4-Bit Dual-Supply Bus Transceiver With Configurable Level-Shifting, Voltage Translation, and 3-State Outputs

1 FEATURES

- **Qualified for Automotive Applications**
- **AEC-Q100 Qualified with the Grade 1**
- **Control Inputs V_{IH}/V_{IL} Levels are Referenced to V_{CCA} Voltage**
- **DIR and $\overline{OE}$ are Supplied by V_{CCA}**
- **Fully Configurable Dual-Rail Design Allows Each Port to Operate Over the Full 1.2V to 3.6V Power-Supply Range**
- **I/Os Are 4.6V Tolerant**
- **I_{off} Supports Partial Power-Down-Mode Operation**
- **Bus Hold on Data Inputs Eliminates the Need for External pull-up/pull-down Resistors**
- **Max Data Rates**
  - **380 Mbps (1.8 V to 3.3 V Translation)**
  - **200 Mbps (<1.8 V to 3.3 V Translation)**
  - **200 Mbps (Translate to 2.5 V or 1.8 V)**
- **Extended Temperature: -40°C to +125°C**

2 APPLICATIONS

- **Automotive Infotainment**
- **Advance Driver Assistance Systems (ADAS)**
- **Telematics**
- **Navigation Systems**
- **Cluster**

3 DESCRIPTIONS

This 4-bit noninverting bus transceiver uses two separate configurable power-supply rails. The A port and B port are separately designed to track V_{CCA} and $V_{CCB,}$ which accept any supply voltage from 1.2 V to 3.6 V. The RS74AVCH4T245-Q1 is optimized to operate with V_{CCA}/V_{CCB} set at 1.4 V to 3.6 V. It is operational with V_{CCA}/V_{CCB} as low as 1.2 V. This allows for universal low voltage bidirectional translation between any of the 1.2V, 1.5V, 1.8V, 2.5V, and 3.3V voltage nodes.

The RS74AVCH4T245-Q1 is designed for asynchronous communication between two data buses. The logic levels of the direction-control (DIR) input and the output-enable ($\overline{OE}$) input activate either the B-port outputs or the A-port outputs or place both output ports into the high-impedance mode. The input circuitry on both A and B ports is always active and must have a logic HIGH or LOW level applied to prevent excess I_{CC} and I_{CCZ}.

Active bus-hold circuitry holds unused or undriven data inputs at a valid logic state. Use of pull-up or pull-down resistors with the bus-hold circuitry is not recommended. The bus-hold circuitry on the powered-up side always stays active.

To ensure the high-impedance state during power up or power down, $\overline{OE}$ should be tied to V_{CC} through a pull-up resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver

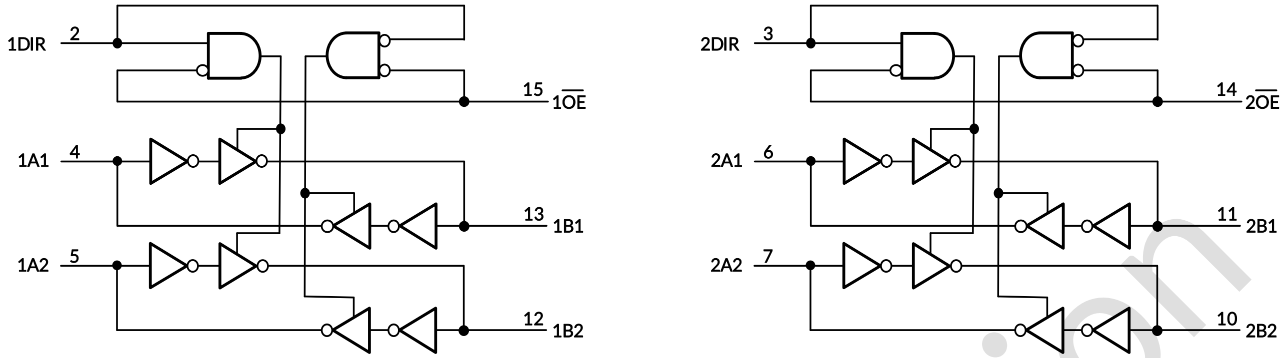
This device is fully specified for partial-power-down applications using I_{off}. The I_{off} circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.

Device Information (1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
RS74AVCH4T245-Q1	QFN2.5X3.5-16	2.50mm×3.50mm

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

4 FUNCTIONAL BLOCK DIAGRAM



Function Table

CONTROL INPUTS		OUTPUT CIRCUITS		OPERATION
$\overline{OE}$	DIR	A PORT	B PORT	
L	L	Enabled	Hi-Z	B data to A bus
L	H	Hi-Z	Enabled	A data to B bus
H	X	Hi-Z	Hi-Z	Isolation

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5 REVISION HISTORY

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

VERSION	Change Date	Change Item
A.0	2025/05/20	Preliminary version completed
A.0.1	2026/02/02	Update ESD Ratings

6 PACKAGE/ORDERING INFORMATION (1)

PRODUCT	ORDERING NUMBER	TEMPERATURE RANGE	PACKAGE LEAD	Lead finish/Ball material (2)	MSL Peak Temp (3)	PACKAGE MARKING (4)	PACKAGE OPTION
RS74AVCH4T245-Q1	RS74AVCH4T245XTQW16-Q1	-40°C ~+125°C	QFN2.5X3.5-16	NIPDAU	MSL1-260°-Unlimited	VH4T245	Tape and Reel, 5000

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.

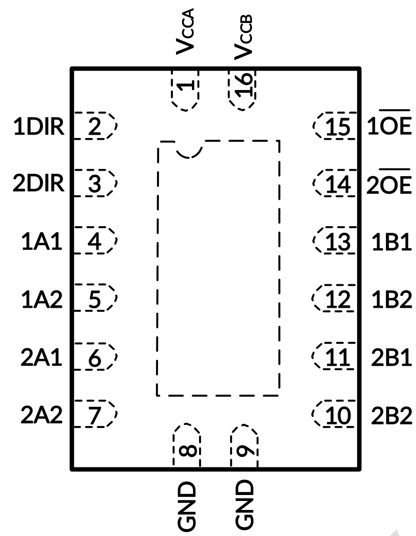
(2) Lead finish/Ball material. Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

(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.

(4) 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.

