DESCRIPTION

This AL0204 consists of bidirectional voltage level translations that operate from 1.2V to 3.6V (A port) and 1.65V to 5.5V (B port). This range allows for bidirectional voltage translations between 1.2V and 5.0V without the need for a direction terminal in open-drain or push-pull applications. The 4-bit non-inverting translator is a bidirectional voltage-level translator and can be used to establish digital switching compatibility between mixed-voltage systems. It uses two separate configurable power-supply rails, with the A ports supporting operating voltages from 1.2V to 3.6V while it tracks the V_{CCA} supply, and the B ports supporting operating voltages from 1.65V to 5.5V while it tracks the V_{CCB} supply. This allows the support of both lower and higher logic signal levels while providing bidirectional translation capabilities between any of the 1.2V , 1.5V , 1.8V , 2.5V , 3.3V and 5V voltage nodes. V_{CCA} must not exceed V_{CCB}. When the output-enable (OE) input is low, all outputs are placed in the high-impedance state, which significantly reduces the power-supply quiescent current consumption. OE has an internal pull-down current source, as long as V_{CCA} is powered. To ensure the high-impedance state during power up or power down, 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.

The AL0204 is available in QFN12(1.7x2), QFN14(3.5x3.5) and TSSOP14 packages.

ORDERING INFORMATION

Package Type	Part Number	
QFN12(1.7x2) SPQ: 3,000/Reel	Q12	AL0204Q12R
		AL0204Q12VR
QFN14(3.5x3.5) SPQ: 5000/Reel	Q14	AL0204Q14R
		AL0204Q14VR
TSSOP14 SPQ: 4000/Reel	TMX14	AL0204TMX14R
		AL0204TMX14VR
Note	V: Halogen free Package R: Tape & Reel	
AiT provides all RoHS products		

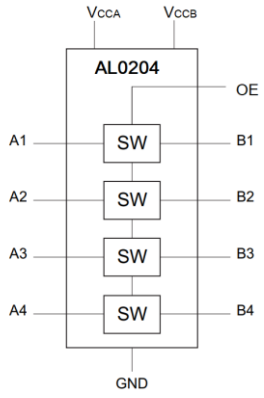
FEATURES

- Provides bidirectional voltage translation with no direction terminal
- Data Rates: 100Mbps
- 1.2V to 3.6V on A ports and 1.65V to 5.5V on B Ports ($V_{CCA} \leq V_{CCB}$)
- V_{CC} Isolation Feature: If Either V_{CC} Input is at GND, Both Ports are in the High-Impedance State
- Output Enable (OE) Input Circuit Referenced to V_{CCA}
- Low Power Consumption,10μA Maximum I_{CC}
- No Power-Supply Sequencing Required: Either V_{CCA} or V_{CCB} can be Ramped First
- I_{OFF}: Supports Partial-Power-Down Mode Operation
- Extended Temperature: -40°C to +85°C

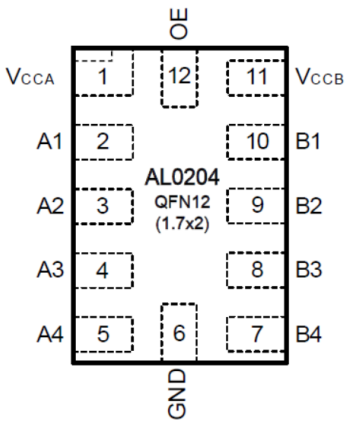
APPLICATION

- GPIO, MDIO, PMBus, SDIO, UART, I²C and other interfaces in Telecom Infrastructure
- Industrial
- Automotive
- Personal Computing
- Handset
- Smartphone
- Tablet

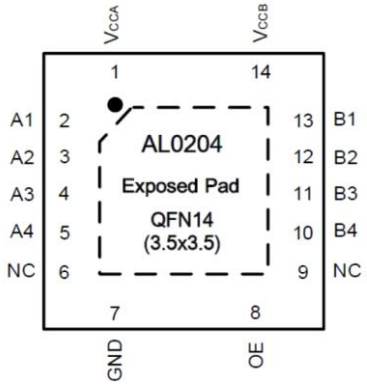
SIMPLIFIED APPLICATION



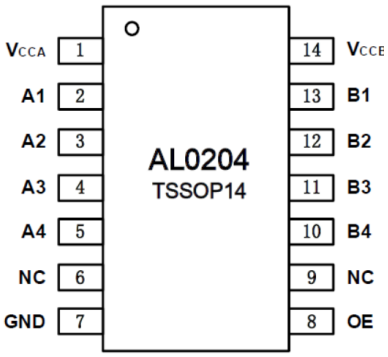
PIN DESCRIPTION



Top View



Top View



Top View

Pin #			Symbol	*Type	Function
QFN12 (1.7x2)	QFN14 (3.5x3.5)	TSSOP14			
1	1	1	V_{CCA}	P	A Port Supply Voltage.1.2V ≤ V_{CCA} ≤ 3.6V and V_{CCA} ≤ V_{CCB}.
2	2	2	A1	I/O	Input/output A1. Reference to V_{CCA}.
3	3	3	A2	I/O	Input/output A2. Reference to V_{CCA}.
4	4	4	A3	I/O	Input/output A3. Reference to V_{CCA}.
5	5	5	A4	I/O	Input/output A4. Reference to V_{CCA}.
6	-	6	NC	–	No internal connection.
7	6	7	GND	–	Ground.
8	12	8	OE	I	Output Enable (Active High). Pull OE low to place all outputs in 3-state mode. Referenced to V_{CCA}.
9	-	9	NC	–	No internal connection.
10	7	10	B4	I/O	Input/output B4. Reference to V_{CCB}.
11	8	11	B3	I/O	Input/output B3. Reference to V_{CCB}.
12	9	12	B2	I/O	Input/output B2. Reference to V_{CCB}.
13	10	13	B1	I/O	Input/output B1. Reference to V_{CCB}.
14	11	14	V_{CCB}	P	B Ports Supply Voltage.1.65V ≤ V_{CCB} ≤ 5.5V.
Exposed Pad	-	-	-	–	Exposed pad should be soldered to PCB board and connected to GND or left floating.

