

# WPC8768L, WPC8769L Mobile Embedded Controller with SPI™ Flash Interface and MCE-Compliant CIR Port

## General Description

The Winbond WPC8768L and WPC8769L are highly integrated embedded controllers (EC) with an embedded RISC core and integrated advanced functions. They are targeted for a wide range of portable applications.

The WPC8768L/WPC8769L incorporate the CompactRISC® CR16CPlus core (a high-performance 16-bit RISC processor), on-chip ROM and RAM memories, system support functions and a Flash Interface Unit (FIU) that interfaces directly with external SPI flash memory devices.

System support functions include: watchdog, PWM, timers, interrupt control, General-Purpose I/O (GPIO) with internal keyboard matrix scanning, PS/2® interface, SMBus® interface, UART, SPI™, high-accuracy analog-to-digital (ADC) and digital-to-analog (DAC) converters for battery charging, system control, system health monitoring and analog controls, and a SensorPath™ interface.

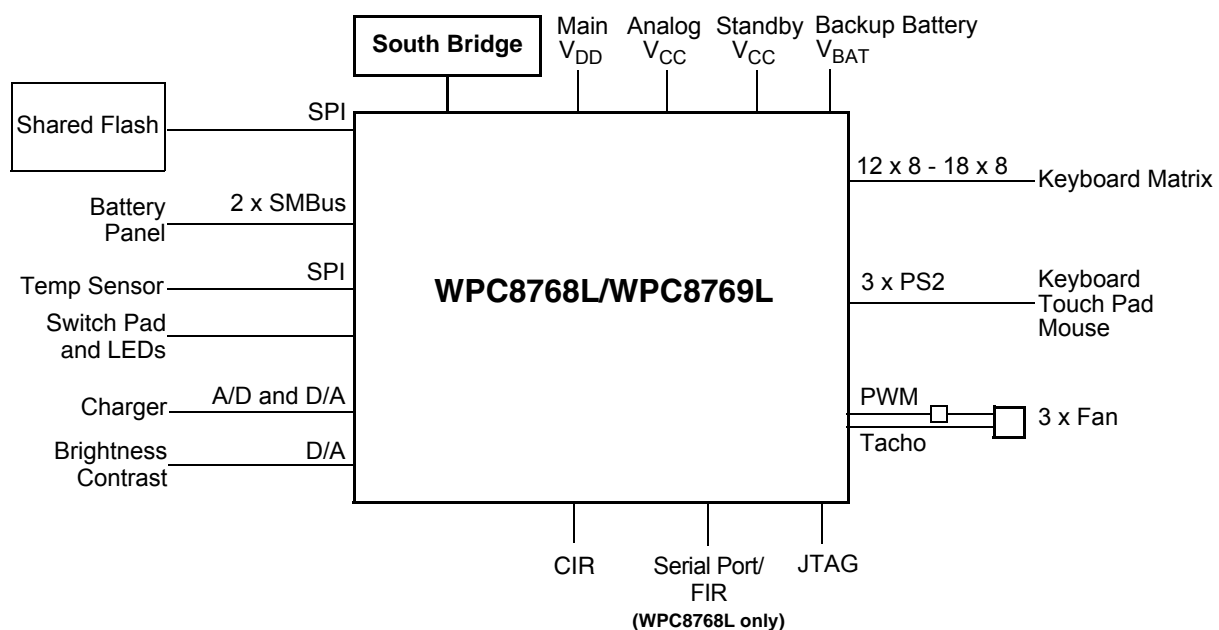
The WPC8768L/WPC8769L interface with the host via an LPC interface. They also include a host-controlled Serial Port, CIR Port and Fast Infrared (FIR, IrDA 1.1 compliant) Port (**WPC8768L only**).

The WPC8768L/WPC8769L are PC01 and ACPI compliant, and offer a single-chip solution for the most commonly used notebook PC I/O peripherals.

