

GENERAL DESCRIPTION

The SGM4562AQ 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 ranges from 0.9V to 3.6V for both A and B ports. The device provides a bidirectional translation function among different voltage nodes (including 1V, 1.2V, 1.5V, 1.8V, 2.5V and 3.3V).

The device has an output enable (OE) function, which controls the inputs and outputs states. When OE is held low, all outputs enter the high-impedance state. A pull-down resistor can be used to keep OE connecting to GND. Thus, the high-impedance state is ensured. The OE input tracks the V_{CCA} supply.

The device is AEC-Q100 qualified (Automotive Electronics Council (AEC) standard Q100 Grade 1) and it is suitable for automotive applications.

The SGM4562AQ is available in Green TSSOP-14 and UTQFN-1.7x2-12L packages. It operates over an ambient temperature range of -40°C to $+125^{\circ}\text{C}$.

FEATURES

- **AEC-Q100 Qualified for Automotive Applications Device Temperature Grade 1**
 $T_A = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$
- **V_{CCA} Supply Voltage Range: 0.9V to 3.6V**
- **V_{CCB} Supply Voltage Range: 0.9V to 3.6V**
- **Support V_{CCA} or V_{CCB} Isolation**
 - ◆ **When V_{CCA} or V_{CCB} is at GND, Device Enters High-Impedance State**
- **OE Input Tracks the V_{CCA} Supply**
- **Low Power Consumption: 5 μA (MAX) (I_{CCA} or I_{CCB})**
- **Support Power-Down Mode**
- **-40°C to $+125^{\circ}\text{C}$ Operating Temperature Range**
- **Available in Green TSSOP-14 and UTQFN-1.7x2-12L Packages**

APPLICATIONS

- Automotive Applications
- Portable Equipment
- Industrial Equipment
- Medical Equipment
- Telecommunications

TYPICAL APPLICATION

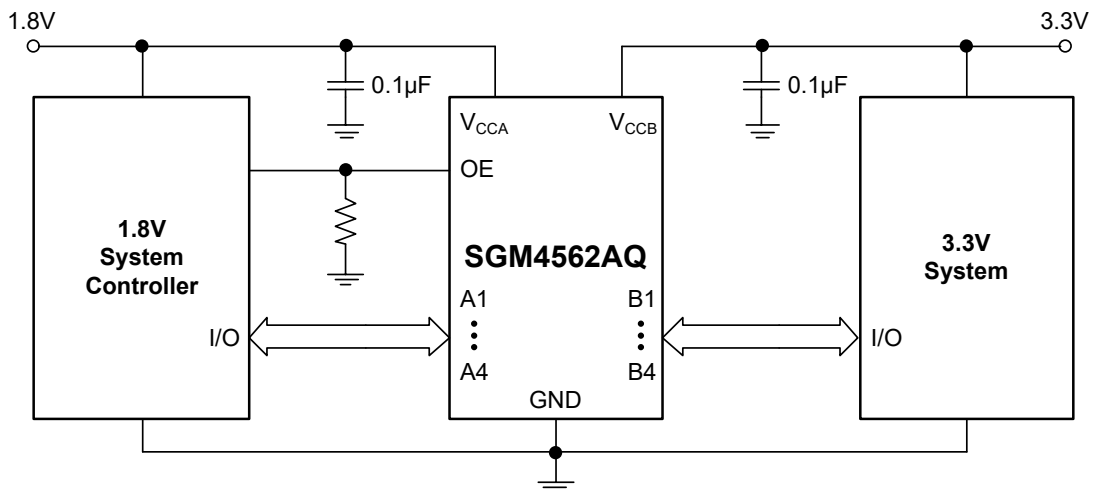


Figure 1. Typical Application Circuit

Automotive, 4-Bit Bidirectional Level-Shifter/ Voltage Translator with Auto Direction Sensing

SGM4562AQ

PACKAGE/ORDERING INFORMATION

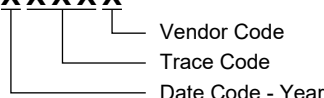
MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE TOP MARKING	PACKING OPTION
SGM4562AQ	TSSOP-14	-40°C to +125°C	SGM4562AQTS14G/TR	0P3 TS14 XXXXX	Tape and Reel, 4000
	UTQFN-1.7×2-12L	-40°C to +125°C	SGM4562AQURF12G/TR	0P2 XXXX	Tape and Reel, 3000

