

NXP dual-supply voltage translators

Low-power, high-speed, dual-supply voltage translation (0.8 to 5.5 V)

Available in a variety of innovative packages and with varying bit counts, these highly efficient dual-supply devices perform voltage translation in the ranges of 0.8 to 3.6 V and 1.2 to 5.5 V with direction control and auto-direction sensing options.

Key features

- ▶ Direction-control and auto-direction devices
- ▶ High speed
- ▶ Low power (typical $C_{PD} = 2 \text{ pF}$ at $V_{CC} = 1.8 \text{ V}$)
- ▶ Live insertion and extraction
- ▶ 3-state and open-drain output options
- ▶ Bus-hold function

Benefits

- ▶ Bidirectional data flow
- ▶ Very low power consumption
- ▶ Devices can be inserted or removed with system power on
- ▶ High-impedance suspend mode
- ▶ Reduced number of external components with no floating inputs

Applications

- ▶ Personal and enterprise computing systems
- ▶ Industrial automation and instrumentation
- ▶ Battery-operated systems
- ▶ Telecom switching terminals
- ▶ Consumer electronics

The NXP logic families AVC, AUP, LVC, and NT support designs that use a mix of supply voltages, ranging from 0.8 to 5.5 V. The output signals of one device can be translated up or down to match the input thresholds of another as required.

Options include bidirectional, dual-supply translators in 1-, 2-, 4-, 8-, 16- and 20-bit formats. This covers the translation voltage ranges of 0.8 to 3.6 V and 1.2 to 5.5 V, making these devices ideal for designs that use supply voltages of 1.2, 1.8, 2.5, 3.3 and 5.0 V.

Since these small footprint translators feature reduced standby and switching currents, they consume very low power while reducing the area required for battery-powered systems. Typical propagation delays are only 2 to 4 ns, with an output drive up to $\pm 32 \text{ mA}$.

In devices with a direction control pin, DIR dictates whether the translation is from the A port to B port or from the B port to A port. Integrated I_{OFF} circuitry eliminates damaging backflow current when outputs are disabled during suspend or power-down mode.



The NT family of auto-direction sense devices have onboard circuitry to automatically change direction. This removes the external direction pin resulting in a smaller package.

Package options include dark green, RoHS compliant and halogen free formats, such as SOIC, TSSOP and the groundbreaking leadless DQFN and DRQFN packages. Low pin-count devices are also available in space-saving MicroPak and PicoGate packages.

Functional description

User defined direction control

The 74LVC2T45 is a common example of a dual-supply translation buffer with user defined direction control input. The logic diagram is shown on the right. $V_{CC(A)}$ and $V_{CC(B)}$ can be supplied at any voltage between 1.2 and 5.5 V. A HIGH on DIR allows transmission from A port to B port and a LOW on DIR allows transmission from B port to A port.

Bus hold is included as an option in voltage level translating transceivers with user defined direction control. It is indicated by the addition of an H after the family in the device name. Active bus hold circuitry in the 74LVCH2T45 prevents floating inputs by holding unused data inputs at a valid logic level.

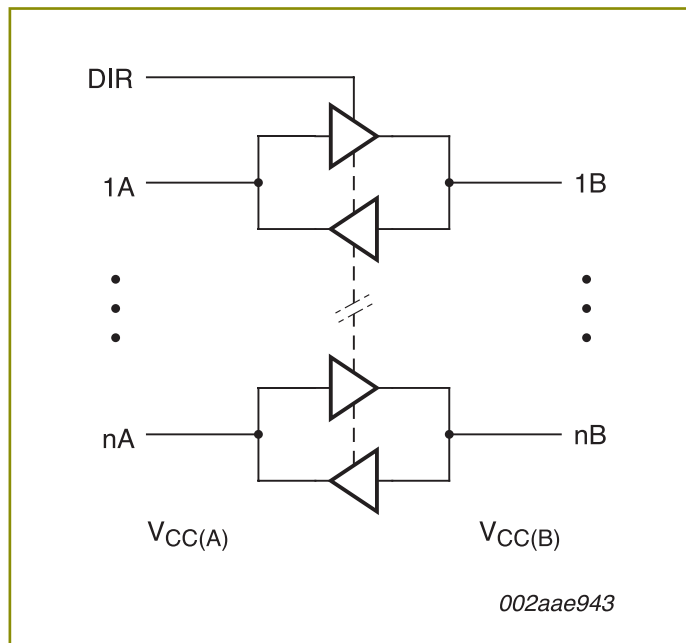
The bus hold circuit acts as an input latch, retaining the last data driven. When power is initially applied the logic state of the bus hold latch is not guaranteed, it may power-up HIGH or LOW. If a default logic state is required external resistors will be required, these should be sized to overdrive the inputs bus hold current to avoid contention issues.

