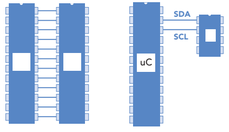
I²C-bus: The serial revolution

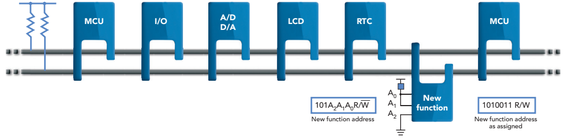
By replacing complex parallel interfaces with a straightforward yet powerful serial structure, the I²C-bus revolutionized chip-to-chip communications.

Invented by NXP (Philips) more than 20 years ago, the I²C-bus uses a simple two-wire format to carry data one bit at a time. It performs inter-chip addressing, selection, control, and data transfer. Speeds are up to 400 kHz, 1 MHz (Fast-mode Plus), or 3.4 MHz (High Speed mode).

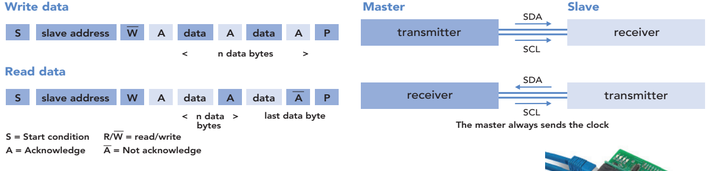


Parallel Interface I²C Serial Interface

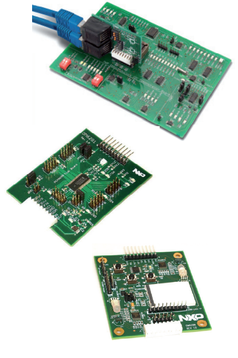
The I²C-bus shrinks the IC footprint and leads to lower IC costs. Plus, since far fewer copper traces are needed, it enables a smaller PCB, reduces design complexity, and lowers system cost.



I²C-bus devices are available in a wide range of functions. Each slave device has its own I²C-bus address, selectable using address pins set high (1) or low (0). Information is transmitted byte by byte, and each byte is acknowledged by the receiver. There can be multiple devices on the same bus, and more than one IC can act as master. The master role is typically played by a microcontroller.



Our I²C-bus website (www.nxp.com/I²C) is a valuable resource for device information and training programs. It gives you direct access to a comprehensive handbook, application notes, information about evaluation kits and training materials, links to application and design support, and more.
The I2C 2005-1 evaluation board and daughter cards make it easy to program new peripherals and are a quick way to learn about the I²C-bus protocol.



OM6275 I2C 2005-1 evaluation board with OM6297 PCA9600 Fm+ 1-MHz bus buffer daughter card

OM6281 PCA9698 Fm+ 40-bit GPIO daughter card with PCA9530 2-bit LED dimmer

OM6298 PCA9632/33 Fm+ 4-bit LED controller daughter card with PCA9901 1-wire LED blinker

Smart, simple solutions for the 10 most common design concerns

NXP I²C-bus solutions

www.nxp.com

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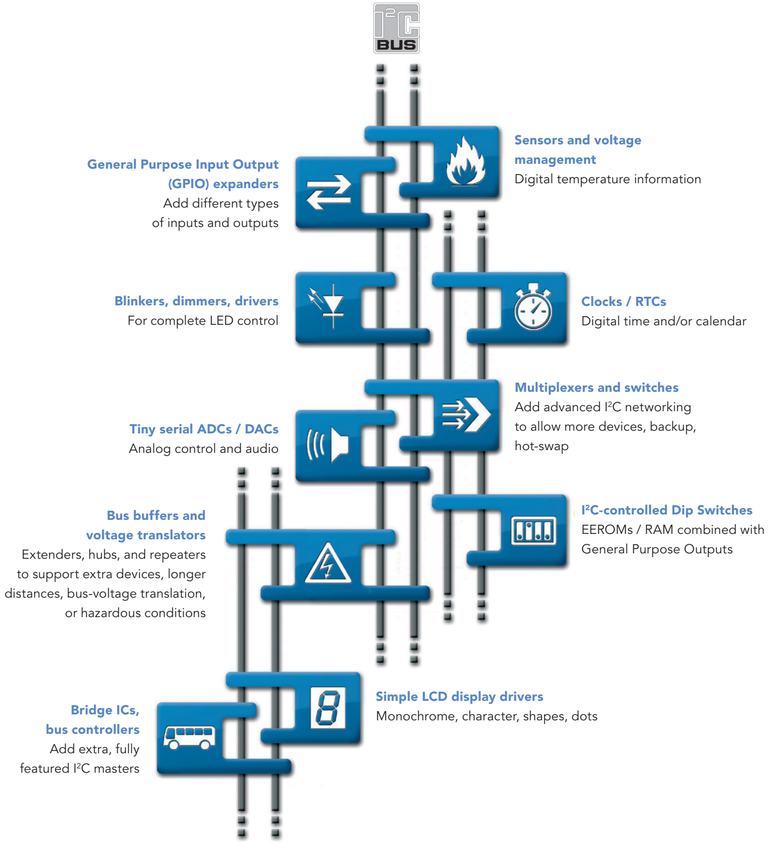
NXP's I²C peripherals portfolio is grouped into ten families, one for each of the most common, everyday design concerns.



