

Efficient white goods



Create smarter, more efficient white goods

An industry-leading portfolio of cost-effective, power-saving solutions for major home appliances

Your reliable partner for white goods





An industry-leading portfolio of cost-effective, power-saving solutions for major home appliances

With NXP Semiconductors as your partner for white goods, you have access to one of the widest portfolios in the industry. We specialize in power efficiency, combined with flexibility and low cost, so you always find the right fit for your next design, whether it's a washing machine, a refrigerator, or a room air conditioner.

We have one of the industry's most extensive selections of 8- and 32-bit microcontrollers, delivering performance and functionality in 80C51, ARM7, and ARM9 formats. We even have advanced ARM-based devices that integrate an LCD controller, so you can save time and simplify development in applications that use a display.

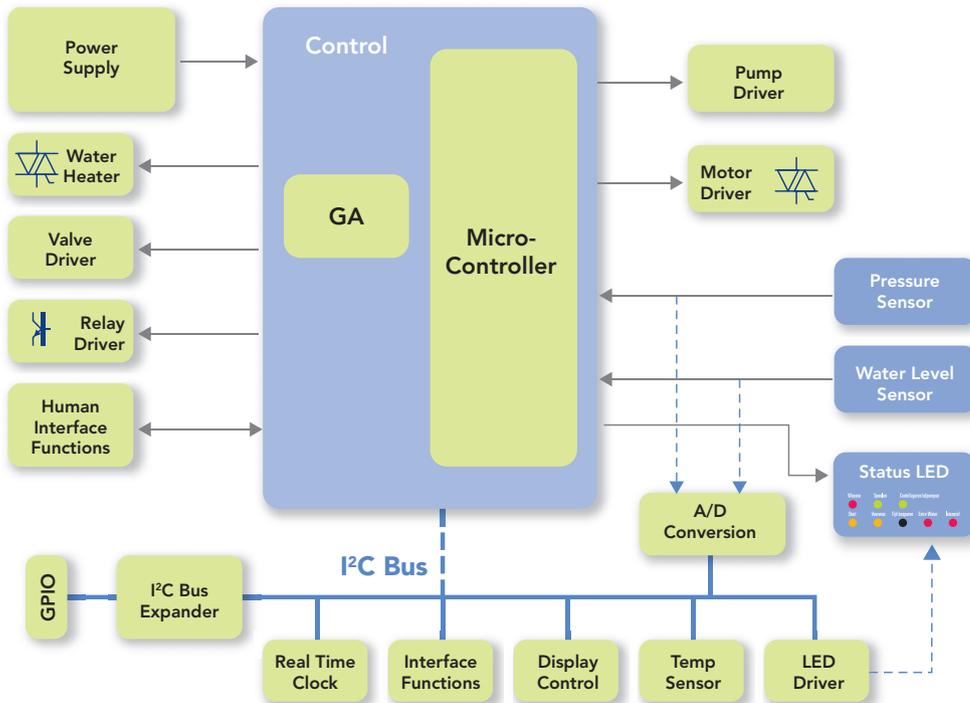
Our power-supply solutions let you optimize your design, using integrated formats that make design-in easy, or with discrete solutions that provide the lowest possible cost.

For applications that use variable speed control, our 3Q Hi-Com triacs deliver the industry's highest immunity ratings, with a lower cost of ownership.