7 PIN CONFIGURATIONS

(TOP VIEW)



QFN2.5X3.5-16

PIN DESCRIPTION

PIN	NAME	TYPE (1)	FUNCTION
QFN2.5X3.5-16			
1	V_{CCA}	P	A-port power supply voltage. 1.2 V ≤ V_{CCA} ≤ 3.6 V
2	1DIR	I	Direction-control input for ”1” ports.
3	2DIR	I	Direction-control input for ”2” ports.
4	1A1	I/O	Input/output 1A1. Referenced to V_{CCA}.
5	1A2	I/O	Input/output 1A2. Referenced to V_{CCA}.
6	2A1	I/O	Input/output 2A1. Referenced to V_{CCA}.
7	2A2	I/O	Input/output 2A2. Referenced to V_{CCA}.
8	GND	G	Ground.
9	GND	G	Ground.
10	2B2	I/O	Input/output 2B2. Referenced to V_{CCB}.
11	2B1	I/O	Input/output 2B1. Referenced to V_{CCB}.
12	1B2	I/O	Input/output 1B2. Referenced to V_{CCB}.
13	1B1	I/O	Input/output 1B1. Referenced to V_{CCB}.
14	2$\overline{OE}$	I	3-state output-mode enables. Pull $\overline{OE}$ high to place “2” outputs in 3-state mode. Referenced to V_{CCA}.
15	1$\overline{OE}$	I	3-state output-mode enables. Pull $\overline{OE}$ high to place “1” outputs in 3-state mode. Referenced to V_{CCA}.
16	V_{CCB}	P	B-port power supply voltage. 1.2 V ≤ V_{CCB} ≤ 3.6 V

(1) I=input, O=output, I/O=input and output, P=power

8 SPECIFICATIONS

8.1 Absolute Maximum Ratings

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

SYMBOL	PARAMETER		MIN	MAX	UNIT
V_{CCA}	Supply Voltage Range		-0.5	4.6	V
V_{CCB}	Supply Voltage Range		-0.5	4.6	V
V_I	Input Voltage Range (2)	I/O ports (A port)	-0.5	4.6	V
		I/O ports (B port)	-0.5	4.6	
		Control inputs	-0.5	4.6	
V_O	Voltage range applied to any output in the high-impedance or power-off state (2)	A port	-0.5	4.6	V
		B port	-0.5	4.6	
V_O	Voltage range applied to any output in the high or low state (2) (3)	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
θ_{JA}	Package thermal impedance (4)	QFN2.5X3.5-16		65	°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 output positive voltage rating may be exceeded up to 4.6V maximum if the output current rating is observed.
(4) The package thermal impedance is calculated in accordance with JESD-51.

8.2 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), per AEC Q100-002 (1)	±2000	V
		Charged-Device Model (CDM), per AEC Q100-011	±1000	V
		Latch-Up (LU), per AEC Q100-004	±200	mA

(1) AEC Q100-002 indicates that HBM stressing shall be in accordance with the ANSI/ESDA/JEDEC JS-001 specification.

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.

8.3 Recommended Operating Conditions

			V_{CCI} (1)	V_{CCO} (2)	MIN	MAX	UNIT
V_{CCA}	Supply voltage				1.2	3.6	V
V_{CCB}	Supply voltage				1.2	3.6	V
V_{IH}	HIGH-level input voltage	Data inputs (4)	1.2 V to 1.95 V		V_{CCI} × 0.65		V
			1.95 V to 2.7 V		1.6		
			2.7 V to 3.6 V		2		
V_{IL}	LOW-level input voltage	Data inputs (4)	1.2 V to 1.95 V			V_{CCI} × 0.35	V
			1.95 V to 2.7 V			0.7	
			2.7 V to 3.6 V			0.8	
V_{IH}	HIGH-level input voltage	DIR (referenced to V_{CCA}) (5)	1.2 V to 1.95 V		V_{CCA} × 0.65		V
			1.95 V to 2.7 V		1.6		
			2.7 V to 3.6 V		2		
V_{IL}	LOW-level input voltage	DIR (referenced to V_{CCA}) (5)	1.2 V to 1.95 V			V_{CCA} × 0.35	V
			1.95 V to 2.7 V			0.7	
			2.7 V to 3.6 V			0.8	
V_I	Input voltage				0	3.6	V
V_O	Output voltage	Active state			0	V_{CCO}	V
		3-state			0	3.6	
I_{OH}	HIGH-level input voltage			1.2 V		-3	mA
				1.4 V to 1.6 V		-6	
				1.65 V to 1.95 V		-8	
				2.3 V to 2.7 V		-9	
				3 V to 3.6 V		-12	
I_{OL}	LOW-level input voltage			1.2 V		3	mA
				1.4 V to 1.6 V		6	
				1.65 V to 1.95 V		8	
				2.3 V to 2.7 V		9	
				3 V to 3.6 V		12	
Δt/Δv	Input transition rise or fall rate						ns/V
T_A	Operating free-air temperature				-40	125	°C

(1) V_{CCI} is the V_{CC} associated with the input port.
(2) V_{CCO} is the V_{CC} associated with the output port.
(3) All unused data inputs of the device must be held at V_{CCI} or GND to ensure proper device operation
(4) For V_{CCI} values not specified in the data sheet, V_{IH} min = V_{CCI} × 0.7 V, V_{IL} max = V_{CCI} × 0.3 V.
(5) For V_{CCA} values not specified in the data sheet, V_{IH} min = V_{CCA} × 0.7 V, V_{IL} max = V_{CCA} × 0.3 V.

8.4 Electrical Characteristics

All typical limits apply over T_A = 25°C, and all maximum and minimum limits apply over T_A = –40°C to 125°C (unless otherwisenoted). (1) (2)

PARAMETER	TEST CONDITIONS		MIN(3)	TYP(4)	MAX(3)	UNIT
V_{OH}	I_{OH}=–100 µA; V_{CCA}=1.2 V to 3.6 V; V_{CCB}=1.2 V to 3.6 V; V_I=V_{IH}		V_{CCO}-0.2			V
	I_{OH}=–3 mA; V_{CCA}=1.2 V; V_{CCB}=1.2 V; V_I=V_{IH}			0.95		
	I_{OH}=–6 mA; V_{CCA}=1.4 V; V_{CCB}=1.4 V; V_I=V_{IH}		1.05			
	I_{OH}=–8 mA; V_{CCA}=1.65 V; V_{CCB}=1.65 V; V_I=V_{IH}		1.2			
	I_{OH}=–9 mA; V_{CCA}=2.3 V; V_{CCB}=2.3 V; V_I=V_{IH}		1.75			
	I_{OH}=–12 mA; V_{CCA}=3.0 V; V_{CCB}=3.0 V; V_I=V_{IH}		2.3			
V_{OL}	I_{OH}=100 µA; V_{CCA}=1.2 V to 3.6 V; V_{CCB}=1.2 V to 3.6 V; V_I=V_{IL}				0.2	V
	I_{OH}=3 mA; V_{CCA}=1.2 V; V_{CCB}=1.2 V; V_I=V_{IL}			0.15		
	I_{OH}=6 mA; V_{CCA}=1.4 V; V_{CCB}=1.4 V; V_I=V_{IL}				0.35	
	I_{OH}=8 mA; V_{CCA}=1.65 V; V_{CCB}=1.65 V; V_I=V_{IL}				0.45	
	I_{OH}=9 mA; V_{CCA}=2.3 V; V_{CCB}=2.3 V; V_I=V_{IL}				0.55	
	I_{OH}=12 mA; V_{CCA}=3.0 V; V_{CCB}=3.0 V; V_I=V_{IL}				0.7	
I_I (DIR input)	V_I=V_{CCA} or GND; V_{CCA} =1.2 V to 3.6 V; V_{CCB}=1.2 V to 3.6 V	T_A = 25°C		±0.045	±1	µA
		T_A = –40°C to 125°C			±2	
I_{BHL} (5)	V_I = 0.42 V; V_{CCA} = 1.2 V; V_{CCB} = 1.2 V		10			µA
	V_I = 0.49 V; V_{CCA} = 1.4 V; V_{CCB} = 1.4 V		15			
	V_I = 0.58 V; V_{CCA} = 1.65 V; V_{CCB} = 1.65 V		25			
	V_I = 0.7 V; V_{CCA} = 2.3 V; V_{CCB} = 2.3 V		45			
	V_I = 0.8 V; V_{CCA} = 3.3 V; V_{CCB} = 3.3 V		70			
I_{BHH} (6)	V_I = 0.78 V; V_{CCA} = 1.2 V; V_{CCB} = 1.2 V		-10			µA
	V_I = 0.91 V; V_{CCA} = 1.4 V; V_{CCB} = 1.4 V		-15			
	V_I = 1.07 V; V_{CCA} = 1.65 V; V_{CCB} = 1.65 V		-25			
	V_I = 1.6 V; V_{CCA} = 2.3 V; V_{CCB} = 2.3 V		-45			
	V_I = 2.0 V; V_{CCA} = 3.3 V; V_{CCB} = 3.3 V		-100			
I_{BHLO} (7)	V_I=0 to V_{CCI}	V_{CCA}=V_{CCB}=1.2 V	60			µA
		V_{CCA}=V_{CCB}=1.6 V	125			
		V_{CCA}=V_{CCB}=1.95 V	200			
		V_{CCA}=V_{CCB}=2.7 V	300			
		V_{CCA}=V_{CCB}=3.6 V	500			

