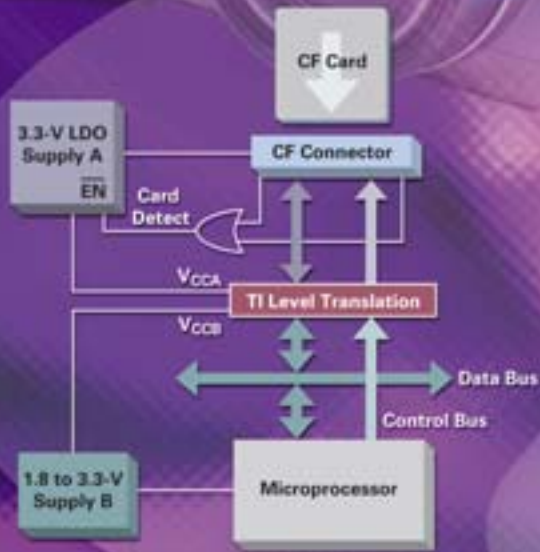
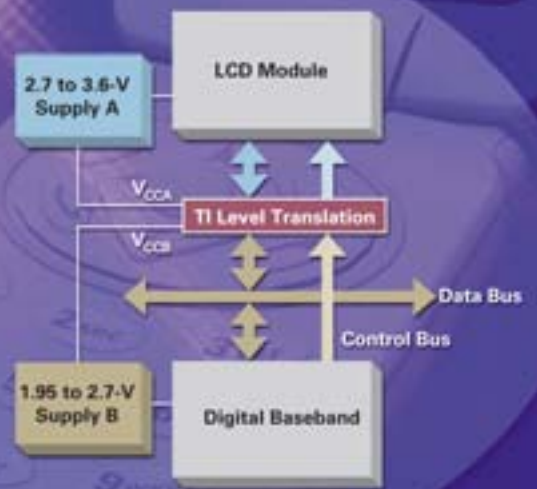


Translation Selection Guide

2007



Compact Flash Interface



LCD Interface



Overview

Overview

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Dual-Supply Translators

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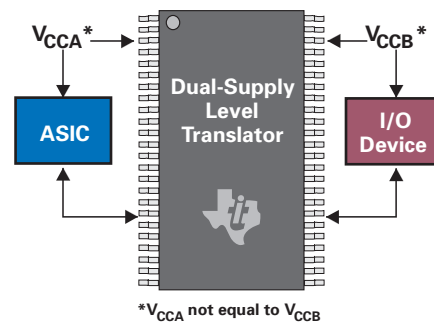
Introduction

The simultaneous use of different supply voltages on the same circuit board has led to the need for voltage-level translation. The driver output thresholds must be compatible with the receiver input thresholds. Texas Instruments (TI) offers a full spectrum of products to achieve voltage-level translation, including dual-supply level translators; FET switches; and devices with overvoltage tolerance, TTL-compatible inputs and open-drain outputs. TI offers the industry's broadest level-translation portfolio to meet all your level-translation needs.

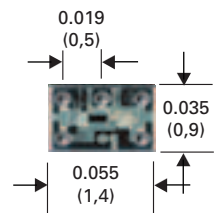
Translation devices are needed in markets such as:

- Computing
 - Protecting microprocessor or DSP inputs that are not overvoltage-tolerant
 - Interfacing any low-voltage component with legacy, high-voltage devices
- Portables
 - Interfacing a 1.8-V microprocessor with a 3.3-V LCD module
 - Interfacing a microprocessor with an external memory card

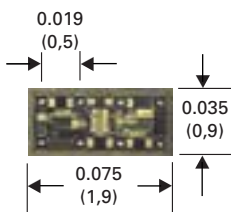
A Typical Level-Translator Situation



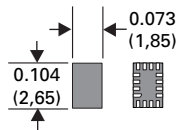
Packages



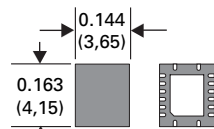
6-ball NanoStar™
(YEP/YZP)



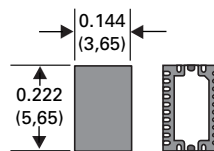
8-ball NanoStar™
(YEP/YZP)