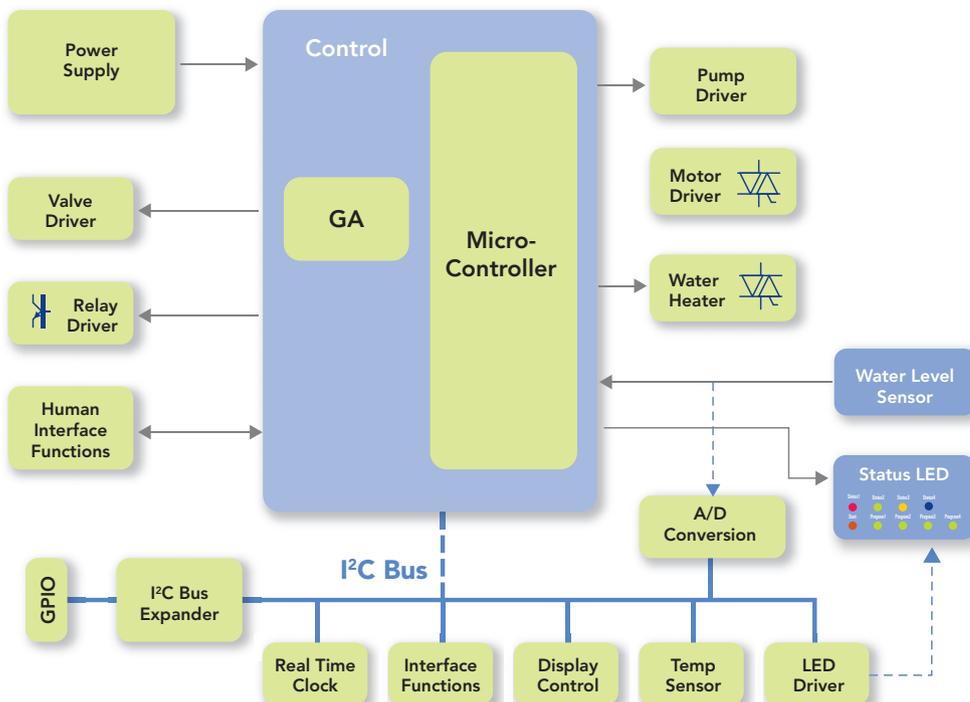
Our I²C-bus portfolio is second to none, with simple-to-use, truly plug-and-play solutions for all kinds of essential distal function blocks, including real-time clocks, temperature buffers with internal or external diodes, and general-purpose I/O (GPIO) expanders.

We regularly introduce new levels of integration and smaller packaging for our general-application products, and are a recognized leader in technologies like BISS (low V_{CEsat}) transistors and Resistor Equipped Transistors (RETs). Plus, as the second-largest supplier of small-signal discretes, we offer one of the largest capacities in the world, so you're always assured of a steady supply, even during peak delivery.

