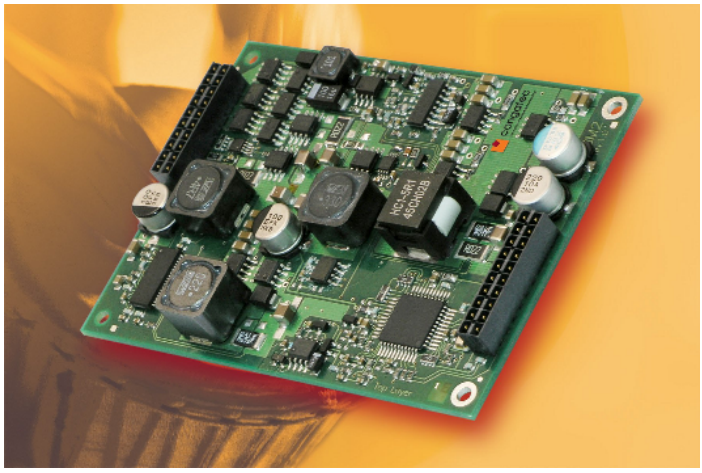
congatec
the rhythm of embedded computing



# conga-SBM²C

***congatec Smart Battery Manager Module***

***User's Guide***

***Revision 1.1***

# Revision History

| Revision | Date (dd.mm.yy) | Author | Changes |
|---|---|---|---|
| 1.0 | 05.03.08 | AHE/GDA | Official release |
| 1.1 | 26.03.08 | GDA | Changed the 12V signal listed in the optional signal table in section 4.3 to 5V_VCC. 5V system power is the optional signal available, not 12V system power. |

# Preface

This user's guide provides information about the components, features, and connectors available on the conga-SBM²C. It is one of three documents that should be referred to when designing a portable battery/power management solution. The other reference documents that should be used include the following:

- congatec Battery Management Interface Specification
- Battery System Design Guide

The links to these documents can be found on the congatec AG website at www.congatec.com

## Disclaimer

The information contained within this user's guide, including but not limited to any product specification, is subject to change without notice.

congatec AG provides no warranty with regard to this user's guide or any other information contained herein and hereby expressly disclaims any implied warranties of merchantability or fitness for any particular purpose with regard to any of the foregoing. congatec AG assumes no liability for any damages incurred directly or indirectly from any technical or typographical errors or omissions contained herein or for discrepancies between the product and the user's guide. In no event shall congatec AG be liable for any incidental, consequential, special, or exemplary damages, whether based on tort, contract or otherwise, arising out of or in connection with this user's guide or any other information contained herein or the use thereof.

## Intended Audience

This user's guide is intended for technically qualified personnel. It is not intended for general audiences.

## Symbols

The following symbols are used in this user's guide:



**Warning**

*Warnings indicate conditions that, if not observed, can cause personal injury.*



**Caution**

*Cautions warn the user about how to prevent damage to hardware or loss of data.*



**Note**

*Notes call attention to important information that should be observed.*

## Terminology

| Term | Description |
|---|---|
| GB | Gigabyte (1,073,741,824 bytes) |
| GHZ | Gigahertz (one billion hertz) |
| kB | Kilobyte (1024 bytes) |
| MB | Megabyte (1,048,576 bytes) |
| Mbit | Megabit (1,048,576 bits) |
| kHz | Kilohertz (one thousand hertz) |
| MHz | Megahertz (one million hertz) |
| SOH | Battery state of health |
| SOC | Battery state of charge |
| <x>S<y>P | Battery pack topology: <x> cells in series, <y> cells in parallel,<br>e.g. 4S1P: 4 cells in series, no cells parallel |
| SBSM | Smart battery system manager |
| I/F | Interface |
| N.C. | Not connected |
| N.A. | Not applicable |
| TBD | To be determined |

## Copyright Notice

Copyright © 2008, congatec AG. All rights reserved. All text, pictures and graphics are protected by copyrights. No copying is permitted without written permission from congatec AG.

congatec AG has made every attempt to ensure that the information in this document is accurate yet the information contained within is supplied “as-is”.

## Trademarks

Intel and Pentium are registered trademarks of Intel Corporation. Expresscard is a registered trademark of Personal Computer Memory Card International Association (PCMCIA). COM Express™ is a registered trademark of PCI Industrial Computer Manufacturers Group. PCI Express is a registered trademark of Peripheral Component Interconnect Special Interest Group (PCI-SIG). I²C is a registered trademark of Philips Corporation. CompactFlash is a registered trademark of CompactFlash Association. Winbond is a registered trademark of Winbond Electronics Corp. AVR is a registered trademark of Atmel Corporation. ETX is a registered trademark of Kontron AG. AMICORE8 is a registered trademark of American Megatrends Inc. Microsoft®, Windows®, Windows NT®, Windows CE®, Windows XP® and Windows Vista® are registered trademarks of Microsoft Corporation. VxWorks is a registered trademark of WindRiver. conga, congatec and XTX are registered trademark of congatec AG. All product names and logos are property of their owners.

## Warranty

congatec AG makes no representation, warranty or guaranty, express or implied regarding the products except its standard form of limited warranty ("Limited Warranty"). congatec AG may in its sole discretion modify its Limited Warranty at any time and from time to time.

Beginning on the date of shipment to its direct customer and continuing for the published warranty period, congatec AG represents that the products are new and warrants that each product failing to function properly under normal use, due to a defect in materials or workmanship or due to non conformance to the agreed upon specifications, will be repaired or exchanged, at congatec AG's option and expense.

