BLACK365 TECHNICAL REFERENCE MANUAL

321030.A00.DR2 (TRM-BLACK365) – Version A00.DR2

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BLACK365

Processor Board

Technical Reference Manual

Revision A00.DR2 | 4th October 2010 | 321030.A00.DR2

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TABLE OF CONTENTS

TABLES

FIGURES

REVISION INFORMATION

DATE	REV	BY	CR	CHANGE
04/10/10	A00	ELR	7199	This is the first version of this manual. It reflects the Rev B01 version of the PCB.

1 INTRODUCTION

The BLACK365, supporting components and software represent a powerful, easy to use embedded computing solution.

This document is the Hardware Technical Reference Manual for the BLACK365 product range including BLACK365 and REDCONN. It provides information on the board-level hardware and specifically includes:

- product specifications
- configuration information
- electrical characteristics
- interface pinouts
- details of EMC and ESD policies

Technical information on LaunchPad Application Development Kits for the BLACK365 is provided in separate documents. Details of hardware configuration and device driver implementations for a supported operating system can be found in the Platform Guide for that particular operating system. This Technical Reference Manual refers to the Platform Guide wherever hardware function is operating system dependent.

1.1 OVERVIEW

BLACK365 is a high performance credit card size single board computer optimized for use in embedded projects. BLACK365 combines the power of the Texas Instruments® DM365™ processor with a carefully selected set of peripherals optimized for high functionality, low power and small form factor. DSP Design has engineered the high risk elements of the system. You receive a fully tested module.

The BLACK365 is a RoHS compliant board. Low power consumption in normal operation and during sleep modes make the BLACK365 ideal for battery operated systems.

The BLACK365 operates as a standalone module requiring only a single 5V input. Alternatively customers can add the REDCONN - a services board for the BLACK365 - or use BLACK365 as a “super component” in their systems.

Preconfigured operating systems are available for the BLACK365. Development is speeded by the availability of the LaunchPad Application Development Kit for BLACK365.

1.2 BLACK365 FEATURES

- DM365™ processor based on the Texas Instruments® DaVinci™ micro-architecture.
- Compliant with the ARMv5TEJ instruction set.
- High performance at very low power consumption.
- 128Mbytes of DDR2 SDRAM soldered to the board.
- 512Mbytes of NAND Flash, typically for the operating system and file system.

- One Micro SD socket for memory expansion.
- Two RS232 serial ports: COM1 is 4-wire (RTS / CTS flow control), COM2 is 2-wire.
- 10/100 Base-T Ethernet port.
- Four USB 2.0 high speed host ports.
- One USB 2.0 full speed device port (available when host operation is disabled).
- 18-bit parallel digital display interface supporting TFT LCDs up to 800x600 resolution.
- Analog composite video output for connection to PAL or NTSC displays.
- 16-bit parallel digital video input interface for connection to video decoders.
- AC97 codec providing:
  - One stereo and two mono line inputs.
  - Three mono microphone inputs or one stereo microphone input.
  - One stereo and one mono line output.
  - Stereo headphone output
  - Four-wire resistive touch screen controller.
- Battery backed real time clock.
- I^2C multi-master serial bus providing simple expansion.
- 16-bit bus providing flexible expansion.
- Fifteen 3.3V general purpose I/O signals, or eleven GPIOs and an SPI expansion bus.
- Watchdog timer generating a full hardware reset.
- Single 5V power supply input.
- Power-switched circuit blocks allowing extremely low power in power managed states.
- 3.3V power output for expansion boards.
- 85mm x 65mm form factor.
- 0ºC to +85ºC operating temperature range.

1.3 REDCONN SERVICES BOARD

The REDCONN services board makes many of the interfaces on BLACK365 easy to use by routing them to standard connectors. This means that you can connect your BLACK365 directly to a wide range of peripherals including a serial port, Ethernet network and audio devices.

REDCONN is available in two variants, which allow different powering schemes:

- REDCDC is powered from DC brick power supplies.
- REDCPOE is powered via Power over Ethernet (IEEE802.3af). PoE technology allows IP telephones, wireless LAN Access Points, webcams and many other appliances to receive power as well as data over existing LAN cabling, without needing to modify the existing Ethernet infrastructure.

REDCONN is an example interface board for BLACK365. Many projects will engineer an

application-specific interface board with I/O suitable for that product. DSP Design call these interfaces “services boards”. Services boards can be produced by DSP Design or by the customer with assistance from DSP Design.

1.4 LAUNCHPAD APPLICATION DEVELOPMENT KIT

DSP Design strongly recommends that you begin your development project by using the LaunchPad Application Development Kit for BLACK365. This is a complete ready to use embedded computer system that is waiting for your application to be placed into the solid-state disk. FIGURE 1 shows the LaunchPad hardware. Not shown are the complete set of software, manuals and accessories (mouse, keyboard, PSU and cables) that are included in the LaunchPad Application Development Kit for BLACK365. The LaunchPad hardware comprises the following items mounted on a laptop style stand:

- BLACK365 processor board.
- REDCDC connector board.
- LCD and backlight inverter.
- Touch-screen.

FIGURE 1 - THE LAUNCHPAD FOR BLACK365

Using the LaunchPad Application Development Kit for BLACK365 will greatly reduce your development time, so your product will get to market sooner, at a fraction of the engineering costs normally associated with product development.

We have two objectives as you begin to use your new LaunchPad Application Development Kit for BLACK365. Firstly, we expect that within an hour of receiving your LaunchPad you will have set up the hardware, connected it to your LAN and run a simple demonstration. Secondly, we expect that within a day you will have installed the

development tools, compiled a sample application, downloaded it to the target hardware, and experimented with debugging this application remotely from the host computer. So on the second day you can begin developing your real application.

For full details of available LaunchPad Application Development kits see our web site at www.dspdesign.com/launchpad.

2 BLACK365 HARDWARE

2.1 BLOCK DIAGRAM

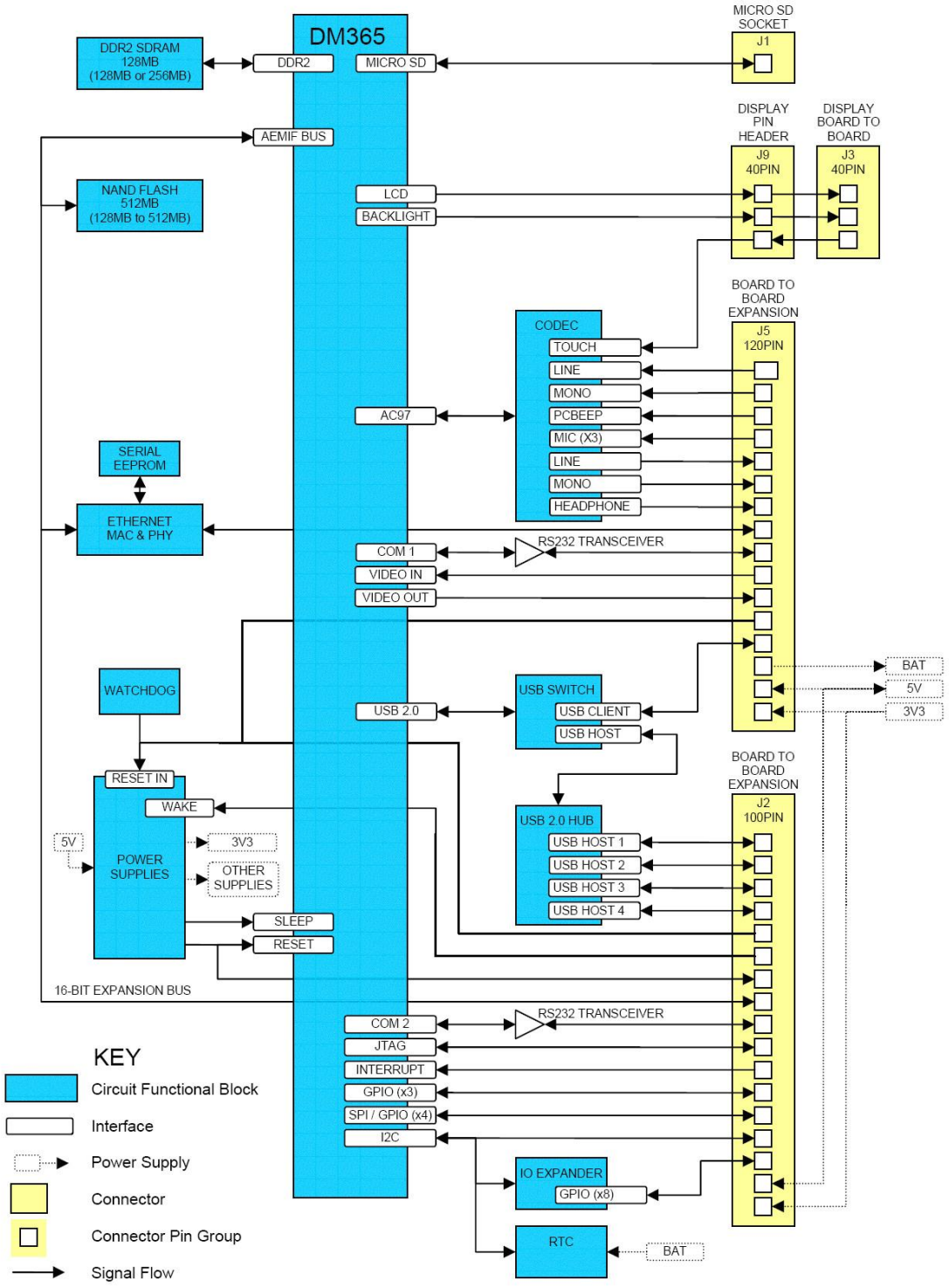

FIGURE 2 - BLACK365 BLOCK DIAGRAM

2.2 PROCESSOR AND MEMORY

2.2.1 Processor

The BLACK365 uses a DM365™ processor, which implements the Texas Instruments® DaVinci™ micro-architecture and uses an ARM9 core compliant with the ARMv5TEJ instruction set. This is an integrated system-on-a-chip microprocessor for digital media applications including high performance, dynamic, low-power portable hand-held and hand-set devices as well as embedded platforms. The chip contains video image co-processors and a wide range of peripherals.

The processor is available with clock rates of 216MHz, 270MHz, 300MHz and 432MHz. By default, the 300MHz processor is fitted, but the other speeds are available for volume applications. Contact DSP Design if you require a faster or slower part.

2.2.2 SDRAM

The DM365™ includes a 16-bit Double Data Rate (DDR2) Synchronous Dynamic RAM (SDRAM) memory interface.

The BLACK365 provides 128Mbytes of DDR2 memory as standard, soldered to the PCB. For volume applications there is an option for 256Mbytes, please contact DSP Design if you wish to discuss this.

2.2.3 Flash Memory

The BLACK365 provides 512Mbytes of NAND Flash as standard, soldered to the PCB. There are options for smaller capacities to reduce cost for volume applications. Contact DSP Design if you wish to discuss these options.

The NAND Flash is connected to the DM365™ processor via the shared system bus. The NAND Flash typically contains the bootloader, operating system and non-volatile storage. Please refer to the Platform Guide for the relevant operating system for further details on how the NAND Flash is utilised.

2.3 MICRO SECURE DIGITAL SOCKET

The BLACK365 provides a Micro Secure Digital (SD) socket suitable for 3.3V memory cards, providing memory expansion. A MicroSD card can be fitted in the socket J1.

The MicroSD hardware controller is implemented in the DM365™. It is compliant with the Secure Digital Part 1 Physical Layer Specification V1.1 and provides hardware support for high-capacity SDHC cards. Please refer to the Platform Guide for the relevant operating system for further details of software support.

Power switching circuitry is provided to power down the MicroSD card, to reduce system power consumption and provide hot swap capability.

The BLACK365 provides ESD protection on all MicroSD card signals to IEC 61000-4-2 Level 4. EMC filtering is not required or provided as the connections to the MicroSD socket will remain within an enclosure. The metal parts of the MicroSD socket connect to a separate CHASSIS ground, which also connects to the mounting hole closest to the socket.

2.4 DISPLAY OUTPUTS

2.4.1 DIGITAL LCD INTERFACE

The BLACK365 provides an 18-bit parallel digital interface for TFT LCD displays. The LCD interface is available at a 40-way pin header, J9, which typically connects to IDC ribbon cable assemblies. The LCD interface is also routed to connector site J3 on the opposite side of the board, which can be used to make direct board to board connections. By default, J3 is not populated. Contact DSP Design if you wish to discuss populating J3 for volume applications.

TABLE 1 lists the signals associated with the LCD interface. Note that connectors J3 and J9 also carry touch-screen signals. Refer to Section 2.5 for further details.

An analog composite video output is also provided. Refer to Section 2.4.2 for further details. The two display outputs can only be used simultaneously if both displays can accept the same standard PAL / NTSC timings. Otherwise, these outputs are mutually exclusive.

The LCD controller is implemented in the DM365™ processor. It is capable of driving colour TFT LCD panels with resolutions up to 800 x 600.

DSP Design offer a range of interface adapter boards, allowing connection to a variety of common displays with both parallel digital and serial LVDS interfaces, and also to analog VGA CRTs. Compatible interface boards and their associated Technical Reference Manuals are listed in APPENDIX C, Options and Ordering Information.

Several TFT panels from different manufacturers have been successfully tested with the BLACK365. Please refer to the Platform Guide for the relevant operating system for further details.

The BLACK365 provides 18 bits of display data consisting of 6 bits of red, 6 bits of green and 6 bits of blue. Some displays will have more than 18 data bits. In this case the display's least significant bits for each colour should be connected to GND.

The LCD interface includes a pulse width modulated (PWM) output which can be used to adjust the brightness of backlight inverters or LED drivers. This output is configured by the operating system. Please refer to the Platform Guide for the relevant operating system for further details.

SIGNAL	J3 / J9 PIN	DESCRIPTION
BKL_EN	1	Backlight Enable
LCD_EN	2	LCD Power Enable
X_LCD_DCLK	4	Pixel Clock
X_LCD_HSYNC	6	Horizontal Sync
X_LCD_VSYNC	8	Vertical Sync
X_LCD_R2	11	Red Colour Bus (1)
X_LCD_R3	12	
X_LCD_R4	14	
X_LCD_R5	15	
X_LCD_R6	16	
X_LCD_R7	18	
X_LCD_G2	22	Green Colour Bus (1)
X_LCD_G3	23	
X_LCD_G4	24	
X_LCD_G5	26	
X_LCD_G6	27	
X_LCD_G7	28	
X_LCD_B2	32	Blue Colour Bus (1)
X_LCD_B3	34	
X_LCD_B4	35	
X_LCD_B5	36	
X_LCD_B6	38	
X_LCD_B7	39	
X_LCD_DE	40	Data Enable
X_PWM0	33	Backlight PWM Control

NOTES:

1) The colour bus signal names correspond with the 24-bit colour numbering used by the DM365™. BLACK365 connects the eighteen most significant bits to J3 and J9 to provide a generic 18-bit LCD interface used on all DSP Design processor boards.

TABLE 1 - BLACK365 LCD INTERFACE SIGNALS

TABLE 2 provides the electrical characteristics for the LCD interface signals. Damage may occur if the LCD interface pins are connected to voltages outside the range -0.5V to +3.8V.

ESD protection for display signals is neither required or provided on BLACK365, as this interface will not be accessible to the end user. EMC filtering is not provided on BLACK365. This interface will always route through a services board before leaving the Faraday cage, if indeed it does leave the Faraday cage. EMC components are best placed on the services

board close to the Faraday cage. It is therefore the product designer's responsibility to ensure that services board designs for the BLACK365 incorporate the necessary EMC circuitry to make the system compliant with the appropriate EMC standard.

The BLACK365 does provide 33R series resistors on all display signals to reduce ringing. Connections to the display interface should be kept as short as possible to reduce electrical noise within the product enclosure.

SIGNAL	PARAMETER	CONDITION	LIMITS			UNITS
			Min	Typ	Max	
X_LCD_DCLK, X_LCD_HSYNC, X_LCD_VSYNC, X_LCD_DE, X_LCD_R[7:2], X_LCD_G[7:2], X_LCD_B[7:2], X_PWM0, BKL_EN, LCD_EN	V_{OH}	I_{OH} = -2mA	2.33	-	VCC_3V3	V
	V_{OL}	I_{OL} = 2mA	GND	-	0.47	V

TABLE 2 - BLACK365 LCD INTERFACE ELECTRICAL CHARACTERISTICS

2.4.2 ANALOG COMPOSITE VIDEO OUTPUT

The BLACK365 provides a standard definition composite video output port implemented using a DAC and Video Buffer in the DM365™. TABLE 3 lists the signals associated with the composite video output.

SIGNAL	J5 PIN	DESCRIPTION
TV_OUT	92	Composite video output (75Ω impedance)
DSP_GND	91, 96	Analog ground reference for composite video output.

TABLE 3 - BLACK365 COMPOSITE VIDEO OUTPUT SIGNALS

The composite video output can connect to standard video connectors such as RCA or BNC sockets on the services board. The video output can directly drive a composite video cable with a 75Ω load impedance.

The composite video output can be configured for NTSC-M or PAL-B/D/G/H/I standard definition formats. Please refer to the Platform Guide for the relevant operating system for further details.

The same picture can be output on both the digital LCD and the analog composite video outputs simultaneously, provided that the same standard PAL / NTSC timings are used for both display outputs.

TABLE 4 provides the electrical characteristics for the composite video output. Damage may occur if the composite video output is connected to voltages outside the range -0.5V to +2.6V.

EMC filtering and ESD protection for the composite video output are not provided on BLACK365. This interface will always route through a services board before leaving the product enclosure. EMC and ESD components are best placed on the services board close to the enclosure boundary. It is therefore the product designer's responsibility to ensure that services board designs for the BLACK365 incorporate the necessary EMC and ESD circuitry to make the system compliant with the appropriate EMC and ESD standards.