*I=input, O=output, I/O=input and output, P=power

ABSOLUTE MAXIMUM RATINGS

over operating free-air temperature range, unless otherwise noted NOTE1

V_{CCA}, Supply Voltage Range		-0.3V ~ 4.6V
V_{CCB}, Supply Voltage Range		-0.3V ~ 6.5V
V_I, Input Voltage Range NOTE1	A port	-0.3V ~ 4.6V
	B port	-0.3V ~ 6.5V
	OE	-0.3V ~ 4.6V
V_O, Voltage range applied to any output in the high-impedance or power-off state NOTE1	A port	-0.3V ~ 4.6V
	B port	-0.3V ~ 6.5V
V_O, Voltage range applied to any output in the high or low state NOTE1,2	A port	-0.3V ~ V_{CCA}+0.3V
	B port	-0.3V ~ V_{CCB}+0.3V
I_{IK}, Input Clamp Current	V_I<0	-50mA
I_{OK}, Output Clamp Current	V_O<0	-50mA
I_O, Continuous Output Current		±50mA
Continuous current through V_{CCA}, V_{CCB} or GND		±100mA
T_J, Junction Temperature		150℃
T_{STG}, Storage Temperature		-65℃ ~ 150℃
ESD Ratings		
$V_{(ESD)}$, Electrostatic Discharge	Human-body model (HBM)	±5000V
	Machine model (MM)	±300V

Stress beyond above listed “Absolute Maximum Ratings” may lead permanent damage to the device. These are stress ratings only and operations of the device at these or any other conditions beyond those indicated in the operational sections of the specifications are not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

NOTE1: The input and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.

NOTE2: The value of V_{CCA} and V_{CCB} are provided in the recommended operating conditions table.

RECOMMENDED OPERATING CONDITIONS

V_{CCI} is the supply voltage associated with the input port. V_{CCO} is the supply voltage associated with the output port.[NOTE3,4]

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
Supply Voltage[NOTE3]	V_{CCA}			1.65	-	5.5	V
	V_{CCB}			2.3	-	5.5	
High-Level Input Voltage	V_{IH}	V_{CCA} = 1.2 V to 3.6 V V_{CCB} = 1.65 V to 5.5 V	A-port inputs	V_{CCI} x0.65[NOTE5]	-	V_{CCI}	V
		V_{CCA} = 1.2 V to 3.6 V V_{CCB} = 1.65 V to 5.5 V	B-port inputs	V_{CCI} x0.65	-	V_{CCI}	
		V_{CCA} = 1.2 V to 3.6 V V_{CCB} = 1.65 V to 5.5 V	OE input	V_{CCA} x0.65	-	5.5	
Low-Level Input Voltage	V_{IL}	V_{CCA} = 1.2 V to 3.6 V V_{CCB} = 1.65 V to 5.5 V	A-port inputs	0	-	V_{CCI} x0.35[NOTE5]	V
		V_{CCA} = 1.2 V to 3.6 V V_{CCB} = 1.65 V to 5.5 V	B-port inputs	0	-	V_{CCI} x0.35	
		V_{CCA} = 1.2 V to 3.6 V V_{CCB} = 1.65 V to 5.5 V	OE input	0	-	V_{CCA} x0.35	
Voltage applied to any output in the high-impedance or power-off state	Vo	V_{CCA} = 1.2 V to 3.6 V V_{CCB} = 1.65 V to 5.5 V	A-port	0	-	3.6	V
		V_{CCA} = 1.2 V to 3.6 V V_{CCB} = 1.65 V to 5.5 V	B-port	0	-	5.5	
Input Transition Rise or Fall Rate	Δt/Δv	V_{CCA} = 1.2V to 3.6V	V_{CCB} = 1.65V to 3.6V	-	-	40	ns/V
			V_{CCB} = 4.5V to 5.5V	-	-	30	
		V_{CCA} = 1.2 V to 3.6 V V_{CCB} = 1.65 V to 5.5 V	A-port inputs	-	-	40	
Operating Free-air Temperature	T_A			-40	-	85	℃

NOTE3: The A and B sides of an unused data I/O pair must be held in the same state, that is, both at V_{CCI} or both at GND.

NOTE4: V_{CCA} must be less than or equal to V_{CCB} and must not exceed 3.6 V.

NOTE5: V_{CCI} is the supply voltage associated with the input port.

ELECTRICAL CHARACTERISTICS

over recommended operating free-air temperature range, T_A=-40°C to +85°C, unless otherwise noted[NOTE6,7,8]