Customer will obtain a Return Material Authorization ("RMA") number from congatec AG prior to returning the non conforming product freight prepaid. congatec AG will pay for transporting the repaired or exchanged product to the customer.

Repaired, replaced or exchanged product will be warranted for the repair warranty period in effect as of the date the repaired, exchanged or replaced product is shipped by congatec AG, or the remainder of the original warranty, whichever is longer. This Limited Warranty extends to congatec AG's direct customer only and is not assignable or transferable.

Except as set forth in writing in the Limited Warranty, congatec AG makes no performance representations, warranties, or guarantees, either express or implied, oral or written, with respect to the products, including without limitation any implied warranty (a) of merchantability, (b) of fitness for a particular purpose, or (c) arising from course of performance, course of dealing, or usage of trade.

congatec AG shall in no event be liable to the end user for collateral or consequential damages of any kind. congatec AG shall not otherwise be liable for loss, damage or expense directly or indirectly arising from the use of the product or from any other cause. The sole and exclusive remedy against congatec AG, whether a claim sound in contract, warranty, tort or any other legal theory, shall be repair or replacement of the product only

## Technical Support

congatec AG technicians and engineers are committed to providing the best possible technical support for our customers so that our products can be easily used and implemented. We request that you first visit our website at www.congatec.com for the latest documentation, utilities and drivers, which have been made available to assist you. If you still require assistance after visiting our website then please contact our technical support department by email at support@congatec.com

## Certification

congatec AG is certified to DIN EN ISO 9001:2000 standard.

## Safety Warning



**Warning**

When the conga-SBM²C is used in conjunction with the SBM²C Smart Battery Management Module starter kit, its use is intended for **ENGINEERING DEVELOPMENT OR EVALUATION PURPOSE ONLY** and is not considered by congatec AG to be fit for commercial use. As such, the goods provided in the SBM²C Smart Battery Management Module starter kit may not be complete in terms of required design-related protective considerations, including product safety measures typically found in the end product incorporating the goods. As a prototype, this starter kit does not fall within the scope of the European Union directive on electromagnetic compatibility and therefore may not meet the technical requirements of the directive.

Persons handling the product must have electronics training and observe good laboratory practice standards.

- The SBM²C Smart Battery Management Module starter kit has not been tested to meet the FCC Rules and/or UL certification and/or CE compliance.
- Do not leave the conga-SBM²C Smart Battery Management Module starter kit unattended. The battery may reach critical conditions during operation.



- Fire, explosion and severe burn hazard could happen if abused.
- Do not crush, disassemble or short circuit the battery.

If the actual conga-SBM²C module is to be implemented in a carrier board design and that carrier board design is used in a complete system for series production, then the system designer/manufacturer must ensure that the system meets all safety, certification, compatibility and/or any other regulations/requirements set for forth by the governing bodies of the jurisdiction wherein said system will be made available for purchase and/or use.

## Electrostatic Sensitive Device



All congatec AG products are electrostatic sensitive devices and are packaged accordingly. Do not open or handle a congatec AG product except at an electrostatic-free workstation. Additionally, do not ship or store congatec AG products near strong electrostatic, electromagnetic, magnetic, or radioactive fields unless the device is contained within its original manufacturer's packaging. Be aware that failure to comply with these guidelines will void the congatec AG Limited Warranty.

## Lead-Free Designs (RoHS)

All congatec AG designs are created from lead-free components and are completely RoHS compliant.

# conga-SBM²C Options Information

The conga-SBM²C is currently available in one variant.

| Part-No. | 026571 |
|---|---|
| **Input Voltage** | 19 V |
| **Output 1** | 12.0 V/6.0 A |
| **Output 2** | 5.1 V/6.5 A |
| **Output 3** | 5.1 V/0.5 A |

# Contents

1 Specifications ..... 9
1.1 Feature List ..... 9
1.2 Supported Operating Systems ..... 9
1.3 Mechanical Dimensions ..... 10
1.4 Environmental Specifications ..... 11
1.5 Input Requirements ..... 11
1.6 Output Characteristics ..... 11
2 Block Diagram ..... 12
3 Cooling ..... 13
4 Signal Descriptions and Pinout Tables ..... 14
4.1 Connector J1 ..... 15
4.2 Connector J2 ..... 16
4.3 Connecting to a COM Express™ CPU Module ..... 17
4.4 Placement and Layout Considerations ..... 18
5 Power Button, Beeper and I/O ..... 19
5.1 Power Button ..... 19
5.2 Beeper Control ..... 19
5.3 I/O Control ..... 19
6 conga-SBM²C Register ..... 21
6.1 Software Considerations ..... 21
6.2 Interface ..... 21
6.2.1 OptionalMfgFunction3 Register (0x3D) ..... 23
7 Industry Specifications ..... 24

# 1 Specifications

## 1.1 Feature List

**Table 1 Feature Summary**

| | |
|---|---|
| **Dimensions** | 68 mm x 110 mm x 12.5 mm |
| **Input** | 19 V, max. 4.5 A with load limiter/balancing |
| **Outputs** | • Main Power Rail: 12.0 V/6.0 A<br>• Standby Rail: 5.1 V/0.5 A<br>• Aux. Rail: 5.1 V/6.5 A |
| **Batteries** | • Li-Ion Battery Pack with 2 Stage Protection must support Smart Battery Specification (SBS) V1.1<br>• 2S1P to 4S2P (for information about alternative configurations other than 4SxP contact your local congatec AG representative)<br>• recommended battery capacity/pack: 2.4 Ah<br>• recommended battery pack voltage: nom. 14.4 V |
| **Power Modes** | • S1: Sleep Mode<br>• S3: Suspend to RAM<br>• S5: Soft Off<br>• G3: Mechanical Off |
| **Supported Modules** | • congatec COM Express™ CPU Modules |
| **Additional Features** | • support for I²C I/O PCA9555 |

## 1.2 Supported Operating Systems

The conga-SBM²C supports the following ACPI Operating Systems.

