UART Application Kit

Hardware Reference

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Digi International Inc.

11001 Bren Road East

Minnetonka, MN 55343 (USA)

* +1 877 912-3444 or +1 952 912-3444

http://www.digi.com

Contents

1 Overview

This document describes the details of the UART application kit hardware board. This board will be called in advance UART_APPKIT.

The UART_APPKIT provides four independent configurable RS232/422/485 serial ports. Each serial port can be configured, by an on-board switch, for RS232 or RS422 or RS485 asynchronous communication in either full-duplex or half-duplex mode. A termination resistor can be added, by an on-board switch, to each port.

The UART_APPKIT is designed to be connected to the peripheral connector of a JSCC9P9360, CCW9C_LC, JSCC9P9215, A9M2410DEV, or JSCC9M2443 board. The board will be powered from the base board.

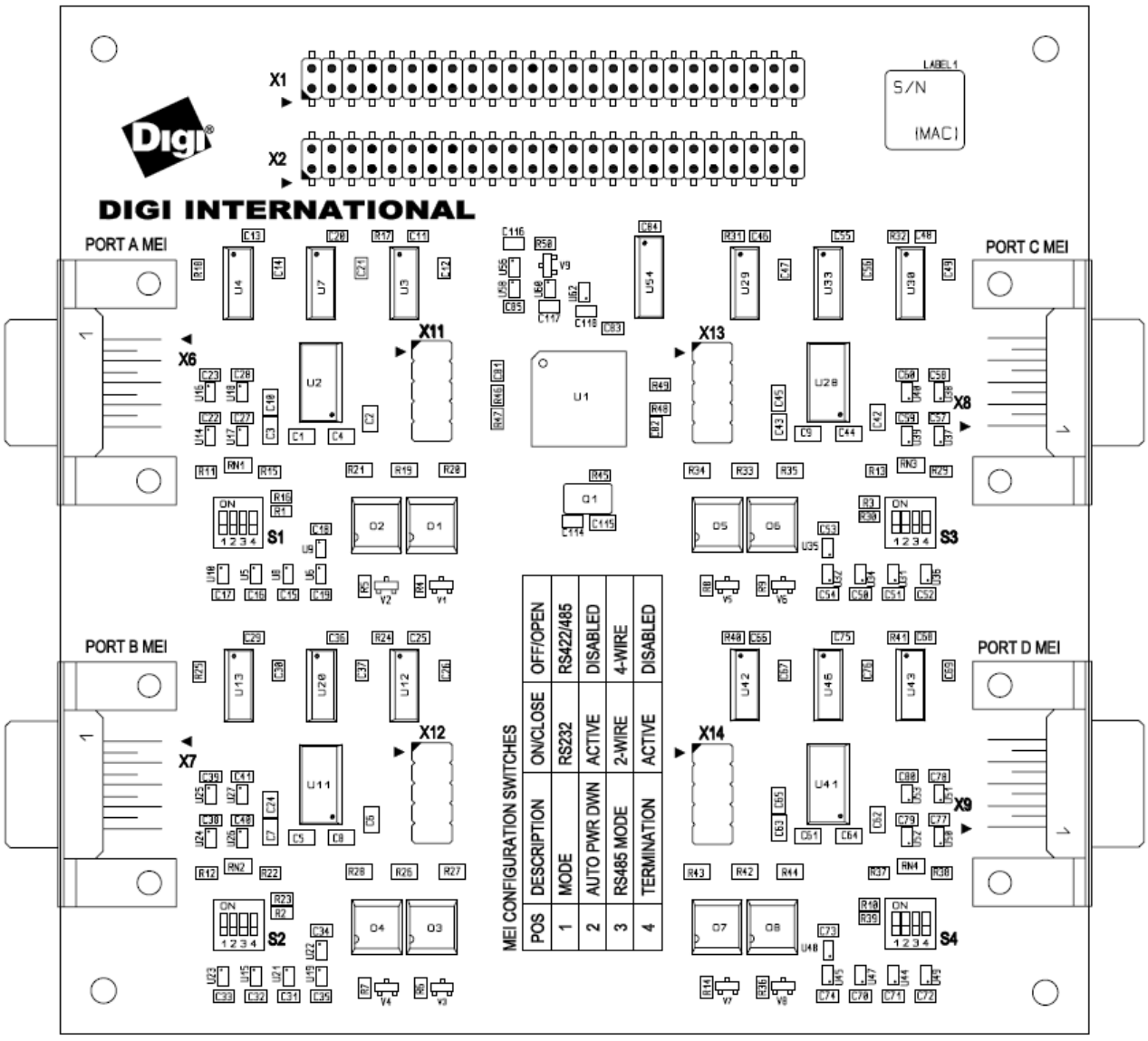
2 Features

The following are major features of the UART_APPKIT board:

- Four (RS232/422/485) MEI serial configurable ports
- Compatibility with the Industry Standard 16C750
- 64-byte transmit/receive FIFO with error flags
- Up to 1.152Mbits/sec baud rate
- Full modem RS232 ports
- Configurable full-duplex or half-duplex RS485/422 ports
- Configurable termination resistor for the RS485/422 ports
- Four 9 way D type connector
- One shared open collector interrupt for all the ports
- Header connector pin to pin compatible with the JSCC9P and CCW9C_LC boards
- Powered from the JSCC9P and CCW9C_LC boards.
- ±15kV ESD protection

3 Basic description

The following figure shows the placement of the UART_APPKIT_0 board.



4 Connection to development board

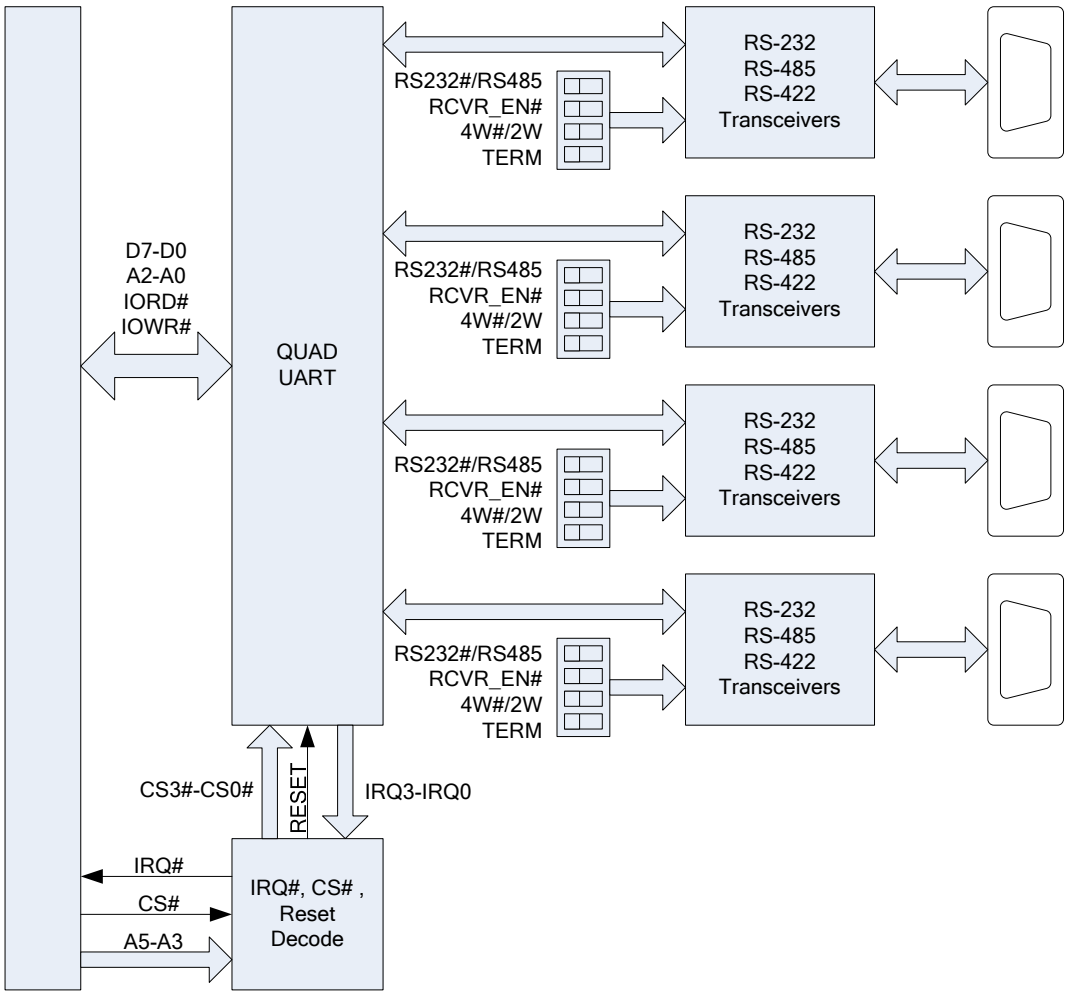
The UART_APPKIT_0 board has two connectors, X1 and X2 for connecting the kit to the JumpStart boards. Depending on the endianness of the CPU module the flat ribbon cable must be connected to a different connector in the UART_APPKIT.