Parameter		Conditions	V_{CCA}	V_{CCB}	Temp	Min	Typ	Max	Unit
V_{OHA}	Port A Output High Voltage	I_{OH} = –20μA	1.2V		+25°C	-	1.1	-	V
			1.4V - 3.6V		-40°C~ +85°C	V_{CCA} - 0.4	-	-	
V_{OLA}	Port A Output Low Voltage	I_{OL} = 20μA	1.2V		+25°C	-	0.3	-	
			1.4V - 3.6V		-40°C~ +85°C	-	-	0.4	
V_{OHB}	Port B Output High Voltage	I_{OH} = –20μA		1.65V - 5.5V	-40°C~ +85°C	V_{CCB} - 0.4	-	-	
V_{OLB}	Port B Output Low Voltage	I_{OL} = 20μA		1.65V - 5.5V	-40°C~ +85°C	-	-	0.4	
I_I	Input Leakage Current	OE V_I=V_{CCI} or GND	1.2V - 3.6V	1.65V - 5.5V	+25°C	-	-	±1	μA
					-40°C~ +85°C	-	-	±2	
I_{off}	Partial Power Down Current	A Ports V_I or Vo=0 to 3.6V	0V	0V to 5.5V	+25°C	-	-	±1	μA
					-40°C~ +85°C	-	-	±2	
		B Ports V_I or Vo=0 to 5.5V	0V to 3.6V	0V	+25°C	-	-	±1	μA
					-40°C~ +85°C	-	-	±2	
I_{OZ}	High-Impedance State Output Current	A or B port OE=GND	1.2V - 3.6V	1.65V - 5.5V	+25°C	-	-	±1	μA
					-40°C to +85°C	-	-	±2	
I_{CCA}	V_{CCA} Supply Current	V_I=V_{CCI} or GND I_O = 0	1.2V	1.65V - 5.5V	+25°C	-	0.06	-	μA
			1.4V - 3.6V	1.65V - 5.5V	-40°C~ +85°C	-	-	5	
			3.6V	0V	-40°C~ +85°C	-	-	2	
			0V	5.5V	-40°C~ +85°C	-	-	-2	
I_{CCB}	V_{CCB} Supply Current	V_I=V_{CCI} or GND I_O = 0	1.2V	1.65V - 5.5V	+25°C	-	3.4	-	μA
			1.4V - 3.6V	1.65V - 5.5V	-40°C~ +85°C	-	-	5	
			3.6V	0V	-40°C~ +85°C	-	-	-2	
			0V	5.5V	-40°C~ +85°C	-	-	2	
I_{CCA} + I_{CCB}	Combined Supply Current	V_I = V_{CCI} or GND I_O = 0	1.2V	1.65V - 5.5V	+25°C	-	3.5	-	μA
			1.4V - 3.6V	1.65V - 5.5V	-40°C~ +85°C	-	-	10	
I_{CCZA}	V_{CCA} Supply Current	V_I = V_{CCI} or GND I_O = 0, OE=GND	1.2V	1.65V - 5.5V	+25°C	-	0.05	-	μA
			1.4V - 3.6V	1.65V - 5.5V	-40°C~ +85°C	-	-	5	
I_{CCZB}	V_{CCB} Supply Current	V_I = V_{CCI} or GND I_O = 0, OE=GND	1.2V	1.65V - 5.5V	+25°C	-	3.3	-	μA
			1.4V - 3.6V	1.65V - 5.5V	--40°C~ +85°C	-	-	5	
C_I	Input Capacitance	OE	1.2V - 3.6V	1.65V - 5.5V	+25°C	-	4	-	pF
C_{IO}	Input-to-Output Internal Capacitance	A port	1.2V - 3.6V	1.65V - 5.5V	+25°C	-	5	-	pF
		B port	1.2V - 3.6V	1.65V - 5.5V	+25°C	-	9	-	

NOTE6: V_{CCI} is the V_{CC} associated with the input port.

NOTE7: V_{CCO} is the V_{CC} associated with the output port

NOTE8: V_{CCA} must be less than or equal to V_{CCB}.

TIMING REQUIREMENTS

V_{CCA}=1.2V

T_A=25°C, V_{CCA}=1.2V

Parameter		V_{CCB}=1.8V	V_{CCB}=2.5V	V_{CCB}=3.3V	V_{CCB}=5V	Unit
		Typ	Typ	Typ	Typ	
Data rate		20	20	20	20	Mbps
Pulse duration(t_w)	data inputs	50	50	50	50	ns

V_{CCA}=1.5V±0.1 V

T_A=25°C, V_{CCA}=1.5V±0.1V, unless otherwise noted

Parameter		V_{CCB}=1.8V ±0.15V	V_{CCB}=2.5V ±0.2V	V_{CCB}=3.3V ±0.3V	V_{CCB}=5V ±0.5V	Unit
		Typ	Typ	Typ	Typ	
Data rate		40	40	40	40	Mbps
Pulse duration(t_w)	data inputs	25	25	25	25	ns

V_{CCA}=1.8V±0.15 V

T_A=25°C, V_{CCA}=1.8V±0.15V, unless otherwise noted

Parameter		V_{CCB}=1.8V ±0.15V	V_{CCB}=2.5V ±0.2V	V_{CCB}=3.3V ±0.3V	V_{CCB}=5V ±0.5V	Unit
		Typ	Typ	Typ	Typ	
Data rate		50	50	50	50	Mbps
Pulse duration(t_w)	data inputs	25	25	25	25	ns

V_{CCA}=2.5V±0.2 V

T_A=25°C, V_{CCA}=2.5V±0.2V, unless otherwise noted

Parameter		V_{CCB}=2.5V ±0.2V	V_{CCB}=3.3V ±0.3V	V_{CCB}=5V ±0.5V	Unit
		Typ	Typ	Typ	
Data rate		70	80	80	Mbps
Pulse duration(t_w)	data inputs	14	12	12	ns

V_{CCA}=3.3V±0.3 V

T_A=25°C, V_{CCA}=3.3V±0.3V (unless otherwise noted)

Parameter		V_{CCB}=3.3V ±0.3V	V_{CCB}=5V ±0.5V	Unit
		Typ	Typ	
Data rate		80	100	Mbps
Pulse duration(t_w)	data inputs	12	10	ns