MARKING INFORMATION

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

TSSOP-14

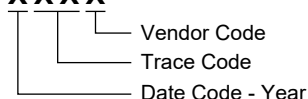
XXXXX



UTQFN-1.7×2-12L

YYY— Serial Number

XXXX



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 ⁽¹⁾

A Ports -0.5V to 4.6V

B Ports -0.5V to 4.6V

Output Voltage Range, V_O ⁽¹⁾

High-Impedance State or Power-Off State

A Ports -0.5V to 4.6V

B Ports -0.5V to 4.6V

High-State or Low-State

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

UTQFN-1.7×2-12L, θ_{JA} 131.5°C/W

UTQFN-1.7×2-12L, θ_{JB} 65.3°C/W

UTQFN-1.7×2-12L, θ_{JC} 77.9°C/W

TSSOP-14, θ_{JA} 146.6°C/W

TSSOP-14, θ_{JB} 109.7°C/W

TSSOP-14, θ_{JC} 75.5°C/W

Junction Temperature⁽²⁾ +150°C

Storage Temperature Range -65°C to +150°C

Lead Temperature (Soldering, 10s) +260°C

ESD Susceptibility^{(3) (4)}

HBM ±7000V

CDM ±1000V

RECOMMENDED OPERATING CONDITIONS

Supply Voltage Range

V_{CCA} 0.9V to 3.6V

V_{CCB} 0.9V to 3.6V

Input Transition Rise or Fall Rate, $\Delta t/\Delta V$

A Ports Inputs ($V_{CCA} = 0.9V$ to 3.6V, $V_{CCB} = 0.9V$ to 3.6V)

..... 40ns/V (MAX)

B Ports Inputs ($V_{CCA} = 0.9V$ to 3.6V, $V_{CCB} = 0.9V$ to 3.6V)

..... 40ns/V (MAX)

Operating Temperature Range -40°C to +125°C

NOTES:

- The minimum input and output voltage ratings may be exceeded if the input and output clamp current ratings are observed.
- The performance capability of a high-performance integrated circuit in conjunction with its thermal environment can create junction temperatures which are detrimental to reliability.
- For human body model (HBM), all pins comply with AEC-Q100-002 specification.
- For charged device model (CDM), all pins comply with AEC-Q100-011 specification.

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

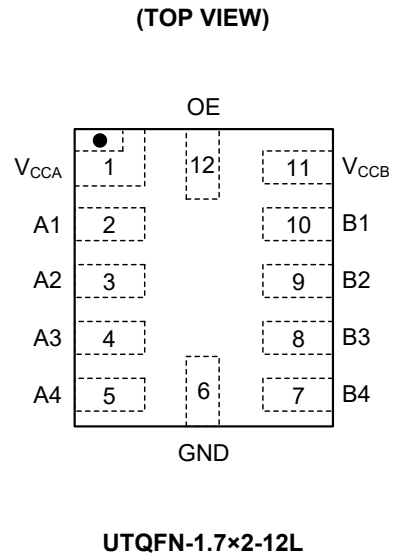
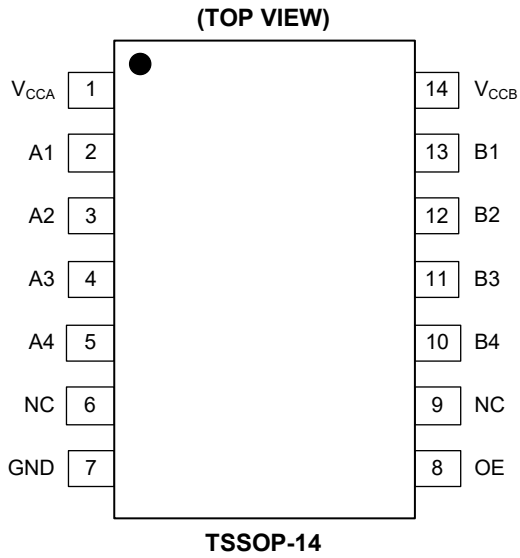
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all

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 CONFIGURATIONS



PIN DESCRIPTION

PIN		NAME	FUNCTION
TSSOP-14	UTQFN-1.7x2-12L		
1	1	V _{CCA}	Supply Voltage on A Ports. It can be operated from 0.9V to 3.6V.
2, 3, 4, 5	2, 3, 4, 5	A1, A2, A3, A4	Data Inputs/Outputs. They track the V _{CCA} supply.
6, 9	—	NC	No Connection.
7	6	GND	Ground.
8	12	OE	Output Enable Input. When OE goes low, all outputs enter into 3-state mode. It tracks the V _{CCA} supply.
10, 11, 12, 13	7, 8, 9, 10	B4, B3, B2, B1	Data Inputs/Outputs. They track the V _{CCB} supply.
14	11	V _{CCB}	Supply Voltage on B Ports. It can be operated from 0.9V to 3.6V.

