

### Product Overview

NCA8T245 is an 8-bit buffer/driver with two separate power supply. The two power supply voltages range from 1.65V to 5.5V. The A port tracks  $V_{CCA}$  and B port tracks  $V_{CCB}$ , so it supports low-voltage bidirectional shift between any of the 1.8V, 2.5V, 3.3V and 5.5V.

NCA8T245 is mainly used for asynchronous communication between two data buses. The device provides a direction-control (DIR) input for transmitting data bidirectionally. When DIR is logic high, it transmits data from A to B, and from B to A when DIR is logic low. The output-enable /OE tracks  $V_{CCA}$  and is low active. When /OE is high, the outputs are in high-impedance state. During power up and power down, /OE should be tied to VCC through a pull-up resistor to ensure the outputs high impedance state.

Each channel of NCA8T245 supports maximum 32 mA current drive when the power supply of output side ranges from 4.5V to 5.5V. All unused inputs must be held at  $V_{CC}$  or GND to prevent excess supply current.

### Key Features

- Qualified for Automotive Grade 1 applications:  
NCA8T245-Q1TSXR
- Control inputs are referenced to  $V_{CCA}$
- Power supply voltage: 1.65V to 5.5V
- ESD Protection Exceeds JESD 22
  - 4000V Human-Body Model
  - 2000V Charged-Device Model
- Operation temperature: -40°C~125°C
- RoHS & REACH compliant package: TSSOP24

### Applications

- Motor driver
- Traction inverter
- Industrial automation
- Telecom

### Device Information

Part Number	Package	Body Size
NCA8T245-DTSXR	TSSOP24	7.80mm × 4.40mm
NCA8T245-Q1TSXR	TSSOP24	7.80mm × 4.40mm

### Functional Block Diagrams

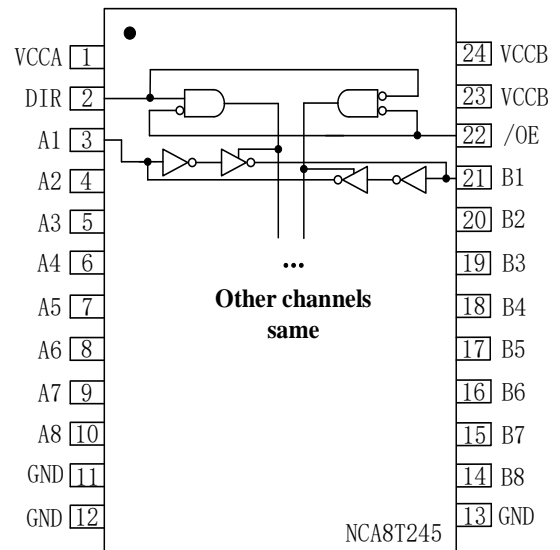


Figure 1. NCA8T245 Block Diagram

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# 1. Pin Configuration and Functions

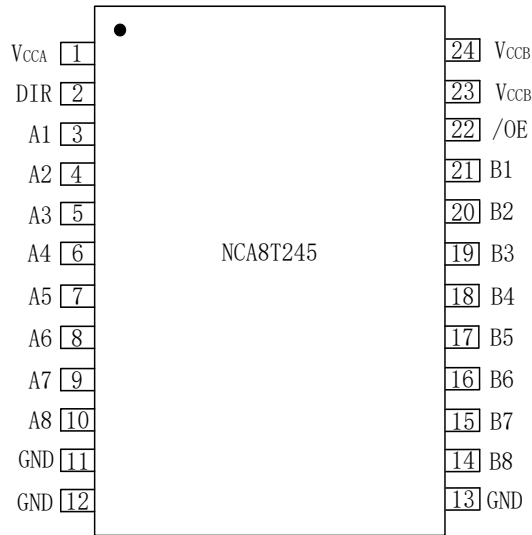


Figure 1.1 NCA8T245 Package

Table 1.1 NCA8T245 Pin Configuration and Description

<b>NCA8T245 PIN NO.</b>	<b>SYMBOL</b>	<b>FUNCTION</b>
1	V <sub>CCA</sub>	Power supply for A side
2	DIR	Direction control, referenced to V <sub>CCA</sub> . DIR is logic high, direction is from A to B while DIR is logic low, transmission is from B to A.
3	A1	Input/Output, referenced to V <sub>CCA</sub>
4	A2	Input/Output, referenced to V <sub>CCA</sub>
5	A3	Input/Output, referenced to V <sub>CCA</sub>
6	A4	Input/Output, referenced to V <sub>CCA</sub>
7	A5	Input/Output, referenced to V <sub>CCA</sub>
8	A6	Input/Output, referenced to V <sub>CCA</sub>
9	A7	Input/Output, referenced to V <sub>CCA</sub>
10	A8	Input/Output, referenced to V <sub>CCA</sub>
11	GND	Ground
12	GND	Ground
13	GND	Ground
14	B8	Input/Output, referenced to V <sub>CCB</sub>
15	B7	Input/Output, referenced to V <sub>CCB</sub>
16	B6	Input/Output, referenced to V <sub>CCB</sub>