SIGNAL	PARAM-ETER	CONDITION	LIMITS			UNITS
			Min	Typ	Max	
TV_OUT	V_{OH}	Top of 75% NTSC / PAL colour bar	-	1.35	-	V
	V_{OL}	Bottom of sync tip	-	0.35	-	V
	RES	Resolution	-	10	-	Bits
	V_{OUT}	R_{LOAD} = 75Ω	0.35	-	1.35	V

TABLE 4 - BLACK365 COMPOSITE VIDEO OUTPUT ELECTRICAL CHARACTERISTICS

2.5 TOUCH-SCREEN

The BLACK365 provides a four-wire resistive touch-screen interface. TABLE 5 lists the signals associated with the touch-screen. Note that connectors J3 and J9 also carry LCD signals. Refer to section 2.4 for further details.

SIGNAL	J3 / J9 PIN	DESCRIPTION
X_XP	9	Touch-screen right contact
X_XN	10	Touch-screen left contact
X_YP	31	Touch-screen top contact
X_YN	30	Touch-screen bottom contact

TABLE 5 - BLACK365 TOUCHSCREEN SIGNALS

When the processor is placed into deep sleep mode it is possible for a touch on the touch-screen to wake the processor. Please refer to the Platform Guide for the relevant operating system for further details.

FIGURE 3 shows the BLACK365 touch-screen controller interfacing to a four-wire resistive touch-screen. The touch-screen controller is implemented within the WM9713 audio codec which interfaces to the DM365™ processor's Multi-Channel Buffered Serial Port via an AC97 bus.

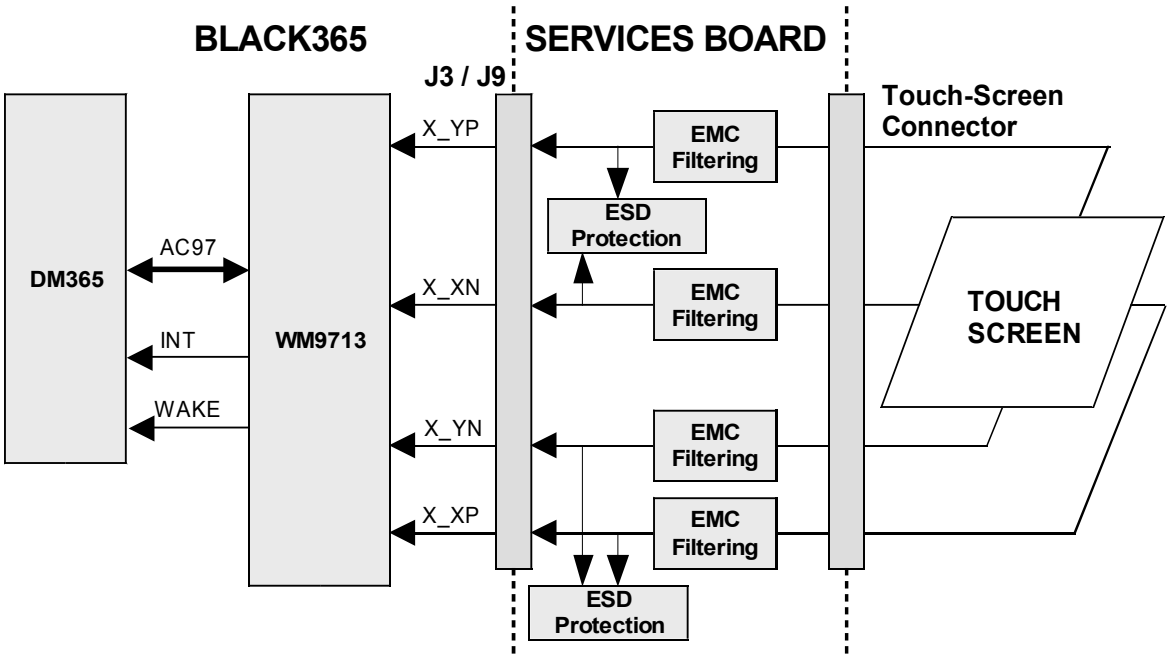

FIGURE 3 - BLACK365 AND SERVICES BOARD TOUCH-SCREEN BLOCK DIAGRAM

The touch screen signals are designed for connecting to a resistive four-wire touch screen only. Do not connect them to anything else.

EMC filtering and ESD protection for touch-screen signals are not provided on BLACK365. This interface will always route through a services board before leaving the product enclosure. EMC and ESD components are best placed on the services board close to the enclosure boundary. It is therefore the product designer's responsibility to ensure that services board designs for the BLACK365 incorporate the necessary EMC and ESD circuitry to make the system compliant with the appropriate EMC and ESD standards.

2.6 SERIAL PORTS

The BLACK365 provides two RS232 serial ports labelled COM1 and COM2. TABLE 6 lists the signals associated with the two serial ports.

Each UART is based on the industry standard TL16C550 Asynchronous Communications Element and can be independently configured for 5-8 data bits, 1-2 stop bits, even, odd or no parity, and baud rates supported by the operating system.

The maximum supported baud rate is 115.2k baud.

COM1 is a four-wire RS232 port with CTS and RTS signals to support modem control functionality.

COM2 is a two-wire RS232 port with no modem control functionality.

SIGNAL	CONNECTOR - PIN	DESCRIPTION
COM1_RXD	J5-2	COM1 RS232 receive data input
COM1_TXD	J5-3	COM1 RS232 transmit data output
COM1_RTS	J5-62	COM1 RS232 request to send output
COM1_CTS	J5-63	COM1 RS232 clear to send input
COM2_RXD	J2-85	COM2 RS232 receive data input
COM2_TXD	J2-86	COM2 RS232 transmit data output

TABLE 6 - BLACK365 SERIAL PORT SIGNALS

The serial ports can be powered off in order to conserve power. In this case the outputs become tri-state and the DM365™ sees all inputs as inactive. The serial ports are enabled by default following a reset.

The serial ports are compliant with the TIA/EIA-232-F and ITU V.28 standards. Typical voltage swings on the output signals are +/- 5.4V when loaded with 3kΩ to ground. Maximum short circuit output current is 60mA.

Damage may occur if voltages exceed +/-25V on input signals and +/-13V on output signals.

Each port uses 3243E transceivers, which provide ESD protection to IEC 61000-4-2 level 4. However, ESD protection is most effective when placed close to the connector that is accessible by the end user. For this reason, it is recommended that services board designs which route the RS-232 serial signals to an external connector place additional ESD protection close to this connector.

EMC filtering for serial signals is not provided on BLACK365. This interface will always route through a services board before leaving the product enclosure. EMC components are best placed on the services board close to the enclosure boundary. It is therefore the product designer's responsibility to ensure that services board designs for the BLACK365 incorporate the necessary EMC circuitry to make the system compliant with the appropriate EMC standard.

The REDCONN provides EMC filtering on all serial signals.

2.7 ETHERNET

The BLACK365 provides a single IEEE 802.3/802.3u compliant 10/100-Base-TX Ethernet port. The Ethernet port is implemented in the LAN9215i Ethernet controller chip which has an integrated MAC and PHY.

TABLE 7 lists the signals associated with the Ethernet port.

SIGNAL	J5 PIN	DESCRIPTION
RDP	26	Receive differential pair positive data input
RDN	27	Receive differential pair negative data input
LAN_3V3A	86	3.3V power output to centre-tap of receive transformer.
TDP	29	Transmit differential pair positive data output
TDN	30	Transmit differential pair negative data output
LINK#	89	Control output for LINK status LED in the RJ45 connector.
10/100#	90	Control output for LAN activity LED in the RJ45 connector.

TABLE 7 - BLACK365 ETHERNET SIGNALS

FIGURE 4 shows the BLACK365 Ethernet block diagram and a typical services board block diagram. The 16-bit LAN9215i Ethernet controller chip interfaces to the DM365™ processor via the 16-bit shared system bus. The transmit and receive differential pairs interface directly to expansion connector J5, from where they travel to an isolation transformer and then the RJ45 Ethernet connector on the services board.

The REDCONN Services Board includes the transformer and RJ45 socket. The socket contains two LEDs. The LINK# signal drives the green LED and the 10/100# signal drives the yellow LED. The LINK# and 10/100# signals are designed to connect to an LED through a 470R series resistor, with the LED connected to VCC_3V3.

Typically, the LINK# LED is on when a link is established and flashes as an activity indicator, and the 10/100# LED is on when the operating speed is 100Mb/s, during auto-negotiation and when the cable is disconnected. Please refer to the Platform Guide for the relevant operating system for the exact details of operation.

Users who intend to design their own Ethernet interface should note that choice of transformer and tracking of the high-speed Ethernet signals are critical for reliable operation. The transformer must be positioned close to the RJ45 socket and must be compatible with the LAN9215i. Please refer to the “Suggested Magnetics” application note available on the SMSC website. This application note provides a list of qualified parts and suggested parts for operation with the LAN9215i.

The Ethernet signals must only be connected as described in the LAN9215i data sheet. Damage may occur if any of the signals are taken outside the range -0.5 to +6V.

EMC filtering and ESD protection for Ethernet signals are not provided on BLACK365. The isolation transformer on the services board will provide the necessary EMC filtering for the differential pairs. ESD protection components are best placed on the services board immediately following the connector and the transformer. It is the product designer's responsibility to ensure that services board designs for the BLACK365 incorporate the necessary EMC and ESD circuitry to make the system compliant with the appropriate EMC and ESD standards.

The REDCONN provides EMC filtering and ESD protection on the Ethernet interface.

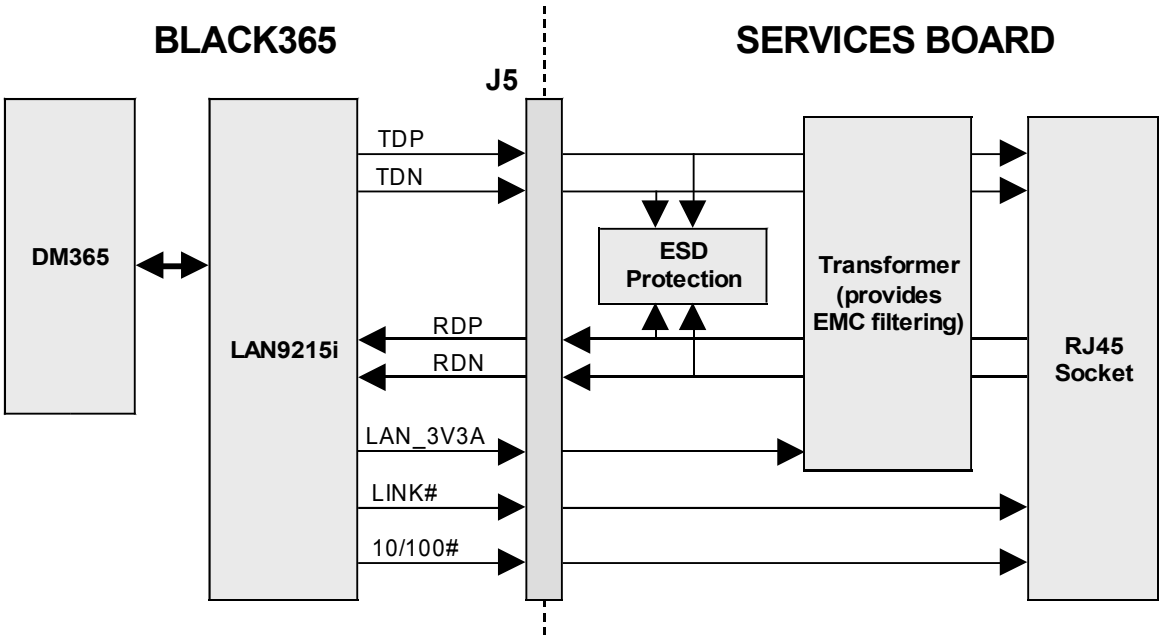

FIGURE 4 - BLACK365 AND SERVICES BOARD ETHERNET BLOCK DIAGRAM

2.8 USB HOST PORTS

The BLACK365 provides four USB host ports compliant with the USB 2.0 high speed specification. These are suitable for connecting to a wide range of USB peripherals, and will transfer data at up to 480M bit/s. TABLE 8 lists the USB host port signals.

SIGNAL	J2 PIN	DESCRIPTION
USBH1P	40	Port 1 USB positive signal
USBH1N	41	Port 1 USB negative signal
USBH1PWR	42	Port 1 switched 125mA current limited +5V supply
USBH2P	37	Port 2 USB positive signal
USBH2N	38	Port 2 USB negative signal
USBH2PWR	39	Port 2 switched 125mA current limited +5V supply
USBH3P	88	Port 3 USB positive signal
USBH3N	87	Port 3 USB negative signal
USBH3PWR	89	Port 3 switched 125mA current limited +5V supply
USBH4P	91	Port 4 USB positive signal
USBH4N	90	Port 4 USB negative signal
USBH4PWR	92	Port 4 switched 125mA current limited +5V supply

TABLE 8 - BLACK365 USB HOST SIGNALS

The USB host and USB device functions are mutually exclusive and software selectable. If any of the USB host ports are being used, then the USB device port will not be available.

FIGURE 5 shows the BLACK365 USB block diagram and a typical services board block diagram.

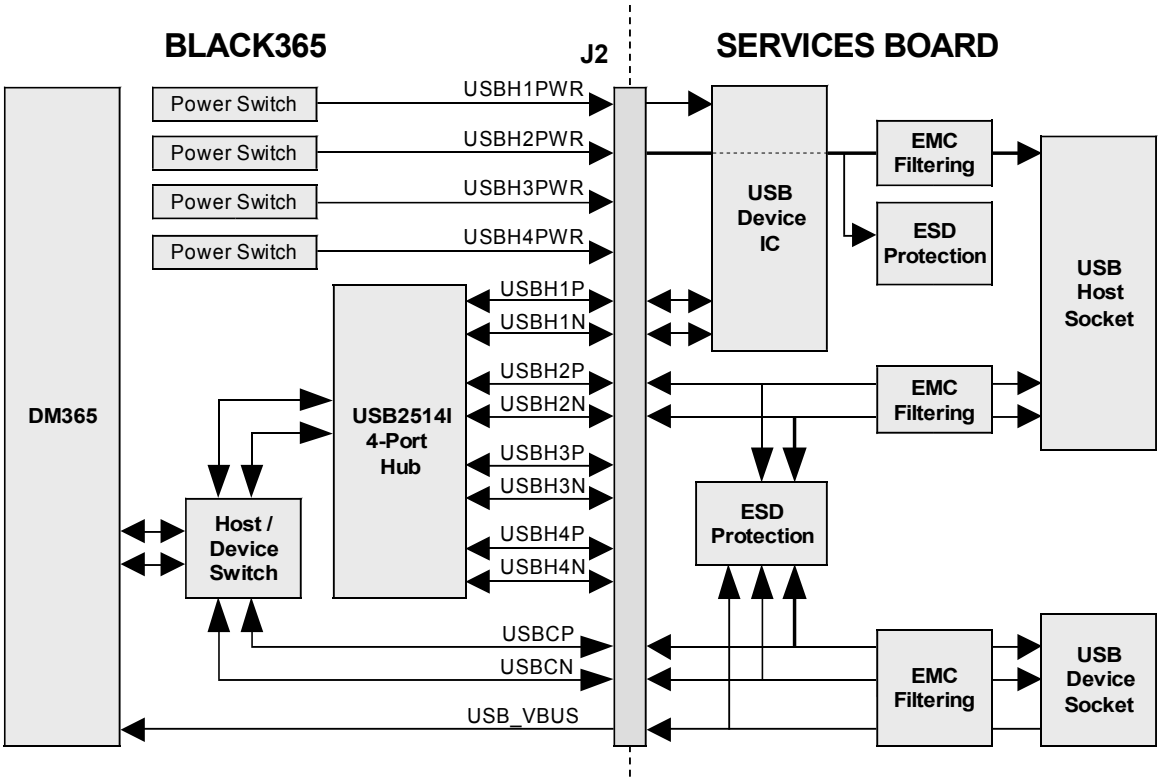

FIGURE 5 - BLACK365 AND SERVICES BOARD USB BLOCK DIAGRAM

All four host ports are implemented using a USB2514I four port hub connected to the single USB port of the DM365™ processor via a host / device switch. All four ports can connect directly to USB ICs or to standard USB connectors on the services board.

The USB host ports are compliant with the USB 2.0 specification and can operate at high speed (480M bit/s), full speed (12M bit/s) or low speed (1.5M bit/s). Please refer to the USB 2.0 specification for the electrical characteristics. Do not connect the signals to anything other than USB peripherals. Damage may occur if voltages exceed those given in TABLE 9.

The USBHPWRx signals are 5V power supplies controlled by independent power distribution switches. Each switch is controlled by the operating system and has a nominal current limit threshold of 125mA. Due to tolerances in the switch, the current limit threshold can vary from 100mA to 150mA over the full operating temperature range.

Users who intend to design their own USB Host interface should note that correct tracking of the high-speed USB signals using controlled impedances is critical for reliable operation.

EMC filtering and ESD protection for USB host signals are not provided on BLACK365. This interface will always route through a services board before leaving the product enclosure. EMC and ESD components are best placed on the services board close to the enclosure boundary. It is therefore the product designer's responsibility to ensure that services board

designs for the BLACK365 incorporate the necessary EMC and ESD circuitry to make the system compliant with the appropriate EMC and ESD standards.

The REDCONN provides EMC filtering and ESD protection on all these signals.

SIGNAL	ABSOLUTE MAX RATING (1)	
	MIN	MAX
USBHxP	-0.5V	+5.5V
USBHxN	-0.5V	+5.5V
USBHxPWR	-0.3V	+7.0V

NOTES:

1) Exceeding the absolute max rating may damage the device.

TABLE 9 - BLACK365 USB HOST ABSOLUTE MAXIMUM RATINGS

2.9 USB DEVICE PORT

The BLACK365 can also operate as a USB device – that is, it can appear as a peripheral when plugged into a computer with a USB host controller. The USB device port is compliant with the full speed USB 2.0 specification.

The USB host and USB device functions are mutually exclusive and software selectable. If the USB device port is being used, then none of the USB host ports will be available.

