HERCROM400G2

Specification

CAL000

Ver 1.3

CALYPSO

Department: European Wireless Terminal Chipset Business Unit

	Originator
Name	Michel Gac
Date	25 - February- 2000

HISTORY

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Notes:
1. Creation of document.
2. Version derived from specification SAMS000 v1.7
3. Final ball-out assignment.
4. Change MPU adress.
5. Updated §4.5.14, §4.5.22, §4.5.23, §4.5.24, §4.9
6. Updated connection figures
7. Fix bug in MPU paragraph.
8. Fix bug for KBC, DATA, TSPEN reset values.
9. Updated section 11.3 : removed warning concerning GNA2 pin connexion.
10. Updated Table 6 INT4n, Update §11.3 (Ground name), remove §reference document, added restrication with NAUSICA usage
11. Update table 3 : Compatibility connection with Nausica, update Table 6 (remove pull up on nIBOOT)
12. Remove all wrong references document.
13. Add §10-Table8 : PAD I/O Buffer type, update §3.5.21 MPU (minimum granularity of 8 bytes), update §3.5.22 DU, update §3.5.24 WRB.
14. Remove Pin EN_LMM_PWR in Ch 8 table Power management (wrong reference), update FIG 4 (1.8V instead of 1.4V)
15. update IOTA to power split DBB supply connections (ch 11.2.1.1)
16. add features for C035 : pin 140 nCS4 : update Table 7&8, Update Ch 7.1(Memory interface using ADD(22), using CS4)
17. Improve lisibility for modifications done in previous version (Ch 8, 9, 10)

18. remove blank chapter 11.1 (Example of mobile terminal appication), update IOTA to power split DBB supply connections figure (pin VLRTC=1.5v)

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SUMMARY

TABLE SUMMARY

FIGURE SUMMARY

1. GLOSSARY

APIF: **A**rm **P**ort **I**nter**F**ace.
BGA: **B**all **G**rid **A**rray.
CLOCK M: **CLOCK M**anagment.
CPU: **C**entral **P**rocessor **U**nit
DAI: **D**igital **A**udio **I**nterface
DSP: **D**igital **S**ignal **P**rocessor.
FLASH: **Flash** E2prom
GSM: **G**lobal **S**ystem for **M**obile communications.
HPI: **H**ost **P**ort **I**nterface.
H/W: **H**ard**W**are.
INTH: **INT**errupt **H**andler.
ISO: **I**nternational **S**tandards **O**rganization
I/O: **I**nput **/ O**utput.
JTAG: **J**oined **T**est **A**ction **G**roup
MxxLyy   **M**ega-module **DSP** with xx RAM and yy ROM.
LCD: **L**iquid **C**ristal **D**isplay
LMM: **DSP M**ega-**M**odule
MCU: **M**icro-**C**ontroller **U**nit.
MCSI: **M**ulti **C**hannels **S**erial **I**nterface
MEM INT: **MEM**ory **INT**erface.
P.C.:   **P**ersonal **C**omputer
PMT: **P**arallel **M**ultiplexing **T**est.
PLL: **P**hase **L**oop **L**ock
RIF: **R**adio **I**nterface **F**unction.
RISC: **R**educed **I**nstruction **S**et **C**omputer
RAM: **R**andom **A**ccess **M**emory
ROM: **R**ead **O**nly **M**emory
SIM: **S**ubscriber **I**dentity **M**odule.
S/W: **S**oft**W**are.
TDMA: **T**ime **D**ivision **M**ultiple **A**ccess.
TPU: **T**ime **P**rocessing **U**nit.
TQFP: **T**hin **Q**uad **F**lat **P**ack.
TSP: **T**ime **S**erial **P**ort.
USART: **U**niversal **S**ynchronous/**A**synchronous **R**eceiver **T**ransmitter
USB: **U**niversal **S**erial **B**us
RTC: **R**eal **T**ime **C**lock
ULPD: **U**ltra **L**ow **P**ower **D**evice
BIST: **B**uilt **I**n **S**elf **T**est
LPG: **L**ed **P**ulse **G**enerator
PWL: **P**seudo-noise pulse **W**idth **L**ight modulator
PWT: **P**ulse **W**idth **T**one generator
I2C: **I**nter **IC C**ontrol

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2. GENERAL DESCRIPTION

CALYPSO is a chip implementing the digital base-band processes of a GSM/GPRS mobile phone. This chip combines a DSP sub-chip (LEAD2 CPU) with its program and data memories, a Micro-Controller core with emulation facilities (ARM7TDMIE), internal 8Kb of Boot ROM memory, 4M bit SRAM memory, a clock squarer cell, several compiled single-port or 2-ports RAM and CMOS gates.

The application of this circuit is the management of the GSM/GPRS base-band processes through the GSM layer 1, 2 and 3 protocols as described in the ETSI standard with a specific attention to the power consumption in both GSM dedicated and idle modes, and GPRS (class 12) capability.

The chip will fully support the GSM full-level test approval (FTA) for both Full-Rate, Enhanced Full-Rate and Half-Rate speech coding.

CALYPSO implements all features for the structural test of the logic (full-SCAN, BIST, PMT, JTAG boundary-SCAN).

3. BLOCK SPECIFICATION

3.1 INTRODUCTION

CALYPSO architecture is based on two processor cores ARM7 and LEAD2 using the generic TI RHEA bus standard as interface with their associated application peripherals.
CALYPSO is composed from the following blocks:

- ARM7TDMIE
    ARM7TDMI CPU core (32/16 bits RISC processor)
    + ARM ice crusher for emulation purpose
- DSP subchip S28C128
    LEAD2 DSP core with 28K words of RAM and 128K words of ROM
    + API (8 Kw part of the 28K of RAM)
    + SPI
    + TIMER
- Clock Squarer analog cell.
- ARM peripherals:
    General purpose peripherals
    - ARM Memory Interface for external RAM, Flash or ROM
    - RHEA bridge
    - 4 Mbit Static RAM with write-buffer
    - Memory Protection Unit (MPU)
    - Debug Unit (DU)
    - 64 Kbit of via2-ROM for internal boot.
    - Die-ID cell (48 bits + 5 spare).
    Application peripherals
    - ARM General purposes I/O with keyboard interface and two PWM modulation signals for light and buzzer with possible tones generation.
    - Micro Wire interfaces for LCD and EEPROM.
    - 3 Timers (generic, watchdog)
    - UART 16C750 interface (UART_IRDA) with
        - IRDA control capabilities (SIR)
        - Software flow control (UART mode).
        - hardware flow protocol (DCD, CTS/RTS)
    - UART 16C750 interface (UART_MODEM) with
        - hardware flow protocol (DCD, CTS/RTS)
        - autobaud function
    - SIM Interface.

- ARM interrupts Handler (INTH).
- GSM real-time sequencer (TPU).
- GSM real-time Serial Port (TSP).
- DMA controller (4 channels – 2 ports)
- Real Time Clock (RTC)
- GSM Ultra Low-Power Device (ULPD)
- Clock generator & control with Digital Phase Locked Loop (CLKM)
- Programmable controller for Led pulse generation (LPG)
- Enhanced tone generator (PWT)
- Pseudo-noise modulator for light level control (PWL)
- Master I2C serial interface
- GPRS Encryption Algorithm module 1 & 2.

- ASIC DSP peripheral:
    General purpose peripherals
    - RHEA bridge
    Application peripherals
    - Radio interface (RIF).
    - Multi Channels Serial Interface (MCSI).
    - A51/A52 ciphering (CRYPT)
    - UART 16C750 interface (UART_MODEM) with
        - hardware flow protocol (DCD, CTS/RTS)
        - autobaud function, local echo.
    - DMA controller (4 channels)
    - DSP interrupts Handler (INTH).
- OTHER ASIC peripherals.
    - JTAG TAP controller.

3.2   ARM megacell (ARM7TDMIE)

The ARM7TDMI is a 32 bits RISC micro-controller core. This microprocessor work in 32 bits or 16 bit instructions and on 32, 16 or 8 bit data. The ARM7 architecture is based on reduced instruction set computer (RISC). Pipelining is employed so that all parts of the processing and memory systems can operate continuously. Typically, while one instruction is being executed, its successor is being decoded, and a third instruction is being fetched from memory. In CALYPSO chips family, ARM7 is intended to work in '**little endian**' mode only.
The CPU is associated with an emulation module called IceCrusher, which provides many debug functions:

- Single processor and multiprocessor debug.
- High level language and assembly debug (Run, Halt, Step...).
- Real Time (CPU continuously running) or Non real-time (CPU stopped) debugs options.
- Combined 32 and 16 bit mode for ARM processor.
- Endianess transparency.
- Unlimited breakpoints via op-code replacement (S/W breakpoint).
- 2 Hardware breakpoints (one configurable as SW breakpoint) with maskable cycle type, address and data compare.
- 2 external breakpoint events.
- Internal events generate external triggers.
- Benchmarking / profiling capability.

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3.3 DSP subchip (S28C128)

The DSP subchip is a Digital Signal Processor core compliant with the TMS320C54x family. The CPU core LEAD2 is associated with a ARM Port Interface (API), an interrupt handler, a parallel interface XIO, a Timer, 28K words of RAM including 8K words of API shared memory, 128K words of ROM, a serial port, and a JTAG interface.
The input clock frequency is delivered by an external DPLL and the functional cycle frequency is planned to be in the range [0 – 91 MHz].

3.4 Clock Squarer cell

The Clock Squarer cell is an analog cell which function is to reshape a clock signal provided by an external oscillator. The input signal is assumed to be a pseudo-sinusoidal signal with a limited dynamic transformed by the Clock Squarer cell in a square waveform with an amplitude of VCC (see electrical characteristics of signal CLKIN in Appendix B).

3.5 ARM peripherals

3.5.1 Memory Interface.

The Arm memory interface handles:
- **External ARM memory access management**: It performs
  ⇒ ARM read and write access size adaptation to the memory width (from 8-bit up to 32-bit).
  ⇒ ARM access duration management (wait state insertion or using 'nREADY' input) to enable the connection of slow memory devices.
  ⇒ Memory control signals generation (chip-selects, write strobe generation,...) with up to 4 chip-select signals corresponding each to an address range of 8 Mbytes.
- **ARM to API memory access management**:
  ⇒ ARM access size adaptation for API read and writes access. A 32-bit API READ transaction is transformed into 2 16-bit read access. A 32-bit API WRITE access is transformed into 2 16-bit write transaction.
  ⇒ Address signal-timing adaptation to be compliant with the API interface requirement.
- **ARM to Rhea bridge access management**:
  ⇒ ARM accesses size adaptation for Rhea accesses. The access size adaptation is done regarding the Rhea peripheral minimal transaction size. If the Rhea peripheral can not handle byte transaction, then no byte write transaction can be done.
- **ARM nWAIT and access control flags generation (byte-latch, etc...).**

3.5.2 Internal Static RAM

Four megabit of static RAM (SRAM) are embedded on the die and mapped on nCS6 chip-select of the memory interface. These memories can be read or written either in 8, 16 or 32 bits format. The access cycle is guaranteed with 0 wait-state for any cycle frequency up to fmax MHz.

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3.5.3 Internal Boot Memory

A 64Kbit ROM is embedded and mapped on nCS7 chip-select of the memory interface. This memory can be read either in 8, 16 or 32 bits format. The access cycle is guaranteed with 0 wait-state for any cycle frequency up to fmax MHz.

Depending of the state of the nIBOOT signal, this memory is mapped on nCS0 or nCS7, to allow the CPU to boot (at reset) on external or internal memory.

3.5.4 Die ID cell

The Die ID cell is a 64-bit register composed of fuse cells programmed by Laser during fabrication process. Each Die ID is unique.

See chapter 16.4.

3.5.5 Interrupt Handler (INTH).

The interrupt handler provides 21 prioritized and maskable interrupts to the ARM core.

It receives interrupts from both internal modules and external chip environment. Each incoming interrupt is configured as a low level sensitive or falling edge sensitive interrupt and can be individually masked using dedicated configuration registers.

An Interrupt Level Register is associated to each incoming interrupt to define a priority to the corresponding interrupt. If several interrupts have the same priority level, they are sent in a predefined order.

Each interrupt can be routed to one of the two input interrupts of the ARM core FIQ (Fast Interrupt request) and IRQ (Low priority Interrupt request).

3.5.6 General purposes I/O (ARMI/O).

We provide fifteen I/O pins configurable in read or write mode by internal registers.

10 special I/O pins are dedicated for keyboard connection: 5 output (Columns) and 5 input (Rows). The five input pins are connected on 1 interruption for wake-up mode.