Devices with 4 channels and above also include an output enable control pin \overline{OE} . A LOW on \overline{OE} will enable the outputs, a HIGH on \overline{OE} will cause the outputs to assume the high-impedance OFF-state.

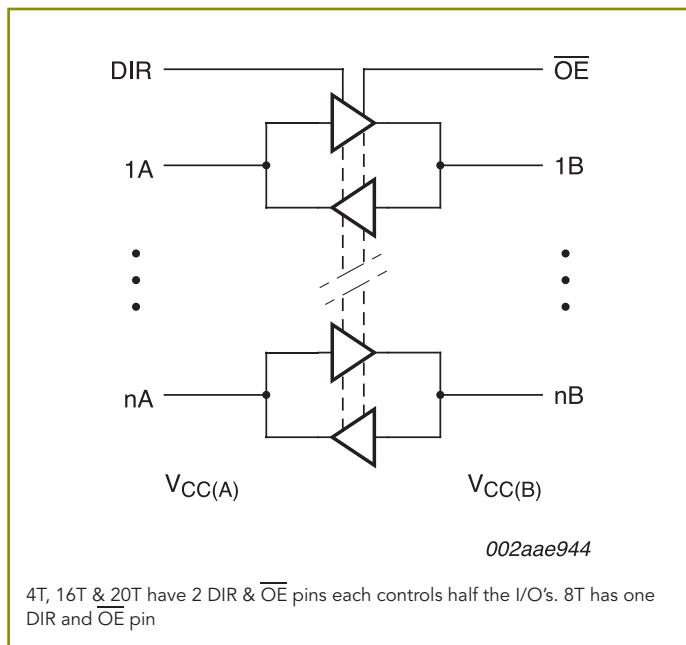
The control pins and A port are referenced to supply $V_{CC(A)}$. The B port is referenced to $V_{CC(B)}$.

The devices are fully specified for partial power-down applications using I_{OFF} . The I_{OFF} circuitry disables the output, preventing any damaging backflow current through the device when it is powered down. In suspend mode when either $V_{CC(A)}$ or $V_{CC(B)}$ are at GND level, both A port and B port are in the high-impedance OFF-state.

Voltage-translator configurations



The 'nT45 function



The 'nT245 function

Auto direction sensing

The NT family of dual-supply translators (NTS-, NTB-, and NTSX-) incorporate automatic direction control logic. This removes the need for an external direction pin and the associated external control logic.

Output edge-rate accelerator

In addition, the NT family includes output edge-rate accelerators to improve LOW-to-HIGH transition time (NTS devices) or both HIGH-to-LOW and LOW-to-HIGH (NTB and NTSX devices). During a transition the output one-shot switches on the NMOS transistor (HIGH-to-LOW transitions) or the PMOS transistor (LOW-to-HIGH transitions). This lowers the output impedance increasing current drive and reducing the output transition time.

The one-shot is activated once the input transition reaches half of its reference supply voltage; it is de-activated approximately 50 ns after the output reaches half of its reference supply voltage. To avoid signal contention and minimize dynamic I_{cc} , the user should wait for the one-shot circuit to turn-off before applying a signal in the opposite direction.

Output configuration

NTSX outputs have no static drive capability; pull-up resistors are required on both data ports.