SWITCHING CHARACTERISTICS

V_{CCA}=1.2V
T_A=25°C, V_{CCA}=1.2V

Parameter		Conditions	V_{CCB}=1.8V	V_{CCB}=2.5V	V_{CCB}=3.3V	V_{CCB}=5V	UNIT
			Typ	Typ	Typ	Typ	
t_{PHL}	Propagation delay time high-to-low output	A-to-B	27.8	21.9	20.3	26.5	ns
t_{PLH}	Propagation delay time low-to-high output	A-to-B	26	19.1	18.6	22.1	ns
t_{PHL}	Propagation delay time high-to-low output	B-to-A	36.9	37.1	37.5	36.6	ns
t_{PLH}	Propagation delay time low-to-high output	B-to-A	34.5	34.4	32.8	33.2	ns
t_{en}	Enable time	OE-to-A or B	378	387	365	348	ns
t_{dis}	Disable time	OE-to-A or B	19	16	15	16	ns
t_{rA}, t_{fA}	Input rise time	A port rise and fall time	12.3	17.1	16.5	13.1	ns
t_{rB}, t_{fB}	Input rise time	B port rise and fall time	6.6	6.5	7.6	5.1	ns
$t_{sk(O)}$	Skew(time), output	Channel-to-Channel Skew	2.4	1.6	1.9	7.1	ns
Maximum data rate			20	20	20	20	Mbps

V_{CCA}=1.5V ± 0.1V

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

Parameter		Conditions	V_{CCB}=1.8V ±0.15V	V_{CCB}=2.5V ±0.2V	V_{CCB}=3.3V ±0.3V	V_{CCB}=5V ±0.5V	Unit
			Typ	Typ	Typ	Typ	
t_{PHL}	Propagation delay time high-to-low output	A-to-B	15.1	15.7	12.8	11.6	ns
t_{PLH}	Propagation delay time low-to-high output	A-to-B	17.9	15.2	11.5	9.8	ns
t_{PHL}	Propagation delay time high-to-low output	B-to-A	17.4	15.3	15.1	19.6	ns
t_{PLH}	Propagation delay time low-to-high output	B-to-A	14.3	15.3	15.7	21	ns
t_{en}	Enable time	OE-to-A or B	225	218	215	216	ns
t_{dis}	Disable time	OE-to-A or B	18.4	15.7	14.2	13.7	ns
t_{rA}, t_{fA}	Input rise time	A port rise and fall time	6.2	6.1	6.1	6.2	ns
t_{rB}, t_{fB}	Input rise time	B port rise and fall time	6.6	4.4	3.7	3.1	ns
$t_{sk(O)}$	Skew(time), output	Channel-to-Channel Skew	2.5	2.0	1.8	1.4	ns
Maximum data rate			40	40	40	40	Mbps

V_{CCA}=1.8V ± 0.15V

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

Parameter		Conditions	V_{CCB}=1.8V ±0.15V	V_{CCB}=2.5V ±0.2V	V_{CCB}=3.3V ±0.3V	V_{CCB}=5V ±0.5V	Unit
			Typ	Typ	Typ	Typ	
t_{PHL}	Propagation delay time high-to-low output	A-to-B	13.8	9.1	6.9	7	ns
t_{PLH}	Propagation delay time low-to-high output	A-to-B	16.4	9.5	7.7	6.5	ns
t_{PHL}	Propagation delay time high-to-low output	B-to-A	13.3	9.3	8.6	8.1	ns
t_{PLH}	Propagation delay time low-to-high output	B-to-A	10.2	8.3	8.6	8	ns
t_{en}	Enable time	OE-to-A or B	185	178	183	167	ns
t_{dis}	Disable time	OE-to-A or B	18.3	13	12.1	11.2	ns
t_{rA}, t_{fA}	Input rise time	A port rise and fall time	5.8	6.3	6.6	7.7	ns
t_{rB}, t_{fB}	Input rise time	B port rise and fall time	6.2	4.5	3.5	3.4	ns
$t_{sk(O)}$	Skew(time), output	Channel-to-Channel Skew	0.8	0.7	0.7	0.6	ns
Maximum data rate			50	50	50	50	Mbps

V_{CCA}=2.5V ± 0.2V

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

Parameter		Conditions	V_{CCB}=2.5V ±0.2V	V_{CCB}=3.3V ±0.3V	V_{CCB}=5V ±0.5V	Unit
			Typ	Typ	Typ	
t_{PHL}	Propagation delay time high-to-low output	A-to-B	6.9	5.3	4	ns
t_{PLH}	Propagation delay time low-to-high output	A-to-B	8.1	6.2	4.8	ns
t_{PHL}	Propagation delay time high- to-low output	B-to-A	5.5	4.6	4.2	ns
t_{PLH}	Propagation delay time low-to-high output	B-to-A	1.9	4.3	4.2	ns
t_{en}	Enable time	OE-to-A or B	157	147	138	ns
t_{dis}	Disable time	OE-to-A or B	13.1	9.7	8.7	ns
t_{rA}, t_{fA}	Input rise time	A port rise and fall time	3.5	2.9	3	ns
t_{rB}, t_{fB}	Input rise time	B port rise and fall time	4	2.8	2.5	ns
$t_{sk(O)}$	Skew(time), output	Channel-to-Channel Skew	0.4	0.4	0.3	ns
Maximum data rate			70	80	80	Mbps