Automotive, 4-Bit Bidirectional Level-Shifter/ Voltage Translator with Auto Direction Sensing

SGM4562AQ

ELECTRICAL CHARACTERISTICS

($V_{CCA} = 0.9V$ to $3.6V$, $V_{CCB} = 0.9V$ to $3.6V$, $T_A = -40^\circ C$ to $+125^\circ C$, all typical values are measured at $T_A = +25^\circ C$, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
High-Level Input Voltage	V_{IH}	Data inputs	$V_{CCA} = V_{CCB} = 0.9V$ to $3.6V$	$0.75 \times V_{CCI}^{(1)}$			V
		OE		$0.7 \times V_{CCA}$			
Low-Level Input Voltage	V_{IL}	Data inputs	$V_{CCA} = V_{CCB} = 0.9V$ to $3.6V$			$0.3 \times V_{CCI}^{(1)}$	V
		OE	$V_{CCA} = 0.9V$ to $1.2V$, $V_{CCB} = 0.9V$ to $3.6V$			$0.3 \times V_{CCA}$	
			$V_{CCA} = 1.2V$ to $3.6V$, $V_{CCB} = 0.9V$ to $3.6V$			$0.35 \times V_{CCA}$	
High-Level Output Voltage	V_{OHA}	A Ports	$I_{OH} = -20\mu A$	$0.9 \times V_{CCA}$			V
	V_{OHB}	B Ports	$I_{OH} = -20\mu A$	$0.9 \times V_{CCB}$			
Low-Level Output Voltage	V_{OLA}	A Ports	$I_{OL} = 20\mu A$			0.2	V
	V_{OLB}	B Ports	$I_{OL} = 20\mu A$			0.2	
Input Leakage Current	I_I	OE	$V_I = V_{CCI}$ or GND ⁽¹⁾	$T_A = +25^\circ C$		± 1	μA
				$T_A = -40^\circ C$ to $+125^\circ C$		± 2	
Power-Off Leakage Current	I_{OFFA}	A Ports	V_I or $V_O = 0V$ to $3.6V$, $V_{CCA} = 0V$, $V_{CCB} = 0.9V$ to $3.6V$	$T_A = +25^\circ C$		± 1	μA
				$T_A = -40^\circ C$ to $+125^\circ C$		± 2	
	I_{OFFB}	B Ports	V_I or $V_O = 0V$ to $3.6V$, $V_{CCA} = 0.9V$ to $3.6V$, $V_{CCB} = 0V$	$T_A = +25^\circ C$		± 1	
				$T_A = -40^\circ C$ to $+125^\circ C$		± 2	
Off-State Output Current	I_{OZ}	A or B Ports	OE = GND	$T_A = +25^\circ C$		± 1	μA
				$T_A = -40^\circ C$ to $+125^\circ C$		± 2	
Supply Current	I_{CCA}	A Ports	$V_I = V_{CCI}$ or GND ⁽¹⁾ , $I_O = 0A$		1.1	5	μA
	I_{CCB}	B Ports			1.2	5	
	$I_{CCA} + I_{CCB}$	A and B Ports			1.2	10	
High-Z State Supply Current	I_{CCZA}	A Ports	$V_I = V_{CCI}$ or GND ⁽¹⁾ , $I_O = 0A$, OE = GND		1.1	5	μA
	I_{CCZB}	B Ports			1.2	5	
Input Capacitance	C_I	OE			7.5		pF
Input/Output Capacitance	C_{IO}	A Ports	OE = GND		7.5		pF
		B Ports			7.5		

NOTE:

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

Automotive, 4-Bit Bidirectional Level-Shifter/ Voltage Translator with Auto Direction Sensing

SGM4562AQ

TIMING REQUIREMENTS

(T_A = -40°C to +125°C, all typical values are measured at T_A = +25°C, unless otherwise noted.)

PARAMETER	CONDITIONS		MIN	TYP	MAX ⁽¹⁾	UNITS
Data Rate	C _L = 15pF	V _{CCA} = V _{CCB} = 0.9V to 3.6V			50	Mbps
		V _{CCA} = V _{CCB} = 1.2V to 3.6V			100	
		V _{CCA} = V _{CCB} = 1.8V to 3.6V			140	
	C _L = 30pF	V _{CCA} = V _{CCB} = 0.9V to 3.6V			40	
		V _{CCA} = V _{CCB} = 1.2V to 3.6V			90	
		V _{CCA} = V _{CCB} = 1.8V to 3.6V			130	
	C _L = 50pF	V _{CCA} = V _{CCB} = 1.2V to 3.6V			75	
		V _{CCA} = V _{CCB} = 1.8V to 3.6V			120	
	C _L = 100pF	V _{CCA} = V _{CCB} = 1.2V to 3.6V			55	
		V _{CCA} = V _{CCB} = 1.8V to 3.6V			90	

NOTE:

- Specified by design and characterization, not production tested.

