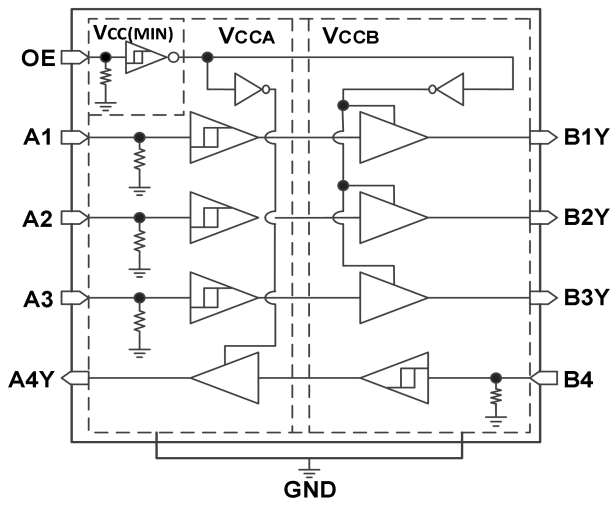


GTXU0304

4-Bit Fixed Direction Voltage-Level Translator

1 Features	2 Application
<ul style="list-style-type: none"> - Up to 200 Mbps support for 3.3 V to 5.0 V - Schmitt-trigger inputs allows for noisy inputs - High drive strength (up to 12 mA at 5 V) - Low power consumption - I_{off} supports partial-power-down mode operation - Operating temperature from -40°C to +125°C - Configurable dual-rail design allows each port to operate from 1.65 V to 5.5 V - Inputs with integrated static pull-down resistors - V_{CC} isolation and V_{CC} disconnect (I_{off}-float) feature - Control logic (OE) with V_{CC(MIN)} circuitry 	<ul style="list-style-type: none"> - Eliminate slow or noisy input signals - Driving indicator LEDs or buzzers - General purpose I/O level shifting - Push-pull level shifting - Debouncing a mechanical switch

3 Description	Circuit Diagram
<p>GTXU0304 is a 4-bit, dual-supply noninverting fixed direction voltage level translation device. Ax pins are referenced to V_{CCA} logic level, OE pin can be referenced to either V_{CCA} or V_{CCB} logic levels, and Bx pins are referenced to V_{CCB} logic levels. The A port is able to accept input voltages ranging from 1.65 V to 5.5 V, while the B port can also accept input voltages from 1.65 V to 5.5 V. Fixed direction data transmission can occur from A to B or B to A when OE is set to high in reference to either supply. When OE is set to low, all output pins are in the high-impedance state.</p>	 <p style="text-align: center;">Functional Block Diagram</p> <p>The diagram shows a 4-bit translator with an OE pin, four input pins (A1-A4) and four output pins (B1Y-B4Y). It features three supply rails: V_{CC(MIN)}, V_{CCA}, and V_{CCB}, all connected to GND. Each input pin has a pull-down resistor to GND. The internal circuitry consists of four bidirectional buffers, each with a Schmitt-trigger input and a push-pull output stage. The OE pin controls the direction of data flow through the buffers.</p>

4 Revision History

Revision	Date	Note
Rev. A1. 0	2023. 09. 02	Original Version
Rev. A1. 1	2023. 12. 15	1.Updated Package Qty 2.Added Tape and Reel Information 3.Added Application Note
Rev. A1. 2	2023. 12. 26	1.Added Marking 2.Added MSL
Rev. A1. 3	2024. 04. 20	Updated Part Name

The latest datasheet version should be checked on the GTIC official website, as the company does not actively inform customers about updates to the datasheet.

5 Device Summary, Pin and Packages

Table 5-1. Device Summary⁽¹⁾

Serial Name	Part Name	Package	Body Size (Nom)	Marking ⁽²⁾⁽⁴⁾	MSL ⁽³⁾	Package Qty
GTXU0304	GTXU0304TD	TSSOP14	5.00mm×4.40mm×1.20mm	GTXU0304 XXXXXXX	3	Tape and Reel,4000

(1) For all available packages, please contact product sales.