V_{CCA}=3.3V ± 0.3V

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

Parameter		Conditions	V_{CCB}=3.3V ±0.3V	V_{CCB}=5V±0.5V	Unit
			Typ	Typ	
t_{PHL}	Propagation delay time high-to-low output	A-to-B	4.8	3.6	ns
t_{PLH}	Propagation delay time low-to- high output	A-to-B	4.9	3.8	ns
t_{PHL}	Propagation delay time high-to-low output	B-to-A	3.5	3.2	ns
t_{PLH}	Propagation delay time low-to-high output	B-to-A	3.9	3.1	ns
t_{en}	Enable time	OE-to-A or B	134	128	ns
t_{dis}	Disable time	OE-to-A or B	9.8	7.7	ns
t_{rA}	Input rise time	A port rise time	1.9	1.9	ns
t_{rB}	Input rise time	B port rise time	1.8	2.3	ns
t_{fA}	Input fall time	A port fall time	2.9	2.6	ns
t_{fB}	Input fall time	B port fall time	1.8	1.6	ns
$t_{sk(O)}$	Skew(time), output	Channel-to-Channel Skew	0.4	0.3	ns
Maximum data rate			80	100	Mbps

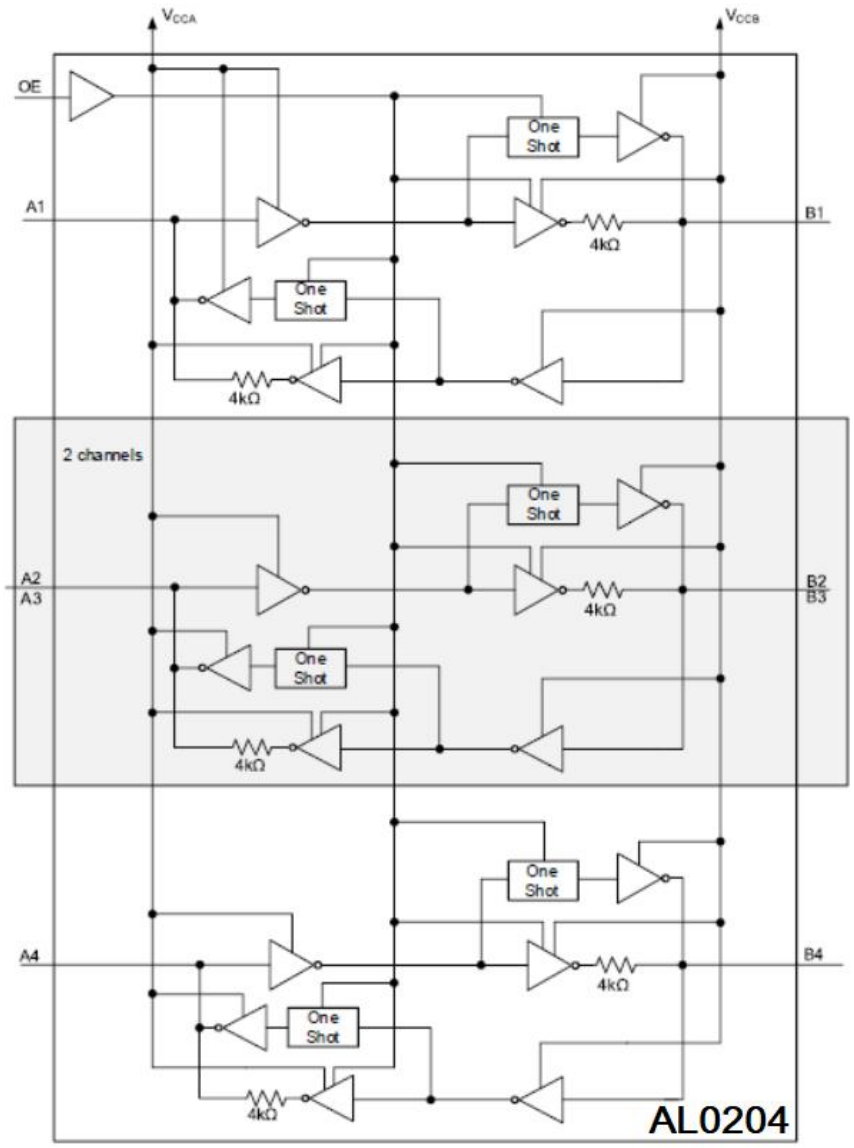
OPERATING CHARACTERISTICS

T_A=25°C

Parameter*	Conditions		V_{CCA}							Unit
			1.2V	1.2V	1.5V	1.8V	2.5V	2.5V	3.3V	
			V_{CCB}							
			5V	1.8V	1.8V	1.8V	2.5V	5V	3.3V to 5V	
			Typ	Typ	Typ	Typ	Typ	Typ	Typ	
C_{pdA}	C_L=0 f=10MHz t_r=t_f=1ns OE=V_{CCA} (outputs enabled)	A-port input B-port output	9	8	7	8	7	8	7	pF
		B-port input A-port output	12	11	12	11	11	11	11	
C_{pdB}		A-port input B-port output	35	26	27	27	27	27	27	
		B-port input A-port output	25	18	19	19	18	19	20	
C_{pdA}	C_L=0 f=10MHz t_r=t_f=1ns OE=GND (outputs enabled)	A-port input B-port output	0.01	0.01	0.01	0.01	0.01	0.01	0.01	pF
		B-port input A-port output	0.01	0.01	0.01	0.01	0.01	0.01	0.01	
C_{pdB}		A-port input B-port output	0.01	0.01	0.01	0.01	0.01	0.01	0.01	
		B-port input A-port output	0.01	0.01	0.01	0.01	0.01	0.01	0.01	

*Power Dissipation Capacitance

BLOCK DIAGRAM



PARAMETER MEASUREMET INFORMATION

Unless otherwise noted, all input pulses are supplied by generators having the following characteristics:

- PRR 10 MHz
- Z_O = 50 Ω
- dv/dt ≥ 1 V/ns

All input pulses are measured one at a time, with one transition per measurement.