The following table shows the correspondence between the connectors of the UART_APPKIT and the supported modules.

JumpStart Kit	Module	Connector
JSCC9P9360	CC9P9360	X1
CCW9C_LC	CC9C / CCWi9C	X1
A9M2410DEV	CC9M2440	X1
JSCC9M2443	CC9M2443	X1
JSCC9P9215	CC9P9215	X2

5 Detailed description

5.1 Block diagram



5.2 UART

The UART_APPKIT board includes one quadruple UART to provide four serial ports. The UART used is the SC16C754 with 64-byte FIFOs, automatic hardware/software flow control, data rates up to 5Mbits/s.

The UART transmits data, sent to it over the peripheral 8-bit bus, on the TX signal and receives characters on the RX signal. Characters can be programmed to be 5, 6, 7, or 8 bits. The UART has a 64-byte receive FIFO and transmit FIFO and can be programmed to interrupt at different trigger levels. The UART generates its own desired baud rate based upon a programmable divisor and its input clock. It can transmit even, odd, or no parity and 1, 1.5, or 2 stop bits. The receiver can detect break, idle, or framing errors, FIFO overflow, and parity errors. The transmitter can detect FIFO underflow. The UART also contains a software interface for modem control operations, and has software flow control and hardware flow control capabilities.

5.2.1 Baud rate generator

The SC16C754 UART contains a programmable baud generator that takes any clock input and divides it by a divisor in the range between 1 and (216 - 1). An additional divide-by-4 prescaler is also available and can be selected by the bit 7 of the MCR register. The output frequency of the baud rate generator is 16x the baud rate. The formula for the divisor is:

$$\text{divisor} = \frac{\left(\frac{\text{XTAL1 cystal input frequency}}{\text{prescaler}}\right)}{(\text{desired baud rate x 16})}$$

Where:

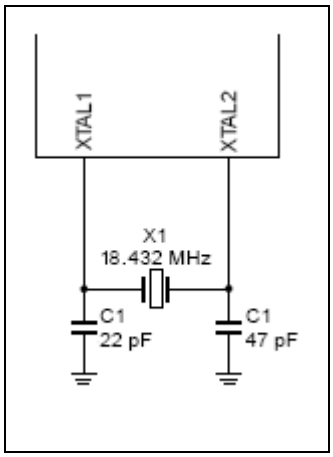
prescaler = 1, when MCR[7] is set to 0 after reset (divide-by-1 clock) (default)

prescaler = 4, when MCR[7] is set to 1 after reset (divide-by-4 clock).

