RS29617 Level-Translating FM+ I²C Bus Repeater

1 FEATURES

- **Two-Channel Bidirectional I²C Buffer**
- **Support for Standard Mode, Fast Mode (400kHz), and Fast Mode+ (1MHz) I²C Operation**
- **Operating supply Voltage Range of 0.8V to 5.5V on A-Side**
- **Operating Supply Voltage Range of 2.2V to 5.5V on B-Side**
- **Voltage-Level Translation from 0.8V to 5.5V and 2.2V to 5.5V**
- **Active-High Repeater-Enable Input**
- **Open-Drain I²C I/O**
- **5.5V Tolerant I²C and Enable Input Support**
- **Lockup-Free Operation**
- **Powered-Off High-Impedance I²C Bus Pins**
- **Support for Clock Stretching and Multiple Controller Arbitration Across the Device**

2 APPLICATIONS

- **Servers**
- **Routers (Telecom Switching Equipment)**
- **Industrial Equipment**
- **Products with Many I²C Targets and/or Long PCB Traces**

3 DESCRIPTIONS

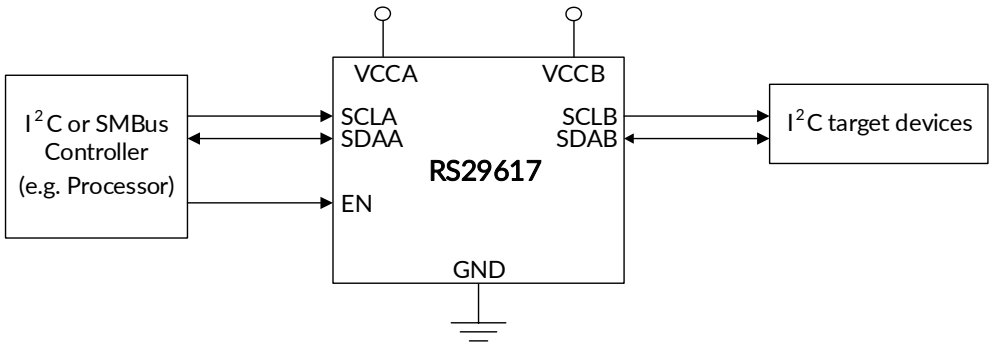
The RS29617 is a BiCMOS dual bidirectional buffer intended for I²C bus and SMBus systems. The device provides bidirectional voltage-level translation (up-translation and down-translation) between low voltages (down to 0.8V) and higher voltages (2.2V to 5.5V) in mixed-mode applications. This device enables I²C and similar bus systems to be extended, without degradation of performance even during level shifting.

The RS29617 buffers both the serial data (SDA) and the serial clock (SCL) signals on the I²C bus, allowing two buses of 550pF to be connected in an I²C application. This device can also be used to separate two halves of a bus for voltage and capacitance.

Device Information (1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
RS29617	MSOP8	3.00mm×3.00mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.



Simplified Schematic

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4 REVISION HISTORY

Note: Page numbers for previous revisions may different from page numbers in the current version.

VERSION	Change Date	Change Item
A.0	2025/05/16	Preliminary version completed
A.0.1	2025/05/23	1. Add Typical Characteristics Figure 3~6 2. Update V_{OL} parameter test conditions
A.1	2025/07/16	Initial version completed

5 PACKAGE/ORDERING INFORMATION (1)

PRODUCT	ORDERING NUMBER	TEMPERATURE RANGE	PACKAGE LEAD	PACKAGE MARKING (2)	MSL (3)	PACKAGE OPTION
RS29617	RS29617XM	-40°C ~+125°C	MSOP8	RS29617	MSL3	Tape and Reel, 4000