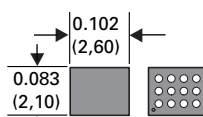
16-Pin
QFN (RSV)



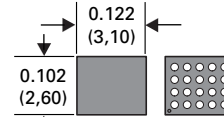
16-Pin
QFN (RGY)



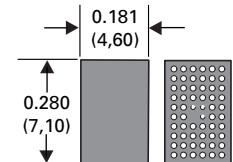
24-Pin
QFN (RHL)



12-Ball
UFBGA (ZXU)

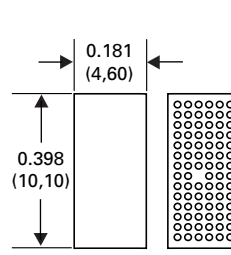


20-Ball
VFBGA (ZXY)

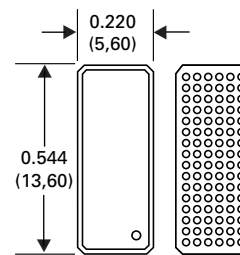


56-Ball
VFBGA (GQL)

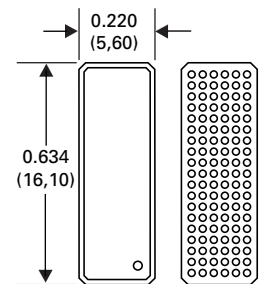
Dimensions are in inches (millimeters)



83-Ball
LFBGA (GRG)



96-Ball
LFBGA (GKE)



114-Ball
LFBGA (GKF)



Auto Direction Sensing

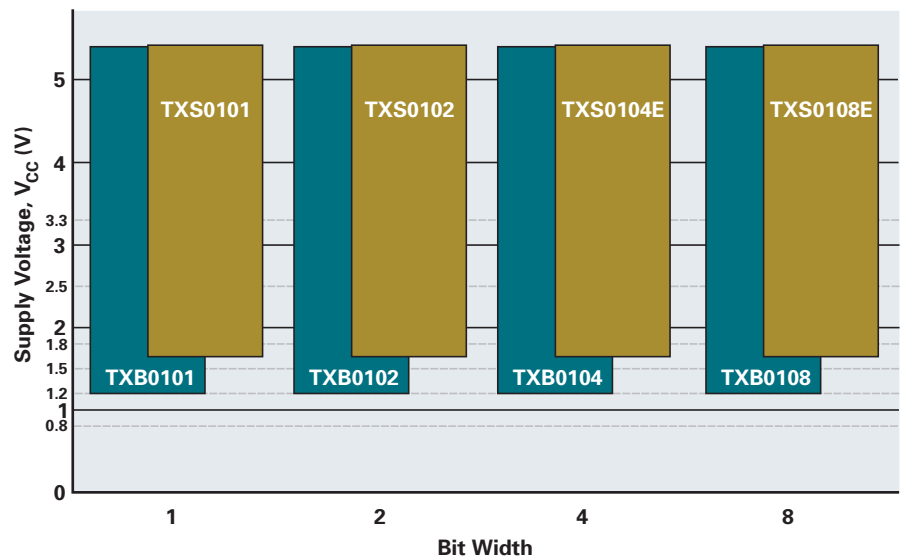


TI's auto direction-sensing translation devices improve connectivity between next-generation processors and peripheral devices. By eliminating the requirement for direction-control signals used by traditional voltage-level translation devices, designers are able to decrease the complexity of control software and save valuable GPIOs on core processors.

Features

- **Auto Direction Sensing** — No direction-control signal needed.
- **V_{CC} Isolation Feature** — If either V_{CC} input is at GND, all outputs are in the high-impedance state.
- **Highly Integrated ESD Protection** — ±15-kV ESD protection on the B port.