A Pulse Width Modulated pin is dedicated to the control of the buzzer. A dedicated timer is used to generate the waveform shape, which modulates the buzzer PWM signal thus producing tones in the human audible spectrum.

3.5.7 Micro Wire interfaces (UWIRE).

This serial interface can drive external devices as serial EEPROM or LCD with 2 chip-selects with respect to the micro wire standard.

The serial clock period is derived from the reference 13MHz clock and can be configured as:

$T_{SCLK} = CK\_FREQ * Csi\_FRQ * T_{13M} = [2/4/7/10] * [2/4/8] * T_{13M}$

_Note__: the use of the uWIRE interface is exclusive with the use of the I2C interface (same I/O pins)._

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3.5.8   Timers (TIMER).

The chip implements three 16 bits timers configurable either in 'auto reload' or in 'one shot' modes. The timers generate interrupts to the ARM when equal to zero.
The first timer is configured by default as a Watchdog for the MCU. If a programmer doesn't want to have this functionality, he must write a specific sequence into a dedicated register in order to configure it as a general-purpose timer.
The two other timers are general-purpose timers.

3.5.9   IrDA Universal Async Receiver/transmitter 16C750 (UART-IRDA).

This UART interface is compatible with 16C750 compliant devices. It includes the Slow Infra Red protocol in order to be connected with an infrared transmitter to any external data peripherals with an IrDA compliant data interface.
The IR function can be disabled and the UART connected through a standard wired interface.
This UART is primarily intended to be linked with the modem of an external PC for concurrent debugging purpose.

The module integrates two 64 words (9 and 11 bits) receive and transmit FIFO and one 8 words (8 bits) status FIFO (IrDA only) which trigger levels are programmable. The baud-rate is internally generated from a programmable divisor.
Transmission parity can be even, odd, none and the number of stop bits is 1, 1.5 or 2.
The receiver can detect break, idle or framing errors, and FIFO overflow and parity errors.
The transmitter can detect FIFO underflow.
All modem operations are controllable via a software interface.
In IrDA mode, this upgraded UART 16C750 includes the following additional features:

- IrDA 1.0 SIR support allows serial communication at baud rates up to 115.2 kbaud.
- Pulse shaping, and pulse recovering. Sending a single infrared pulse signals a zero. A one is signaled by not sending any pulse. The width of the pulse can be either 1.6 us or $3/16^{th}$ of a single bit time.

- The device operation, in IrDA 1.0 SIR, is similar to the operation in UART mode. The main difference being that the data transfer operations are normally performed in half-duplex, the modem control and status signals are not used.

- Frame formatting: addition of variable xBOF characters and EOF characters

- Uplink/downlink CRC generation/detection

- Asynchronous transparency (automatic insertion of break character)

- 8 characters status FIFO available to monitor frames length and frame errors.

- Variable frame length for RX and TX IrDA frame.

Note: MIR and FIR are not implemented.

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3.5.10   Universal Async Receiver/transmitter 16C750 (UART-MODEM)

This UART interface is compatible with the NS 16C750 device.
This UART 16C750 is devoted to the connection to a Modem through a standard wired interface.

The module integrates two 64 words (9 and 11 bits) receive and transmit FIFOs which trigger levels are programmable. The baud-rate is internally generated from a programmable divisor.
Transmission parity can be even, odd, or none and the number of stop bits is either1, 1.5 or 2.
The receiver can detect break, idle or framing errors, FIFO overflow and parity errors.
The transmitter can detect FIFO underflow.

All modem operations are controllable either via a software interface or using hardware flow control signals.
This upgraded UART 16C750 includes the following additional features:
- Hardware flow control (DCD, RTS/CTS)
- Auto-bauding with the possibility to match to baud-rate from 1200 to 115.2Kbits/s.

This UART is shared between the ARM7 and the DSP processors. One processor only at a time can controlled the UART. The allocation of the UART is defined by the ARM7 (configuration register). By default, the UART is connected to the ARM7 RHEA bus.

3.5.11   Subscriber Identity Module Interface (SIM).

The Subscriber Identity Module interface will be fully compliant with the GSM 11.11 and ISO/IEC 7816-3 standards.
Its external interface is 3 Volts only. 5 Volts adaptation will be based on external level shifters.
The SIM interface supports the cold and warm reset procedures and the disabling of the clock (static SIM cards).

3.5.12   Serial Port Interface (SPI)

The SPI is a full-duplex serial port configurable from 1 to 32 bits and provides 3 enable signals programmable either as positive or negative edge or level sensitive.
The serial clock period is derived from the reference 13MHz clock and can be configured as:
$T_{MCUCLK} = PTV * T_{13M} = [1/2/4/8/16] * T_{13M}$

3.5.13   Time Processing Unit (TPU)

The TPU is a real-time sequencer dedicated to the monitoring of GSM base-band processing's.
Working from an event table referring to a GSM TDMA time base, the TPU activates tasks to control DSP peripherals with respect of the time constraints related to the GSM sequencing.
To store the real-time microinstructions of the sequencer, the TPU includes one 2 ports RAM of 1024 words of 16 bits with a dual page addressing capability.
MCU could access at the full RAM in write mode only when TPU is running.

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3.5.14   Time Serial Port (TSP)

The TSP is a peripheral of the TPU, which includes both a serial port (32 bits) and a parallel interface. The serial port can be programmed by the TPU with a time accuracy of the quarter of GSM bit. The serial port is uni-directional (transmit only) when used with NAUSICA but can be configured in bi-directional to keep compliant with VEGA3. The serial ports provide 4 enable signals programmable either as positive or negative edge or level sensitive.
The parallel interface allows controlling 13 external individual output and 1 internal signal with a time accuracy of the quarter of GSM bit.
These parallel output signals are mainly used to control the RF activity.
The single internal signal is looped on one interrupt line of the DSP in order to offer a possibility of sequencing the DSP tasks scheduling on a quarter of GSM bit time accurate event.
The serial clock frequency is fixed to 6.5MHz.

3.5.15   Direct Memory Access controller (DMA)

The DMA controller manages data transfers between the RHEA peripherals and the DSP API memory. The main features are:

- Four independent DMA channels
- Configuration of channels from the MCU only (master, direction)
- Either the DSP or the ARM host can control each DMA channel
- All DMA transactions are using the ARM Rhea bus
- The DMA transaction width can be either 8 or 16-bit data
- Unknown transfer length support and double-page destination buffers

3.5.16   Clock Management (CLKM)

This module is in charge of the control of the clock activity for the DSP, MCU and RHEA peripherals. It includes one DPLL and configuration register for DSP and MCU clocks frequencies programming.
CLKM manages also the reset of all modules connected either to the MCU Rhea bus or the DSP Rhea bus and the scheduling of the deep power of the external FLASH memory.
The DPLL is programmable in "multiplication-mode" with the following values:

$$F_{out} = F_{in} \times \frac{m}{d}$$ m = 1 up-to 32 (step 1)   d = 1, 2, 3 or 4

It could be also programmable in "division-Mode" with the following:

$$F_{out} = \frac{F_{in}}{k}$$ k = 1, 2 or 4

3.5.17   Pulse Width Tones (PWT)

This module generates a modulated frequency signal for the external buzzer. Frequency is programmable between 349Hz and 5276Hz with 12 half tone frequencies per octave. The volume is also programmable.

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3.5.18   Pulse Width Light (PWL)

This module allows the control of the backlight of LCD and keypad by employing a 4096bit random sequence. This voltage level control technique decreases the spectral power at the modulator harmonic frequencies. The block uses a switchable clock of 32kHz, independent of UPS.

3.5.19   Light Pulse Generator (LPG)

This peripheral produces the signal for the blinking LED. Blink period and duration are programmable.

3.5.20   I2C master serial interface (I2C)

The I2C is a half-duplex serial port using 2 lines (data and clock) for data transmission with software addressable external devices. The interface is compliant with the Philips standard.
The main features of the interface are:
- single master only
- standard (100KHz) and the fast (400KHz) transmission modes
- support both burst write, single read and combined read modes
- transmit burst buffer of 16 words
- 3 bits programmable spike filtering logic
- error handling capability during I2C bus access

Note: the use of the I2C interface is exclusive with the use of the uWIRE interface (same I/O pins).

3.5.21   Memory Protection Unit (MPU)

Within a memory space, the MPU allows defining memory sub-regions, each having a separate Read/Write protection attribute; this permits for partitioning the memory space into program instruction, system data, user data, stack …

The application program configures the MPU, which interfaces to the processor via the RHEA bus. The address bus directly issued from the processor is monitored providing a real-time position of the memory region accessed. When a protection breach attempt occurs, the memory control signals are affected, not selecting the memory, and the fault condition is indicated to the processor.

The MPU allows for controlling:
- Up to four programmable protected regions within a memory space of 512 Kbyte.
- A maximum protected size of 128 Kbyte for each region (512 Kbyte for 4 regions).
- A minimum granularity of 8 bytes.
- A privileged-code memory region.

For each region, memory mapped control registers define:
- Protected memory region base-address.
- Starting/ending addresses within the protected memory region.
- Protection mode (Non-User R/W, User Read-only, ROM, Privileged-region write… -see Protection Mode definition-) applied to the memory sub-region bounded by the starting/ending addresses.
- Out-of-protection (upper-bound) indication enabled/disabled.

The MPU generates:

- An illegal-access signal if the application program attempts a non-authorized access to a memory region (i.e. User write access to a region programmed for User Read-only accesses).
- An Out-of-protection signal when the application program attempts to read or write to a location within a memory region (defined by the base-address) and above the upper limit (end-address) of the protected sub-region. (helpful for stack overflow/under-flow monitoring).
- A MPU-fault signal which is the OR'ed combination of both Illegal-access and Out-of-protection signals.
- A fault indication (Illegal-access and/or Out-of-protection) flagged into the MPU status register which is available to the processor for fault analyze.

3.5.22   Debug Unit (DU)

The Debug Unit is a hardware resource intended to provide additional support to a software abort-handler. The DU provides **64** stages deep history table of the last memory accesses prior entering the abort mode, then permitting analysis of previous bus transaction' s.

The DU is an autonomous function that does not need to be configured, hence, does not interfaces to a control bus such as RHEA. The DU is connected directly to the processor busses (Address & Control) from where it collects the data, and to the memory interface system where the saved history table can be read.

The Debug Unit offers the following:

- Sixty-four 32-bit words deep FIFO register file
- 26-bit Processor Address and 8 Processor control signals recorded
  (nM[1:0], MAS[1:0], nEXEC, nOPC, nMREQ, nRW)
- Continuous storage for every processor fetch (either instruction or data)
- Data record automatically frozen upon switch to abort mode
- Memory-like read access during abort operating mode
- Enable/disable control from input module pin (typically connected to a chip-configuration register-bit).
- General purpose RAM when debug function is disabled.

3.5.23   GPRS Encryption Algorithm (GEA1-2)

In GPRS mode, the data confidentiality is performed by a ciphering function (GPRS Encryption Algorithm). The ciphering is executed within the LLC upper layer. According to the option negotiated with the network the GEA mode 1 or mode 2 may be selected.

The purpose of the LLC is to convey information between the mobile station and the Serving GPRS Support Node. The procedures used are modeled upon the HDLC concepts. The LLC shall support both acknowledge and unacknowledged mode and implement a FCS according to the mode used.

The HW block provided support the computation of the FCS according to the LLC frame to send/received as well as the ciphering/deciphering GEA mode 1 and 2. These procedures are described in 01.61, 04.64 GSM recommendations and detailed in GSM MoU documents.

3.5.24   Internal RAM write buffer (WRB)

The write buffer increases the speed of memory accesses, thanks to write pipe mechanism. (The idea is to allow a complete CPU cycle time for read access).

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3.5.25   Real Time Clock (RTC)

The RTC block is an embedded Real Time Clock module, directly accessible from RHEA bus interface.
Its basic functions are:
- Time information (seconds/minutes/hours) coded in BCD
- Calendar Information (Day/Month/Year/ Day of the week) directly in BCD code up to year 2099
- Alarm function with interrupts generation based on a periodical (second/minute/hour/day) or a precise time event in the century (second accuracy).
- 30s time range correction
- 32KHz oscillator frequency gauging.

