

2 Channel Auto-Bidirectional Multi-Voltage Level Translator for Open-Drain and Push-Pull Applications

1 FEATURES

- Provides Bidirectional Voltage Translation With No Direction Pin
- Supports Up to 100MHz Up Translation and Greater than 100MHz Down Translation at $\leq 30\text{pF}$ Capacitive Load and Up to 40MHz Up or Down Translation at 50pF Capacitive Load
- Allows Bidirectional Voltage-Level Translation Between
 - 0.8V \leftrightarrow 1.8/2.5/3.3/5V
 - 1.2V \leftrightarrow 1.8/2.5/3.3/5V
 - 1.8V \leftrightarrow 2.5/3.3/5V
 - 2.5V \leftrightarrow 3.3/5V
 - 3.3V \leftrightarrow 5V
- Low Standby Current
- 5V Tolerance I/O Port to Support TTL
- Low R_{ON} Provides Less Signal Distortion
- High-impedance I/O Pins for EN = Low
- Flow-through Pinout for Easy PCB Trace Routing
- -40°C to 125°C Operating Temperature Range

2 APPLICATIONS

- GPIO, MDIO, PMBus, SMBus, SDIO, UART, I²C, and Other Interfaces in Telecom Infrastructure
- Enterprise Systems
- Communications Equipment
- Personal Electronics
- Industrial Applications

3 DESCRIPTIONS

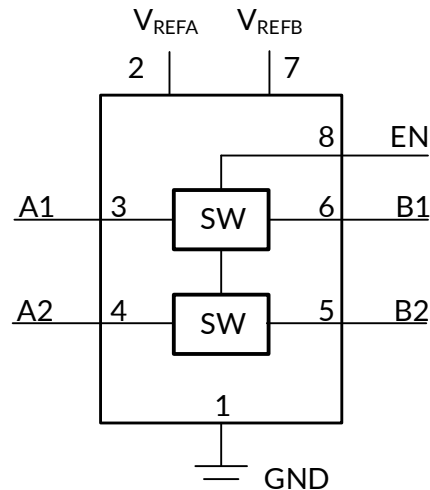
The RSF0102 device supports bidirectional voltage translation without the need for DIR pin which minimizes system effort (for PMBus, I²C, SMBus, and so forth). The device supports up to 100MHz up translation and greater than 100MHz down translation at $\leq 30\text{pF}$ capacitive load and up to 40MHz up or down translation at 50pF capacitive load which allows the device to support more consumer or telecom interfaces (MDIO or SDIO).

This device supports 5V tolerance on I/O port which makes it compatible with TTL levels in industrial and telecom applications. The device is able to set up different voltage translation levels which makes it very flexible.

Device Information ⁽¹⁾

PART NUMBER	PACKAGE	BODY SIZE (NOM)
RSF0102	VSSOP8	2.00mm \times 2.30mm

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



Functional Block Diagram

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4 REVISION HISTORY

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

VERSION	Change Date	Change Item
A.0	2025/12/19	Preliminary version completed

Preliminary version

5 PACKAGE/ORDERING INFORMATION ⁽¹⁾

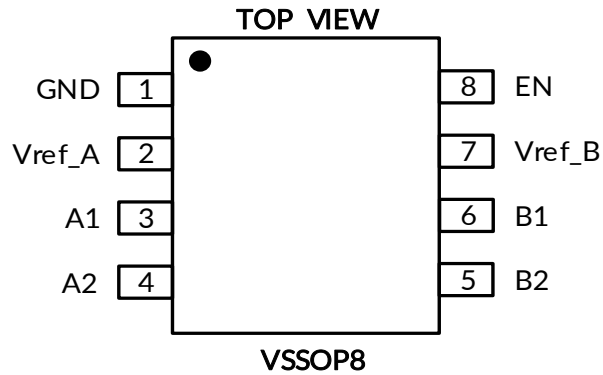
PRODUCT	ORDERING NUMBER	TEMPERATURE RANGE	PACKAGE LEAD	PACKAGE MARKING ⁽²⁾	MSL ⁽³⁾	PACKAGE OPTION
RSF0102	RSF0102XVS8	-40°C ~125°C	VSSOP8	F102	MSL3	Tape and Reel, 3000

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.