TABLE 10 lists the signals associated with the USB device port.

SIGNAL	J5 PIN	DESCRIPTION
USBCP	43	USB device positive signal
USBCN	44	USB device negative signal
USB_VBUS	45	+5V input from USB host

TABLE 10 - BLACK365 USB DEVICE SIGNALS

The USB device port is compliant with the USB 2.0 specification. Operation at full speed (12M bit/s) and low speed (1.5M bit/s) is supported. Please refer to the USB 2.0 specification for the electrical characteristics. Do not connect the signals to anything other than USB host ports. Damage may occur if voltages exceed those given in TABLE 11.

The USB_VBUS input connects to the +5V power supply of a remote USB host port. The BLACK365 uses the USB_VBUS input to detect when a USB host port is connected. The BLACK365 is self powered and does not actually draw power from the USB_VBUS input.

FIGURE 5 shows the BLACK365 USB block diagram and a typical services board block diagram. The USB device port is implemented using the single USB port of the DM365™

processor and is active when the host / device switch is set to the device position by the operating system software. The USB device port can connect to a standard USB device connector on the services board.

Users who intend to design their own USB Device interface should note that correct tracking of the high-speed USB signals using controlled impedances is critical for reliable operation.

EMC filtering and ESD protection for USB device signals are not provided on BLACK365. This interface will always route through a services board before leaving the product enclosure. EMC and ESD components are best placed on the services board close to the enclosure boundary. It is therefore the product designer's responsibility to ensure that services board designs for the BLACK365 incorporate the necessary EMC and ESD circuitry to make the system compliant with the appropriate EMC and ESD standards.

The REDCONN provides EMC filtering and ESD protection on the USB device differential signals.

SIGNAL	ABSOLUTE MAX RATING (1)	
	MIN	MAX
USBCP	-0.5V	+4.6V
USBCN	-0.5V	+4.6V
USB_VBUS	0V	+5.5V

NOTES:

1) Exceeding the absolute max rating may damage the device.

TABLE 11 - BLACK365 USB DEVICE ABSOLUTE MAXIMUM RATINGS

2.10 AUDIO

2.10.1 Audio Sub-System

The BLACK365 provides an audio sub-system implemented in the WM9713 codec which interfaces to the DM365™ processor Multi-Channel Buffered Serial Port via an AC97 bus.

The WM9713 codec also includes a 4-wire touch-screen controller. This is described separately in section 2.5.

The routing, mixing and gain of audio signals within the audio codec is operating system dependant. Please refer to the Platform Guide for the relevant operating system for further details.

2.10.2 Audio Inputs

The BLACK365 audio sub-system provides one stereo line level, two mono line level, and three mono microphone audio inputs. Alternatively, two of the mono microphone inputs can be configured as a stereo microphone input.

TABLE 12 lists the signals associated with the audio sub-system inputs.

SIGNAL	J5 PIN	DESCRIPTION
LINEINL	108	Left line level input.
LINEINR	109	Right line level input.
PCBEEP	110	Mono line level input.
MONOIN	111	Mono line level input.
MIC1	120	Microphone input, single only, with bias voltage applied.
MIC2A	113	Microphone input, single or dual with MIC2A.
MIC2B	114	Microphone input, single or dual with MIC2B.
MICCM	115	Microphone common mode input. Connect to AGND.
AC97_MICBIAS	112	Microphone bias voltage output for electret microphones. This bias voltage is applied to MIC1 only on the BLACK365.
AGND	57, 59, 60, 117, 119	Analog GND reference for all audio input signals.

TABLE 12 - BLACK365 AUDIO INPUT SIGNALS

FIGURE 6 shows the BLACK365 audio inputs and a typical services board block diagram.

The audio signals can connect to standard audio connectors on the services board.

MIC1, MIC2A and MIC2B are microphone inputs to the WM9713 audio codec. The BLACK365 provides 1uF AC coupling capacitors on all microphone inputs. The WM9713 can be configured to use either three single microphone inputs, where one at a time is selected as the input source, or a dual microphone input, where the MIC2A and MIC2B inputs operate simultaneously for stereo applications. Please refer to the Platform Guide for the relevant operating system for further details.

Services board designs should ensure that MICCM is connected to AGND on the services board. This connection is made by the REDCONN services board.

Active microphones that don't incorporate a battery (e.g. electret microphones) require a bias voltage on the MICx signal to operate correctly. The BLACK365 applies a 2.97V bias voltage via a 1K5 resistor to the MIC1 input. Do not connect the MIC1 input to any other type of microphone.

The BLACK365 does not apply a bias voltage to the MIC2A or MIC2B inputs. If a bias voltage is required, then connect the AC97_MICBIAS reference voltage output to the MIC2x signal via a suitable resistor (680R to 2K2) on the services board. Table 11 provides the electrical characteristics of the AC97_MICBIAS output.

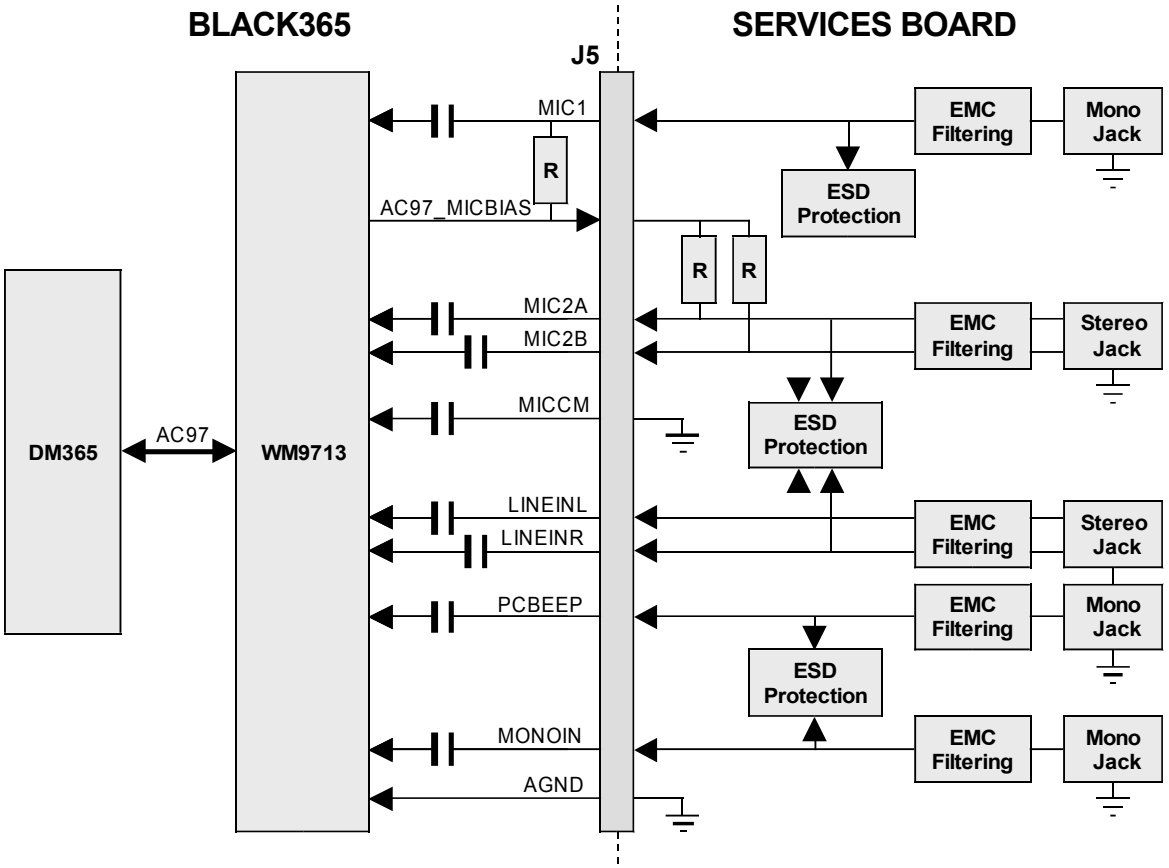

FIGURE 6 - BLACK365 AND SERVICES BOARD AUDIO INPUT BLOCK DIAGRAM

LINEINL, LINEINR, PCBEEP and MONOIN are inputs to the WM9713 audio codec and are designed to record line level signals. The BLACK365 provides 1uF AC coupling capacitors on these inputs.

TABLE 13 provides the electrical characteristics for the audio input signals.

EMC filtering and ESD protection for audio signals are not provided on BLACK365. This interface will always route through a services board before leaving the product enclosure. EMC and ESD components are best placed on the services board close to the enclosure boundary. It is therefore the product designer's responsibility to ensure that services board designs for the BLACK365 incorporate the necessary EMC and ESD circuitry to make the system compliant with the appropriate EMC and ESD standards.

The REDCONN provides EMC filtering and ESD protection on the MIC1 microphone input, which is the only BLACK365 audio input supported by this services board.

SIGNAL	PARAMETER	CONDITION	LIMITS (1)			UNITS
			Min	Typ	Max	
LINEINL, LINEINR, PCBEEP, MONOIN,	Full scale input signal level (0dBFS)	-	-	1.0	-	V rms
MIC1, MIC2A, MIC2B	Full scale input signal level (0dBFS)	Single-ended	-	1.0	-	V rms
		Differential	-	0.5	-	V rms
AC97_MICBIAS	Bias Voltage	-	2.92	2.97	3.00	V
	Bias Current Source	-	-	-	3	mA

NOTES:

1) The limits apply to T_A = 25°C.

TABLE 13 - BLACK365 AUDIO INPUT ELECTRICAL CHARACTERISTICS

2.10.3 Audio Outputs

The BLACK365 audio sub-system provides one stereo and one mono line level output, and one stereo headphone output.

TABLE 14 lists the signals associated with the audio sub-system outputs.

SIGNAL	J5 PIN	DESCRIPTION
SPKL	116	Left line level output.
SPKR	56	Right line level output.
MONO	55	Mono line level output.
HPL	118	Left headphone output.
HPR	58	Right headphone output.
AGND	57, 59, 60, 117, 119	Analog GND reference for all audio output signals.

TABLE 14 - BLACK365 AUDIO OUTPUT SIGNALS

FIGURE 7 shows the BLACK365 audio outputs and a typical services board block diagram.

The audio signals can connect to standard audio connectors on the services board.

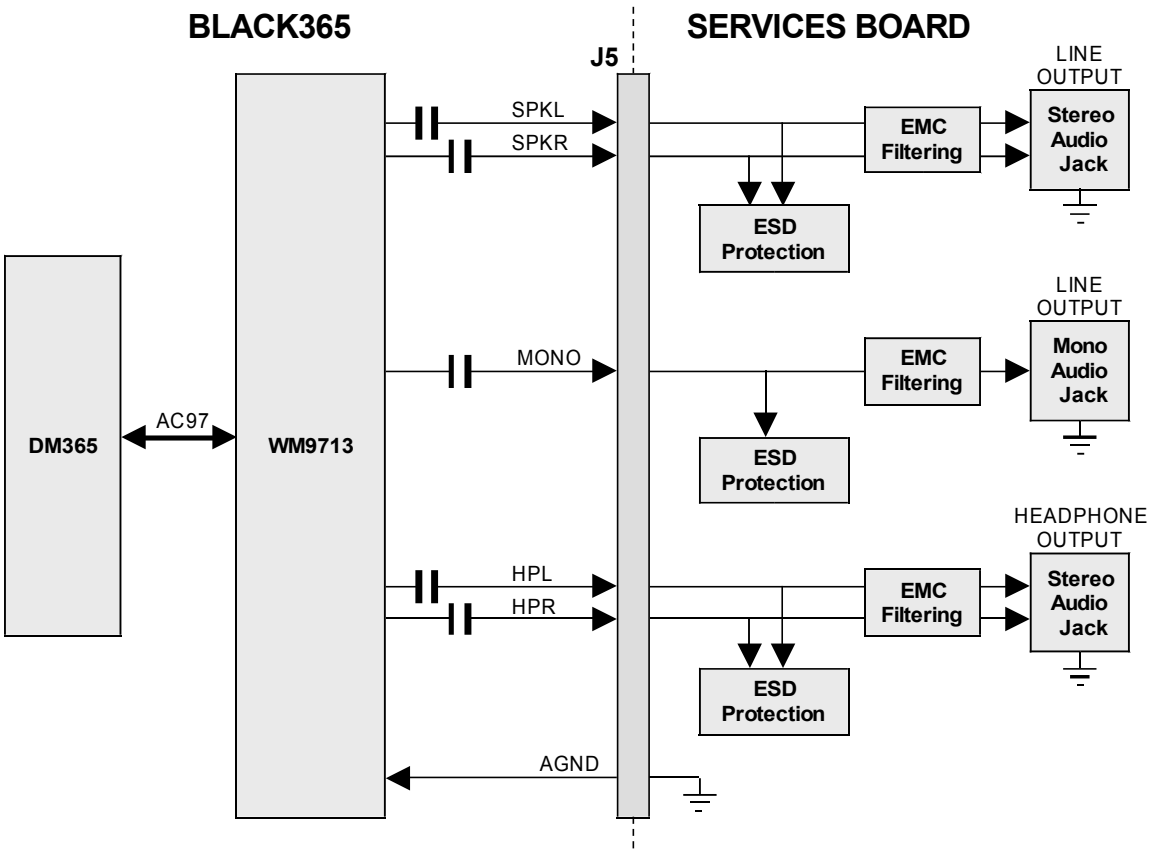

FIGURE 7 - BLACK365 AND SERVICES BOARD AUDIO OUTPUT BLOCK DIAGRAM

SKPL, SPKR and MONO are outputs of the WM9713 audio codec, These are line level outputs intended to drive high impedance loads. 1uF AC coupling capacitors and 100R series resistors are provided on the BLACK365.

HPL and HPR are outputs of the WM9713 audio codec. These outputs are intended to drive 16Ω or 32Ω headphone loads. 220UF AC coupling capacitors are provided on the BLACK365.

TABLE 15 provides the electrical characteristics for the audio output signals.

EMC filtering and ESD protection for audio signals are not provided on BLACK365. This interface will always route through a services board before leaving the product enclosure. EMC and ESD components are best placed on the services board close to the enclosure boundary. It is therefore the product designer's responsibility to ensure that services board designs for the BLACK365 incorporate the necessary EMC and ESD circuitry to make the system compliant with the appropriate EMC and ESD standards.

The REDCONN provides EMC filtering and ESD protection on the SPKL and SPKR line outputs, which route to the green 3.5mm audio socket. The HPL, HPR and MONO outputs are not supported by REDCONN.

SIGNAL	PARAMETER	CONDITION	LIMITS (1)			UNITS
			Min	Typ	Max	
SPKL, SPKR, MONO	Full scale output (0dBFS)	R_L = 10kΩ	-	1.0	-	V rms
HPL, HPR	Output power	THD = -80dB,	-	10	-	mW
		THD = -78dB,	-	20	-	mW

NOTES:

1) The limits apply to T_A = 25°C.

TABLE 15 - BLACK365 AUDIO OUTPUT ELECTRICAL CHARACTERISTICS

2.11 VIDEO INPUT

The BLACK365 provides a 16-bit parallel video input port implemented using the DM365™ Image Sensor Interface (ISIF).

The video input can accept raw (unprocessed) 8 to 16 bit video data from a CMOS or CCD sensor, or YUV video data in numerous formats from a video decoder device on a services board. The following YUV formats are supported:

- ITU-R BT.601/656/1120 standard format.
- YCbCr 4:2:2 format, either 8-bit or 16-bit, with discrete sync signals.

TABLE 16 lists the signals associated with the video input interface. The signal descriptions for the VDIN bus depend on the selected data input format. Please refer to the Platform Guide for the relevant operating system for the supported data input formats.

TABLE 17 provides the electrical characteristics for the video input signals. Damage may occur if the video input pins are connected to voltages outside the range -0.5V to +3.8V.

EMC filtering and ESD protection for video input signals are not provided on BLACK365. The video bus will always be routed from a sensor or decoder IC on a services board via a short bus within the product enclosure, and will not be accessible to the end user. If a video decoder device is used on a services board, then this may in turn have analog video inputs which may require EMC and ESD protection. It is the product designer's responsibility to ensure that services board designs for the BLACK365 incorporate the necessary EMC and ESD circuitry to make the system compliant with the appropriate EMC and ESD standards.

Due to the high speed nature of the video bus, all routing to this input should be kept as short as possible and referenced to the BLACK365 GND plane to ensure signal integrity and to minimise electrical noise within the product enclosure.

SIGNAL	J5 Pin	Description	Image Data Input Format		
			16-bit Raw	16-bit YCbCr	8-bit YCbCr
VDIN_Y7	18	Image data input.	C_DATA15	Y7	-
VDIN_Y6	17		C_DATA14	Y6	-
VDIN_Y5	16		C_DATA13	Y5	-
VDIN_Y4	15		C_DATA12	Y4	-
VDIN_Y3	1		C_DATA11	Y3	-
VDIN_Y2	13		C_DATA10	Y2	-
VDIN_Y1	12		C_DATA9	Y1	-
VDIN_Y0	11		C_DATA8	Y0	-
VDIN_C7	40	Image data input.	C_DATA7	Cb7, Cr7	Y7, Cb7, Cr7
VDIN_C6	39		C_DATA6	Cb6, Cr6	Y6, Cb6, Cr6
VDIN_C5	38		C_DATA5	Cb5, Cr5	Y5, Cb5, Cr5
VDIN_C4	37		C_DATA4	Cb4, Cr4	Y4, Cb4, Cr4
VDIN_C3	36		C_DATA3	Cb3, Cr3	Y3, Cb3, Cr3
VDIN_C2	35		C_DATA2	Cb2, Cr2	Y2, Cb2, Cr2
VDIN_C1	34		C_DATA1	Cb1, Cr1	Y1, Cb1, Cr1
VDIN_C0	33		C_DATA0	Cb0, Cr0	Y0, Cb0, Cr0
VDIN_HD	20	Horizontal sync signal, input (slave mode) or output (master mode)			
VDIN_VD	21	Vertical sync signal, input (slave mode) or output (master mode)			
VDIN_WEN	22	Field identification input for interlaced frames.			
VDIN_PCLK	23	Pixel clock input. Supports sensor clocks up to 120MHz.			