(1) V_{CCI} is the V_{CC} associated with the input port.
(2) V_{CCO} is the V_{CC} associated with the output port.
(3) Limits are 100% production tested at 25°C. Limits over the operating temperature range are ensured through correlations using statistical quality control (SQC) method.
(4) 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.
(5) The bus-hold circuit can sink at least the minimum low sustaining current at V_{IL} max. I_{BHL} should be measured after lowering V_{IN} to GND and then raising it to V_{IL} max.
(6) The bus-hold circuit can source at least the minimum high sustaining current at V_{IH} min. I_{BHH} should be measured after raising V_{IN} to V_{CC} and then lowering it to V_{IH} min.
(7) An external driver must source at least I_{BHLO} to switch this node from low to high.

Electrical Characteristics (continued)

All typical limits apply over T_A = 25°C, and all maximum and minimum limits apply over T_A =–40°C to 125°C (unless otherwisenoted). (1) (2)

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
I_{BHHO} (8)		V_I=0 to V_{CCI}	V_{CCA}=V_{CCB}=1.2 V	-60			µA
			V_{CCA}=V_{CCB}=1.6 V	-125			
			V_{CCA}=V_{CCB}=1.95 V	-200			
			V_{CCA}=V_{CCB}=2.7 V	-300			
			V_{CCA}=V_{CCB}=3.6 V	-500			
I_{off}	A port	V_I or V_O=0 V to 3.6 V; V_{CCA} = 0 V; V_{CCB} = 0 V to 3.6 V	T_A = 25°C		±0.001	±1	µA
			T_A = –40°C to 125°C			±2	
	B port	V_I or V_O=0 V to 3.6 V; V_{CCA} =0 V to 3.6 V; V_{CCB} = 0 V	T_A = 25°C		±0.007	±1	
			T_A = –40°C to 125°C			±2	
I_{OZ} (9)	A port & B port	V_O=V_{CCO} or GND; V_I=V_{CCI} or GND; $\overline{OE}$=V_{IH}; V_{CCA}=3.6 V; V_{CCB}=3.6 V	T_A = 25°C		±0.052	±1	µA
			T_A = –40°C to 125°C			±2	
	B port	V_O=V_{CCO} or GND; V_I=V_{CCI} or GND; $\overline{OE}$=don't care; V_{CCA}=0 V; V_{CCB}=3.6 V				±0.1	
	A port	V_O=V_{CCO} or GND; V_I=V_{CCI} or GND; $\overline{OE}$=don't care; V_{CCA}=3.6 V; V_{CCB}=0 V				±1	
I_{CCA}		V_I=V_{CCI} or GND, I_O=0	V_{CCA}=1.2V to 3.6V; V_{CCB}=1.2V to 3.6V			5	µA
			V_{CCA}=0V; V_{CCB}=3.6V			-3	
			V_{CCA}=3.6V; V_{CCB}=0V			3	
I_{CCB}		V_I=V_{CCI} or GND, I_O=0	V_{CCA}=1.2V to 3.6V; V_{CCB}=1.2V to 3.6V			5	µA
			V_{CCA}=0V; V_{CCB}=3.6V			3	
			V_{CCA}=3.6V; V_{CCB}=0V			-1.5	
I_{CCA}+I_{CCB}		V_I=V_{CCI} or GND, I_O=0; V_{CCA}=1.2 V to 3.6 V; V_{CCB}=1.2 V to 3.6 V				10	µA
C_i	Control inputs	V_I = 3.3 V or GND; V_{CCA} = 3.3 V; V_{CCB} = 3.3 V			5.5	8	pF
C_{io}	A or B port	V_O = 3.3 V or GND; V_{CCA} = 3.3 V; V_{CCB} = 3.3 V			6.6	9	pF

(8) An external driver must sink at least I_{BHHO} to switch this node from high to low.
(9) For I/O ports, the parameter I_{OZ} includes the input leakage current.

8.5 Switching Characteristics, V_{CCA}=1.2 V

over recommended operating free-air temperature range.

PARAMETER	FROM(INPUT)	TO(OUTPUT)	V_{CCB}	TYP	UNIT
t_{PLH}, t_{PHL}	A	B	V_{CCB}=1.2V	22.3	ns
			V_{CCB} = 1.5 V ± 0.1 V	17.3	
			V_{CCB} = 1.8 V ± 0.15 V	15.8	
			V_{CCB} = 2.5 V ± 0.2 V	14.8	
			V_{CCB} = 3.3 V ± 0.3 V	14.8	
t_{PLH}, t_{PHL}	B	A	V_{CCB}=1.2V	21.8	ns
			V_{CCB} = 1.5 V ± 0.1 V	17.0	
			V_{CCB} = 1.8 V ± 0.15 V	15.0	
			V_{CCB} = 2.5 V ± 0.2 V	14.0	
			V_{CCB} = 3.3 V ± 0.3 V	13.8	
t_{PZH}, t_{PZL}	$\overline{OE}$	A	V_{CCB}=1.2V	16.3	ns
			V_{CCB} = 1.5 V ± 0.1 V	14.8	
			V_{CCB} = 1.8 V ± 0.15 V	14.3	
			V_{CCB} = 2.5 V ± 0.2 V	13.5	
			V_{CCB} = 3.3 V ± 0.3 V	14.3	
t_{PZH}, t_{PZL}	$\overline{OE}$	B	V_{CCB}=1.2V	16.5	ns
			V_{CCB} = 1.5 V ± 0.1 V	14.8	
			V_{CCB} = 1.8 V ± 0.15 V	14.8	
			V_{CCB} = 2.5 V ± 0.2 V	13.5	
			V_{CCB} = 3.3 V ± 0.3 V	14.5	
t_{PHZ}, t_{PLZ}	$\overline{OE}$	A	V_{CCB}=1.2V	21.8	ns
			V_{CCB} = 1.5 V ± 0.1 V	15.3	
			V_{CCB} = 1.8 V ± 0.15 V	14.0	
			V_{CCB} = 2.5 V ± 0.2 V	12.5	
			V_{CCB} = 3.3 V ± 0.3 V	12.5	
t_{PHZ}, t_{PLZ}	$\overline{OE}$	B	V_{CCB}=1.2V	22.3	ns
			V_{CCB} = 1.5 V ± 0.1 V	15.3	
			V_{CCB} = 1.8 V ± 0.15 V	14.5	
			V_{CCB} = 2.5 V ± 0.2 V	13.0	
			V_{CCB} = 3.3 V ± 0.3 V	12.8	

8.6 Switching Characteristics, V_{CCA}=1.5 V ± 0.1 V

over recommended operating free-air temperature range.