17	B5	Input/Output, referenced to $V_{CCB}$
18	B4	Input/Output, referenced to $V_{CCB}$
19	B3	Input/Output, referenced to $V_{CCB}$
20	B2	Input/Output, referenced to $V_{CCB}$
21	B1	Input/Output, referenced to $V_{CCB}$
22	/OE	Active low output enable, referenced to $V_{CCA}$
23	$V_{CCB}$	Power supply for B side
24	$V_{CCB}$	Power supply for B side

## 2. Absolute Maximum Ratings

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Power Supply Voltage	$V_{CCA}, V_{CCB}$	-0.5		7	V	
Input Voltage	$V_I$	-0.5		7	V	A, B port, control inputs
Output Voltage	$V_O$	-0.5		7	V	Voltage range applied to any output in the high-impedance or power-off state
		-0.5		$V_{CCA}/V_{CCB}+0.5$	V	Voltage range applied to any output in the high or low state
Input clamp current	$I_{IK}$			-50	mA	$V_I < 0$
Output clamp current	$I_{OK}$			-50	mA	$V_O < 0$
Continuous output current	$I_O$	-50		50	mA	$V_O=0$ to $V_{CC}$
		-100		100	mA	$V_{CCA}, V_{CCB}, GND$
Absolute Maximum Junction Temperature	$T_J$			150	°C	
Storage Temperature	$T_{stg}$	-65		150	°C	

## 3. ESD Ratings

Parameters	Ratings	Value	Unit
Electrostatic discharge	Human body model (HBM), per AEC-Q100-002-RevD	$\pm 4.0$	kV
	Charged device model (CDM), per AEC-Q100-011-RevB	$\pm 2.0$	kV

## 4. Recommended Operating Conditions

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Power Supply Voltage	$V_{CCA}, V_{CCB}$	1.65		5.5	V	
High-level input voltage	$V_{IH}$	$V_{CC1}^{(1)} * 0.65$			V	$V_{CC1}$ :1.65V to 1.95V
		1.7				$V_{CC1}$ :2.3V to 2.7V
		2				$V_{CC1}$ :3V to 3.6V
		$V_{CC1} * 0.7$				$V_{CC1}$ :4.5V to 5.5V
Low-level input voltage	$V_{IL}$			$V_{CC1} * 0.35$	V	$V_{CC1}$ :1.65V to 1.95V
				0.7		$V_{CC1}$ :2.3V to 2.7V
				0.8		$V_{CC1}$ :3V to 3.6V
				$V_{CC1} * 0.3$		$V_{CC1}$ :4.5V to 5.5V
Input/Output Voltage	$V_{I/O}$	0		$V_{CC0}$	V	Active state
		0		5.5	V	3-state
High-level output current	$I_{OH}$	-4			mA	$V_{CC0}^{(2)}$ :1.65V to 1.95V
		-8				$V_{CC0}$ :2.3V to 2.7V
		-24				$V_{CC0}$ :3V to 3.6V
		-32				$V_{CC0}$ :4.5V to 5.5V
Low-level output current	$I_{OL}$			4	mA	$V_{CC0}$ :1.65V to 1.95V
				8		$V_{CC0}$ :2.3V to 2.7V
				24		$V_{CC0}$ :3V to 3.6V
				32		$V_{CC0}$ :4.5V to 5.5V
Input transition rise or fall rate	$\Delta t/\Delta v$			20	ns/V	$V_{CC1}$ :1.65V to 1.95V
				20		$V_{CC1}$ :2.3V to 2.7V
				10		$V_{CC1}$ :3V to 3.6V
				5		$V_{CC1}$ :4.5V to 5.5V
Operating free-air temperature	$T_A$	-40		125	°C	

(1)  $V_{CC1}$  is the power supply of data input port.

(2)  $V_{CC0}$  is the power supply of data output port.

## 5. Thermal Information

Parameters	Symbol	TSSOP24	Unit
Junction-to-ambient thermal resistance	$\theta_{JA}$	90.6	°C/W
Junction-to-case(top) thermal resistance	$\theta_{JC (top)}$	27.6	°C/W

Junction-to-board thermal resistance	$\theta_{JB}$	45.3	°C/W
Junction-to-top characterization parameter	$\Psi_{JT}$	1.3	°C/W
Junction-to-board characterization parameter	$\Psi_{JB}$	44.8	°C/W

## 6. Specifications

### 6.1. Electrical Characteristics

(Ta = -40°C to 125°C. Unless otherwise noted, Typical values are at Ta = 25°C)