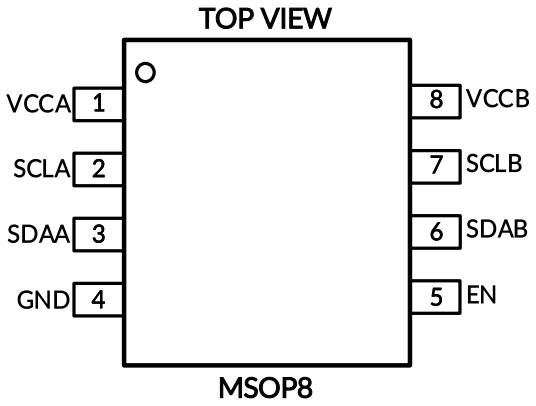
NOTE:

(1) This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the right-hand navigation.

(2) There may be additional marking, which relates to the lot trace code information(data code and vendor code), the logo or the environmental category on the device.

(3) RUNIC classify the MSL level with using the common preconditioning setting in our assembly factory conforming to the JEDEC industrial standard J-STD-20F. Please align with RUNIC if your end application is quite critical to the preconditioning setting or if you have special requirement.

6 PIN CONFIGURATIONS



PIN DESCRIPTION

PIN		FUNCTION
NAME	NO.	
VCCA	1	A-side supply voltage (0.8V to 5.5V).
SCLA	2	I^2C SCL line, A side. Connect to V_{CCA} through a pull-up resistor.
SDAA	3	I^2C SDA line, A side. Connect to V_{CCA} through a pull-up resistor.
GND	4	Supply ground.
EN	5	Active-high repeater enable input. Internally connected to V_{CCB} through a weak pull-up resistor.
SDAB	6	I^2C SDA line, B side. Connect to V_{CCB} through a pull-up resistor.
SCLB	7	I^2C SCL line, B side. Connect to V_{CCB} through a pull-up resistor.
VCCB	8	B-side and device supply voltage (2.2V to 5.5V)

7 SPECIFICATIONS

7.1 Absolute Maximum Ratings

Over operating free-air temperature range (unless otherwise noted) (1)

SYMBOL	PARAMETER		MIN	MAX	UNIT
V_{CCB}	Supply Voltage Range		-0.5	6.5	V
V_{CCA}	Supply Voltage Range		-0.5	6.5	V
V_I	Enable input voltage range (2)		-0.5	6.5	V
V_{IO}	I^2C bus voltage range (2)		-0.5	6.5	V
I_{IK}	Input clamp current	V_I<0		-50	mA
I_{OK}	Output clamp current	Vo<0		-50	mA
I_O	Continuous output current			±50	mA
	Continuous current through V_{CC} or GND			±100	mA
θ_{JA}	Package thermal impedance (3)	MSOP8		170	°C/W
T_{stg}	Storage temperature		-65	150	°C

(1) Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions. Exposure to absolute-maximum-rated 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 package thermal impedance is calculated in accordance with JESD-51.

7.2 ESD Ratings

The following ESD information is provided for handling of ESD-sensitive devices in an ESD protected area only.

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-Body Model (HBM)	±4000	V
		Charged-Device Model (CDM)	±1000	V
		Machine Model (MM)	±200	V

ESD SENSITIVITY CAUTION

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.

7.3 Recommended Operating Conditions

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

		MIN	MAX	UNIT
V_{CCA}	Supply voltage, A-side bus	0.8	V_{CCB}	V
V_{CCB}	Supply voltage, B-side bus	2.2	5.5	V
I_{OLA}	Low-level output current		30	mA
I_{OLB}	Low-level output current		30	mA
T_A	Ambient temperature	-40	125	°C

7.4 Electrical Characteristics

V_{CCB} = 2.2V to 5.5V, GND = 0V, T_A = –40°C to 125°C. All typical values are at T_A = 25°C. (unless otherwise noted).