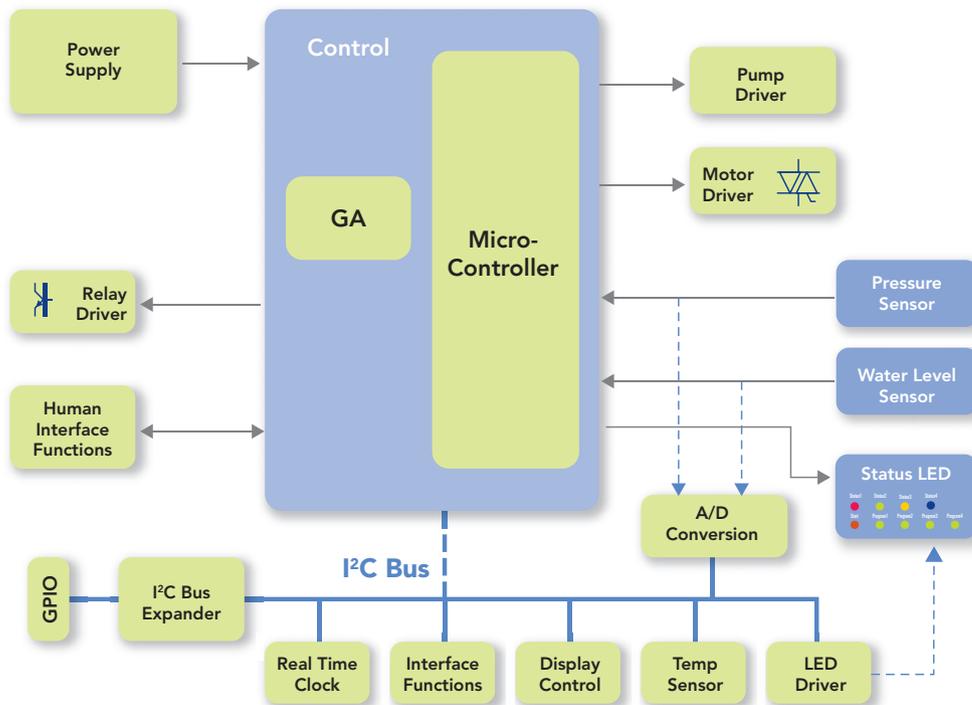
Washing machine application



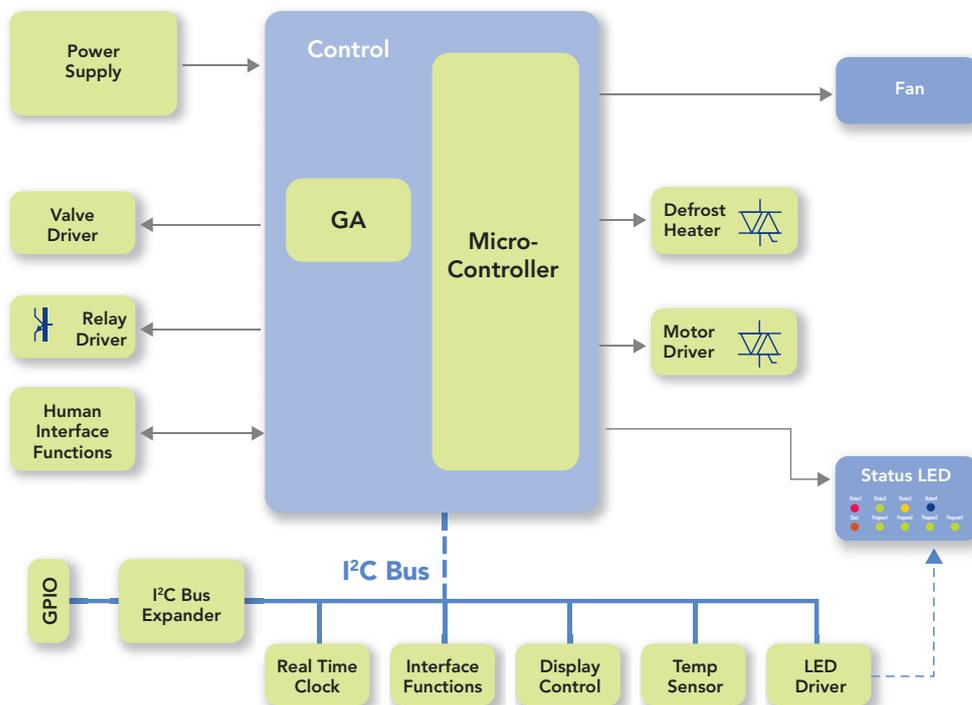
Dishwasher application



Dryer application



Refrigerator application





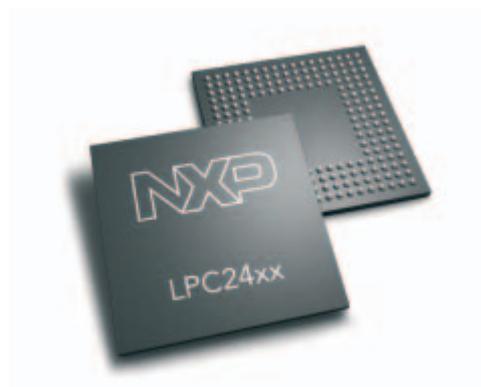
For white goods, we take a family approach, offering the widest selection of ARM7 and ARM9 microcontrollers. That means you'll always find the right core, the right memory size, and the right mix of peripherals for your application. The LPC family provides an added level of flexibility, too, since you can reuse software code, hardware, and design tools throughout the family.

We support the move toward high-end features, with integrated LCD controllers and a wide range of connectivity interfaces. The NXP BlueStreak family, for example, includes an LCD controller in every device. Looking to the future, we will continue to expand our ARM portfolio, building on a new licensing agreement that also includes access to the ARM Cortex family of processors.

LPC2000 series

LPC2000 microcontrollers are 32-bit ARM7 devices that operate at up to 72 MHz. They integrate up to 512 kB of zero wait-state Flash memory, so each device runs as fast as SRAM memory.

- ▶ 32-bit ARM7TDMI-S core with speeds up to 72 MHz
- ▶ Up to 512 kB of zero wait-state Flash
- ▶ Options for serial interfaces: I²C-bus, UART, SPI, CAN
- ▶ Options for 10-bit ADCs and DACs
- ▶ Low power consumption
- ▶ Package options include tiny (7 x 7 mm) LQFP



“From the smallest 8-bit 80C51 devices to the highest performing 32-bit ARM devices, our microcontrollers drive the industry. ”

Industry-leading options for microcontrollers

LH75x and LH7A404 (BlueStreak) series

These flexible, powerful microcontrollers, based on ARM7 and ARM9 cores, integrate an LCD controller so they save time-to-market for applications that use an LCD screen. They're supported by comprehensive software and hardware design tools, for the easiest possible design-in.