OPERATING CHARACTERISTICS

(V_{CCA} = 0.9V to 3.6V, V_{CCB} = 0.9V to 3.6V, T_A = -40°C to +125°C, all typical values are measured at T_A = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS																				
Power Dissipation Capacitance ⁽¹⁾	C _{PD} A	From An to Bn	C _L = 0F, f = 10MHz, t _R = t _F = 1ns, OE = V _{CCA} (outputs enabled)		38																					
		From Bn to An																								
	C _{PD} B	From An to Bn					C _L = 0F, f = 10MHz, t _R = t _F = 1ns, OE = GND (outputs disabled)		24																	
		From Bn to An																								
	C _{PD} A	From An to Bn									C _L = 0F, f = 10MHz, t _R = t _F = 1ns, OE = GND (outputs disabled)		24													
		From Bn to An																								
	C _{PD} B	From An to Bn													C _L = 0F, f = 10MHz, t _R = t _F = 1ns, OE = GND (outputs disabled)		37									
		From Bn to An																								
	C _{PD} A	From An to Bn																	C _L = 0F, f = 10MHz, t _R = t _F = 1ns, OE = GND (outputs disabled)		0.03					
		From Bn to An																								
	C _{PD} B	From An to Bn																					C _L = 0F, f = 10MHz, t _R = t _F = 1ns, OE = GND (outputs disabled)		0.03	
		From Bn to An																								

NOTE:

- C_{PD} is used to determine the dynamic power dissipation (P_D in μW).

$$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$$

where:

f_i = Input frequency in MHz.

f_o = Output frequency in MHz.

C_L = Output load capacitance in pF.

V_{CC} = Supply voltage in Volts.

N = Number of inputs switching.

Σ(C_L × V_{CC}² × f_o) = Sum of outputs.

Automotive, 4-Bit Bidirectional Level-Shifter/ SGM4562AQ Voltage Translator with Auto Direction Sensing

SWITCHING CHARACTERISTICS

(T_A = -40°C to +125°C, all typical values are measured at T_A = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS			MIN ⁽¹⁾	TYP	MAX ⁽¹⁾	UNITS
Propagation Delay ⁽²⁾	t _{PD}	From An to Bn	C _L = 15pF	V _{CCA} = V _{CCB} = 0.9V to 3.6V	0.1	14.7	40.2	ns
				V _{CCA} = V _{CCB} = 1.2V to 3.6V	0.5	6.8	17.0	
				V _{CCA} = V _{CCB} = 1.8V to 3.6V	0.5	3.6	7.3	
			C _L = 30pF	V _{CCA} = V _{CCB} = 0.9V to 3.6V	0.1	15.7	41.9	
				V _{CCA} = V _{CCB} = 1.2V to 3.6V	0.5	7.2	14.7	
				V _{CCA} = V _{CCB} = 1.8V to 3.6V	0.5	3.8	7.2	
			C _L = 50pF	V _{CCA} = V _{CCB} = 1.2V to 3.6V	0.5	7.8	16.2	
				V _{CCA} = V _{CCB} = 1.8V to 3.6V	0.5	4.2	7.6	
			C _L = 100pF	V _{CCA} = V _{CCB} = 1.2V to 3.6V	0.5	9.0	18.4	
		V _{CCA} = V _{CCB} = 1.8V to 3.6V		0.5	5.0	8.9		
		From Bn to An	C _L = 15pF	V _{CCA} = V _{CCB} = 0.9V to 3.6V	0.5	14.8	37.6	
				V _{CCA} = V _{CCB} = 1.2V to 3.6V	0.5	6.8	14.3	
				V _{CCA} = V _{CCB} = 1.8V to 3.6V	0.5	3.6	6.9	
			C _L = 30pF	V _{CCA} = V _{CCB} = 0.9V to 3.6V	0.5	15.7	41.7	
				V _{CCA} = V _{CCB} = 1.2V to 3.6V	0.5	7.2	14.4	
				V _{CCA} = V _{CCB} = 1.8V to 3.6V	0.5	3.9	7.2	
			C _L = 50pF	V _{CCA} = V _{CCB} = 1.2V to 3.6V	0.5	7.7	16.0	
				V _{CCA} = V _{CCB} = 1.8V to 3.6V	0.5	4.2	7.7	
C _L = 100pF	V _{CCA} = V _{CCB} = 1.2V to 3.6V		0.5	9.0	18.1			
	V _{CCA} = V _{CCB} = 1.8V to 3.6V	0.5	5.0	8.9				
Enable Time ⁽²⁾	t _{EN}	From OE to An	C _L = 15pF	V _{CCA} = V _{CCB} = 0.9V to 3.6V		182	396	ns
				V _{CCA} = V _{CCB} = 1.2V to 3.6V		142	392	
				V _{CCA} = V _{CCB} = 1.8V to 3.6V		149	393	
		From OE to Bn	C _L = 15pF	V _{CCA} = V _{CCB} = 0.9V to 3.6V		181	406	
				V _{CCA} = V _{CCB} = 1.2V to 3.6V		141	402	
				V _{CCA} = V _{CCB} = 1.8V to 3.6V		149	403	
Disable Time ⁽²⁾	t _{DIS}	From OE to An	C _L = 15pF	V _{CCA} = V _{CCB} = 0.9V to 3.6V		172	231	ns
		From OE to Bn	C _L = 15pF	V _{CCA} = V _{CCB} = 0.9V to 3.6V		170	240	
B Ports Rise and Fall Times	t _{RB} , t _{FB}	C _L = 15pF		V _{CCA} = V _{CCB} = 0.9V to 3.6V		2.8	7.7	ns
A Ports Rise and Fall Times	t _{RA} , t _{FA}	C _L = 15pF		V _{CCA} = V _{CCB} = 0.9V to 3.6V		2.7	7.3	ns
Channel-to-Channel Skew	t _{SK(O)}	C _L = 15pF		V _{CCA} = V _{CCB} = 0.9V to 3.6V		0.4	1.0	ns