PARAMETER	FROM(INPUT)	TO(OUTPUT)	V_{CCB}	MIN	TYP	MAX	UNIT
t_{PLH}, t_{PHL}	A	B	V_{CCB}=1.2V		13.5		ns
			V_{CCB} = 1.5 V ± 0.1 V	5.6		13.1	
			V_{CCB} = 1.8 V ± 0.15 V	4.5		10.6	
			V_{CCB} = 2.5 V ± 0.2 V	3.8		8.1	
			V_{CCB} = 3.3 V ± 0.3 V	3.4		7.5	
t_{PLH}, t_{PHL}	B	A	V_{CCB}=1.2V		13.3		ns
			V_{CCB} = 1.5 V ± 0.1 V	5.3		13.1	
			V_{CCB} = 1.8 V ± 0.15 V	4.1		9.4	
			V_{CCB} = 2.5 V ± 0.2 V	3.4		7.5	
			V_{CCB} = 3.3 V ± 0.3 V	3.0		6.9	
t_{PZH}, t_{PZL}	$\overline{OE}$	A	V_{CCB}=1.2V		14.5		ns
			V_{CCB} = 1.5 V ± 0.1 V	9.0		16.3	
			V_{CCB} = 1.8 V ± 0.15 V	9.0		15.0	
			V_{CCB} = 2.5 V ± 0.2 V	8.3		14.4	
			V_{CCB} = 3.3 V ± 0.3 V	7.9		15.6	
t_{PZH}, t_{PZL}	$\overline{OE}$	B	V_{CCB}=1.2V		14.5		ns
			V_{CCB} = 1.5 V ± 0.1 V	9.0		16.3	
			V_{CCB} = 1.8 V ± 0.15 V	9.0		15.6	
			V_{CCB} = 2.5 V ± 0.2 V	8.3		14.4	
			V_{CCB} = 3.3 V ± 0.3 V	8.3		16.3	
t_{PHZ}, t_{PLZ}	$\overline{OE}$	A	V_{CCB}=1.2V		21.3		ns
			V_{CCB} = 1.5 V ± 0.1 V	9.0		22.5	
			V_{CCB} = 1.8 V ± 0.15 V	10.1		18.8	
			V_{CCB} = 2.5 V ± 0.2 V	9.0		15.0	
			V_{CCB} = 3.3 V ± 0.3 V	8.3		14.4	
t_{PHZ}, t_{PLZ}	$\overline{OE}$	B	V_{CCB}=1.2V		22.3		ns
			V_{CCB} = 1.5 V ± 0.1 V	9.0		22.5	
			V_{CCB} = 1.8 V ± 0.15 V	10.1		18.1	
			V_{CCB} = 2.5 V ± 0.2 V	9.0		15.0	
			V_{CCB} = 3.3 V ± 0.3 V	8.3		14.4	

8.7 Switching Characteristics, V_{CCA}=1.8 V ± 0.15 V

over recommended operating free-air temperature range.

PARAMETER	FROM(INPUT)	TO(OUTPUT)	V_{CCB}	MIN	TYP	MAX	UNIT
t_{PLH}, t_{PHL}	A	B	V_{CCB}=1.2V		13.3		ns
			V_{CCB} = 1.5 V ± 0.1 V	5.3		12.5	
			V_{CCB} = 1.8 V ± 0.15 V	4.5		10.0	
			V_{CCB} = 2.5 V ± 0.2 V	3.4		7.5	
			V_{CCB} = 3.3 V ± 0.3 V	3.4		6.9	
t_{PLH}, t_{PHL}	B	A	V_{CCB}=1.2V		13.3		ns
			V_{CCB} = 1.5 V ± 0.1 V	4.9		11.9	
			V_{CCB} = 1.8 V ± 0.15 V	4.1		9.4	
			V_{CCB} = 2.5 V ± 0.2 V	3.4		6.9	
			V_{CCB} = 3.3 V ± 0.3 V	3.0		6.3	
t_{PZH}, t_{PZL}	$\overline{OE}$	A	V_{CCB}=1.2V		10.0		ns
			V_{CCB} = 1.5 V ± 0.1 V	5.6		10.6	
			V_{CCB} = 1.8 V ± 0.15 V	5.3		10.0	
			V_{CCB} = 2.5 V ± 0.2 V	4.9		8.1	
			V_{CCB} = 3.3 V ± 0.3 V	5.3		9.4	
t_{PZH}, t_{PZL}	$\overline{OE}$	B	V_{CCB}=1.2V		9.8		ns
			V_{CCB} = 1.5 V ± 0.1 V	5.6		10.6	
			V_{CCB} = 1.8 V ± 0.15 V	5.3		10.0	
			V_{CCB} = 2.5 V ± 0.2 V	4.9		8.1	
			V_{CCB} = 3.3 V ± 0.3 V	4.9		9.8	
t_{PHZ}, t_{PLZ}	$\overline{OE}$	A	V_{CCB}=1.2V		21.0		ns
			V_{CCB} = 1.5 V ± 0.1 V	8.3		18.1	
			V_{CCB} = 1.8 V ± 0.15 V	7.5		15.0	
			V_{CCB} = 2.5 V ± 0.2 V	6.4		11.3	
			V_{CCB} = 3.3 V ± 0.3 V	5.3		11.3	
t_{PHZ}, t_{PLZ}	$\overline{OE}$	B	V_{CCB}=1.2V		20.8		ns
			V_{CCB} = 1.5 V ± 0.1 V	8.3		18.1	
			V_{CCB} = 1.8 V ± 0.15 V	7.5		13.8	
			V_{CCB} = 2.5 V ± 0.2 V	6.2		11.9	
			V_{CCB} = 3.3 V ± 0.3 V	5.3		11.9	

8.8 Switching Characteristics, V_{CCA}=2.5 V ± 0.2 V

over recommended operating free-air temperature range.