- ▶ 32-bit ARM7TDMI-S, ARM720T, and ARM922T cores with speeds up to 266 MHz
- ▶ Video support (ARM9)
- ▶ Integrated display buffer (ARM9) for maximizing system performance
- ▶ Integrated LCD controller (supporting VGA up to 1024 x 768 resolution)
- ▶ 32-bit external bus with SDRAM controller and NAND Flash boot capability
- ▶ Options for serial interfaces: USB 2.0, I²C-bus, I²S, UART, SSI/SSP, IrDA
- ▶ Options for 10-bit ADC with touchscreen interface
- ▶ Low power consumption

LPC3000 series

LPC3000 series microcontrollers use a powerful ARM926 core, an LCD controller, and a large set of standard peripherals to achieve outstanding performance. The integrated LCD controller makes them an especially good choice for white goods that use an LCD panel.

- ▶ 32-bit ARM926EJ-S core with speeds up to 200 MHz
- ▶ Unique ARM9 Vector Floating Point coprocessor
- ▶ Highest ARM9 memory implementation for faster operation (256-k on-chip SRAM , 32-k D-cache, 32-k I-cache)
- ▶ High-performance TFT controller with color depth up to 24 bits
- ▶ 32-bit external bus for use with DDR, DRAM, NAND Flash, SRAM
- ▶ Advanced peripherals, including Ethernet, USB, SD Card, SPI, and more
- ▶ Low-power process consumption
- ▶ Advanced power management

More information: www.nxp.com/microcontrollers

High-efficiency power supplies optim

NXP is committed to sustainability and eco-friendly design, and offers a full range of power-saving technologies that increase efficiency and save energy. Use an integrated solution for easy design-in, or create a discrete solution for the lowest cost.

STARplug ICs for universal AC/DC supply

Our proven STARplug family offers true valley switching, very high efficiency, and a competitive BOM count. Each highly integrated controller includes a full range of protection features that reduce external components and lower overall cost, and they're all available in space-saving SO and DIP packages.

The family includes a 650-V MOSFET and operates over a wide V_{CC} range to deliver output power up to 30 W. The ICs support low-power standby operation with frequency reduction, and integrate an internal error amplifier that enables primary sensing and uses adjustable over-current protection.



Optimized for simplicity and cost



STARplug ICs for white goods

Type	Package	$R_{DS(on)}$ (Ω)	Max. output power global mains (W)
TEA1520T	SO-14	48	2 – 5
TEA1520P	DIP-8	48	2 – 5
TEA1521T	SO-14	24	3 – 7
TEA1521P	DIP-8	24	3 – 7
TEA1522T *	SO-14	12	7 – 9
TEA1522P *	DIP-8	12	7 – 9
TEA1523P	DIP-8	6.5	9 – 12
TEA1620P	DIP-8	48	2 – 5
TEA1622P *	DIP-8	12	7 – 9
TEA1623P	DIP-8	6.5	9 – 12
TEA1623PH	HDIP-16	6.5	12 – 30

* recommended for most white goods

Discrete solutions for the main power supply

With proven technology, smaller packages, and a wide selection at a lower cost, our commodity products and complex discretes work together to create a highly efficient main power supply.

Zener diodes	BZX84x (SOT23) series, BZX384x (SOD323) series
Switching diodes	PRLL4148 (SOD80C), BAS16 (SOT23), BAS316 (SOD323)
General-purpose diodes	BAS20 (SOT23), BAS321 (SOD323)
General-purpose transistors	BC847 (SOT23), BC847W (SOT323)
Voltage regulators	PVR series (combines transistor and Zener diode)
Mosfet drivers	PMD series (up to 4 discretes in one package)
Rectifier diodes	BY229-600, BY229X-600, BY229X-800
Secondary rectifier diodes	BYQ28x, BYW29x, BYQ30x, BYV32x, BYV42x, BYV72x, BYV79x
MEGA Schottky secondary rectifiers	PMEG2020EJ, PMEG3020EJ, PMEG4010EJ, PMEG6010CEJ SOD323F packages replace SMA and SOD123 packages