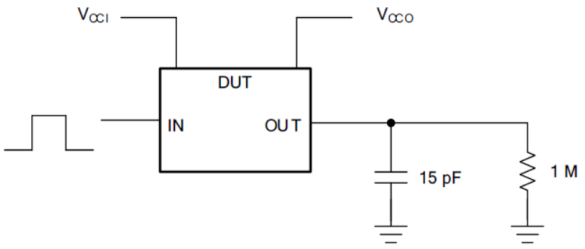


Fig1. Data Rate, Pulse Duration, Propagation Delay, Output Rise & Fall Time Measurement Using A Push-Pull Driver

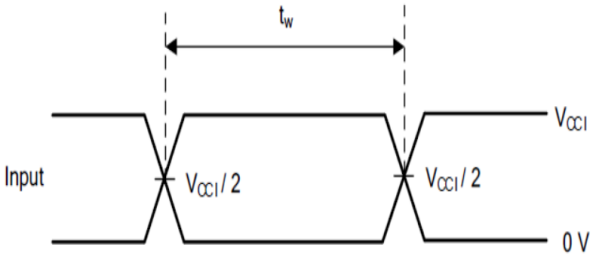


Fig3. Voltage Waveforms Pulse Duration

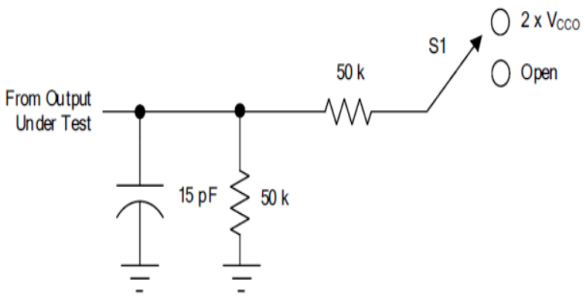


Fig2. Load Circuit for Enable/Disable Time Measurement

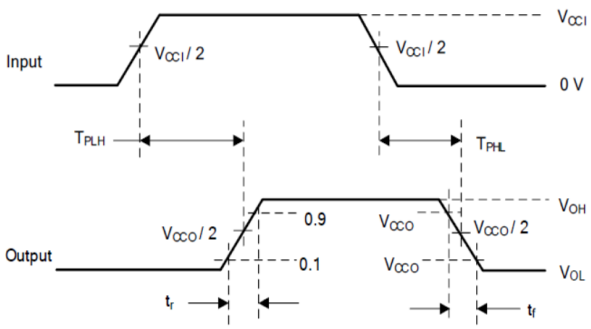


Fig4. Voltage Waveforms Propagation Delay Times

TEST	S1
t_{PZL}[NOTE9], t_{PLZ}[NOTE10]	2 × V_{CCO}
t_{PHZL}[NOTE9], t_{PZH}[NOTE10]	Open

NOTE9: t_{PZL} and t_{PZH} are the same as t_{en}.

NOTE10: t_{PLZ} and t_{PHZ} are the same as t_{dis}

Table 1. Switch Configuration for Enable/Disable Timing

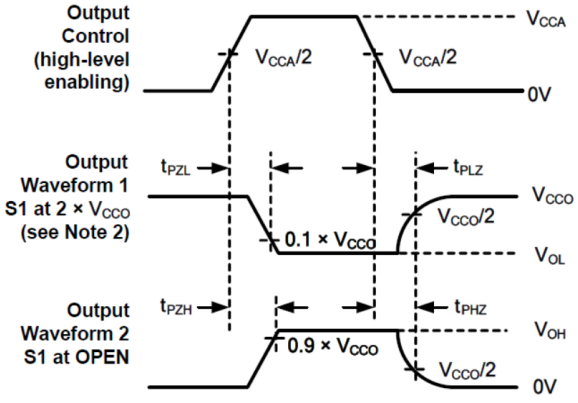


Fig5. Voltage Waveforms Enable and Disable

DETAILED INFORMATION

Overview

The AL0204 device is a 4-bit, directionless 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. If for open-drain signal translation, please refer to AL0204 products.

Architecture

The AL0204 device architecture (see Fig6) 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 device maintain a high or low, but are designed to be weak, so the output drivers can be overdriven by an external driver when data on the bus flows 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 70Ω at V_{CCO} = 1.2V to 1.8V, 50Ω at V_{CCO} = 1.8V to 3.3V, and 40Ω at V_{CCO} = 3.3V to 5V.

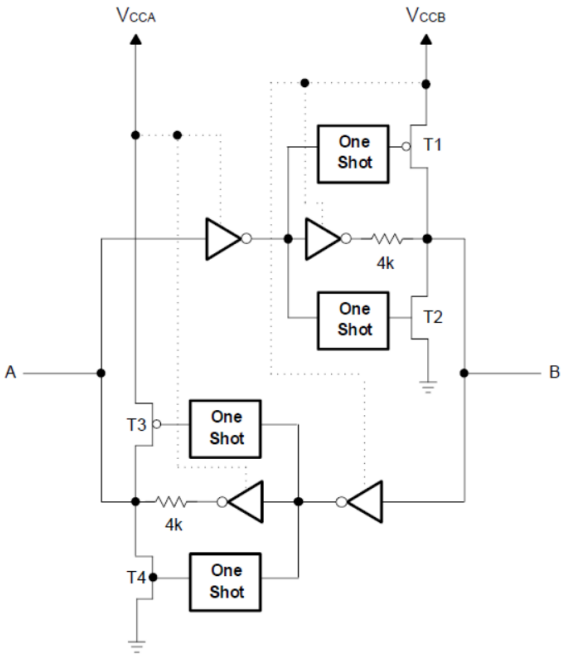
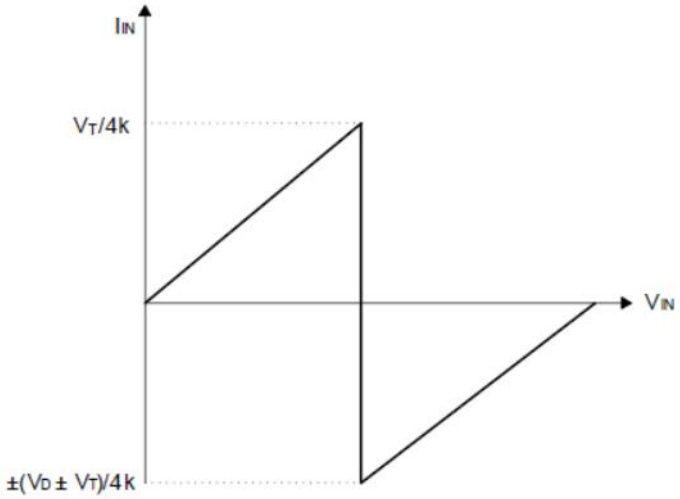