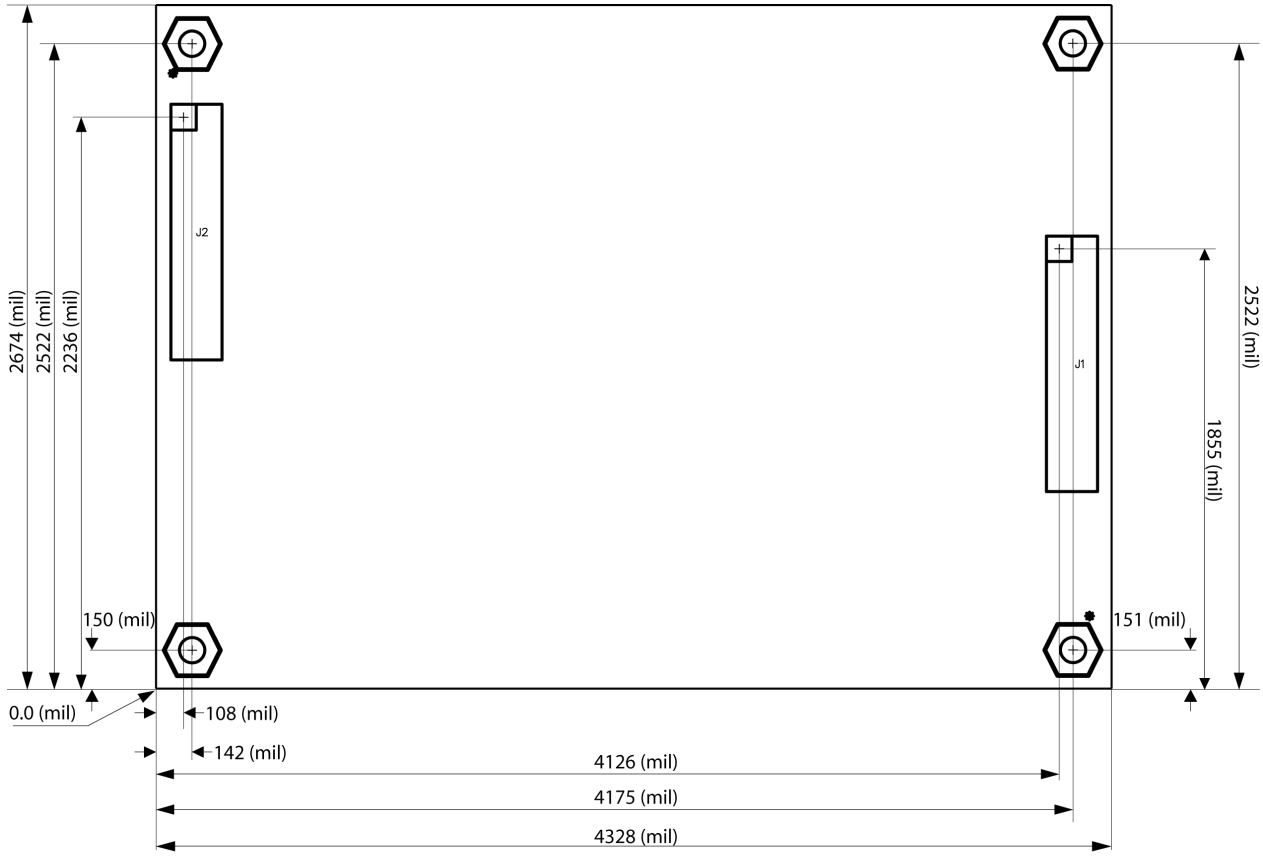
- Microsoft® Windows® XP/2000
- Microsoft® Windows ®XP Embedded
- Linux

The conga-SBM²C supports the following Operating Systems when using congatec CGOS interface to communicate to the conga-SBM²C.

- Microsoft® Windows® XP/2000
- Microsoft® Windows ®XP Embedded
- Linux
- QNX
- VxWorks

## 1.3 Mechanical Dimensions

- 109.0 mm x 67.9 mm (4.3” x 2.6”)
- Height approx. 9.7 mm (0.4”) excluding connectors.