Three-quadrant Hi-Com triacs for

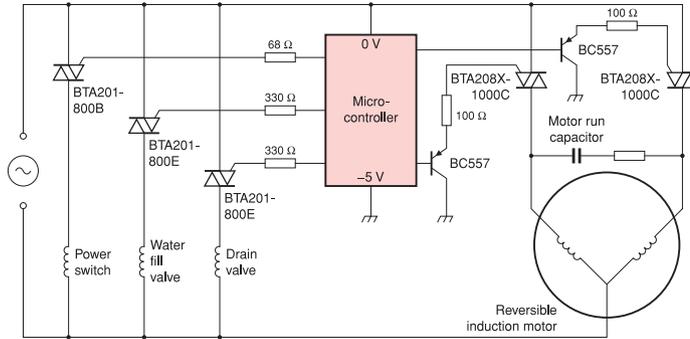


NXP's three-quadrant (3Q) Hi-Com triacs offer the best immunity to false triggering, with a lower cost of ownership, and are essential components in appliances that use variable speed control. The BTA series uses an innovative implementation to deliver higher static stability, higher resistance to fast current transients, and very robust commutation performance. Simple circuitry leads to increased reliability, and the wide range of package options makes them easy to mount. Plus, when used in combination with one of NXP's advanced LPC microcontrollers, they eliminate the need for a separate gate driver.

Features

- ▶ Highest V_{DRM} and high dV_{D}/dt for increased static stability
- ▶ High dI_{T}/dt for greater resistance to fast current transients
- ▶ High dI_{com}/dt and dV_{com}/dt for better commutation performance
- ▶ Increased reliability with simpler circuitry
- ▶ Mechanically and electrically compatible with any triac on the market
- ▶ Benchmark cost position
- ▶ Excellent quality records
- ▶ Optimized for use with NXP LPC series microcontrollers (separate gate driver not needed)
- ▶ Operate in 1st, 2nd and 3rd quadrants with positive or negative gate-triggering current
- ▶ Operate in all IC and discrete trigger circuits, isolated and non-isolated
- ▶ Wide variety of package options for best mounting

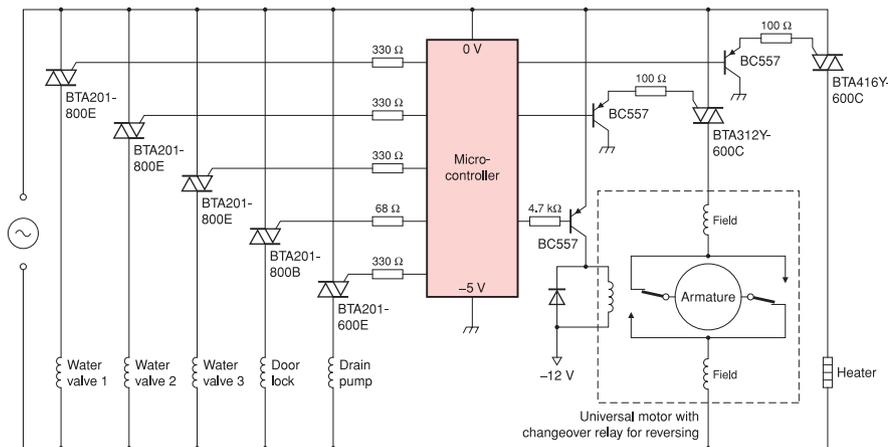
greater efficiency at a lower cost



Note: 0 V may be described as +5 V and -5 V may be described as 0 V in your system

brb186

BTA series triacs in horizontal-axis washer



Note: 0 V may be described as +5 V and -5 V may be described as 0 V in your system

brb187

BTA series triacs in vertical-axis washer

Recommended BTA series triacs for washing machines

Water Fill Valve	Induction Motor	Power Switch	Drain Valve / Pump
BTA201-600E	BTA208X-1000C	BTA201-600B	BTA201-600E
BTA201-800E	BTA208B-1000C	BTA201-800B	BTA201-800E
			BTA202X-600E
			BTA202X-800E

For vertical axis washer

Water Fill Valve	Universal Motor	Heater Control	Door Lock	Drain Pump
BTA201-600E	BTA312-600C	BTA316-600C	BTA201-600B	BTA201-600E
BTA201-800E	BTA312-800C	BTA416Y-600C	BTA201-800B	BTA201-800E
	BTA312Y-600C		BTA201-600E	BTA202X-600E
	BTA312Y-800C		BTA201-800E	BTA202X-800E

