

用于开漏和推挽应用的2路、4路双向电平转换器

2-Bit, 4-Bit Bidirectional Voltage-Level Translator for Open-Drain and Push-Pull Applications

FEATURES

- HT0102, 2-Bit; HT0104, 4-Bit
- Bidirectional translator, No Direction-Control Signal Needed
- Data Rates
 - 24Mbps (Push-Pull); 2Mbps (Open-Drain)
- 1.65V ~ 5.5V on A Port, 2.3V to 5.5V on B Port ($V_{CCA} \leq V_{CCB}$)
- VCC Isolation: Either V_{CCA} or V_{CCB} is at GND, all ports will be in Hi-Z State
- No Power-Supply Sequencing Required: Either V_{CCA} or V_{CCB} can be Ramped First
- HT0102, 2路; HT0104, 4路
- 双向电平转换, 无需方向控制信号
- 最大数据速率
 - 推拉24Mbps, 开漏2Mbps
- A端口: 1.65V~5.5V电压, B端口: 2.3V~5.5V电压 ($V_{CCA} \leq V_{CCB}$)
- VCC隔离: 任一电源拉到地, 则端口呈现高阻态
- 无电源时序要求: V_{CCA} 或 V_{CCB} 均可优先斜升

APPLICATIONS

- I²C
- UART
- JTAG
- I²C
- GPIO
- SPI
- SMBus
- MDIO

DESCRIPTION

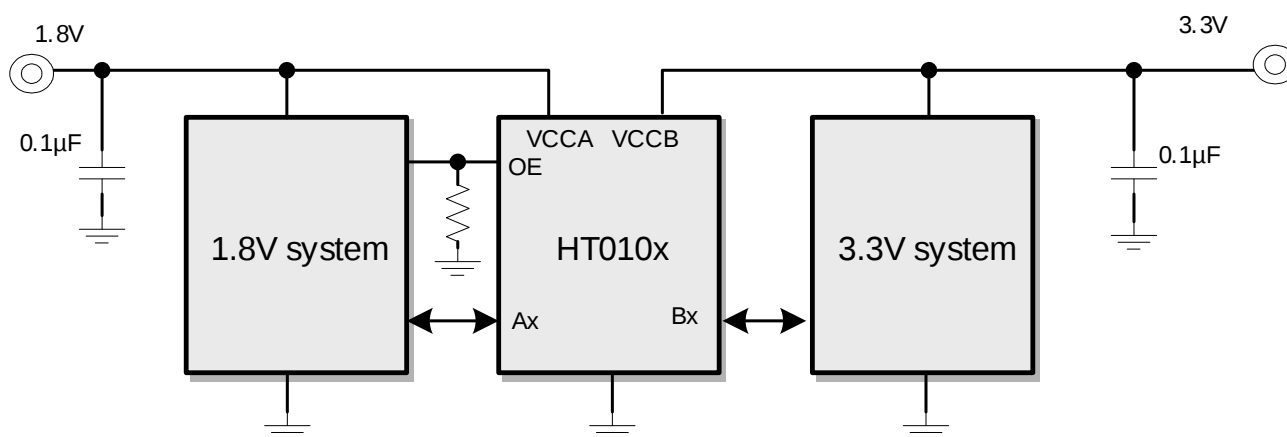
HT0102, HT0104 is a stereo and quad channel bidirectional translator with two separate power supply V_{CCA} and V_{CCB} . The low voltage signal present on A port with operating voltage from 1.65V to 5.5V referenced to V_{CCA} , and the high voltage signal present on B port with operating voltage from 2.3V to 5.5V referenced to V_{CCB} .

HT010x enters a low current consumption mode with all IOs places in Hi-Z, once the OE pin is pulled low.

HT0102, HT0104是一款2路、4路双向电平转换器, 其使用两个独立的供电 V_{CCA} 和 V_{CCB} 。电压较低的电平信号接入A端口, 支持1.65V~5.5V电压, 其对应 V_{CCA} ; 电压较高的电平信号接入B端口, 支持2.3V~5.5V电压, 其对应 V_{CCB} 。

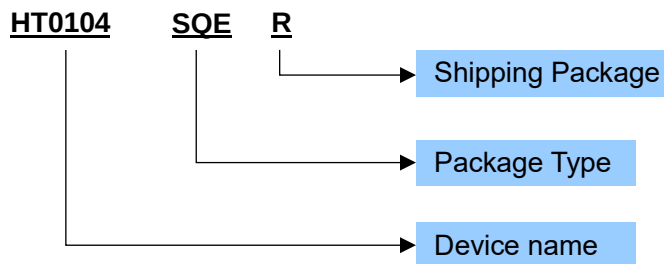
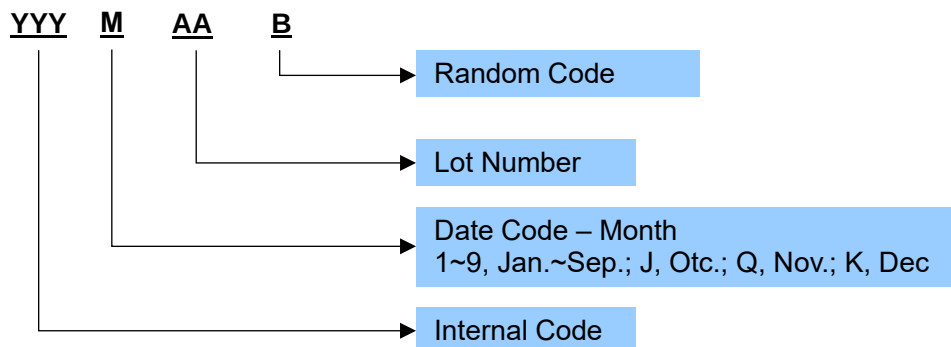
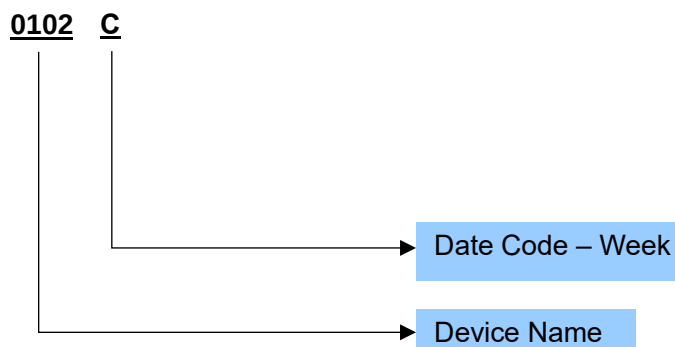
当OE脚拉低时, HT010x进入低功耗模式, 所用IO进入高阻状态。