(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) MSL, The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications.

(4) "XXXXX" in Marking will be appeared as the batch code.

5 Device Summary, Pin and Packages(Continued)

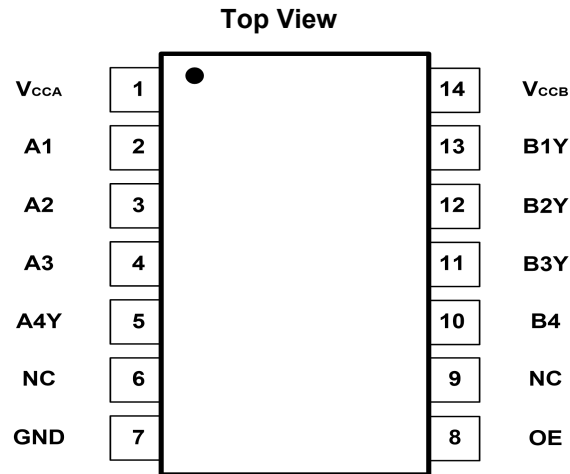


Fig.5-1. GTXU0304: TD (TSSOP14) Package

Table 5-1 TD Pin Definition

PIN		I/O	Description
Name	TD		
A1	2	I	Input A1. Referenced to V_{CCA}
A2	3	I	Input A2. Referenced to V_{CCA} .
A3	4	I	Input A3. Referenced to V_{CCA} .
A4Y	5	O	Output A4. Referenced to V_{CCA} .
B1Y	13	O	Output B1. Referenced to V_{CCB} .
B2Y	12	O	Output B2. Referenced to V_{CCB} .
B3Y	11	O	Output B3. Referenced to V_{CCB} .
B4	10	I	Input B4. Referenced to V_{CCB} .
GND	7	-	Ground
NC	6,9	-	No internal connection.
OE	8	I	Output Enable. Pull to GND to place all outputs in high-impedance mode. Pull to V_{CCA} or V_{CCB} to enable all outputs.
V_{CCA}	1	-	A-port supply voltage. $1.65\text{ V} \leq V_{CCA} \leq 5.5\text{ V}$
V_{CCB}	14	-	B-port supply voltage. $1.65\text{ V} \leq V_{CCB} \leq 5.5\text{ V}$

* It is suggested to leave the unconnected pins floating.

6 Voltage, Temperature, ESD and Thermal Ratings

6.1 Absolute Maximum Ratings⁽¹⁾

Parameters		Min.	Max.	Unit
V _{CC}	Supply voltage range	-0.5	6.5	V
V _I	Input voltage range ⁽²⁾	-0.5	6.5	V
V _O	Voltage range applied to any output in the high-impedance or power-off state ⁽²⁾	-0.5	6.5	V
V _O	Voltage range applied to any output in the high or low State ⁽²⁾⁽³⁾	-0.5	V _{CC} +0.5	V
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 _{CC} or GND		±100	mA
T _J	Junction temperature	-55	150	°C
T _{stg}	Storage temperature	-55	150	°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 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 6.5 V maximum if the output current rating is observed.

6.2 ESD Ratings

ESD		Value	Unit
V(ESD)	Electrostatic discharge	Human-Body Model (HBM) ⁽¹⁾	8 K
		Charged-Device Model (CDM) ⁽²⁾	2 K

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

6 Voltage, Temperature, ESD and Thermal Ratings(Continued)

6.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted) ⁽¹⁾ ⁽²⁾ ⁽³⁾

		MIN	MAX	UNIT	
V _{CCA}	Supply voltage A		1.65	5.5	V
V _{CCB}	Supply voltage B		1.65	5.5	V
I _{OH}	High-level output current	V _{CCO} =1.65 V		-4.5	mA
		V _{CCO} =2.3 V		-8	
		V _{CCO} =3 V		-10	
		V _{CCO} =4.5 V		-12	
I _{OL}	Low-level output current	V _{CCO} =1.65 V		4.5	
		V _{CCO} =2.3 V		8	
		V _{CCO} =3 V		10	
		V _{CCO} =4.5 V		12	
V _I	Input voltage ⁽³⁾		0	5.5	V
V _O	Output voltage	Active State	0	V _{CCO}	V
		Tri-State	0	5.5	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 control inputs and data I/Os of this device have weak pulldowns to ensure the line is not floating when undefined external to the device. The input leakage from these weak pulldowns is defined by the I_I specification indicated under Electrical Characteristics.