Fig6. Architecture of AL0204 Device I/O Cell

Input Driver Requirements

Typical I_{IN} vs V_{IN} characteristics of the device are shown in Fig7. For proper operation, the device driving the data I/Os of the AL0204 device must have driven strength of at least ±2mA.



V_T is the input threshold of the AL0204 device, (typically V_{CC} / 2).
V_D is the supply voltage of the external driver.

Fig7. Typical I_{IN} vs V_{IN} Curve

Output Load Considerations

We recommend careful PCB layout practices with short PCB trace lengths to avoid excessive capacitive loading and to ensure that proper O.S. triggering takes place. PCB signal trace-lengths must be kept short enough such that the round-trip delay of any reflection is less than the one-shot duration. This improves signal integrity by ensuring that any reflection sees a low impedance at the driver. The O.S. circuits have been designed to stay on for approximately 10 ns. The maximum capacitance of the lumped load that can be driven also depends directly on the one-shot duration. With very heavy capacitive loads, the one-shot can time-out before the signal is driven fully to the positive rail. The O.S. duration has been set to best optimize trade-offs between dynamic ICC, load driving capability, and maximum bit-rate considerations. Both PCB trace length and connectors add to the capacitance that the device output sees, so it is recommended that this lumped-load capacitance be considered to avoid O.S. retriggering, bus contention, output signal oscillations, or other adverse system-level affects.

TYPICAL APPLICATION

The AL0204 device 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.

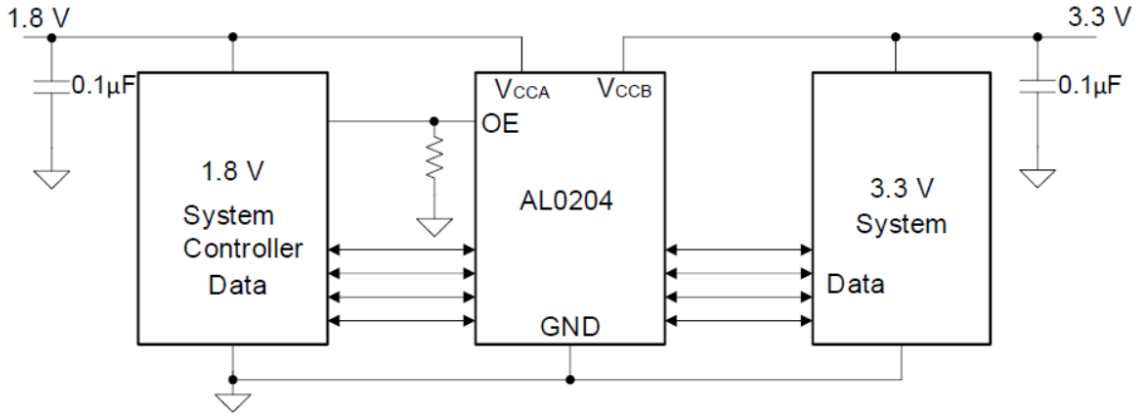


Fig8. Typical Application Circuit

Enable and Disable

The AL0204 device has an OE input that is used to disable the device by setting OE = low, which places all I/Os in the high-impedance (Hi-Z) state. The disable time (t_{dis}) indicates the delay between when OE goes low and when the outputs actually get disabled (Hi-Z). The enable time (t_{en}) indicates the amount of time the user must allow for the one-shot circuitry to become operational after OE is taken high.

Pullup or Pulldown Resistors on I/O Lines

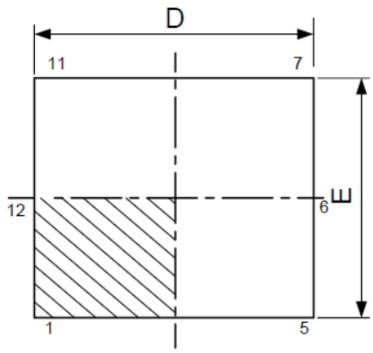
The AL0204 is designed to drive capacitive loads of up to 70pF. The output drivers of the AL0204 device have low dc drive strength. If pullup or pulldown resistors are connected externally to the data I/Os, their values must be kept higher than 50kΩ to ensure that they do not contend with the output drivers of the AL0204 device. For the same reason, the AL0204 device must not be used in applications such as I2C or 1-Wire where an open-drain driver is connected on the bidirectional data I/O. For these applications, use a device from the AL0204 series of level translators.