TABLE 16 - BLACK365 VIDEO INPUT SIGNALS

SIGNAL	PARAMETER	CONDITION	LIMITS			UNITS
			Min	Typ	Max	
VDIN_Yx, VDIN_Cx, VDIN_HD, VDIN_VD, VDIN_WEN, VDIN_PCLK	V_{IH}	-	2	-	VCC_3V3	V
	V_{IL}	-	GND	-	0.8	V
VDIN_HD, VDIN_VD	V_{OH}	I_{OH} = -2mA	2.4	-	VCC_3V3	V
	V_{OL}	I_{OL} = 2mA	GND	-	0.4	V

TABLE 17 - BLACK365 VIDEO INPUT ELECTRICAL CHARACTERISTICS

2.12 DIL SWITCHES

The BLACK365 provides 8 DIL switches in a single package for board configuration.

Three of these switches (SW1.8 to SW1.6) configure the boot mode of the DM365™. The boot modes shown in TABLE 18 are supported in hardware. Please refer to the Platform Guide for the relevant operating system for details of software support.

SW1.6	SW1.7	SW1.8	BOOT MODE
OFF	OFF	OFF	NAND (normal position once board has been programmed)
OFF	ON	ON	UART
ON	OFF	OFF	USB Device

TABLE 18 - BLACK365 BOOT MODE SWITCHES

The remaining five switches (SW1.5 to SW1.1) connect directly to DM365™ processor GIO pins and are accessible to software. Please refer to the Platform Guide for the relevant operating system for details of how the system software uses these switches.

When a switch is in the ON position, the processor GIO input is a logic low. When a switch is in the OFF position, the processor GIO input is a logic high. The ON position of a switch is the position closest to IC3 (furthest away from the board edge).

These switches will not be accessible to the end user, therefore no ESD protection has been provided on the BLACK365.

2.13 REAL TIME CLOCK

The BLACK365 provides a DS1338U Real Time Clock (RTC) connected to the I^2C bus with an accuracy better than 5 seconds a day.

The RTC can be connected to an external 3V lithium battery using signal VBACK_BAT to maintain time and date when power is removed from the BLACK365. The RTC will operate with battery voltages in the range 1.3V to 3.7V. If a battery is not used then VBACK_BAT must be grounded. Damage may occur if the VBACK_BAT voltage is outside the range -0.3V to +6V.

The RTC will draw a maximum of 1.2uA from the backup battery to maintain time and date. A typical 3V CR1225 battery with a 48mAh capacity will therefore have a lifespan of at least 4.5 years.

The DS1338U RTC has a 7-bit binary I^2C slave address of 0b1101000. As well as the real-time clock function, it includes 56 bytes on non-volatile RAM.

TABLE 19 identifies the connectors where the VBACK_BAT battery input can be accessed. This signal is intended to remain within an enclosure and not be accessible by the end user. EMC filtering and ESD protection are therefore not required or provided on the BLACK365 or on the REDCONN.

SIGNAL	J5 PIN	DESCRIPTION
VBACK_BAT	66, 67	RTC backup battery input.

TABLE 19 - BLACK365 RTC BATTERY INPUT

2.14 WATCHDOG TIMER

The BLACK365 provides a watchdog timer implemented in hardware. The watchdog timer has a nominal timeout period of 2.2s. Due to component tolerances, the timeout period can vary from 1.96s to 2.44s between samples and over the full operating temperature range.

The watchdog timer generates a cold reset when it times out, which cycles all of the on-board power supplies. The watchdog timer is disabled following power up or a cold reset and must be enabled by software. Please refer to the Platform Guide for the relevant operating system for further details.

2.15 GENERAL PURPOSE I/O

The BLACK365 provides fifteen General Purpose IO (GPIO) signals available on expansion connector J2. These signals can be programmed to be inputs or outputs as required. At reset, all GPIOs are inputs.

TABLE 20 lists the signals associated with the GPIO interface.

Eight GPIOs are implemented using a PCA9555 I/O expander on the I2C bus. A weak pull up to VCC_3V3 is applied to each GPIO by the PCA9555. These GPIOs are 5V tolerant.

Seven GPIOs connect directly to DM365™ GIO pins. A weak pull down to GND is applied to each GPIO at reset within the DM365™. The pull down resistor can be disabled by software. Please refer to the Platform Guide for the relevant operating system for further details. These GPIOs are 3.3V signals and are not 5V tolerant.

Four of the GPIOs connected to the DM365™ can alternatively be configured as an SPI expansion bus. If the SPI expansion bus is used, then only eleven GPIOs will be available. Refer to Section 2.16 for details of the alternative SPI functionality.

The signals named GIO15 and GIO3 have interrupt capability. In addition, the PCA9555 I/O expander can generate an interrupt when any of its eight GPIO inputs change state. Please refer to the Platform Guide for the relevant operating system for further details of interrupt support.

TABLE 21 provides the absolute maximum ratings for the GPIO signals. Damage may occur if voltages exceed those shown.

SIGNAL	J2 PIN	IMPLEMENTATION	PULL RESISTOR
IOP1_P10	74	PCA9555 I/O expander on I2C bus.	Pull up, 55KΩ min.
IOP1_P11	75		
IOP1_P12	76		
IOP1_P13	77		
IOP1_P14	78		
IOP1_P15	79		
IOP1_P16	80		
IOP1_P17	81		
SCS0_GIO29_G0 (1)	24	DM365 GIO29 pin via 33R resistor.	Pull down, 33KΩ typ.
SCLK_GIO28_B1 (1)	25	DM365 GIO28 pin via 33R resistor.	Pull down, 33KΩ typ.
SOMI_GIO27_B0 (1)	26	DM365 GIO27 pin via 33R resistor.	Pull down, 33KΩ typ.
SIMO_GIO26 (1)	27	DM365 GIO26 pin via 33R resistor.	Pull down, 33KΩ typ.
GIO30	30	DM365 GIO30 pin via 33R resistor.	Pull down, 33KΩ typ.
GIO15	28	DM365 GIO3 pin. Interrupt capable.	Pull down, 33KΩ typ.
GIO3	29	DM365 GIO15 pin. Interrupt capable.	Pull down, 33KΩ typ.

NOTES:

1) These GPIO are alternatively configurable as an SPI expansion bus. See Section 2.16 for details of SPI functionality.

TABLE 20 - BLACK365 GPIO SIGNALS

SIGNAL	ABSOLUTE MAX RATING (1)	
	MIN	MAX
IOP1_P1[7:0]	-0.5V	+6V
SCS0_GIO29_G0, SCLK_GIO28_B1, SOMI_GIO27_B0, SIMO_GIO26, GIO30, GIO15, GIO3	-0.5V	+3.8V

NOTES:

1) Exceeding the absolute max rating may damage the device.

TABLE 21 - BLACK365 GPIO ABSOLUTE MAXIMUM RATINGS

TABLE 22 provides the electrical characteristics for the GPIO signals.

EMC filtering and ESD protection for GPIO signals are not provided on BLACK365. This interface will always route through a services board before leaving the product enclosure. EMC and ESD components are best placed on the services board close to the enclosure boundary. It is therefore the product designer's responsibility to ensure that services board designs for the BLACK365 incorporate the necessary EMC and ESD circuitry to make the system compliant with the appropriate EMC and ESD standards.

SIGNAL	PARAM-ETER	CONDITION	LIMITS			UNITS
			Min	Typ	Max	
IOP1_P1[7:0]	V_{IH}	-	0.7 x VCC_3V3	-	5.5	V
	V_{IL}	-	-0.5	-	0.7 x VCC_3V3	V
	V_{OH}	I_{OH} = -10mA	2.5	-	VCC_3V3	V
	V_{OL}	I_{OL} = 10mA	0.15	-	0.23	V
SCS0_GIO29_G0, SCLK_GIO28_B1, SOMI_GIO27_B0, SIMO_GIO26, GIO30, GIO15, GIO3	V_{IH}	-	2	-	VCC_3V3	V
	V_{IL}	-	GND	-	0.8	V
	V_{OH}	I_{OH} = -2mA	2.33	-	VCC_3V3	V
	V_{OL}	I_{OH} = 2mA	GND	-	0.47	V

TABLE 22 - BLACK365 GPIO ELECTRICAL CHARACTERISTICS

2.16 SPI EXPANSION

The BLACK365 provides a four pin Serial Peripheral Interface (SPI) expansion bus. The SPI bus interfaces to a large range of simple data acquisition/control slave devices available from a number of manufacturers.

The SPI signals can also be configured as General Purpose I/Os (GPIOs). If the SPI expansion bus is used, then the number of available GPIOs is reduced from fifteen down to eleven. Refer to Section 2.15 for details of the alternative GPIO functionality.

TABLE 23 lists the signals associated with the SPI bus.

SIGNAL	J2 PIN	DESCRIPTION
SCS0_GIO29_G0	24	SPI chip select output.
SCLK_GIO28_B1	25	SPI clock output.
SOMI_GIO27_B0	26	SPI serial data input.
SIMO_GIO26	27	SPI serial data output.

TABLE 23 - BLACK365 SPI SIGNALS

The SPI bus master is implemented in the DM365™ processor. The programmable configuration capability of the SPI bus master allows it to gluelessly interface to a variety of SPI format devices. The SPI interface does not conform to a specific industry standard.

Damage may occur if the SPI pins are connected to voltages outside the range -0.5V to +3.8V.

TABLE 24 provides the electrical characteristics for the SPI signals.

These signals are intended to control local peripherals on a services board within an enclosure and not be accessible by the end user. EMC filtering and ESD protection are therefore not required or provided by the BLACK365. If a services board design routes the SPI bus over a significant distance or outside of the Faraday cage, then it is the product designer's responsibility to incorporate the necessary EMC and ESD circuitry to make the system compliant with the appropriate EMC and ESD standards.

SIGNAL	PARAM-ETER	CONDITION	LIMITS			UNITS
			Min	Typ	Max	
SCS0_GIO29_G0, SCLK_GIO28_B1, SOMI_GIO27_B0, SIMO_GIO26	V_{IH}	-	2	-	VCC_3V3	V
	V_{IL}	-	GND	-	0.8	V
	V_{OH}	I_{OH} = -2mA	2.33	-	VCC_3V3	V
	V_{OL}	I_{OH} = 2mA	GND	-	0.47	V

TABLE 24 - BLACK365 SPI ELECTRICAL CHARACTERISTICS

2.17 I²C EXPANSION

The BLACK365 provides a two pin serial Inter-Integrated Circuit (I²C) expansion bus. The I²C bus interfaces to a large range of simple data acquisition/control slave devices available from a number of manufacturers. TABLE 25 lists the I²C bus signals.

SIGNAL	J2 PIN	DESCRIPTION
I2C_SCL	35	I²C clock output.
I2C_SDA	36	I²C serial data I/O.

TABLE 25 - BLACK365 I²C SIGNALS

The I²C bus master is implemented in the DM365™ processor and is compliant with the Philips I²C Bus Specification Version 2.1, supporting both standard-speed (100k bit/s) and fast-mode (400k bit/s) operation. There are 2.2 kΩ pull-up resistors fitted on the SDA and SCL signals.

There are two I²C slave devices already on the BLACK365: a real time clock (RTC) and an IO expansion device. The 7-bit binary addresses of these devices are summarised in TABLE 26.

PART	I2C SLAVE ADDRESS	DESCRIPTION
DS1338U	0b 1101000	Real time clock
PCA9555	0b 0100111	IO expansion

TABLE 26 - BLACK365 I²C ON-BOARD DEVICES

TABLE 27 provides the electrical characteristics for the I²C signals. Damage may occur if the I²C pins are connected to voltages outside the range -0.3V to +3.8V.

These signals are intended to control local peripherals on a services board within an enclosure and not be accessible by the end user. EMC filtering and ESD protection are therefore not required or provided by the BLACK365. If a services board design routes the I2C bus over a significant distance or outside of the Faraday cage, then it is the product designer's responsibility to incorporate the necessary EMC and ESD circuitry to make the system compliant with the appropriate EMC and ESD standards.

SIGNAL	PARAMETER	CONDITION	LIMITS			UNITS
			Min	Typ	Max	
I2C_SDA, I2C_SCL	V_{OL}	I_{OL} = 2mA	GND	-	0.4	V
I2C_SDA	V_{IH}	-	2	-	VCC_3V3	V
	V_{IL}	-	GND	-	0.8	V

TABLE 27 - BLACK365 I²C ELECTRICAL CHARACTERISTICS

2.18 16-BIT EXPANSION BUS

The BLACK365 provides a 16-bit expansion bus. This can be used to interface to a wide range of 8 and 16-bit memory and I/O chips. Contact DSP Design to discuss how we can support you using this bus.

TABLE 28 lists the signals associated with the 16-bit expansion bus.

SIGNAL	J2 PIN	DESCRIPTION	SIGNAL	J2 PIN	DESCRIPTION
EM_D0	1		EM_A0	51	
EM_D1	2		EM_A1	52	
EM_D2	3		EM_A2	53	
EM_D3	4		EM_A3	54	
EM_D4	5		EM_A4	55	
EM_D5	6		EM_A5	56	
EM_D6	7		EM_A6	57	
EM_D7	8		EM_A7	58	Address bus
EM_D8	9	Data bus	EM_A8	59	
EM_D9	10		EM_A9	60	
EM_D10	11		EM_A10	61	
EM_D11	12		EM_A11	62	
EM_D12	13		EM_A12	63	
EM_D13	14		EM_A13	64	
EM_D14	15		EM_BA0	65	Bank address 0
EM_D15	16		EM_BA1	66	Bank address 1
EM_WAIT#	18	Wait input	EM_WE#	67	Write enable output
EM_A14_GIO36	20	Address bit 14	EM_OE#	68	Pin enable output
EM_A16_GIO39	21	Address bit 16	EM_CS1A#	70	Chip select output
EXT_INT#	22	Interrupt input	EM_A15_GIO38	71	Address bit 15
RESET#	23	Reset output			

TABLE 28 - BLACK365 16-BIT EXPANSION BUS SIGNALS

FIGURE 8 shows how to connect this bus to 8-bit and 16-bit expansion devices.

TABLE 29 provides the electrical characteristics for the 16-bit expansion bus signals. The BLACK365 may be damaged if voltages outside the range -0.3V to VCC_3V3 + 0.3V are applied to any of these signals.

These signals are intended to control local peripherals on a services board within an enclosure and not be accessible by the end user. EMC filtering and ESD protection are therefore not required or provided by the BLACK365. If a services board design routes the expansion bus over a significant distance or outside of the Faraday cage, then it is the product designer's responsibility to incorporate the necessary EMC and ESD circuitry to make the system compliant with the appropriate EMC and ESD standards.

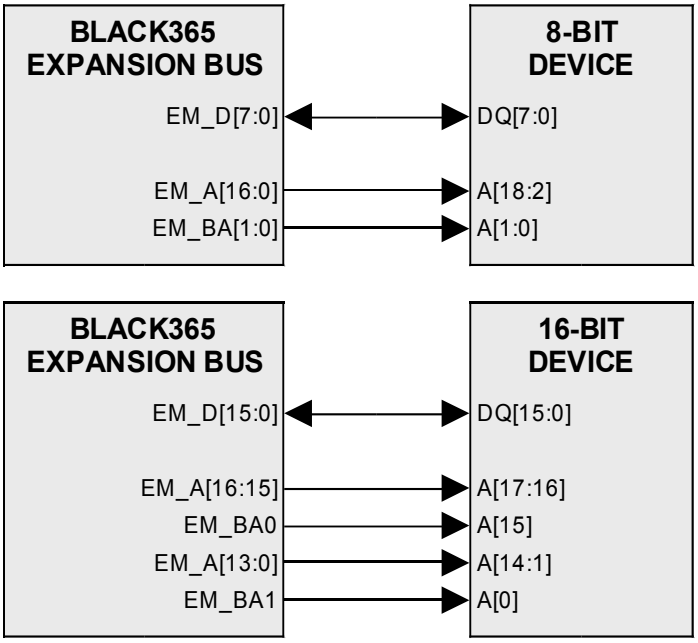

FIGURE 8 - BLACK365 EXPANSION BUS CONNECTIONS TO 8-BIT AND 16-BIT DEVICES

SIGNAL	PARAMETER	CONDITION	LIMITS			UNITS
			Min	Typ	Max	
EM_D[15:0], EM_WAIT#, EXT_INT#	V_{IH}	-	2	-	VCC_3V3	V
	V_{IL}	-	GND	-	0.8	V
EM_D[15:0], EM_A[16:0], EM_BA[1:0], EM_WE#, EM_OE#	V_{OH}	I_{OH} = -2mA	2.33	-	VCC_3V3	V
	V_{OL}	I_{OL} = 2mA	GND	-	0.47	V
EM_CS1A#	V_{OH}	I_{OH} = -100uA	VCC_3V3 – 0.2	-	VCC_3V3	V
		I_{OH} = -24mA	2.2		VCC_3V3	V
	V_{OL}	I_{OL} = 100uA	GND	-	0.2	V
		I_{OL} = 24mA	GND	-	0.55	V
RESET#	V_{OH}	I_{OL} = -100uA	VCC_3V3 – 0.3	-	VCC_3V3	V
	V_{OL}	I_{OL} = 1mA	GND	-	0.5	V

TABLE 29 - BLACK365 16-BIT EXPANSION BUS ELECTRICAL CHARACTERISTICS

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3 POWER SUPPLIES, POWER MANAGEMENT AND RESET

3.1 POWER INPUT

The BLACK365 operates from a single +5V input and generates all other supplies internally. Power can be applied to the BLACK365 via J2 and J5. All VCC5V and GND pins of both connectors should be connected to the PCB power traces on the services board. These PCB power traces are preferably implemented as power planes on a multi-layer PCB to minimise the voltage drop between the power supply and the BLACK365.