## Outstanding Features

- Shared BIOS flash memory
- Support for SPI flash memories
- Flash page programming support
- MCE-compliant Consumer Infrared (CIR) Port
- Fast Infrared Port (FIR, IrDA 1.1 compliant) (**WPC8768L only**)
- High-accuracy, high-speed ADC
- Up to 88 GPIO ports (including keyboard scanning) with a variety of wake-up events
- 16-bit RISC core, with up to 4 Mbytes of external address space, running at up to 25 MHz
- 128-pin LQFP package

## System Block Diagram



## Device-Specific Information

The following table shows the main differences between the WPC8768L and WPC8769L devices.

Feature	WPC8768L	WPC8769L
FIR Port	✓	✗

## Features

### Embedded Controller Features

- Processing Unit
  - CompactRISC CR16CPlus 16-bit embedded RISC processor core (the “core”)
  - Up to 4 Mbytes of external address space
- Internal Memory
  - 1 Kbyte of ROM
  - 4 Kbytes of on-chip RAM
  - All memory types can hold both code and data
- Flash Interface Unit (FIU)
  - Up to 4 Mbytes of code and data
  - Hardware-protected boot zone block protection
  - SPI External Memory
    - Up to 32 Mbits
    - Fast Read mode
    - Page programming support
    - Configurable clock rate
  - Field upgradeable
- Shared Memory Controller (SHM)
  - Supports BIOS (flash) memory sharing with PC host
  - Supports host-controlled code download and update
  - Memory access protection

### LPC System Interface

- Based on Intel's *LPC Interface Specification Revision 1.1*, August 2002
- Four optional 8-bit DMA channels
- I/O, Memory and 8-bit Firmware Memory read and write cycles, Firmware Memory writes may insert wait cycles
- Bootable Memory Support
- Base Address (BADDR1-0) straps to determine the base address of the index-data register pair
  - Alternate base address configurable by the core
- $\overline{\text{LPCPD}}$  and  $\overline{\text{CLKRUN}}$  support

### Embedded Controller System Features

- Host Interface
  - Comprises host interface channels, typically used for KBC and ACPI Private or Shared EC channels
  - 8042 KBC-standard interface (legacy 60h, 64h)
  - Two PM interface ports (legacy 62h, 66h; 68h, 6Ch)
  - ACPI EC with either Shared or Private interface through the PM interface
  - Two Mailbox areas for host-core communication, up to 4 Kbytes each; maximum 4 Kbytes total
  - Generates IRQ, SMI and SCI
  - Provides IRQ1 and IRQ12 support
  - Provides Fast Gate A20 and Fast Host reset via firmware
- Interrupt Control Unit (ICU)
  - 31 maskable vectored interrupts (of which eight are external)
  - General-purpose external interrupt inputs through MIWU
  - Enable and pending indication for each interrupt
  - Non-maskable interrupt input
- Multi-Input Wake-Up (MIWU)
  - Up to 40 wake-up or interrupt inputs
  - Generates wake-up event to PMC (Power Management Controller)
  - Generates interrupts to ICU
  - User-selectable trigger conditions
- Internal Keyboard Matrix Scanning
  - Up to 18 open-collector outputs (at least 12)
  - Eight Schmitt inputs with internal pull-ups
- General-Purpose I/O (GPIO) Ports
  - 64 port pins
  - I/O pins individually configured as input or output
  - Configurable internal pull-up / pull-down resistors
  - Outputs individually configured as push-pull or open-drain
  - Two echo inputs with wake-enabled interrupts
  - Additional 12 GPIOs with wake-enabled interrupts
  - Four GPIOs capable of 12 mA sink current
  - Seven GPIOs are accessible to the host
  - Optional low-cost external GPIO expansion through the SensorPath interface
- PS/2 Interface
  - Three external ports: can be used for keyboard, mouse and an additional pointing device
  - Byte-level handling via hardware accelerator