Preliminary version

6 PIN CONFIGURATION AND FUNCTIONS



PIN DESCRIPTION

PIN		TYPE ⁽¹⁾	DESCRIPTION
NAME	NO.		
An	3, 4	I/O	Auto-Bidirectional Data port.
Bn	6, 5	I/O	
EN	8	I	Enable input; connect to Vref_B and pull-up through a high resistor (200kΩ).
GND	1	-	Ground
Vref_A	2	-	Reference supply voltage.
Vref_B	7	-	

(1) I=input, O=output.

7 SPECIFICATIONS

7.1 Absolute Maximum Ratings

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

		MIN	MAX	UNIT
V _I	Input voltage ⁽²⁾	-0.5	7	V
V _{I/O}	Input/output voltage ⁽²⁾	-0.5	7	V
	Continuous channel current		128	mA
I _{IK}	Input clamp current	V _I <0	-50	mA
θ _{JA}	Package thermal impedance ⁽³⁾	VSSOP8	199	°C/W
T _J	Junction Temperature ⁽⁴⁾		150	°C
T _{stg}	Storage temperature range	-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 input or output negative-voltage ratings may be exceeded if the input and input or output clamp-current ratings are observed.

(3) The package thermal impedance is calculated in accordance with JESD-51.

(4) The maximum power dissipation is a function of T_{J(MAX)}, R_{θJA}, and T_A. The maximum allowable power dissipation at any ambient temperature is P_D = (T_{J(MAX)} - T_A) / R_{θJA}. All numbers apply for packages soldered directly onto a PCB.

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), ANSI/ESDA/JEDEC JS-001-2023	±2000	V
		Charged-Device Model (CDM), ANSI/ESDA/JEDEC JS-002-2022	±1000	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 _{I/O}	Input/output voltage	0	5.5	V
V _{ref_A/B/EN}	Reference voltage	0	5.5	V
I _{PASS}	Pass transistor current		64	mA
T _A	Operating free-air temperature	-40	125	°C

7.4 Electrical Characteristics

over recommended operating free-air temperature range (unless otherwise noted). All typical values are at $T_A = 25^\circ\text{C}$.

PARAMETER	TEST CONDITIONS		MIN ⁽¹⁾	TYP ⁽²⁾	MAX ⁽¹⁾	UNITS
V_{IK}	$I_I = -18\text{mA}$	$V_{EN} = 0$			-1.2	V
I_{IH}	$V_I = 5\text{V}$	$V_{EN} = 0$			5	μA
$C_{I(\text{ref_A/B})}$	$V_I = 3\text{V}$ or 0V			6		pF
$C_{io(\text{off})}$	$V_O = 3\text{V}$ or 0V	$V_{EN} = 0$		4		pF
$C_{io(\text{on})}$	$V_O = 3\text{V}$ or 0V	$V_{EN} = 3\text{V}$		10		pF
$r_{on}^{(3)}$	$V_I = 0$	$I_O = 64\text{mA}$	$V_{\text{ref_A}} = 3.3\text{V}; V_{\text{ref_B}} = V_{EN} = 5\text{V}$	2.5		Ω
			$V_{\text{ref_A}} = 1.8\text{V}; V_{\text{ref_B}} = V_{EN} = 5\text{V}$	3		
			$V_{\text{ref_A}} = 1.0\text{V}; V_{\text{ref_B}} = V_{EN} = 5\text{V}$	4		
	$V_I = 0$	$I_O = 32\text{mA}$	$V_{\text{ref_A}} = 1.8\text{V}; V_{\text{ref_B}} = V_{EN} = 5\text{V}$	3		Ω
			$V_{\text{ref_A}} = 2.5\text{V}; V_{\text{ref_B}} = V_{EN} = 5\text{V}$	2.5		
	$V_I = 1.8\text{V}$	$I_O = 15\text{mA}$	$V_{\text{ref_A}} = 3.3\text{V}; V_{\text{ref_B}} = V_{EN} = 5\text{V}$	3.5		Ω
	$V_I = 1.0\text{V}$	$I_O = 10\text{mA}$	$V_{\text{ref_A}} = 1.8\text{V}; V_{\text{ref_B}} = V_{EN} = 3.3\text{V}$	5		Ω
	$V_I = 0\text{V}$	$I_O = 10\text{mA}$	$V_{\text{ref_A}} = 1.0\text{V}; V_{\text{ref_B}} = V_{EN} = 3.3\text{V}$	4		Ω
$V_I = 0\text{V}$	$I_O = 10\text{mA}$	$V_{\text{ref_A}} = 1.0\text{V}; V_{\text{ref_B}} = V_{EN} = 1.8\text{V}$	4		Ω	

- Limits are 100% production tested at 25°C . Limits over the operating temperature range are ensured through correlations using statistical quality control (SQC) method.
- 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.
- Measured by the voltage drop between the A and B pins at the indicated current through the switch. On-state resistance is determined by the lowest voltage of the two (A or B) pins.