One 18.432MHz crystal is used in the UART_APPKIT board to generate the baud rate. The following figure shows the baud rate and divisor correlation for crystal with frequency 18.432MHz.

Desired baud rate	Divisor used to generate 16xclock	Percent error difference between desired and actual
110	10473	0.0026
300	3840	
1200	960	
2400	480	
4800	240	
9600	120	
19200	60	
38400	30	
57600	20	
115200	10	
230400	5	
576000	2	
1152000	1	

The following figure shows the crystal clock circuit reference.



5.2.2 UART reset

This Reset pin of the UART will reset the internal registers and all the outputs. The UART transmitter output and the receiver input will be disabled during reset time.

RESET is an active-HIGH input.

The UART registers DLL, DLH, SPR, Xon1, Xon2, Xoff1, Xoff2 are not reset by the Reset signal, and they hold their initialization values during reset.

The peripheral connector does not have a reset signal from the main base board, so a memory mapped SW reset mechanism will be implemented on the UART_APPKIT. The address line A5 will be used to generate the SW reset. To make a software reset of the UART a write operation has to be done to one address of the following address range:

Chip Select (CS#)	Write Enable (WE#)	A5 – A0	Description
0	0	1XXXXX	UART SW Reset

5.3 Interrupt generation

The SC16C754 provides individual interrupt outputs for each port. Interrupt conditions include: receiver errors, available receiver buffer data, available transmit buffer space, or when a modem status flag is detected. The four interrupt outputs are high level active, and are in the high-impedance state after reset.

The four interrupt outputs will be combined to generate a shared open collector interrupt output. This interrupt output will be an active low interrupt.

5.4 Chip Select decode

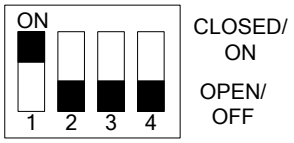
The SC16C754 provides individual chip select inputs to enable data transfers between the CPU and each port of the UART. These chip select signal are low level active.

In the peripheral connector of the UART_APPKIT board only one chip select signal is available. To select between the four different channels of the UART with only one chip select input a 74LVC139 decoder is used. Address lines A4 and A3 are used to decode the four chip selects. The following table shows the memory map of the UART_APPKIT board.

Chip Select (CS#)	A5 – A0	Description
0	000000-000111	UART Channel A
0	001000-001111	UART Channel B
0	010000-010111	UART Channel C
0	011000-011111	UART Channel D

5.5 Port configuration

The UART_APPKIT board has four serial ports. Each serial port can be individually configured with a 4-switch. The switch has two positions: OPEN/OFF and CLOSED/ON:



The following paragraphs describe the configuration options.

5.5.1 RS232 / RS485

If the pos-1 of the switch is closed, the serial port is configured to work in RS232 mode.

If the pos-1 of the switch is open, the serial port is configured to work in RS485 mode.

5.5.2 Auto power down

If the pos-2 of the switch is closed the corresponding RS232 driver will be configured to work in AUTO ONLINE® mode. This mode will set the driver in low power consumption mode when the serial cable was disconnected or the serial peripheral was turned off.

If the pos-2 of the switch is open the corresponding RS232 driver will be configured to work in always online mode. In this mode the RS232 transceiver will not automatically enter in power save mode.

5.5.3 Full / half duplex

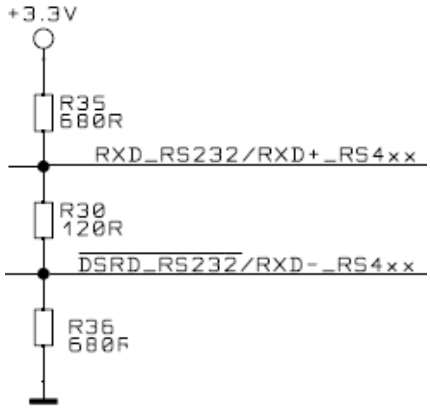
If the pos-3 of the switch is closed, the RS485 serial port is configured to work in half-duplex mode.