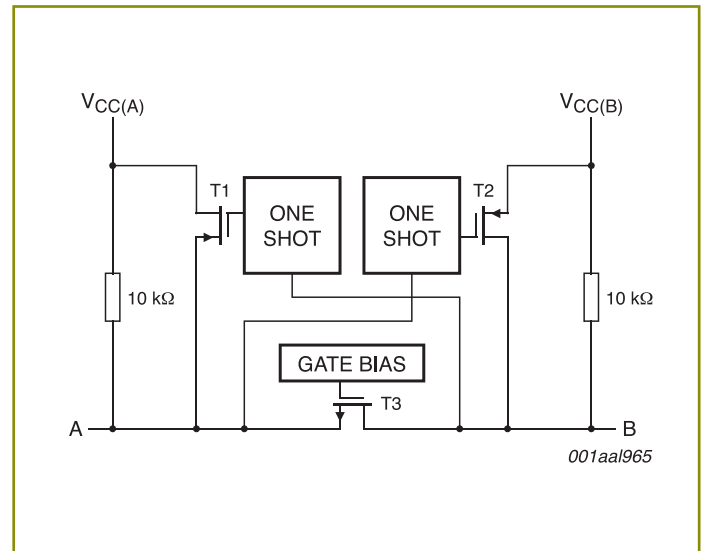
NTS outputs include integrated 10 k Ω pull-up resistors which are disabled when the output enable input is set LOW.

NTB has low drive push-pull outputs which do not require external resistors, if a pull-up resistor is used it should be greater than 50 k Ω to avoid contention issues.

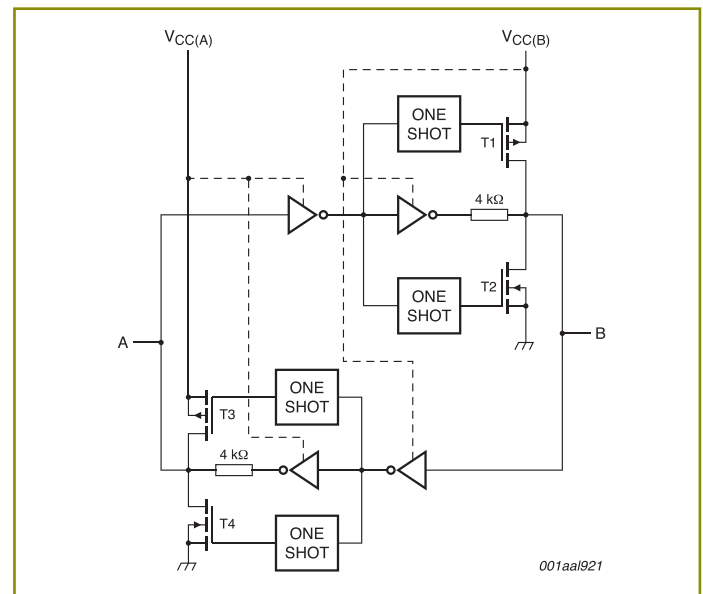
Power sequencing

No special power up sequence is required for NXP's nT245, nT45 user defined direction control translator functions or the NT family of auto-direction sensing translators. Either $V_{CC(A)}$ or $V_{CC(B)}$ can be applied first.

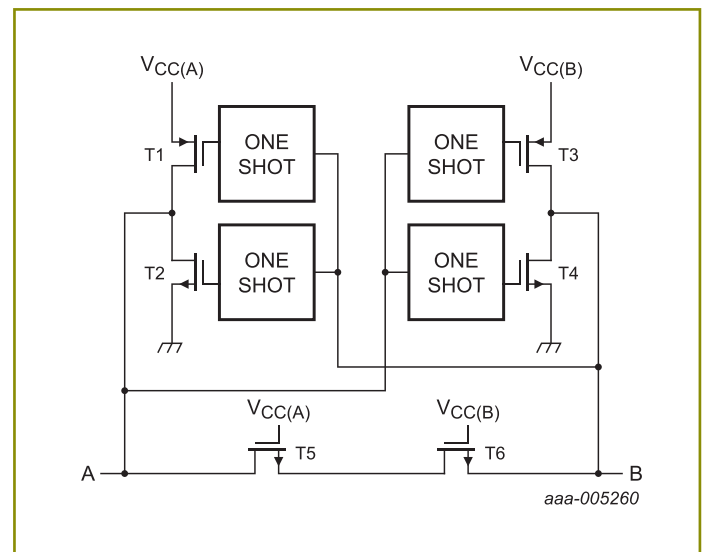
Architecture of NTS- I/O cell (one channel)