PARAMETER	FROM(INPUT)	TO(OUTPUT)	V_{CCB}	MIN	TYP	MAX	UNIT
t_{PLH}, t_{PHL}	A	B	V_{CCB}=1.2V		12.3		ns
			V_{CCB} = 1.5 V ± 0.1 V	5.3		11.9	
			V_{CCB} = 1.8 V ± 0.15 V	4.1		9.4	
			V_{CCB} = 2.5 V ± 0.2 V	3.4		7.5	
			V_{CCB} = 3.3 V ± 0.3 V	3.0		6.3	
t_{PLH}, t_{PHL}	B	A	V_{CCB}=1.2V		13.0		ns
			V_{CCB} = 1.5 V ± 0.1 V	4.9		11.3	
			V_{CCB} = 1.8 V ± 0.15 V	3.8		8.8	
			V_{CCB} = 2.5 V ± 0.2 V	3.0		6.3	
			V_{CCB} = 3.3 V ± 0.3 V	2.6		5.6	
t_{PZH}, t_{PZL}	$\overline{OE}$	A	V_{CCB}=1.2V		9.3		ns
			V_{CCB} = 1.5 V ± 0.1 V	4.9		9.4	
			V_{CCB} = 1.8 V ± 0.15 V	4.9		8.1	
			V_{CCB} = 2.5 V ± 0.2 V	3.8		6.3	
			V_{CCB} = 3.3 V ± 0.3 V	3.8		7.5	
t_{PZH}, t_{PZL}	$\overline{OE}$	B	V_{CCB}=1.2V		9.0		ns
			V_{CCB} = 1.5 V ± 0.1 V	4.1		9.4	
			V_{CCB} = 1.8 V ± 0.15 V	4.9		8.1	
			V_{CCB} = 2.5 V ± 0.2 V	3.8		6.3	
			V_{CCB} = 3.3 V ± 0.3 V	3.8		7.5	
t_{PHZ}, t_{PLZ}	$\overline{OE}$	A	V_{CCB}=1.2V		17.8		ns
			V_{CCB} = 1.5 V ± 0.1 V	9.0		18.1	
			V_{CCB} = 1.8 V ± 0.15 V	7.5		15.0	
			V_{CCB} = 2.5 V ± 0.2 V	6.2		12.5	
			V_{CCB} = 3.3 V ± 0.3 V	5.4		10.6	
t_{PHZ}, t_{PLZ}	$\overline{OE}$	B	V_{CCB}=1.2V		18.0		ns
			V_{CCB} = 1.5 V ± 0.1 V	9.0		18.1	
			V_{CCB} = 1.8 V ± 0.15 V	7.5		13.8	
			V_{CCB} = 2.5 V ± 0.2 V	6.2		11.9	
			V_{CCB} = 3.3 V ± 0.3 V	5.4		10.6	

8.9 Switching Characteristics, V_{CCA}=3.3 V ± 0.3 V

over recommended operating free-air temperature range.

PARAMETER	FROM(INPUT)	TO(OUTPUT)	V_{CCB}	MIN	TYP	MAX	UNIT
t_{PLH}, t_{PHL}	A	B	V_{CCB}=1.2V		12.3		ns
			V_{CCB} = 1.5 V ± 0.1 V	4.9		11.3	
			V_{CCB} = 1.8 V ± 0.15 V	4.1		8.8	
			V_{CCB} = 2.5 V ± 0.2 V	3.4		6.9	
			V_{CCB} = 3.3 V ± 0.3 V	3.0		5.6	
t_{PLH}, t_{PHL}	B	A	V_{CCB}=1.2V		13.0		ns
			V_{CCB} = 1.5 V ± 0.1 V	4.9		10.6	
			V_{CCB} = 1.8 V ± 0.15 V	3.4		8.8	
			V_{CCB} = 2.5 V ± 0.2 V	3.0		6.3	
			V_{CCB} = 3.3 V ± 0.3 V	2.3		5.0	
t_{PZH}, t_{PZL}	$\overline{OE}$	A	V_{CCB}=1.2V		8.8		ns
			V_{CCB} = 1.5 V ± 0.1 V	4.5		8.8	
			V_{CCB} = 1.8 V ± 0.15 V	4.5		7.5	
			V_{CCB} = 2.5 V ± 0.2 V	3.8		6.9	
			V_{CCB} = 3.3 V ± 0.3 V	3.8		6.9	
t_{PZH}, t_{PZL}	$\overline{OE}$	B	V_{CCB}=1.2V		8.8		ns
			V_{CCB} = 1.5 V ± 0.1 V	4.5		9.4	
			V_{CCB} = 1.8 V ± 0.15 V	4.5		7.5	
			V_{CCB} = 2.5 V ± 0.2 V	3.0		6.3	
			V_{CCB} = 3.3 V ± 0.3 V	3.8		7.3	
t_{PHZ}, t_{PLZ}	$\overline{OE}$	A	V_{CCB}=1.2V		18.8		ns
			V_{CCB} = 1.5 V ± 0.1 V	9.4		18.8	
			V_{CCB} = 1.8 V ± 0.15 V	8.6		15.0	
			V_{CCB} = 2.5 V ± 0.2 V	6.0		15.0	
			V_{CCB} = 3.3 V ± 0.3 V	5.6		14.4	
t_{PHZ}, t_{PLZ}	$\overline{OE}$	B	V_{CCB}=1.2V		18.8		ns
			V_{CCB} = 1.5 V ± 0.1 V	9.0		18.8	
			V_{CCB} = 1.8 V ± 0.15 V	9.0		15.0	
			V_{CCB} = 2.5 V ± 0.2 V	6.0		14.4	
			V_{CCB} = 3.3 V ± 0.3 V	5.3		14.4	

8.10 Operating Characteristics

T_A=25°C

PARAMETER			TEST CONDITIONS	V_{CCA}	TYP	UNIT
C_{pdA} (1)	A to B	Outputs enabled	C_L=0, f=10 MHz, t_r = t_f = 1 ns	V_{CCA}=V_{CCB}=1.2V	0.6	pf
				V_{CCA}=V_{CCB}=1.5V	0.8	
				V_{CCA}=V_{CCB}=1.8V	1.0	
				V_{CCA}=V_{CCB}=2.5V	1.7	
				V_{CCA}=V_{CCB}=3.3V	2.7	
		Outputs disable	C_L=0, f=10 MHz, t_r = t_f = 1 ns	V_{CCA}=V_{CCB}=1.2V	0.2	pf
				V_{CCA}=V_{CCB}=1.5V	0.3	
				V_{CCA}=V_{CCB}=1.8V	0.4	
				V_{CCA}=V_{CCB}=2.5V	0.8	
				V_{CCA}=V_{CCB}=3.3V	1.5	
	B to A	Outputs enabled	C_L=0, f=10 MHz, t_r = t_f = 1 ns	V_{CCA}=V_{CCB}=1.2V	3.4	pf
				V_{CCA}=V_{CCB}=1.5V	4.7	
				V_{CCA}=V_{CCB}=1.8V	5.8	
				V_{CCA}=V_{CCB}=2.5V	8.5	
				V_{CCA}=V_{CCB}=3.3V	12.3	
		Outputs disable	C_L=0, f=10 MHz, t_r = t_f = 1 ns	V_{CCA}=V_{CCB}=1.2V	0.4	pf
				V_{CCA}=V_{CCB}=1.5V	0.5	
				V_{CCA}=V_{CCB}=1.8V	0.6	
				V_{CCA}=V_{CCB}=2.5V	1.0	
				V_{CCA}=V_{CCB}=3.3V	1.6	
C_{pdB} (1)	A to B	Outputs enabled	C_L=0, f=10 MHz, t_r = t_f = 1 ns	V_{CCA}=V_{CCB}=1.2V	3.4	pf
				V_{CCA}=V_{CCB}=1.5V	4.7	
				V_{CCA}=V_{CCB}=1.8V	5.8	
				V_{CCA}=V_{CCB}=2.5V	8.5	
				V_{CCA}=V_{CCB}=3.3V	12.4	
		Outputs disable	C_L=0, f=10 MHz, t_r = t_f = 1 ns	V_{CCA}=V_{CCB}=1.2V	0.4	pf
				V_{CCA}=V_{CCB}=1.5V	0.5	
				V_{CCA}=V_{CCB}=1.8V	0.6	
				V_{CCA}=V_{CCB}=2.5V	1.0	
				V_{CCA}=V_{CCB}=3.3V	1.6	
	B to A	Outputs enabled	C_L=0, f=10 MHz, t_r = t_f = 1 ns	V_{CCA}=V_{CCB}=1.2V	0.6	pf
				V_{CCA}=V_{CCB}=1.5V	0.8	
				V_{CCA}=V_{CCB}=1.8V	1.0	
				V_{CCA}=V_{CCB}=2.5V	1.7	
				V_{CCA}=V_{CCB}=3.3V	2.7	
		Outputs disable	C_L=0, f=10 MHz, t_r = t_f = 1 ns	V_{CCA}=V_{CCB}=1.2V	0.2	pf
				V_{CCA}=V_{CCB}=1.5V	0.3	
				V_{CCA}=V_{CCB}=1.8V	0.4	
				V_{CCA}=V_{CCB}=2.5V	0.8	
				V_{CCA}=V_{CCB}=3.3V	1.5	