1 mil = 0.0254 millimeter

## 1.4 Environmental Specifications

| | | |
|---|---|---|
| Temperature | Operation: 0° to 60°C | Storage: -20° to +80°C |
| Humidity | Operation: 10% to 90% rel. | Storage: 5% to 95% rel. |

**Note**

*Humidity specifications are for non-condensing conditions.*

*The above operating temperatures must be strictly adhered to at all times.*

*It is the responsibility of the operator to ensure that all components found on the module operate within the component manufacturer's specified temperature range.*

*For more information about cooling the conga-SBM²C module see section 3 or contact congatec technical support.*

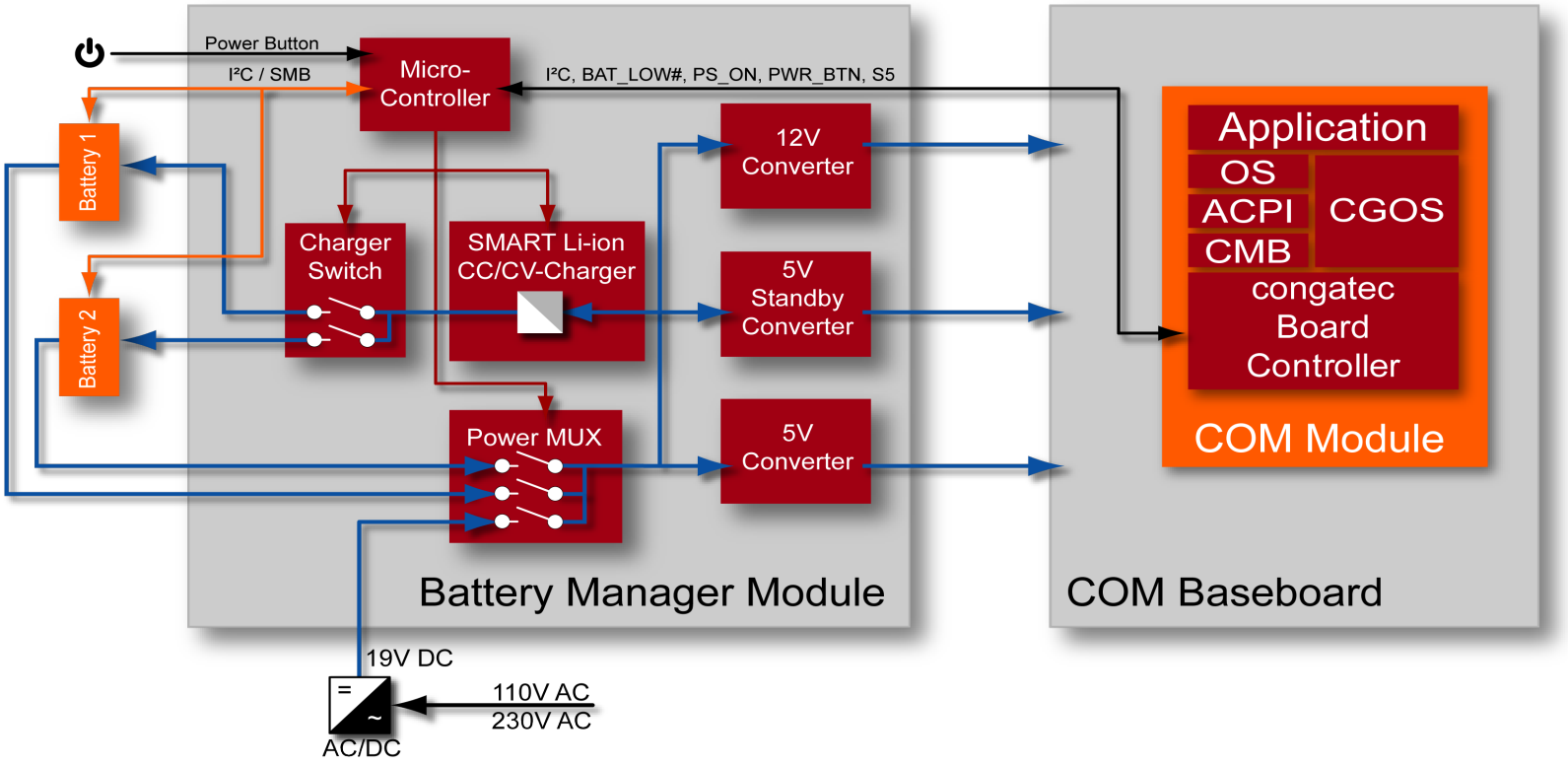
## 1.5 Input Requirements

| | Power Brick Input | Battery |
|---|---|---|
| **Voltage** | 19.0 V | 14.4 V nom. |
| **Tolerance** | +/-3% | n.a. |
| **Max. Current** | 4.5 A typ. | 6.5 A |
| **Standby Current (G3 Mode)** | 30 mA typ. | < 3 mA typ. |
| **Power (continuous)** | 85 W typ. | n.a. |

## 1.6 Output Characteristics

| | 5V Regulator | 5VSB Regulator | 12V Regulator | CC/CV Charger |
|---|---|---|---|---|
| **Voltage** | 5.1 V | 5.1 V | 12.0 V | max. 16.80 V |
| **Tolerance** | +2.5 %/-5 % | +2.5 %/-5 % | +/-5 % | +/- 1% |
| **Voltage Ripple @ 10Hz-20MHz** | 100 $mV_{pp}$ | 100 $mV_{pp}$ | n.a. | n.a. |
| **Max. Current** | 6.5 A | 500 mA | 6.0 A | 3.0 A |
| **Max. Current (t<10sec.)** | 7 A | 500 mA | 2.3 A | n.a. |
| **Power (continuous)** | 30 W | 2.5 W | 72 W | 50 W |

# 2 Block Diagram



# 3 Cooling

The conga-SBM²C module is designed to meet the latest efficiency standards and requirements therefore the produced power dissipation is minimal. To be able to use the module in a wide temperature range, it is recommended that you attach some form of a cooling solution to the module.