TYPICAL APPLICATION

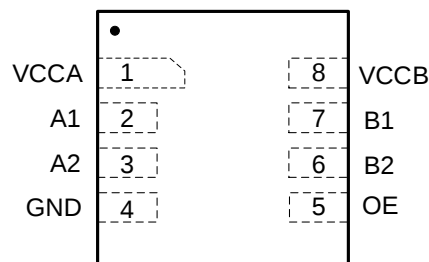
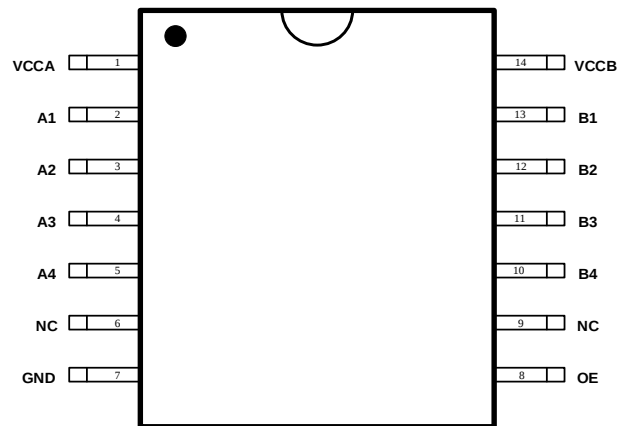
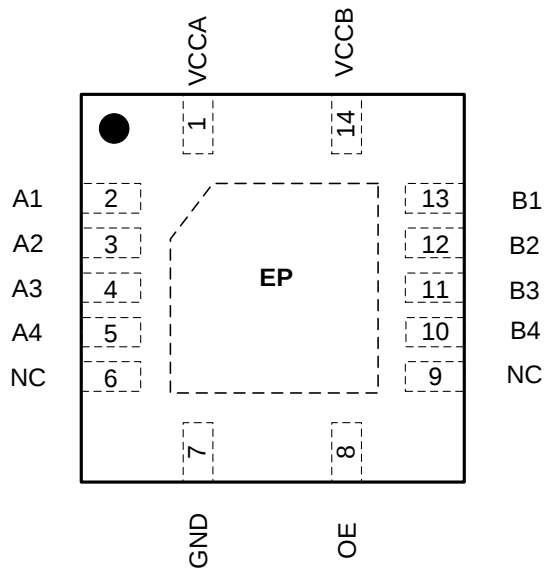


ORDERING INFORMATION

Part Number	Package Type	Marking	Operating Temperature Range	Shipping Package / MOQ
HT0104SQER	QFN14L-3.5×3.5 (SQE)	HT0104 YYYMAAB ¹	-40℃～85℃	Tape and Reel / 5000pcs
HT0104MTNR	TSSOP14L (MTN)	HT0104 YYYMAAB	-40℃～85℃	Tape and Reel / 3000pcs
HT0102DNER	DFN1.5×1.0-8L (DNE)	0102C	-40℃～85℃	Tape and Reel / 5000pcs

Part Number

Production Tracking Code

Marking

¹ YYYMAAB is production tracking code

■ TERMINAL CONFIGURATION



■ TERMINAL FUNCTION

Terminal No.			Name	I/O	Description
SQE	DNE	MTN			
1	1	1	VCCA	-	A port power supply, $1.65V \leq VCCA \leq 5.5V$ and $VCCA \leq VCCB$
2	2	2	A1	I/O	Input/Output A1, referenced to VCCA
3	3	3	A2	I/O	Input/Output A2, referenced to VCCA
4	--	4	A3	I/O	Input/Output A3, referenced to VCCA
5	--	5	A4	I/O	Input/Output A4, referenced to VCCA
6	--	6	NC	-	No connection
7	4	7	GND	-	Ground
8	5	8	OE	I	Pull OE low to place all outputs in Hi-Z.
9	--	9	NC	-	No connection
10	--	10	B4	I/O	Input/Output B4, referenced to VCCB
11	--	11	B3	I/O	Input/Output B3, referenced to VCCB
12	6	12	B2	I/O	Input/Output B2, referenced to VCCB
13	7	13	B1	I/O	Input/Output B1, referenced to VCCB
14	8	14	VCCB	-	B port power supply, $2.3V \leq VCCB \leq 5.5V$
EP	--	-	NC	-	No connection

■ SPECIFICATIONS¹

● Absolute Maximum Ratings²

PARAMETER	Symbol	MIN	TYP	MAX	UNIT
Supply voltage range	VCCA	-0.5		6.5	V
Supply voltage range	VCCB	-0.5		6.5	V
Input voltage range ³ (A ports, B ports, OE)	V _I	-0.5		6.5	V
Voltage range applied to any output in the high-impedance or power-off state	V _O	-0.5		6.5	V
Voltage range applied to any output in the high or low state		-0.5		V _{CCx} + 0.5	V
Input clamp current, V _I < 0	I _{IK}			- 50	mA
Output clamp current, V _O < 0	I _{OK}			-50	mA
Continuous output current	I _O			± 50	mA
Continuous current through VCCx or GND				± 100	mA
Storage Temperature	T _{STG}	-65		150	°C
Junction Temperature				150	°C
ESD (HBM)			2		kV
ESD (CDM)			1		kV

● Recommended Operating Conditions

Over operating free-air temperature range, unless otherwise specified.