## Features (Continued)

- Two SMBus (SMB) Interface Modules; each module:
    - Is Intel SMBus, Philips I<sup>2</sup>C<sup>®</sup> and ACCESS.bus compatible
    - Is SMBus master and slave
    - Supports up to two simultaneous slave addresses
    - Supports polling- and interrupt-controlled operations
    - Generates a wake-up signal on detection of a Start condition while in Idle mode
    - Supports an optional internal pull-up on SDA and SCL pins
  - Core Universal Asynchronous Receiver-Transmitter (CR\_UART) Module
    - A full-duplex UART channel
    - Programmable baud rate
    - Data transfer via interrupt or polling
  - Two 16-bit Multi-Function Timer (MFT16) Modules; each module has:
    - Two 16-bit timers with a 5-bit prescaler
    - Pulse Width Modulation (PWM), Capture and Timer/Counter modes
    - Capture inputs with programmable edge detection
    - An interrupt on compare match
  - Two Pulse Width Modulation (PWM) Modules
    - Group A\_PWM: two outputs
    - Group B\_PWM: one output
  - Serial Peripheral Interface (SPI) Module
    - Bus master
    - 8-bit interface
    - Up to 10 MHz data clock rate
    - Clock can be selected to be high or low in Idle mode
    - Clock polarity can be selected for normal (sample on rising edge) or alternate (sample on falling edge)
  - Timer and Watchdog (TWD)
    - 16-bit periodic interrupt timer with 30  $\mu$ s resolution and 5-bit prescaler for system tick and periodic wake-up tasks
    - 8-bit watchdog timer with enable/disable
    - “Watchdog occurred” flag
    - Two watchdog reset options: warm or cold
  - SensorPath™ Bus Interface
    - Single Wire bus master
    - Supports up to seven slave devices
    - x1, x4 SensorPath clock rate support
  - Analog-to-Digital Converter (ADC)
    - Six channels, with 8-bit resolution
    - 125  $\mu$ s conversion time
    - External voltage reference
  - Digital-to-Analog Converter (DAC)
    - Four channels, 8-bit resolution
    - 1  $\mu$ s conversion time for 50 pF load
    - Full output range from AGND to AVCC
  - Development Support
    - Interface to debugger via Nexus 5001 interface
      - Physical connection using JTAG
      - On-board Debug mode with eight hardware breakpoints
      - Embedded memory programming via JTAG with content read protection
  - Core Access to Host Modules
    - Enabled via lock mechanism
- ### Host Function Features
- Mobile System Wake-Up Control (MSWC)
    - Software-controlled off events
    - Event routing to IRQ,  $\overline{\text{SMI}}$  or  $\overline{\text{PWUREQ}}$
  - Host- or Core-Controlled CEIR (Consumer Electronic IR) Receiver
    - Supports RC-5, RC-6 and NEC protocols
    - Wake-up on a pre-configured message
  - Infrared Port
    - Supports IR learning and emitting
    - Software compatible with the 16550A and the 16450
    - Shadow register support for write-only bit monitoring
    - HP-SIR
    - ASK-IR option of SHARP-IR
    - DASK-IR option of SHARP-IR
    - Consumer Remote Control supports RC-5, RC-6, NEC, RCA and RECS 80
  - Fast Infrared (FIR) Port (**WPC8768L only**)
    - Software compatible with the 16550A and the 16450
    - Shadow register support for write-only bit monitoring
    - FIR IrDA 1.1 compliant
    - HP-SIR
    - ASK-IR option of SHARP-IR
    - DASK-IR option of SHARP-IR
    - Consumer Remote Control supports RC-5, RC-6, NEC, RCA and RECS 80
    - DMA support: one or two channels
  - Serial Port (SP)
    - In the WPC8768L, SP can be used only when FIR is not needed
    - Software compatible with the 16550A and the 16450
    - Shadow register support for write-only bit monitoring
    - UART data rates up to 1.5 Mbaud
  - Supports *Microsoft® Advanced Power Management (APM) Specifications Revision 1.2*, February 1996
    - Generates the System Management Interrupt (SMI)
  - PC01 Rev 1.0 and ACPI 3.0 Compliant
    - PnP configuration register structure
    - Flexible resource allocation for all logical devices
      - Relocatable base address
      - 15 IRQ routing options
      - Four optional 8-bit DMA channels (where applicable)