The back of conga-SBM²C does not contain any components and is designed so that the module can be attached to the system chassis or a heatsink using thermal conductive gap filler pads.

You can use for example:

- Chomerics THERM-A-GAP:
  http://www.chomerics.com
- T-Global L37 series
  http://www.tglobal.com.tw/
- Bergquist Gap-Pad
  http://www.bergquistcompany.com

# 4 Signal Descriptions and Pinout Tables

The following section describes the signals found on the conga-SBM²C located on the left and right side of the module.

This table describes the terminology used in this section for the Signal Description tables. The PU/PD column indicates if an internal pull-up or pull-down resistor has been used on the conga-SBM²C, if the field entry area in this column for the signal is empty, then no pull-up or pull-down resistor has been implemented.

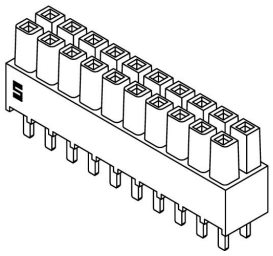
The "#" symbol at the end of the signal name indicates that the active or asserted state occurs when the signal is at a low voltage level. When "#" is not present, the signal is asserted when at a high voltage level.

**Table 2 Signal Tables Terminology Descriptions**

| Term | Description |
|---|---|
| PU | SBM²C internally implemented pull-up resistor |
| PD | SBM²C internally implemented pull-down resistor |
| I/O 3.3V | Bi-directional signal 3.3V tolerant |
| I/O 5V | Bi-directional signal 5V tolerant |
| I 3.3V | Input 3.3V tolerant |
| I 5V | Input 5V tolerant |
| I/O 3.3VSB | Input 3.3V tolerant active in standby state |
| O 3.3V | Output 3.3V signal level |
| O 5V | Output 5V signal level |
| P | Power Input/Output |
| PP | Push-Pull Output |
| OC | Open Collector |

## 4.1 Connector J1

**Connector Type** **SAMTEC IPS1-110-01-S-D**



*mates with*

**SAMTEC IPT1-110-01-S-D**

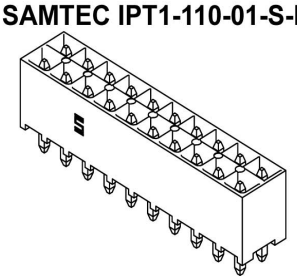


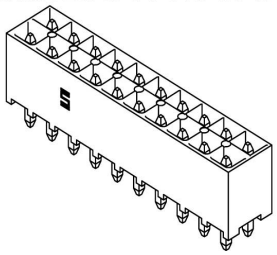
**Table 2 J1 signals**

| Pin | Signal | Description | I/O | PU/PD |
|---|---|---|---|---|
| 1 | 5V_VCC | 5V system power output | P | |
| 2 | 5V_VCC | 5V system power output | P | |
| 3 | GND | Ground | P | |
| 4 | GND | Ground | P | |
| 5 | GND -> +12V | 12V system power output | P | |
| 6 | GND -> +12V | 12V system power output | P | |
| 7 | GND | Ground | P | |
| 8 | GND | Ground | P | |
| 9 | 5VSB | System standby power | P | |
| 10 | C_SCL | I²C-bus clock line used for communication with the system host | I/O 5V | |
| 11 | C_SDA | I²C-bus clock line used for communication with the system host | I/O 5V | |
| 12 | C_SLP_S5# | Signal for S5 state | I 5V | |
| 13 | Reset# | | | |
| 14 | BPR | Buzzer output | O 5V | PP |
| 15 | I_OnBut# | Power button signal from front panel | I/O 5V | PU 15k µC_VCC |
| 16 | C_BATLOW# | Interrupt output | O 5V | OC, 8 mA |
| 17 | C_PBTN# | Power button signal to the CPU module | O 5V | OC, 8 mA |
| 18 | C_PSON# | Power on/off request line from the CPU module | I 5V | |
| 19 | M_SCL | Clock line of internal I²C-bus | I/O 5V | PU 15k µC_VCC |
| 20 | M_SDA | Data line of internal I²C-bus | I/O 5V | PU 15k µC_VCC |

