6-Bit Bidirectional Voltage-Level Translator with Automatic Direction Sensing

Features

- AEC-Q100 Qualified With Following Results：
  - Device Operating Temperature Grade 1: -40°C to +125°C
  - Device HBM ESD Classification: Class 3A
  - Device CDM ESD Classification: Class C3
- 1.2V~3.6V on A Port and 1.65V~5.5V on B Port($V_{CCA} \leq V_{CCB}$)
- Maximum Data Rates:100Mbps(Push Pull)
- This Device Can Only Translate Push-pull CMOS Logic Outputs
- No Direction-Control Signal Required
- Qualified for Automotive Applications
- V_{CC} Isolation Feature – If Either V_{CC} Input is at GND, All Output are in the High-Impedance State
- OE Input Circuit Referenced to V_{CCA}
- Support Ultra-Low Power Consumption Mode with OE Pin is Low Voltage Level
- ESD Protection Exceeds AEC-Q100

  A Port:
  - 4KV Human-Body Model (ANSI/ESDA/JEDEC JS-001-2023)
  - 1KV Charged-Device Model (ANSI/ESDA/JEDEC JS-002-2022)

  B Port:
  - 15KV Human-Body Model (ANSI/ESDA/JEDEC JS-001-2023)
  - 1KV Charged-Device Model (ANSI/ESDA/JEDEC JS-002-2022)

Applications

- Telematics
- Advanced Driver Assistance System (ADAS)
- Automotive information

General Description

AW39216-Q1 is a 6-bit high-performance voltage-level translator without direction control signal, that enables bidirectional voltage level translation. It features two 6-bit input-output ports (An and Bn), one output enable input (OE) and two supply pins (V_{CCA} and V_{CCB}). V_{CCA} can be supplied with any voltage between 1.2V and 3.6V. V_{CCB} can be supplied with any voltage between 1.65V and 5.5V. The range of supply voltages makes the device suitable for translating between any of the low voltage nodes (1.2V, 1.5V, 1.8V, 2.5V, 3.3V and 5.0V).

The AW39216-Q1 is designed so that the OE input circuit is supplied by V_{CCA}. 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 pulldown resistor; the minimum value of the resistor is determined by the current-sourcing capability of the driver.

This product has been qualified to the Automotive Electronics Council (AEC) standard Q100 (Grade1) and is suitable for use in automotive applications.

Device Information

PART NUMBER	PACKAGE	BODY SIZE (NOM)
AW39216-Q1	TSSOP-16L	4.96mm ×4.4mm

.

Typical Application Circuit

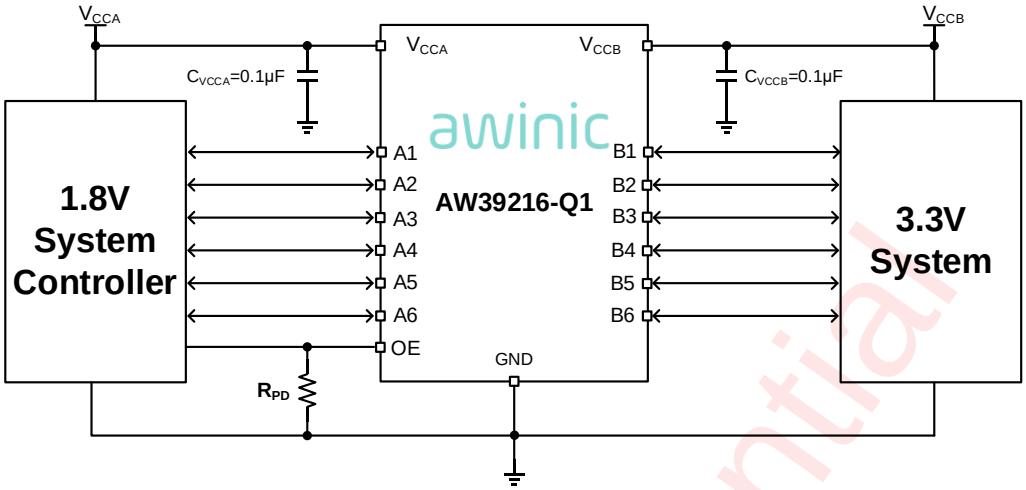
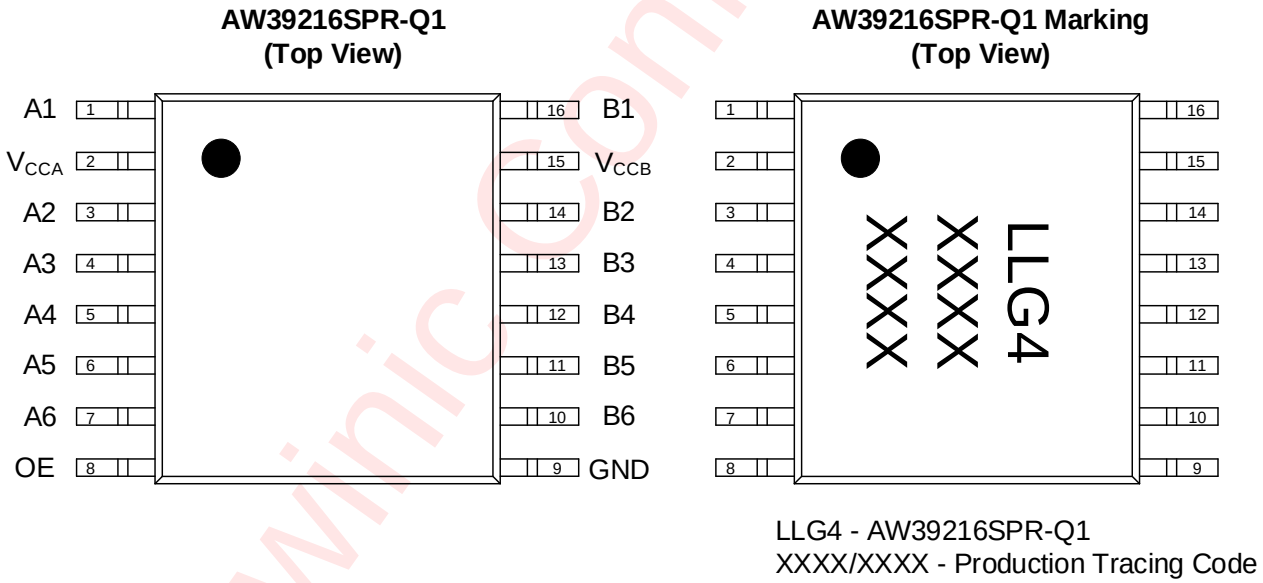


Figure 1 Typical Application Circuit of AW39216-Q1

Pin Configuration And Top Mark



LLG4 - AW39216SPR-Q1
XXXX/XXXX - Production Tracing Code

Figure 2 Pin Configuration and Top Mark

Pin Definition

No.	NAME	DESCRIPTION
1	A1	Input/output A1.
2	V_{CCA}	A-port supply voltage. 1.2V ≤ V_{CCA} ≤ 3.6V, V_{CCA} ≤ V_{CCB}.
3	A2	Input/output A2.
4	A3	Input/output A3.