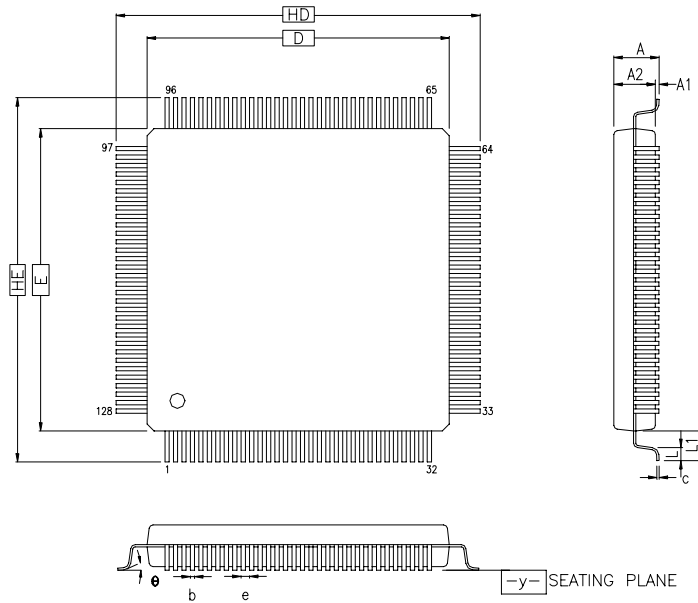
## Features (Continued)

### Clocking, Supply and Package Information

- Strap Input-Controlled Operating Modes:
  - Shared BIOS memory mode
  - TRI-STATE<sup>®</sup> mode
  - Development mode
- Clocks
  - Single 32.768 KHz crystal oscillator
  - On-chip high-frequency clock generators
  - Either 32.768 KHz or CR16CPlus clock out
- Testability
  - XOR-tree structure includes all device pins (except supply, A/D, D/A, and crystal oscillator pins), selected at power-up by strap inputs
  - TRI-STATE device pins, selected at power-up by strap input (TRIS)
- Power Supply
  - 3.3V supply operation
  - 5V tolerance and back-drive protection on all pins (except crystal oscillator, A/D, D/A, LPC bus, and SPI flash pins)
  - Separate supply for host I/F ( $V_{DD}$ ) and EC functions ( $V_{CC}$ )
  - Backup battery input for wake-up configuration
  - Reduced power consumption capability
  - Software- or hardware-switched power modes:
    - Active mode
    - Active mode executing WAIT
    - Idle
    - Deep Idle
    - Suspend
    - Power Off, for oscillator only, from the backup battery
  - Automatic wake-up on system events
- Package Options
  - 128-pin LQFP package

## Physical Dimensions

Control dimensions are in millimeters



SYMBOL	MILLIMETER			INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	—	—	1.60	—	—	0.063
A1	0.05	—	0.15	0.002	—	0.006
A2	1.35	1.40	1.45	0.053	0.055	0.057
HD	16.00 BSC.			0.630 BSC.		
D	14.00 BSC.			0.551 BSC.		
HE	16.00 BSC.			0.630 BSC.		
E	14.00 BSC.			0.551 BSC.		
b	0.13	0.16	0.23	0.005	0.006	0.009
e	0.40 BSC.			0.016 BSC.		
θ	0°	3.5°	7°	0°	3.5°	7°
c	0.09	—	0.20	0.004	—	0.008
L	0.45	0.60	0.75	0.018	0.024	0.030
L <sub>1</sub>	1.00 REF			0.039 REF		
y	—	—	0.1	—	—	0.004

### 128-Pin Low-Profile Plastic Quad Flatpack (LQFP) Order Numbers WPC8768LDG / WPC8769LDG

#### Important Notice

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