General Purpose Input Output (GPIO) expanders
Add different types of inputs and outputs

Sensors and voltage management
Digital temperature information

Blinkers, dimmers, drivers
For complete LED control

Clocks / RTCs
Digital time and/or calendar

Multiplexers and switches
Add advanced I²C networking to allow more devices, backup, hot-swap

Tiny serial ADCs / DACs
Analog control and audio

I²C-controlled Dip Switches
EEROMs / RAM combined with General Purpose Outputs

Bus buffers and voltage translators
Extenders, hubs, and repeaters to support extra devices, longer distances, bus-voltage translation, or hazardous conditions

Bridge ICs, bus controllers
Add extra, fully featured I²C masters

Simple LCD display drivers
Monochrome, characters, shapes, dots

More information
www.nxp.com/I2Clogic

I²C bus product summary

GPIO		
4-bit GPIO	PCA9536	4-bit I²C Fast Mode totem-pole GPIO with pull-up resistor
	PCA9537	4-bit I²C Fast Mode totem-pole GPIO with interrupt and reset
8-bit GPIO	PCA8574	8-bit I²C Fast Mode quasi-bidirectional GPIO with interrupt and pull-up resistors
	PCA8574A	8-bit I²C Fast Mode quasi-bidirectional GPIO with interrupt and pull-up resistors (ALT address)
	PCA9500	8-bit I²C Fast Mode quasi-bidirectional GPIO with pull-up resistors and 2-K EEPROM
	PCA9501	8-bit I²C Fast Mode quasi-bidirectional GPIO with interrupt, pull-up resistors and 2-K EEPROM
	PCA9502	8-bit I²C /SPI Fast Mode totem-pole GPIO with interrupt and reset
	PCA9538	8-bit I²C Fast Mode totem-pole GPIO with interrupt and reset
	PCA9554	8-bit I²C Fast Mode totem-pole GPIO with interrupt and pull-up resistors
	PCA9554A	8-bit I²C Fast Mode totem-pole GPIO with interrupt and pull-up resistors (ALT address)
	PCA9557	8-bit I²C Fast Mode totem-pole GPIO with reset
	PCA9574	8-bit I²C Fast Mode LV totem-pole/OD GPIO with interrupt, reset, and pull-up/pull-down resistors
	PCA9670	8-bit I²C Fast-mode Plus quasi-bidirectional GPIO with reset and pull-up resistors
	PCA9672	8-bit I²C Fast-mode Plus quasi-bidirectional GPIO with interrupt, reset, and pull-up resistors
	PCA9674	8-bit I²C Fast-mode Plus quasi-bidirectional GPIO with interrupt and pull-up resistors
	PCA9674A	8-bit I²C Fast-mode Plus quasi-bidirectional GPIO with interrupt and pull-up resistors (ALT address)
	PCF8574	8-bit I²C 100 kHz quasi-bidirectional GPIO with interrupt and pull-up resistors
	PCF8574A	8-bit I²C 100 kHz quasi-bidirectional GPIO with interrupt and pull-up resistors (ALT address)
	PCA9702	8-bit SPI GPI interrupt with 18-V input (AEC-Q100)
16-bit GPIO	PCA8575	16-bit I²C Fast Mode quasi-bidirectional GPIO with interrupt and pull-up resistors
	PCA9535	16-bit I²C Fast Mode totem-pole GPIO with interrupt
	PCA9535C	16-bit I²C Fast Mode open-drain GPIO with interrupt
	PCA9539	16-bit I²C Fast Mode totem-pole GPIO with interrupt and reset
	PCA9555	16-bit I²C Fast Mode totem-pole GPIO with interrupt and pull-up resistors
	PCA9575	16-bit I²C Fast Mode LV totem-pole/OD GPIO with interrupt, reset, and pull-up/pull-down resistors
	PCA9671	16-bit I²C Fast-mode Plus quasi-bidirectional GPIO with reset and pull-up resistors
	PCA9673	16-bit I²C Fast-mode Plus quasi-bidirectional GPIO with interrupt, reset, and pull-up resistors
	PCA9675	16-bit I²C Fast-mode Plus quasi-bidirectional GPIO with interrupt and pull-up resistors
	PCF8575	16-bit I²C Fast Mode quasi-bidirectional GPIO with interrupt and pull-up resistors
	PCF8575C	16-bit I²C Fast Mode open-drain GPIO with interrupt
	PCA9701	16-bit SPI GPI interrupt with 18-V input (AEC-Q100)
40-bit GPIO	PCA9505	40-bit I²C Fast Mode totem-pole GPIO with interrupt, reset, pull-up resistors and output enable
	PCA9506	40-bit I²C Fast Mode totem-pole GPIO with interrupt, reset, and output enable
	PCA9698	40-bit I²C Fast-mode Plus totem-pole GPIO with interrupt, reset, pull-up resistors and output enable