Parameters	Symbol	Min	Typ	Max	Unit	Comments
High-level output voltage	$V_{OH}$	$V_{CC0}^{(1)}-0.1$			V	$I_{OH}=-100\mu A$ , $V_{CCA}=V_{CCB}=1.65$ to $4.5V$
		1.2				$I_{OH}=-4mA$ , $V_{CCA}=V_{CCB}=1.65V$
		1.9				$I_{OH}=-8mA$ , $V_{CCA}=V_{CCB}=2.3V$
		2.4				$I_{OH}=-24mA$ , $V_{CCA}=V_{CCB}=3V$
		3.8				$I_{OH}=-32mA$ , $V_{CCA}=V_{CCB}=4.5V$
Low-level output voltage	$V_{OL}$			0.1	V	$I_{OL}=100\mu A$ , $V_{CCA}=V_{CCB}=1.65$ to $4.5V$
				0.45		$I_{OL}=4mA$ , $V_{CCA}=V_{CCB}=1.65V$
				0.3		$I_{OL}=8mA$ , $V_{CCA}=V_{CCB}=2.3V$
				0.55		$I_{OL}=24mA$ , $V_{CCA}=V_{CCB}=3V$
				0.55		$I_{OL}=32mA$ , $V_{CCA}=V_{CCB}=4.5V$
Input current	$I_i$	-2		2	$\mu A$	DIR pin $V_i=V_{CCA}$ or GND, $V_{CCA}=V_{CCB}=1.65$ to $5.5V$
Shut down leakage current	$I_{off}$	-2		2	$\mu A$	$V_i$ or $V_o=0$ to $5.5V$ , $V_{CCA}=0V$ , $V_{CCB}=0$ to $5.5V$
		-2		2		$V_i$ or $V_o=0$ to $5.5V$ , $V_{CCA}=0$ to $5.5V$ , $V_{CCB}=0V$
Three-state output current	$I_{oz}$	-2		2	$\mu A$	$V_o = V_{CC0}$ or GND, $/OE = V_{IH}$ $V_{CCA}=V_{CCB}=1.65$ to $5.5V$
Supply current	$I_{CCA}$			15	$\mu A$	$V_i = V_{CC1}^{(2)}$ or GND, $I_o = 0$ $V_{CCA}=V_{CCB}=1.65$ to $5.5V$
				15		$V_i = V_{CC1}$ or GND, $I_o = 0$ $V_{CCA}=5V$ , $V_{CCB}=0V$
				-2		$V_i = V_{CC1}$ or GND, $I_o = 0$ $V_{CCA}=0V$ , $V_{CCB}=5V$
	$I_{CCB}$			15	$\mu A$	$V_i = V_{CC1}$ or GND, $I_o = 0$ $V_{CCA}=V_{CCB}=1.65$ to $5.5V$

				-2		$V_i = V_{CCi}$ or GND, $I_o = 0$ $V_{CCA}=5V, V_{CCB}=0V$
				15		$V_i = V_{CCi}$ or GND, $I_o = 0$ $V_{CCA}=0V, V_{CCB}=5V$
	$I_{CCA}+I_{CCB}$			25	uA	$V_i = V_{CCi}$ or GND, $I_o = 0$ $V_{CCA}=V_{CCB}=1.65$ to $5.5V$
Increasing supply current <sup>(3)</sup>	$\Delta I_{CCA}$			50	uA	One A port at $V_{CCA}-0.6V$ , $V_{CCA}=V_{CCB}=3$ to $5.5V$ DIR at $V_{CCA}$ , B port = open
				50		DIR at $V_{CCA}-0.6V$ , B port = open, $V_{CCA}=V_{CCB}=3$ to $5.5V$ A port at $V_{CCA}$ or GND
	$\Delta I_{CCB}$			50	uA	One B port at $V_{CCB}-0.6V$ , $V_{CCA}=V_{CCB}=3$ to $5.5V$ DIR at GND, A port = open
Input capacitance	$C_i$		4		pF	Control inputs
Output capacitance	$C_o$		8.5		pF	

(1)  $V_{CCo}$  is the power supply of output.

(2)  $V_{CCi}$  is the power supply of input.

(3) The increasing of supply current for each input that is at one of the specified voltage levels, rather than 0V or  $V_{CC}$ .

### 6.2. Dynamic Characteristics — $V_{CCA}=1.8V \pm 0.15V$

( $V_{CCA}=1.8V \pm 0.15V, T_a=-40^{\circ}C$  to  $125^{\circ}C$ . Unless otherwise noted, Typical values are at  $T_a = 25^{\circ}C$ ) ( See [figure 6.1](#))