7.5 AC Performance (Translating Down) Switching Characteristics, $V_{CCB} = 3.3\text{V}$

over recommended operating free-air temperature range, $V_{CCB} = 3.3\text{V}$, $V_{CCB} = V_{IH} = V_{\text{ref_A}} + 1$, $V_{IL} = 0$, and $V_M = 0.5V_{\text{ref_A}}$ (unless otherwise noted)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$C_L = 50\text{pF}$		$C_L = 30\text{pF}$		$C_L = 15\text{pF}$		UNIT
			TYP	MAX	TYP	MAX	TYP	MAX	
t_{PLH}	A or B	B or A	1.1		0.7		0.3		ns
t_{PHL}			1.2		0.8		0.4		

7.6 AC Performance (Translating Down) Switching Characteristics, $V_{CCB} = 2.5\text{V}$

over recommended operating free-air temperature range, $V_{CCB} = 2.5\text{V}$, $V_{CCB} = V_{IH} = V_{\text{ref_A}} + 1$, $V_{IL} = 0$, and $V_M = 0.5V_{\text{ref_A}}$ (unless otherwise noted)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$C_L = 50\text{pF}$		$C_L = 30\text{pF}$		$C_L = 15\text{pF}$		UNIT
			TYP	MAX	TYP	MAX	TYP	MAX	
t_{PLH}	A or B	B or A	1.2		0.8		0.35		ns
t_{PHL}			1.3		1		0.5		

7.7 AC Performance (Translating Up) Switching Characteristics, $V_{CCB} = 3.3\text{V}$

over recommended operating free-air temperature range, $V_{CCB} = 3.3\text{V}$, $V_{CCB} = V_T = V_{\text{ref_A}} + 1$, $V_{\text{ref_A}} = V_{IH}$, $V_{IL} = 0$, $V_M = 0.5V_{\text{ref_A}}$ and $R_L = 300$ (unless otherwise noted)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$C_L = 50\text{pF}$		$C_L = 30\text{pF}$		$C_L = 15\text{pF}$		UNIT
			TYP	MAX	TYP	MAX	TYP	MAX	
t_{PLH}	A or B	B or A	1		0.8		0.4		ns
t_{PHL}			1		0.9		0.4		

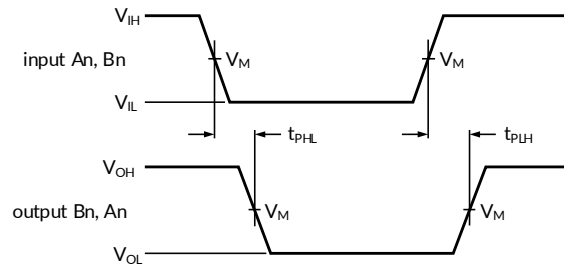
7.8 AC Performance (Translating Up) Switching Characteristics, $V_{CCB} = 2.5V$

over recommended operating free-air temperature range, $V_{CCB} = 2.5V$, $V_{CCB} = V_T = V_{ref_A} + 1$, $V_{ref_A} = V_{IH}$, $V_{IL} = 0$, $V_M = 0.5V_{ref_A}$ and $R_L = 300$ (unless otherwise noted)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$C_L = 50pF$		$C_L = 30pF$		$C_L = 15pF$		UNIT
			TYP	MAX	TYP	MAX	TYP	MAX	
t_{PLH}	A or B	B or A	1.1		0.9		0.45		ns
t_{PHL}			1.3		1.1		0.6		