PARAMETER	Symbol	CONDITION	MIN	TYP	MAX	UNIT
Power supply voltage	VCCA		1.65		5.5	V
Power supply voltage	VCCB		2.3		5.5	V
Input voltage	V _I		0		5.5	V
High-level input voltage	V _{IH}	A port, VCCA=1.65~1.95V VCCB = 2.3~5.5V	V _{CCI} ⁴ - 0.2		V _{CCI}	V
		A port, VCCA=2.3~5.5V VCCB = 2.3~5.5V	V _{CCI} - 0.4		V _{CCI}	V
		B port, VCCA=2.3~5.5V VCCB = 2.3~5.5V	V _{CCI} - 0.4		V _{CCI}	V
		OE, VCCA=2.3~5.5V VCCB = 2.3~5.5V	V _{CCA} × 0.65		5.5	V
Low-level input voltage	V _{IL}	A port, VCCA=2.3~5.5V VCCB = 2.3~5.5V	0		0.15	V
		B port, VCCA=2.3~5.5V VCCB = 2.3~5.5V	0		0.15	V
		OE, VCCA=2.3~5.5V VCCB = 2.3~5.5V	0		V _{CCA} × 0.35	V
Input transition rise or fall rate	Δt/Δv	A port, push-pull			10	ns/V
		B port, push-pull			10	
		Control input			10	
Operating free-air temperature	T _A		-40		85	°C

¹ Depending on parts and PCB layout, characteristics may be changed.

² 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.

³ The input negative-voltage and output voltage ratings may be exceeded if the input and output current ratings are observed.

⁴ V_{CCI} is the supply voltage associated with the input port.

● Electrical Characteristics

Over operating free-air temperature range, unless otherwise specified.

PARAMETER	Symbol	CONDITION	MIN	TYP	MAX	UNIT
A ports output high voltage	V_{OHA}	$I_{OH} = -20 \mu A, V_{IB} \geq V_{CCB} - 0.4 V$	$V_{CCA} \times 0.8$			V
A ports output low voltage	V_{OLA}	$I_{OL} = 1mA, V_{IB} \leq 0.15V$			0.4	V
B ports output high voltage	V_{OHB}	$I_{OH} = -20 \mu A, V_{IB} \geq V_{CCB} - 0.2 V$	$V_{CCB} \times 0.8$			V
B ports output low voltage	V_{OLB}	$I_{OL} = 1mA, V_{IB} \leq 0.15V$			0.4	V
Input leakage current	I_L	$V_I = V_{CCI} \text{ or } GND$	-2		2	μA
High-impedance state output current	I_{OZ}	$OE = L$	-2		2	μA
Quiescent current of VCCA	I_{CCA}	$V_I = V_O = \text{Open}, I_O = 0, V_{CCA} = 1.65V \sim V_{CCB}, V_{CCB} = 2.3V \sim 5.5V$			2.4	μA
		$V_I = V_O = \text{Open}, I_O = 0, V_{CCA} = 3.6V, V_{CCB} = 0V$			2.2	μA
		$V_I = V_O = \text{Open}, I_O = 0, V_{CCA} = 0V, V_{CCB} = 5.5V$			-1	μA
Quiescent current of VCCB	I_{CCB}	$V_I = V_O = \text{Open}, I_O = 0, V_{CCA} = 1.65V \sim V_{CCB}, V_{CCB} = 2.3V \sim 5.5V$			12	μA
		$V_I = V_O = \text{Open}, I_O = 0, V_{CCA} = 3.6V, V_{CCB} = 0V$			-1	μA
		$V_I = V_O = \text{Open}, I_O = 0, V_{CCA} = 0V, V_{CCB} = 5.5V$			1	μA
Total quiescent current	$I_{CCA} + I_{CCB}$	$V_I = V_O = \text{Open}, I_O = 0$			14.4	μA
Input capacitance	C_i	$V_{CCA} = 3.3V, V_{CCB} = 3.3V$		2.5		pF
Input-to-output internal capacitance	C_{io}	$V_{CCA} = 3.3V, V_{CCB} = 3.3V, A \text{ ports}$		5		pF
		$V_{CCA} = 3.3V, V_{CCB} = 3.3V, B \text{ ports}$		12		pF

● Timing Requirements

$T_a = 25^\circ C$, unless otherwise specified

PARAMETER	Symbol	CONDITION	VCCB			UNIT
			2.5V	3.3V	5V	
VCCA = 1.8V						
Maximum Data Rate		Push Pull	24	24	24	Mbps
		Open Drain	2	2	2	Mbps
Minimum Pulse duration	t _w	Push Pull, data inputs	41	41	41	ns
		Open Drain, data inputs	500	500	500	ns
VCCA = 2.5V						
Maximum Data Rate		Push Pull	24	24	24	Mbps
		Open Drain	2	2	2	Mbps
Minimum Pulse duration	t _w	Push Pull, data inputs	41	41	41	ns
		Open Drain, data inputs	500	500	500	ns
VCCA = 3.3V						
Maximum Data Rate		Push Pull	24	24	24	Mbps
		Open Drain	2	2	2	Mbps
Minimum Pulse duration	t _w	Push Pull, data inputs	41	41	41	ns
		Open Drain, data inputs	500	500	500	ns

● Switching Characteristics

Ta = 25°C, unless otherwise specified.