Parameters	Symbol	$V_{CCB}=1.8V \pm 0.15V$		$V_{CCB}=2.5V \pm 0.2V$		$V_{CCB}=3.3V \pm 0.3V$		$V_{CCB}=5V \pm 0.5V$		Unit	Comments
		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX		
		Propagation Delay	$t_{PLH}$	1	15	1	15	1	15		
$t_{PHL}$	1		15	1	15	1	15	1	15	ns	B to A
$t_{PZH}$	2		25	2	25	2	25	2	25	ns	/OE to A
$t_{PZL}$			25		20		25		25	ns	/OE to B
Enable to Data high Valid	$t_{PZH}$		25		20		25		25	ns	/OE to B
Enable to Data Low Valid	$t_{PZL}$		25		25		25		25	ns	/OE to A
Disable high to tri-state	$t_{PHZ}$		25		25		25		25	ns	/OE to A
Disable low to tri-state	$t_{PLZ}$		25		25		25		25	ns	/OE to A

Disable high to tri-state	$t_{PHZ}$		25		25		25		25	ns	/OE to B
Disable low to tri-state	$t_{PLZ}$										

### 6.3. Dynamic Characteristics — $V_{CCA}=2.5V \pm 0.2V$

( $V_{CCA}=2.5V \pm 0.2V$ ,  $T_a=-40^\circ\text{C}$  to  $125^\circ\text{C}$ . Unless otherwise noted, Typical values are at  $T_a = 25^\circ\text{C}$ ) ( See [figure 6.1](#))

Parameters	Symbol	$V_{CCB}=1.8V \pm 0.15V$		$V_{CCB}=2.5V \pm 0.2V$		$V_{CCB}=3.3V \pm 0.3V$		$V_{CCB}=5V \pm 0.5V$		Unit	Comments
		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX		
		Propagation Delay	$t_{PLH}$	1.5	15	1.5	15	1.5	15		
	$t_{PHL}$										
	$t_{PLH}$	1.5	15	1.5	15	1.5	15	1.5	15	ns	B to A
	$t_{PHL}$										
Enable to Data high Valid	$t_{PZH}$	1	20	1	20	1	20	1	20	ns	/OE to A
Enable to Data Low Valid	$t_{PZL}$										
Enable to Data high Valid	$t_{PZH}$	1	20	1	20	1	20	1	20	ns	/OE to B
Enable to Data Low Valid	$t_{PZL}$										
Disable high to tri-state	$t_{PHZ}$		20		20		20		20	ns	/OE to A
Disable low to tri-state	$t_{PLZ}$										
Disable high to tri-state	$t_{PHZ}$		20		20		20		20	ns	/OE to B
Disable low to tri-state	$t_{PLZ}$										

### 6.4. Dynamic Characteristics — $V_{CCA}=3.3V \pm 0.3V$

( $V_{CCA}=3.3V \pm 0.3V$ ,  $T_a=-40^\circ\text{C}$  to  $125^\circ\text{C}$ . Unless otherwise noted, Typical values are at  $T_a = 25^\circ\text{C}$ ) ( See [figure 6.1](#))

Parameters	Symbol	$V_{CCB}=1.8V \pm 0.15V$		$V_{CCB}=2.5V \pm 0.2V$		$V_{CCB}=3.3V \pm 0.3V$		$V_{CCB}=5V \pm 0.5V$		Unit	Comments
		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX		
		Propagation Delay	$t_{PLH}$	1.5	15	1.5	15	1.5	15		
	$t_{PHL}$										
	$t_{PLH}$	1.5	15	1.5	15	1.5	15	1.5	15	ns	B to A
	$t_{PHL}$										
Enable to Data high Valid	$t_{PZH}$	1.5	20	1.5	20	1.5	20	1.5	20	ns	/OE to A
Enable to Data Low Valid	$t_{PZL}$										