7 Electrical Specifications

7.1 Electrical Characteristics

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

Parameter		Test Conditions	V _{CCA}	V _{CCB}	Operating Free-air Temperature (TA)			Unit
					-40°C to 125°C			
					Min	Typ	Max	
VT+	Positive Going Input Threshold Voltage	Data Inputs (Ax, Bx) (Referenced to V _{CCI})	1.65V	1.65V	0.88		1.19	V
			2.3V	2.3V	1.13		1.36	
			3V	3V	1.39		1.68	
			4.5V	4.5V	1.98		2.48	
			5.5V	5.5V	2.42		3.01	
		OE (Referenced to V _{CCA} or V _{CCB})	1.65V	1.65V	1		1.29	V
			2.3V	2.3V	1.26		1.69	
			3V	3V	1.52		2.03	
			4.5V	4.5V	2.16		2.78	
			5.5V	5.5V	2.63		3.33	
VT-	Negative Going Input Threshold Voltage	Data Inputs (Ax, Bx) (Referenced to V _{CCI})	1.65V	1.65V	0.41		0.57	V
			2.3V	2.3V	0.59		0.83	
			3V	3V	0.88		1.1	
			4.5V	4.5V	1.4		1.73	
			5.5V	5.5V	1.74		2.15	
		OE (Referenced to V _{CCA} or V _{CCB})	1.65V	1.65V	0.44		0.63	V
			2.3V	2.3V	0.68		0.96	
			3V	3V	1.02		1.29	
			4.5V	4.5V	1.53		1.95	
			5.5V	5.5V	1.82		2.37	
ΔVT	Input Threshold Hysteresis (VT+ – VT-)	Data Inputs (Ax, Bx) (Referenced to V _{CCI})	1.65V	1.65V	0.39		0.78	V
			2.3V	2.3V	0.43		0.75	
			3V	3V	0.45		0.66	
			4.5V	4.5V	0.53		0.79	
			5.5V	5.5V	0.62		0.93	
		OE (Referenced to V _{CCA} or V _{CCB})	1.65V	1.65V	0.44		0.85	V
			2.3V	2.3V	0.43		0.95	
			3V	3V	0.47		0.88	
			4.5V	4.5V	0.63		0.96	
			5.5V	5.5V	0.81		1.06	