Architecture of NTB- I/O cell (one channel)



Architecture of NTSX- I/O cell (one channel)



Dual supply translators with direction control pin

Type number	Description	V _{CC(A)} (V)	V _{CC(B)} (V)	Output drive (mA)	t _{pd} (ns)	T _{amb} (°C)	Package type	Package drawing
74ALVC164245BX	16-bit transceiver (3-state)	1.5 - 5.5	1.5 - 3.6	+/- 24	2.9	-40~85	HXQFN60	SOT1134-2
74ALVC164245DGG	16-bit transceiver (3-state)	1.5 - 5.5	1.5 - 3.6	+/- 24	2.9	-40~85	TSSOP48	SOT362-1
74ALVC164245DL	16-bit transceiver (3-state)	1.5 - 5.5	1.5 - 3.6	+/- 24	2.9	-40~85	SSOP48	SOT370-1
74AUP1T34GF	single translating buffer	1.1 - 3.6	1.1 - 3.6	+/- 1.9	15.2	-40~125	XSON6	SOT891
74AUP1T34GM	single translating buffer	1.1 - 3.6	1.1 - 3.6	+/- 1.9	15.2	-40~125	XSON6	SOT886
74AUP1T34GN	single translating buffer	1.1 - 3.6	1.1 - 3.6	+/- 1.9	15.2	-40~125	XSON6	SOT1115
74AUP1T34GS	single translating buffer	1.1 - 3.6	1.1 - 3.6	+/- 1.9	15.2	-40~125	XSON6	SOT1202
74AUP1T34GW	single translating buffer	1.1 - 3.6	1.1 - 3.6	+/- 1.9	15.2	-40~125	XSON6	SOT353-1
74AUP1T45GF	single transceiver (3-state)	1.1 - 3.6	1.1 - 3.6	+/- 1.9	15.6	-40~125	XSON6	SOT891
74AUP1T45GM	single transceiver (3-state)	1.1 - 3.6	1.1 - 3.6	+/- 1.9	15.6	-40~125	XSON6	SOT886
74AUP1T45GN	single transceiver (3-state)	1.1 - 3.6	1.1 - 3.6	+/- 1.9	15.6	-40~125	XSON6	SOT1115
74AUP1T45GS	single transceiver (3-state)	1.1 - 3.6	1.1 - 3.6	+/- 1.9	15.6	-40~125	XSON6	SOT1202
74AUP1T45GW	single transceiver (3-state)	1.1 - 3.6	1.1 - 3.6	+/- 1.9	15.6	-40~125	TSSOP6	SOT363
74AVC(H)16T245BX	16-bit transceiver (3-state)	0.8 - 3.6	0.8 - 3.6	+/- 12	2.1	-40~125	HXQFN60	SOT1134-2
74AVC(H)16T245DGG	16-bit transceiver (3-state)	0.8 - 3.6	0.8 - 3.6	+/- 12	2.1	-40~125	TSSOP48	SOT362-1
74AVC(H)16T245DGV	16-bit transceiver (3-state)	0.8 - 3.6	0.8 - 3.6	+/- 12	2.1	-40~125	TSSOP48	SOT480-1
74AVC(H)16T245EV	16-bit transceiver (3-state)	0.8 - 3.6	0.8 - 3.6	+/- 12	2.1	-40~125	VFBGA56	SOT702-1
74AVC(H)1T45GM	single transceiver (3-state)	0.8 - 3.6	0.8 - 3.6	+/- 12	2.1	-40~125	XSON6	SOT886