The voltage supplied to the BLACK365 should be 5V +/-5%. The BLACK365 may be damaged in the voltage on the VCC5V line is outside the range -0.3V to +6V.

TABLE 30 lists all the connector pins that can be used to supply power to the BLACK365.

SIGNAL	J2 PINS	J5 PINS
VCC5V	32 through 34, 82 through 84.	6 through 9, 76 through 85.
GND	G1 through G10 (dedicated ground connections).	5, 10, 19, 24, 25, 28, 31, 32, 42, 65 48 through 54.

TABLE 30 - BLACK365 POWER INPUT

3.2 POWER CONSUMPTION

The BLACK365 power consumption depends on what it is doing, as power management software can reduce power consumption when the processor is not required. Thus when executing an operating system such as Windows CE, the operating system will reduce clock speed or execute halt instructions when there is reduced user or application activity. On the other hand, power consumption will increase if processor-intensive operations, such as playing videos, are being performed. The BLACK365 can also enter a sleep state, where peripherals are powered down and the processor clock turned off.

In practical applications that use LCD panels, system power consumption will be influenced by the power taken by the display, in particular by the display's backlight.

TABLE 31 provides some typical figures for power consumption for the BLACK365. Note that these figures are for a stand alone system with no display and no peripherals connected.

CONFIGURATION	TYPICAL POWER CONSUMPTION	
	mA @ 5V	W
BLACK365 and REDCDC with no peripherals connected – operating system running.	300	1.5
BLACK365 and REDCDC with no peripherals connected – low power sleep mode.	19	0.95

TABLE 31 - BLACK365 POWER CONSUMPTION

3.3 POWER OUTPUT

The BLACK365 generates +3.3V on-board and is able to supply up to 350mA from this 3.3V rail to external peripherals such as LCD display panels. Users must ensure that this current is not exceeded. Note that this limit applies to the peak current, and not the average current.

VCC_3V3 is output from BLACK365 on J2, J5, J9 and J3 (if fitted).

To minimise voltage drop between the BLACK365 and the peripheral, power should be applied through short, low-resistance wires or PCB traces. If power is applied through the ribbon cable display connector J9, then all VCC_3V3 and GND pins should be connected to the peripheral.

When using the board-to-board connectors J2 and J5, all VCC_3V3 and GND pins of *both* connectors should be connected to the PCB power traces on the services board to ensure that the specified output current can be supplied without damage to the BLACK365. The PCB power traces are preferably implemented as power planes on a multi-layer PCB.

TABLE 32 lists all the connector pins that can be used to supply external peripherals.

SIGNAL	J2 PINS	J5 PINS	J9 / J3 PINS
VCC_3V3	31.	68 through 70.	25, 29.
GND	G1 through G10 (dedicated ground connections).	5, 10, 19, 24, 25, 28, 31, 32, 42, 65 48 through 54.	3, 5, 7, 13, 17, 21.

TABLE 32 - BLACK365 POWER OUTPUT

3.4 RESET

3.4.1 RESET INPUT

The BLACK365 can be reset by driving the HARD_RST# signal low. In this way a system reset can be generated by an external IC or switch. HARD_RST# is an open-drain signal with a 1kΩ pull-up resistor. It must be driven by an open drain driver or a switch to GND. The BLACK365 may be damaged if the voltage on this pin is outside the range -0.3V to 6V.

HARD_RST# connects to a power sequencing circuit which cycles the on-board power supplies and asserts an on-board RESET# signal to the processor while the power supplies stabilise. The processor in turn generates the reset signals for on-board peripherals such as the LAN9215i Ethernet controller, the WM9713 audio codec and the USB2514i USB hub.

HARD_RST# can also be asserted by a watchdog timeout event or under operating system control. Please refer to the Platform Guide for the relevant operating system for further details of software controlled reset.

TABLE 33 lists the connector pins that the HARD_RST# input is available on.

SIGNAL	J2 PIN	J5 PIN	DESCRIPTION
HARD_RST#	17	71	Open drain reset input

TABLE 33 - BLACK365 RESET INPUT

EMC filtering and ESD protection for the reset input are not provided on BLACK365. If this signal is driven by a user accessible switch on the services board, then ESD protection is best placed on the services board close to the reset switch. REDCONN does not provide ESD protection or EMC filtering for this signal..

3.4.2 RESET OUTPUT

The on-board RESET# signal used to reset the processor is also available as a reset output on connectors J2 and J5. This RESET# signal can be used to reset external peripherals on services boards that are powered from the VCC_3V3 rail.

TABLE 34 lists the connector pins that the RESET# output is available on. TABLE 35 provides the electrical characteristics for the reset output. The BLACK365 may be damaged if the voltage on this pin is outside the range -0.3V to 3.8V.

EMC filtering and ESD protection are not provided by the BLACK365, as the reset output is intended to route to peripheral ICs within a product enclosure only.

SIGNAL	J2 PIN	DESCRIPTION
RESET#	23	Reset output.

TABLE 34 - BLACK365 RESET OUTPUT

SIGNAL	PARAMETER	CONDITION	LIMITS			UNITS
			Min	Typ	Max	
RESET#	V_{OH}	I_{OL} = -100uA	VCC_3V3 – 0.3	-	VCC_3V3	V
	V_{OL}	I_{OL} = 1mA	GND	-	0.5	V

TABLE 35 - BLACK365 RESET OUTPUT ELECTRICAL CHARACTERISTICS

3.5 POWER MANAGEMENT

The BLACK365 provides a very low power sleep mode and a number of wakeup options, including:

- Wake from touch-screen press.
- Wake from WAKE# input.

Sleep mode is entered under software control. When the BLACK365 is in the low power sleep mode, it can be woken up by driving the WAKE# signal low. In this way, an external IC or switch can wake up the system. WAKE# is an open-drain signal with a 12K pull-up resistor. It must be driven by an open-drain driver or a switch to GND. The BLACK365 may be damaged if the voltage on this pin is outside the range -0.5V to 6V.

TABLE 36 lists the connector pins that the WAKE# input is available on.

SIGNAL	J2 PIN	DESCRIPTION
WAKE#	72	Open drain wake input

TABLE 36 - BLACK365 WAKE INPUT

EMC filtering and ESD protection for the wake input are not provided on BLACK365. If this signal is driven by a user accessible switch on the services board, then ESD protection is best placed on the services board close to this switch.

DSP Design can discuss detailed technical support surrounding power management to volume customers who are implementing their own operating system. Please refer to the Platform Guide for power management implementation details for supported operating systems.

APPENDIX A - MECHANICAL, ENVIRONMENTAL, HANDLING

A.1 DIMENSIONS

- PCB dimensions are 85mm x 65mm.
- PCB thickness is 1.6mm.
- Maximum component height above the PCB top side is 4.9mm.
- Maximum component height below the PCB bottom side is 3.8mm.
- When mounted on a services board using connectors J2 and J5 there is 4mm between the two PCBs assuming that the following mating connectors are used:
  - Hirose FX10x-100S/10-SV used to mate with J2.
  - Hirose FX8-120P-SV1 used to mate with J5.

A.2 WEIGHT

30g.

A.3 OPERATING TEMPERATURE RANGE

0ºC to +85ºC.

A.4 HUMIDITY

10% - 90%, non-condensing.

A.5 ELECTRO-STATIC SENSITIVE DEVICE (ESD)

The BLACK365 and REDCONN contain CMOS devices which can be damaged by static electricity discharging through the device. Please observe anti-static handling precautions when handling the BLACK365 and REDCONN or when adding or removing connectors.

For ESD protection to be effective any ESD protection components should be placed close to connectors or interfaces that are accessible by the end user. ESD protection is therefore best implemented on a services board where all the end-user accessible connectors are mounted. For that reason the BLACK365 lacks ESD protection components on many of its signals. Conversely, the REDCONN does include ESD protection components on most connectors. The nature of any ESD protection is noted elsewhere in this manual.

It is the responsibility of the product designer to ensure that products using the BLACK365, REDCONN and any other sub-assemblies are compliant with the appropriate ESD standards and provide adequate protection for the application.

A.6 ELECTROMAGNETIC COMPATIBILITY (EMC)

Most finished products that use the BLACK365 will be subject to EMC regulations, such as those required by the EU's EMC Directive. Finished products may require EMC tests, and in order to pass these tests the product may need to be enclosed in a Faraday cage formed by the enclosure, and may need to have EMC filtering on conductors that pass through the enclosure.

User accessible connectors (such as Ethernet and USB) and interfaces (such as touch-screen) must pass through the Faraday cage formed by the enclosure. For EMC filtering to be effective, any EMC filters must be placed close to the enclosure boundary. All of the BLACK365 external interfaces available at J2, J3, J5 and J9 must route through a services board before going to the outside world. EMC filtering is therefore best implemented on this services board where all the connectors to the outside world are mounted. For that reason the BLACK365 does not provide filter components on any of its external interfaces.

The MicroSD socket provided by the BLACK365 will always sit within a product enclosure and is therefore classed as an internal interface. As such, the BLACK365 does not provide filter components on this interface.

Conversely, the REDCONN does include EMC filtering on most connectors. The nature of any EMC filtering is noted elsewhere in this manual.

It is the responsibility of the product designer to ensure that systems using the BLACK365, REDCONN and any other sub-assemblies are compliant with the appropriate EMC standards and provide adequate filtering for the application.

A.7 CHASSIS

The BLACK365 provides four mounting holes. One is connected to a CHASSIS plane and three are isolated from all signals and planes. The metal part of connector J1 is connected to the CHASSIS plane.

The mounting hole connected to CHASSIS is the mounting holes closest to J1.

EMC performance may be improved by ensuring a low impedance bond between the pad of the CHASSIS mounting hole and the conductive enclosure, and by connecting CHASSIS to GND at a single star point. The BLACK365 makes this connection between CHASSIS and GND using a single ferrite bead.

REDCONN also connects the two mounting holes closest to the Ethernet and USB connectors to a CHASSIS plane, and links CHASSIS to GND using a single ferrite bead. When using BLACK365 with REDCONN, this ferrite bead may be removed from REDCONN to avoid a multi-point connection between CHASSIS and GND.

A.8 RoHS COMPLIANCE

The BLACK365 and REDCONN are only available as fully RoHS compliant products and do not exceed the limits of the six banned substances specified in the RoHS Directive 2002/95/EC.

APPENDIX B - BLACK365 DRAWINGS

B.1 COMPONENT PLACEMENT

FIGURE B1 and FIGURE B2 show the component placement for the top and bottom sides of the BLACK365 respectively.

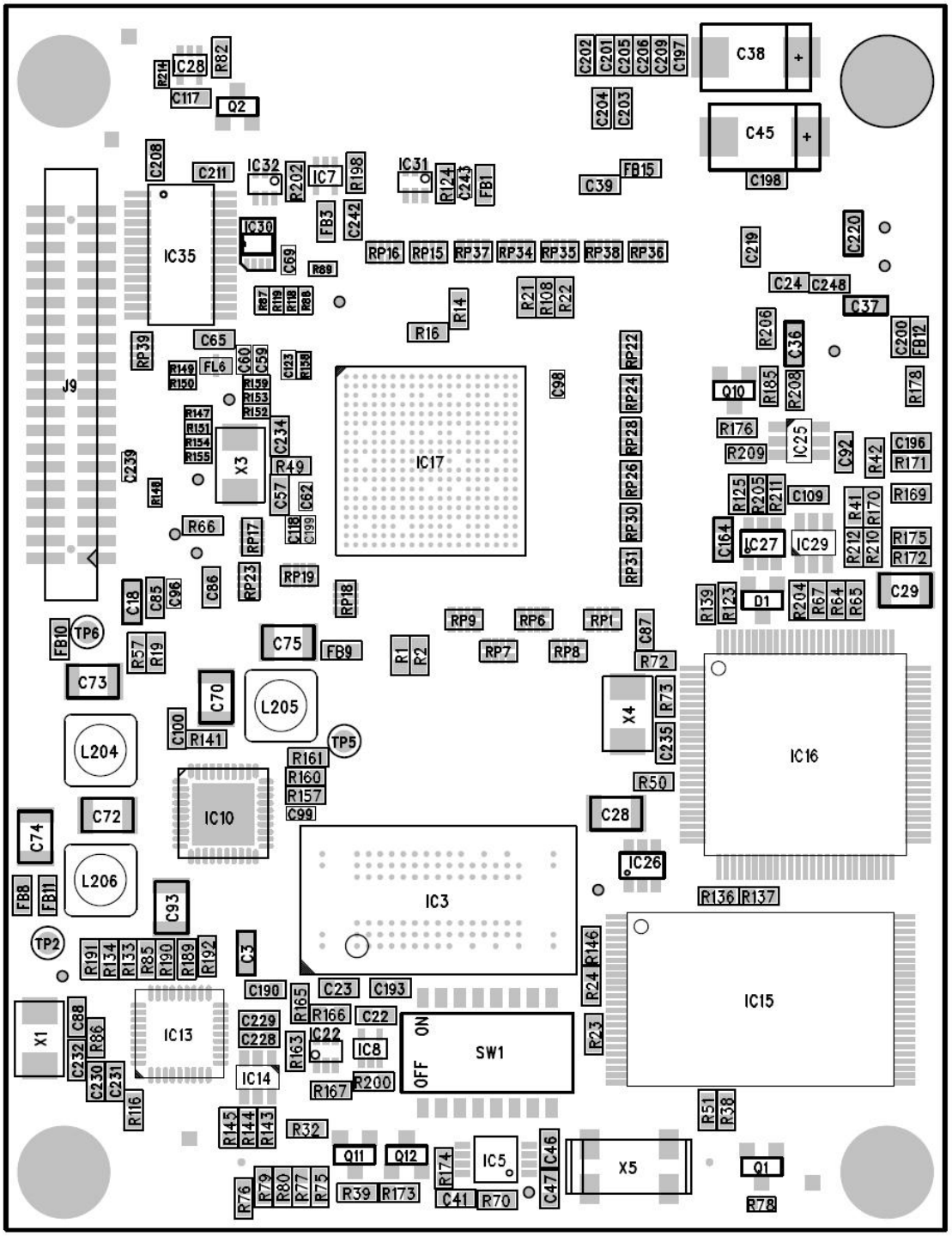

FIGURE B1 - BLACK365 COMPONENT PLACEMENT – TOP SIDE

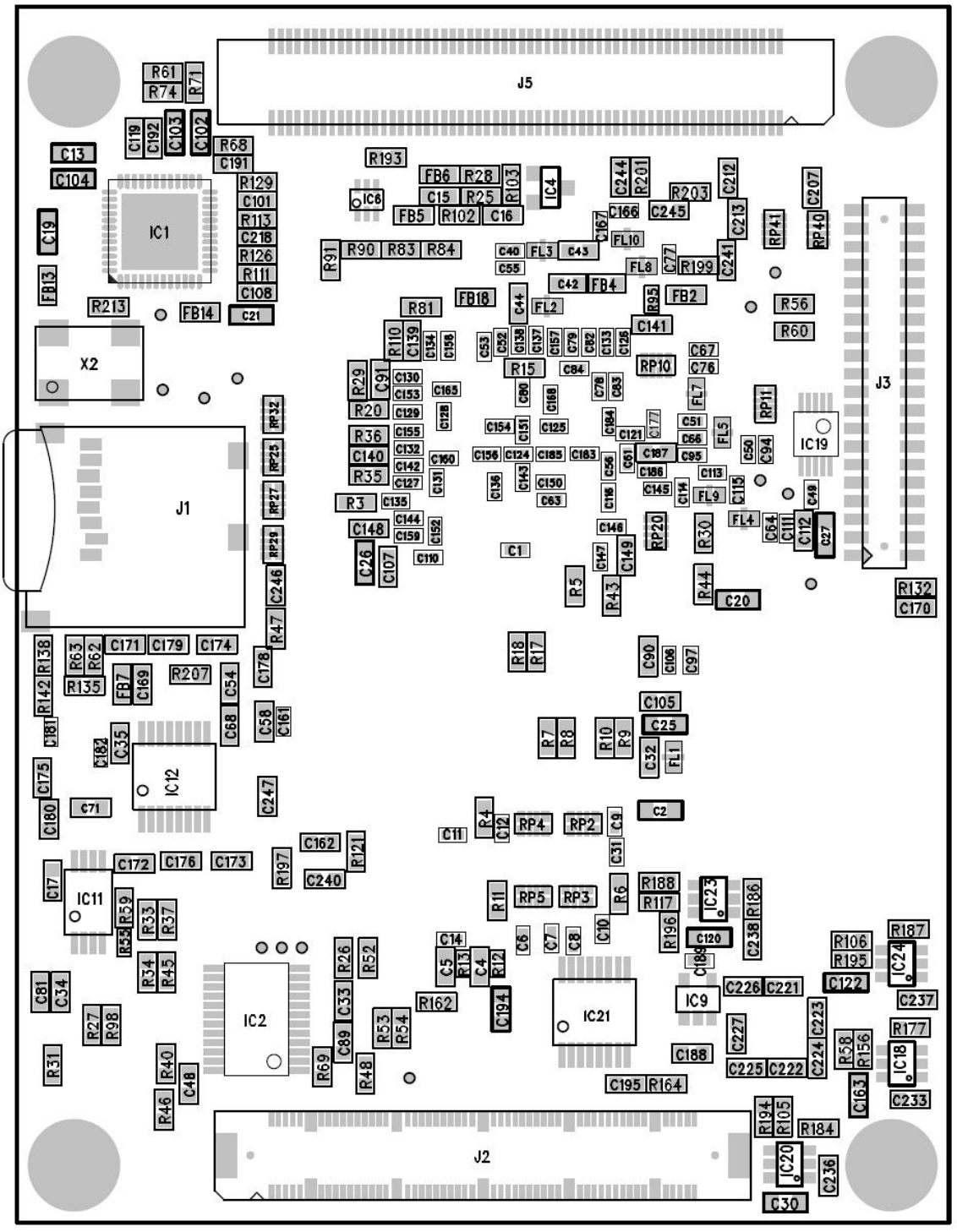

FIGURE B2 - BLACK365 COMPONENT PLACEMENT – BOTTOM SIDE

B.2 MECHANICAL DIMENSIONS

Mechanical dimensions are shown in FIGURE B3. Connector positions are shown in FIGURE B4 and FIGURE B5. All dimensions are to pad or hole centres. The four mounting holes have a diameter of 3.2mm ±0.1mm. The board profile tolerance is ±0.5mm. Assume a typical pad positional tolerance of ±0.5mm.