7 Electrical Specifications(Continued)

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

Parameter		Test Conditions	V _{CCA}	V _{CCB}	Operating Free-air Temperature (TA)			Unit
					-40°C to 125°C			
					Min		Max	
V _{OH}	High-Level Output Voltage	I _{OH} =-0.1mA	1.65V-5.5V	1.65V-5.5V	V _{CCO} -0.1			V
		I _{OH} =-4.5mA	1.65V	1.65V	1.41			
		I _{OH} =-8.0mA	2.3V	2.3V	2.15			
		I _{OH} =-10mA	3V	3V	2.85			
		I _{OH} =-12mA	4.5V	4.5V	4.35			
V _{OL}	Low-Level Output Voltage	I _{OL} =0.1mA	1.65V-5.5V	1.65V-5.5V			0.1	V
		I _{OL} =4.5mA	1.65V	1.65V			0.138	
		I _{OL} =8.0mA	2.3V	2.3V			0.182	
		I _{OL} =10mA	3V	3V			0.199	
		I _{OL} =8.0mA	4.5V	4.5V			0.143	
		I _{OL} =12mA	4.5V	4.5V			0.177	
I _I	Input Leakage Current	OE V _I =V _{CC} or GND	1.65V-5.5V	1.65V-5.5V	-0.1		2	μA
		Data Inputs(Ax,Bx) V _I =V _{CCi} or GND	1.65V-5.5V	1.65V-5.5V	-0.1		2	
I _{off}	Partial Power Down Current	A Port or B Port V _I or V _O =0 V - 5.5 V	0V	0V-5.5V	-2.5		2.5	μA
			0V-5.5V	0V	-2.5		2.5	
I _{off-float}	Floating Supply Partial Power Down Current	A Port or B Port V _I or V _O =GND	Floating	0V-5.5V	-2.5		2.5	μA
			0V-5.5V	Floating	-2.5		2.5	
I _{oz}	Tri-State Output Current	A or B Port: V _I =V _{CCi} or GND V _O =V _{CCO} or GND OE=GND	1.65V-5.5V	1.65V-5.5V	-2.5		2.5	μA
I _{CCA}	V _{CCA} Supply Current	V _I =V _{CCi} or GND I _O =0	1.65V-5.5V	1.65V-5.5V			6	μA
			0V	5.5V	-1			
			5.5V	0V			3	
I _{CCB}	V _{CCB} Supply Current	V _I =V _{CCi} or GND I _O =0	1.65V-5.5V	1.65V-5.5V			6	μA
			0V	5.5V			3	
			5.5V	0V	-1			
		V _I =GND I _O =0	5.5V	Floating			15	
I _{CCA} + I _{CCB}	Combined Supply Current	V _I =V _{CCi} or GND I _O =0	1.65V-5.5V	1.65V-5.5V			6	μA
C _I	Control Input Capacitance	V _I =3.3 V or GND	3.3V	3.3V		10.2		PF

7 Electrical Specifications(Continued)

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

Parameter		Test Conditions	V _{CCA}	V _{CCB}	Operating Free-air Temperature (TA)		Unit
					25°C		
					TYP		
C _{io}	Data I/O Capacitance	OE=GND, VO=1.65V DC +1 MHz -16 dBm sine wave	3.3V	3.3V	3.84		PF

7.2 Switching Characteristics: T_{sk}, T_{max}

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

Parameter	Test Conditions	V _{CCI}	V _{CCO}	Operating Free-air Temperature (TA)			Unit
				-40°C to 125°C			
				Min	TYP	Max	
T _{MAX} - Maximum Data Rate	50% Duty Cycle Input One Channel Switching 20% of Pulse > 0.7*V _{CCO} 20% of Pulse < 0.3*V _{CCO}	Up Translation	3.0V-3.6V	4.5V-5.5V	200		Mbps
			1.65V-1.95V	4.5V-5.5V	150		
			1.65V-1.95V	3.0V-3.6V	100		
		Down Translation	4.5V-5.5V	3.0V-3.6V	125		
			4.5V-5.5V	1.65V-1.95V	50		
			3.0V-3.6V	1.65V-1.95V	50		
T _{sk} - Output Skew	Timing Skew Between Any Switching Outputs on The Rising or Falling Edge	Up Translation	3.0V-3.6V	4.5V-5.5V			3
			1.65V-1.95V	4.5V-5.5V			10
			1.65V-1.95V	3.0V-3.6V			8
		Down Translation	4.5V-5.5V	3.0V-3.6V			3
			4.5V-5.5V	1.65V-1.95V			10
			3.0V-3.6V	1.65V-1.95V			8

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

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

Parameter		From	To	Test Conditions	B-Port Supply Voltage (V _{CCB})				Unit
					1.8V±0.15V		5V±0.5V		
					Min	Max	Min	Max	
t _{pd}	Propagation Delay Time	A	B	-40°C to 125°C	13.3	22.3	7.6	10.3	ns
t _{dis}	Disable Time	OE	B	-40°C to 125°C	16.7	36.3	11.7	22.2	ns
t _{en}	Enable Time	OE	B	-40°C to 125°C	15.8	41.7	11.5	23.5	ns