NOTES:

1. Specified by design and characterization, not production tested.
2. t_{PD} is the same as t_{PLH} and t_{PHL}, t_{DIS} is the same as t_{PLZ} and t_{PHZ}, t_{EN} is the same as t_{PZL} and t_{PZH}.

SGM4562AQ Automotive, 4-Bit Bidirectional Level-Shifter/ Voltage Translator with Auto Direction Sensing

FUNCTIONAL BLOCK DIAGRAM

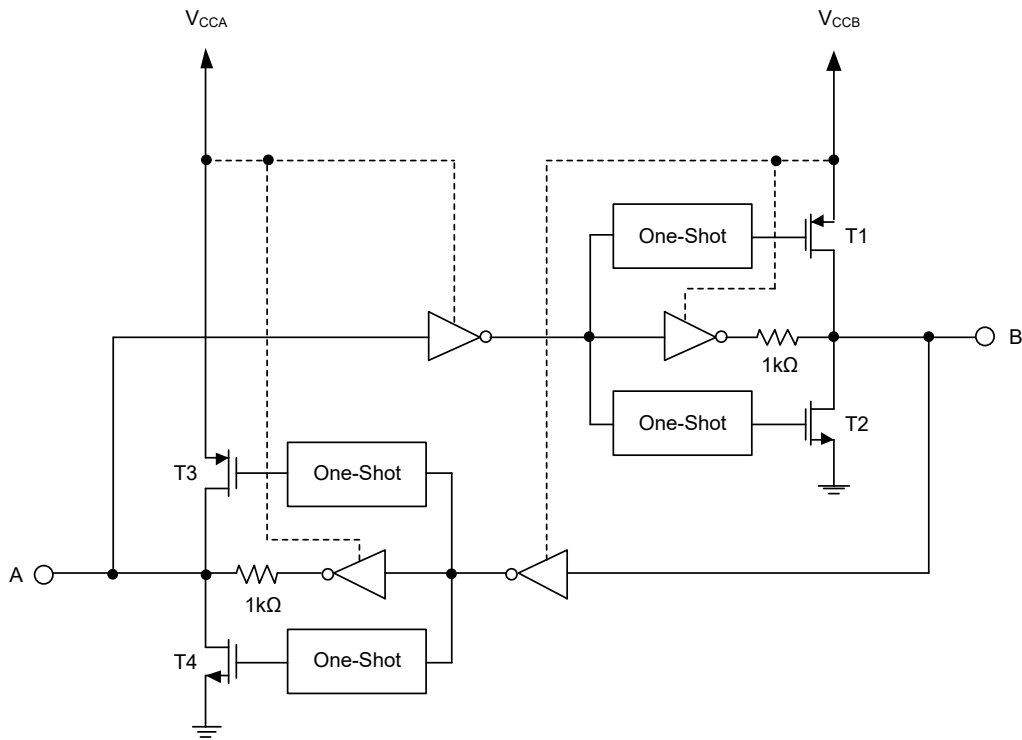
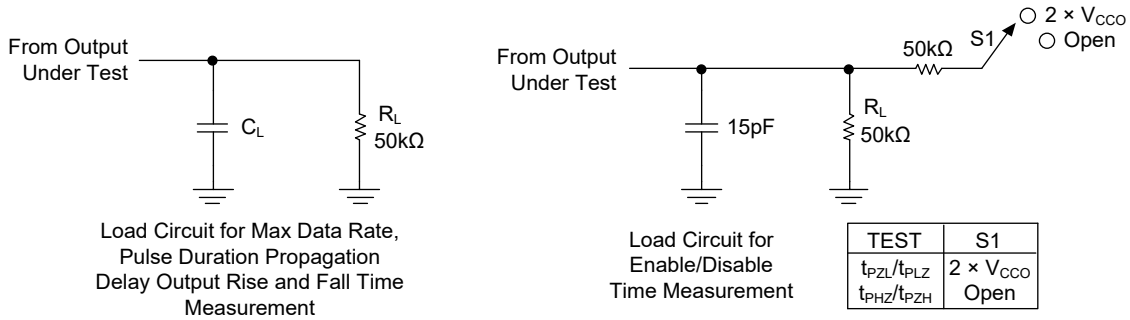