PARAMETER	FROM (INPUT)	TO(OUTPUT)	VCCB	Condition	VCCA = 1.8V			UNIT
					MIN	TYP	MAX	
t _{PHL}	A	B	5.0V	Push-pull		4.3		ns
				Open-drain		26.7		
			3.3V	Push-pull		3.0		
				Open-drain		26.3		
			2.5V	Push-pull		2.4		
				Open-drain		26		
t _{PLH}	A	B	5.0V	Push-pull		3.5		ns
				Open-drain		110		
			3.3V	Push-pull		3.6		
				Open-drain		145		
			2.5V	Push-pull		4.0		
				Open-drain		175		
t _{PHL}	B	A	5.0V	Push-pull		2.1		ns
				Open-drain		26.2		
			3.3V	Push-pull		1.9		
				Open-drain		26.1		
			2.5V	Push-pull		2.0		
				Open-drain		26		
t _{PLH}	B	A	5.0V	Push-pull		1.4		ns
				Open-drain		51		
			3.3V	Push-pull		1.5		
				Open-drain		69		
			2.5V	Push-pull		1.7		
				Open-drain		133		
t _{EN}	OE	A or B	5.0V			18		ns
			3.3V			20		
			2.5V			24		
t _{DIS}	OE	A or B	5.0V			1200		ns
			3.3V			1200		
			2.5V			1200		
t _{rA}	Port A rise time		5.0V	Push-pull		5.4		ns
				Open-drain		10		
			3.3V	Push-pull		5.8		
				Open-drain		31		
			2.5V	Push-pull		6.6		
				Open-drain		89		
t _{rB}	Port B rise time		5.0V	Push-pull		3.9		ns
				Open-drain		58		
			3.3V	Push-pull		4.6		
				Open-drain		98		
			2.5V	Push-pull		5.6		
				Open-drain		128		
t _{rA}	Port A fall time		5.0V	Push-pull		2.6		ns
				Open-drain		1.6		
			3.3V	Push-pull		2.7		
				Open-drain		1.7		
			2.5V	Push-pull		2.9		
				Open-drain		1.7		

			Open-drain	1.9	
t_{FB}	Port B fall time	5.0V	Push-pull	8.0	ns
			Open-drain	2.9	
		3.3V	Push-pull	5.9	
			Open-drain	2.3	
		2.5V	Push-pull	4.6	
			Open-drain	2.3	
t_{SK}	Channel to Channel skew time, output	5.0V		0.5	ns
		3.3V		0.5	
		2.5V		0.5	
	Maximum data rate	5.0V	Push-pull	24	Mbps
			Open-drain	2	
		3.3V	Push-pull	24	
			Open-drain	2	
		2.5V	Push-pull	24	
			Open-drain	2	

PARAMETER	FROM (INPUT)	TO(OUTPUT)	VCCB	Condition	VCCA = 2.5V			UNIT
					MIN	TYP	MAX	
t_{PHL}	A	B	5.0V	Push-pull		4.8		ns
				Open-drain		26.7		
			3.3V	Push-pull		3.3		
				Open-drain		26.4		
			2.5V	Push-pull		2.7		
				Open-drain		26.2		
t_{PLH}	A	B	5.0V	Push-pull		2.3		ns
				Open-drain		110		
			3.3V	Push-pull		2.4		
				Open-drain		144		
			2.5V	Push-pull		2.6		
				Open-drain		169		
t_{PHL}	B	A	5.0V	Push-pull		2.4		ns
				Open-drain		26.5		
			3.3V	Push-pull		2.3		
				Open-drain		26.4		
			2.5V	Push-pull		2.4		
				Open-drain		26.3		
t_{PLH}	B	A	5.0V	Push-pull		1.8		ns
				Open-drain		55		
			3.3V	Push-pull		1.9		
				Open-drain		118		
			2.5V	Push-pull		2.0		
				Open-drain		165		
t_{EN}	OE	A or B	5.0V			16		ns
			3.3V			19		
			2.5V			23		
t_{DIS}	OE	A or B	5.0V			1200		ns
			3.3V			1200		
			2.5V			1200		
t_{rA}	Port A rise time		5.0V	Push-pull		2.6		ns
				Open-drain		10		
			3.3V	Push-pull		2.8		

		2.5V	Open-drain	70	
			Push-pull	3.2	
			Open-drain	120	
t_{rB}	Port B rise time	5.0V	Push-pull	2.6	ns
			Open-drain	62	
		3.3V	Push-pull	3.4	
			Open-drain	96	
		2.5V	Push-pull	4.5	
			Open-drain	122	
t_{fA}	Port A fall time	5.0V	Push-pull	4.8	ns
			Open-drain	1.7	
		3.3V	Push-pull	5.0	
			Open-drain	1.9	
		2.5V	Push-pull	4.9	
			Open-drain	2.0	
t_{fB}	Port B fall time	5.0V	Push-pull	8.3	ns
			Open-drain	2.7	
		3.3V	Push-pull	6.1	
			Open-drain	2.1	
		2.5V	Push-pull	4.8	
			Open-drain	1.9	
t_{SK}	Channel to Channel skew time, output	5.0V		0.5	ns
		3.3V		0.5	
		2.5V		0.5	
	Maximum data rate	5.0V	Push-pull	24	Mbps
			Open-drain	2	
		3.3V	Push-pull	24	
			Open-drain	2	
		2.5V	Push-pull	24	
			Open-drain	2	