3.5.26   Ultra Low-Power Down controller (ULPD)

The ULPD block is used for the DEEP SLEEP MODE management. It allows stopping the accurate 13MHz VTCXO during the discontinuous reception phases in GSM idle mode in order to save power consumption. Moreover, the ULPD sequencer is used to monitor the chip activity in terminal OFF mode, thus deriving the original GSM Deep Sleep mode concept to the whole terminal activity.
The main functions of the ULPD block are:
- gauging of the 32 kHz quartz based oscillator
- maintenance of GSM time during deep sleep mode with the minimum time accuracy to allow a burst demodulation at wake-up
- programmable timer to exit deep sleep mode
- delivery of the 13MHz master to the CLKM module
- switching between 13MHz and 32KHz
- generation of chip functional reset

3.6   Specific power-split for RTC

To have a minimum of consumption in mobile equipment, only the active logic elements have to be supplied. This approach is possible by using Split Power.

It consists by the use of Tactical Cells to split the core power domain in two sub domains powered with different voltage supplies.

The separation between the core and the active domain is realized by Tactical cells and more precisely by Internal Level Shifters. The Internal Level Shifters (ILS) are library standard macro-cells to interface two core domains with two different supplies.

When the core domain is unknown, these cells have a Power-Down signal, which allows to set the output of the ILS to 0 and to have any through current. So ILS are going to be placed on each wire between the active elements and the core.

The aim of the Split Power is to have a minimum of consumption in OFF state. For a mobile the only necessary element to supply in OFF is the RTC. So the tactical cells will be placed to isolate the RTC.

To use the Split Power, Calypso had to have pins VDDRTC, VDDSRTC, VSSRTC as specific power-supplies for both core and IOs.

The pin which are going to be suplied with specific power supplies are :
- ON/OFF   (in)
- NRESPWRON   (in)
- IT_WAKEUP   (out)
- CLK32K_OUT   (out)
- OSC32K_IN   (Xtal in)
- OSC32K_OUT   (Xtal out)

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3.7   DSP peripherals

3.7.1   Radio interface (RIF)

The RIF (Radio Interface) Module is a buffered serial port derived from the BSP peripheral module of the defined for TMS320C5X
The external serial data transmission is supported by a full-duplex double buffered serial port interface.

The DSP exchanges data with the RIF through either its

    -XIO interface for configuration data and radio data in word by word protocol or its

    - API interface for radio data in DMA mode (buffered mode with data block transfer)

For each data transfer between DSP and RIF, an interrupt is sent to DSP (XIO mode) or a DMA request and an 'end-DMA' request is sent to ARM.

Transmit serial clock is either generated internally or externally. Receive serial clock is always generated externally.

The RIF uses an internal 13MHz clock to manage the auto-buffering function.

3.7.2   Multi-Channel Serial Interface (MCSI)

The MCSI is a serial interface supporting both single and multi-channels (x16) communications. Words length, frame format, baud-rates are fully programmable.
The interface can be additionally configured to support GSM DAI test mode with the possibility to synchronize DAI with the voice frame signal.

3.7.3   Ciphering processor (CRYPT)

The ciphering processor implements both A51 and A52 algorithms as defined in GSM Rec03.20 and detailed in GSM MoU documents.

3.7.4   Universal Asynchronous Receiver/transmitter (16C750)

UART interface compatible with the NS 16C750 device.
This UART is shared between the ARM7 and the DSP processors. One processor only at a time can control the UART. The ARM7 configuration register defines the allocation of the UART). By default, the UART is connected to the ARM7 RHEA bus.

3.7.5   Direct Memory Access controller (DMA)

The DMA module is shared between DSP and MCU processors. The DMA have only two port DSP-API memory and MCU-RHEA, so it allows RHEA peripheral to use DMA channel between us and the API memory.

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3.7.6   Interrupt Handler (INTH).

The interrupt handler provides 21 interrupts to the DSP core.

It receives interrupts from both internal modules and external chip environment. Each incoming interrupt is configured as a low level sensitive or falling edge sensitive interrupt. The mask and the interruption level of the interrupts are configured in the DSP core itself.

.

3.8   General purpose peripherals

3.8.1   JTAG

The JTAG interface (TAP) of the chip can be selected either

1. to access the 2 processors on-chip emulators with a pseudo IEEE JTAG protocol for emulation purposes. A PC or workstation can be connected to the interface to set the bi-emulation mode with the ARM core linked to DSP core. The IceCrusher module supports the synchronization between the 2 cores.

Or

2. To dialog with an embedded TAP controller which instructions set support all the IEEE 1149 BSCAN modes, the programming of the chip I/Os configuration (PMT modes, full-scan modes, BIST modes, functional 1 or 2 modes) and the selection of the boundary-scan chain for FLASH EPROM programming.

3.8.2   IDDQ

Pulling high the IDDQ pin sets the IDDQ configuration.
In IDDQ mode, all analog devices are disabled thus allowing reducing the chip current consumption to the single leakage currents. Moreover, a direct control of the ARM and DSP resets and clocks is allowed through, respectively, the pin BCLKR and CLKTCXO of the chip.

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3.9   Block Diagram
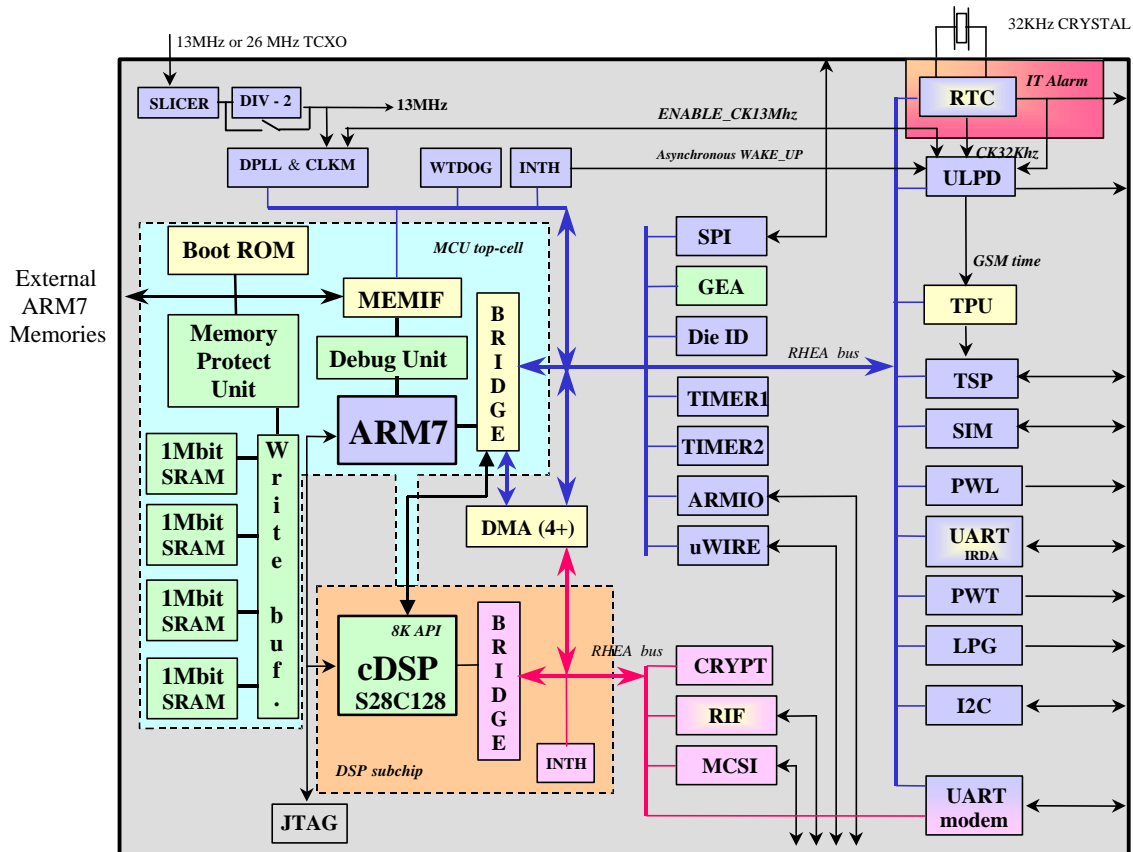
Figure 1: CALYPSO internal architecture

4.   INITIALIZATION PROTOCOL

4.1   Hardware logic reset

The chip receives one external reset signal (active low):

* The power-on reset (nRESPWRON) initializes the whole digital logic devices. It is activated each time the power supply is applied to the chip.

The functional reset is generated internally from the ULPD controller:

* The internal functional reset (nRESET) initializes the logic devices working on any clocks derived from the 13MHz-clock reference or the processor strobes. This reset is activated each time the terminal is switched in OFF mode and maintained active as long as the external control pin ON_nOFF is at low level.

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Internally to the chip, three reset signals are provided in order to dissociate the reset of the logic working on the 32KHz or TCK clocks and the reset of the logic working on clocks derived from the reference clock 13MHz or the processors strobes. Namely:

- nRESET_32K   ⇒ JTAG, RTC and ULPD modules.

- nRESET_DSP   ⇒ all logic mapped on the DSP Rhea bus except 32KHz based logic

- nRESET_MCU   ⇒ all logic mapped on the MCU Rhea bus except 32KHz based logic

Externally to the chip, two reset signals can be controlled by the MCU to reset selectively external components and to control the deep power mode of external FLASH memories

- nRESET_OUT   ⇒ external components.

- FDP   ⇒ FLASH deep power (reset delay controlled with
                          CNTL_ARM_CLK (deep_power).

Control	Reset signal				
	nRESET_32K	NRESET_DSP	nRESET_MCU	nRESET_OUT	FDP
NRESPWRON	Yes	Yes	Yes	Yes	Yes
NRESET	No	Yes	Yes	Yes	Yes
RST_CMD watchdog	No	Yes	Yes	No	Yes
CNTL_RST(DSP_reset)	No	Yes	No	No	No
CNTL_RST(ext_reset)	No	No	No	Yes	No

Table 1: Reset management

* CNTL_RST is a control register mapped in the MCU memory space

After ARM reset the ARM program counter point to 0000:0000 address.
After DSP reset the DSP program counter point to 0000:FF80 address.

Each module implements in its control register a software-reset bit, which can be activated by its master processor. By default, these bits are set as soon as the processor reset (nRESET_DSP or nRESET_DSP) is activated.

4.2   ARM code downloading

In debug mode, when external Ram is used to replace FLASH or ROM, the program code is downloaded thanks to JTAG facilities. Flash memory program is downloaded through the JTAG TAP using the dedicated boundary-scan chain.

ROM or EPROM devices must be programmed before assembly.

4.3   DSP code execution

When releasing the DSP reset signal nRESET_DSP, the DSP fetches the reset interrupt vector at address FF80h and begins the execution of the program code.

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5. INTERRUPTS MANAGEMENT

5.1 DSP INTERRUPTS

The DSP subchip owns 17 interrupt lines with 11 of which INT0n to INT10n are dedicated for external peripherals. These interrupts are mapped as follows:

- RSN		->	reset (HW or SW)
- INT0n -	(level)	->	RIF receive interrupt
- INT1n	(level)	->	RIF transmit interrupt
- INT2n	(level)	->	UART interrupt

        1.   Error on receiver line.
        2.   Receive timeout.
        3.   Received character.
        4.   Character to transmit.
        5.   Modem status change.
        6.   Received XOFF / special character detected.
        7.   CTS/RTS deactivation.

- TINT		->	Timer interrupts
- RINT		->	SPI receive interrupt
- RINT		->	SPI transmit interrupt
- INT3n	(level)	->	MCSI receive interrupt
- INT4n	(level)	->	MCSI transmit interrupt
- INT5n	(level)	->	MCSI frame duration error interrupt
- INT6n	(level)	->	MCSI DAI interrupt
- INT7n	(edge)	->	CYPHER interrupts

        1.   end of ciphering process
        2.   error of processing

- INT8n	(edge)	->	TPU frame interrupt
- AINT		->	API interrupts
- INT9n	(edge)	->	TPU programmable interrupt
- INT10n	(level)	->	DMA interrupt
- nMIN		->	Abort on Rhea bus OR INT4n redirection

<u>Note:</u> The TPU programmable interrupt (INT9n) is a facility offered to the DSP programmer in order to allow the generation of a DSP interrupt at a dedicated time with a quarter of GSM bit accuracy. The interrupt is set in a scenario by using a time-stamped instruction.