Figure 2. Architecture of SGM4562AQ I/O Cell

Automotive, 4-Bit Bidirectional Level-Shifter/ Voltage Translator with Auto Direction Sensing

SGM4562AQ

TEST CIRCUIT



NOTES:

1. R_L refers to load resistance. C_L refers to load capacitance (includes jig and probe).
2. All input pulses are supplied by generators featured by: PRR \leq 10MHz, $Z_o = 50\Omega$, $dV/dt \geq 1V/ns$.
3. One output is measured at a time with one transition in each measurement.

Figure 3. Test Circuit for Measuring Switching Times

WAVEFORMS

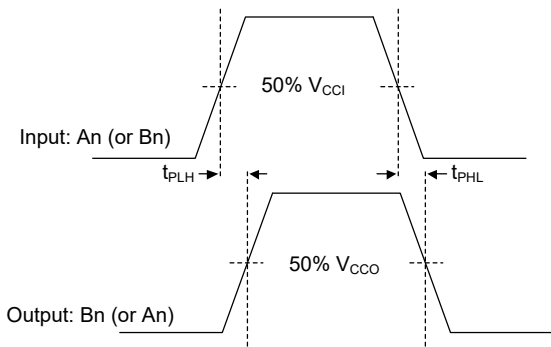


Figure 4. Propagation Delays (Data Input to Data Output)

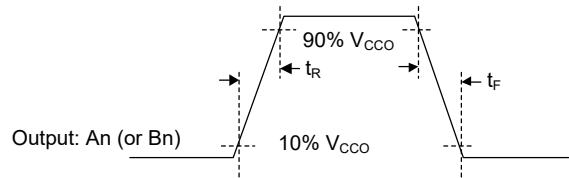


Figure 5. Rise and Fall Time of Data Output

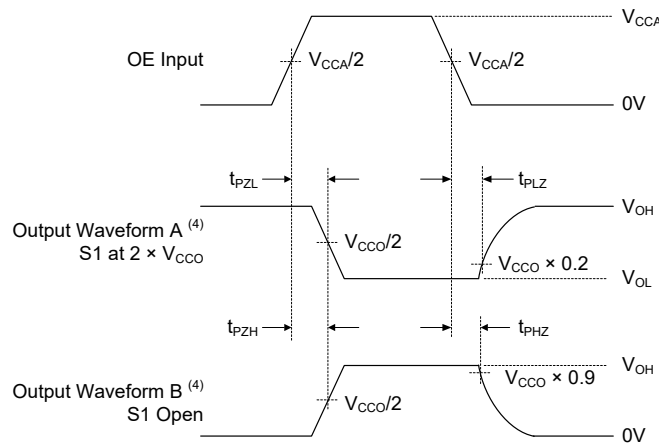


Figure 6. Enable and Disable Times

NOTES:

1. V_{CCI} is the supply voltage associated with the data input port, V_{CC0} is the supply voltage associated with the data output port.
2. t_{PLH} and t_{PHL} are the same as t_{PD} , t_{PLZ} and t_{PHZ} are the same as t_{DIS} , t_{PZL} and t_{PZH} are the same as t_{EN} .
3. The parameters and waveforms are not suitable for all devices.
4. Waveform A shows an output that is high except for OE is high. Waveform B shows an output that is low except for OE is high.

APPLICATION INFORMATION

Power Supply Recommendations

When V_{CC} is turned off ($V_{CCA}/V_{CCB} = 0V$), the SGM4562AQ has a circuit that disables all output ports. The OE (output enable) input circuit is designed to be provided by V_{CCA} , and when the OE input is low, all outputs are in a high impedance state. In order to ensure a high impedance state output during power-up or power-down, the OE input pin must be connected to GND through a pull-down resistor and cannot be enabled until V_{CCA} and V_{CCB} are fully ramp up and stabilized. The minimum value of the pull-down resistance to GND is dependent on the current source capability of the driver.