5	A4	Input/output A4.
6	A5	Input/output A5.
7	A6	Input/output A6.
8	OE	3-state output-mode enable. Pull OE low to place all outputs in 3-state mode. Active HIGH, Referenced to V_{CCA}.
9	GND	Ground.
10	B6	Input/output B6.
11	B5	Input/output B5.
12	B4	Input/output B4.
13	B3	Input/output B3.
14	B2	Input/output B2.
15	V_{CCB}	B-port supply voltage. 1.65V ≤ V_{CCB} ≤ 5.5V.
16	B1	Input/output B1.

Functional Block Diagram

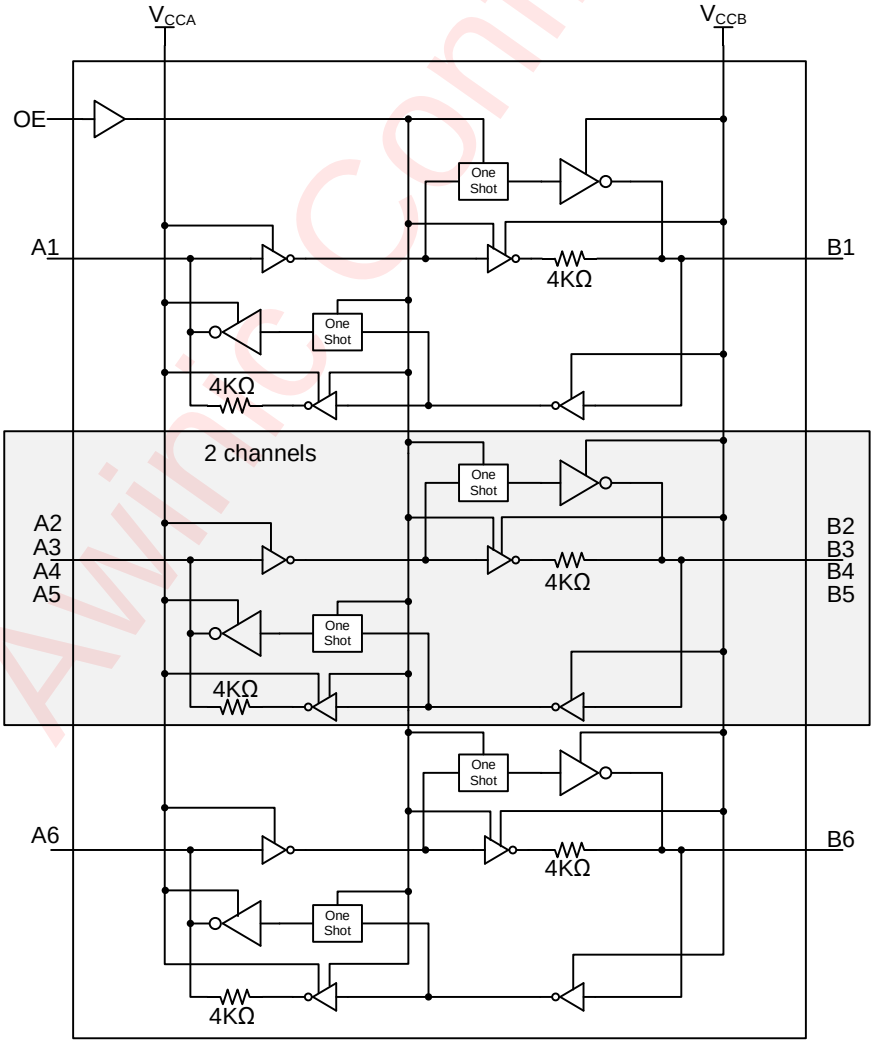


Figure 3 AW39216-Q1 Function Block

Typical Application Circuits

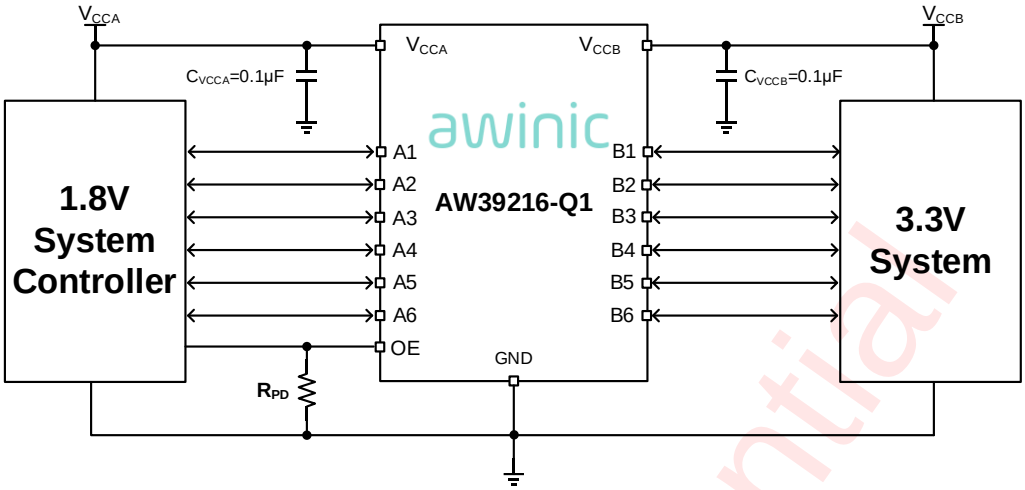


Figure 4 Typical Application Circuit of AW39216-Q1

Notice *for typical application circuits:*

1. In any case, the A/B Ports Voltage cannot be higher than the V_{CCA}/V_{CCB} voltage. Otherwise, the leakage current will flow from A/B Ports to V_{CCA}/V_{CCB}.
2. The device driving the A/B ports must have the driving capacity at least ±2mA.

