MPR - Mote Processor Radio Board

MIB - Mote Interface / Programming Board

User's Manual

MPR500CA, MPR510CA

MPR400CB, MPR410CB

MPR300CA, MPR310CA

MIB300CA, MIB500CA

Rev. A, April 2003

Document 7430-0021-01

Crossbow

Crossbow Technology, Inc., 41 Daggett Dr., San Jose, CA 95134
Tel: 408-965-3300, Fax: 408-324-4840
email: info@xbow.com, website: www.xbow.com

1 Introduction

This User's Manual describes the hardware features of the MICA and MICA2 Motes. It is intended for understanding and leveraging the Mote hardware design in real-world sensor network applications. This User's Manual also describes and explains the Mote Interface Boards (MIB) for base station and programming requirements.

This manual is NOT a software guide to programming the Motes in TinyOS/nesC, nor is it a guide to pre-built software packages that run on top of the Motes. The following resources are available regarding software:

- TinyOS Getting Started Guide by Crossbow
- http://webs.cs.berkeley.edu/tos

Mote Hardware Feature	MICA2 MPR400/410	MICA2DOT MPR500/510	MICA MPR300/310
10-Bit ADC	✓	✓	✓
Digital I/O	✓	✓	✓
UART	✓	✓	
LEDS	3	3	1
AM Radio			✓
FM Tunable Radio	✓	✓	
Base Radio Frequency (Mhz)	916/433	916/433	916/433
Flash Data Logger Memory	✓	✓	✓
Antennae Connector	✓		
3.3V Booster			✓

2 MPR400/MPR410 (MICA2)

The MPR400 (916MHz) and MPR410 (433MHz) Series hardware is Crossbow's latest generation of Mote technology. Both the MPR400 and MPR500 units utilize a powerful Atmega128L micro-controller and a frequency tunable radio with extended range. The MPR400 and MPR500 radios are compatible and can communicate with each other.

2.1 Powering the Mote

The MPR400 is battery powered. The form factor of the MPR400 was designed to match up with two AA batteries; however any battery combination (AAA, C, D cells) can be used provided that the output is between 2.7 – 3.3VDC.

Care should be used in selecting the battery and its capacity to match the energy needs of the Motes and their deployment mission. Also make sure that the temperature range and associated capacity degradation are looked at prior to deployment. The section below provides some useful guidance on how to predict battery life. The spreadsheet can be found at http://www.xbow.comunder the Support section.

SYSTEM SPECIFICATIONS		
Currents		**Example Duty Cycle**
Processor		
current (full operation)	8mA	1
current sleep	8uA	99
Radio		
current in receive	8mA	0.75
current transmit	12mA	0.25
current sleep	2uA	99
Logger Memory		
Write	15mA	0
Read	4mA	0
Sleep	2uA	100
Sensor Board		
current (full operation)	5mA	1
current sleep	5uA	99
Computed mA-hr used each hour		
Processor		0.0879

Radio	0.0920
Logger Memory	0.0020
Sensor Board	0.0550
Total current (mA-hr) used	**0.2369**

Computed battery life vs. battery size

Battery Capacity (mA-hr)	Battery Life (months)
250	1.45
1000	5.78
3000	17.35

WARNING

In most Mote applications, the processor and radio run for a brief period of time, followed by a sleep cycle. During sleep, current consumption is measured in micro amps as opposed to milliamps, and therefore battery life is significantly extended. The result is very low-current draw for the majority of the time, and short duration spikes while processing, receiving, and transmitting data. This method does result in extended battery life; however, due to the current surges, it also reduces specified battery capacity. Battery capacity is generally specified for a nominal current drawn constantly by the manufacturer.

2.2 Radio Antennae Considerations

Care should be taken to provide an antenna that provides proper coverage for the environment expected. Range and performance are strongly affected by choice of antenna and antenna placement within the environment. In addition, care must be taken to ensure compliance with FCC article 15 regulations for intentional radiators. An omni directional antenna such as a quarter wavelength whip should be sufficient to meet most user requirements.