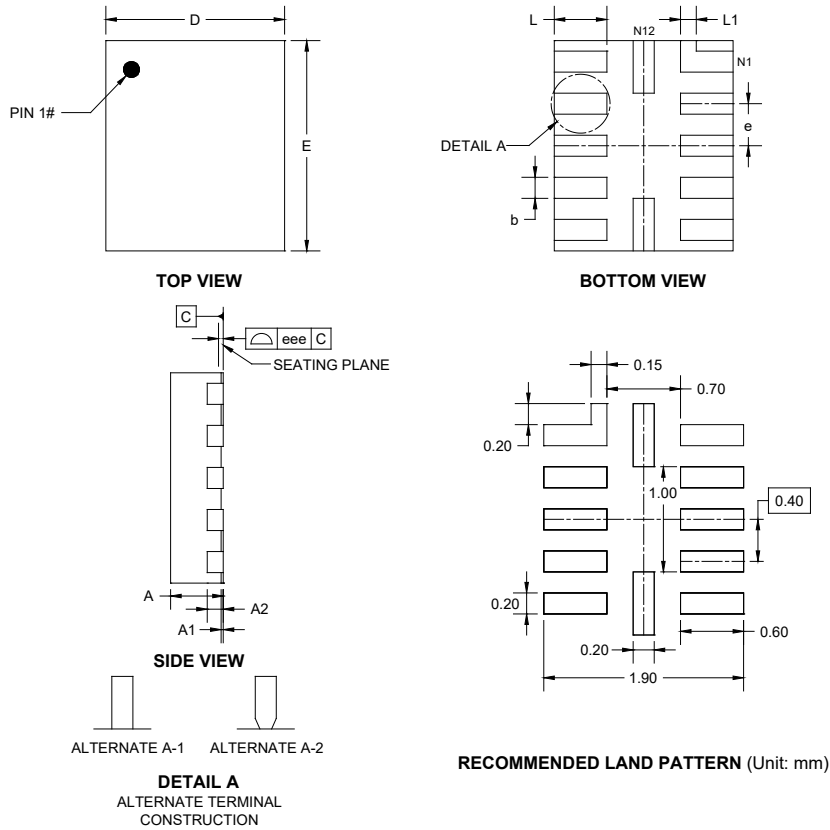
REVISION HISTORY

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

Changes from Original (DECEMBER 2024) to REV.A	Page
Changed from product preview to production data.....	All

PACKAGE OUTLINE DIMENSIONS

UTQFN-1.7x2-12L

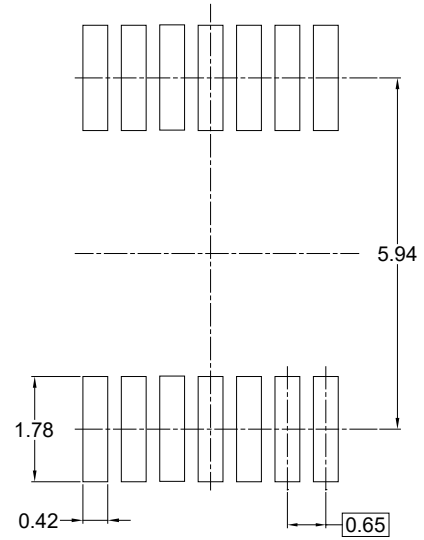
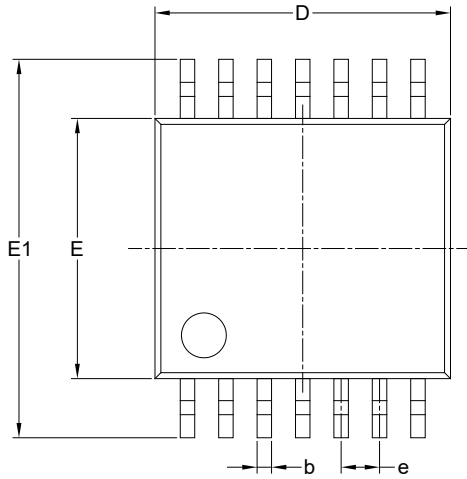


Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	0.450	-	0.550
A1	0.000	-	0.050
A2	0.152 REF		
b	0.150	-	0.250
D	1.600	-	1.800
E	1.900	-	2.100
e	0.400 BSC		
L	0.450	-	0.550
L1	0.150 REF		
eee	0.080		

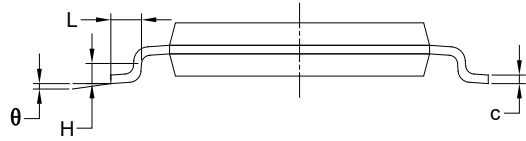
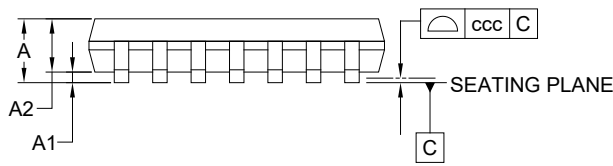
NOTE: This drawing is subject to change without notice.