## 4.2 Connector J2

**Connector Type**

SAMTEC IPT1-110-01-S-D



*mates with*

SAMTEC IPS1-110-01-S-D

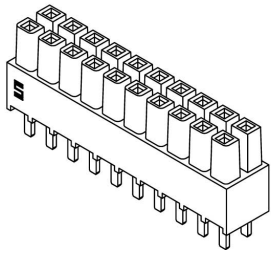


**Table 2 J2 signals**

| Pin | Signal | Description | I/O | PU/PD |
|---|---|---|---|---|
| 1 | BAT1 | Battery 1 power | P | |
| 2 | BAT1 | Battery 1 power | P | |
| 3 | GND | Ground | P | |
| 4 | GND | Ground | P | |
| 5 | BAT2 | Battery 2 power | P | |
| 6 | BAT2 | Battery 2 power | P | |
| 7 | TDI | JTAG interface | I/O 5V | PU 10k µC_VCC |
| 8 | TDO | JTAG interface | I/O 5V | PU 10k µC_VCC |
| 9 | TCK | JTAG interface | I/O 5V | PU 10k µC_VCC |
| 10 | TMS | JTAG interface | I/O 5V | PU 10k µC_VCC |
| 11 | B2_SCL | I²C-bus data line used for communication with battery 1 | I/O 5V | PU 15k µC_VCC |
| 12 | B2_SDA | I²C-bus data line used for communication with battery 1 | I/O 5V | PU 15k µC_VCC |
| 13 | B2_TP | Reserved | | |
| 14 | B1_TP | Reserved | | |
| 15 | B1_SDA | I²C-bus clock line used for communication with battery 2 | I/O 5V | PU 15k µC_VCC |
| 16 | B1_SCL | I²C-bus clock line used for communication with battery 2 | I/O 5V | PU 15k µC_VCC |
| 17 | GND | Ground | P | |
| 18 | GND | Ground | P | |
| 19 | Uin | Power input 19V/4.5A | P | |
| 20 | Uin | Power input 19V/4.5A | P | |

## 4.3 Connecting to a COM Express™ CPU Module

The conga-SBM²C signals listed in the following table must be connected to a COM Express™ CPU module via the carrier board.

| conga-SBM²C Signal | COM Express™ Signal |
|---|---|
| +12V | VCC_12V |
| 5VSB | VCC_5V_SBY |
| GND | GND |
| C_SCL | I2C_CK |
| C_SDA | I2C_DAT |
| C_BATLOW# | BATLOW# |
| C_PBTN# | PWRBTN# |
| C_PSON# | SUS_S3# |
| C_SLP_S5# | SUS_S5# |

The following table lists additional conga-SBM²C signals that are mandatory and must be implemented on the COM Express™ carrier board in order to ensure basic functionality.

| SBM²C Signal | Description |
|---|---|
| I_OnBut# | Must be connected to a signal used to turn on the system such as a button on a front panel |
| BAT1 | Battery 1 power connection |
| B1_SDA, B1_SCL | I²C-bus used for communication with battery 1 |
| Uin | Connection to 19V/4.5A power source |

The following table lists additional conga-SBM²C signals that are optional and can be implemented on the COM Express™ carrier board. Utilizing these signals will provide additional functionality.

| SBM²C Signal | Description |
|---|---|
| BPR | Buzzer output |
| µC_VCC | Supply for external I/O |
| TDI, TDO, TCK, TMS | JTAG interface |
| M_SDA, M_SCL | SBM²C internal I²C-bus |
| BAT2 | Battery 2 power connection |
| B2_SDA, B2_SCL | I²C-bus used for communication with battery 2 |
| 5V_VCC | 5V system power |

The following table lists signals which are important when designing a battery powered system that is in compliance with the congatec Battery Management Interface Specification.

| Signal (COM Express™) | Description |
|---|---|
| BATLOW# | This signal is used by the battery system to generate interrupts upon special events such as AC power changes, attaching/detaching of batteries, battery low conditions, etc. A low pulse of at least one microsecond is necessary to be recognized by the system host. |
| PS_ON# | A low level on PS_ON# or high level on SUS_S3# indicates that the Battery Management System should turn on system power. Otherwise the Battery Management System must turn off system power. |
| PWRBTN# | This signal is used to send a power-on request to the CPU module. The low pulse should be about 250 milliseconds long. |
| I2CLK | I²C-bus clock line used for communication between Battery Management System controller and system host |
| I2DAT | I²C-bus data line used for communication between Battery Management System controller and system host |
| SLP_S5# | This signal is active low when the system switches to the S5 (soft off) state. |

## 4.4 Placement and Layout Considerations

The conga-SBM²C is designed to minimize component count and layout complexity of the carrier baseboard but there is still the necessity to follow high power and noise separation layout rules.

- Utilize enough trace width for power rails such as 5V, battery rails, DC-in rails.
- Keep the trace length of the power rails short.
- Keep power rails away from noise sensitive COM Express™ signals (LVDS, IDE, VGA, Ethernet, USB).
- Keep power rails away from noisy COM Express™ signals (PCICLK, etc.).
- Keep battery bus and COM Express™ I²C Bus away from noisy signals.
- Route all I²C Buses and SMBuses CLK and DATA signals close together.
- Add ESD protective devices to signals where necessary

For more detailed information about high power layout rules consult literature found on the web.

# 5 Power Button, Beeper and I/O

## 5.1 Power Button

The conga-SBM²C is intended to be used to control the power of the complete system. The signal is pulled-up internally so there is no need for an external pull-up resistor on the carrier baseboard. Pull the signal low by a pushbutton to control the conga-SBM²C module. There is no need for special debounce components because the controller onboard the conga-SBM²C will debounce the pushbutton signal via software.

The pushbutton behavior is generally comparable to the button in a standard ATX system.

| Button Down Time | Functionality |
|---|---|
| 120 ms < t < 4 s | Turn on<br>Turn off, shutdown Windows |
| t > 4 s | Instant off |

## 5.2 Beeper Control

The conga-SBM²C provides an active high beeper output signal. The maximum load on this pin should not exceed 10mA. The output voltage level on this pin is 3.3V/5V and follows uC_VCC.

| Beeper | Functionality |
|---|---|
| 3 beeps | Warning level, configurable |
| continuous beep | Alarm level, configurable |