Ordering Information

Part Number	Temperature	Package	Marking	Moisture Sensitivity Level	Environmental Information	Delivery Form
AW39216SPR-Q1	-40°C~125°C	TSSOP-16L	LLG4	MSL1	RoHS + HF	3000 units/ Tape and Reel

Absolute Maximum Ratings(1)

over operating free-air temperature range (unless otherwise noted)

PARAMETERS			MIN	MAX	UNIT
V_{CCA}	Supply voltage		–0.5	6.5	V
V_{CCB}			–0.5	6.5	
V_I	Input voltage range	A port	–0.5	6.5	V
		B port	–0.5	6.5	
V_O	Voltage applied to any output in the high-impedance or power-off state	A port	–0.5	6.5	V
		B port	–0.5	6.5	
V_O	Voltage applied to any output in the high or low state(2)	A port	–0.5	V_{CCA} + 0.5	V
		B port	–0.5	V_{CCB} + 0.5	
I_{Ik}	Input clamp current	V_I<0		–50	mA
I_{OK}	Output clamp current	V_O<0		–50	mA
I_O	Continuous output current			±50	mA
	Continuous current through V_{CCA}, V_{CCB}, or GND			±100	mA
Storage temperature T_{STG}			-65	150	°C
Lead temperature (soldering 10 seconds)				260	°C

(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 under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

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

ESD Ratings

		VALUE	UNIT
Human-body model (HBM)(1)	A port	±4K	V
	B port	±15K	
Charged-device model (CDM)(2)	A port	±1K	
	B port	±1K	
Latch-Up(3)		+IT：200 -IT：-200	mA

(1)The human body model is a 100pF capacitor discharged through a 1.5kΩ resistor into each pin. Test method: ANSI/ESDA/JEDEC JS-001-2023

(2) Test method: ANSI/ESDA/JEDEC JS-002-2022

(3) Test method: JESD78F.02-2023

Recommended Operating Conditions (1)(2)

SYMBOL	PARAMETERS	CONDITIONS		MIN	MAX	UNIT
V_{CCA}	Supply voltage			1.2	3.6	V
V_{CCB}	Supply voltage			1.65	5.5	V
V_{IH}	High-level input voltage	Data inputs	V_{CCA}=1.2V~3.6V V_{CCB}=1.65V~5.5V	V_{CCI} × 0.65(3)	V_{CCI}	V
		OE	V_{CCA}=1.2V~3.6V V_{CCB}=1.65V~5.5V	V_{CCA}×0.65	5.5	V
V_{IL}	Low-level input voltage	Data inputs	V_{CCA}=1.2V~5.5V V_{CCB}=1.65V~5.5V	0	V_{CCI} × 0.35(3)	V
		OE input	V_{CCA}=1.2V~3.6V V_{CCB}=1.65V~5.5V	0	V_{CCA}×0.35	V
V_O	Voltage range applied to any output in the high-impedance or power-off state	A-port	V_{CCA}=1.2V~3.6V V_{CCB}=1.65V~5.5V	0	3.6	V
		B-port		0	5.5	V
Δt/ΔV	Input transition rise or fall rate	A-port inputs	V_{CCA}=1.2V~3.6V V_{CCB}=1.65V~5.5V		40	ns/V
		B-port inputs	V_{CCA}=1.2V~3.6V V_{CCB}=1.65V~3.6V		40	ns/V
			V_{CCA}=1.2V~3.6V V_{CCB}=4.5V~5.5V		30	ns/V
T_A	Operating free-air temperature T_A			-40	125	°C

(1) 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.

(2) V_{CCA} must be less than or equal to V_{CCB} and must not exceed 3.6 V.

(3) V_{CCI} is the supply voltage associated with the input port.

Thermal Information

THERMAL METRIC		AW39216-Q1	UNIT
$R_{\theta JA}$	Junction-to-ambient thermal resistance	131.76	℃/W
$R_{\theta JC}$	Junction-to-case thermal resistance	51.92	
$R_{\theta JB}$	Junction-to-board thermal resistance	90.16	
Ψ_{JT}	Junction-to-board thermal resistance	3.4	
Ψ_{JB}	Junction-to-top characterization param	88.52	

Electrical Characteristics

DC Electrical Characteristics

over recommended operating free-air temperature range (unless otherwise noted) (1) (2)

PARAMETER		TEST CONDITIONS	$V_{CCA(V)}$	$V_{CCB(V)}$	T_A(°C)	MIN	TYP	MAX	UNIT
V_{OHA}		I_{OH} = -20μA	1.2		25		1.1		V
			1.4~3.6		-40~125	V_{CCA}-0.4			
V_{OLA}		I_{OL} = 20μA	1.2		25		0.08		V
			1.4~3.6		-40~125			0.4	
V_{OHB}		I_{OH} = -20μA		1.65~5.5	-40~125	V_{CCB}-0.4			V
V_{OLB}		I_{OL} = 20μA		1.65~5.5	-40~125			0.4	V
I_I	OE	V_I = V_{CCI} or GND	1.2~3.6	1.65~5.5	25			±1	μA
					-40~125			±5	
I_{off}	A port	V_I or V_O = 0~3.6V	0	0~5.5	25			±1	μA
					-40~125			±10	
	B port	V_I or V_O = 0~5.5V	0~3.6	0	25			±1	μA
					-40~125			±10	
I_{OZ}	A or B port	OE = GND	1.2~3.6	1.65~5.5	25			±1	μA
					-40~125			±10	
I_{CCA}		V_I = V_{CCI} or GND, I_O = 0	1.2	1.65~5.5	25		0.06		μA
			1.4~3.6	1.65~5.5	-40~125			15	
			3.6	0	-40~125			10	
			0	5.5	-40~125			-10	
I_{CCB}		V_I = V_{CCI} or GND, I_O = 0	1.2	1.65~5.5	25		3.0		μA
			1.4~3.6	1.65~5.5	-40~125			15	
			3.6	0	-40~125			-10	
			0	5.5	-40~125			10	
I_{CCA}+I_{CCB}		V_I = V_{CCI} or GND, I_O = 0	1.2	1.65~5.5	25		3.06		μA
			1.4~3.6	1.65~5.5	-40~125			30	
I_{CCZA}		V_I = V_{CCI} or GND, I_O = 0,OE = GND	1.2	1.65~5.5	25		0.05		μA
			1.4~3.6	1.65~5.5	-40~125			15	
I_{CCZB}		V_I = V_{CCI} or GND, I_O = 0,OE = GND	1.2	1.65~5.5	25		3.3		μA
			1.4~3.6	1.65~5.5	-40~125			15	
C_i	OE		1.2~3.6	1.65~5.5	25		4		pF

C_{io}	A port		1.2~3.6	1.65~5.5	25		6		pF
	B port		1.2~3.6	1.65~5.5	25		13		pF

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

(2) V_{CCO} is the supply voltage associated with the output port.