(1) Power dissipation capacitance per transceiver.

8.11 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.

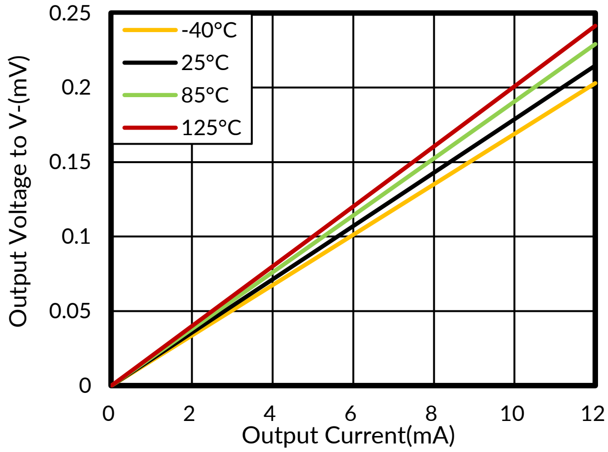


Figure 1. Output Voltage Low vs Output Current, 3V

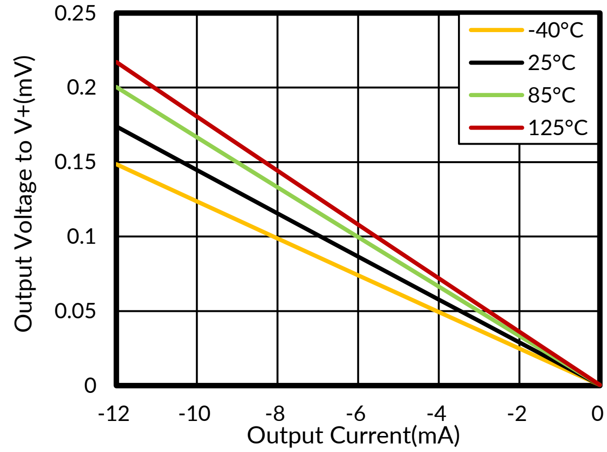
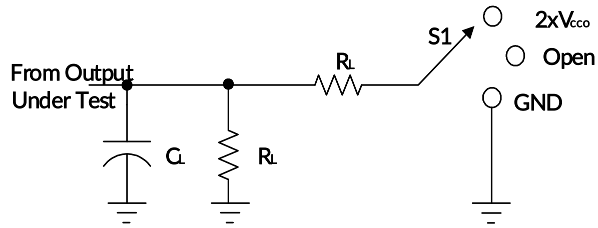


Figure 2. Output Voltage High vs Output Current, 3V

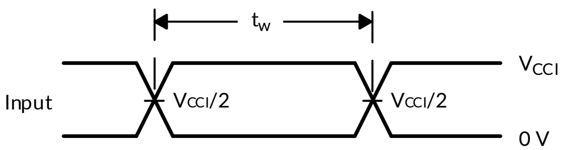
9 PARAMETER MEASUREMENT INFORMATION



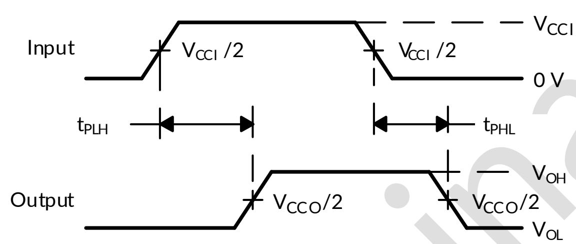
LOAD CIRCUIT

TEST	S1
t_{pd}	Open
t_{PLZ}/t_{PZL}	2 x V_{CCO}
t_{PHZ}/t_{PZH}	GND

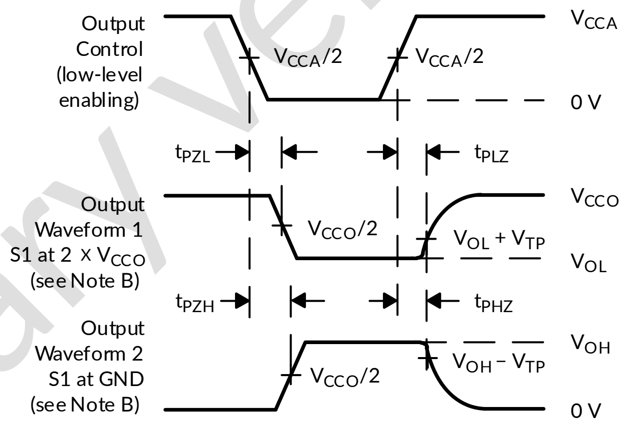
V_{CC}	C_L	R_L	V_{TP}
1.2V	15pF	2kΩ	0.1V
1.5V±0.1V	15pF	2kΩ	0.1V
1.8V±0.15V	15pF	2kΩ	0.15V
2.5V±0.2V	15pF	2kΩ	0.15V
3.3V±0.3V	15pF	2kΩ	0.3V



VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES

NOTES: A. C_L includes probe and jig capacitance.

B. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.

C. All input pulses are supplied by generators having the following characteristics: PRR≤10 MHz, Z_O = 50Ω, dv/dt≥1V/ns.

D. The outputs are measured one at a time, with one transition per measurement.

E. t_{PLZ} and t_{PHZ} are the same as t_{dis}.

F. t_{PZL} and t_{PZH} are the same as t_{en}.

G. t_{PLH} and t_{PHL} are the same as t_{pd}.

H. V_{CCI} is the V_{CC} associated with the input port.

I. V_{CCO} is the V_{CC} associated with the output port.

Figure 3. Load Circuit and Voltage Waveforms

10 DETAILED DESCRIPTION

10.1 Overview

The RS74AVCH4T245-Q1 is a 4-bit, dual-supply noninverting bidirectional voltage level translation device. Ax pins and control pins (1DIR, 2DIR,$1\overline{OE}$, and $2\overline{OE}$) are supported by V_{CCA}, and Bx pins are supported by V_{CCB}. 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 1.2 V to 3.6 V. A high on DIR allows data transmission from Ax to Bx and a low on DIR allows data transmission from Bx to Ax when $\overline{OE}$ is set to low. When $\overline{OE}$ is set to high, both Ax and Bx pins are in the high-impedance state.