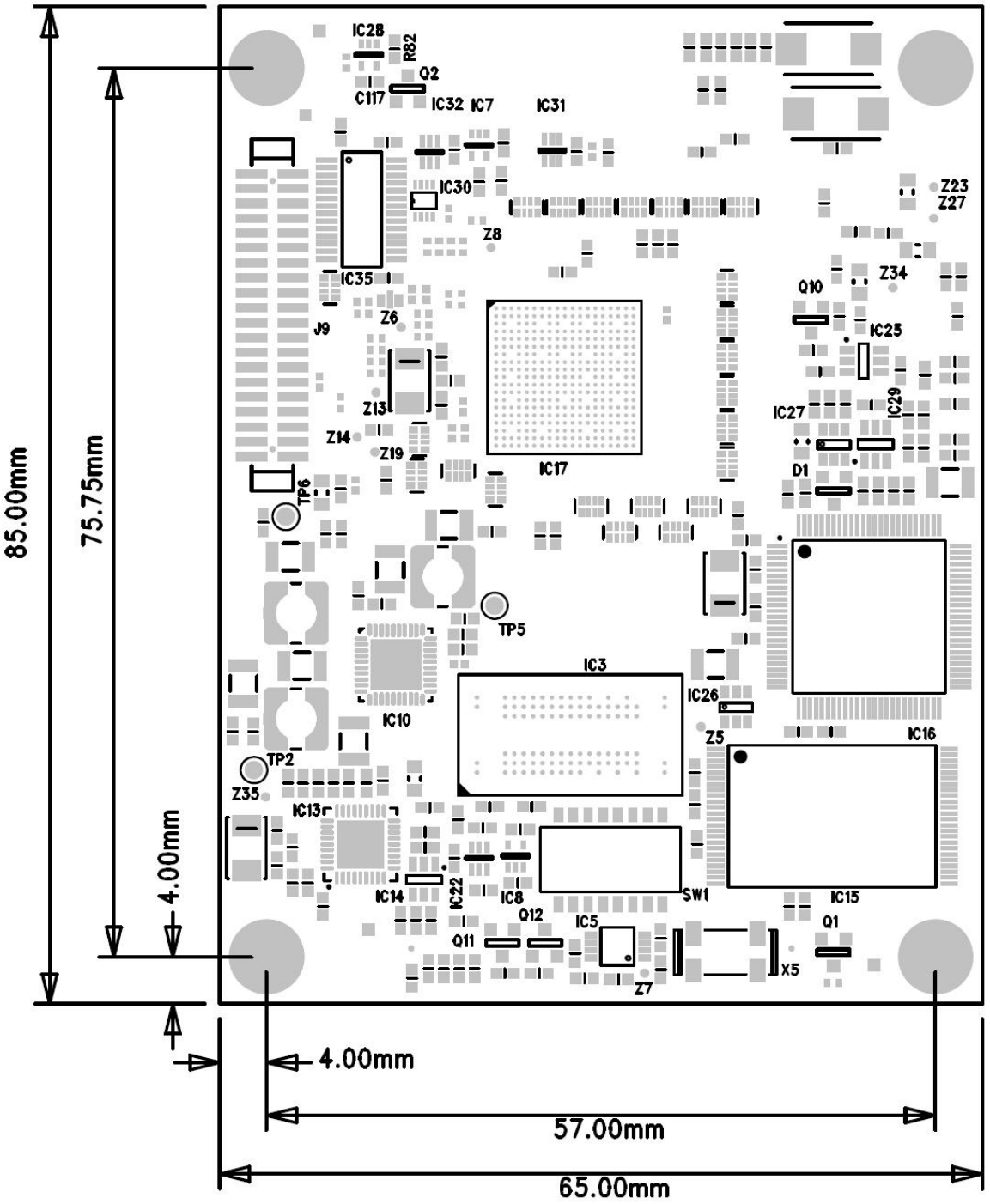

FIGURE B3 - BLACK365 BOARD PROFILE

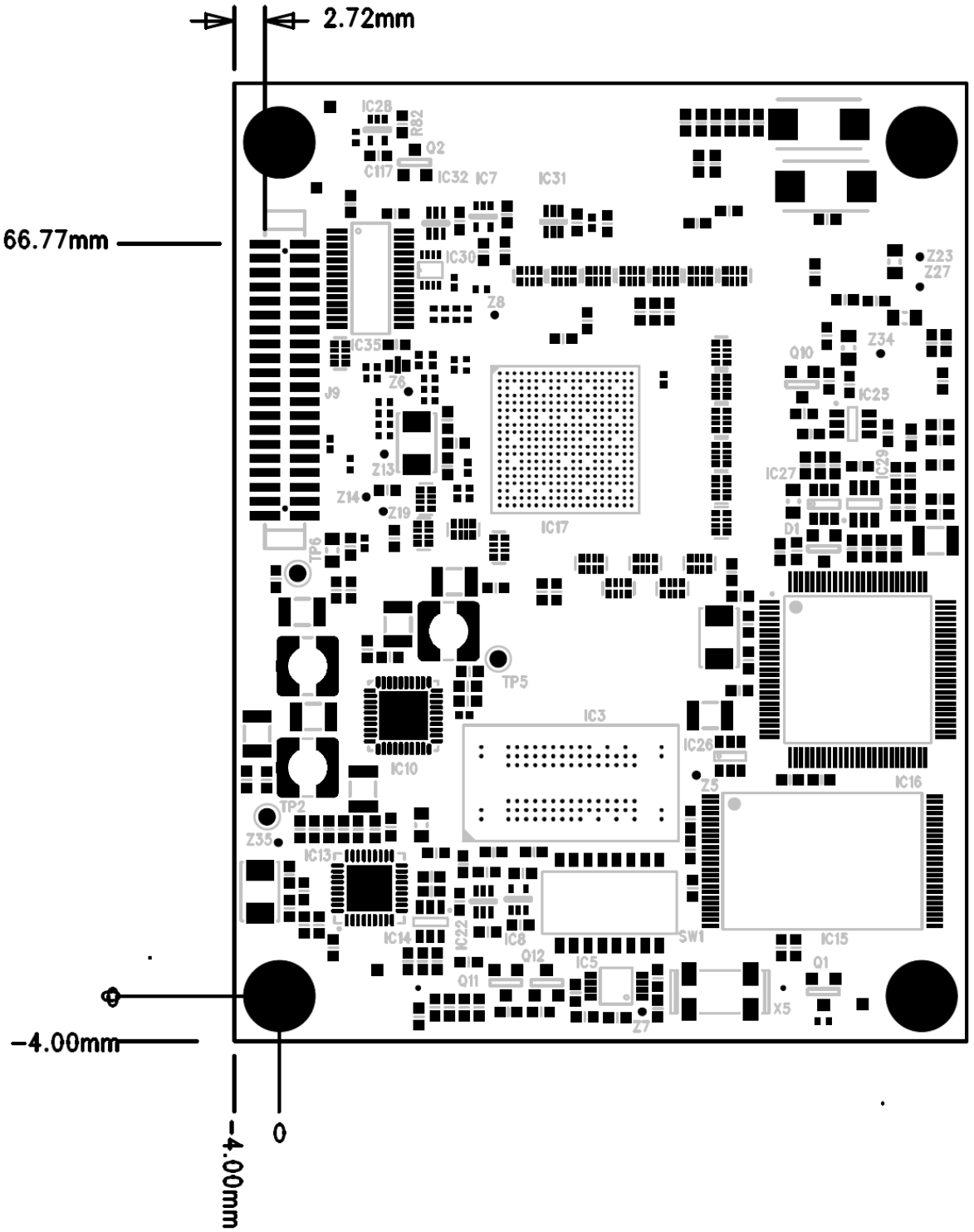

FIGURE B4 - BLACK365 TOP SIDE CONNECTOR POSITIONS

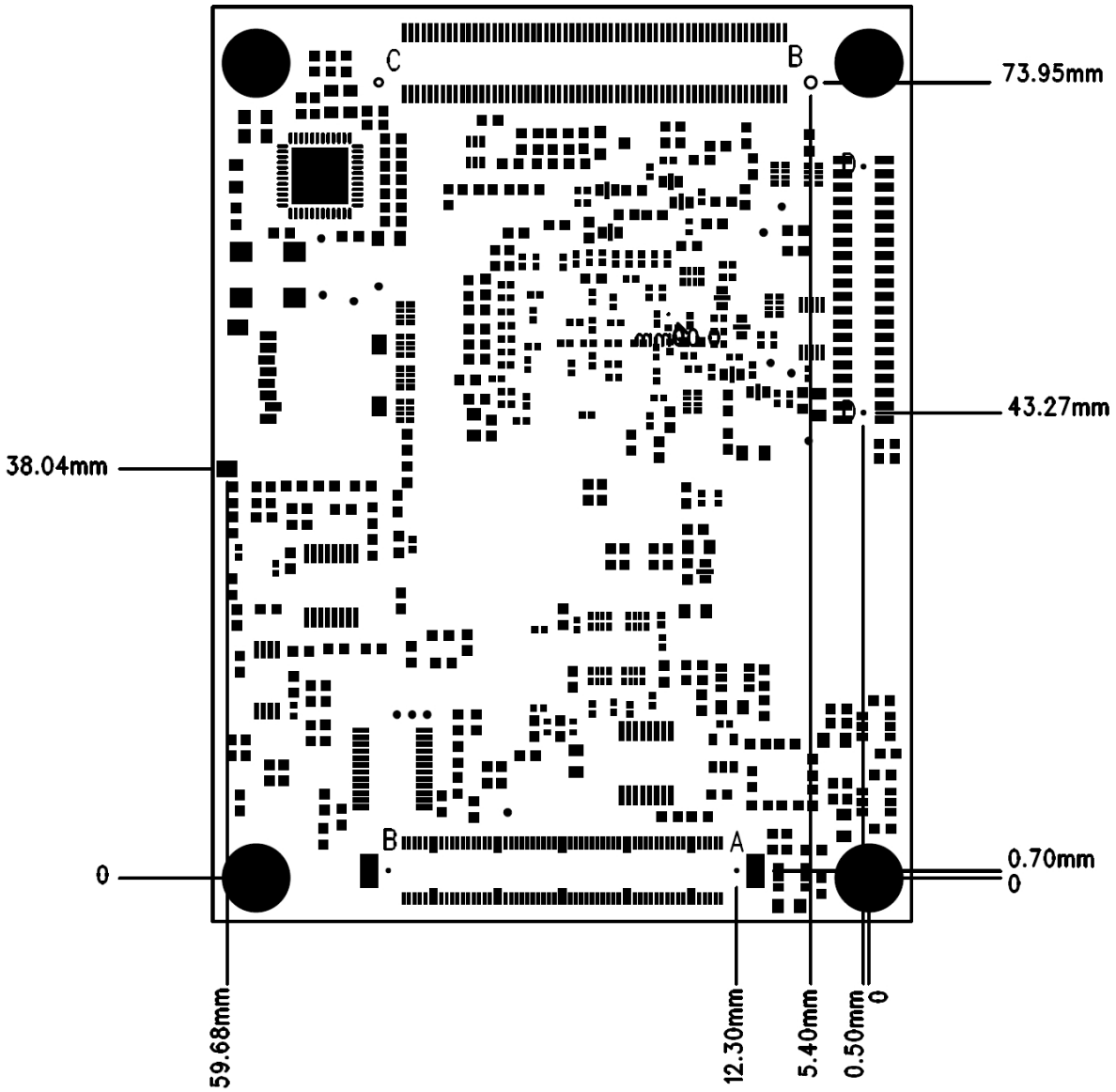

FIGURE B5 - BLACK365 BOTTOM SIDE CONNECTOR POSITIONS

TABLE B1 lists the holes sizes shown in FIGURE B5.

HOLE REFERENCE	DIAMETER
A	1.2mm
B	1.1mm
C	0.7mm
D	0.8mm

TABLE B1 - BLACK365 HOLE SIZES

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APPENDIX C - OPTIONS AND ORDERING INFORMATION

This appendix lists the range of products available from DSP Design related to the BLACK365. Order codes prefixed with “DSP-” indicate the items are RoHS compliant.

Additional products are added all the time, please visit our website for up-to-date details.

C.1 PROCESSOR MODULES

TABLE C1 contains the order codes for the BLACK365 processor.

ITEM	DESCRIPTION
DSP-BLACK365xx	BLACK365 300MHz processor module. The item code ending will vary depending on the programmed operating system. Please visit our website for available processor modules.

TABLE C1 - PROCESSOR MODULES

C.2 LAUNCHPAD APPLICATION DEVELOPMENT KITS

TABLE C2 contains the order codes for the LaunchPad Application Development Kits for BLACK365.

ITEM	DESCRIPTION
DSP-LPBLACK365xx	LaunchPad Application Development Kit for the BLACK365. The item code ending will vary depending on the programmed operating system. Please visit our website for available LaunchPad Application Development Kits.

TABLE C2 - LAUNCHPAD APPLICATION DEVELOPMENT KITS

C.3 DISPLAY ACCESSORIES

TABLE C3 contains the order codes for the display interface boards and cables for the BLACK365.

ITEM	DESCRIPTION
DSP-TFTIF-CAB7	40 way ribbon cable assembly for DSP-TFTIFxxx boards, connectors at both ends, length 7 inches
DSP-TFTIF-CAB11	40 way ribbon cable assembly for DSP-TFTIFxxx boards, connectors at both ends, length 11 inches
DSP-TFTIF31M	Display interface adapter. Connects a 40-way ribbon cable to LCDs which use the 31-pin Hirose DF9 connector. **Note:** A minor modification is required to this board to make it compatible with BLACK365. Please contact DSP Design if you wish to discuss using this interface board for volume applications.
DSP-TFTIF41	Display interface adapter. Connects a 40-way ribbon cable to LCDs which use the 41-pin Hirose DF9 connector. **Note:** A minor modification is required to this board to make it compatible with BLACK365. Please contact DSP Design if you wish to discuss using this interface board for volume applications.
DSP-TFTIFKYV	Display interface adapter. Connects a 40-way ribbon cable to Kyocera LCDs.
TRM-TFTIFKYV	Printed and bound Technical Reference Manual describing the TFTFIFKYV adapter board.
DSP-TFTKYV75	A Kyocera V-series 640 X 480 7.5” TFT display.
DSP-TFTKYV75-KIT	A display kit, comprising the TFTKYV75, TFTIFKYV, backlight inverter and cables.
DSP-TFTIFLVDS4X	Display interface adapter. Connects a 40-way ribbon cable to 18-bit LCDs with an LVDS interface consisting of 4 twisted pairs.
DSP-TFTIFLVDS5X	Display interface adapter. Connects a 40-way ribbon cable to 24-bit LCDs with an LVDS interface consisting of 5 twisted pairs.
TRM-TFTIFLVDS	Printed and bound Technical Reference Manual describing the TFTIFLVDS adapter boards.
DSP-AAVGA	Display interface adapter for VGA CRTs. Connects 40-way ribbon cable to a video D/A converter and 15-pin D-type connector. **Note:** A minor modification is required to this board to make it compatible with BLACK365. Please contact DSP Design if you wish to discuss using this interface board for volume applications.

TABLE C3 - DISPLAY ACCESSORIES

C.4 OTHER ACCESSORIES

TABLE C4 contains the order codes for miscellaneous accessories for the BLACK365.

ITEM	DESCRIPTION
DSP-TCONN-PSU	20W 5V 4A AC-DC PSU for the REDCDC.
DSP-REDCDC	Connector breakout board for BLACK365 with DC input power jack.
DSP-REDCPOE	Connector breakout board for BLACK365 with PoE capability.
DSP-MSD4G	4 Gbyte MicroSD card.

TABLE C4 - OTHER ACCESSORIES

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APPENDIX D - BLACK365 CONNECTOR PIN ASSIGNMENTS

D.1 BLACK365 CONNECTOR SUMMARY

TABLE E1 provides a summary of the connectors used on the BLACK365.

REF	FUNCTION	TYPE	MANUFACTURER / PART NO
J1	MicroSD	MicroSD socket with push/push mechanism	Etec TFCMF-20801B0T0
J2	High-speed I/O	100 way board-to-board with ground plate	Hirose FX10A-100P/10-SV(71)
J3	Display & touch	2 x 20 way 1.27mm pitch low profile socket	Not fitted
J4	(There is no connector labelled J4 on the current PCB revision)		
J5	I/O	120 way board-to-board	Hirose FX8-120S-SV-(21)
J6	(There is no connector labelled J6 on the current PCB revision)		
J7	(There is no connector labelled J7 on the current PCB revision)		
J8	(There is no connector labelled J8 on the current PCB revision)		
J9	Display & touch	2 x 20 way 1.27mm pitch pin header	Etec SS2-040-H70/0-55/11A

TABLE E1 - BLACK365 CONNECTOR SUMMARY

The mating connectors for J2 and J5 are shown below. Use these variants to ensure a 4mm stacking height between the BLACK365 and the services board.

- Hirose FX10x-100S/10-SV mates with J2.
- Hirose FX8-120P-SV1 mates with J5.

FIGURE E1 and FIGURE E2 show the connector positions on the BLACK365.