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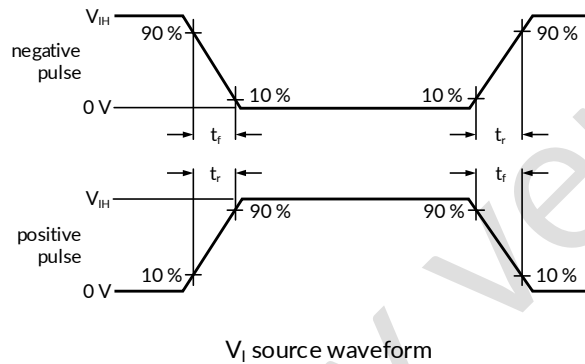
8 PARAMETER MEASUREMENT INFORMATION



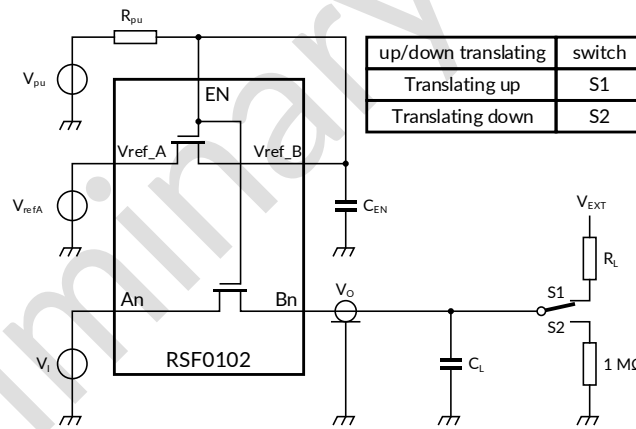
Measurement points are given in Table 1.

Logic levels: V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

Figure 1. The data input (An, Bn) to output (Bn, An) propagation delay times



V_I source waveform



Test circuit

Test data is given in Table 1.

The An and Bn pins may be exchanged.

All input pulses are supplied by generators having the following characteristics: PRR \leq 10 MHz; $Z_O = 50 \Omega$.

Definitions test circuit:

C_L = Load capacitance including jig and probe capacitance; C_{EN} = Decoupling capacitance;

R_{pu} = Pull-up resistance; R_L = Load resistance; S1/S2 = Test selection switch

Figure 2. Test circuit for measuring switching times

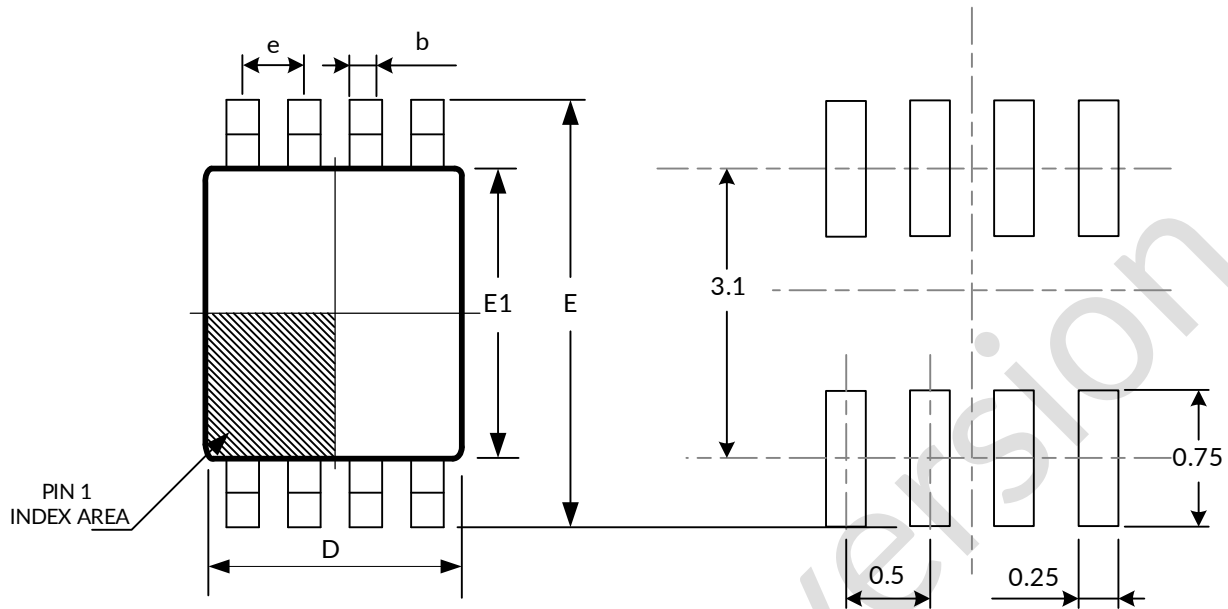
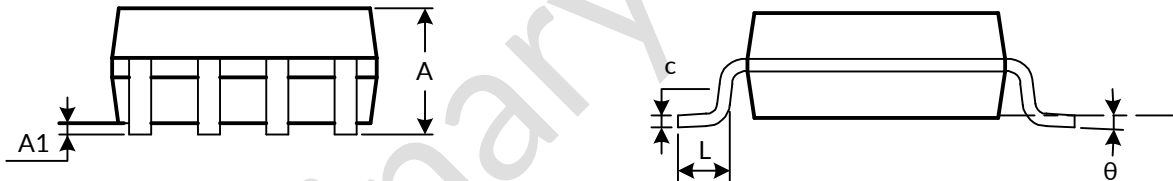
Table 1. Test data