5.2 MCU INTERRUPTS

The ARM7 owns 2 interrupt lines nIRQ and nFIQ.
The NAUSICA fast interrupt is mapped on nFIQ

All other peripheral interrupts are mapped on nIRQ as follows:

Name	Sense	IRQ	FIQ	Function
IRQ0	edge	✔		Watchdog TIMER interrupts
IRQ1	edge	✔		TIMER1 interrupt
IRQ2	edge	✔		TIMER2 interrupt
IRQ3			✔	TSP receives interrupt
IRQ4	edge	✔		TPU frame interrupt
IRQ5	edge	✔		TPU page interrupt
IRQ6	edge	✔		SIM interrupt 1. no answer to reset 2. character underflow 3. character overflow 4. character to transmit 5. received character 6. SIM card insertion/extraction
IRQ7	level	✔		UART_MODEM interrupts 1. error on receiver line 2. receive timeout 3. received character 4. character to transmit 5. modem status change 6. Received XOFF / special character detected 7. CTS/RTS deactivation 8. DSR/RxD activity detection (OFF mode only)
IRQ8	level	✔		Keyboard *or* JogDial interrupt
IRQ9	edge	✔		RTC periodical timer interrupt
IRQ10	level	✔		RTC ALARM *or* I2C data transfer error / completion
IRQ11	edge	✔		ULPD end of gauging interrupt
IRQ12	level	✔		External interrupt
IRQ13	edge	✔		SPI interrupt 1. received data 2. data to transmit
IRQ14	level	✔		DMA interrupt
IRQ15	edge	✔		API interrupts (nHINT)
IRQ16			✔	SIM card-detect fast interrupt
IRQ17			✔	Fast external interrupt
IRQ18	level	✔		UART_IRDA interrupts 1. error on receiver line 2. receive timeout 3. received character 4. character to transmit 5. modem status change 6. Received XOFF / special character detected 7. CTS/RTS deactivation
IRQ19	level	✔		ULPD GSM timer
IRQ20	level	✔		GEA interrupt

6.   DMA MAPPING

The DMA controller is managing the access to the DSP API 6K-word shared memory.

1. The MCU ARM7.
2. The Radio InterFace (RIF).
3. The MODEM UART.
4. The IRDA UART.

The RIF-RX and RIF-TX have a dedicated channel each. For UART the following combination are possible:

⇨ UART-MODEM have 2 channels:
- ch#2: TX
- ch#3: RX

⇨ UART-IRDA have 2 channels:
- ch#2: RX
- ch#3: TX

⇨ UART-MODEM and UART-IRDA have one channel each
- ch#2: UART-MODEM
- ch#3: UART-IRDA

RX and/or TX are independently selectable for each module.

⇨ UART-MODEM have one channel
- ch#2: RX or TX

⇨ UART-IRDA have one channel
- ch#3: RX or TX

⇨ UARTs have no DMA.

After reset, all modules have DMA functions disabled.

DMA request	channel			
	0	1	2	3
RIF_DMA_REQ_X	✔			
RIF_DMA_REQ_R		✔		
nDMA_REQ_ARM(0) MODEM			✔	
nDMA_REQ_ARM(1) MODEM				✔
nDMA_REQ_ARM(0) IRDA				✔
nDMA_REQ_ARM(1) IRDA			✔	

Table 2: DMA channels allocation

Note: ***Only one UART at a time should be allocated to one DMA channel (2 or 3). The potential conflicts between concurrent DMA requests MUST be solved at system level with only one peripheral configured in DMA mode.***

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7. ADDRESS MAPPING

7.1 ARM MEMORY SPACE

ARM memory space is shared between external Memory Interface and RHEA bus.
The Memory Interface is providing 6 chip-select signals.
All internal peripherals are mapped on ARM memory space with a range of 32Kbytes.

7.1.1 Memory interface: using CS4 (default)

Important : nCS4 is only available from Calypso C035 – F751619

(*): External memory

Device name	nIBOOT	Start address	Stop address	Size (byte)	Data
nCS0 *(*)*	1	0000:0000	003F:FFFF	4M	8/16/32
	0	0000:2000	003F:FFFF	4M – 8K	
nCS6	-	0080:0000	00BF:FFFF	512K	8/16/32
not allocated	-	*00C0:0000*	*00FF:FFFF*	-	-
nCS1 *(*)*	-	0100:0000	013F:FFFF	4M	8/16/32
nCS2 *(*)*	-	0180:0000	01BF:FFFF	4M	8/16/32
nCS3 *(*)*	-	0200:0000	023F:FFFF	4M	8/16/32
CS4 *(*)*	-	0280:0000	02BF:FFFF	4M	8/16/32
nCS4 *(*)*	-	0280:0000	02BF:FFFF	4M	8/16/32
nCS0 image	-	0300:0000	033F:FFFF	4M	8/16/32
nCS7	1	0380:0000	03BF:FFFF	4M	8/16/32
	0	0000:0000	0000:1FFF	8K	
Debug Unit (DU)	-	03C0:0000	03FF:FFFF	32	32
not allocated	-	*0400:0000*	*FFCF:FFFF*	-	-
API RAM	-	FFD0:0000	FFD0:3FFF	16K	16/32
API control register	-	FFE0:0000	FFE0:0001	2	16

7.1.2 Memory interface: using ADD(22)

Important : nCS4 is only available from Calypso C035 – F751619

(*): External memory

Device name	nIBOOT	Start address	Stop address	Size (byte)	Data
nCS0 *(*)*	1	0000:0000	007F:FFFF	8M	8/16/32
	0	0000:2000	007F:FFFF	8M – 8K	
nCS6	-	0080:0000	00BF:FFFF	512K	8/16/32
not allocated	-	*00C0:0000*	*00FF:FFFF*	-	-
nCS1 *(*)*	-	0100:0000	017F:FFFF	8M	8/16/32
nCS2 *(*)*	-	0180:0000	01FF:FFFF	8M	8/16/32
nCS3 *(*)*	-	0200:0000	027F:FFFF	8M	8/16/32
nCS4 *(*)*	-	0280:0000	02BF:FFFF	8M	8/16/32
nCS0 image	-	0300:0000	037F:FFFF	8M	8/16/32
nCS7	1	0380:0000	03FF:FFFF	8M	8/16/32
	0	0000:0000	0000:1FFF	8K	
Debug Unit (DU)	-	03C0:0000	03FF:FFFF	32	32
not allocated	-	*0400:0000*	*FFCF:FFFF*	-	-
API RAM	-	FFD0:0000	FFD0:3FFF	16K	16/32
API control register	-	FFE0:0000	FFE0:0001	2	16
Debug Unit	-				

7.1.3   External Flash/ROM image

In all case and whatever the value of the nIBOOT signal, the external memory mapped on nCS0 is accessible at address defined in nCS0-image range.

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RHEA peripherals

Strobe 0 - Device name		Start address	Stop address	Size in bytes	Data
reserved	---	*FFFF:0000*	*FFFF:0FFF*	-	-
TPU registers	CS2	FFFF:1000	FFFF:13FF	1K	16
reserved	---	*FFFF:1400*	*FFFF:4FFF*		
UART_IRDA	CS10	FFFF:5000	FFFF:57FF	2K	8
UART_MODEM	CS11	FFFF:5800	FFFF:5FFF	2K	8
UART_MODEM	CS12	FFFF:6000	FFFF:67FF	2K	8
reserved	---	*FFFF:6800*	*FFFF:6FFF*	-	-
RIF	CS14	FFFF:7000	FFFF:77FF	2K	16
reserved	---	*FFFF:7800*	*FFFF:97FF*	-	-
TPU RAM	CS18	FFFF: 9000	FFFF:97FF	2K	16
DPLL configuration	CS19	FFFF:9800	FFFF:9801	2	16
not allocated	---	*FFFF:9802*	*FFFF:F7FF*	-	-
GEA	CS24	FFFF:C000	FFFF:C7FF	2K	8/16
not allocated	---	*FFFF:C800*	*FFFF:F7FF*	-	-
Watchdog timer	CS31	FFFF:F800	FFFF:F8FF	256	16
RHEA bridge		FFFF:F900	FFFF:F9FF	256	16
INTH		FFFF:FA00	FFFF:FAFF	256	16
Memory Interface		FFFF:FB00	FFFF:FBFF	256	16
DMA controller		FFFF:FC00	FFFF:FCFF	256	16
CLKM		FFFF:FD00	FFFF:FDFF	256	16
JTAG ID code		FFFF:FE00	FFFF:FE03	4	16
MPU		FFFF:FF00	FFFF:FFFF	256	16
Strobe 1 – Device Name		**Start address**	**Stop address**	**Size in bytes**	**Data**
SIM	CS0	FFFE:0000	FFFE:07FF	2K	16
TSP	CS1	FFFE:0800	FFFE:0FFF	2K	16
reserved	---	*FFFE:1000*	*FFFE:17FF*	-	-
RTC	CS3	FFFE:1800	FFFE:1FFF	2K	8
ULPD	CS4	FFFE:2000	FFFE:27FF	2K	16
I2C	CS5	FFFE:2800	FFFE:2FFF	2K	8
SPI	CS6	FFFE:3000	FFFE:37FF	2K	16
TIMER1	CS7	FFFE:3800	FFFE:3FFF	2K	16
UWIRE	CS8	FFFE:4000	FFFE:47FF	2K	16
ARMIO	CS9	FFFE:4800	FFFE:4FFF	2K	16
reserved	---	*FFFE:5000*	*FFFE:67FF*	-	-
TIMER2	CS13	FFFE:6800	FFFE:6FFF	2K	16
reserved	---	*FFFE:7000*	*FFFE:77FF*	-	-
LPG	CS15	FFFE:7800	FFFE:7FFF	2K	8
PWL	CS16	FFFE:8000	FFFE:87FF	2K	8
PWT	CS17	FFFE:8800	FFFE:8FFF	2K	8
reserved	---	*FFFE:9000*	*FFFE:EFFF*	-	-
JTAG ID code	CS30	FFFE:F000	FFFE:F003	4	
DSP configuration		FFFE:F004	FFFE:F005	2	16
ARM configuration		FFFE:F006	FFFE:F007	2	16
Asic configuration		FFFE:F008	FFFE:F009	2	16
IO selection config		FFFE:F00A	FFFE:F00B	2	16
Osc32K config		FFFE:F00C	FFFE:F00D	2	16
MCU emu config		FFFE:F00E	FFFE:F00F	2	16
DIE id code		FFFE:F010	FFFE:F017	8	16
reserved	CS31	*FFFE:F800*	*FFFE:FFFF*	-	-

Table 3: ARM memory space

D32 -------------> D24	D23 -------------> D16	D15 --------------->D8	D7 ----------------> D0
	nCS0		
	nCS1		
	nCS2		
	nCS3		
	CS4		
	nCS6		
	nCS7		
	API RAM		
NOT MAPPED		MPU	
		GEA	
		APIC	
		SIM	
		TSP	
		TPU_REG	
		TPU_RAM	
		NOT MAPPED	RTC
		ULPD	
		NOT MAPPED	I2C
		SPI	
		TIMER1	
		NOT MAPPED	LPG
			PWL
		Reserved	
		NOT MAPPED	PWT
		UWIRE	
		ARMIO	
		NOT MAPPED	UART_IRDA
			UART_MODEM
		TIMER2	
		RHEA bridge	
		INTH	
		Memory Interface	
		DMA controller	
		CLKM	
		JTAG ID code	
		Die ID code	

Table 4: ARM data format

7.2   DSP MEMORY SPACE

1. Provides 8K of API RAM starting at 0800h
2. RAM in a minimum system would be 8K.

	Data	Prog0	Prog1	Prog2	Prog3
0000	DARAM overlay over the program area - 2K				
0800	API overlay over the program area **8K**				
1000					
1800					
2000					
2800	DARAM overlay over the program area **18K**				
3000					
3800					
4000					
4800					
5000					
5800					
6000					
6800					
7000		PROM **28K**			
7800					
8000			PROM **32K**	PROM **32K**	PROM **8K**
8800					
9000	DROM **20K**				
9800					
A000					
A800					
B000					
B800					
C000					
C800					
D000					
D800					
E000	PDROM **8K**				
E800					
F000					
F800					

7.2.1   API

The API interface offers a dual access capability to 8 kWords of 16 bits of mixed data program memory, it can be configured to manage data access of 8,16 or 32 bits through the API control registers and the memory interface configuration registers (See document [7]).

The API dual access capability is either enabled (SAM mode) or disabled (HOM mode) by the DSP. SAM mode is the default configuration when the DSP exits from a reset phase.

In SAM mode (Shared Access Mode), ARM (or DMA controller) and DSP can both access simultaneously to this shared memory space with ARM access resynchronized on DSP cycle-clock (3 times ratio required between ARM and DSP cycle clocks).

In HOM mode (Host Only Mode), the API RAM is dedicated to external access under the control of either the ARM or the DMA controller and therefore the access time is limited by the maximum access time of the used DARAM..