Timing Requirements: V_{CCA} = 1.2V

T_A = 25℃, V_{CCA} = 1.2V

			V_{CCB}=1.8V	V_{CCB}=2.5V	V_{CCB}=3.3V	V_{CCB}=5V	UNIT
			TYP	TYP	TYP	TYP	
Data rate			20	20	4	2	Mbps
tw	Pulse duration	Data inputs	50	50	250	500	ns

Timing Requirements: V_{CCA} = 1.5V ± 0.1V

Over recommended operating free-air temperature range, V_{CCA} = 1.5V ± 0.1V(unless otherwise noted)

		V_{CCB}=1.8V ±0.15V		V_{CCB}=2.5V ±0.2V		V_{CCB}=3.3V ±0.3V		V_{CCB}=5V ±0.5V		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
Data rate			40		40		40		40	Mbps
tw Pulse duration	Data inputs	25		25		25		25		ns

Timing Requirements: V_{CCA} = 1.8V ± 0.15V

Over recommended operating free-air temperature range, V_{CCA}=1.8V ± 0.15V(unless otherwise noted)

		V_{CCB}=1.8V ±0.15V		V_{CCB}=2.5V ±0.2V		V_{CCB}=3.3V ±0.3V		V_{CCB}=5V ±0.5V		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
Data rate			60		60		60		60	Mbps
tw Pulse duration	Data inputs	17		17		17		17		ns

Timing Requirements: V_{CCA} = 2.5V ± 0.2V

Over recommended operating free-air temperature range, V_{CCA} = 2.5V ± 0.2V(unless otherwise noted)

		V_{CCB}=2.5V±0.2V		V_{CCB}=3.3V±0.3V		V_{CCB}=5V±0.5V		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	
Data rate			100		100		100	Mbps
tw Pulse duration	Data inputs	10		10		10		ns

Timing Requirements: V_{CCA} = 3.3V ± 0.3V

Over recommended operating free-air temperature range, V_{CCA} = 3.3V ± 0.3V(unless otherwise noted)

			V_{CCB}=3.3V±0.3V		V_{CCB}=5V±0.5V		UNIT
			MIN	MAX	MIN	MAX	
Data rate				100		100	Mbps
tw	Pulse duration	Data inputs	10		10		ns

Switching Characteristics: V_{CCA} = 1.2V

T_A = 25℃, V_{CCA} = 1.2V

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CCB}=1.8V	V_{CCB}=2.5V	V_{CCB}=3.3V	V_{CCB}=5V	UNIT
			TYP	TYP	TYP	TYP	
t_{pd}	A	B	13	10.5	9.7	9.2	ns
	B	A	10	8.3	7.9	36	
t_{en}	OE	A	1	1	1	1	μs
		B	1	1	1	1	
t_{dis}	OE	A	320	320	320	330	ns
		B	150	110	150	110	
t_{rA},t_{fA}	A-port rise and fall times		6	6	160	200	ns
t_{rB},t_{fB}	B-port rise and fall times		3	3	2	2	ns
$t_{sk(o)}$	Channel-to-channel skew		0.5	0.5	0.5	0.5	ns

Switching Characteristics: V_{CCA} = 1.5V ± 0.1V

Over recommended operating free-air temperature range, V_{CCA} = 1.5V ± 0.1V(unless otherwise noted)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CCB}=1.8V± 0.15V		V_{CCB}=2.5V± 0.2V		V_{CCB}=3.3V± 0.3V		V_{CCB}=5V± 0.5V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{pd}	A	B		15.9		13.1		13		12.9	ns
	B	A		17.2		15		14.7		16.7	
t_{en}	OE	A		1		1		1		1	μs
		B		1		1		1		1	
t_{dis}	OE	A		340		280		280		300	ns
		B		400		350		430		300	
t_{rA},t_{fA}	A-port rise and fall times			7.1		7.1		7.1		7.1	ns
t_{rB},t_{fB}	B-port rise and fall			6.5		5.2		4.8		4.7	ns

	times					
$t_{sk(o)}$	Channel-to-channel skew	0.7	0.7	0.7	0.7	ns

Switching Characteristics: V_{CCA} = 1.8V ± 0.15V

Over recommended operating free-air temperature range, V_{CCA} = 1.8V ± 0.15V(unless otherwise noted)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CCB}=1.8V± 0.15V		V_{CCB}=2.5V± 0.2V		V_{CCB}=3.3V± 0.3V		V_{CCB}=5V± 0.5V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{pd}	A	B		14.0		10.7		9.8		9.5	ns
	B	A		15.0		11.4		10.6		10.1	
t_{en}	OE	A		1		1		1		1	µs
		B		1		1		1		1	
t_{dis}	OE	A		280		250		250		250	ns
		B		380		260		400		260	
t_{rA},t_{fA}	A-port rise and fall times			6.2		6.1		6.1		6.1	ns
t_{rB},t_{fB}	B-port rise and fall times			5.8		5.2		4.8		4.7	ns
$t_{sk(o)}$	Channel-to-channel skew			0.7		0.7		0.7		0.7	ns

Switching Characteristics: V_{CCA} = 2.5V ± 0.2V

Over recommended operating free-air temperature range, V_{CCA} = 2.5V ± 0.2V(unless otherwise noted)

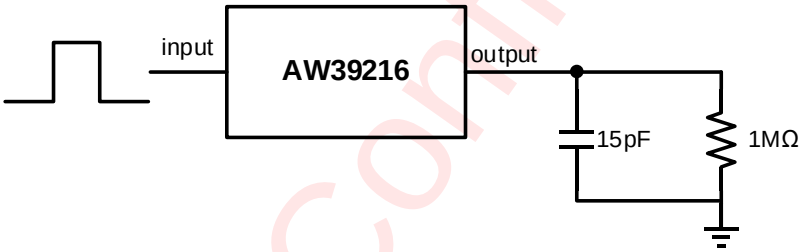
PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CCB}=2.5V±0.2V		V_{CCB}=3.3V±0.3V		V_{CCB}=5V±0.5V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
t_{pd}	A	B		9.3		8.2		7.7	ns
	B	A		9.6		8.6		7.4	
t_{en}	OE	A		1		1		1	µs
		B		1		1		1	
t_{dis}	OE	A		220		220		220	ns
		B		260		400		260	
t_{rA},t_{fA}	A-port rise and fall times			5.0		5.0		5.0	ns
t_{rB},t_{fB}	B-port rise and fall times			4.6		4.8		4.7	ns
$t_{sk(o)}$	Channel-to-channel skew			0.5		0.5		0.5	ns