10.2 Feature Description

10.2.1 Fully Configurable Dual-Rail Design Allows Each Port to Operate Over the Full 1.2V to 3.6V Power-Supply Range

Both V_{CCA} and V_{CCB} can be supplied at any voltage between 1.2 V and 3.6 V; thus, making the device suitable for translating between any of the low voltage nodes (1.2 V, 1.8 V, 2.5 V, and 3.3 V).

10.2.2 Supports High Speed Translation

The RS74AVCH4T245-Q1 device can support high data rate applications. The translated signal data rate can be up to 380 Mbps when the signal is translated from 1.8 V to 3.3 V.

10.2.3 I_{off} Supports Partial-Power-Down Mode Operation

I_{off} will prevent backflow current by disabling I/O output circuits when device is in partial-power-down mode.

10.2.4 Bus-Hold Circuitry

This device has active bus-hold circuitry that holds unused or undriven inputs at a valid logic state. Use of pull-up or pull-down resistors with the bus-hold circuitry is not recommended. Pullup and pulldown resistors are not recommended on the inputs of devices with bus-hold. Unused inputs can be left floating.

10.2.5 Vcc Isolation Feature

The V_{CC} isolation feature ensures that if either V_{CCA} or V_{CCB} are at GND (or < 0.4V), both ports will be in a high-impedance state (I_{OZ} shown in Electrical Characteristics). This prevents false logic levels from being presented to either bus.

11 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.

11.1 Application Information

RS74AVCH4T245-Q1 device can be used in level-shifting applications for interfacing devices or systems operating at different interface voltages with one another. The RS74AVCH4T245-Q1 device is ideal for use in applications where a push-pull driver is connected to the data I/Os. The max data rate can be up to 380 Mbps when device translates a signal from 1.8 V to 3.3 V.

11.2 Typical Application

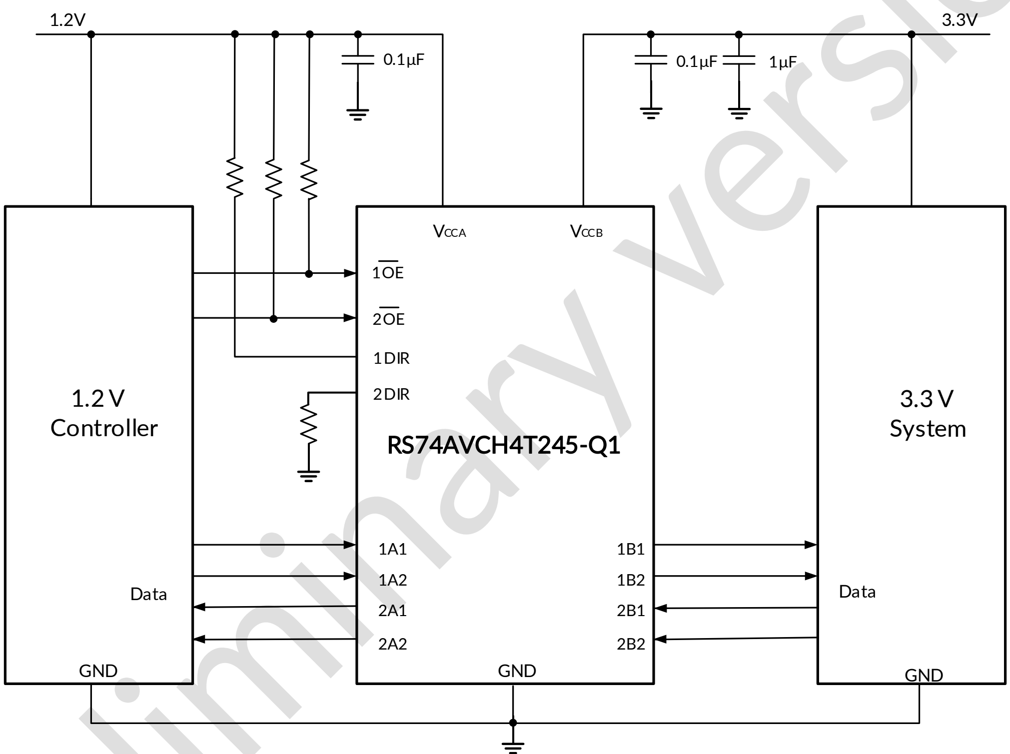


Figure 4. Typical Application Diagram

12 POWER SUPPLY RECOMMENDATIONS

The RS74AVCH4T245-Q1 device uses two separate configurable power-supply rails, V_{CCA} and V_{CCB}. V_{CCA} accepts any supply voltage from 1.2 V to 3.6 V and V_{CCB} accepts any supply voltage from 1.2 V to 3.6 V. The A port and B port are designed to track V_{CCA} and V_{CCB} respectively allowing for low voltage bidirectional translation between any of the 1.2 V, 1.5 V, 1.8 V, 2.5 V, and 3.3 V voltage nodes.

The output-enable ($\overline{OE}$) input circuit is designed so that it is supplied by V_{CCA} and when the $\overline{OE}$ input is high, 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 $\overline{OE}$ input pin must be tied to V_{CCA} through a pull-up resistor and must not be enabled until V_{CCA} and V_{CCB} are fully ramped and stable. The minimum value of the pull-up resistor to V_{CCA} is determined by the current-sinking capability of the driver.

V_{CCA} or V_{CCB} can be powered up first. If the RS74AVCH4T245-Q1 is powered up in a permanently enabled state, pull-up resistors are recommended at the input. This ensures proper/glitch-free power-up.