7.4 Switching Characteristics, V_{CCA}=5V±0.5V

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

Parameter		From	To	Test Conditions	B-Port Supply Voltage (V _{CCB})				Unit
					1.8V±0.15V		5V±0.5V		
					Min	Max	Min	Max	
t _{pd}	Propagation Delay Time	A	B	-40°C to 125°C	7	13.7	2.1	2.8	ns
t _{dis}	Disable Time	OE	B	-40°C to 125°C	10.8	36.6	4.5	7.3	ns
t _{en}	Enable Time	OE	B	-40°C to 125°C	10	42	2.5	3.3	ns

7.5 Operating Characteristics

Parameter		Test Conditions(25°C)	Supply Voltage (V _{CCB} =V _{CCA})				Unit
			1.8±0.15V	2.5±0.2V	3.3±0.3V	5V±0.5V	
			Typ	Typ	Typ	Typ	
C _{pdA}	A to B: Outputs Enabled	A Port CL=0, RL=Open f=10 MHz t _{rise} =t _{fall} =5 ns	0.5	0.9	1.5	3.6	PF
C _{pdB}	A to B: Outputs Enabled	B Port CL=0, RL=Open f=10 MHz t _{rise} =t _{fall} =5 ns	3.9	5.7	8.5	15.8	PF

8 Typical Characteristics

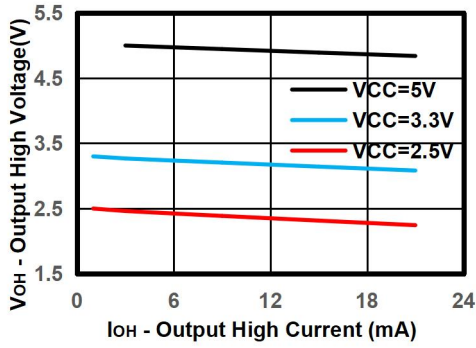


Fig.8-1. Typical ($T_A=25^\circ C$) Output High Voltage (V_{OH}) vs Source Current (I_{OH})

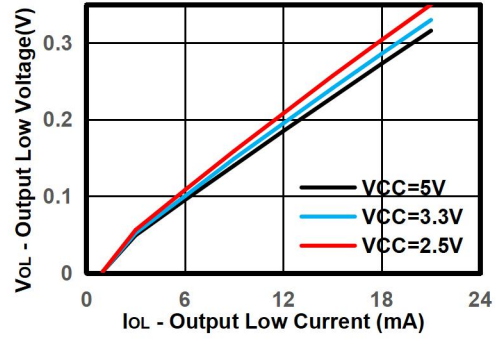


Fig.8-2. Typical ($T_A=25^\circ C$) Output Low Voltage (V_{OL}) vs Sink Current (I_{OL})

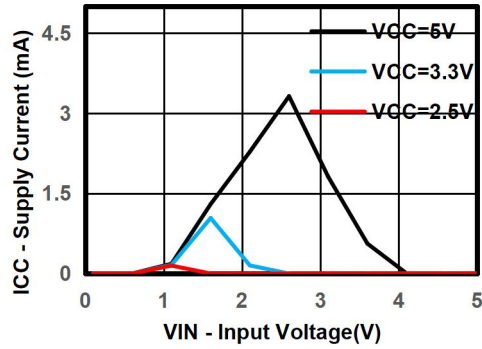
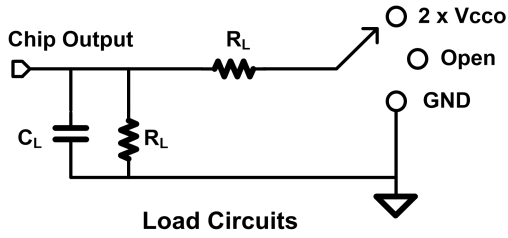
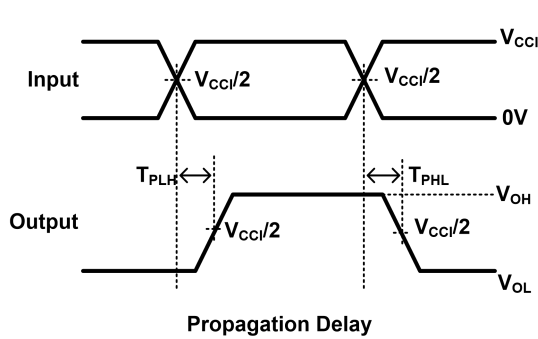