Auto-Direction-Sensing Translators



Bidirectional Voltage-Level Translator With Auto Direction Sensing and ±15-kV ESD Protection

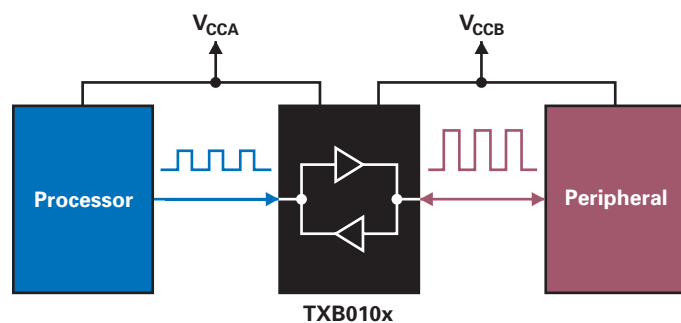
TXB010x

Key Features

- V_{CC} isolation feature
- OE input circuit referenced to V_{CCA}
- Low power consumption
- I_{OFF} supports operation in partial-power-down mode
- 1.2 V to 3.6 V on A port and 1.65 V to 5.5 V on B port (V_{CCA} ≤ V_{CCB})

Applications

- Cell phones
- SD/SDIO level translation
- SPI and GPIO level translations



Bidirectional Voltage-Level Translator for Open-Drain Applications

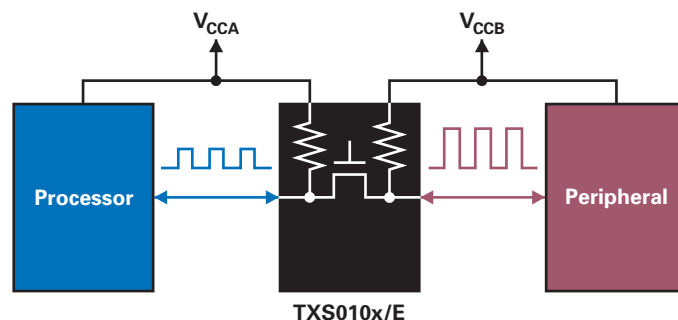
TXS010x

Key Features

- 1.65 V to 3.6 V on A port and 2.3 V to 5.5 V on B port (V_{CCA} ≤ V_{CCB})
- No power supply sequencing required

Applications

- Cell phones
- I²C level translation
- MMC and SIM card level translations



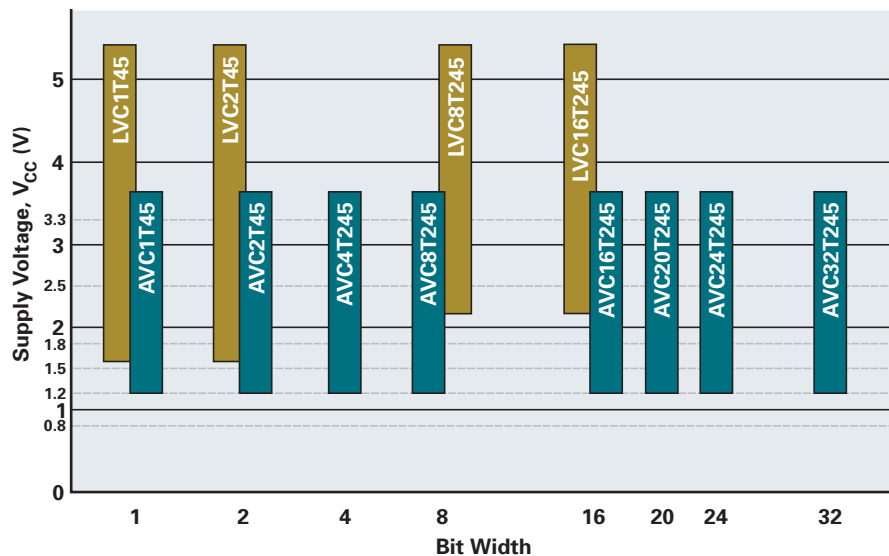
➔ Direction Control

The TI translators with direction control are designed for asynchronous communication between two buses or devices operating at different supply voltages: V_{CCA} to interface with the A side, and V_{CCB} to interface with the B side. These devices are available in a variety of bit widths and cover nearly every supply-voltage node in use today. They are flexible, easy to use, and can translate bidirectionally (up-translate and down-translate), which makes them an ideal choice for most level-translation applications.