7.2.2   XIO-RHEA

Internal and external peripherals are mapped on XIO or data memory spaces. Theses spaces are accessible through nXSTROBE[3:0] with a range of 2Kbytes for external peripherals allowing to connect up to :

- 6 external devices on program space
- 26 external devices on data space
- 31 external devices on I/O space
- internals peripherals are connected on I/O space or data memory space

DSP XIO-RHEA mapping.					
Device name		Start address	Stop address	Size in bytes	Data
External peripherals mapping - Program space					
Strobe 0					
not allocated	CS0	0000	07FF	2K	16
…	…	…	…	…	…
not allocated	CS5	3000	37FF	2K	16
External peripherals mapping - Data Space 1					
Strobe 1					
not allocated	CS6	3800	3FFF	2K	16
…	…	…	…	…	…
not allocated	CS15	7800	7FFF	2K	16
External peripherals mapping - Data Space 2					
Strobe 2					
UART_MODEM	CS16	8000	87FF	2K	8
not allocated	CS17	8800	8FFF	2K	16
…	…	…	…	…	…
not allocated	CS31	F800	FFFF	2K	16
External peripherals mapping -I/O Space					
Strobe 3					
RIF	CS0	0000	07FF	2K	16
MCSI	CS1	0800	0FFF	2K	16
not allocated	CS2	1000	17FF	2K	16
not allocated	CS3	1800	1FFF	2K	16
not allocated	CS4	2000	27FF	2K	16
CYPHER	CS5	2800	2FFF	2K	16
…	…	…	…	…	…
not allocated	CS30	F000	F7FF	2K	16
XI0-2-RHEA bridge	CS31	F800	F8FF	256	16
API Control		F900	F9FF	256	16
INTH		FA00	FAFF	256	16
not allocated		FB00	FBFF	256	
DMA controller		FC00	FCFF	256	16
not allocated		FD00	FDFF	256	
not allocated		FE00	FEFF	256	
not allocated		FF00	FFFF	256	

Table 5: DSP XIO memory space

8.   CALYPSO PINS DESCRIPTION

TI code name: **F741979**

MICRO_WIRE INTERFACE : 5 pins.			Pull	Reset
SDI	IN	Data in.	**LPU**	input
SDO	OUT	Data out.		0
SCLK	OUT	Serial clock.		0
nSCS0	OUT	chip select 0.		1
nSCS1	OUT	chip select 1.		1

UART16C750 INTERFACE (UART_IRDA): 5 pins.			Pull	Reset
TXIR_IRDA	OUT	Infra-Red transmit pulse.		0
TX_IRDA	OUT	Transmit Data		1
RXIR_IRDA	IN	Infra-Red receive pulse.		Input
RX_IRDA	IN	Receive Data.		Input
SD_IRDA	OUT	IRDA transceiver ShutDown mode.		1

UART16C750 INTERFACE (UART_MODEM): 5 pins.			Pull	Reset
TX_MODEM	OUT	Transmit Data.		1
RX_MODEM	IN	Receive Data.		Input
CTS_MODEM	IN	Clear To Send.		Input
RTS_MODEM	OUT	Request To Send.		1
DSR_MODEM	IN	Data Set Ready.		Input

GENERIC I/O PORT : 16 pins.			Pull	Reset
BU	OUT	Buzzer output with PWM.		0
LT	OUT	Light output with PWM.		0
IO(3:0)	IN/OUT	generic Input/Output.		input
KBC(4:0)	OUT	Keyboard matrix 5 by 5 column access.		11111
KBR(4:0)	IN	Keyboard matrix 5 by 5 row access.	**PU**	input

ARM MEMORY INTERFACE: 49 pins.			Pull	Reset
ADD(21:0)	OUT	ARM address bus out		00000
DATA(15:0)	IN/OUT	ARM data bus		Output
nCS(3:0)	OUT	4 chip select active low.		1111
CS4	OUT	1 chip-select active high		0
RnW	OUT	RAM/FLASH memory read no write signal.		1
nBHE	OUT	Ext RAM1/RAM2 chip select .		0
nBLE	OUT	Ext RAM1/RAM2 chip select.		0
nFOE	OUT	Flash output enable for standby mode..		1
nFWE	OUT	VPP command for flash write.		1
FDP	OUT	Flash deep low-power		0

Important: From Calypso C035 - F751619:				
Replace line above by				
nCS(4:0)	OUT	5 chip select active low.		11111

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TPU PARALLEL PORT : 12 pins.			**Pull**	**Reset**
TSPACT(11:0)	OUT	Synchronous activation signal (GSM qbit)		H0000

TPU SERIAL PORT : 7 pins.			**Pull**	**Reset**
TSPDO	OUT	Output serial data.		0
TSPDI	IN	Input serial data (VEGA3 compatibility only)		input
TSPEN(3)	OUT	Configurable triggers (edge/level)		1
TSPEN(2)	OUT	Configurable triggers (edge/level)		0
TSPEN(1:0)	OUT	Configurable triggers (edge/level)		11
TSPCLKX	OUT	Transfer serial clock (VEGA3 compatible)		0

ARM SERIAL PORT : 5 pins.			**Pull**	**Reset**
MCUDI	IN	Input serial data.		input
MCUDO	OUT	Output serial data.		0
MCUEN(2:0)	OUT	Configurable enable triggers (edge/level)		111

JTAG PORT : 7 pins.			**Pull**	**Reset**
TDI	IN	Test Data Input.	**LPU**	Input
TDO	OUT	Test Data Output.		Z
TMS	IN	Test Mode Select.	**LPU**	Input
TCK	IN	Test Clock.	**LPD**	Input
nEMU0	IN/OUT	Test Emulation pin 0.	**PU**	Input
nEMU1	IN/OUT	Test Emulation pin 1.	**PU**	Input
NBSCAN	IN	Boundary-scan selection	**PU**	1

MISCELLANEOUS : 11 pins.			**Pull**	**Reset**
CLKTCXO	IN	VCTXO input clock (13MHz or 26MHz).		Input
CLK13M_OUT	OUT	CLKM output clock (13MHz).		0
OSC32K_IN	IN	Input component signal of 32KHz quartz.		Input
OSC32K_OUT	IN	Output component signal of 32KHz quartz.		Input
CLK32K_OUT	OUT	32KHz oscillator square waveform output		0
NRESPWRON	IN	Chip Power-On reset		0
nRESET_OUT	OUT	Reset of external peripherals.		0
EXT_IRQ	IN	External interrupt for ARM	**PU**	Input
EXT_FIQ	IN	Fast external interrupt for ARM	**PU**	Input
IDDQ	IN	Static config. in IDDQ mode (active high)		Input
nIBOOT	IN	Internal/External Boot memory		Input

POWER MANAGEMENT : 5 pins.			**Pull**	**Reset**
IT_WAKEUP	OUT	Wake-up interrupt of Real Time Clock.		0
TCXOEN	OUT	External TCXO enable		0
RFEN	OUT	External RF IC enable		0
ON_OFF	IN	Regulators activity		Input

VOICE BAND INTERFACE : 4 pins.			**Pull**	**Reset**
VCLKRX	IN	Transmit/Receive clock.		Input
VDX	OUT	Transmit Data.		0
VDR	IN	Receive data.		Input
VFSRX	IN	Transmit/Receive Synchro.		Input

MCSI INTERFACE : 4 pins.			**Pull**	**Reset**
MCSI_TXD	OUT	Transmit serial data		0
MCSI_RXD	IN	Receive serial data		Input
MCSI_CLK	IN/OUT	Bit synchronization clock		Input
MCSI_FSYNCH	IN/OUT	Frame synchronization clock or SS reset		Input

BASE BAND INTERFACE : 6 pins.			**Pull**	**Reset**
BFSR	IN	Receive synchro.		Input
BDR	IN	Receive data.		Input
BFSX	OUT	Transmit synchro.		0
BDX	OUT	Transmit data.		0
BCLKR	IN	Receive serial clock (*VEGA3 compatibility*)		Input
BCLKX	IN/OUT	Transmit serial clock (*VEGA3 compatibility*)		Input

SIM INTERFACE : 6 pins.			**Pull**	**Reset**
SIM_RST	OUT	Sim reset.		0
SIM_PWCTRL	OUT	Power Control.		0
SIM_IO	IN/OUT	Input output signal.		0
SIM_CLK	OUT	Output clock.		0
SIM_CD	IN	Card detect (*VEGA3 compatibility*)		Input
SIM_RnW	OUT	Direction of IO data line		0

POWER & GROUND : 33 pins.			**Nb**
VDD	-	VCC voltage for ASIC core & CPUs	6
VDDPLL	-	VCC voltage for DPLL	1
VDDRTC	-	VCC voltage for RTC split powered	1
VDDS-MIF	-	VCC voltage dedicated to memory interface	4
VDDS-RTC	-	VCC voltage dedicated to RTC split powered I/Os	1
VDDS-1	-	VCC voltage for ASIC I/Os	2
VDDS-2			1
VSS	-	common ground for ASIC core, I/Os and CPUs	12
VSSPLL	-	ground dedicated to DPLL	1
VSSRTC	-	ground dedicated to RTC split powered	1
VDDANG	-	Analog VCC for clock squarer.	1
VSSANG	-	Analog ground for clock squarer	1
VSSO	-	Reference ground for 32KHz oscillator.	1

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FUNCTIONAL MUXED : 23 pins			Pull	Reset
nSCS2	OUT	uWIRE chip select 2.		1
CK16X_IRDA	OUT	IRDA mode: 16X serial transmission clock		0
IO(15:4)	IN/OUT	Additional generic Input/Output.		Input
ADD(22)	OUT	ARM address bus out		0
CLKX_SPI	OUT	SPI Serial clock output		0
SCL	OUT	I2C INTERFACE Master serial clock		Z
SDA	OUT	I2C INTERFACE Serial bidirectional data		Z
LPG	OUT	Light pulse Generator LED control signal		0
PWT	OUT	Pulse Width modulated signal for buzzer		0
PWL	OUT	Pulse Width modulated signal for light		0
ARMCLK	IN	ARM external clock input		Input
nRDYMEM	IN	Ready signal for slow peripheral		

SOFTWARE DEBUG : 35 pins		(test and validation only)	Pull	Reset
XDI_O(7:0)	OUT	DSP XI/O Data bus.		N/A
X_A(4:0)	OUT	DSP XI/O Address bus		N/A
X_IOSTRB	OUT	DSP XI/O strobe		1
TOUT	OUT	DSP timer output.		0
XF	OUT	DSP External flag.		0
INT10n	OUT	DSP external interrupt 10 (DMA int.).		1
INT1n	OUT	DSP external interrupt 1 (RIF transmit int.).		1
INT4n	OUT	DSP external interrupt 4 (MCSI Tx int.).		1
IRQ4	OUT	ARM external interrupt 4 (TPU frame int.).		1
IACKn	OUT	DSP interrupt acknowledge.		1
CLKOUT_DSP	OUT	DSP clock out.		0
DPLLCLK	OUT	DPLL clock out.		0
MCLK	OUT	ARM clock in		0
nOPC	OUT	ARM not op-code fetch		0
nMREQ	OUT	ARM not memory request		0
nWAIT	OUT	ARM not wait		0
MAS(1:0)	OUT	ARM memory access size		10
nFIQ	OUT	ARM fast interrupts.		1
nIRQ	OUT	ARM normal interrupts.		1
nCS6	OUT	ARM chip-select RAM interne		1
TPU_WAIT	OUT	TPU in WAIT mode (WAIT / AT instruction)		0
TPU_IDLE	OUT	TPU in IDLE mode (SLEEP instruction)		1
START_BIT	OUT	Start bit detection		0

Table 6: CALYPSO pins description

Note: reset values are defined as follows,
>   *0 : driven low (output)*
>   *1 : driven high (output)*
>   *Z : high impedance (output disabled)*
>   *N/A : non-applicable*