PARAMETER	FROM (INPUT)	TO(OUTPUT)	VCCB	Condition	VCCA = 3.3V			UNIT
					MIN	TYP	MAX	
t _{PHL}	A	B	5.0V	Push-pull	4.9			ns
				Open-drain	26.7			
			3.3V	Push-pull	3.5			
				Open-drain	26.3			
t _{PLH}	A	B	5.0V	Push-pull	2.0			ns
				Open-drain	104			
			3.3V	Push-pull	2.2			
				Open-drain	133			
t _{PHL}	B	A	5.0V	Push-pull	3.2			ns
				Open-drain	26.8			
			3.3V	Push-pull	3.0			
				Open-drain	26.6			
t _{PLH}	B	A	5.0V	Push-pull	1.7			ns
				Open-drain	83			
			3.3V	Push-pull	1.8			
				Open-drain	132			
t _{EN}	OE	A or B	5.0V		15			ns
			3.3V		18			
t _{DIS}	OE	A or B	5.0V		1200			ns

		3.3V		1200	
t_{rA}	Port A rise time	5.0V	Push-pull	2.0	ns
			Open-drain	36	
		3.3V	Push-pull	2.2	
			Open-drain	87	
t_{rB}	Port B rise time	5.0V	Push-pull	2.3	ns
			Open-drain	56	
		3.3V	Push-pull	2.9	
			Open-drain	87	
t_{fA}	Port A fall time	5.0V	Push-pull	5.8	ns
			Open-drain	2.0	
		3.3V	Push-pull	6.2	
			Open-drain	2.3	
t_{fB}	Port B fall time	5.0V	Push-pull	8.2	ns
			Open-drain	2.5	
		3.3V	Push-pull	6.5	
			Open-drain	2.0	
t_{sk}	Channel to Channel skew time, output	5.0V		0.5	ns
		3.3V		0.5	
	Maximum data rate	5.0V	Push-pull	24	Mbps
			Open-drain	2	
		3.3V	Push-pull	24	
			Open-drain	2	

■ Parameter Measurement Information

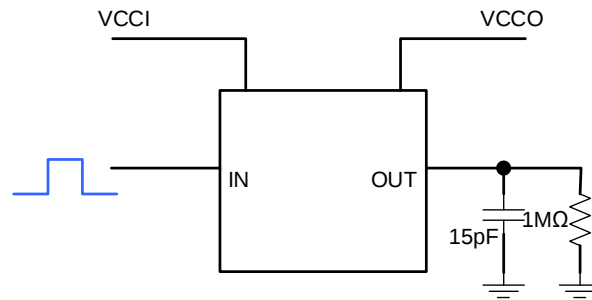


Figure 1 Data Rate, Pulse Duration, Propagation Delay, Output Rise and Fall Time Measurement
Using a Push-pull Driver

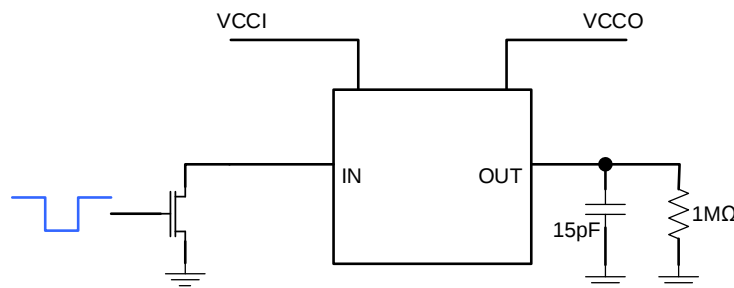


Figure 2 Data Rate, Pulse Duration (t_W), Propagation Delay (t_{PHL} , t_{PLH}), Output Rise (t_r) and Fall Time (t_f) Measurement

Using an Open-Driver

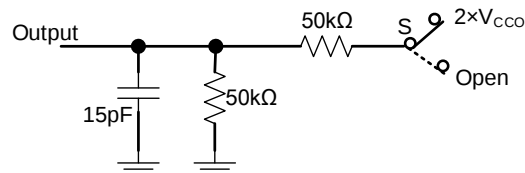


Figure 3 Load Circuit for Enable and Disable Time (t_{EN} , t_{DIS}) Measurement

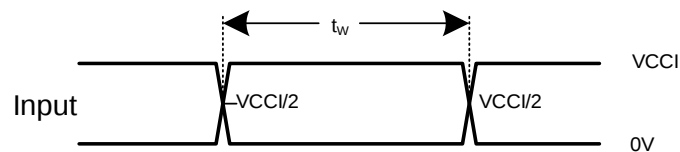


Figure 4 Pulse Duration

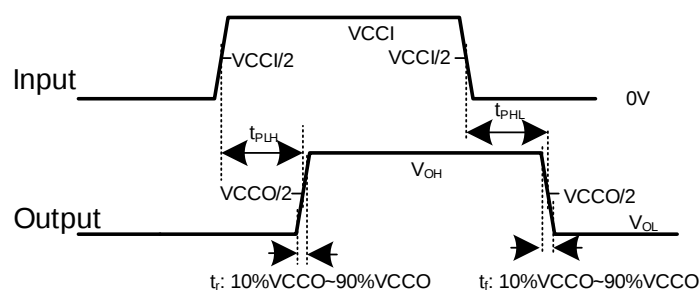


Figure 5 Propagation Delay Time, Output Rise and Fall Time

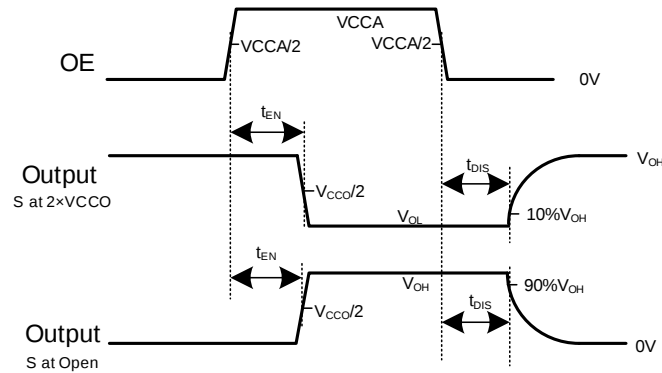


Figure 6 Enable and Disable Time

NOTES:

- A. C_L includes probe and jig capacitance.
- B. All input pulses are supplied by generators having the following characteristics: PRR < 10 MHz, $Z_O = 50\Omega$, $dv/dt > 1V/ns$.
- C. The outputs are measured one at a time, with one input transition per measurement.
- D. All parameters and waveforms are not applicable to all devices.

■ DETAILED DESCRIPTION

1 Overview

HT0102, HT0104 is a stereo and quad channel bidirectional translator with two separate power supply VCCA and VCCB. The low voltage signal present on A port with operating voltage from 1.65V to 5.5V referenced to VCCA, and the high voltage signal present on B port with operating voltage from 2.3V to 5.5V referenced to VCCB.

HT010x enters a low current consumption mode with all IOs places in Hi-Z, once the OE pin is pulled low.

2 Application and Implementation

HT010x is a bidirectional translator that can automatically detect the direction of data flow from port A to port B or from port B to port A. Therefore, each IO can be configured as input or output.

Each port A IO has an internal 10k ohm resistor pulled up to VCCA, and each port B IO has an internal 10k ohm resistor pulled up to VCCB. An external resistor can be added in parallel with the internal 10k ohm resistor to get a smaller value of pullup resistor.

The fall time (t_{fA} , t_{fB}), the high-to-low output delay time (t_{PHL}) and the maximum data rates depend on the output impedance of the external device.

When powering up, either VCCA or VCCB can be ramped up first. However, during normal operation, $VCCA \leq VCCB$ all the time.

Once OE terminal is pulled low, all IOs will be placed into Hi-Z.

HT0102, HT0104 是一款 2 路, 4 路双向电平转换器, 其使用两个独立的供电 VCCA 和 VCCB。电压较低的电平信号接入 A 端口, 支持 1.65V~5.5V 电压, 其对应 VCCA; 电压较高的电平信号接入 B 端口, 支持 2.3V~5.5V 电压, 其对应 VCCB。

当 OE 脚拉低时, HT010x 进入低功耗模式, 所用 IO 进入高阻状态。

HT010x 是一个双路电平转换器, 能够自动检测信号方向, 从端口 A 到端口 B, 或从端口 B 到端口 A。因此, 每个 IO 口均可作为输入或输出端口。

每个 A 端口均有一个内置 10k 欧姆的电阻上拉到 VCCA, 每个 B 端口均有一个内置 10k 欧姆的电阻上拉到 VCCB。当需要更小的上拉电阻时, 可在外部并联一个上拉电阻。

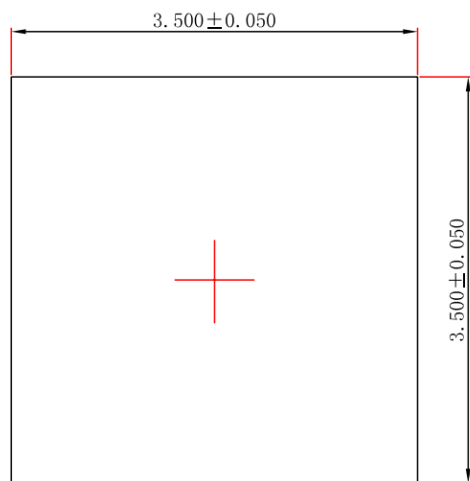
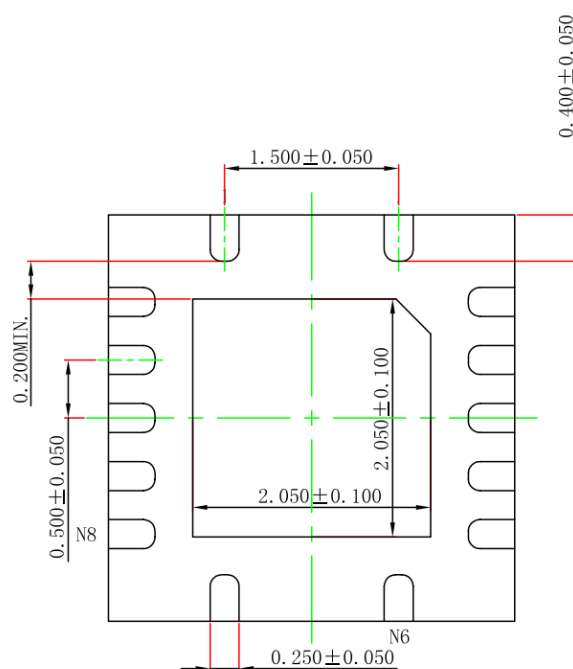
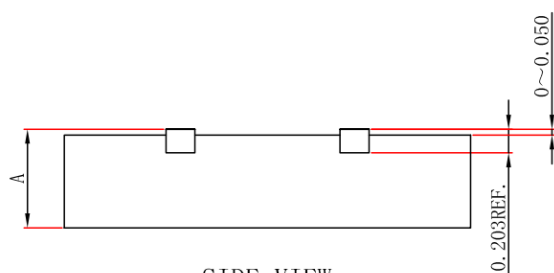
t_{fA} , t_{fB} 和 t_{PHL} 取决于外部驱动器的输出阻抗。