Features

- **Fully Configurable Rails** — Each V_{CC} rail is fully configurable from 1.2 V to 3.6 V (AVCxT devices) and from 1.65 V to 5.5 V (LVCxT devices).
- **No Power-Up Sequencing** — Either V_{CC} can be powered up first (AVCxT and LVCxT devices only).
- **Standby Mode** — When one V_{CC} is switched off, all I/O ports are placed in the HiZ mode (AVCxT and LVCxT devices only).

Direction-Control Translators



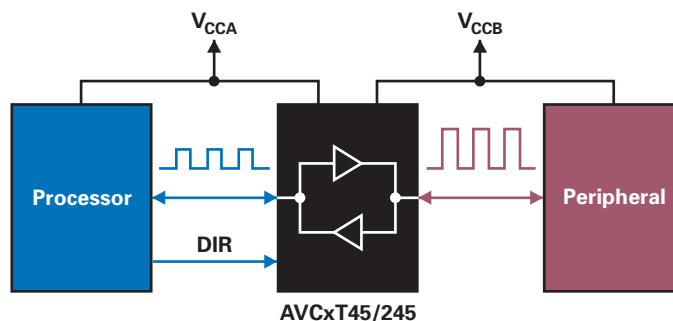
Dual-Supply Bus Transceiver With Configurable Voltage Translation and 3-State Outputs SN74AVCxT

Key Features

- Control input levels, V_{IH}/V_{IL} , are referenced to V_{CCA} voltage
- Fully configurable dual-rail design allows each port to operate over full 1.2-V to 3.6-V power-supply range
- I_{OFF} supports operation in partial-power-down mode

Applications

- Handsets
- PDAs
- Computing
- Smartphones





Dual-Supply Bus Transceiver With Configurable Voltage Translation and 3-State Outputs

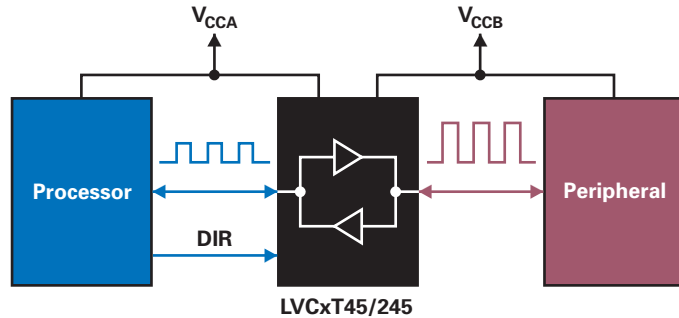
SN74LVCxT

Key Features

- Control input levels, V_{IH}/V_{IL} , are referenced to V_{CCA} voltage
- Fully configurable dual-rail design allows each port to operate over full 1.65-V to 5.5-V power-supply range
- I_{OFF} supports operation in partial-power-down mode

Applications

- Portables
- Telecom
- Computing
- Translation from 3.3 V to 5 V



Application Specific



MMC, SD Card, Memory Stick™ Voltage-Translation Transceiver

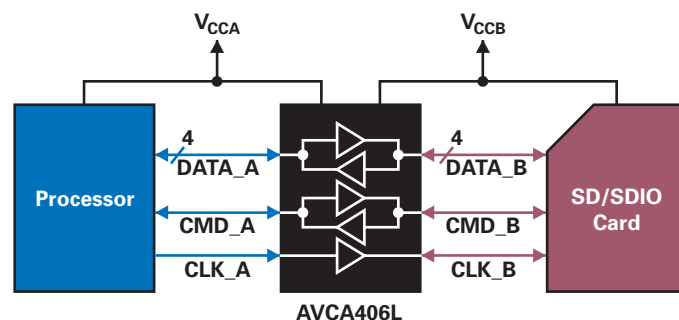
SN74AVCA406L

Key Features

- Transceiver for memory-card interface
- Configurable I/O switching levels with dual-supply pins operating over full 1.2-V to 3.6-V power-supply range
- For low-power operation, A and B ports are placed in high-impedance state when either supply voltage is switched off

Applications

- Mobile phones
- PDAs
- Digital cameras
- Personal media players
- Camcorders
- Set-top boxes