Fig.8-3. Typical ($T_A=25^\circ C$) Supply Current (I_{CC}) vs Input Voltage (V_{IN})

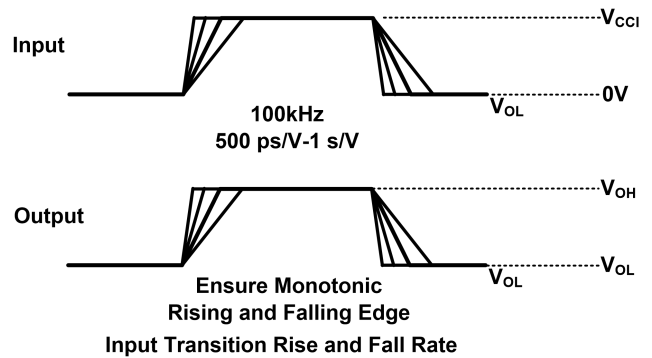
9 Measurement Information



Parameter	V _{CCO}	R _L	C _L	S ₁	V _{TP}
T _{pd} Propagation delay time	1.65V-5.5V	10 kΩ	5 pF	Open	N/A
T _{en} , T _{dis} Enable time, disable time	1.65V-2.7V	10 kΩ	5 pF	2 x V _{CCO}	0.15V
	3.0V-5.5V	10 kΩ	5 pF	2 x V _{CCO}	0.3V
T _{en} , T _{dis} Enable time, disable time	1.65V-2.7V	10 kΩ	5 pF	GND	0.15V
	3.0V-5.5V	10 kΩ	5 pF	GND	0.3V

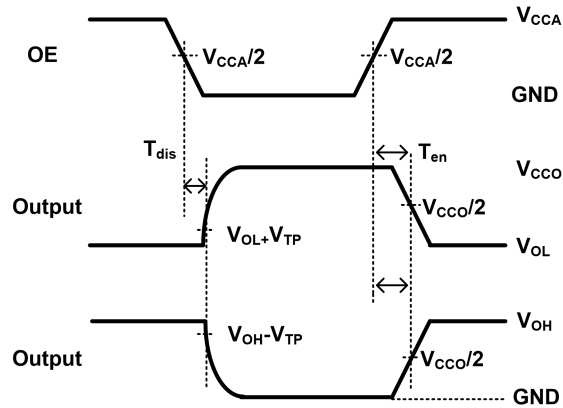


1. V_{CC1} is the supply pin associated with the input port.
2. V_{OH} and V_{OL} are typical output voltage levels that occur with specified R_L, C_L, and S₁.



1. V_{CC1} is the supply pin associated with the input port.
2. V_{OH} and V_{OL} are typical output voltage levels that occur with specified R_L, C_L, and S₁.

9 Parameter Measurement Information(Continued)



**Enable and Disable Times
Low-And High-Level Enabling**

1. Output waveform on the condition that input is driven to a valid Logic Low.
2. Output waveform on the condition that input is driven to a valid Logic High.
3. V_{CCO} is the supply pin associated with the output port.
4. V_{OH} and V_{OL} are typical output voltage levels with specified R_L , C_L , and S_1 .

10 Detailed Description

The GTXU0304 is a 4-bit translating transceiver that uses two individually configurable power-supply rails. The device is operational with V_{CCA} and V_{CCB} supplies as low as 1.65 V and as high as 5.5 V. Additionally, the device can be operated with $V_{CCA}=V_{CCB}$. The A port is designed to track V_{CCA} , and the B port is designed to track V_{CCB} .