PARAMETER			TEST CONDITIONS	V_{CCB}	MIN(1)	TYP(2)	MAX(1)	UNIT
V_{IK}	Input Clamp Voltage		I_I= -18mA	2.2V to 5.5V	-1		0	V
V_{OL}	Low-Level Output Voltage	SDAB, SCLB	I_{OL} = 100µA or 13mA, V_{ILA} = 0V	2.2V to 5.5V	0.4	0.55	0.6	V
		SDAA, SCLA	I_{OL} = 13mA			0.15	0.2	
V_{IH}	High-Level Input Voltage	SDAA, SCLA		2.2V to 5.5V	0.7×V_{CCA}		5.5	V
		SDAB, SCLB			0.7×V_{CCB}		5.5	
		EN			0.7×V_{CCB}		5.5	
V_{IL}	Low-Level Input Voltage	SDAA, SCLA		2.2V to 5.5V			0.3×V_{CCA}	V
		SDAB, SCLB					0.4	
		EN					0.3×V_{CCB}	
I_{CCA}	Quiescent Supply Current for V_{CCA}		Both channels low, SDAA = SCLA = GND and I_{OLB} =100µA, or SDAA = SCLA = open and SDAB = SCLB = GND	2.2V to 5.5V			40	µA
I_{CCB}	Quiescent Supply Current		Both Channels high, SDAA = SCLA = VCCA B-side pulled up to VCCB with pull-up resistors	2.2V to 5.5V		1.4	2	mA
			Both channels low, SDAA = SCLA = GND, I_{OLB} = 100µA	5.5V		1.5	2	
I_I	Input Leakage Current	SDAB, SCLB	V_I = V_{CCB}	2.2V to 5.5V	-1		1	µA
			V_I = 0.2V, EN = 0		-10		10	
			V_I = V_{CCB} – 0.2V		-1		1	
			V_I = 5.5V, V_{CCA} = 0V	0V	-10		10	
		SDAA, SCLA	V_I = V_{CCA}	2.2V to 5.5V	-1		1	
			V_I = 0.2V, EN = 0		-10		10	
			V_I = V_{CCA} – 0.2V		-1		1	
			V_I = 5.5V, V_{CCA} = 0V	0V	-10		10	
		EN	V_I = V_{CCB}		-1		1	
			V_I = 0.2V		-15			
C_I	Input Capacitance	EN	V_I = 3V or 0V	3.3V			5	pF
C_{IO}	Input/Output Capacitance	SCLA, SDAA	V_I = 3V or 0V	3.3V			9	pF
				0V			9	
		SCLB, SDAB	V_I = 3V or 0V	3.3V			8	
				0V			8	

NOTE:

(1) Limits are 100% production tested at 25°C. Limits over the operating temperature range are ensured through correlations using statistical quality control (SQC) method.

(2) Typical values represent the most likely parametric norm as determined at the time of characterization. Actual typical values may vary over time and will also depend on the application and configuration.

7.5 Timing Requirements

V_{CCA} = 0.8V to 5.5V, V_{CCB} = 2.2V to 5.5V, GND = 0V, T_A = −40°C to 125°C (unless otherwise noted) (1) (2) (3)

PARAMETER		FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH}	Propagation Delay	SDAB, SCLB	SDAA, SCLA		35		85	ns
t_{PLH}	Propagation Delay	SDAA, SCLA	SDAB, SCLB		60		100	ns
t_{PHL}	Propagation Delay	SDAB, SCLB	SDAA, SCLA		55		180	ns
t_{PHL}	Propagation Delay	SDAA, SCLA	SDAB, SCLB		50		95	ns
t_{TLH} (4)	Transition Time	B side	30%	70%		92		ns
		A side				62		ns
t_{THL}	Transition Time	B side	70%	30%	8		50	ns
		A side			7		60	ns
$t_{su,en}$ (5)	Setup time, EN high before Start condition				100			ns

(1) Times are specified with loads of 240 Ω ±1% and 400 pF ±10% on B-side and 240 Ω ±1% and 200 pF ±10% on A-side. Different load resistance and capacitance alter the rise time, thereby changing the propagation delay and transition times.
(2) Times are specified with A-side signals pulled up to V_{CCA} and B-side signals pulled up to V_{CCB}.
(3) Typical values were measured with V_{CCA} = 0.9 V and V_{CCB} = 2.5 V at T_A = 25°C, unless otherwise noted.
(4) T_{TLH} is determined by the pull-up resistance and load capacitance
(5) EN should change state only when the global bus and the repeater port are in an idle state

7.6 Typical Characteristics

NOTE: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only.