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9. CALYPSO BALL-OUT

9.1 179GHH PACKAGE

Important: From Calypso C035 – F751619, in table below, replace

C11	140		VDD	VSS		

By

C11	140		VDD	VSS		nCS4

Important: From Calypso C035 – F751619, in table below, replace

K7	63		VDD	VSS	BU	PWT
L7	64		VDD	VSS	LT	PWL

By

K7	63		VDD	VSS	BU	PWT/DmaDbg
L7	64		VDD	VSS	LT	PWL/nEndDma

The DmaDbg mode is entered by setting bit 3&4 of ASIC_CONF_REG

Ball	Pad	IO supply	Core	Gnd	Functional	Dual mode
B2	1	VDDS-MIF	VDD	VSS	RnW	
C2	2		VDD	VSS	nCS0	
C3	3		VDD	VSS	nCS1	
B1*	4				**VSS**	
C1	5		VDD	VSS	nCS2	
D3	6		VDD	VSS	nCS3	INT4N
D2	7		VDD	VSS	CS4	ADD(22)
D1	8				**VDDS-MIF**	
F5	9		VDD	VSS	nBHE	IO(14)
E4	10		VDD	VSS	nBLE	IO(15)
E2	11		VDD	VSS	nFOE	X_A(3)
E3	12		VDD	VSS	nFWE	X_A(0)
E1	13				**VDD**	
F4	14		VDD	VSS	FDP	NIACK
F3	15		VDD	VSS	ADD(0)	
F2	16		VDD	VSS	ADD(1)	
F1	17				**VSS**	
G5	18		VDD	VSS	ADD(2)	
G4	19		VDD	VSS	ADD(3)	
G2	20		VDD	VSS	ADD(4)	
G3	21		VDD	VSS	ADD(5)	
G1	22				**VDDS-MIF**	
H1	23		VDD	VSS	ADD(6)	
H3	24		VDD	VSS	ADD(7)	
H2	25		VDD	VSS	ADD(8)	

H4	26		VDD	VSS	ADD(9)	
H5	27		VDD	VSS	ADD(10)	
J1	28		VDD	VSS	ADD(11)	
J2	29		VDD	VSS	ADD(12)	
J3	30		VDD	VSS	ADD(13)	
J4	31		VDD	VSS	ADD(14)	
K1	32			**VSS**		
K3	33		VDD	VSS	ADD(15)	
K2	34		VDD	VSS	ADD(16)	
K4	35		VDD	VSS	ADD(17)	
J5	36		VDD	VSS	ADD(18)	
L1	37		VDD	VSS	ADD(19)	
L2	38		VDD	VSS	ADD(20)	
L3	39		VDD	VSS	ADD(21)	CK16X_IRDA
M1	40	VDDS-1		**VDD**		
N1*	41		VDD	VSS	nIBOOT	
M3	42		VDD	VSS	EXT_IRQ	
M2	43		VDD	VSS	IDDQ	
P1*	44		VDD	VSS	EXT_FIQ	
N2	45		VDD	VSS	nRESET_OUT	IO(7)
P2*	46			**VSS**		
N3	47		VDD	VSS	IO(0)	TPU-WAIT
P3	48		VDD	VSS	IO(1)	TPU-IDLE
L4	49		VDD	VSS	IO(2)	IRQ4
M4	50		VDD	VSS	IO(3)	SIM_RNW
N4	51		VDD	VSS	KBC(0)	NFIQ
P4	52			**VSS**		
K5	53		VDD	VSS	KBC(1)	NIRQ
L5	54		VDD	VSS	KBC(2)	XDIO(0)
N5	55			**VDDS-1**		
P5	56		VDD	VSS	KBC(3)	XDIO(1)
M5	57		VDD	VSS	KBC(4)	XDIO(2)
K6	58		VDD	VSS	KBR(0)	XDIO(3)
M6	59		VDD	VSS	KBR(1)	XDIO(4)
P6	60		VDD	VSS	KBR(2)	XDIO(5)
N6	61		VDD	VSS	KBR(3)	XDIO(6)
L6	62		VDD	VSS	KBR(4)	XDIO(7)
K7	63		VDD	VSS	BU	PWT
L7	64		VDD	VSS	LT	PWL
P7	65			**VDD**		
N7	66		VDD	VSS	MCUDI	
M7	67		VDD	VSS	MCUDO	
M8	68		VDD	VSS	MCUEN(0)	
N8	69			**VSS**		
P8	70		VDD	VSS	MCUEN(1)	IO(8)
L8	71		VDD	VSS	MCUEN(2)	IO(13)
K8	72		VDD	VSS	SDO	INT10n
L9	73		VDD	VSS	nSCS0	SCL
N9	74		VDD	VSS	nSCS1	X_A(2)
P9	75		VDD	VSS	SCLK	INT1n

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			VDD	VSS	SDI	SDA
M9	76		VDD	VSS	SDI	SDA
K9	77		VDD	VSS	MCSI_FSYNCH	IO(12)
M10	78		VDD	VSS	MCSI_RXD	IO(10)
P10	79			**VSS**		
N10	80		VDD	VSS	MCSI_CLK	IO(11)
L10	81		VDD	VSS	MCSI_TXD	IO(9)
K10	82		VDD	VSS	BDR	
P11	83		VDD	VSS	BCLKR	ARMCLK
N11	84		VDD	VSS	BCLKX	IO(6)
M11	85		VDD	VSS	BDX	
L11	86		VDD	VSS	BFSR	
P12	87		VDD	VSS	BFSX	
N12	88		VDD	VSS	VCLKRX	
P13*	89			**VSS**		
N13	90		VDD	VSS	VDR	
P14*	91		VDD	VSS	VDX	
M13	92		VDD	VSS	VFSRX	
M12	93		VDD	VSS	TSPACT(0)	
N14*	94			**VDD**		
M14	95		VDD	VSS	TSPACT(1)	
L12	96		VDD	VSS	TSPACT(2)	
L13	97		VDD	VSS	TSPACT(3)	
L14	98			**VDDS-1**		
J10	99		VDD	VSS	TSPACT(4)	NREADYMEM
K11	100		VDD	VSS	TSPACT(5)	DPLLCLK
K13	101		VDD	VSS	TSPACT(6)	NCS6
K12	102		VDD	VSS	TSPACT(7)	CLKX_SPI
K14	103	VDDS-1	VDD	VSS	TSPACT(8)	NMREQ
J11	104		VDD	VSS	TSPACT(9)	MAS(1)
J12	105		VDD	VSS	TSPACT(10)	NWAIT
J13	106		VDD	VSS	TSPACT(11)	MCLK
J14	107		VDD	VSS	TSPCLKX	
H10	108		VDD	VSS	TSPDI	IO(4)
H11	109		VDD	VSS	TSPDO	
H13	110		VDD	VSS	TSPEN(0)	
H12	111		VDD	VSS	TSPEN(1)	
H14	112		VDD	VSS	TSPEN(2)	
G14	113			**VSS**		
G12	114		VDD	VSS	TSPEN(3)	NSCS2
G13	115		VDD	VSS	SIM_IO	
G11	116		VDD	VSS	SIM_CD	MAS(0)
G10	117		VDD	VSS	SIM_RST	
F14	118		VDD	VSS	SIM_PWRCTRL	IO(5)
F13	119		VDD	VSS	SIM_CLK	
F12	120		VDD	VSS	CLK13M_OUT	START_BIT
F11	121			**VDDPLL**		
E14	122			**VSSPLL**		

E12	123	VDDANG			**VSSANG**	
E13	124		VDDANG	VSSANG	CLKTCXO	
E11	125				**VDDANG**	
F10	126	VDDS-RTC	VDDRTC	VSSRTC	ON_OFF	
D14	127				**VDDRTC**	
D13	128				**VDDS-RTC**	
D12	129		VDDRTC	VSSRTC	RESPWRONZ	
C14	130				**VSSRTC**	
B14*	131		VDDRTC	VSSRTC	IT_WAKEUP	
C12	132		VDDRTC	VSSRTC	CLK32K_OUT	
C13	133		VDDRTC	VSSO	OSC32K_IN	
A14*	134				**VSSO**	
B13	135		VDDRTC	VSSO	OSC32K_OUT	
A13*	136	VDDS-2	VDD	VSS	RFEN	NOPC
B12	137				**VDD**	
A12	138		VDD	VSS	TCXOEN	
D11	139		VDD	VSS	nBSCAN	
C11	140		VDD	VSS		
B11	141		VDD	VSS	nEMU0	
A11	142				**VDDS-2**	
E10	143		VDD	VSS	nEMU1	
D10	144		VDD	VSS	TDI	
B10	145		VDD	VSS	TCK	
A10	146		VSS		**VSS**	
C10	147		VDD	VSS	TDO	
E9	148		VDD	VSS	TMS	
C9	149		VDD	VSS	CTS_MODEM	XF
A9	150		VDD	VSS	RX_MODEM	
B9	151		VDD	VSS	TX_MODEM	XIOSTRBN
D9	152		VDD	VSS	DSR_MODEM	LPG
E8	153		VDD	VSS	RTS_MODEM	TOUT
D8	154		VDD	VSS	RX_IRDA	
A8	155		VDD	VSS	RXIR_IRDA	X_A(1)
B8	156		VDD	VSS	SD_IRDA	CLKOUT_DSP
C8	157		VDD	VSS	TX_IRDA	
C7	158		VDD	VSS	TXIR_IRDA	X_A(4)

B7	159		VDD	VSS	DATA(0)
A7	160				**VSS**
D7	161		VDD	VSS	DATA(1)
E7	162		VDD	VSS	DATA(2)
D6	163		VDD	VSS	DATA(3)
B6	164				**VDDS-MIF**
A6	165		VDD	VSS	DATA(4)
C6	166		VDD	VSS	DATA(5)
E6	167		VDD	VSS	DATA(6)
C5	168		VDD	VSS	DATA(7)
A5	169	VDDS-MIF			**VDD**
B5	170		VDD	VSS	DATA(8)
D5	171		VDD	VSS	DATA(9)
E5	172		VDD	VSS	DATA(10)
A4	173				**VDDS-MIF**
B4	174		VDD	VSS	DATA(11)
C4	175		VDD	VSS	DATA(12)
D4	176		VDD	VSS	DATA(13)
A3	177		VDD	VSS	DATA(14)
B3	178		VDD	VSS	DATA(15)
A2*	179				**VSS**

Table 7: CALYPSO ball mapping

10. PAD I/O BUFFER TYPE

Important: From Calypso C035 – F751619, in table below, replace

C11	140	**PWR**	xxxAVAILABLExxx	IDI091	

By

C11	140	**PWR**	nCS4		OUI831

PAD Definition				BUFFER TYPE	
Ball	Finger	PAD	PAD_name	Input_Pad	Output_Pad
B2	1	IO	RnW	IDI041	OUI831
C2	2	O	nCS0		OUI831
C3	3	O	nCS1		OUI831
B1*	4	**PWR**	VSS	*power*	*power*
C1	5	O	nCS2		OUI831
D3	6	IO	nCS3	IDI041	OUI831
D2	7	IO	CS4	IDI041	OUI831
D1	8	**PWR**	VDDS-MIF	*power*	*power*
F5	9	IO	nBHE	IDI041	OUI831
E4	10	IO	nBLE	IDI041	OUI831
E2	11	O	nFOE		OUI831
E3	12	IO	nFWE	IDI041	OUK831
E1	13	**PWR**	VDD	*power*	*power*
F4	14	IO	FDP	IDI041	OUO431
F3	15	O	ADD_15_0(0)		OUI831
F2	16	O	ADD_15_0(1)		OUI831
F1	17	**PWR**	VSS	*power*	*power*
G5	18	O	ADD_15_0(2)		OUI831
G4	19	O	ADD_15_0(3)		OUI831
G2	20	O	ADD_15_0(4)		OUI831
G3	21	O	ADD_15_0(5)		OUI831
G1	22	**PWR**	VDDS-MIF	*power*	*power*
H1	23	O	ADD_15_0(6)		OUI831
H3	24	O	ADD_15_0(7)		OUI831
H2	25	O	ADD_15_0(8)		OUI831
H4	26	O	ADD_15_0(9)		OUI831
H5	27	O	ADD_15_0(10)		OUI831
J1	28	O	ADD_15_0(11)		OUI831
J2	29	O	ADD_15_0(12)		OUI831
J3	30	O	ADD_15_0(13)		OUI831
J4	31	O	ADD_15_0(14)		OUI831
K1	32	**PWR**	VSS	*power*	*power*
K3	33	O	ADD_15_0(15)		OUI831
K2	34	IO	ADD_20_16(16)	IDI041	OUI831
K4	35	IO	ADD_20_16(17)	IDI041	OUI831
J5	36	IO	ADD_20_16(18)	IDI041	OUI831