Temp sensors		
Local	LM75A	I²C local ± 2 °C temperature sensor
	SE95	I²C local ± 1 °C temperature sensor
	SE98	I²C local ± 2 °C temperature sensor DIMM (3.0 - 3.6 V)
	SE98A	I²C local ± 1 °C temperature sensor DIMM (1.7 - 3.6 V)
Local and EEPROM	SE97	I²C local ± 1 °C temperature sensor + SPD DIMM (3.0 - 3.6 V)
	SE97A	I²C local ± 1 °C temperature sensor + SPD DIMM (1.7 - 3.6 V)
Local and remote	NE1617A	I²C local ± 2 °C and remote ± 3 °C temperature sensor
	SA56004	I²C local ± 2 °C and remote ± 1 °C temperature sensor
Local, remote, and voltage monitor	NE1619	I²C local ± 2 °C and remote ± 3 °C temperature sensor with voltage monitor (12, 5, 3.3, and 2.5 V, V_{CCP}, and V_{DD})

LED controllers		
Dimmer (2 PWM, 25 mA / 5 V)	PCA9530	2-bit I²C Fast Mode open-drain LED with dimmer and reset
	PCA9531	8-bit I²C Fast Mode open-drain LED with dimmer and reset
	PCA9532	16-bit I²C Fast Mode open-drain LED with dimmer and reset
	PCA9533	4-bit I²C Fast Mode open-drain LED with dimmer
Blinker	PCA9901	1-bit 1 LED low power current source blinker with three sequential PWM cycles
Blinker (2 PWM, 25 mA / 5 V)	PCA9550	2-bit I²C Fast Mode open-drain LED with blinker and reset
	PCA9551	8-bit I²C Fast Mode open-drain LED with blinker and reset
	PCA9552	16-bit I²C Fast Mode open-drain LED with blinker and reset
	PCA9553	4-bit I²C Fast Mode open-drain LED with blinker
8-segment	SAA1064	16-bit I²C Standard Mode current source/sink 4x8-segment LED display
Controller (PWM / Ch, 25 mA / 5 V)	PCA9632	4-bit I²C Fast-mode Plus low-power totem-pole LED controller
	PCA9633	4-bit I²C Fast-mode Plus totem-pole LED controller with output enable
	PCA9634	8-bit I²C Fast-mode Plus totem-pole LED controller with output enable
	PCA9635	16-bit I²C Fast-mode Plus totem-pole LED controller with output enable
	PCA9685	16-bit I²C Fast-mode Plus totem-pole LED controller with 12-bit PWMs and output enable
Controller (PWM / Ch, 100 mA / 40 V)	PCA9624	8-bit I²C Fast-mode Plus totem-pole LED high-voltage/current controller with output enable
	PCA9622	16-bit I²C Fast-mode Plus totem-pole LED high-voltage/ current controller with output enable
	PCA9626	24-bit I²C Fast-mode Plus totem-pole LED high-voltage/ current controller with output enable