74AVC(H)1T45GN	single transceiver (3-state)	0.8 - 3.6	0.8 - 3.6	+/- 12	2.1	-40~125	XSON6	SOT1115
74AVC(H)1T45GS	single transceiver (3-state)	0.8 - 3.6	0.8 - 3.6	+/- 12	2.1	-40~125	XSON6	SOT1202
74AVC(H)1T45GW	single transceiver (3-state)	0.8 - 3.6	0.8 - 3.6	+/- 12	2.1	-40~125	TSSOP6	SOT363
74AVC20T245BX	20-bit transceiver (3-state)	0.8 - 3.6	0.8 - 3.6	+/- 12	3.5	-40~125	HXQFN60	SOT1134-2
74AVC(H)20T245DGG	20-bit transceiver (3-state)	0.8 - 3.6	0.8 - 3.6	+/- 12	3.5	-40~125	TSSOP56	SOT364-1
74AVC(H)20T245DGV	20-bit transceiver (3-state)	0.8 - 3.6	0.8 - 3.6	+/- 12	3.5	-40~125	TSSOP56	SOT481-2
74AVC(H)2T45DC	dual-bit transceiver (3-state)	0.8 - 3.6	0.8 - 3.6	+/- 12	2.1	-40~125	VSSOP8	SOT765-1
74AVC2T45DP	dual-bit transceiver (3-state)	0.8 - 3.6	0.8 - 3.6	+/- 12	2.1	-40~125	TSSOP8	SOT505-2
74AVC(H)2T45GD	dual-bit transceiver (3-state)	0.8 - 3.6	0.8 - 3.6	+/- 12	2.1	-40~125	XSON8	SOT996-2
74AVC(H)2T45GF	dual-bit transceiver (3-state)	0.8 - 3.6	0.8 - 3.6	+/- 12	2.1	-40~125	XSON8	SOT1089
74AVC(H)2T45GN	dual-bit transceiver (3-state)	0.8 - 3.6	0.8 - 3.6	+/- 12	2.1	-40~125	XSON8	SOT1116
74AVC(H)2T45GS	dual-bit transceiver (3-state)	0.8 - 3.6	0.8 - 3.6	+/- 12	2.1	-40~125	XSON8	SOT1203
74AVC(H)2T45GT	dual-bit transceiver (3-state)	0.8 - 3.6	0.8 - 3.6	+/- 12	2.1	-40~125	XSON8	SOT833-1
74AVC32T245EC	32-bit transceiver (3-state)	0.8 - 3.6	0.8 - 3.6	+/- 12	2.1	-40~125	LFBGA96	SOT536-1
74AVC(H)4T245BQ	4-bit transceiver (3-state)	0.8 - 3.6	0.8 - 3.6	+/- 12	2.1	-40~125	DHVQFN16	SOT763-1
74AVC(H)4T245D	4-bit transceiver (3-state)	0.8 - 3.6	0.8 - 3.6	+/- 12	2.1	-40~125	SO16	SOT109-1
74AVC(H)4T245GU	4-bit transceiver (3-state)	0.8 - 3.6	0.8 - 3.6	+/- 12	2.1	-40~125	XQFN16	SOT1161-1
74AVC(H)4T245PW	4-bit transceiver (3-state)	0.8 - 3.6	0.8 - 3.6	+/- 12	2.1	-40~125	TSSOP16	SOT403-1
74AVC4TD245BQ	4-bit transceiver (3-state)	0.8 - 3.6	0.8 - 3.6	+/- 12	2.1	-40~125	DHVQFN16	SOT763-1
74AVC4TD245GU	4-bit transceiver (3-state)	0.8 - 3.6	0.8 - 3.6	+/- 12	2.1	-40~125	XQFN16	SOT1161-1