## 5.3 I/O Control

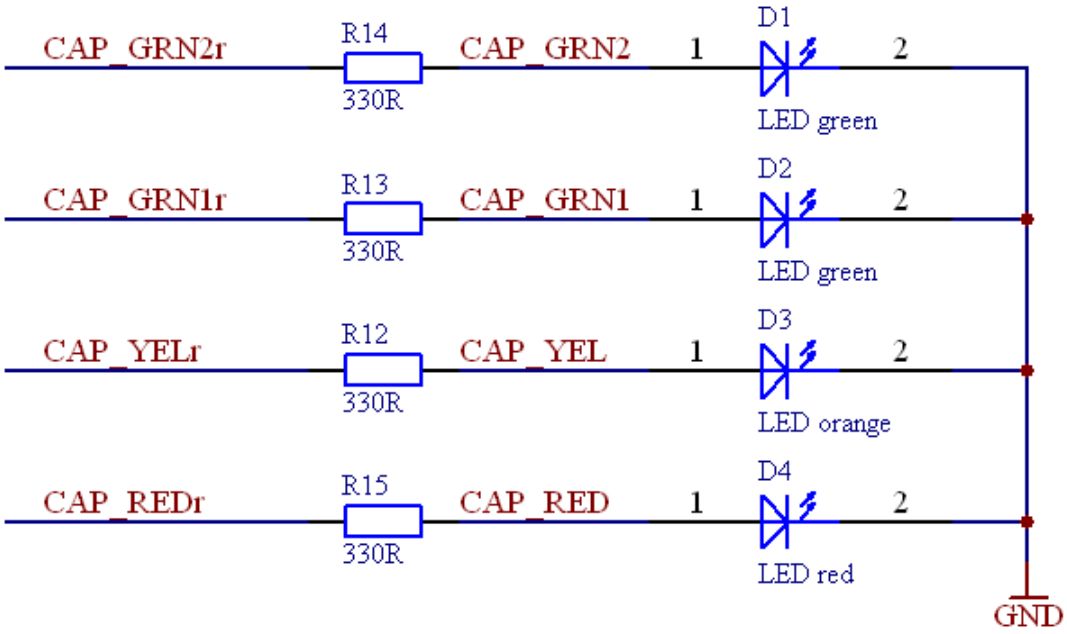
The conga-SBM²C supports the Philips/NXP PCA9555 I²C I/O controller (http://www.nxp.com). You can attach LEDs to indicate different modes and statuses.

The conga-SBM²C addresses the PCA9555 using the addresses shown below.

| I²C address | HEX | MSB | | | | | | | LSB |
|---|---|---|---|---|---|---|---|---|---|
| 7 bit | 0x20 | | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 8 bit | 0x40 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | R#/W |

Make sure you configured the PCA9555 address jumpers to the specific address.

The status LED outputs are configured to be push outputs, therefore the LEDs should be connected with common GND. Depending on the power supply voltage of the PCA9555, the selected series resistance to the LEDs must meet the LEDs' and PCA9555's maximum current requirements.




The following table shows the behavior of the different status LEDs that display operating and battery status.

| LED | Functionality | Port |
|---|---|---|
| LINE | 18.0 V < Uin < 20 V<br>Flashing during charging | P0.5 |
| PWRON | All output voltages are on<br>Flashing in S3 mode | P0.4 |
| GREEN2 | SOC: 75% to 100% | P0.0 |
| GREEN1 | SOC: 50% to 74% | P0.1 |
| YELLOW | SOC: 25% to 49% | P0.2 |
| RED | SOC: 0% to 24%<br>Flashing when SOC below configurable level | P0.3 |
| BAT1 EMPTY | Flashing when SOC below configurable level | P0.6 |
| BAT2 EMPTY | Flashing when SOC below configurable level | P0.7 |

# 6 conga-SBM²C Register

## 6.1 Software Considerations

The conga-SBM²C fully complies with the congatec Battery Management Interface Specification. As a result of this, the conga-SBM²C is recognized automatically by all congatec CPU modules supporting battery management. Running an ACPI operating system will bring notebook functionality to the system without the need for additional software installation.

CPU modules from other vendors may require a BIOS firmware update to be compatible with the congatec Battery Management System.

## 6.2 Interface

The I²C device addresses of the conga-SBM²C module are:

| I²C address | HEX | MSB | | | | | | | LSB |
|---|---|---|---|---|---|---|---|---|---|
| 7 bit | 0x0B | | 0 | 0 | 0 | 1 | 0 | 1 | 1 |
| 8 bit | 0x16 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | R#/W |

The following table lists all defined registers. The column 'Access' shows how the system host (cBC) accesses the individual registers. An entry 'r' or 'r/w' means that the implementation of the particular register is mandatory in order for the congatec battery management solution to function properly. An empty entry means that the particular register is optional and may be implemented by the SBSM for completeness.

| Function | Register Address | Access | Data Type | Data Length |
|---|---|---|---|---|
| ManufacturerAccess | 0x00 | r | Battery manufacturer specific | word |
| RemainingCapacityAlarm | 0x01 | r/w | mAh / unsigned integer | word |
| RemainingTimeAlarm | 0x02 | r/w | Minutes / unsigned integer | word |
| BatteryMode | 0x03 | r | Flags / bit map | word |
| AtRate | 0x04 | r | mA / signed integer | word |
| AtRateTimeToFull | 0x05 | r | Minutes / unsigned integer | word |
| AtRateTimeToEmpty | 0x06 | r | Minutes / unsigned integer | word |
| AtRateOK | 0x07 | r | TRUE or FALSE / boolean | word |
| Temperature | 0x08 | r | 0.1°K / unsigned integer | word |
| Voltage | 0x09 | r | mV / unsigned integer | word |
| Current | 0x0A | r | mA / signed integer | word |
| AverageCurrent | 0x0B | r | mA / signed integer | word |
| MaxError | 0x0C | r | Percent / unsigned integer | word |
| RelativeStateOfCharge | 0x0D | r | Percent / unsigned integer | word |
| AbsoluteStateOfCharge | 0x0E | r | Percent / unsigned integer | word |
| RemainingCapacity | 0x0F | r | mAh / unsigned integer | word |