The GTXU0304 device is designed for asynchronous communication between data buses, and transmits data with fixed direction from the A bus to the B bus on some channels and from the B bus to the A bus on the remaining channels. The output-enable input (OE) is used to disable the outputs so the buses are effectively isolated. The output-enable pin of the GTXU0304 (OE) can be referenced to either V_{CCA} or V_{CCB} . The OE pin can be left floating or externally pulled down to ground to ensure the high-impedance state of the level shifter outputs during power up or power down.

This device is fully specified for partial-power-down applications using the I_{off} current. The I_{off} protection circuitry ensures that no excessive current is drawn from or sourced into an input or output while the device is powered down.

Table. 10-1. Function table

Control Input OE	Port Status		Operation
	Input	Output	
H	L	L	Unidirectional non-inverting voltage translation
H	H	H	Unidirectional non-inverting voltage translation
L	X	Hi-z	Isolation

11 Application Note

The GTXU0304 device can be used in level-translation applications for interfacing devices or systems operating at different interface voltages with one another. The GTXU0304 device is ideal for use in applications where a push-pull driver is connected to the data Inputs. The maximum data rate can be up to 200 Mbps when the device translates a signal from 3.3 V to 5.0 V.

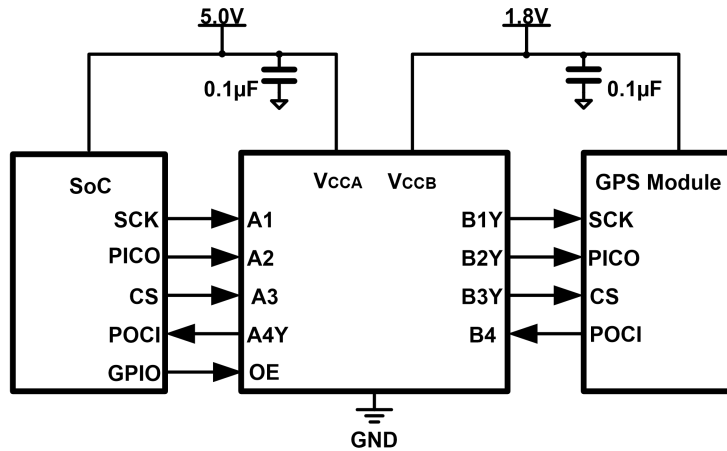
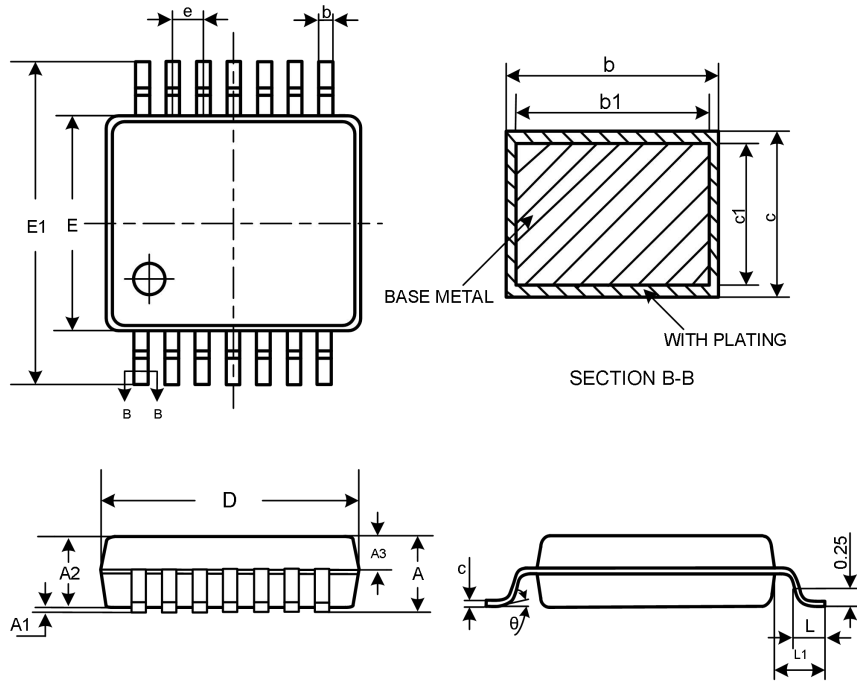