Switching Characteristics: V_{CCA} = 3.3V ± 0.3V

Over recommended operating free-air temperature range, V_{CCA} = 3.3V ± 0.3V(unless otherwise noted)

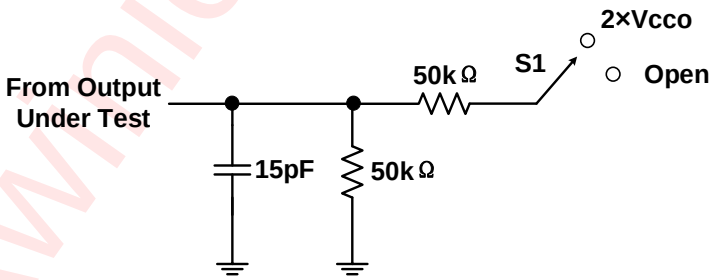
PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CCB}=3.3V±0.3V		V_{CCB}=5V±0.5V		UNIT
			MIN	MAX	MIN	MAX	
t_{pd}	A	B		7.7		7.0	ns
	B	A		7.9		6.8	
t_{en}	OE	A		1		1	μs
		B		1		1	
td_{is}	OE	A		280		280	ns
		B		400		260	
t_{rA},t_{fA}	A-port rise and fall times			4.5		4.5	ns
t_{rB},t_{fB}	B-port rise and fall times			4.1		4.7	ns
$t_{sk(o)}$	Channel-to-channel skew			0.7		0.7	ns

Test Information



Test Circuit for Date Rate, Pulse Duration, Propagation Delay, Rise Time and Fall Time

Figure 5 Load Circuit of Push-Pull Driver



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

Figure 6 Load Circuit for Enable-Time and Disable-Time Measurement

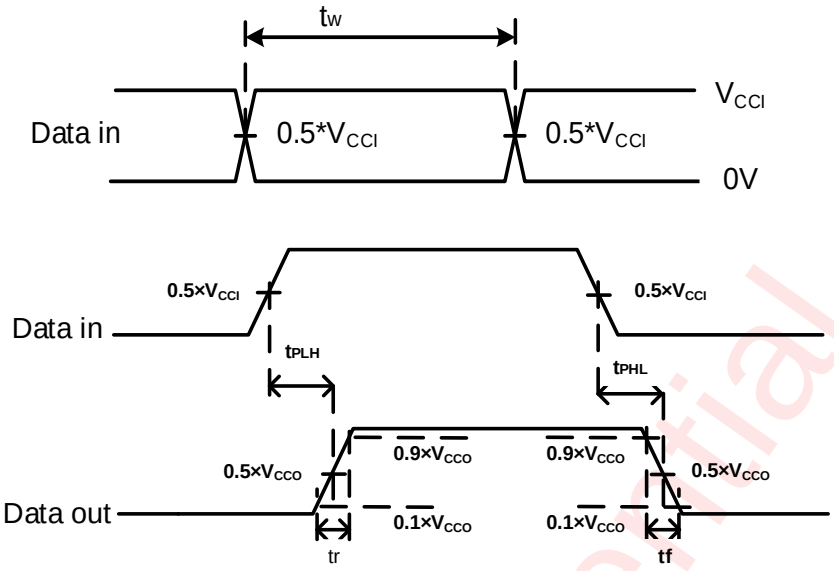


Figure 7 Timing Parameter Definition

A. C_L includes probe and jig capacitance.
B. All input pulses are supplied by generators having the following characteristics: PRR_10 MHz, Z_O = 50 Ω, dv/dt ≥ 1V/ns.
C. The outputs are measured one at a time, with one transition per measurement.
D. t_{PLH} and t_{PHL} are the same as t_{pd}.
E. V_{CCI} is the V_{CC} associated with the input port.
F. V_{CCO} is the V_{CC} associated with the output port.
G. All parameters and waveforms are not applicable to all devices.

Detailed Functional Description

The AW39216-Q1 device is a 6-Bit, bi-directional voltage-level translator specifically designed for translating logic voltage levels. The A port is able to accept I/O voltages ranging from 1.2 V to 3.6 V, while the B port can accept I/O voltages from 1.65 V to 5.5 V. The device is a buffered architecture with edge-rate accelerators (one-shots) to improve the overall data rate. This device can only translate push-pull CMOS logic outputs.

One-shot Architecture

The AW39216-Q1 architecture (see Functional Block Diagram) 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 AW39216-Q1 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 70 Ω at V_{CCO} = 1.2 V to 1.8 V,50 Ω at V_{CCO} = 1.8 V to 3.3 V, and 40 Ω at V_{CCO} = 3.3 V to 5 V.

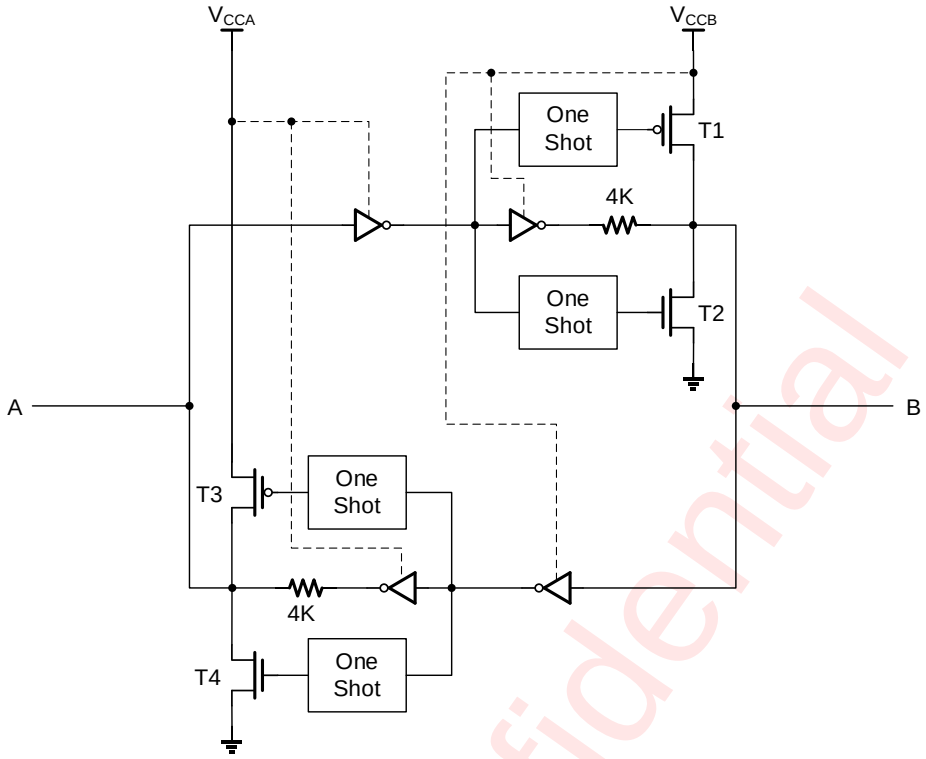
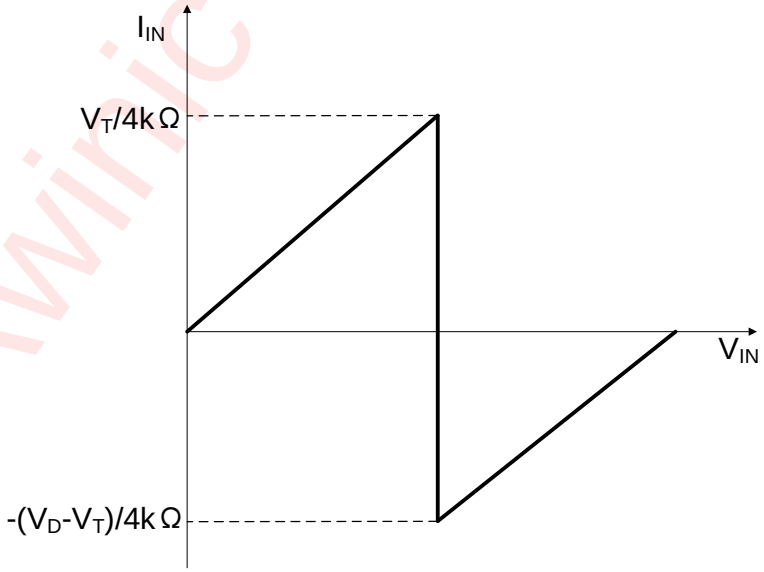