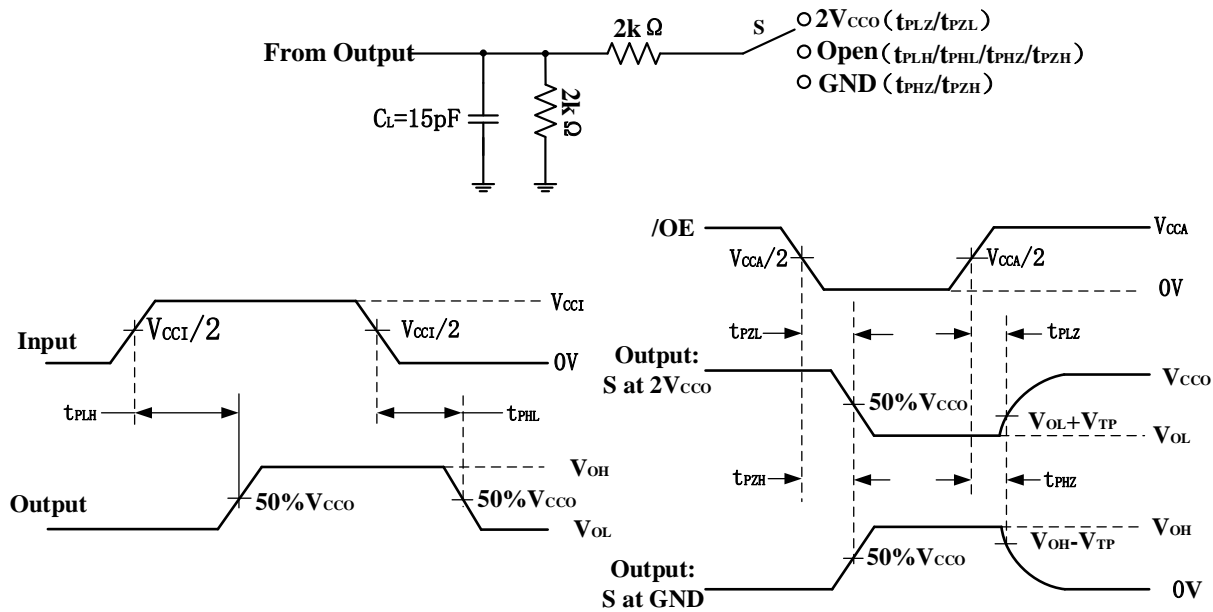
Enable to Data high Valid	$t_{PZH}$	1.5	20	1.5	20	1.5	20	1.5	20	ns	/OE to B
Enable to Data Low Valid	$t_{PZL}$										
Disable high to tri-state	$t_{PHZ}$	1.5	20	1.5	20	1.5	20	1.5	20	ns	/OE to A
Disable low to tri-state	$t_{PLZ}$										
Disable high to tri-state	$t_{PHZ}$	1.5	20	1.5	20	1.5	20	1.5	20	ns	/OE to B
Disable low to tri-state	$t_{PLZ}$										

### 6.5. Dynamic Characteristics — $V_{CCA}=5V \pm 0.5V$

( $V_{CCA}=5V \pm 0.5V$ ,  $T_a=-40^\circ\text{C}$  to  $125^\circ\text{C}$ . Unless otherwise noted, Typical values are at  $T_a = 25^\circ\text{C}$ ) ( See [figure 6.1](#))

Parameters	Symbol	$V_{CCB}=1.8V \pm 0.15V$		$V_{CCB}=2.5V \pm 0.2V$		$V_{CCB}=3.3V \pm 0.3V$		$V_{CCB}=5V \pm 0.5V$		Unit	Comments
		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX		
		Propagation Delay	$t_{PLH}$	1.5	25	1	20	1	10		
	$t_{PHL}$										
	$t_{PLH}$	1.5	25	1	20	1	10	1	10	ns	B to A
	$t_{PHL}$										
Enable to Data high Valid	$t_{PZH}$	1	15	1	15	1	15	1	15	ns	/OE to A
Enable to Data Low Valid	$t_{PZL}$										
Enable to Data high Valid	$t_{PZH}$	1	15	1	15	1	15	1	15	ns	/OE to B
Enable to Data Low Valid	$t_{PZL}$										
Disable high to tri-state	$t_{PHZ}$	1.5	15	1.5	15	1.5	15	1.5	15	ns	/OE to A
Disable low to tri-state	$t_{PLZ}$										
Disable high to tri-state	$t_{PHZ}$	1.5	15	1.5	15	1.5	15	1.5	15	ns	/OE to B
Disable low to tri-state	$t_{PLZ}$										

### 6.6. Parameter measurement information



Note: (1) All input pulses with the following characteristics: PRR ≤10MHz, ZO = 50 Ω, dv/dt ≥1V/ns.  
 (2) VCCO=1.8V ± 0.15V or VCCO=2.5V ± 0.2V: VTP=0.15V; VCCO=3.3V ± 0.3V or VCCO=5V ± 0.5V: VTP=0.3V.

Figure 6.1. Load Circuit and Voltage Waveforms

## 7. Function Description

### 7.1. Overview

NCA8T245 is an 8-bit buffer with dual supply and bidirectional transmission. A port and control signal pin are referenced to VCCA while B port is referenced to VCCB. The supply voltages VCCA and VCCB range from 1.65V to 5.5V, so NCA8T245 can shift different voltage level. It provides eight bidirectional channels with direction control DIR and output-enable(/OE). When DIR is logic high, the direction is from A to B and when DIR is logic low, the transmission is from B to A. /OE is low active, When /OE is high, the outputs are in the high-impedance state. During power up and power down, /OE should be tied to Vcc through a pull-up resistor to ensure the high impedance state. All unused inputs of NCA8T245 must be held at Vcc or GND to prevent excess Icc.

Table 7.1 Function Table

DIR	/OE	A	B	VCCA	VCCB	Comment
L <sup>(1)</sup>	L	L	L	Ready	Ready	Normal operation. Transmission from B to A
L	L	H	H	Ready	Ready	
H	L	L	L	Ready	Ready	Normal operation. Transmission from A to B
H	L	H	H	Ready	Ready	
L	H	Z	X	Ready	Ready	Output Disabled, the output is high impedance.
H	H	X	Z	Ready	Ready	
X	X	Z	Z	Ready	Unready	The output follows the same status with the input after Vcc is powered on and output is enabled.
X	X	Z	Z	Unready	Ready	
X	X	Z	Z	Unready	Unready	

(1) L=Logic low; H=Logic high; X=Logic low or logic high.