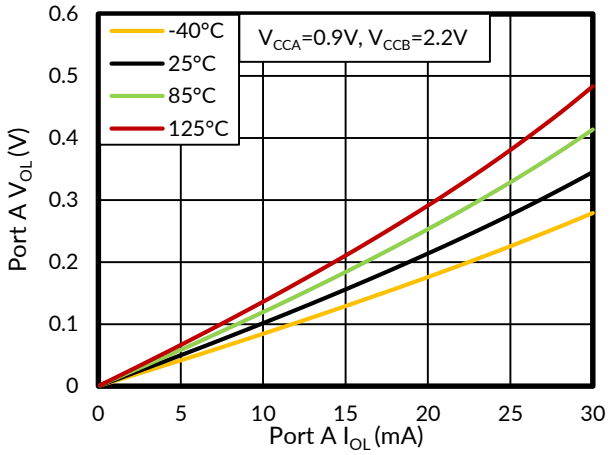


Figure 1. Port A V_{OL} vs I_{OL}

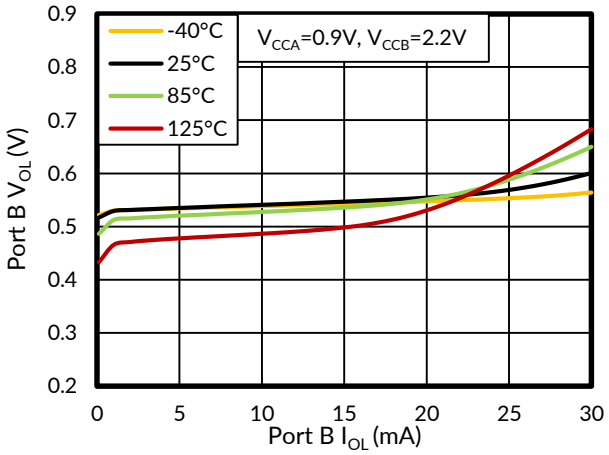


Figure 2. Port B V_{OL} vs I_{OL}

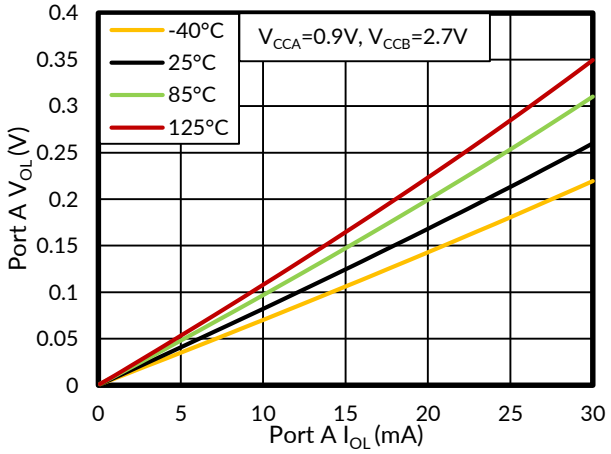


Figure 3. Port A V_{OL} vs I_{OL}

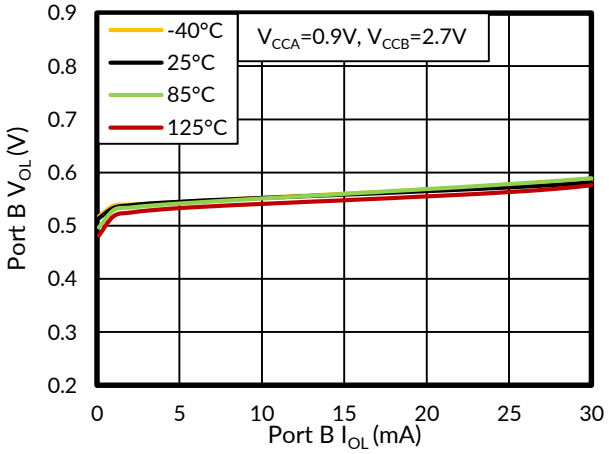


Figure 4. Port B V_{OL} vs I_{OL}

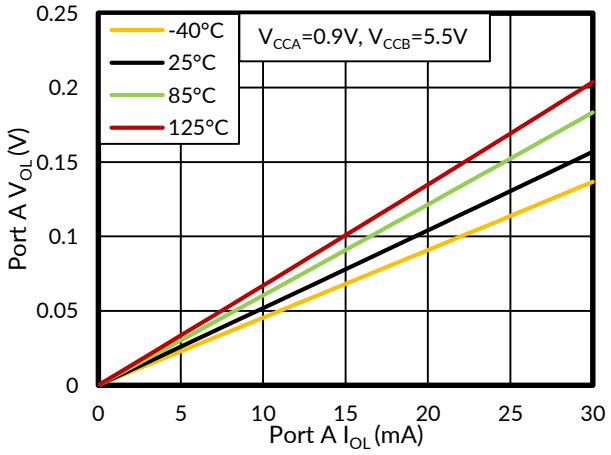


Figure 5. Port A V_{OL} vs I_{OL}

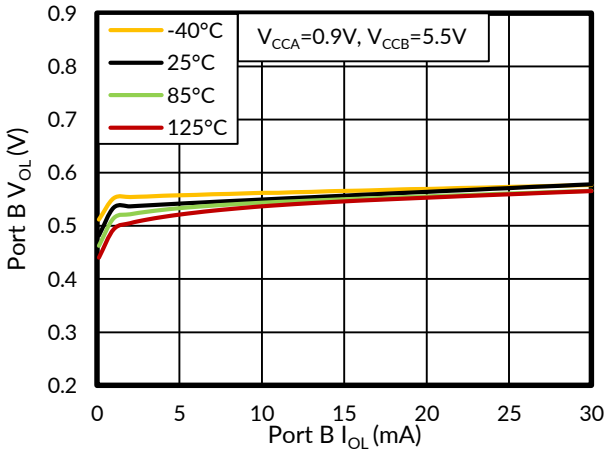


Figure 6. Port B V_{OL} vs I_{OL}

8 DETAILED DESCRIPTION

The RS29617 is an I²C−bus repeater that provides level shifting between low voltage (0.8 V to 5.5 V) and higher voltage (2.2 V to 5.5 V) for Fast−Mode Plus (FM+) I²C−bus or SMBus applications.
This device enables I²C and similar bus systems to be extended, without degradation of performance even during level shifting.

The RS29617 buffers both the serial data (SDA) and the serial clock (SCL) signals on the I²C bus, allowing two buses of 550pF to be connected in an I²C application. This device can also be used to separate two halves of a bus for voltage and capacitance.

8.1 Overview

The RS29617 is a BiCMOS dual bidirectional buffer intended for I²C bus and SMBus systems. As with the standard I²C system, pull-up resistors are required to provide the logic high levels on the buffered bus. The RS29617 has standard open-drain configuration of the I²C bus. The size of these pull-up resistors depends on the system, but each side of the repeater must have a pull-up resistor. The device is designed to work with Standard mode, Fast mode and Fast Mode+ I²C devices. The SCL and SDA lines shall be at high-impedance when either one of the supplies is powered off.