TEXAS INSTRUMENTS

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L1	37	IO	ADD_20_16(19)	IDI041	OUI831
L2	38	IO	ADD_20_16(20)	IDI041	OUI831
L3	39	O	ADD_21		OUI831
M1	40	**PWR**	**VDD**	*power*	*power*
N1*	41	I	nIBOOT	IDI091	
M3	42	I	EXT_IRQ	IDI091	
M2	43	I	IDDQ	IDI091	
P1*	44	I	EXT_FIQ	IDI091	
N2	45	IO	nRESET_OUT	IDI041	OUO231
P2*	46	**PWR**	**VSS**	*power*	*power*
N3	47	IO	IO(0)	IDI041	OUO431
P3	48	IO	IO(1)	IDI041	OUO431
L4	49	IO	IO(2)	IDI041	OUO431
M4	50	IO	IO(3)	IDI041	OUO431
N4	51	IO	KBC(0)	IDI041	OUO431
P4	52	**PWR**	**VSS**	*power*	*power*
K5	53	IO	KBC(1)	IDI041	OUO431
L5	54	IO	KBC(2)	IDI041	OUO431
N5	55	**PWR**	**VDDS-1**	*power*	*power*
P5	56	IO	KBC(3)	IDI041	OUO431
M5	57	IO	KBC(4)	IDI041	OUO431
K6	58	IO	KBR(0)	IDI041	OUO231
M6	59	IO	KBR(1)	IDI041	OUO231
P6	60	IO	KBR(2)	IDI041	OUO231
N6	61	IO	KBR(3)	IDI041	OUO231
L6	62	IO	KBR(4)	IDI041	OUO231
K7	63	O	BU		OUK831
L7	64	O	LT		OUK431
P7	65	**PWR**	**VDD**	*power*	*power*
N7	66	I	MCUDI	IDI041	
M7	67	O	MCUDO		OUK431
M8	68	IO	MCUEN(0)	IDI041	OUK431
N8	69	**PWR**	**VSS**	*power*	*power*
P8	70	IO	MCUEN(1)	IDI041	OUK431
L8	71	IO	MCUEN(2)	IDI041	OUK431
K8	72	O	SDO		OUK431
L9	73	O	nSCS0		OUK431
N9	74	O	nSCS1		OUK431
P9	75	O	SCLK		OUI431
M9	76	IO	SDI	IDI041	OUO431
K9	77	IO	MCSI_FSYNCH	IDI041	OUK431
M10	78	IO	MCSI_RXD	IDI041	OUK431
P10	79	**PWR**	**VSS**	*power*	*power*
N10	80	IO	MCSI_CLK	IDI041	OUI431
L10	81	IO	MCSI_TXD	IDI041	OUK431
K10	82	I	BDR	IDI041	
P11	83	I	BCLKR	IDI091	
N11	84	IO	BCLKX	IDI091	OUI431
M11	85	O	BDX		OUK431

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L11	86	I	BFSR	IDI041	
P12	87	IO	BFSX	IDI041	OUK431
N12	88	I	VCLKRX	IDI091	
P13*	89	PWR	VSS	*power*	*power*
N13	90	I	VDR	IDI041	
P14*	91	O	VDX		OUK431
M13	92	I	VFSRX	IDI041	
M12	93	IO	TSPACT_4_0(0)	IDI041	OUO231
N14*	94	PWR	VDD	*power*	*power*
M14	95	IO	TSPACT_4_0(1)	IDI041	OUO231
L12	96	IO	TSPACT_4_0(2)	IDI041	OUO231
L13	97	IO	TSPACT_4_0(3)	IDI041	OUO231
L14	98	PWR	VDDS-1	*power*	*power*
J10	99	IO	TSPACT_4_0(4)	IDI041	OUO231
K11	100	O	TSPACT_12_5(5)		OUO231
K13	101	O	TSPACT_12_5(6)		OUO231
K12	102	O	TSPACT_12_5(7)		OUO231
K14	103	O	TSPACT_12_5(8)		OUO231
J11	104	O	TSPACT_12_5(9)		OUO231
J12	105	O	TSPACT_12_5(10)		OUO231
J13	106	O	TSPACT_12_5(11)		OUO431
J14	107	O	TSPCLKX		OUI431
H10	108	IO	TSPDI	IDI041	OUK431
H11	109	IO	TSPDO	IDI041	OUK431
H13	110	O	TSPEN_0		OUK431
H12	111	IO	TSPEN_3_1(1)	IDI041	OUK431
H14	112	IO	TSPEN_3_1(2)	IDI041	OUK431
G14	113	PWR	VSS	*power*	*power*
G12	114	IO	TSPEN_3_1(3)	IDI041	OUK431
G13	115	IO	SIM_IO	IDI041	OUO431
G11	116	IO	SIM_CD	IDI091	OUO431
G10	117	IO	SIM_RST	IDI041	OUO431
F14	118	IO	SIM_PWRCTRL	IDI041	OUO431
F13	119	IO	SIM_CLK	IDI041	OUO431
F12	120	IO	CLK13M_OUT	IDI041	OUI431
F11	121	PWR	VDDPLL	*power*	*power*
E14	122	PWR	VSSPLL	*power*	*power*
E12	123	PWR	VSSANG	*power*	*power*
E13	124	I	CLKTCXO	IOH121	
E11	125	PWR	VDDANG	*power*	*power*
F10	126	I	ON_OFF	IDI091	
D14	127	PWR	VDDRTC	*power*	*power*
D13	128	PWR	VDDS-RTC	*power*	*power*
D12	129	I	nRESPWRON	IDI091	
C14	130	PWR	VSSRTC	*power*	*power*
B14*	131	O	IT_WAKEUP		OUK431
C12	132	O	CLK32K_OUT		OUK431
C13	133	I	OSC32K_IN	OS0171	
A14*	134	PWR	VSSO	*power*	*power*

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B13	135	I	OSC32K_OUT	UOS266	
A13*	136	O	RFEN		OUK431
B12	137	**PWR**	**VDD**	*power*	*power*
A12	138	O	TCXOEN		OUO431
D11	139	I	NBSCAN	IDI041	
C11	140	**PWR**	xxxAVAILABLExxx	IDI091	
B11	141	IO	nEMU0	IDI091	OUO231
A11	142	**PWR**	**VDDS-2**	*power*	*power*
E10	143	IO	nEMU1	IDI091	OUO231
D10	144	I	TDI	IDI091	
B10	145	I	TCK	IDI091	
A10	146	**PWR**	**VSS**	*power*	*power*
C10	147	O	TDO		OUK431
E9	148	I	TMS	IDI091	
C9	149	IO	CTS_MODEM	IDI091	OUO231
A9	150	IO	RX_MODEM	IDI091	OUO231
B9	151	O	TX_MODEM		OUK831
D9	152	IO	DSR_MODEM	IDI091	OUK831
E8	153	O	RTS_MODEM		OUK831
D8	154	I	RX_IRDA	IDI091	
A8	155	IO	RXIR_IRDA	IDI091	OUK431
B8	156	O	SD_IRDA		OUK431
C8	157	IO	TX_IRDA	IDI041	OUK831
C7	158	IO	TXIR_IRDA	IDI041	OUK831
B7	159	IO	DATA(0)	IDI041	OUI831
A7	160	**PWR**	**VSS**	*power*	*power*
D7	161	IO	DATA(1)	IDI041	OUI831
E7	162	IO	DATA(2)	IDI041	OUI831
D6	163	IO	DATA(3)	IDI041	OUI831
B6	164	**PWR**	**VDDS-1**	*power*	*power*
A6	165	IO	DATA(4)	IDI041	OUI831
C6	166	IO	DATA(5)	IDI041	OUI831
E6	167	IO	DATA(6)	IDI041	OUI831
C5	168	IO	DATA(7)	IDI041	OUI831
A5	169	**PWR**	**VDD**	*power*	*power*
B5	170	IO	DATA(8)	IDI041	OUI831
D5	171	IO	DATA(9)	IDI041	OUI831
E5	172	IO	DATA(10)	IDI041	OUI831
A4	173	**PWR**	**VDDS-1**	*power*	*power*
B4	174	IO	DATA(11)	IDI041	OUI831
C4	175	IO	DATA(12)	IDI041	OUI831
D4	176	IO	DATA(13)	IDI041	OUI831
A3	177	IO	DATA(14)	IDI041	OUI831
B3	178	IO	DATA(15)	IDI041	OUI831
A2	179	**PWR**	**VSS**	*power*	*power*

Table 8: I/O buffer type in 179 balls version

11. APPLICATION EXAMPLE

11.1 Power-supplies connection

11.1.1 Compatibility schematic Nausica CALYPSO
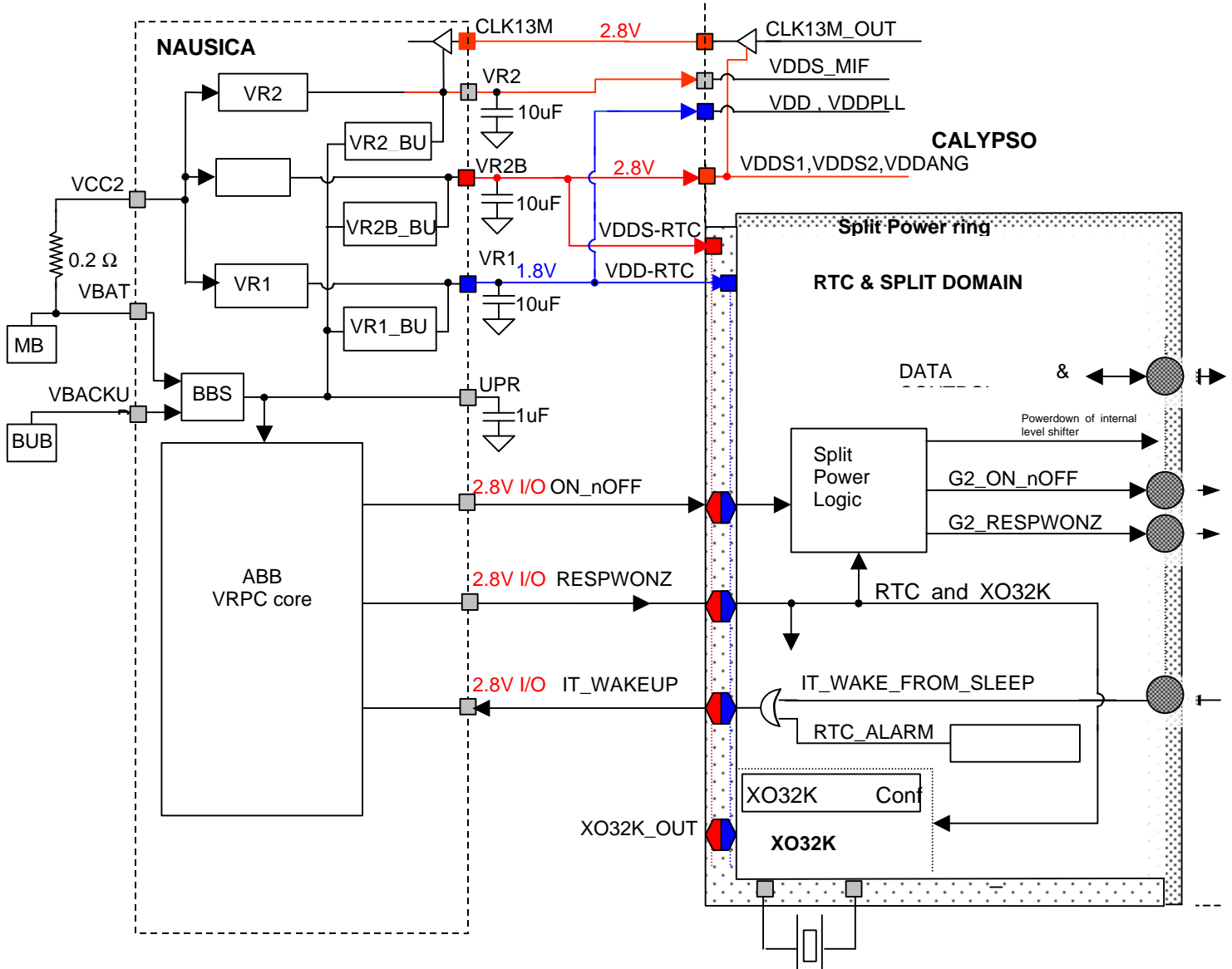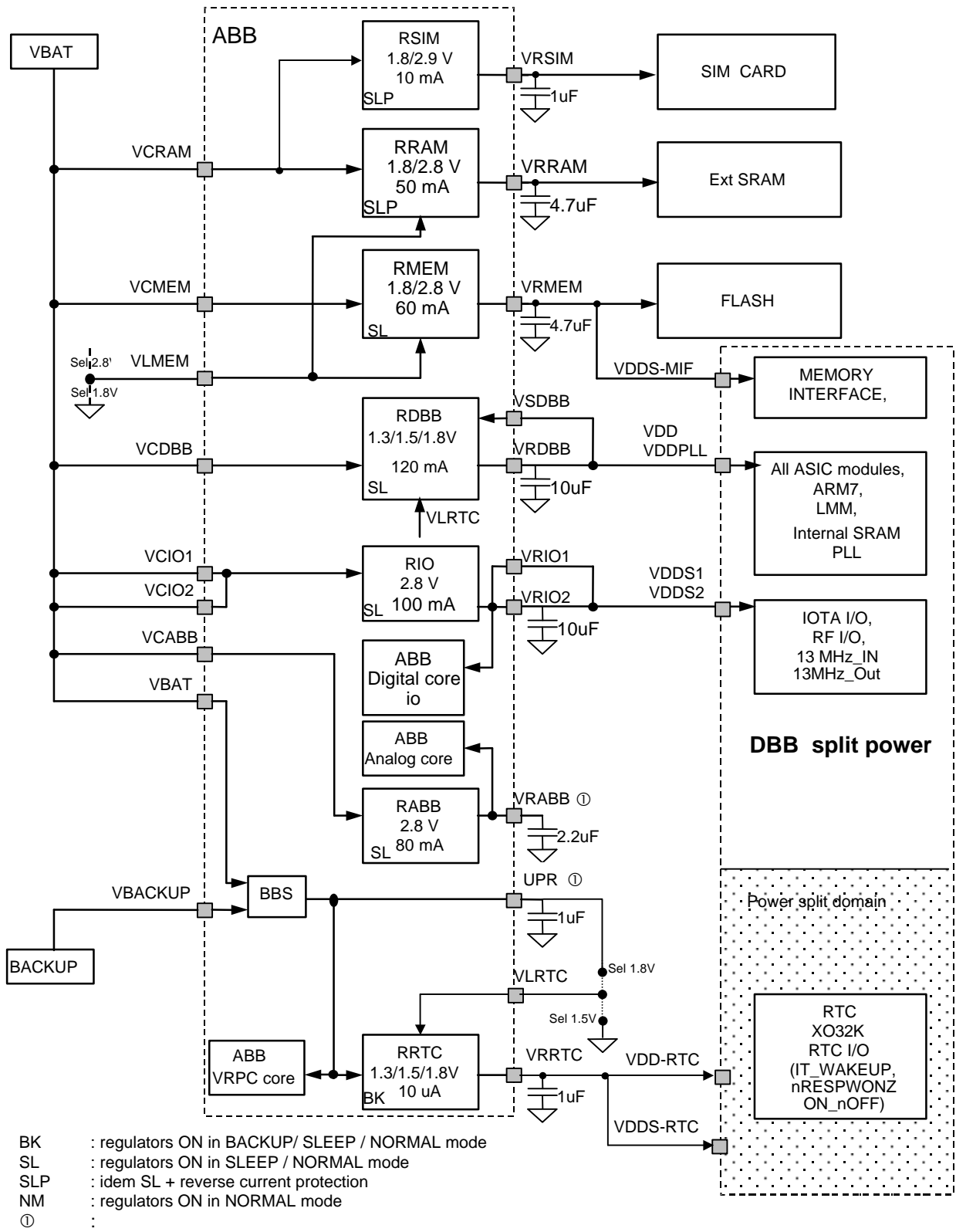