If the pos-3 of the switch is open, the RS485 serial port is configured to work in full-duplex mode.

5.5.4 RS485 Termination resistor

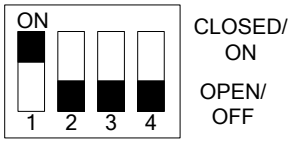
If the pos-4 of the switch is closed, the serial port will have the termination resistor.

If the pos-4 of the switch is open, the serial port will not have a termination resistor.



5.5.5 Switch configurations

The following table shows the switch configurations for each port of the UART_APPKIT.



Switch-1	Switch-2	Switch-3	Switch-4	Description
Closed	Closed	Closed	Closed	Not allowed
Closed	Closed	Closed	Open	RS-232 with Auto Power down (default)
Closed	Closed	Open	Closed	Not allowed
Closed	Closed	Open	Open	RS-232 with Auto Power down
Closed	Open	Closed	Closed	Not allowed
Closed	Open	Closed	Open	RS-232 always enabled
Closed	Open	Open	Closed	Not allowed
Closed	Open	Open	Open	RS-232 always enabled
Open	Closed	Closed	Closed	RS-485 , 2W, termination resistor
Open	Closed	Closed	Open	RS-485 , 2W, No termination resistor
Open	Closed	Open	Closed	RS-485 , 4W, termination resistor
Open	Closed	Open	Open	RS-485 , 4W, No termination resistor
Open	Open	Closed	Closed	RS-485 , 2W, termination resistor
Open	Open	Closed	Open	RS-485 , 2W, No termination resistor
Open	Open	Open	Closed	RS-485 , 4W, termination resistor
Open	Open	Open	Open	RS-485 , 4W, No termination resistor

5.6 Transceivers

Each serial channel of the UART_APPKIT board can be configured to work like RS232, RS485 or RS422 serial port.

To generate the RS232 compliant signals one SP3243 device is used. The SP3243 is a RS232 compliant, 3-driver/5-receiver device. The SP3243 devices feature AUTO ON-LINE® circuitry which reduces the power supply drain to a 1µA supply current. In many portable or hand-held applications, an RS232 cable can be disconnected or a connected peripheral can be turned off. Under these conditions, the internal charge pump and the drivers will be shut down. Otherwise, the system automatically comes online. The following figure summarizes the logic of the AUTO ONLINE® operating modes.

RS-232 Signal at Receiver Input	SHUTDOWN# Input	ONLINE# Output	STATUS# Output	Transceiver Status
YES	HIGH	LOW	HIGH	Normal Operation (Auto-Online)
NO	HIGH	HIGH	LOW	Normal Operation
NO	HIGH	LOW	LOW	Shutdown (Auto-Online)
YES	LOW	HIGH/LOW	HIGH	Shutdown
NO	LOW	HIGH/LOW	LOW	Shutdown

To generate the RS485/RS422 serial signals one MAX3483 device is used. The MAX383 is ±15kV ESD-protected, +3.3V, low-power full duplex transceivers for RS485 and RS422 communications. Each device contains one driver and one receiver that can transmit at up to 12Mbps.

5.7 Power save mode

The UART_APPKIT board provides different configurable features to save power consumption. The following paragraphs describe the power save features.

5.7.1 UART sleep mode

The SC16C754 UART has a sleep mode feature. Sleep mode is entered when:

The serial data input line, RX, is idle

The TX FIFO and TX shift register are empty.

There are no interrupts pending except THR and time-out interrupts.

In sleep mode, the UART clock and baud rate clock are stopped. Since most registers are clocked using these clocks, the power consumption is greatly reduced. The UART will wake up when any change is detected on the RX line, when there is any change in the state of the modem input pins, or if data is written to the TX FIFO.