74AVC4TD245PW	4-bit transceiver (3-state)	0.8 - 3.6	0.8 - 3.6	+/- 12	2.1	-40~125	TSSOP16	SOT403-1
74AVC(H)8T245BQ	8-bit transceiver (3-state)	0.8 - 3.6	0.8 - 3.6	+/- 12	2.1	-40~125	DHVQFN24	SOT815-1
74AVC(H)8T245PW	8-bit transceiver (3-state)	0.8 - 3.6	0.8 - 3.6	+/- 12	2.1	-40~125	TSSOP24	SOT355-1
74LVC(H)1T45GF	single transceiver (3-state)	1.2 - 5.5	1.2 - 5.5	+/- 24	2.5	-40~125	XSON6	SOT891
74LVC(H)1T45GM	single transceiver (3-state)	1.2 - 5.5	1.2 - 5.5	+/- 24	2.5	-40~125	XSON6	SOT886
74LVC(H)1T45GN	single transceiver (3-state)	1.2 - 5.5	1.2 - 5.5	+/- 24	2.5	-40~125	XSON6	SOT1115
74LVC(H)1T45GS	single transceiver (3-state)	1.2 - 5.5	1.2 - 5.5	+/- 24	2.5	-40~125	XSON6	SOT1202
74LVC(H)1T45GW	single transceiver (3-state)	1.2 - 5.5	1.2 - 5.5	+/- 24	2.5	-40~125	TSSOP6	SOT363
74LVC(H)2T45DC	dual-bit transceiver (3-state)	1.2 - 5.5	1.2 - 5.5	+/- 24	2.5	-40~125	VSSOP8	SOT765-1
74LVC(H)2T45GD	dual-bit transceiver (3-state)	1.2 - 5.5	1.2 - 5.5	+/- 24	2.5	-40~125	XSON8	SOT996-2
74LVC(H)2T45GF	dual-bit transceiver (3-state)	1.2 - 5.5	1.2 - 5.5	+/- 24	2.5	-40~125	XSON8	SOT1089
74LVC(H)2T45GM	dual-bit transceiver (3-state)	1.2 - 5.5	1.2 - 5.5	+/- 24	2.5	-40~125	XQFN8	SOT902-1
74LVC(H)2T45GN	dual-bit transceiver (3-state)	1.2 - 5.5	1.2 - 5.5	+/- 24	2.5	-40~125	XSON8	SOT1116
74LVC(H)2T45GS	dual-bit transceiver (3-state)	1.2 - 5.5	1.2 - 5.5	+/- 24	2.5	-40~125	XSON8	SOT1203
74LVC(H)2T45GT	dual-bit transceiver (3-state)	1.2 - 5.5	1.2 - 5.5	+/- 24	2.5	-40~125	XSON8	SOT833-1
74LVC(H)8T245BQ	8-bit transceiver (3-state)	1.2 - 5.5	1.2 - 5.5	+/- 24	3.5	-40~125	DHVQFN24	SOT815-1
74LVC(H)8T245PW	8-bit transceiver (3-state)	1.2 - 5.5	1.2 - 5.5	+/- 24	3.5	-40~125	TSSOP24	SOT355-1
74LVC4245ABQ	8-bit transceiver (3-state)	1.2 - 5.5	1.2 - 5.5	+/- 24	3.5	-40~125	DHVQFN24	SOT815-1
74LVC4245AD	8-bit transceiver (3-state)	1.5 - 5.5	1.5 - 3.6	+/- 24	4	-40~125	SO24	SOT137-1
74LVC4245ADB	8-bit transceiver (3-state)	1.5 - 5.5	1.5 - 3.6	+/- 24	4	-40~125	SSOP24	SOT340-1
74LVC4245APW	8-bit transceiver (3-state)	1.5 - 5.5	1.5 - 3.6	+/- 24	4	-40~125	TSSOP24	SOT355-1