For horizontal axis washer



BTA series (3Q) Hi-Com triacs

$I_{T(RMS)}$ (A)	V_{DRM} (V)	$I_{GT} (max)$ (mA)	SOT54 (TO92)	SOT78 (TO220AB)	SOT78D (internally insulated TO220AB)	SOT186A (isolated TO220AB)	SOT223	SOT404 (D ² PAK)	SOT428 (DPAK)
0.8	600 / 800	D/E	BTA2008						
1	600 / 800	B/E/ER	BTA201						
1	600 / 800	E					BTA201W		
1	600	B/C/D/E/F					BTA204W		
1	800	C/E					BTA204W		
2	600 / 800	D/E				BTA202X			
4	600	B/C/D/E/F		BTA204		BTA204X			BTA204S
4	800	B/C/E		BTA204		BTA204X			BTA204S
8	600	B/D/E/F		BTA208		BTA208X			BTA208S
8	800	B/E		BTA208		BTA208X			BTA208S
8	1000	C				BTA208X		BTA208B	
12	600	B/D/E/F		BTA212		BTA212X		BTA212B	
12	600	D		BTA312		BTA312X		BTA312B	
12	600	CT		BTA312				BTA312B	
12	600 / 800	B/C/E		BTA312		BTA312X		BTA312B	
12	600 / 800	C			BTA312Y				
12	800	B/E		BTA212		BTA212X		BTA212B	
12	800	ET		BTA312				BTA312B	
12	600 / 800	B/C			BTA412Y				
16	600	B/D/E/F		BTA216		BTA216X		BTA216B	
16	600	BT		BTA216					
16	600	BT/D		BTA316					
16	600 / 800	B/C/E		BTA316		BTA316X		BTA316B	
16	800	B		BTA216		BTA216X		BTA216B	
16	600 / 800	B/C			BTA416Y				
25	600	BT		BTA225					
25	600 / 800	B		BTA225				BTA225B	

$I_{GT}(max)$ ratings: D = 5 mA; E, ET, ER = 10 mA; F = 25 mA; C, CT = 35 mA; B, BT = 50 mA

Types in **bold** represent new products



4Q triacs

NXP's four-quadrant (4Q) triacs are optimized for "easy" resistive loads and are ideal for low-current, sensitive-gate designs. Our portfolio supports competitor type numbers, for easy second-sourcing, without changes to the existing BOM.

BT series 4Q triacs

$I_{T(RMS)}$ (A)	Type	Application
0.6	BT1306 MAC97xx	Defrost heater
0.8	BT1308 Z00607MA	Defrost heater
1	BT131 Z010xx	Defrost heater, valves
4	BT134	Defrost heater, valves
4	BT136	Defrost heater, valves
16	BT139	Water heater
25	BTA140	Water heater

More information: www.nxp.com/products/discretes/triacs_thyristors/



Timing and temperature, buffers, and other general-purpose functions

In the more than 20 years since we first introduced the I²C-bus (as Philips Semiconductors), this simple, two-wire protocol has been a key enabling technology for a broad range of applications. We offer the industry's broadest portfolio of I²C-bus logic, providing essential components like GPIO expanders, bus expanders, voltage translators, LED blinkers and dimmers, tiny serial ADCs and DACs, buffers, clocks and RTCs, simple LCD display drivers, DIP switches, EEPROMs, RAM, and CBT switches, multiplexers, digital temperature sensors, bridge ICs, and more.

More information: www.nxp.com/i2c/



I²C-bus analog-to-digital converters

- ▶ Convert signals from digital to analog, analog to digital
- ▶ Internal oscillator
- ▶ Power On Reset (POR)

PCA9691	4-channel 8-bit 11 kbt/s A/D and D/A converter; I ² C: 100 kHz
PCF8591	4-channel 8-bit 110 kbt/s A/D and D/A converter; I ² C: 1 MHz
TDA8444	8-channel 6-bit D/A converter

I²C-bus LED dimmers/blinkers

- ▶ General-purpose I/O and LED control
- ▶ No external components required: internal oscillator provides PWM frequency and duty cycles
- ▶ Programmable blink rates
- ▶ On/off/blink or dim LED

- ▶ LED brightness controlled by setting frequency to and changing duty cycle to vary LED's average current
- ▶ For certain types extra pins can be used as inputs or outputs
- ▶ For certain types: hardware reset pin for state machine
- ▶ Open-drain outputs capable of 25-mA sink