Real-time clocks		
Low-power	PCF8563	Ultra low-power clock/calendar
	PCF8564	Ultra low-power clock/calendar, COB
Normal	PCA8565	Automotive clock/calendar
	PCF8583	Clock/calendar with 256x8 SRAM
	PCF8593	Low-power clock/calendar
Temp-compensated	PCF2128	High accuracy, power management, 512x8 RAM

Hot product

The PCA9574 is a must-have for mobile applications that need more I/O. It's an 8-bit GPIO that has two V_{CC}s for level shifting between 1.1 and 3.6 V, a selectable pull-up/pull-down resistor, outputs configurable as totem pole or open drain, and inputs with bus hold.

Muxes and switches		
2-channel	PCA9540B	2-channel I²C mux
	PCA9542A	2-channel I²C mux with interrupt
	PCA9543A	2-channel I²C switch with interrupt and reset
2-to-1 demux	PCA9541/01	2:1 I²C demux with interrupt and reset (channel 0 default)
	PCA9541/03	2:1 I²C demux with interrupt and reset
4-channel	PCA9544A	4-channel I²C mux with interrupt
	PCA9545A	4-channel I²C switch with interrupt and reset
	PCA9546A	4-channel I²C switch with reset
8-channel	PCA9547	8-channel I²C mux with reset (channel 0 default)
	PCA9548A	8-channel I²C switch with reset
Cross bus switch	PCA9549	8-bit I²C switch (CBT) with reset

Bus buffers		
Hot-swap	PCA9510A	Fast Mode hot-swap I²C/SMBus bus buffer
	PCA9511A	Fast Mode hot-swap I²C/SMBus bus buffer
	PCA9512A	Fast Mode shift I²C/SMBus bus buffer
	PCA9513A	Fast Mode hot-swap I²C/SMBus bus buffer
	PCA9514A	Fast Mode hot-swap I²C/SMBus bus buffer
Long-distance bus	P82B715	Fast Mode I²C bus extender (no static offset)
	P82B845	Fast Mode differential bus buffer
	P82B846	Fast Mode differential bus buffer and interrupt
	P82B96	Fast Mode dual bidirectional bus buffer
	PCA9600	Fast-mode Plus dual bidirectional bus buffer
Static-offset (1 side)	PCA9507	Fast Mode shift DDC buffer with accelerator
	PCA9508	Fast Mode shift hot-swap I²C bus repeater
	PCA9509	Fast Mode shift bus buffer with current source
	PCA9517A	Fast Mode shift I²C bus repeater
	PCA9519	4-channel version of PCA9509
Static-offset (All sides)	PCA9515/ 15A	Fast Mode I²C bus repeater
	PCA9516/ 16A	Fast Mode 5-channel I²C hub
	PCA9518A	Fast Mode expandable 5-channel I²C hub
Voltage translator (doesn't isolate capacitance)	GTL2000	Fast-mode Plus 22-bit voltage clamp translator
	GTL2002	Fast-mode Plus 2-bit voltage clamp translator
	GTL2003	Fast-mode Plus 8-bit voltage clamp translator
	GTL2010	Fast-mode Plus 10-bit voltage clamp translator
	PCA9306	Fast-mode Plus dual I²C/SMBus voltage translator

LCD drivers		
Character driver	PCF2113	2 line 12 char. 120 icons
	PCF2116	2 line 24 or 4 line 12
	PCF2119	2 line 16 char. 160 icons
Graphic driver	PCF8531	34x128-pixel
	PCF8535	65x133-pixel
	PCF8578	Dot-matrix LCD driver (row/column)
	PCF8579	Dot-matrix LCD driver (column)
	PCF8811	80x128-pixel
Segment driver	PCF8532	640-segment, COG
	PCF8533	320-segment, COG
	PCF8534A	240-segment
	PCF8562	128-segment
	PCF8566	96-segment
	PCF8576D	160-segment
	PCF8577C	64-segment

Hot products

The PCA9507 translates 5 V to 3.3 V, has a rise-time accelerator supporting 1500 pF, and is perfect for HDMI DDC connections on DVDs and STRs. The PCA9665 Fast-mode Plus bus controller has a 68-byte buffer, so it greatly reduces microcontroller loading.