Dual supply translators with auto-direction sensing


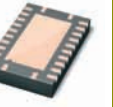
Type number	Description	V _{CC(A)} (V)	V _{CC(B)} (V)	Output drive (mA)	t _{pd} (ns)	T _{amb} (°C)	Package type	Package drawing
NTB0101GF	single transceiver (3-state)	1.2 - 3.6	1.65 - 5.5	+/- 0.02	3.8	-40~125	XSON6	SOT891
NTB0101GM	single transceiver (3-state)	1.2 - 3.6	1.65 - 5.5	+/- 0.02	3.8	-40~125	XSON6	SOT886
NTB0101GS	single transceiver (3-state)	1.2 - 3.6	1.65 - 5.5	+/- 0.02	3.8	-40~125	XSON6	SOT1202
NTB0101GW	single transceiver (3-state)	1.2 - 3.6	1.65 - 5.5	+/- 0.02	3.8	-40~125	TSSOP6	SOT363
NTB0102DP	dual-bit transceiver (3-state)	1.2 - 3.6	1.65 - 5.5	+/- 0.02	3.8	-40~125	TSSOP8	SOT505-2
NTB0102GD	dual-bit transceiver (3-state)	1.2 - 3.6	1.65 - 5.5	+/- 0.02	3.8	-40~125	XSON8	SOT996-2
NTB0102GF	dual-bit transceiver (3-state)	1.2 - 3.6	1.65 - 5.5	+/- 0.02	3.8	-40~125	XSON8	SOT1089
NTB0102GT	dual-bit transceiver (3-state)	1.2 - 3.6	1.65 - 5.5	+/- 0.02	3.8	-40~125	XSON8	SOT833-1
NTB0102GU	dual-bit transceiver (3-state)	1.2 - 3.6	1.65 - 5.5	+/- 0.02	3.8	-40~125	XQFN10	SOT1160-1
NTB0104BQ	4-bit transceiver (3-state)	1.2 - 3.6	1.65 - 5.5	+/- 0.02	3.8	-40~125	DHVQFN14	SOT762-1
NTB0104GU12	4-bit transceiver (3-state)	1.2 - 3.6	1.65 - 5.5	+/- 0.02	3.8	-40~125	XQFN12	SOT1174-1
NTB0104UK	4-bit transceiver (3-state)	1.2 - 3.6	1.65 - 5.5	+/- 0.02	3.8	-40~125	WLCSP12	OL-NTB0104UK
NTBA104BQ	4-bit transceiver (3-state)	1.2 - 3.6	1.65 - 5.5	+/- 0.02	3.8	-40~125	DHVQFN14	SOT762-1
NTBA104GU12	4-bit transceiver (3-state)	1.2 - 3.6	1.65 - 5.5	+/- 0.02	3.8	-40~125	XQFN12	SOT1174-1
NTBA104GU16	4-bit transceiver (3-state)	1.2 - 3.6	1.65 - 5.5	+/- 0.02	3.8	-40~125	XQFN16	SOT1161-1
NTS0101GF	single transceiver (3-state)	1.65 - 3.6	2.3 - 5.5	-0.02	4.4	-40~125	XSON6	SOT891
NTS0101GM	single transceiver (3-state)	1.65 - 3.6	2.3 - 5.5	-0.02	4.4	-40~125	XSON6	SOT886
NTS0101GS	single transceiver (3-state)	1.65 - 3.6	2.3 - 5.5	-0.02	4.4	-40~125	XSON6	SOT1202
NTS0101GW	single transceiver (3-state)	1.65 - 3.6	2.3 - 5.5	-0.02	4.4	-40~125	TSSOP6	SOT363
NTS0102DP	dual-bit transceiver (3-state)	1.65 - 3.6	2.3 - 5.5	-0.02	4.4	-40~125	TSSOP8	SOT505-2
NTS0102GD	dual-bit transceiver (3-state)	1.65 - 3.6	2.3 - 5.5	-0.02	4.4	-40~125	XSON8	SOT996-2
NTS0102GF	dual-bit transceiver (3-state)	1.65 - 3.6	2.3 - 5.5	-0.02	4.4	-40~125	XSON8	SOT1089
NTS0102GT	dual-bit transceiver (3-state)	1.65 - 3.6	2.3 - 5.5	-0.02	4.4	-40~125	XSON8	SOT833-1
NTS0102GU	dual-bit transceiver (3-state)	1.65 - 3.6	2.3 - 5.5	-0.02	4.4	-40~125	XQFN10	SOT1160-1
NTS0102GU8	dual-bit transceiver (3-state)	1.65 - 3.6	2.3 - 5.5	-0.02	4.4	-40~125	XQFN8	SOT1309-1
NTS0103GU10	3-bit transceiver (3-state)	1.65 - 3.6	2.3 - 5.5	-0.02	4.4	-40~125	XQFN10	SOT1160-1
NTS0104BQ	4-bit transceiver (3-state)	1.65 - 3.6	2.3 - 5.5	-0.02	4.4	-40~125	DHVQFN14	SOT762-1
NTS0104GU12	4-bit transceiver (3-state)	1.65 - 3.6	2.3 - 5.5	-0.02	4.4	-40~125	XQFN12	SOT1174-1
NTS0104PW	4-bit transceiver (3-state)	1.65 - 3.6	2.3 - 5.5	-0.02	4.4	-40~125	TSSOP14	SOT402-1
NTS0104UK	4-bit transceiver (3-state)	1.65 - 3.6	2.3 - 5.5	-0.02	4.4	-40~125	WLCSP12	OL-NTS0104UK
NTSX2102	dual-bit transceiver (open-drain)	1.65 - 5.5	1.65 - 5.5	-6.0	4	-40~125	XQFN8	SOT902-2
NTSX2102	dual-bit transceiver (open-drain)	1.65 - 5.5	1.65 - 5.5	-6.0	4.0	-40~125	XQFN8	SOT1309-1
NTSX2102	dual-bit transceiver (open-drain)	1.65 - 5.5	1.65 - 5.5	-6.0	4	-40~125	XQFN8	SOT996-2