Device Functional Modes

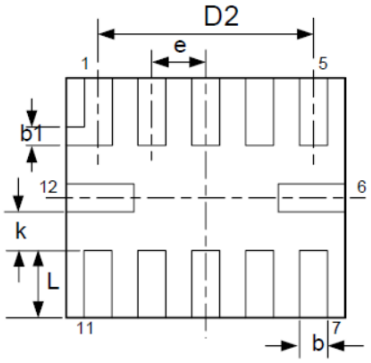
The AL0204 device has two functional modes, enabled and disabled. To disable the device, set the OE input to low, which places all I/Os in a high impedance state. Setting the OE input to high will enable the device.

PACKAGE INFORMATION

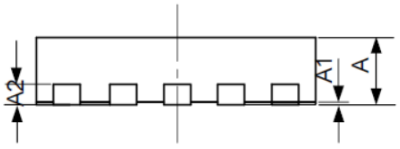
Dimension in QFN12(1.7x2) (Unit: mm)



TOP VIEW



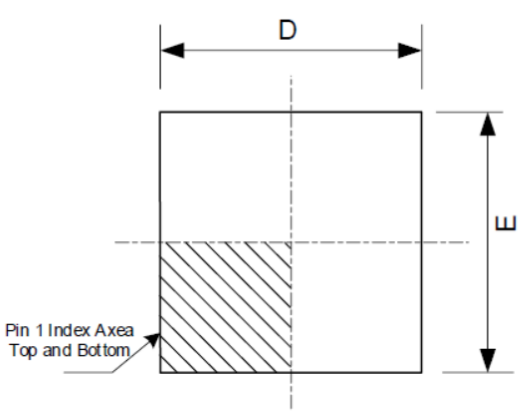
BOTTOM VIEW



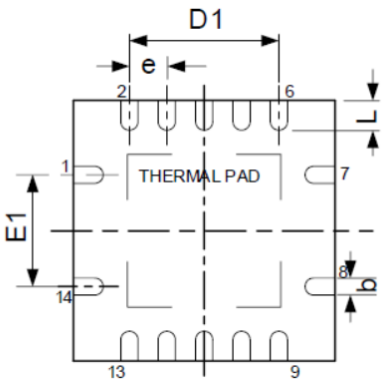
SIDE VIEW

Symbol	Millimeters	
	Min	Max
A	0.450	0.550
A1	0.000	0.050
A2	0.152 REF	
D	1.900	2.100
E	1.600	1.800
D2	1.500	1.700
b	0.150	0.250
b1	0.150 REF	
k	0.250 REF	
e	0.400 BSC	
L	0.450	0.550

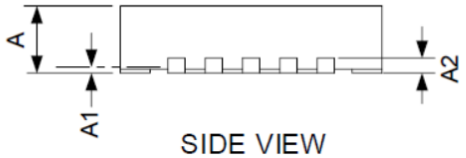
Dimension in QFN14(3.5x3.5)(Unit: mm)



TOP VIEW



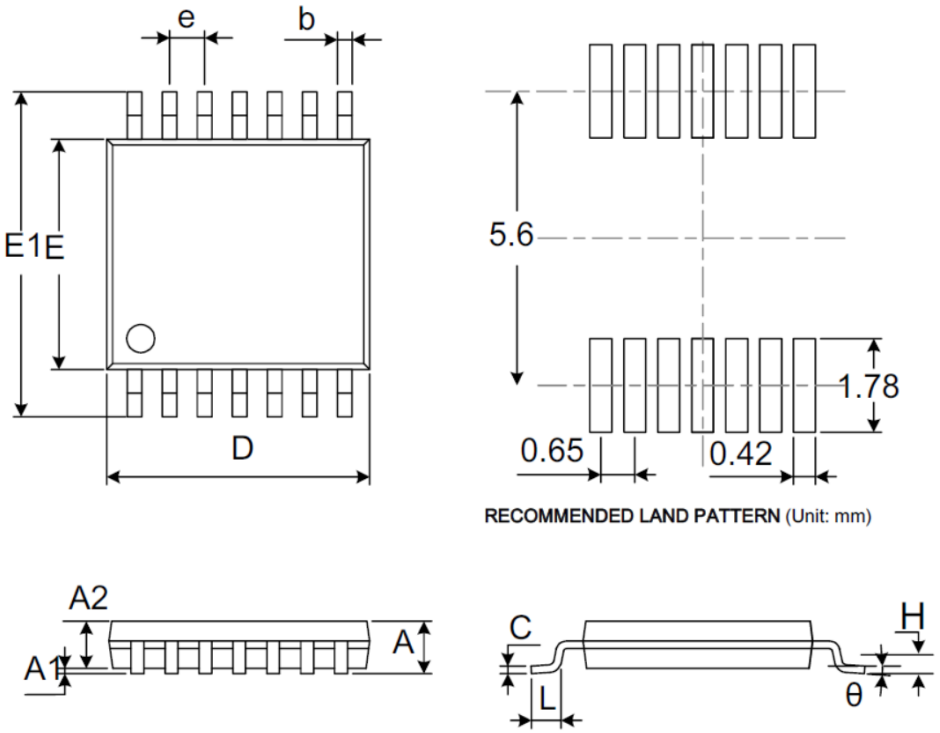
BOTTOM VIEW



SIDE VIEW

Symbol	Millimeters	
	Min	Max
A	0.800	1.000
A1	0.000	0.050
A2	0.200 REF	
b	0.180	0.300
D	3.350	3.650
D1	2.000 TYP	
E	3.350	3.650
E1	1.500 TYP	
e	0.500 TYP	
L	0.300	0.500

Dimension in TSSOP14 (Unit: mm)



Symbol	Millimeters	
	Min	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	6.250	6.550
e	0.650 BSC	
L	0.500	0.700
H	0.25 TYP	
θ	1°	7°

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