The RS29617 B-side drivers operate from 2.2V to 5.5V. The output low level for this internal buffer is approximately 0.5V, but the input voltage must be below V_{IL} when the output is externally driven low. The higher-voltage low signal is called a buffered low. When the B-side I/O is driven low internally, the low is not recognized as a low by the input. This feature prevents a lockup condition from occurring when the input low condition is released. This type of design on the B side prevents RS29617 from being used in series with another RS29617 B-side or other buffers that incorporate a static or dynamic offset voltage. This is because these devices do not recognize buffered low signals as a valid low and do not propagate the signal as a buffered low again.

The RS29617 A-side drivers operate from 0.8V to 5.5V and do not have the buffered low feature (or the static offset voltage). This means that a low signal on the B side translates to a nearly 0V low on the A side, which accommodates smaller voltage swings of low-voltage logic. The output pull-down on the A side drives a hard low, and the input level is set to 30% of V_{CCA} to accommodate the need for a lower low level in systems where the low-voltage-side supply voltage is as low as 0.8V.

The A side of two or more RS29617 can be connected together to allow a star topology, with the A side on the common bus. Also, the A side can be connected directly to any other buffer with static or dynamic offset voltage. Multiple RS29617 can be connected in series, A side to B side, with no buildup in offset voltage. The number of devices that can be connected in series is limited by repeater delay/time-of-flight considerations on the maximum bus speed requirements.

The RS29617 includes a power-up circuit that keeps the output drivers turned off until V_{CCB} is above 2V and V_{CCA} is above 0.7V. V_{CCA} is only used to provide references for the A-side input comparators and the power-good-detect circuit. The RS29617 internal circuitry and all I/Os are powered by the V_{CCB} pin.

After power up and with the EN high, the A side falling below 30% of V_{CCA} turns on the corresponding B-side driver (either SDA or SCL) and drives the B-side down momentarily to 0V before settling to approximately 0.5V. When the A-side rises above 30% of V_{CCA}, the B-side pull-down driver is turned off and the external pull-up resistor pulls the pin high. If the B side falls first and goes below 0.4V, the A-side driver is turned on and drives the A-side to 0V. When the B-side rises above 0.45V, the A-side pull-down driver is turned off and the external pull-up resistor pulls the pin high.

9 APPLICATION AND IMPLEMENTATION

Information in the following applications sections is not part of the RUNIC component specification, and RUNIC does not warrant its accuracy or completeness. RUNIC's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

9.1 Design Requirements

For the level-translating application, the following must be true:

- V_{CCA} = 0.8V to 5.5V
- V_{CCB} = 2.2V to 5.5V
- $V_{CCA} \leq V_{CCB}$
- $I_{OL} > I_O$