LED dimmers (Freq. range: 152 Hz to 1.69 sec.)	
PCA9530	2-bit LED dimmer
PCA9531	8-bit LED dimmer
PCA9532	16-bit LED dimmer
PCA9533	4-bit LED dimmer
PCA9632/33	Fm+ 4-bit 5-PWM LED controller
PCA9634	Fm+ 8-bit 9-PWM LED controller
PCA9635	Fm+ 16-bit 17-PWM LED controller
PCA9685	Fm+ 16-bit 4Kstep LED controller

LED blinkers (Freq. range: 152 Hz to 1.69 sec.)	
PCA9550	2-bit LED blinker
PCA9551	8-bit LED blinker
PCA9552	16-bit LED blinker
PCA9553	4-bit LED blinker
PCA9625	Fm+ LED controller (24 V, 100 mA)
SAA1064	4 x 7 I ² C-bus LED driver with decimal



I²C-bus general-purpose I/O (GPIO) expanders

- ▶ Connect parallel I/O to serial I²C-bus or SMBus and provide I/O expansion
- ▶ Quasi output: upper transistor is on for half a clock cycle and then held up by a weak current source (25-mA sink)
- ▶ Extend GPIO from I²C-bus or SMBus
- ▶ True Output: configurable as input or output with polarity inversion (push/ pull with 25-mA sink and 10-mA source)

Quasi output (weak current source)	
PCA8574/74A	8-bit with interrupt
PCA8575	16-bit with interrupt
PCA9500	8-bit with 2-kbit EEPROM
PCA9501	8-bit with 2-kbit EEPROM, interrupt
PCA9558	8-bit w/ 5-bit DIP, 2-kbit EEPROM
PCA9670	Fm+ 8-bit with reset
PCA9671	Fm+ 16-bit with reset
PCA9672	Fm+ 8-bit with interrupt, reset
PCA9673	Fm+ 16-bit with interrupt, reset
PCA9674/74A	Fm+ 8-bit with interrupt
PCA9675	Fm+ 16-bit with interrupt
PCF8574/74A	8-bit with interrupt
PCF8575/75C	16-bit with interrupt

True output (configurable push/pull)	
PCA9502	8-bit SPI/I ² C with interrupt, reset
PCA9505/06	40-bit with interrupt, reset, OE
PCA9534/54/54A	8-bit with interrupt
PCA9535/35C/55	16-bit with interrupt
PCA9536	4-bit
PCA9537	4-bit with interrupt, reset
PCA9538	8-bit with interrupt, reset
PCA9539	16-bit with interrupt, reset
PCA9557	8-bit with reset
PCA9698	Fm+ 40-bit with interrupt, reset, OE

I²C-bus temperature and voltage sensors

- ▶ Hardware monitors use I²C-bus to report temperature and/or voltage
- ▶ Remote sensor is more accurate than package-mounted sensors (analog input pins let external

- transistors and diodes – in a processor, for example – perform very precise temperature sensing)
- ▶ SE97/98 per JEDEC specification for RDIMM and SO-DIMM applications

LM75A/B	±2 °C local I ² C-bus temperature sensor and thermal watchdog™
NE1617A	±2 °C local / remote I ² C-bus temperature monitor
NE1619	±2 °C local / remote I ² C-bus temperature and voltage monitor
SA56004	±1 °C local / remote digital temp sensor with over-temp alarms
SE95	±1 °C high accuracy local I ² C-bus temperature sensor and thermal Watchdog
SE97	±1 °C local I ² C-bus temperature sensor with 2-Kbit EEPROM SPD
SE98	±1 °C local I ² C-bus temperature sensor

I²C-bus real-time clocks

- ▶ 32.768-kHz quartz oscillator
- ▶ Year, month, day, hour, minute, second (1/100-sec resolution)
- ▶ Alarm and timer functions

- ▶ Wide operating supply voltage range (1.0 to 5.5 V)
- ▶ Open drain interrupt pin
- ▶ Low back-up current (0.25 µA at 3 V)
- ▶ Low-voltage detection
- ▶ Temperature compensation, integrated quartz