## 8. Application Note

### 8.1. Application Information

The NCA8T245 can be used in voltage level-shift applications for interface device or systems requiring different voltages. The maximum output current can be up to 32 mA at 5V supply.

### 8.2. Typical Application Circuit

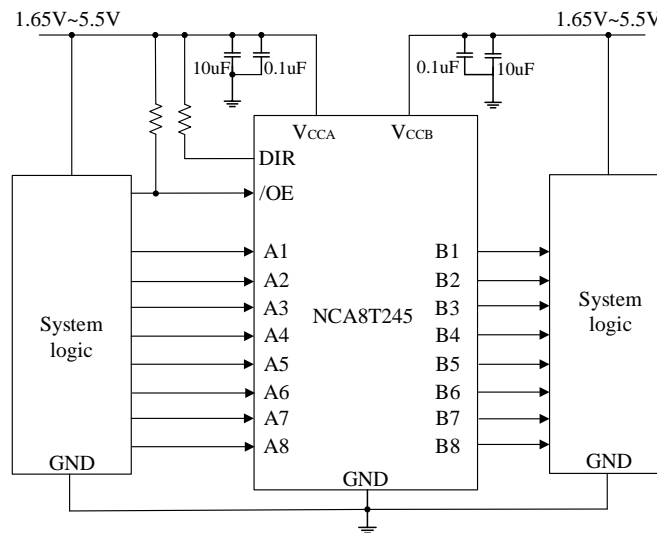
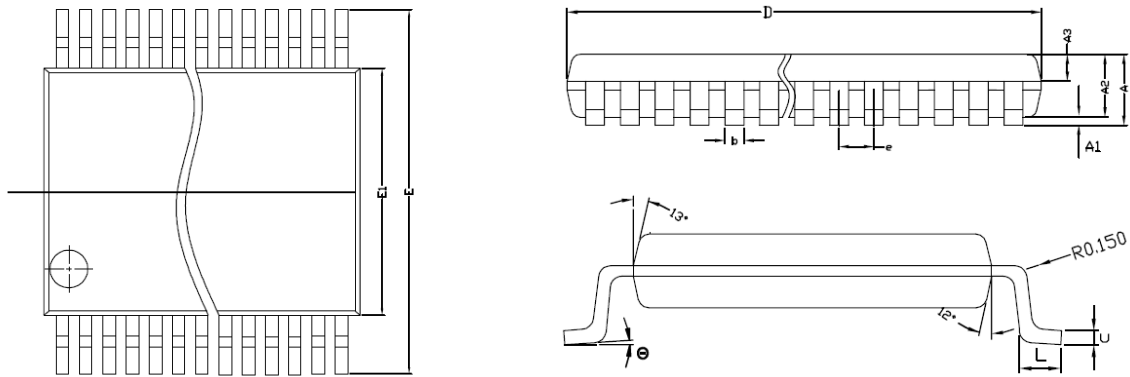


Figure 8.1 Typical application circuit for NCA8T245

### 9. Package Information



TSSOP(M)24			
DIM SYMBOL	MIN.	NOM.	MAX.
A	-	-	1.20
A1	0.05	-	0.15
A2	0.80	0.90	1.00
A3	0.34	0.39	0.44
b	0.19	-	0.30
c	0.09	-	0.20
D	7.70	7.80	7.90
E	6.25	6.40	6.55
E1	4.30	4.40	4.50
e	0.65BSC		
L	0.45	-	0.75
$\theta$	0°	-	8°