Figure 2: Compatibility connection with Nausica

Restrictions :

    1/ CALYPSO could be used with NAUSICA without using the CALYPSO split power capability.

    2/ It is not possible to use 1.8V external memory on CALYPSO when using a NAUSICA.

11.1.2 IOTA to power split DBB supply connections

BK   : regulators ON in BACKUP/ SLEEP / NORMAL mode
SL   : regulators ON in SLEEP / NORMAL mode
SLP   : idem SL + reverse current protection
NM   : regulators ON in NORMAL mode
①   :

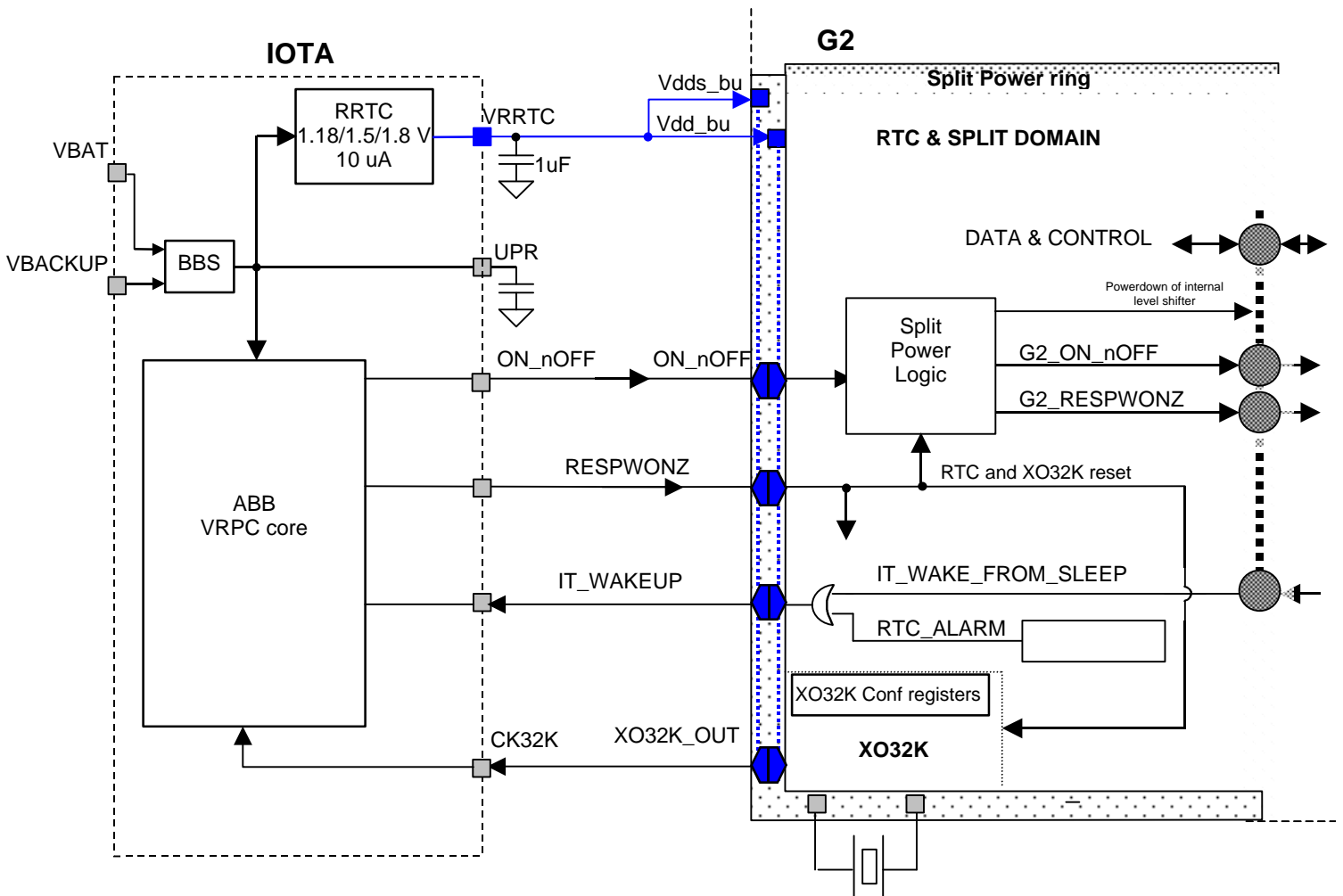### 11.1.3   *Power Supplies connection with IOTA ABB*

Figure 3: Power Supplies connection with IOTA ABB

11.2   32KHz quartz connection

See Technical memo 32pcbguide.doc

11.3   SIM card connection

The SIM card or the SIM level-shifters are connected to the chip using:
- SIM_CLK   SIM card reference clock
- SIM_RST   SIM card async/sync reset
- SIM_IO   SIM card bidirectional data line
- SIM_PWCTRL SIM card power activation
- SIM_RnW   SIM card data line direction
- SIM_CD   SIM card presence detection

The SIM_RnW signal is only used with some external devices to control level-shifters direction. The SIM_CD signal should be connected to the SIM card reader in order to get SIM_CD at low level (GND) when no card is present and at high level (VDDS2) when a card is present. The SIM_PWCTRL signal can be used for a direct control of the SIM card power-supply. However, this control is S/W programmable through the MCU serial port when using the NAUSICA chip for the SIM card interface.
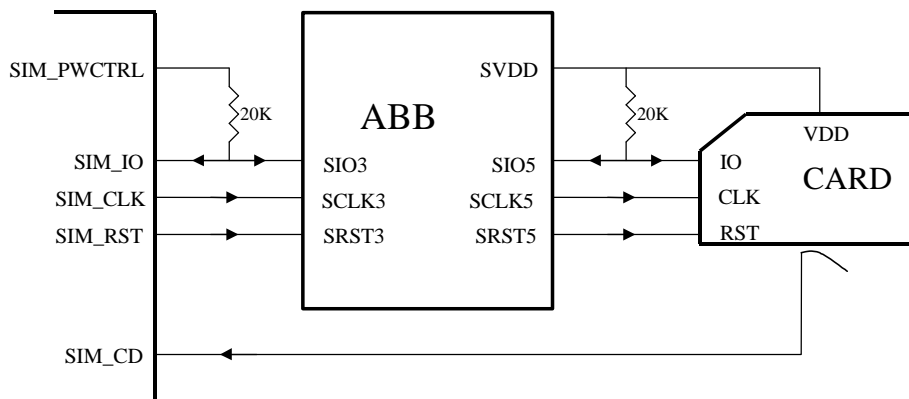
Figure 4: SIM card connection

11.4   Keyboard connection

The keyboard is connected to the chip using:
- KBR (4:0) input pins for row lines
- KBC (4:0) output pins for column lines

If a key button of the keyboard matrix is pressed, the corresponding row and column lines are shorted together.
To allow key press detection, all input pins (KBR) are pulled up to VCC and all output pins (KBC) are driving a low level. Any action on a button will generate an interrupt to the micro-controller which will, as answer, scan the column lines with the sequence describe below.
This sequence is written to allow detection of simultaneous press actions on several key buttons.

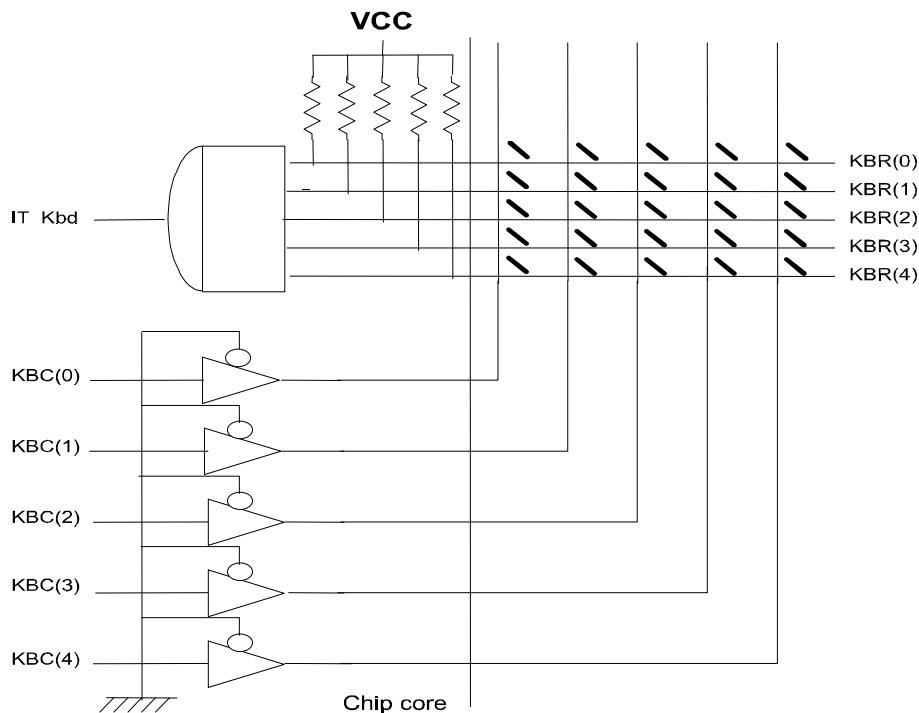|	RESET	IDLE	KEYBOARD SCANNING						IDLE
KBC(0)	1	0	1	0	1	1	1	1	0
KBC(1)	1	0	1	1	0	1	1	1	0
KBC(2)	1	0	1	1	1	0	1	1	0
KBC(3)	1	0	1	1	1	1	0	1	0
KBC(4)	1	0	1	1	1	1	1	0	0

Table 9: Keyboard scanning sequence

Figure 5: Keyboard connection