9.2 Star Application

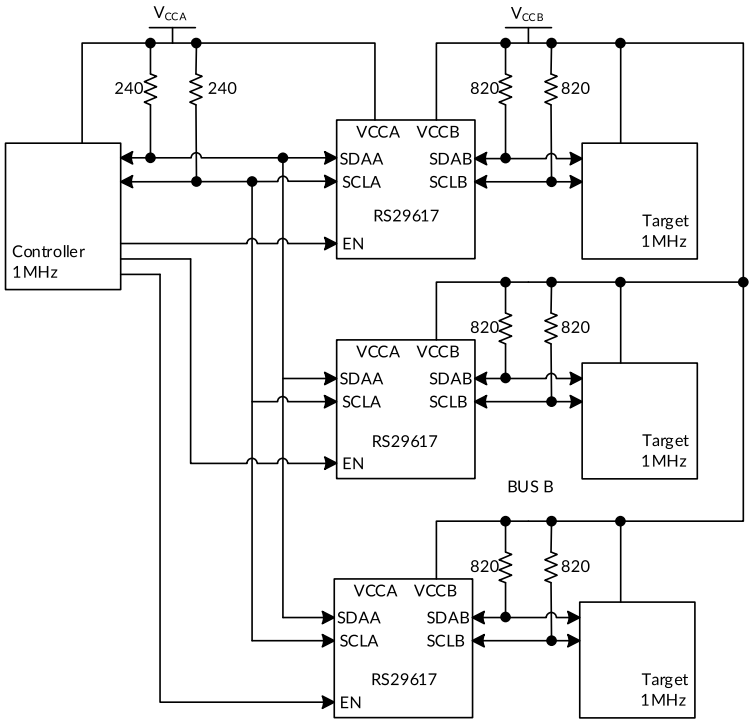


Figure 7. Typical Star Application

9.3 Series Application

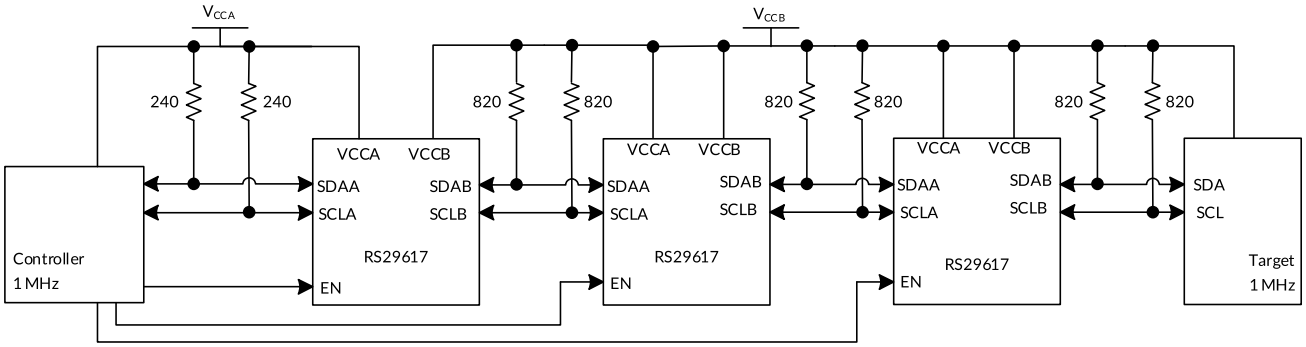
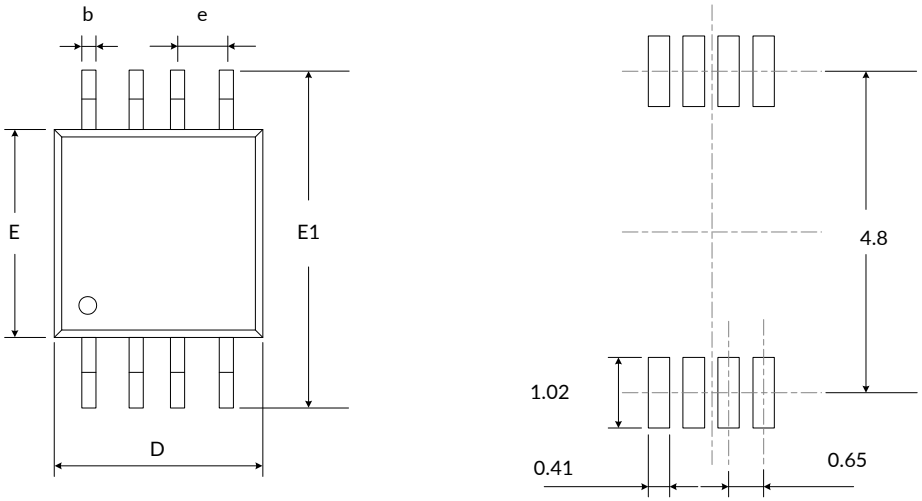