上电时, VCCA 和 VCCB 无需时序要求, VCCA 或 VCCB 均可优先斜升。但是在正常工作过程中, 需 $VCCA \leq VCCB$ 。

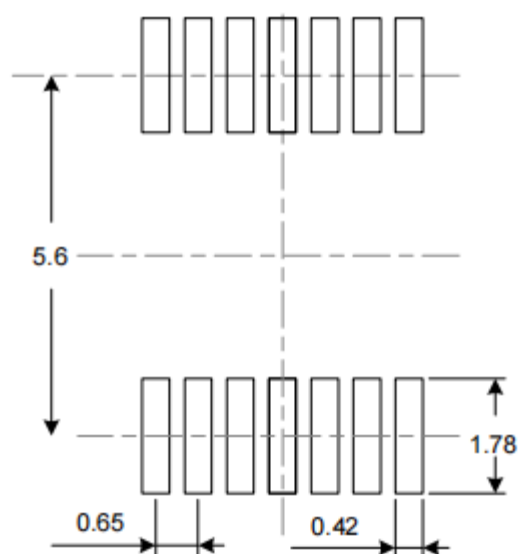
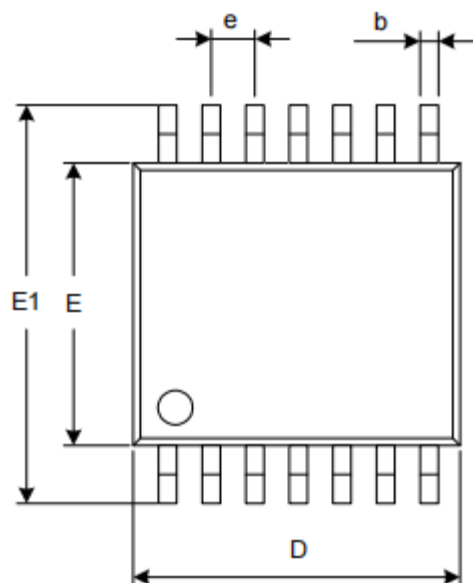
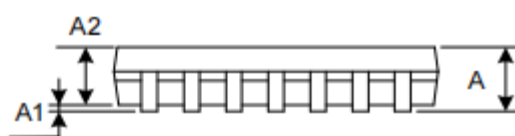
OE 脚拉低时, 所有 IO 进入高阻状态。

PACKAGE OUTLINE

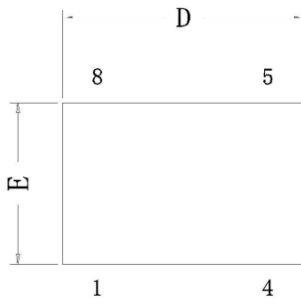
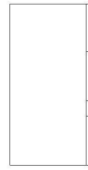
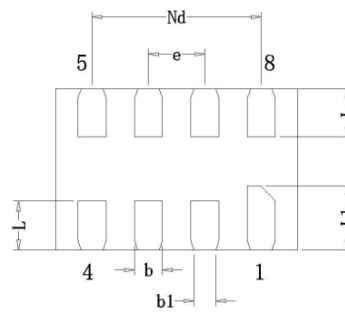
SQE (QFN14L-3.5×3.5), Dimensions in Millimeters


 TOP VIEW
 [顶视图]

 BOTTOM VIEW
 [背视图]

 SIDE VIEW
 [侧视图]

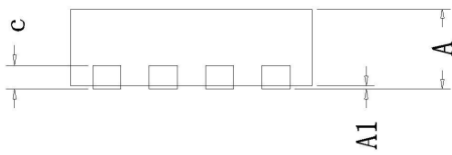
Symbol	Dimensions in Millimeters		
	Min.	Typ.	Max.
A	0.700	0.750	0.800

MTN(TSSOP14)

RECOMMENDED LAND PATTERN (Unit: mm)


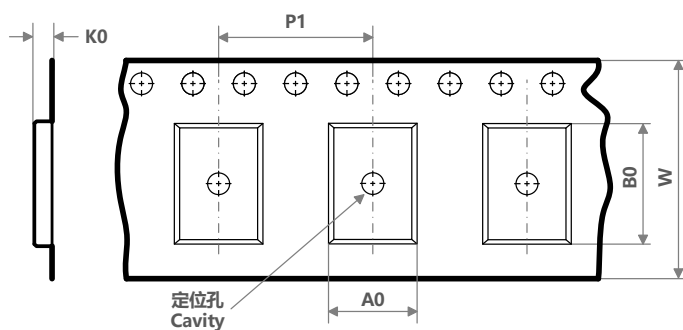
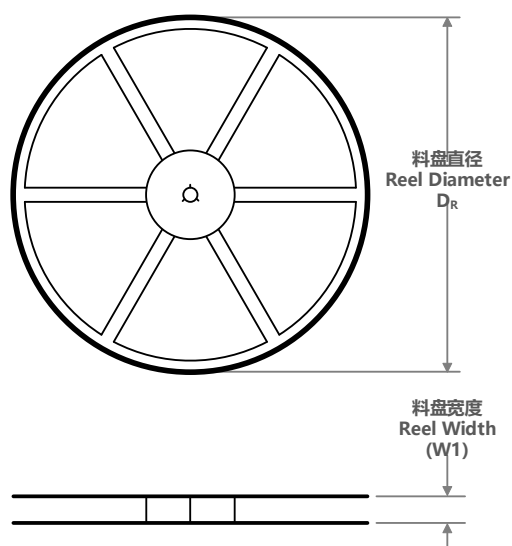
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A		1.200		0.047
A1	0.050	0.150	0.002	0.006
A2	0.800	1.050	0.031	0.041
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D	4.860	5.100	0.191	0.201
E	4.300	4.500	0.169	0.177
E1	6.250	6.550	0.246	0.258
e	0.650(BSC)		0.026(BSC)	
L	0.500	0.700	0.020	0.028
H	0.250(TYP)		0.010(TYP)	
θ	1°	7°	1°	7°