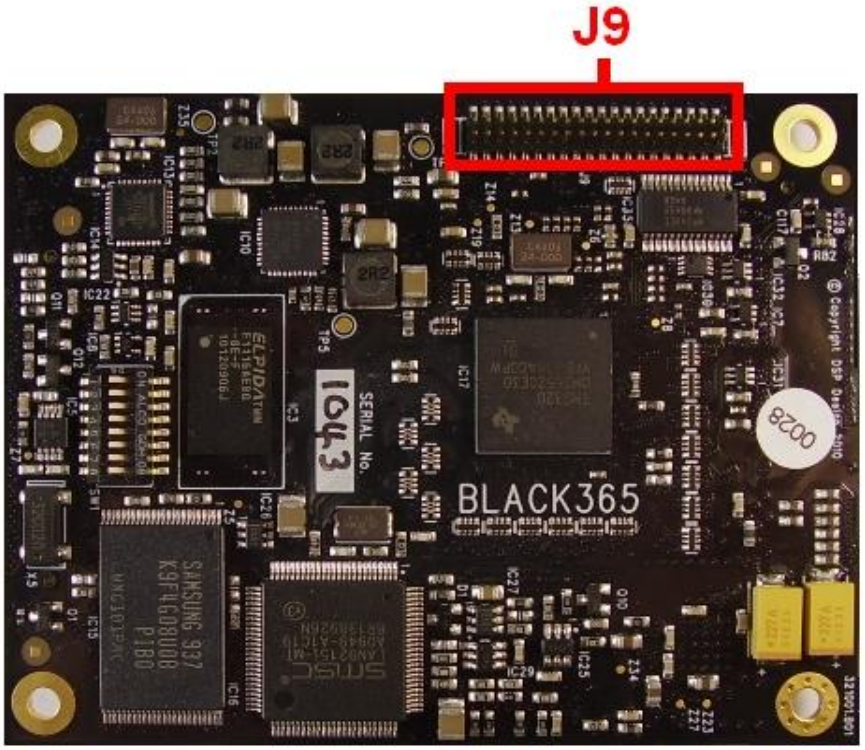

FIGURE E1 - BLACK365 CONNECTOR POSITIONS – TOP SIDE

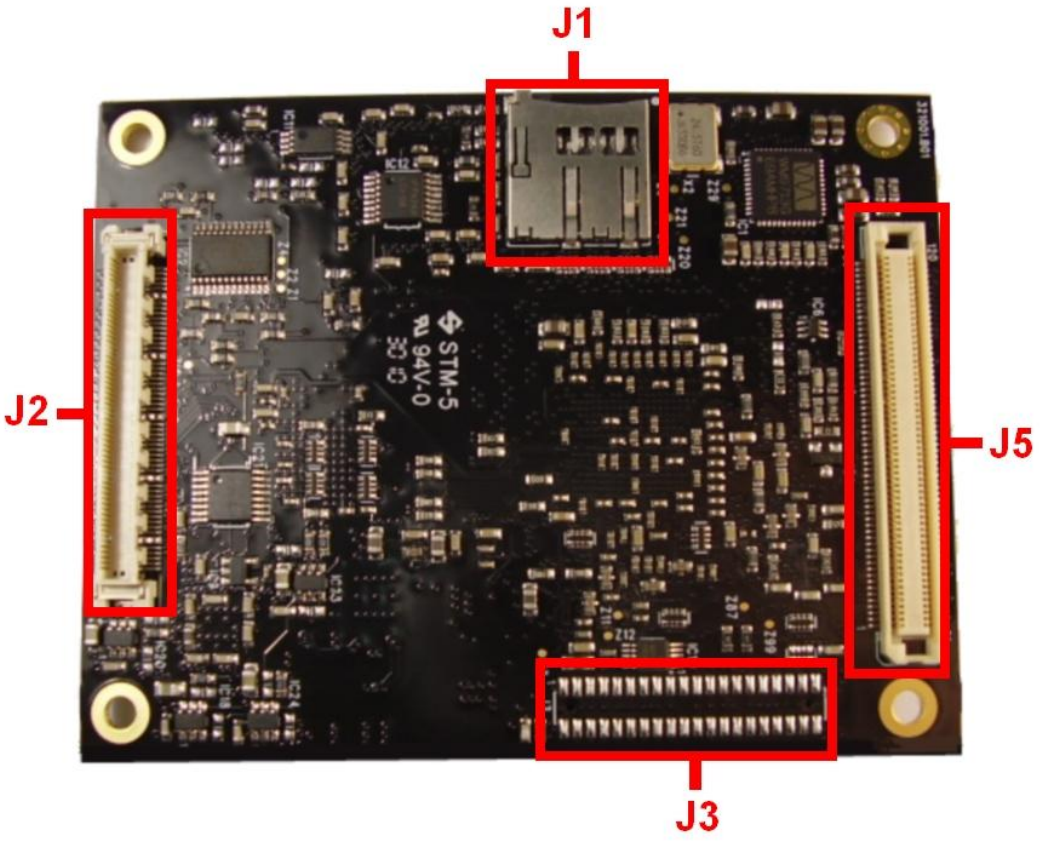

FIGURE E2 - BLACK365 CONNECTOR POSITIONS – BOTTOM SIDE

D.2 BOARD-TO-BOARD CONNECTORS J2 AND J5

Connectors J2 and J5 enable the BLACK365 to plug onto another PCB.

Some pins are reserved for future use. Do not make any connection to these pins.

Pin 1 is identified in FIGURE B2 in APPENDIX B by a triangle. J2 pins are numbered 1-50 on one row and 51-100 on the other, with pins 1 and 51 opposite each other. J5 pins are numbered 1-60 on one row and 61-120 on the other, with pins 1 and 61 opposite each other.

Connector J2 incorporates a ground plate with equally spaced dedicated ground connections in addition to the signal connections shown in TABLE E2. The larger pads in FIGURE B2 are the dedicated GND connections. There is one GND connection for every ten signal connections.

PIN	SIGNAL	PIN	SIGNAL	PIN	SIGNAL	PIN	SIGNAL
1	EM_D0	26	SOMI_GIO27_B0	51	EM_A0	76	IOP1_P12
2	EM_D1	27	SIMO_GIO26	52	EM_A1	77	IOP1_P13
3	EM_D2	28	GIO15	53	EM_A2	78	IOP1_P14
4	EM_D3	29	GIO3	54	EM_A3	79	IOP1_P15
5	EM_D4	30	GIO30	55	EM_A4	80	IOP1_P16
6	EM_D5	31	VCC_3V3	56	EM_A5	81	IOP1_P17
7	EM_D6	32	VCC5V	57	EM_A6	82	VCC5V
8	EM_D7	33	VCC5V	58	EM_A7	83	VCC5V
9	EM_D8	34	VCC5V	59	EM_A8	84	VCC5V
10	EM_D9	35	I2C_SCL	60	EM_A9	85	COM2_RXD
11	EM_D10	36	I2C_SDA	61	EM_A10	86	COM2_TXD
12	EM_D11	37	USBH2P	62	EM_A11	87	USBH3N
13	EM_D12	38	USBH2N	63	EM_A12	88	USBH3P
14	EM_D13	39	USBH2PWR	64	EM_A13	89	USBH3PWR
15	EM_D14	40	USBH1P	65	EM_BA0	90	USBH4N
16	EM_D15	41	USBH1N	66	EM_BA1	91	USBH4P
17	HARD_RST#	42	USBH1PWR	67	EM_WE#	92	USBH4PWR
18	EM_WAIT#	43	Reserved	68	EM_OE#	93	Reserved
19	Reserved	44	Reserved	69	Reserved	94	Reserved
20	EM_A14_GIO36	45	Reserved	70	EM_CS1A#	95	Reserved
21	EM_A16_GIO39	46	Reserved	71	EM_A15_GIO38	96	Reserved
22	EXT_INT#	47	Reserved	72	WAKE#	97	Reserved
23	RESET#	48	Reserved	73	Reserved	98	Reserved
24	SCS0_GIO29_G0	49	Reserved	74	IOP1_P10	99	Reserved
25	SCLK_GIO28_B1	50	Reserved	75	IOP1_P11	100	Reserved

TABLE E2 - J2 BOARD-TO-BOARD CONNECTOR PIN ASSIGNMENTS

PIN	SIGNAL	PIN	SIGNAL	PIN	SIGNAL	PIN	SIGNAL
1	Reserved	31	GND	61	Reserved	91	DSP_GND
2	COM1_RXD	32	GND	62	COM1_RTS	92	TV_OUT
3	COM1_TXD	33	VDIN_C0	63	COM1_CTS	93	Reserved
4	Reserved	34	VDIN_C1	64	Reserved	94	Reserved
5	GND	35	VDIN_C2	65	GND	95	Reserved
6	VCC5V	36	VDIN_C3	66	VBACK_BAT	96	DSP_GND
7	VCC5V	37	VDIN_C4	67	VBACK_BAT	97	Reserved
8	VCC5V	38	VDIN_C5	68	VCC_3V3	98	Reserved
9	VCC5V	39	VDIN_C6	69	VCC_3V3	99	Reserved
10	GND	40	VDIN_C7	70	VCC_3V3	100	Reserved
11	VDIN_Y0	41	Reserved	71	HARD_RST#	101	Reserved
12	VDIN_Y1	42	GND	72	Reserved	102	Reserved
13	VDIN_Y2	43	USBCP	73	Reserved	103	Reserved
14	VDIN_Y3	44	USBCN	74	Reserved	104	Reserved
15	VDIN_Y4	45	USB_VBUS	75	Reserved	105	Reserved
16	VDIN_Y5	46	Reserved	76	VCC5V	106	Reserved
17	VDIN_Y6	47	Reserved	77	VCC5V	107	Reserved
18	VDIN_Y7	48	GND	78	VCC5V	108	LINEINL
19	GND	49	GND	79	VCC5V	109	LINEINR
20	VDIN_HD	50	GND	80	VCC5V	110	PCBEEP
21	VDIN_VD	51	GND	81	VCC5V	111	MONOIN
22	VDIN_WEN	52	GND	82	VCC5V	112	AC97_MICBIAS
23	VDIN_PCLK	53	GND	83	VCC5V	113	MIC2A
24	GND	54	GND	84	VCC5V	114	MIC2B
25	GND	55	MONO	85	VCC5V	115	MICCM
26	RDP	56	SPKR	86	LAN_3V3A	116	SPKL
27	RDN	57	AGND	87	Reserved	117	AGND
28	GND	58	HPR	88	Reserved	118	HPL
29	TDP	59	AGND	89	LINK#	119	AGND
30	TDN	60	AGND	90	10/100#	120	MIC1

TABLE E3 - J5 BOARD-TO-BOARD CONNECTOR PIN ASSIGNMENTS

D.3 DISPLAY CONNECTORS J3 AND J9

Connector J9 is for connection to an LCD. As well as the LCD signals it carries touch-screen signals and signals for backlight inverter control.

To connect to J9 use 0.025-inch pitch ribbon cable and a 2 x 20 way 1.27mm (0.05-inch) pitch ribbon cable connector. Pin 1 is identified in FIGURE B1 in APPENDIX B by a triangle.

Some pins are reserved for future use. Do not make any connection to these pins.

Connector site J3 has the same pinout as J9. By default, J3 is not populated. Contact DSP Design if you wish to discuss populating J3 for volume applications.

PIN	SIGNAL	PIN	SIGNAL
1	BKL_EN	2	LCD_EN
3	GND	4	X_LCD_DCLK
5	GND	6	X_LCD_HSYNC
7	GND	8	X_LCD_VSYNC
9	X_XP	10	X_XN
11	X_LCD_R2	12	X_LCD_R3
13	GND	14	X_LCD_R4
15	X_LCD_R5	16	X_LCD_R6
17	GND	18	X_LCD_R7
19	Reserved	20	Reserved
21	GND	22	X_LCD_G2
23	X_LCD_G3	24	X_LCD_G4
25	VCC_3V3	26	X_LCD_G5
27	X_LCD_G6	28	X_LCD_G7
29	LCD_3V3	30	X_YN
31	X_YP	32	X_LCD_B2
33	X_PWM0	34	X_LCD_B3
35	X_LCD_B4	36	X_LCD_B5
37	VCC5V	38	X_LCD_B6
39	X_LCD_B7	40	X_LCD_DE

TABLE E4 - J3 AND J9 DISPLAY CONNECTOR PIN ASSIGNMENTS

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APPENDIX E - REDCONN SERVICES BOARD FOR THE BLACK365

E.1 INTRODUCTION

The REDCONN is a services board for the BLACK365 processor board. It breaks out some of the interfaces from BLACK365 to standard connectors.

The REDCONN provides the following standard PC connectors mounted along two edges of the board for easy mounting in an enclosure:

- One RJ45 Ethernet socket.
- One USB device Mini-AB connector.
- One 9-way male D-type serial connector.
- Two 3.5mm audio jacks for line-out (green) and microphone (pink).
- One 2mm power jack.

Two stacked USB host Type-A connectors are also provided on the board edge, however these make no connection with BLACK365. On the BLACK365, the USB host ports route to J2, not J5, and are therefore not accessible by REDCONN.

The REDCONN provides a 6-way board-to-wire connector for providing power to a backlight inverter within an enclosure. A 2-way board-to-wire connector for interfacing to a speaker is also provided, however this interface is not supported by BLACK365.

There are two variants of the REDCONN available:

- The REDCPOE includes PoE capability and excludes the DC input power jack.
- The REDCDC includes the DC input power jack and excludes PoE capability.

The differences are described in more detail in section E.6. Unless otherwise described in the following sections, the two variants will be referred to as the REDCONN.

E.2 BLOCK DIAGRAM

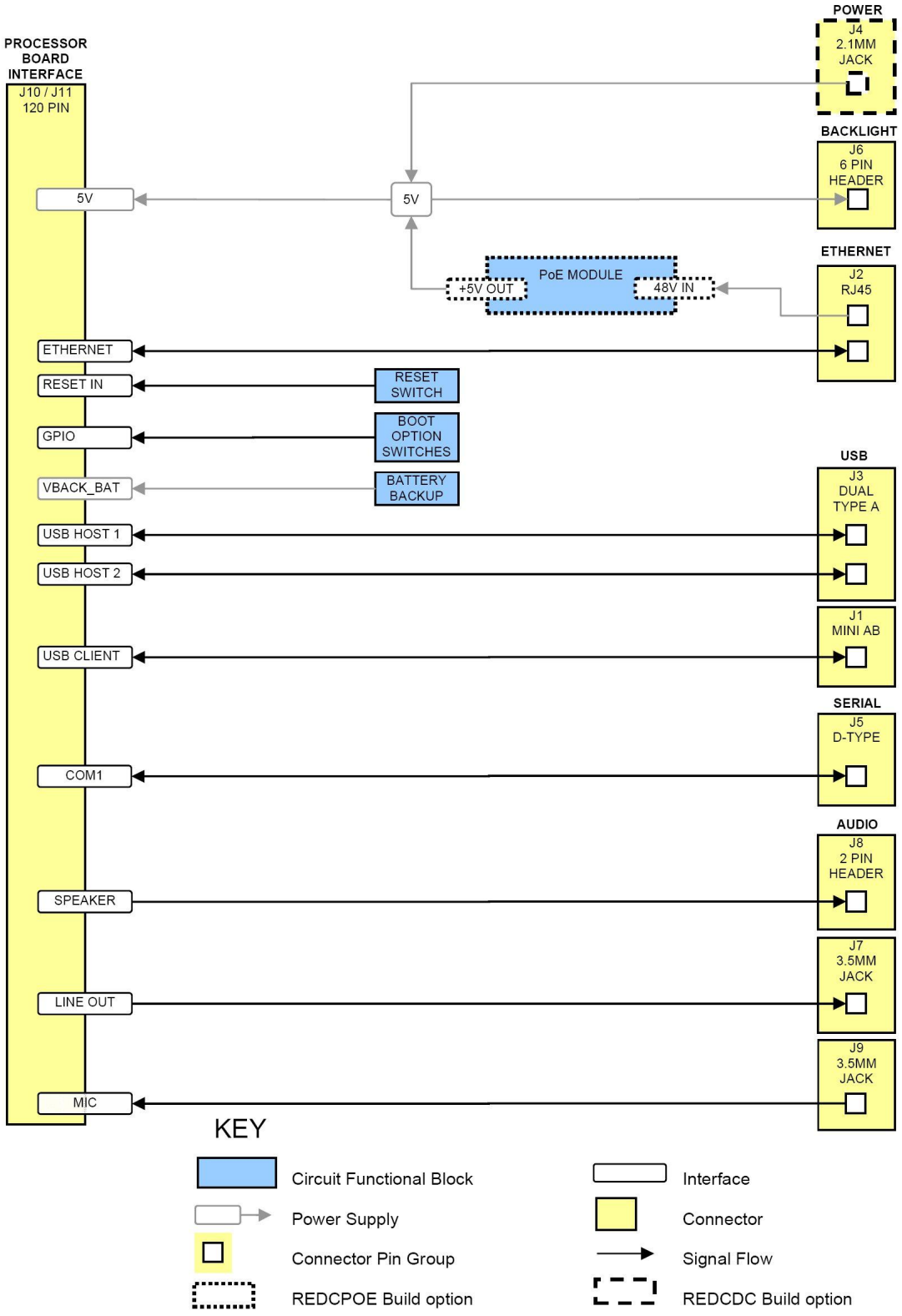

FIGURE F1 - REDCONN BLOCK DIAGRAM

E.3 INTERFACING REDCONN TO BLACK365

The BLACK365 connects to the REDCONN through the 120-way connectors. If the REDCONN is to be fitted end to end with the BLACK365 then connector J5 of the BLACK365 mounts with J10 of the REDCONN as shown in FIGURE F2. If the REDCONN is to be fitted underneath the BLACK365 then connector J5 of the BLACK365 mounts with J11 of the REDCONN as shown in FIGURE F3.

FIGURE F2 - BLACK365 AND REDCONN CONNECTED END-TO-END

FIGURE F3 - BLACK365 AND REDCONN CONNECTED BACK-TO-BACK

E.4 REDCONN CONNECTOR SUMMARY

TABLE F1 provides a summary of the connectors on the REDCONN. FIGURE F4 and FIGURE F5 show their positions.

The function and pin assignment for the backlight power connector J6 is detailed in a subsequent section of this appendix. The function and pin assignment for connectors J10 and J11 are identical to that given in APPENDIX D for the BLACK365 connector J5. The remaining connectors use standard pin allocations and are not detailed in this document.