Figure 9.1 TSSOP24 Package Shape and Dimension in millimeters for NCA8T245-DTSXR

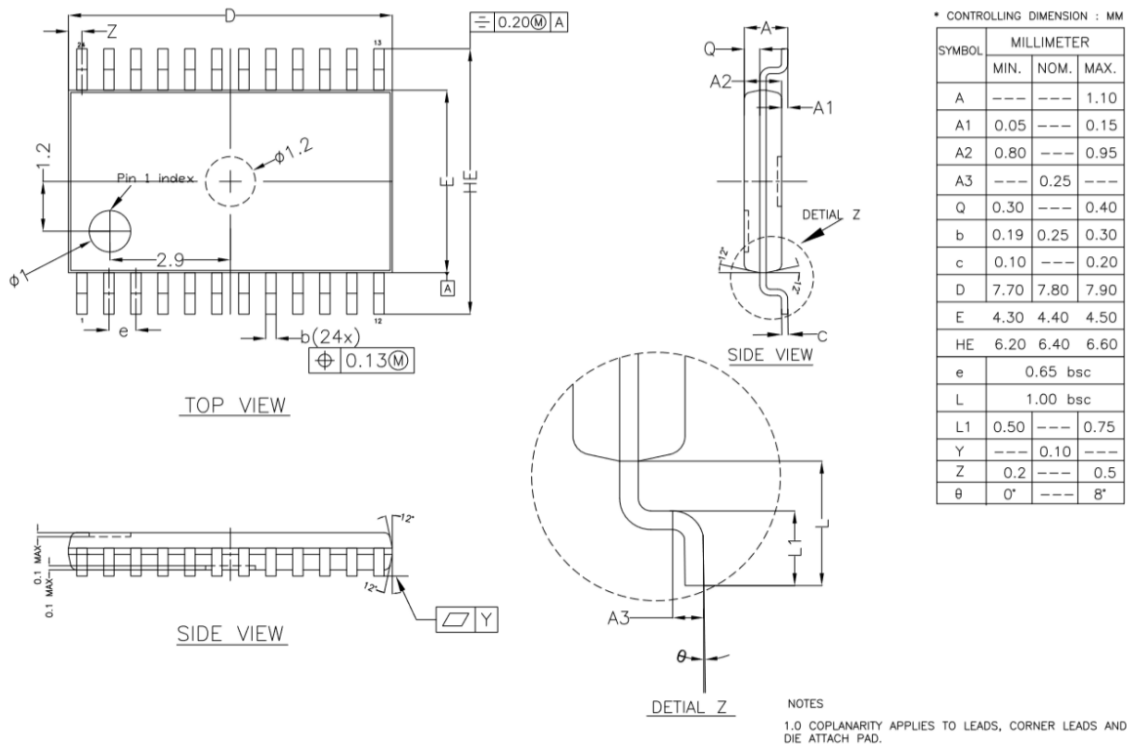


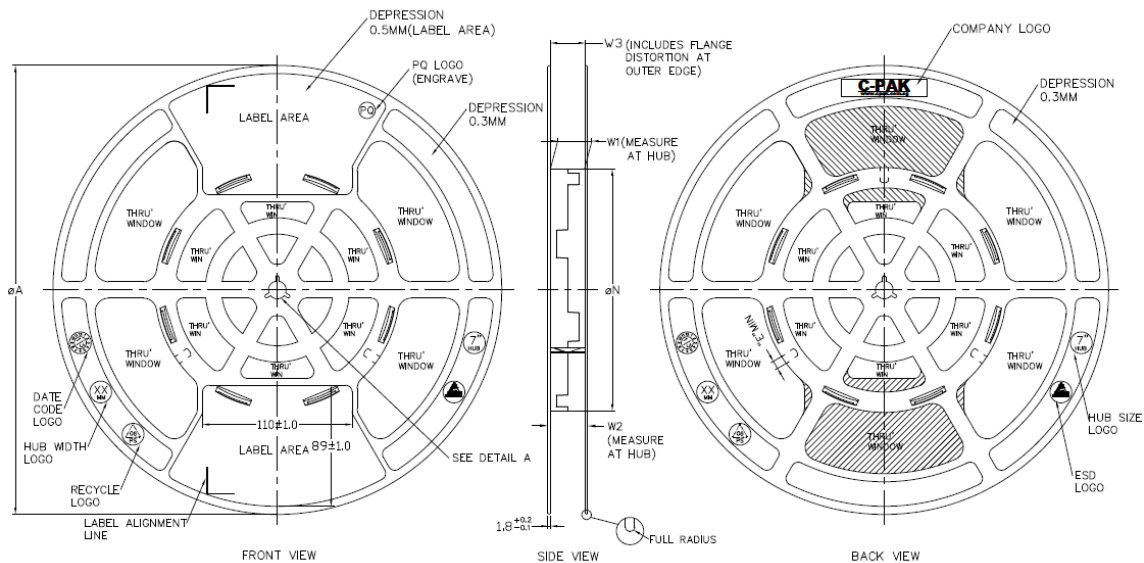
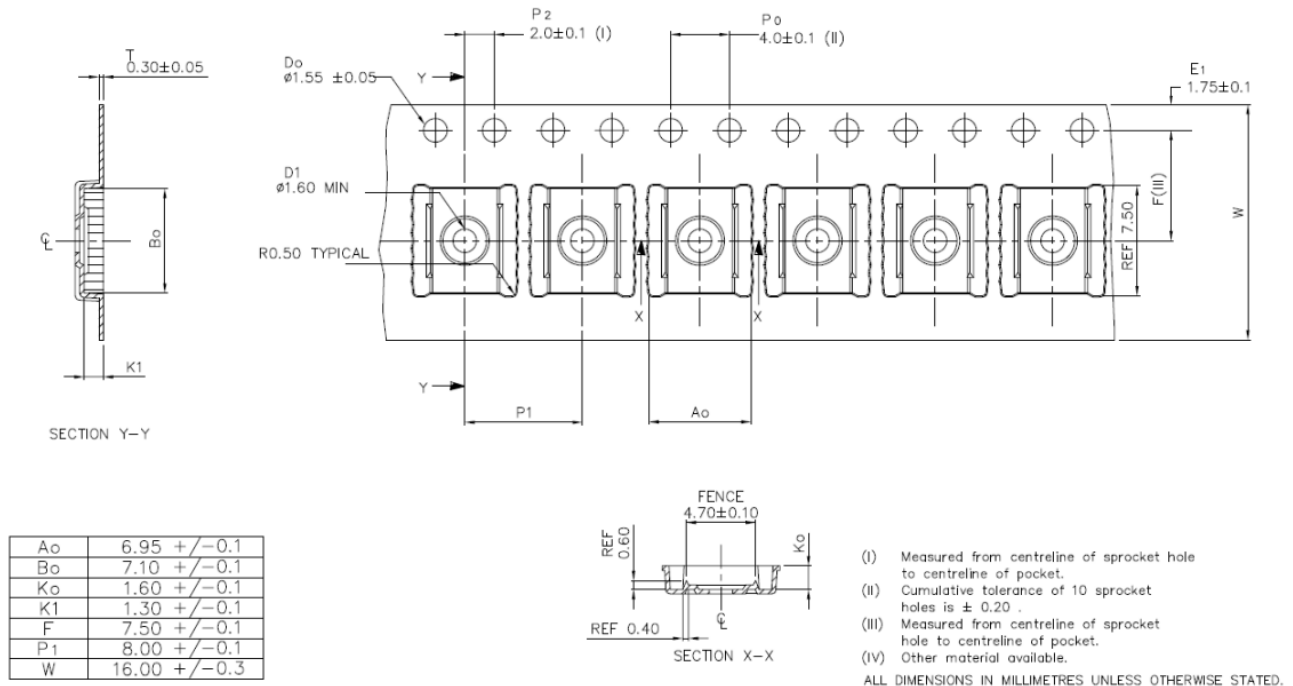
Figure 9.2 TSSOP24 Package Shape and Dimension in millimeters for NCA8T245-Q1TSXR