Selection Guide and Translator Nomenclature

Dual-Supply Translators

Device	Bit Width	V _{CC} Min. to Max. (V)		V _{CCA} (V)							V _{CCB} (V)							Smallest Package
		V _{CCA}	V _{CCB}	1.2	1.5	1.8	2.5	2.7	3.3	5	1.2	1.5	1.8	2.5	2.7	3.3	5	
1-Bit																		
SN74AVC1T45 ¹	1	1.2 to 3.6	1.2 to 3.6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	6-ball NanoStar™/NanoFree™	
SN74LVC1T45	1	1.65 to 5.5	1.65 to 5.5			✓	✓	✓	✓	✓			✓	✓	✓	✓	6-ball NanoStar/NanoFree	
TXB0101	1	1.2 to 3.6	1.65 to 5.5	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	6-ball NanoFree	
TXS0101	1	1.65 to 3.6	2.3 to 5.5			✓	✓	✓	✓				✓	✓	✓	✓	6-ball NanoFree	
2-Bit																		
SN74AVC2T45 ¹	2	1.2 to 3.6	1.2 to 3.6	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		8-ball NanoStar/NanoFree	
SN74LVC2T45	2	1.65 to 5.5	1.65 to 5.5			✓	✓	✓	✓	✓			✓	✓	✓	✓	8-ball NanoStar/NanoFree	
TXB0102	2	1.2 to 3.6	1.65 to 5.5	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	8-ball NanoFree	
TXS0102	2	1.65 to 3.6	2.3 to 5.5			✓	✓	✓	✓				✓	✓	✓	✓	8-ball NanoFree	
4-Bit																		
SN74AVC4T245 ¹	4	1.2 to 3.6	1.2 to 3.6	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		16-pin QFN	
TXB0104	4	1.2 to 3.6	1.65 to 5.5	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	12-ball UFBGA	
TXS0104E	4	1.65 to 3.6	2.3 to 5.5			✓	✓	✓	✓				✓	✓	✓	✓	12-ball UFBGA	
8-Bit																		
SN74AVC8T245 ¹	8	1.2 to 3.6	1.2 to 3.6	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		24-pin QFN	
SN74LVC8T245 ¹	8	1.65 to 5.5	1.65 to 5.5			✓	✓	✓	✓	✓			✓	✓	✓	✓	24-pin QFN	
TXB0108	8	1.2 to 3.6	1.65 to 5.5	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	20-ball VFBGA	
TXS0108E	8	1.65 to 3.6	2.3 to 5.5			✓	✓	✓	✓				✓	✓	✓	✓	20-ball VFBGA	
16-Bit																		
SN74AVC16T245 ¹	16	1.2 to 3.6	1.2 to 3.6	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		56-ball VFBGA	
SN74LVC16T245 ¹	16	1.65 to 5.5	1.65 to 5.5			✓	✓	✓	✓	✓			✓	✓	✓	✓	56-ball VFBGA	
20-Bit																		
SN74AVC20T245 ¹	20	1.2 to 3.6	1.2 to 3.6	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		56-ball VFBGA	
24-Bit																		
SN74AVC24T245 ¹	24	1.2 to 3.6	1.2 to 3.6	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		83-ball LFBGA	
32-Bit																		
SN74AVC32T245 ¹	32	1.2 to 3.6	1.2 to 3.6	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		96-ball LFBGA	
Application-Specific																		
CF4320H	—	1.65 to V _{CCB}	3 to 5.5			✓	✓	✓	✓	✓					✓	✓	114-ball LFBGA	
SN74AVCA406L	—	1.2 to 3.6	1.2 to 3.6	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		20-ball VFBGA	

¹Bus-hold option available.