A/D-D/A converters		
8-bit ADC	PCA9691	Fast-mode Plus ADC/DAC I²C
	PCF8591	Fast Mode ADC/DAC I²C
Demo boards		
e-Tools	OM6270	SPI/I²C-to-UART bridge demo (SC16IS750)
	OM6271	SPI-to-I²C-master bridge demo (SC18IS600)
	OM6272	UART-to-I²C-master bridge demo (SC18IM700)
	OM6273	SPI/I²C-to-DUART/IrDA/GPIO (SC16IS752)
	OM6274	I²C-to-SPI-master bridge demo (SC18IS602)
	OM6275	I2C 2005-1 evaluation board
	OM6276	PCA9633 demo board
	OM6277	PCA9564 evaluation board
	OM6278	I2C 2002-1A evaluation board
	OM6279	LED dimmer demo board
	OM6280	PCA9665 evaluation board (I²C Master)
	OM6281	PCA9698 daughter card for I2C 2005-1
	OM6282	PCA9633 daughter card for I2C 2005-1
	OM6283	SE97 daughter card for I2C 2005-1
	OM6285	I2C 2002-1A evaluation board without PC controller board
	OM6294	PCA9508 daughter card for I2C 2005-1
	OM6295	PCA9507 daughter card for I2C 2005-1
	OM6297	PCA9600 daughter card for I2C 2005-1
	OM6298	Mobile demo daughter card for I2C 2005-1
	OM6299	Industrial demo board with P82B486

EEPROMs		
16-kbit	PCF85116	2048x8 EEPROM I²C-bus
1-kbit	PCA8581	128x8-bit EEPROM I²C-bus
	PCA8581C	128x8-bit EEPROM I²C-bus (5-V only)
2-kbit	PCF85102C	256x8-bit EEPROM I²C-bus
	PCF85103C	256x8-bit EEPROM I²C-bus (ALT address)
	PCF8582C	256x8 EEPROM I²C-bus
	PCF8570	256x8-bit RAM I²C-bus
4-kbit	PCF8594C	512x8 EEPROM I²C-bus
8-kbit	PCA24S08	1024x8 EEPROM I²C with access protection
	PCF8598C	1024x8 EEPROM I²C-bus
Dip switch	PCA8550	4-bit 1-of-2 I²C mux
	PCA9558	5-bit MP/1-bit latch - 6-bit I²C EEPROM
	PCA9559	5-bit mux/1-bit latch - 6-bit I²C EEPROM
	PCA9560	2x5-bit mux/1-bit latch - 6-bit I²C EEPROM
	PCA9561	4x6-bit mux - 6-bit I²C EEPROM

Bridge and bus controllers		
Bridge	SC16IS740	I²C/SPI-to-UART bridge with IRDA
	SC16IS750	I²C/SPI-to-UART bridge with IRDA and GPIO
	SC16IS752	I²C/SPI-to-DUART bridge with IRDA and GPIO
	SC16IS760	I²C/SPI-to-UART bridge with IRDA and GPIO
	SC16IS762	I²C/SPI-to-DUART bridge with IRDA and GPIO
	SC16IS850	1.8-V I²C/SPI-to-UART bridge
	SC16IS850L	1.8-V I²C/SPI-to-UART bridge
	SC16IS852	1.8-V I²C/SPI-to-UART bridge
	SC16IS852L	1.8-V I²C/SPI-to-UART bridge
	SC18IM700	UART-to-I²C-master bridge with GPIO
	SC18IS600	SPI-to-I²C-master bridge, 4 M / GPIO
	SC18IS601	SPI-to-I²C-master bridge, 4 M / GPIO
	SC18IS603	I²C-to-SPI bridge, external clock
	SC18S602	I²C-slave-to-SPI master bridge
Controller	PCA9665	Fast-mode Plus I²C-bus controller with 68-byte buffer
	PCF8584	100-kHz I²C-bus controller
	PCA9564	400-kHz I²C-bus controller