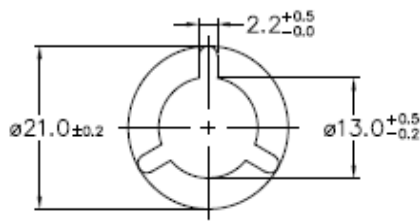
### 10. Ordering Information

Part Number	PINS	Temperature	MSL	Package Type	Package Drawing	SPQ
NCA8T245-DTSXR	24	-40 to 125°C	1	TSSOP24	TSSOP24	3000
NCA8T245-Q1TSXR	24	-40 to 125°C	1	TSSOP24	TSSOP24	2500

NOTE: All packages are RoHS-compliant with peak reflow temperatures of 260 °C according to the JEDEC industry standard classifications and peak solder temperatures.

### 11. Tape and Reel Information





ARBOR HOLE  
DETAIL A  
SCALE : 3:1

PRODUCT SPECIFICATION						
TAPE WIDTH	øA ±2.0	øN ±2.0	W1	W2 (MAX)	W3	E (MIN)
08MM	330	178	8.4 ±0.3	14.4	SHALL ACCOMMODATE TAPE WIDTH WITHOUT INTERFERENCE	5.5
12MM	330	178	12.4 ±0.3	18.4		5.5
16MM	330	178	16.4 ±0.3	22.4		5.5
24MM	330	178	24.4 ±0.3	30.4		5.5
32MM	330	178	32.4 ±0.3	38.4		5.5

SURFACE RESISTIVITY			
LEGEND	SR RANGE	TYPE	COLOUR
A	BELOW 10 <sup>10</sup>	ANTISTATIC	ALL TYPES
B	10 <sup>9</sup> TO 10 <sup>11</sup>	STATIC DISSIPATIVE	BLACK ONLY
C	10 <sup>9</sup> & BELOW 10 <sup>8</sup>	CONDUCTIVE (GENERIC)	BLACK ONLY
E	10 <sup>8</sup> TO 10 <sup>10</sup>	ANTISTATIC (COATED)	ALL TYPES

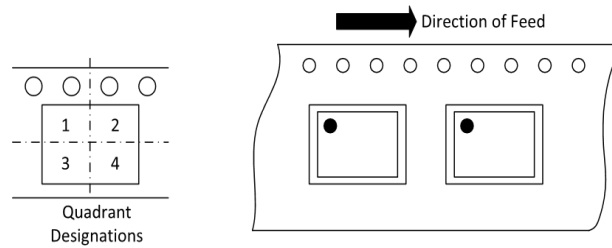


Figure 11.1 Tape and Reel Information of TSSOP

## 12. Revision History

Revision	Description	Date
1.0	Initial Version.	2023/4/23
1.1	Modify the POD information for NCA8T245-DTSXR and the SPQ	2023/12/13

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