DNE (DFN1.5×1.0-8L)

Top View

Side View

Bottom View

SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.425	0.475	0.525
A1	—	0.02	0.05
b	0.125	0.175	0.225
b1	0.085	0.135	0.185
c	0.127 REF		
D	1.40	1.50	1.60
Nd	1.05 BSC		
e	0.35 BSC		
E	0.90	1.00	1.10
L	0.25	0.30	0.35
L1	0.35	0.40	0.45

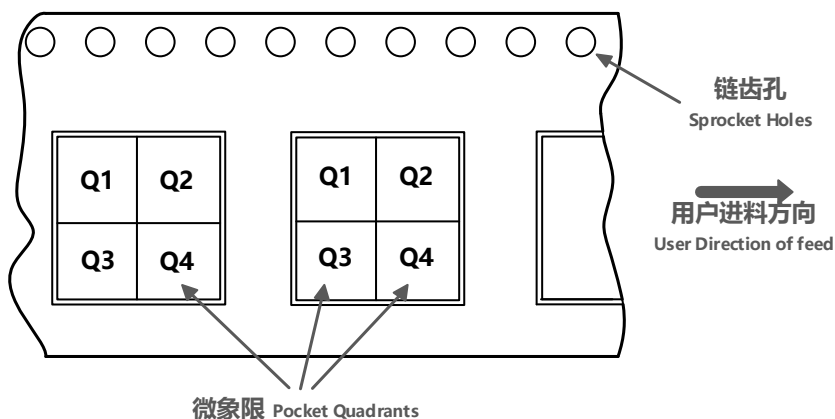


TAPE AND REEL INFORMATION

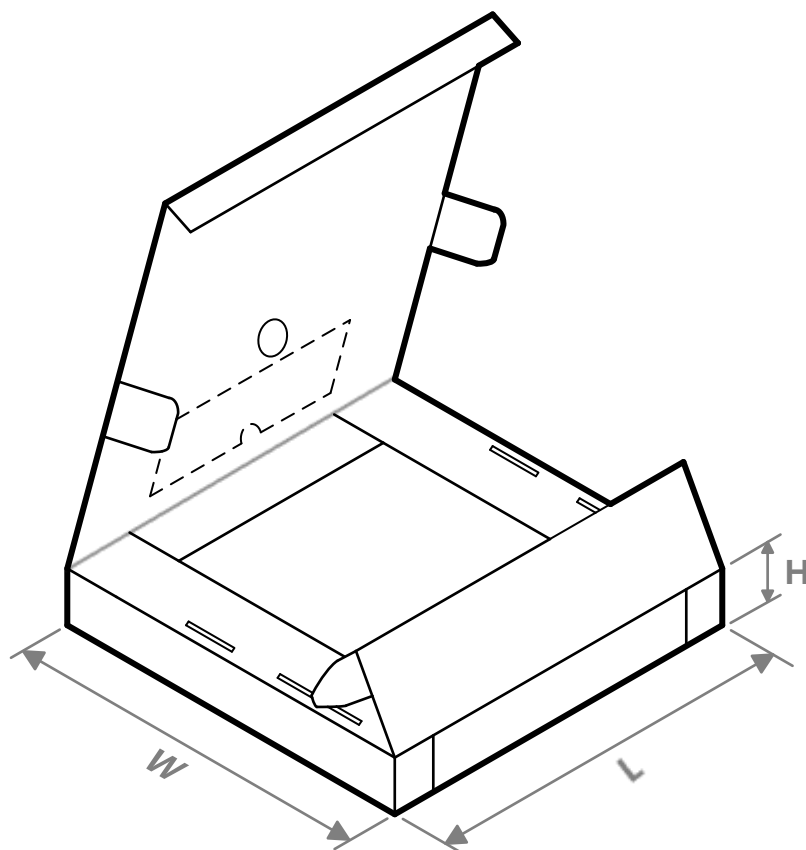


A0	Dimension designed to accommodate the component width; 料槽宽度
B0	Dimension designed to accommodate the component length; 料槽长度
K0	Dimension designed to accommodate the component thickness; 料槽厚度
W	Overall width of the carrier tape; 载带整体宽度
P1	Pitch between successive cavity centers; 相邻槽中心间距

编带 PIN1 方位象限分配 Quadrant Assignments for Pin1 Orientation in Tape



器件料号 Part No.	封装 类型 Package Type	封装 标识 Package Abbr.	引脚 数 Pins	SPQ	料盘 直径 D_R (mm)	料盘 宽度 $W1$ (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 象限 Quadrant
HT0104SQER	QFN3.5×3.5	SQE	14	5000	330	12	3.65	3.65	1.1	8	12	Q1
HT0104MTNR	TSSOP	MTN	14	3000	330	16.5	5	5	1.3	4	16	Q1
HT0102DNER	DFN1.5×1.0	DNE	8	5000	179	9	1.15	1.64	0.65	4	8	Q1

TAPE AND REEL BOX INFORMATION


器件料号 Part No.	封装类型 Package Type	封装标识 Package Abbr.	引脚数 Pins	SPQ	长度 Length (mm)	宽度 Width (mm)	高度 Height (mm)
HT0104SQER	QFN3.5×3.5	SQE	14	10000	360	345	65
HT0104MTNR	TSSOP	MTN	14	6000	380	340	60
HT0102DNER	DFN1.5×1.0	DNE	8	50000	210	210	210

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