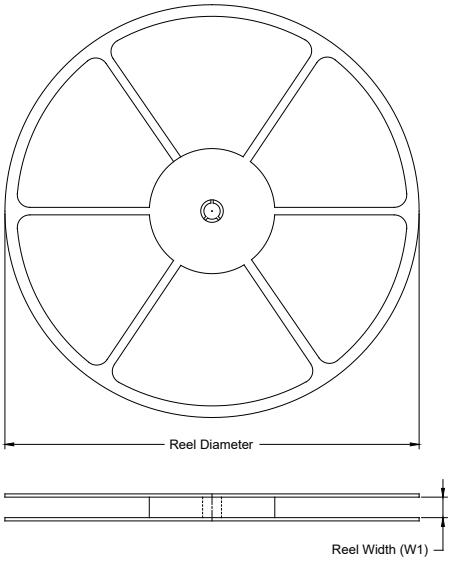
RECOMMENDED LAND PATTERN (Unit: mm)

Symbol	Dimensions In Millimeters		
	MIN	MOD	MAX
A	-	0.310	0.330
A1	0.000	-	0.050
A2	0.100 REF		
D	1.250	1.350	1.450
E	0.900	1.000	1.100
b	0.110	0.160	0.210
e	0.350 BSC		
L	0.250	0.300	0.350
L1	0.300	0.350	0.400
L2	0.075 REF		
eee	-	0.050	-

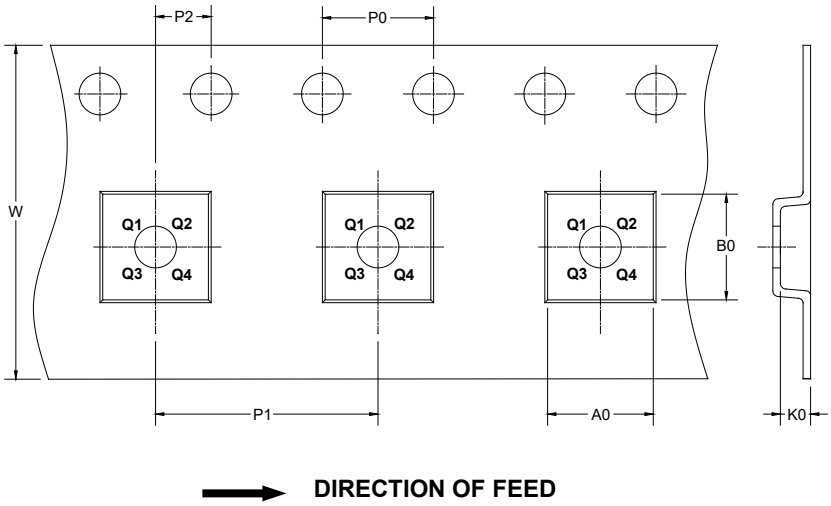
NOTE: This drawing is subject to change without notice.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



DIRECTION OF FEED

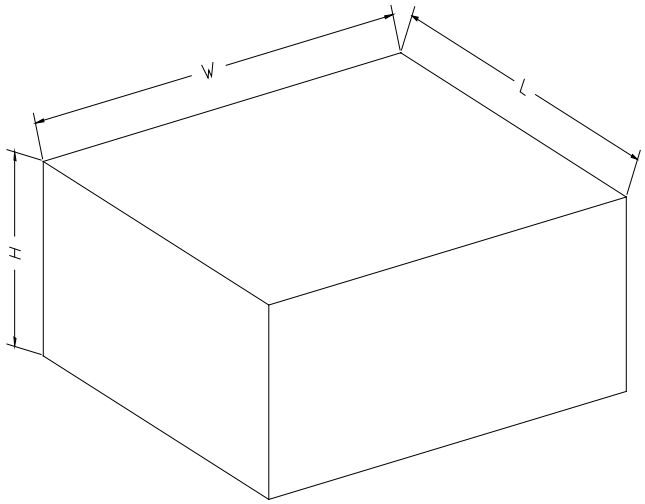
NOTE: The picture is only for reference. Please make the object as the standard.

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
XTDFN-1.35×1-8L	7″	9.5	1.21	1.51	0.39	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

DD0002