Antenna lengths for quarter wavelength whip antennas:

Unit	Whip Antenna Length(inches)
MPR400 (916 Mhz)	3.2
MPR410(433Mhz)	6.8

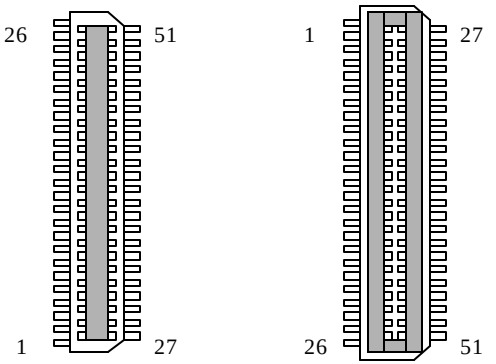
2.3 Data Logger and Other Features

The MICA2 Mote features a 4M-bit serial FLASH for storing data, measurements, and other user-defined information. TinyOS supports a micro file system that runs on top of this FLASH/Logger component. The serial flash device supports over 100,000 Measurement readings. Also on the MICA2 is a 64-bit serial ID chip.

2.4 Expansion Connector

The expansion connector provides a user interface for additional sensor boards. The connector includes interfaces for power and ground, power control of peripheral sensors, ADC inputs for reading sensor outputs, a UART interface, and I2C interface, general purpose digital I/O, and others.

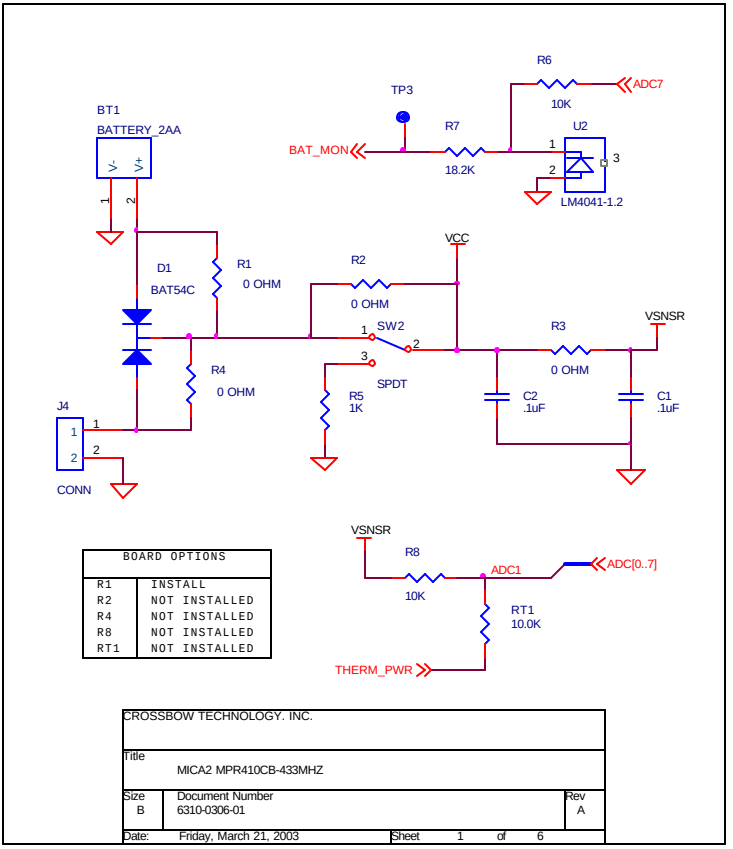
PIN	DESCRIPTION	PIN	DESCRIPTION
1	GND	27	UART_RXD0
2	VSNSR	28	UART_TXD0
3	INT3	29	PW0
4	INT2	30	PW1
5	INT1	31	PW2
6	INT0	32	PW3
7	BAT_MON	33	PW4
8	LED3	34	PW5
9	LED2	35	PW6
10	LED1	36	ADC7
11	RD	37	ADC6
12	WR	38	ADC5
13	ALE	39	ADC4
14	PW7	40	ADC3
15	USART1_CLK	41	ADC2
16	PROG_MOSI	42	ADC1
17	PROG_MISO	43	ADC0
18	SPI_CLK	44	THERM_PWR
19	USART1_RXD	45	THRU1
20	USART1_TXD	46	THRU2
21	I2C_CLK	47	THRU3
22	I2C_DATA	48	RESETN
23	PWM0	49	PWM1B
24	PWM1A	50	VCC
25	AC+	51	GND
26	AC-		