Input		Output	Load			
t_r, t_f	V_M	V_M	C_L	$C_{EN}^{(1)}$	$R_L^{(1)}$	R_{pu}
≤ 2 ns	$0.5V_{ref_A}$	$0.5V_{ref_A}$	15 pF, 30 pF, 50 pF	100 nF	300 Ω	200 k Ω

(1) All typical values are measured at $T_A = 25^\circ C$.

9 PACKAGE OUTLINE DIMENSIONS

VSSOP8⁽³⁾


RECOMMENDED LAND PATTERN (Unit: mm)


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A ⁽¹⁾	0.600	0.900	0.024	0.085
A1	0.000	0.100	0.000	0.004
b	0.170	0.250	0.007	0.010
c	0.100	0.200	0.004	0.008
D ⁽¹⁾	1.900	2.100	0.075	0.083
e	0.500 (BSC) ⁽²⁾		0.020 (BSC) ⁽²⁾	
E	3.000	3.200	0.118	0.126
E1 ⁽¹⁾	2.200	2.400	0.087	0.095
L	0.200	0.350	0.008	0.014
θ	0°	6°	0°	6°

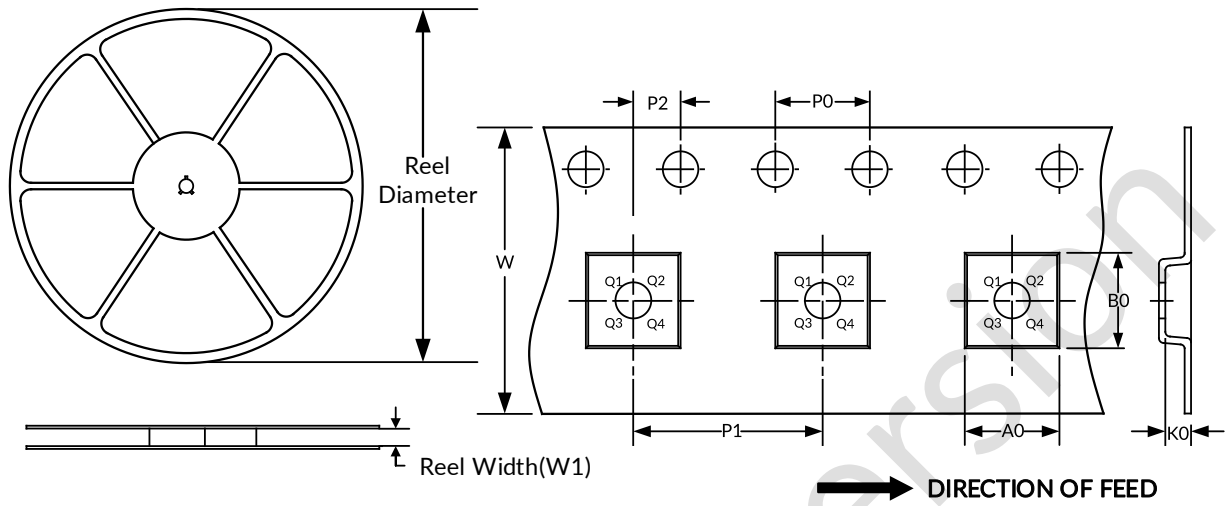
NOTE:

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. This drawing is subject to change without notice.

10 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
VSSOP8	7"	9.5	2.25	3.35	1.40	4.0	4.0	2.0	8.0	Q3

NOTE:

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

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