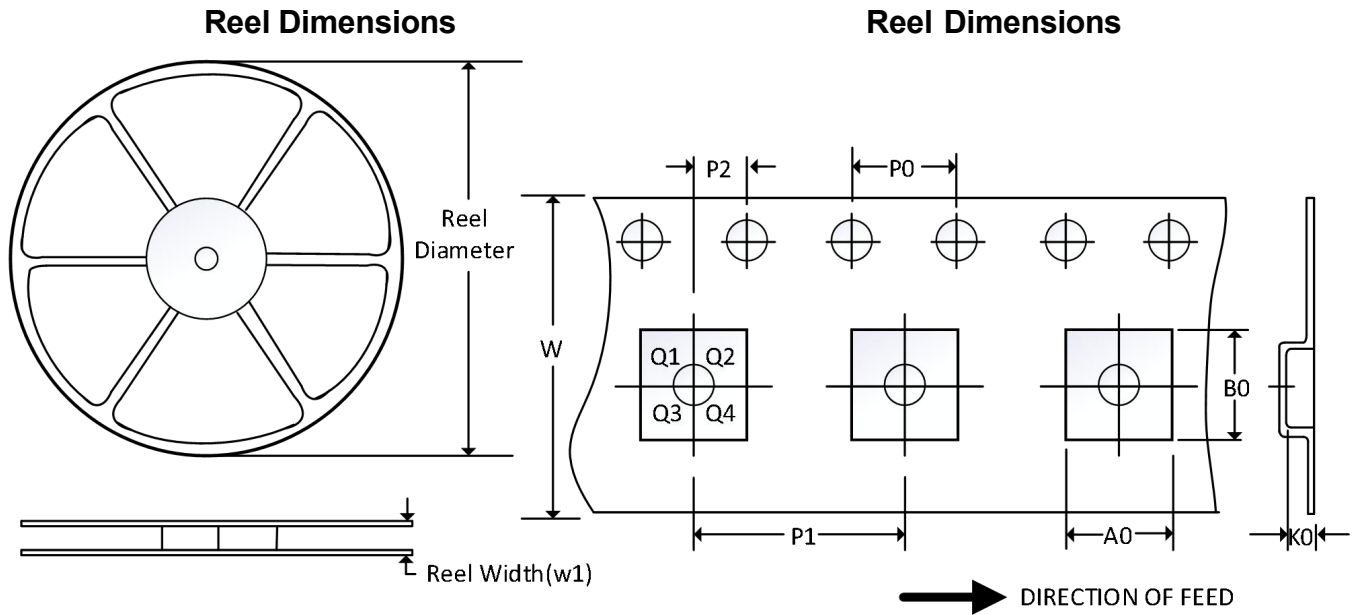
Fig.11-1. Typical Application Schematic

12 Package Outline Dimension

TSSOP14


Symbol	Dimensions in Millimeters			Dimensions in Inches		
	Min	Nom	Max	Min	Nom	Max
A	—	—	1.20	—	—	0.047
A1	0.05	—	0.15	0.002	—	0.006
A2	0.90	1.00	1.05	0.035	0.039	0.041
A3	0.39	0.44	0.49	0.015	0.017	0.019
b	0.20	—	0.28	0.008	—	0.011
b1	0.19	0.22	0.25	0.007	0.009	0.010
c	0.13	—	0.17	0.005	—	0.007
c1	0.12	0.13	0.14	0.005	0.005	0.006
D	4.90	5.00	5.10	0.193	0.197	0.201
E	4.30	4.40	4.50	0.169	0.173	0.177
E1	6.20	6.40	6.60	0.244	0.252	0.260
e	0.65BSC			0.026BSC		
L	0.45	0.60	0.75	0.018	0.024	0.030
L1	1.00BCS			0.039BSC		
θ	0	—	8°	0	—	8°

13 Tape and Reel Information



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
TSSOP14	13"	12.4	6.95	5.60	1.20	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.