Translator Nomenclature	TX	S	01	04	E	RGY	R
Prefix: TX = TI Translator							
Device Type: S = Switch, B = Buffer							
Grade							
Bit Width							
ESD Protection: E = IEC Level 4							
TI Package Designator							
Tape and Reel: R or none = Standard reel, T = Small reel							

Translator Nomenclature	SN74	AVC	20	T	245	DGV	R
TI Prefix							
Technology Family: AHC, AHCT, AVC, AUC, CBT, CBTD, CB3T, HCT, LVC, TVC							
Bit Width							
Device Type: T = Translation							
Function Identifier							
TI Package Designator							
Tape and Reel: R or none = Standard reel, T = Small reel							

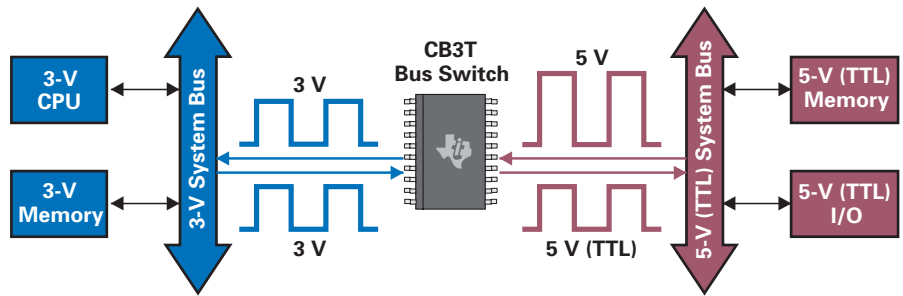


FET Switches

Devices from TI's CBT, CBTD, CB3T and TVC families can be used in level-translation applications. The diagram shows a CB3T bus switch interfacing a 3-V bus with a 5-V (TTL) bus. The CB3T device down-translates the signals from the 5-V bus to 3-V levels.

No translation is necessary to transfer signals from the 3-V bus to the 5-V (TTL) bus, since the V_{OH} level from the CB3T switch is greater than the required V_{IL} of the 5-V (TTL) devices connected to the 5-V bus.

FET Switch for Translation



Advantage

- Fast propagation delays

Overvoltage-Tolerant Devices

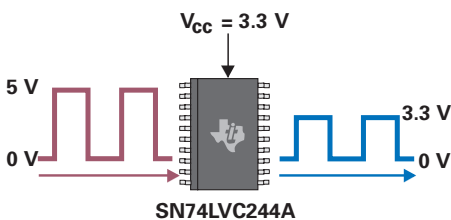
Devices with overvoltage-tolerant inputs can be used to perform down-translation as shown in the diagram. Logic families with overvoltage-tolerant inputs include:

- AHC
- LV-A
- AUC
- LVC
- AVC

Advantages

- Only one supply voltage needed
- Broad portfolio of AHC, AUC, AVC, LV-A and LVC devices

Down-Translation



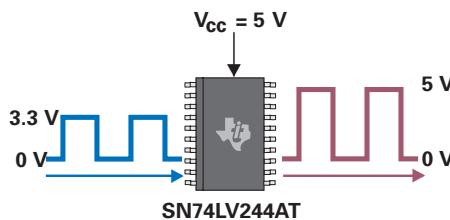
Devices With TTL-Compatible Inputs

Up-translation from 3.3-V LVCMOS/LVTTL to 5-V CMOS levels can be achieved with logic devices from TI's HCT, AHCT, ACT and AUP families.

Advantages

- Only one supply voltage needed
- Broad portfolio of HCT, AHCT, ACT and AUP devices

TTL Up-Translation



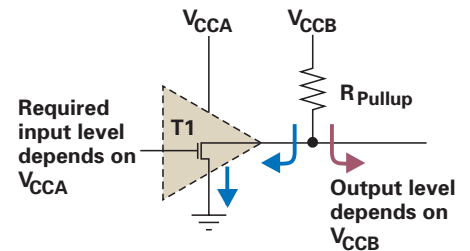
Devices With Open-Drain Outputs

Devices with open-drain outputs can be used to perform both up-translation and down-translation. The output voltage is determined by V_{CCB} . This output level can be higher than V_{CCA} (up-translation) or lower than V_{CCA} (down-translation).

Advantage

- Flexibility in translating to/from a variety of voltage nodes

Translation With Open-Drain Buffers



Translation Sample Requests

Working day and night and need a free TI product sample fast? We're waiting to take your order online 24/7.

We'll help you. That's what our product-sample program is all about.

- Free product samples
- 10,000 different devices plus package options
- No waiting to talk to TI salespeople or distributors
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- Shipping confirmation notice lets you track your order on the UPS Web site
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