Figure 8 Architecture of AW39216-Q1 I/O Cell

Input Driver Requirements

Typical I_{IN} vs V_{IN} characteristics of the AW39216-Q1 are shown in Figure 9. For proper operation, the device driving the data I/Os of the AW39216-Q1 must have drive strength of at least ±2 mA.



A. V_T is the input threshold voltage of the AW39214 (typically $V_{CCI}/2$).
B. V_D is the supply voltage of the external driver.

Figure 9 Typical I_{IN} vs V_{IN} Curve

Output Load Considerations

It is recommended that a PCB layout with short PCB layout length:

1. Avoid excessive capacitive load triggers ONE-SHOT circuit falsely;
2. It can ensure that the round trip delay of any reflection is less than a single ONE-SHOT duration;
3. Improve signal integrity.

Meanwhile, the pulse width of the ONE-SHOT circuit is approximately 10ns, which determines the maximum output load capacitance that the chip can drive. For very heavy output capacitive loads, the one-shot accelerator will time-out before the output is fully pulled to high level, at which case the signal transmission will be distorted. So the ONE-SHOT duration design requires a trade-off between dynamic power consumption, capacitive load driving capability and maximum data rate. The signal t_w at the maximum translation rate should be greater than the maximum pulse width of the ONE-SHOT circuit, and the delay caused by the output capacitive load should be less than the maximum pulse width of the ONE-SHOT circuit.

Enable and Disable

An output enable input (OE) is used to disable the device. Setting OE = LOW causes all I/Os to assume the high-impedance OFF-state. The disable time (t_{dis} with no external load) indicates the delay between when OE goes LOW and when outputs actually become disabled. The enable time (t_{en}) indicates the amount of time the user must allow for one one-shot circuitry to become operational after OE is taken HIGH. To ensure the high-impedance OFF-state during power-up or power-down, pin 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.

Pullup or Pulldown Resistors on I/O Lines

As mentioned previously the AW39216-Q1 is designed with low static drive strength to drive capacitive loads of up to 70pF. To avoid output contention issues, any pull-up or pull-down resistors used must be kept higher than 50kΩ For this reason the AW39216-Q1 is not recommended for use in open drain driver applications such as 1-Wire or I2C.

Device Functional Modes

The AW39216-Q1 device has two functional modes, enabled and disabled. To disable the device, set the OE input to low, which places all I/Os in a high impedance state. Setting the OE input to high will enable the device.

Application Information

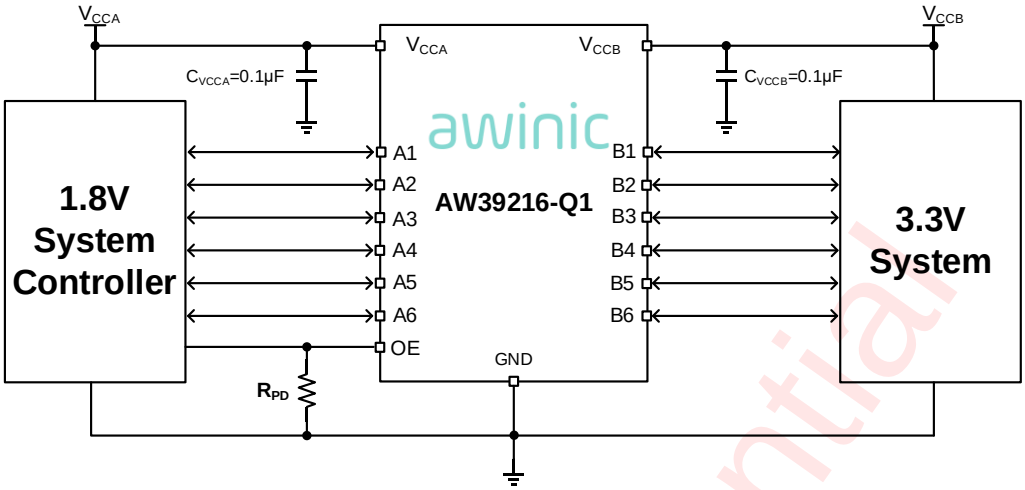


Figure 10 AW39216-Q1 Application Circuit

The AW39216-Q1 can be used in level-translation applications for interfacing devices or systems operating at different interface voltages with one another. It can only translate push-pull CMOS logic outputs. Any external pulldown or pullup resistors are recommended larger than 50kΩ.

Design Requirements

For this design example, use the parameters listed in Table 1. And make sure the $V_{CCA} \leq V_{CCB}$.