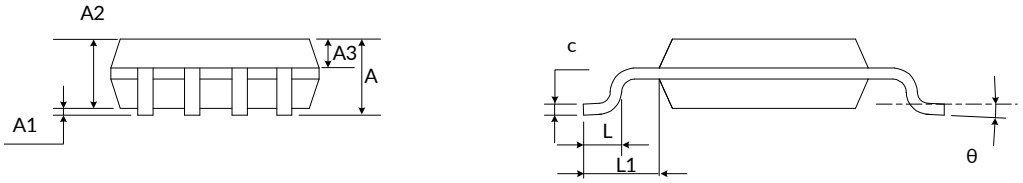
Figure 8. Typical Series Application

10 PACKAGE OUTLINE DIMENSIONS

MSOP8 (4)



RECOMMENDED LAND PATTERN (Unit: mm)



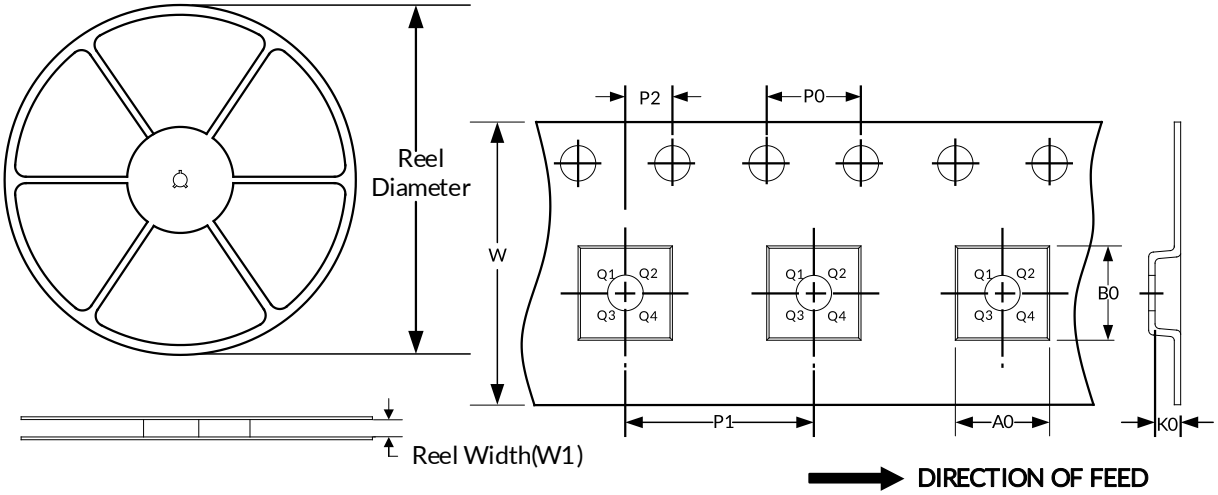
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A (1)		1.100		0.043
A1	0.050	0.150	0.002	0.006
A2	0.750	0.950	0.030	0.037
A3	0.300	0.400	0.012	0.016
b	0.280	0.360	0.011	0.014
c	0.150	0.190	0.006	0.007
D (1)	2.900	3.100	0.114	0.122
e	0.650(BSC) (2)		0.026(BSC) (2)	
E (1)	2.900	3.100	0.114	0.122
E1	4.700	5.100	0.185	0.200
L	0.400	0.700	0.016	0.027
L1	0.950(REF) (3)		0.037(REF) (3)	
θ	0°	8°	0°	8°

NOTE:

1. Plastic or metal protrusions of 0.15mm maximum per side are not included.
2. BSC (Basic Spacing between Centers), "Basic" spacing is nominal.
3. REF is the abbreviation for Reference.
4. This drawing is subject to change without notice.

11 TAPE AND REEL INFORMATION

REEL DIMENSIONS **TAPE DIMENSION**



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 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
MSOP8	13”	12.4	5.20	3.30	1.50	4.0	8.0	2.0	12.0	Q1

NOTE:
1. All dimensions are nominal.
2. Plastic or metal protrusions of 0.15mm maximum per side are not included.

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