PACKAGE OUTLINE DIMENSIONS

TSSOP-14



RECOMMENDED LAND PATTERN (Unit: mm)



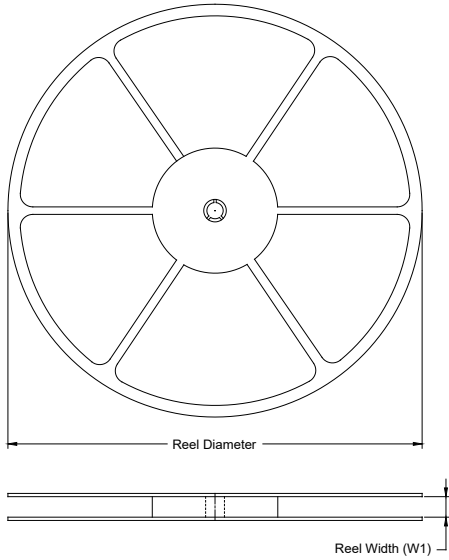
Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	-	-	1.200
A1	0.050	-	0.150
A2	0.800	-	1.050
b	0.190	-	0.300
c	0.090	-	0.200
D	4.860	-	5.100
E	4.300	-	4.500
E1	6.200	-	6.600
e	0.650 BSC		
L	0.450	-	0.750
H	0.250 TYP		
θ	0°	-	8°
ccc	0.100		

NOTES:

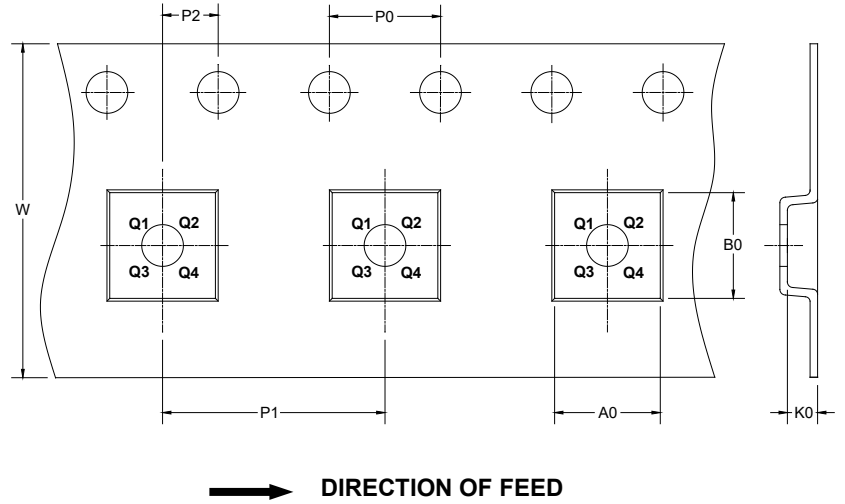
1. This drawing is subject to change without notice.
2. The dimensions do not include mold flashes, protrusions or gate burrs.
3. Reference JEDEC MO-153.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



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

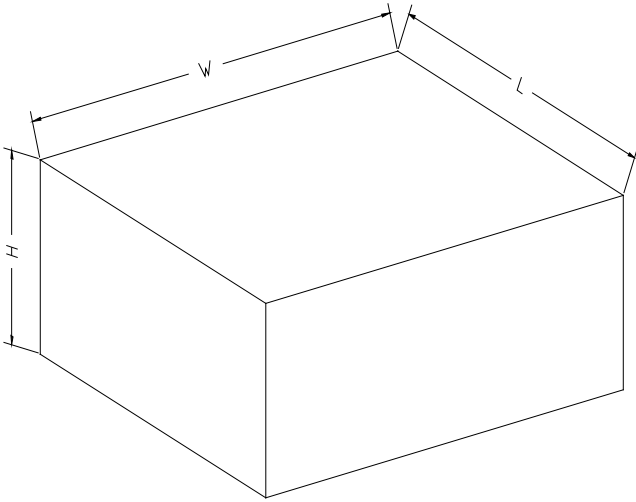
KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
UTQFN-1.7×2-12L	7"	9.5	1.90	2.30	0.75	4.0	4.0	2.0	8.0	Q1
TSSOP-14	13"	12.4	6.80	5.40	1.50	4.0	8.0	2.0	12.0	Q1

D20001

PACKAGE INFORMATION

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

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