For more information about our NT auto direction sensing translator portfolio visit <http://www.nxp.com/products/logic/family/NT/>

Packages

Package suffix	GW	GF	GW	GV	GS	GM	GT	GF
	5	6	6	6	6	6	8	8
								
Package	SOT353	SOT891	SOT363	SOT457	SOT1202	SOT886	SOT833	SOT1089
Width (mm)	2.10	1.00	2.10	2.80	1.00	1.00	1.00	1.35
Length (mm)	2.00	1.00	2.00	1.50	1.00	1.45	1.95	1.00
Pitch (mm)	0.65	0.35	0.65	0.95	0.35	0.50	0.50	0.35

Package suffix	GU-8	GM	GD	DP	GU	GF	UK	GU-12
	8	8	8	8	10	10	12	12
								
Package	SOT1309	SOT902	SOT996	SOT505	SOT1160	SOT1081-2	WLCSP12	SOT1174
Width (mm)	1.40	1.60	3.00	3.00	1.40	1.70	1.60	1.70
Length (mm)	1.20	1.60	2.00	3.00	1.80	1.00	1.20	2.00
Pitch (mm)	0.40	0.50	0.50	0.65	0.40	0.35	0.40	0.40

Package suffix	BQ	PW	GU-16	BQ	PW	D	BQ	PW
	14	14	16	16	16	16	24	24
								
Package	SOT762	SOT402-1	SOT1161	SOT763-1	SOT403-1	SOT109-1	SOT815-1	SOT355-1
Width (mm)	3.00	5.00	1.80	2.50	6.40	6.00	3.50	6.40
Length (mm)	2.50	4.40	2.60	3.50	5.00	9.90	5.50	7.80
Pitch (mm)	0.50	0.65	0.40	0.50	0.65	1.27	0.50	0.65

Package suffix	D	DGV	DGG	DGV	DGV	DGG	BQ	EC
	24	48	48	56	56	56	60	96
								
Package	SOT137-1	SOT480-1	SOT362-1	SOT481-2	SOT481-2	SOT364-1	SOT1134	SOT536-1
Width (mm)	15.50	6.40	8.10	6.40	6.40	8.10	4.00	13.5
Length (mm)	7.50	10.10	12.50	11.30	11.30	14.00	6.00	5.5
Pitch (mm)	1.27	0.40	0.50	0.40	0.40	0.50	0.50	0.8

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