5.7.2 Serial port enable

Each serial channel of the UART_APPKIT board can be individually enabled or disabled. When a channel is disabled the transceivers are disabled and in low power consumption mode.

To disable a serial port the configuration switch has to be configured in RS232, Auto power down, and the cable of the connector has to be disconnected.

5.7.3 RS232 transceiver AUTO ONLINE®

If a serial port is enabled and in RS232 mode, it can be configured to work in AUTO ONLINE® mode. When configured in this mode the RS232 transceiver will automatically enter in power save mode if the RS232 cable is disconnected or if the connected peripheral is powered off.

6 Memory map

The following table shows the memory map of the UART_APPKIT board.

Chip Select (CS#)	Write Enable (WE#)	A5 – A0	Description
0	x	000000-000111	UART Channel A
0	x	001000-001111	UART Channel B
0	x	010000-010111	UART Channel C
0	x	011000-011111	UART Channel D
0	0	1xxxxx	UART SW Reset

7 Connectors pinout

7.1 Little-Endian Peripheral connector

Pin	Name	Type	Comment
1	GND	Ground	
2	D0	I/O	
3	D1	I/O	
4	D2	I/O	
5	D3	I/O	
6	GND	Ground	
7	D4	I/O	
8	D5	I/O	
9	D6	I/O	
10	D7	I/O	
11	GND	Ground	
12	-	-	
13	-	-	
14	-	-	
15	-	-	
16	GND	Ground	
17	-	-	
18	-	-	
19	-	-	
20	-	-	
21	GND	Ground	
22	-	-	
23	GND	Ground	
24	+3.3V	Power	
25	+3.3V	Power	
26	A0	I	
27	A1	I	
28	A2	I	
29	A3	I	
30	GND	Ground	
31	A4	I	
32	A5	I	
33	-	-	
34	-	-	

Pin	Name	Type	Comment
35	GND	Ground	
36	-	-	
37	-	-	
38	GND	Ground	
39	CS#	I	
40	-	-	
41	IOWR#	I	
42	IORD#	I	
43	-	-	
44	IRQ#	OD	
45	+3.3V	Power	
46	+3.3V	Power	
47	-	-	
48	-	-	
49	-	-	
50	GND	Ground	

7.2 Big-Endian Peripheral connector

Pin	Name	Type	Comment
1	GND	Ground	
2	-		
3	-		
4	-		
5	-		
6	GND	Ground	
7	-		
8	-		
9	-		
10	-		
11	GND	Ground	
12	D0	I/O	
13	D1	I/O	
14	D2	I/O	
15	D3	I/O	
16	GND	Ground	
17	D4	I/O	
18	D5	I/O	

Pin	Name	Type	Comment
19	D6	I/O	
20	D7	I/O	
21	GND	Ground	
22	-	-	
23	GND	Ground	
24	+3.3V	Power	
25	+3.3V	Power	
26	A0	I	
27	A1	I	
28	A2	I	
29	A3	I	
30	GND	Ground	
31	A4	I	
32	A5	I	
33	-	-	
34	-	-	
35	GND	Ground	
36	-	-	
37	-	-	
38	GND	Ground	
39	CS#	I	
40	-	-	
41	IOWR#	I	
42	IORD#	I	
43	-	-	
44	IRQ#	OD	
45	+3.3V	Power	
46	+3.3V	Power	
47	-	-	
48	-	-	
49	-	-	
50	GND	Ground	

7.3 Serial port A

Pin	Name	Type	Comment
1	DCDA_RS232#/CTSA-_RS4xx	I	
2	RXA_RS232/RXA+_RS4xx	I	

Pin	Name	Type	Comment
3	TXA_RS232/TXA+_RS4xx	O	
4	DRTA_RS232#/RTSA-_RS4xx	O	
5	GND	Ground	
6	DSRA_RS232#/RXA-_RS4xx	I	
7	RTSA_RS232#/RTSA+_RS4xx	O	
8	CTSA_RS232#/CTSA+_RS4xx	I	
9	RIA_RS232#/TXA-_RS4xx	I/O	