Table 1. Design Parameters

DESIGN PARAMETERS	EXAMPLE VALUE
Input voltage range	1.2 V to 3.6 V
Output voltage range	1.65V to 5.5V

Detailed Design Procedure

To begin the design process, determine the following:

• Input voltage range

- Use the supply voltage of the device that is driving the AW39216-Q1 device to determine the input voltage range. For a valid logic high the value must exceed the V_{IH} of the input port. For a valid logic low the value must be less than the V_{IL} of the input port.

• Output voltage range

- Use the supply voltage of the device that the AW39216-Q1 device is driving to determine the output voltage range.

- It is not recommended to have the external pullup or pulldown resistors. If mandatory, it is recommended the value should be larger than 50 kΩ.

• An external pulldown or pullup resistor decreases the output V_{OH} and V_{OL}. Use the below equations to draft estimate the V_{OH} and V_{OL} as a result of an external pulldown and pullup resistor.

$V_{OH} = V_{CCx} \times R_{PD} / (R_{PD} + 4.5\ k\Omega)$

$V_{OL} = V_{CCx} \times 4.5\ k\Omega / (R_{PU} + 4.5\ k\Omega)$

where

- V_{CCx} is the output port supply voltage on either V_{CCA} or V_{CCB}
- R_{PD} is the value of the external pull down resistor
- R_{PU} is the value of the external pull up resistor
- 4.5 kΩ is the counting the variation of the serial resistor 4 kΩ in the I/O line

Power Supply Recommendations

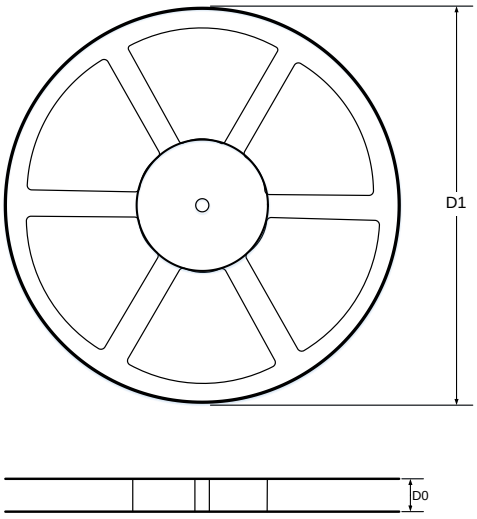
During operation, ensure that $V_{CCA} \leq V_{CCB}$ at all times. During power-up sequencing, $V_{CCA} \geq V_{CCB}$ does not damage the device, so any power supply can be ramped up first. The AW39216-Q1 has circuitry that disables all output ports when either V_{CC} is switched off ($V_{CCA/B}$ = 0 V). The output-enable (OE) input circuit is designed so that it is supplied by V_{CCA} and when the (OE) input is low, all outputs are placed in the high-impedance state. To ensure the high-impedance state of the outputs during power up or power down, the OE input pin must be tied to GND through a pulldown resistor and must not be enabled until V_{CCA} and V_{CCB} are fully ramped and stable. The minimum value of the pulldown resistor to ground is determined by the current-sourcing capability of the driver.

VCC Capacitor Selection

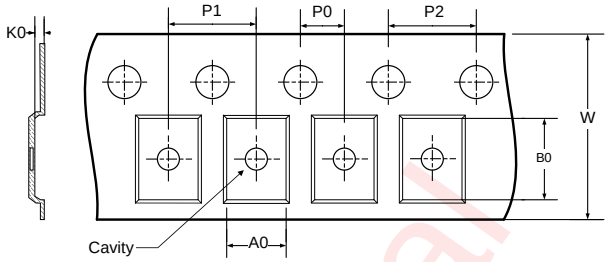
The device is a 6-Bit high-performance voltage-level translator that requires adequate power supply decoupling. Place a low equivalent-series-resistance (ESR) ceramic capacitor, recommend 0.1μF or larger than 0.1μF.

Tape And Reel Information

REEL DIMENSIONS

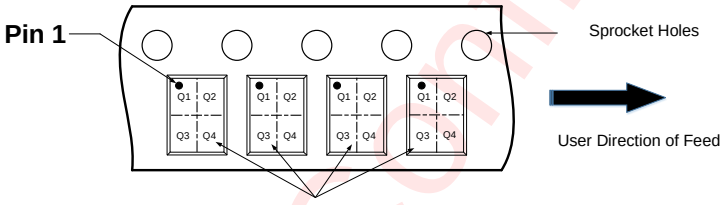


TAPE DIMENSIONS



A0：Dimension designed to accommodate the component width
B0：Dimension designed to accommodate the component length
K0：Dimension designed to accommodate the component thickness
W：Overall width of the carrier tape
P0：Pitch between successive cavity centers and sprocket hole
P1：Pitch between successive cavity centers
P2：Pitch between sprocket hole
D1：Reel Diameter
D0：Reel Width

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



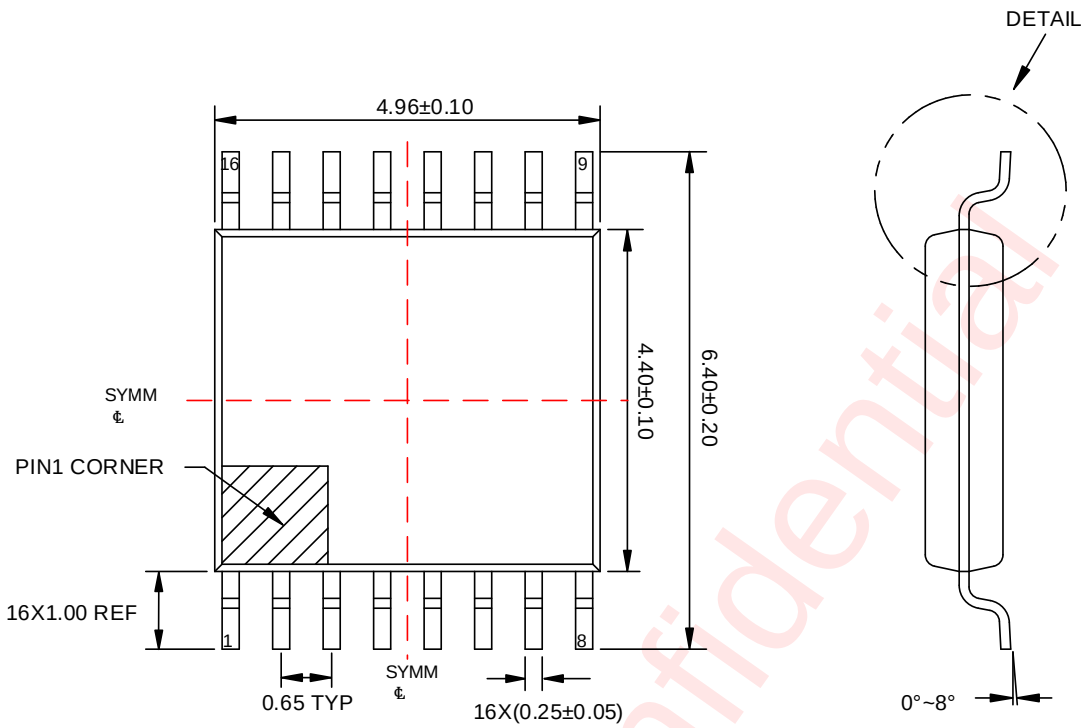
Note：The above picture is for reference only. Please refer to the value in the table below for the actual size