Copyright © 2008 congatec AG

| Function | Register Address | Access | Data Type | Data Length |
|---|---|---|---|---|
| FullChargeCapacity | 0x10 | r | mAh / unsigned integer | word |
| RunTimeToEmpty | 0x11 | r | Minutes / unsigned integer | word |
| AverageTimeToEmpty | 0x12 | r | Minutes / unsigned integer | word |
| AverageTimeToFull | 0x13 | r | Minutes / unsigned integer | word |
| ChargingCurrent | 0x14 | r | mA / unsigned integer | word |
| ChargingVoltage | 0x15 | r | mV / unsigned integer | word |
| BatteryStatus | 0x16 | r | Flags / bit map | word |
| CycleCount | 0x17 | r | Count / unsigned integer | word |
| DesignCapacity | 0x18 | r | mAh or 10mWh / unsigned integer | word |
| DesignVoltage | 0x19 | r | mV / unsigned integer | word |
| SpecificationInfo | 0x1A | r | Packed data / bit map | word |
| ManufactureDate | 0x1B | r | Packed date / unsigned integer | word |
| SerialNumber | 0x1C | r | Number / unsigned integer | word |
| Reserved | 0x1D - 0x1F | | | |
| ManufacturerName | 0x20 | r | Character string | block |
| DeviceName | 0x21 | r | Character string | block |
| DeviceChemistry | 0x22 | r | Character string | block |
| ManufacturerData | 0x23 | r | Battery manufacturer specific | block |
| Reserved | 0x25 - 0x2E | | | |
| OptionalMfgFunction5 | 0x2F | r | Battery manufacturer specific | block |
| Reserved | 0x30 - 0x3B | | | |
| Firmware Revision | 0x3C | r/w | Unsigned integer, congatec specific | word |
| Blink Warn Capacity | 0x3D | r/w | Unsigned integer, congatec specific / see section 6.2.1 | word |
| Beep Warn Capacity | 0x3E | r/w | Unsigned integer, congatec specific | word |
| Beep On Capacity | 0x3F | r/w | Unsigned integer, congatec specific | word |
| Reserved | 0x40 | | | |
| BatterySystemState | 0x41 | r/w | Packed data / bit map | word |
| BatterySystemStateCont | 0x42 | r | Packed data / bit map | word |
| Reserved | 0x43 | | | |
| BatterySystemInfo | 0x44 | r | Packed data / bit map | word |
| Reserved | 0x45 - 0xFF | | | |

Copyright © 2008 congatec AG

### 6.2.1 OptionalMfgFunction3 Register (0x3D)

Today's computer systems are able to distinguish between different power off states. For a battery powered system the states S3 (suspend to RAM), S5 (soft off) and G3 (mechanical off) are of particular importance. The main system power is switched off in all cases, however the system standby power is switched off in the G3 state only.

Of course the system states S3 and S5 provide features such as wake-on-LAN or fast system resume times. However, for a battery powered system with long standby times it may be more useful to switch off to the G3 state to minimize power consumption. Therefore, congatec has defined two bits 'S3' and 'S5' in the smart battery register OptionalMfgFunction3. These bits are used to signal the SBSM (Smart Battery System Manager) whether it may additionally switch off the system standby power after the main system power has been switched off. The following table shows the detailed OptionalMfgFunction3 register definition:

| Bit Number | Bit Name | Default Value | Description |
|---|---|---|---|
| 0-7 | | 0xA | Blink warn level [percent] |
| 8 | S5 | 0 | Setting this bit to 1 tells the SBSM that it must not switch off the system standby power because the system is required to stay in the S5 state after switching off the main system power.<br><br>*Note: When the SBSM is completely restarted it must reset this bit to its default value. Usually this bit is set/reset by the system host during the power-on-self-test (POST) of the system based on CMOS RAM settings.* |
| 9 | S3 | 0 | Setting this bit to 1 tells the SBSM that it must not switch off the system standby power because the system is going to enter the S3 state when switching off the main system power. This bit is set by the system host right before the system enters the S3 state. The S3 bit must be cleared by the SBSM when the system resumes from the S3 state, i.e. when main system power is turned on again. |
| 10 | S1 | 0 | This bit indicates that the system is running in a power saving mode. It is set/reset by the system host when entering/leaving the power saving mode. |
| 11-15 | | | Reserved |

# 7 Industry Specifications

The list below provides links to industry specifications that apply to congatec AG modules.

| Specification | Link |
|---|---|
| COM Express™ Specification | http://www.picmg.org |
| congatec White Paper 'Embedded Battery Management' | http://www.congatec.com/fileadmin/Technology/battery_management/fb_battery_management_-_en.pdf |
| congatec Battery Management Interface Specification | http://www.congatec.com/sbm2.html |
| Smart Battery System Specifications | http://www.sbs-forum.org/specs/ |