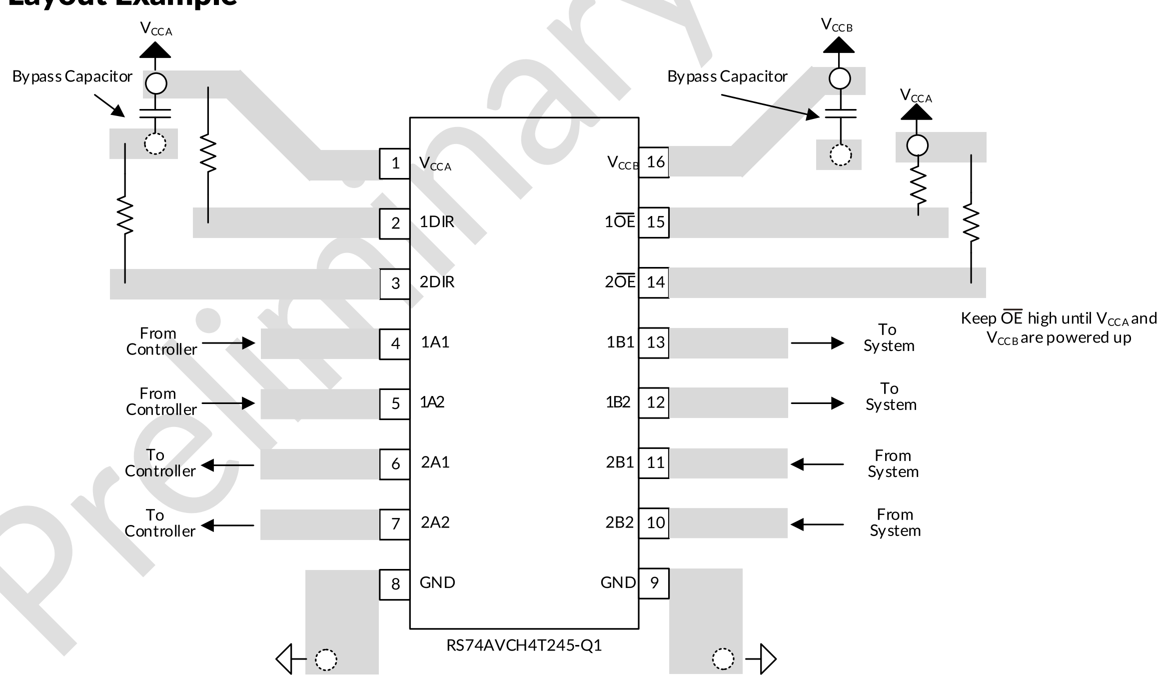
13 LAYOUT

13.1 Layout Guidelines

To ensure reliability of the device, following common printed-circuit board layout guidelines is recommended.

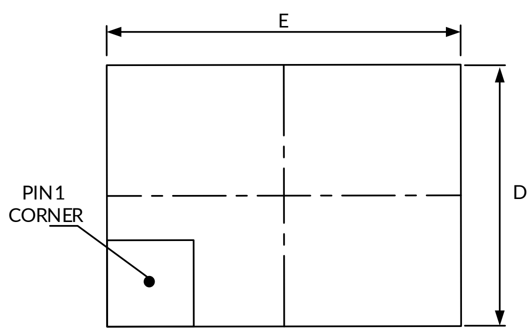
- Bypass capacitors should be used on power supplies.
- Short trace lengths should be used to avoid excessive loading.
- Place pads on the signal paths for loading capacitors or pull-up resistors to help adjust rise and fall times of signals, depending on the system requirements.

13.2 Layout Example

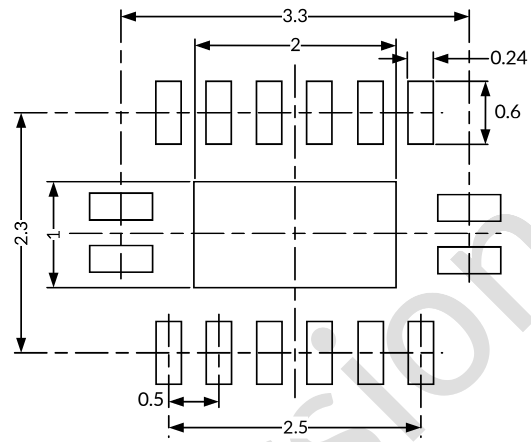


14 PACKAGE OUTLINE DIMENSIONS

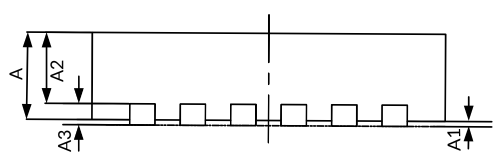
QFN2.5X3.5-16 (4)



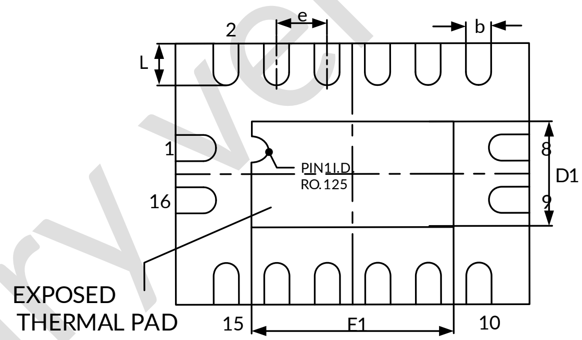
TOP VIEW



RECOMMENDED LAND PATTERN (Unit: mm)



SIDE VIEW



BOTTOM VIEW

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A (1)	0.800	1.000	0.031	0.039
A1	0.000	0.050	0.000	0.002
A2	0.600	0.700	0.024	0.028
A3	0.203(REF) (2)		0.008(REF) (2)	
D (1)	2.400	2.600	0.094	0.102
E (1)	3.400	3.600	0.134	0.142
e	0.500(BSC) (3)		0.020(BSC) (3)	
b	0.180	0.300	0.007	0.012
L	0.300	0.500	0.012	0.020
D1	0.850	1.150	0.033	0.045
E1	1.850	2.150	0.073	0.085

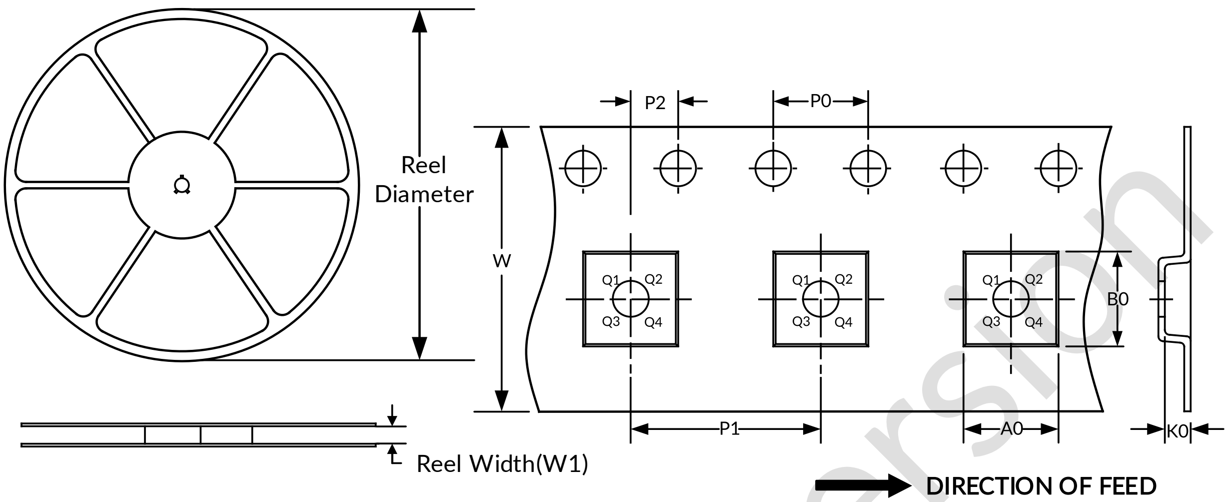
NOTE:

1. Plastic or metal protrusions of 0.075mm maximum per side are not included.
2. REF is the abbreviation for Reference.
3. BSC (Basic Spacing between Centers), "Basic" spacing is nominal.
4. This drawing is subject to change without notice.

15 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
QFN2.5X3.5-16	7"	15.0	2.80	3.80	1.20	4.0	4.0	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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