PCA8565	High-temperature (125 °C) I ² C-bus real-time clock
PCF8563	Low-power I ² C-bus real-time clock
PCF8583	I ² C real-time clock with 240-byte RAM
PCF8593	I ² C real-time clock with 1/100-second resolution
PCF2128	RTC with integrated temperature compensated quartz oscillator

I²C-bus LCD drivers

- ▶ Low power
- ▶ On-chip bias
- ▶ Temperature compensation

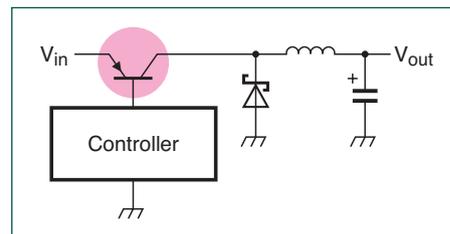
- ▶ Blinking
- ▶ No external parts required

PCF2113/2116/2119	I ² C-bus LCD character display
PCF8531/8535/8811	I ² C-bus LCD graphic drivers
PCF8533	80-to-320 segment I ² C-bus LCD segment driver
PCF8534A	60-to-240 segment I ² C-bus LCD segment driver
PCF8562	32-to-128 segment I ² C-bus LCD segment driver
PCF8566	24-to-96 segment I ² C-bus LCD segment driver
PCF8576D	40-to-160 segment I ² C-bus LCD segment driver
PCF8577C	32-to-64 segment I ² C-bus LCD segment driver
PCF8578/79	>384 segment I ² C-bus LCD segment/dot driver

As the second-largest supplier of small-signal discretes, we offer one of the largest production capacities in the world. We give you the broadest range of options, so you get choice as well as the ability to support peak delivery. We cover a wide range of functionality, from Darlington and switching devices right up to the latest developments in Resistor Equipped Transistors (RETs) and low V_{CEsat} (BISS) transistors. We are always expanding our portfolio, with new levels of integration, smaller packaging, and improved performance.

A complete range of general-applications

BISS transistors



Key features

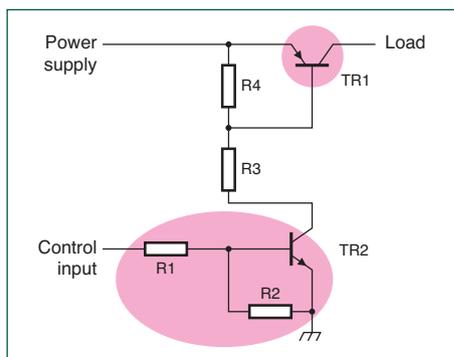
- ▶ Low saturation voltage ($V_{CEsat} = 334$ mV at 5 A)
- ▶ High collector current (SOT223: $I_{c(max)} = 5$ A; SOT666: $I_{c(max)} = 2$ A; SOT883: $I_{c(max)} = 0.5$ A)
- ▶ Reduced board space via smaller packages
- ▶ Bipolar transistors cost up to 50% less than MOSFETs
- ▶ Best-in-class solutions for loadswitch applications
- ▶ Exceptionally low losses when switching loads
- ▶ Very high current gain

More information: www.nxp.com/products/discretes/bipolar_transistors



ion products

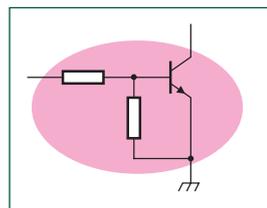
Load switches



Key features

- ▶ High performance at a low price
- ▶ Large load currents driven by only a fraction of a mA
- ▶ Lowest losses in the pass transistor via PNP-BISS technology
- ▶ Ready-to-use, integrated solution saves time
- ▶ Replaces expensive P-MOSFETs
- ▶ Best-in-class solutions for loadswitch applications
- ▶ Many resistor combinations available
- ▶ Exceptionally low losses when switching loads
- ▶ Very high current gain
- ▶ Space-saving solution through integration of RET and low V_{CEsat} transistor
- ▶ Low "threshold" voltage ($< 1\text{ V}$)
- ▶ Low drive power required

Resistor-equipped transistors (RETs)



Key features

- ▶ 500- and 800-mA RETs (PDTx and PBRx series)
- ▶ Best-in-class solutions for higher currents (up to 800 mA)
- ▶ Many resistor combinations available
- ▶ Very high current gain
- ▶ Space-saving solution through integration of resistor and low V_{CEsat} transistor
- ▶ Miniaturization of end products



www.nxp.com

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