REF	FUNCTION	TYPE	MANUFACTURER / PART NO
J1	USB Device	Mini AB USB socket	Samtec MUSB-05-S-AB-SM-A
J2	Ethernet	RJ45 socket	Kycon GWLX-S9-88-G/Y
J3	Not used by BLACK365	Dual (stacked) USB Type A socket	AMP 5787617-1
J4	Power	2mm power jack (REDCDC only)	Kycon KLDX-SMT2-0202-A
J5	COM1 serial port	9 way male D-type	Etec-SDM-009-US91-95/N
J6	Backlight power	6 way 1.25mm pitch pin header	Molex 53398-0671
J7	Audio line out	3.5mm audio jack, green	Connect-Tech CTP-322-1-LG
J8	Not used by BLACK365	2 way 1.25mm pitch pin header	Molex 53398-0271
J9	Microphone	3.5mm audio jack, pink	Connect-Tech CTP-322-1-PK
J10	BLACK365 interface	120-way board to board	Hirose FX8-120P-SV1
J11	BLACK365 interface	120-way board to board	Hirose FX8-120P-SV1

TABLE F1 - RECONN CONNECTOR SUMMARY

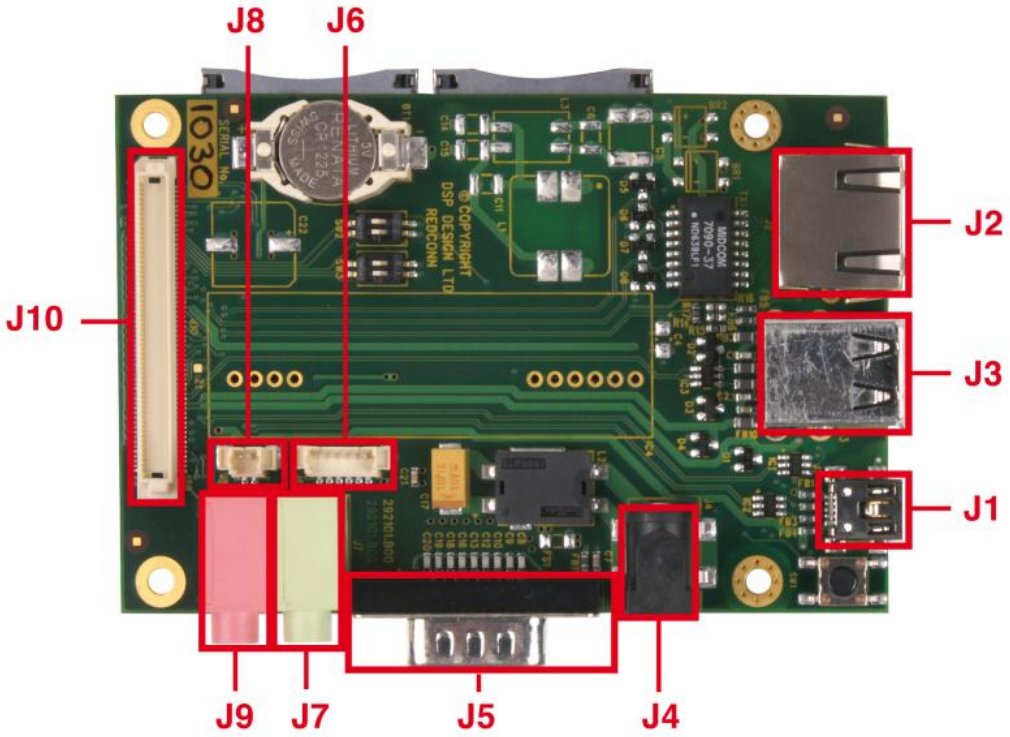

FIGURE F4 - REDCONN CONNECTOR LOCATIONS – TOP SIDE

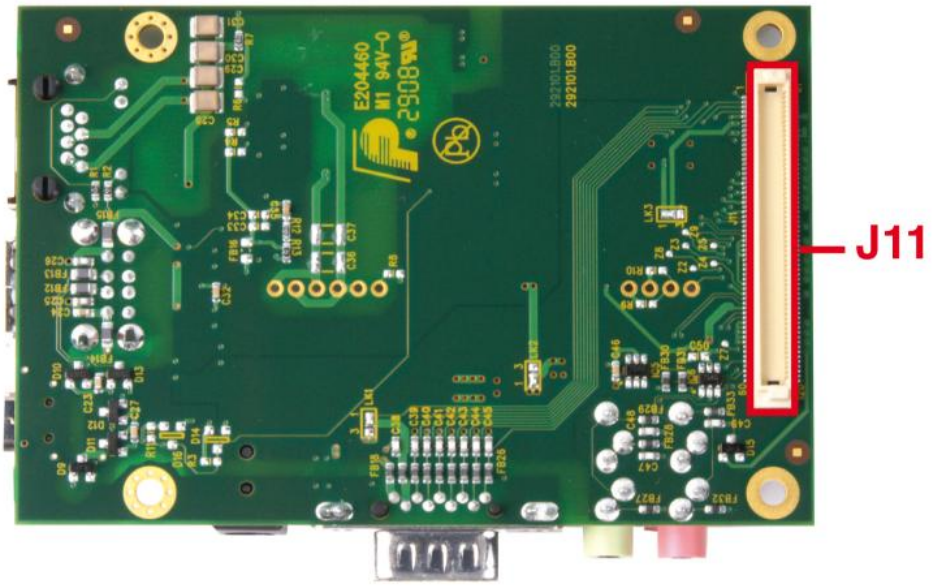

FIGURE F5 - REDCONN CONNECTOR LOCATIONS – BOTTOM SIDE

E.5 COM1 SERIAL PORT

The REDCONN provides a 9-pin D-type socket J5 for COM1.

The REDCONN provides EMC filtering on all pins of J5. The REDCONN does not provide ESD protection on any of the COM1 signals. However the 3243E transceiver on the BLACK365 provides ESD protection. See section 2.6 for more details.

There is a solder link option to connect pin 9 of this connector to VCC_5V through a fuse. Contact DSP Design if you have a volume requirement for this feature.

E.6 ETHERNET AND POWER

The REDCONN provides an RJ45 socket J2 for Ethernet. This includes two LEDs that indicate LAN activity. The RJ45 socket connects to the BLACK365 via one of the board-to-board connectors J10 or J11 and an isolation transformer and the necessary passive components.

The REDCONN provides EMC filtering and ESD protection on all pins of J2.

The REDCDC variant provides a DC jack, J4, for connecting to standard brick power supplies, such as the TCONN-PSU available from DSP Design. In this case the Ethernet interface is a conventional type. FIGURE F6 shows a block diagram of the REDCDC Ethernet circuit and its interface with the BLACK365. The REDCDC provides EMC filtering on the DC jack input. The REDCDC does not provide ESD protection on the DC jack input.

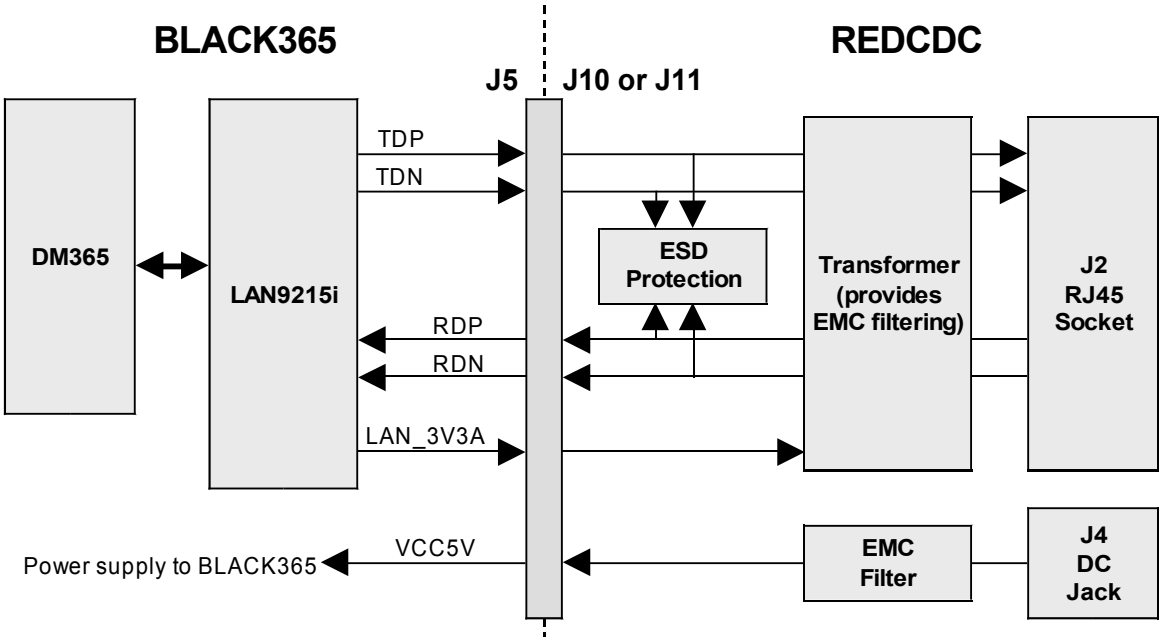

FIGURE F6 - REDCDC ETHERNET BLOCK DIAGRAM

The REDCPOE variant allows power to be sourced using IEEE802.3af Power Over Ethernet technology. This technology superimposes a 48V DC voltage on the Ethernet cable. Components on the REDCPOE feed this 48V through an isolated power supply and provide a regulated 5V for the BLACK365. FIGURE F7 shows a block diagram of the REDCPOE Ethernet circuit and its interface with the BLACK365. Note that power is derived from the centre-taps of the TX and RX transformers, and may also be supplied on the spare pairs. EMC filtering and ESD protection are omitted from this figure, but are present as shown in FIGURE F6.

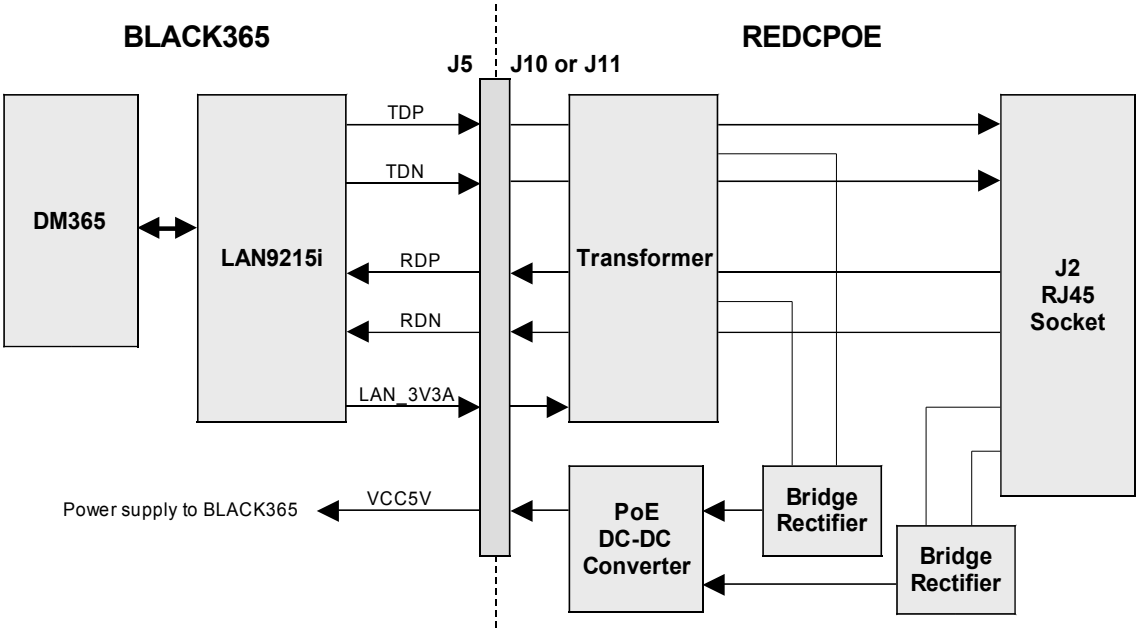

FIGURE F7 - REDCPOE ETHERNET AND POE BLOCK DIAGRAM

E.7 USB HOST

The REDCONN is fitted with two stacked Type-A USB host sockets in a single connector package J3. These sockets make no connection with BLACK365. On the BLACK365, the USB host ports route to J2, not J5, and are therefore not accessible by REDCONN.

E.8 USB DEVICE

The REDCONN provides a USB device port socket J1.

The REDCONN provides EMC filtering on all pins of J1 including VBUS and ground. The REDCONN provides clamping diodes to VCC_3V3 and GND on the USB data pair to protect against ESD.

E.9 AUDIO

The REDCONN provides two 3.5mm audio jacks, J7 and J9.

J7 provides stereo line output and uses the standard green identification. J7 connects to the SPKL and SPKR line level outputs of BLACK365.

J9 provides mono microphone input and uses the standard pink identification. J9 connects to the MIC1 input of BLACK365.

The REDCONN provides EMC filtering on all pins of J7 and J9 including ground.

The REDCONN provides clamping diodes to VCC_3V3 and GND on all audio signals at J7 and J9 to protect against ESD.

The speaker connector J8 is not supported by the BLACK365.

E.10 SWITCHES

The REDCONN provides four DIL switches. These switches are not used by the BLACK365.

E.11 RESET

The REDCONN provides a push button reset switch SW1. The switch connects to the HARD_RST# input on the BLACK365. When pressed, the switch will force a cold reset on the BLACK365.

E.12 RTC BATTERY

The REDCONN provides a 3.0V lithium CR1225 battery in a battery holder BT1. The battery connects to the VBACK_BAT input on the BLACK365 via one of the board-to-board connectors J10 or J11. The battery provides backup for the RTC when power is removed from the BLACK365.

The REDCONN provides a solder link, LK3, which provides the following options:

- Fitted 1-2, battery connected to VBACK_BAT. This is the default setting
- Fitted 2-3, battery isolated, VBACK_BAT connected to GND.
- Not fitted, battery isolated, VBACK_BAT not connected on the REDCONN.

All links are located on the bottom side of the REDCONN, and are clearly marked - pin 1 and pin 3 are identified on the silkscreen for each link.

If short circuited the battery may explode or leak, causing injury or damage to the equipment. To prevent short circuits, observe the following guidelines:

- Remove the battery when changing the setting of LK3.
- Use insulated tools when removing the battery from the holder.
- Ensure the battery is not placed on a conductive surface.
- After changing the setting of LK3 and before reinstalling the battery ensure all three pads are not connected together.

E.13 BACKLIGHT POWER

The REDCONN provides a six pin board to wire connector J6. The connector provides either 5V or 3.3V to backlight inverters. TABLE F2 lists connector J6 pin allocations.

SIGNAL	J6 PIN	DESCRIPTION
VCC_5V or VCC_3V3	4, 5, 6	5V or 3.3V selected by solder link LK2
GND	1, 2, 3	Ground

TABLE F2 - BACKLIGHT CONNECTOR J6 PIN ASSIGNMENTS

The REDCONN provides a solder link, LK2, which provides the following options:

- Fitted 1-2: J6 is connected to VCC_5V. This is the default setting.
- Fitted 2-3: J6 is connected to VCC_3V3.
- Not fitted: J6 pins 4, 5 and 6 are not connected on the REDCONN.

All links are located on the bottom side of the REDCONN, and are clearly marked - pin 1 and pin 3 are identified on the silkscreen for each link.

After changing the setting of LK2 ensure all three pads are not connected together.

E.14 CHASSIS

The REDCONN provides four mounting holes. Two are connected to a CHASSIS plane and two are isolated from all signals and planes. The metal parts of connectors J1, J2, J3 and J5 are connected to the CHASSIS plane.

The two mounting holes connected to CHASSIS are the mounting holes closest to the USB and RJ45 sockets.

The CHASSIS plane connects to the GND plane via a single ferrite bead, FB11. It may be beneficial to remove this ferrite bead if CHASSIS and GND are connected elsewhere in the system.

E.15 ASSEMBLY AND MECHANICAL DRAWINGS

High resolution REDCONN assembly and mechanical drawings are available on the DSP Design website.

E.16 REDCONN DIMENSIONS

- PCB dimensions are 97.5mm x 65.0mm.
- PCB thickness is 1.6mm.
- Maximum component height above the PCB is 16.20mm.
- Maximum component height below the PCB is 2.5mm.

E.17 WEIGHT

- DSP-REDCDC 48g.
- DSP-REDCPOE 64g.

E.18 OPERATING TEMPERATURE RANGE

0°C to +70°C.

E.19 HUMIDITY

10% - 90% non-condensing.

APPENDIX F - FAULT REPORTING

DSP Design makes every effort to ship products and documentation that are completely free from faults, design errors and inconsistencies. Sometimes, however, problems do show up in the field. To help us put these right as quickly and efficiently as possible, we need as much information as possible from you, the user.

For this reason we have included here a “Product Fault Report” form. If you ever have cause to return a board for repair, or if you detect an error in the documentation, we would appreciate it if you could fill in the form on the next page, or a copy of it, and return the form to DSP Design with the faulty product.

Prior to returning a faulty product, please check the following:

1) The board has been correctly configured for the intended application as described by this TRM.
2) The power supplies are providing correct voltage levels.
3) Cabling to the board is sound and connected correctly.
4) Other cards in the system are known to be correctly configured and functioning.
5) PLEASE RETURN THE BOARD TO US IN EXACTLY THE SAME CONFIGURATION AS IT FAILED IN.

Your help with this will enable us to sort out your problem more quickly. Thank you.

PRODUCT FAULT REPORT			
CUSTOMER INFORMATION:		**PRODUCT INFORMATION:**	
Company Name:		Product Name:	
Contact Name:		Serial No.:	
Phone No:		Date of return:	
SYMPTOMS OBSERVED:			
SYSTEM CONFIGURATION (e.g. other boards present, operating system and software):			
For DSP Design Use:			
Product Test Report:			
Date of Receipt:		Repaired by:	
Charges to be invoiced:			
Date of Return:		Returned by:	

TABLE G1 - PRODUCT FAULT REPORT FORM

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