DIMENSIONS AND PIN1 ORIENTATION

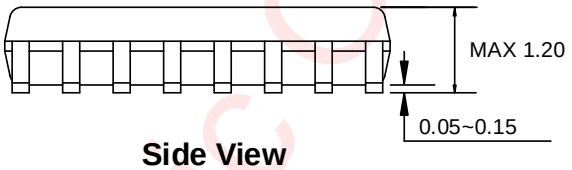
D1 (mm)	D0 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
330	12.4	6.8	5.4	1.5	2	8	4	12	Q1

All dimensions are nominal

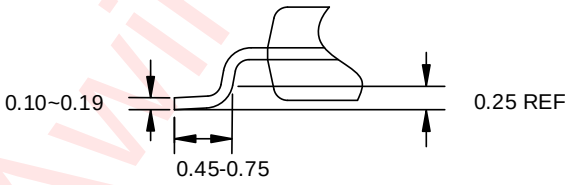
Package Description



Top View **Side View**



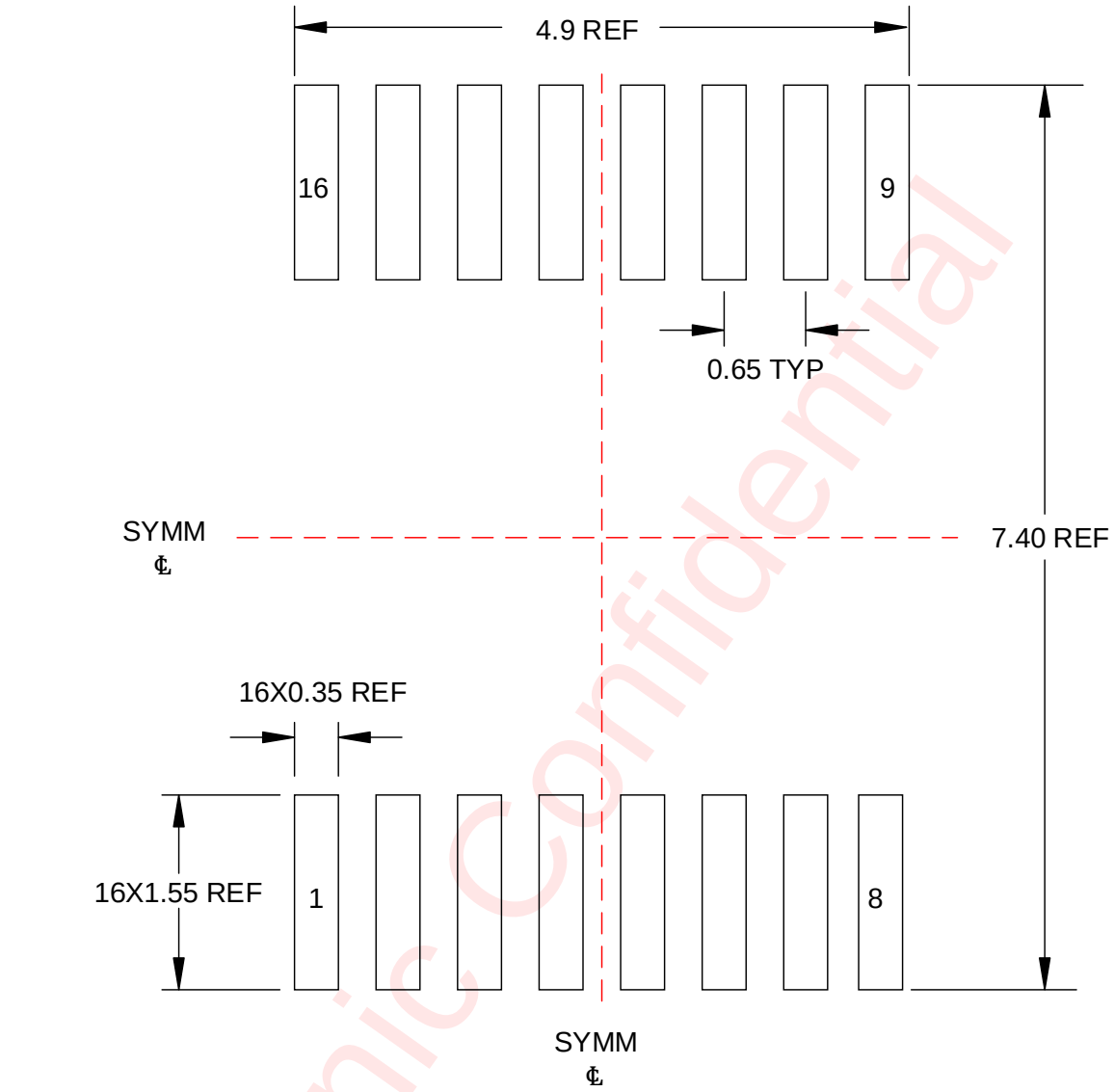
Side View

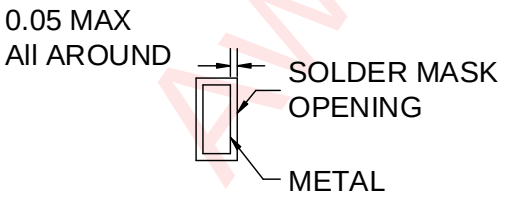


DETAIL

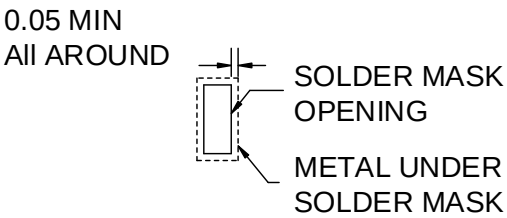
Unit：mm

Land Pattern Data





NON-SOLDER MASK DEFINED



SOLDER MASK DEFINED

Unit：mm

Revision History

Version	Date	Change Record
V1.0	Nov. 2024	Officially released

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