7.4 TTL port A

Pin	Name	Type	Comment
1	UART_DCDA#	I	
2	UART_DSRA#	I	
3	UART_RXA	I	
4	UART_RTSA#	O	
5	UART_TXA	O	
6	UART_CTSA#	I	
7	UART_DTRA#	O	
8	UART_RIA#	I/O	
9	GND	G	
10	+3.3V	P	

7.5 Serial port B

Pin	Name	Type	Comment
1	DCDB_RS232#/CTSB-_RS4xx	I	
2	RXB_RS232/RXB+_RS4xx	I	
3	TXB_RS232/TXB+_RS4xx	O	
4	DRTB_RS232#/RTSB-_RS4xx	O	
5	GND	Ground	
6	DSRB_RS232#/RXB-_RS4xx	I	
7	RTSB_RS232#/RTSB+_RS4xx	O	
8	CTSB_RS232#/CTSB+_RS4xx	I	
9	RIB_RS232#/TXB-_RS4xx	I/O	

7.6 TTL port B

Pin	Name	Type	Comment
1	UART_DCDB#	I	
2	UART_DSRB#	I	
3	UART_RXB	I	
4	UART_RTSB#	O	
5	UART_TXB	O	
6	UART_CTSB#	I	
7	UART_DTRB#	O	
8	UART_RIB#	I/O	
9	GND	G	
10	+3.3V	P	

7.7 Serial port C

Pin	Name	Type	Comment
1	DCDC_RS232#/CTSC-_RS4xx	I	
2	RXC_RS232/RXC+_RS4xx	I	
3	TXC_RS232/TXC+_RS4xx	O	
4	DRTC_RS232#/RTSC-_RS4xx	O	
5	GND	Ground	
6	DSRC_RS232#/RXC-_RS4xx	I	
7	RTSC_RS232#/RTSC+_RS4xx	O	
8	CTSC_RS232#/CTSC+_RS4xx	I	
9	RIC_RS232#/TXC-_RS4xx	I/O	

7.8 TTL port C

Pin	Name	Type	Comment
1	UART_DCDC#	I	
2	UART_DSRC#	I	
3	UART_RXC	I	
4	UART_RTSC#	O	
5	UART_TXC	O	
6	UART_CTSC#	I	
7	UART_DTRC#	O	
8	UART_RIC#	I/O	
9	GND	G	

Pin	Name	Type	Comment
10	+3.3V	P	

7.9 Serial port D

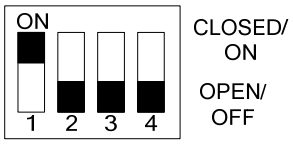
Pin	Name	Type	Comment
1	DCDD_RS232#/CTSD-_RS4xx	I	
2	RXD_RS232/RXD+_RS4xx	I	
3	TXD_RS232/TXD+_RS4xx	O	
4	DRTD_RS232#/RTSD-_RS4xx	O	
5	GND	Ground	
6	DSRD_RS232#/RXD-_RS4xx	I	
7	RTSD_RS232#/RTSD+_RS4xx	O	
8	CTSD_RS232#/CTSD+_RS4xx	I	
9	RID_RS232#/TXD-_RS4xx	I/O	

7.10 TTL port D

Pin	Name	Type	Comment
1	UART_DCDD#	I	
2	UART_DSRD#	I	
3	UART_RXD	I	
4	UART_RTSD#	O	
5	UART_TXD	O	
6	UART_CTSD#	I	
7	UART_DTRD#	O	
8	UART_RID#	I/O	
9	GND	G	
10	+3.3V	P	

8 Factory default configuration

The factory default configuration of the four MEIs is the following:



Switch	Status	Description
1	CLOSED/ON	RS-232 mode
2	OPEN/OFF	Power save mode disabled
3	OPEN/OFF	4W (for RS-485)
4	OPEN/OFF	No termination resistor