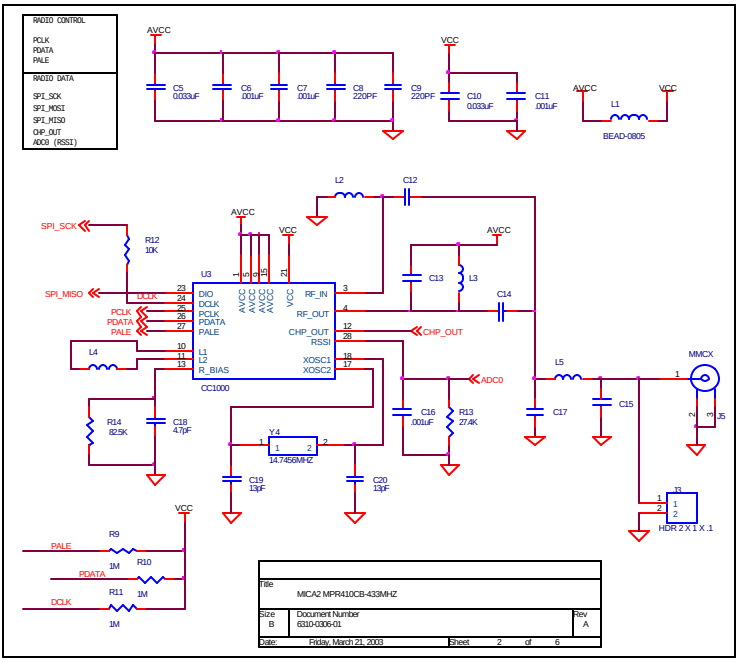


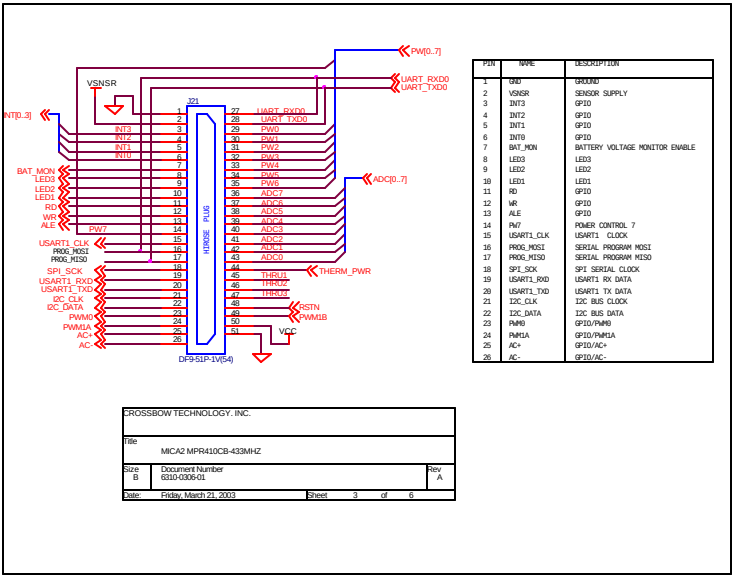
Hirose: DF9-51(S,P)-1V(54)

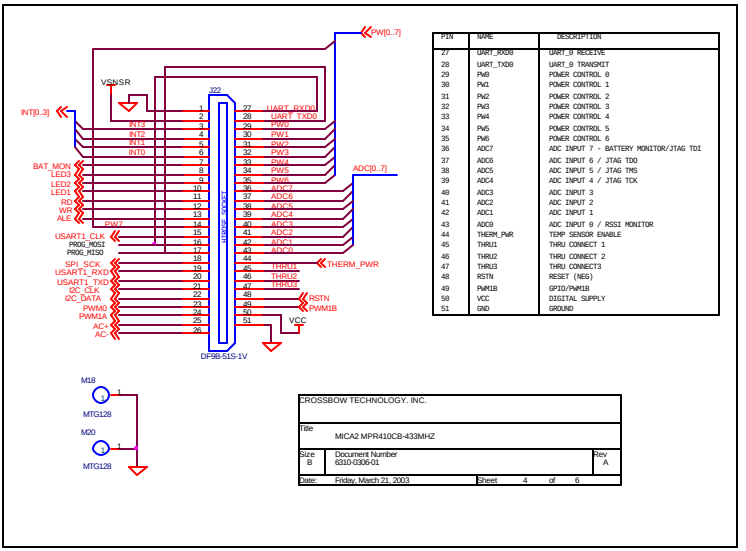
Digikey: H2163-ND, H2175-ND

2.5 Schematics

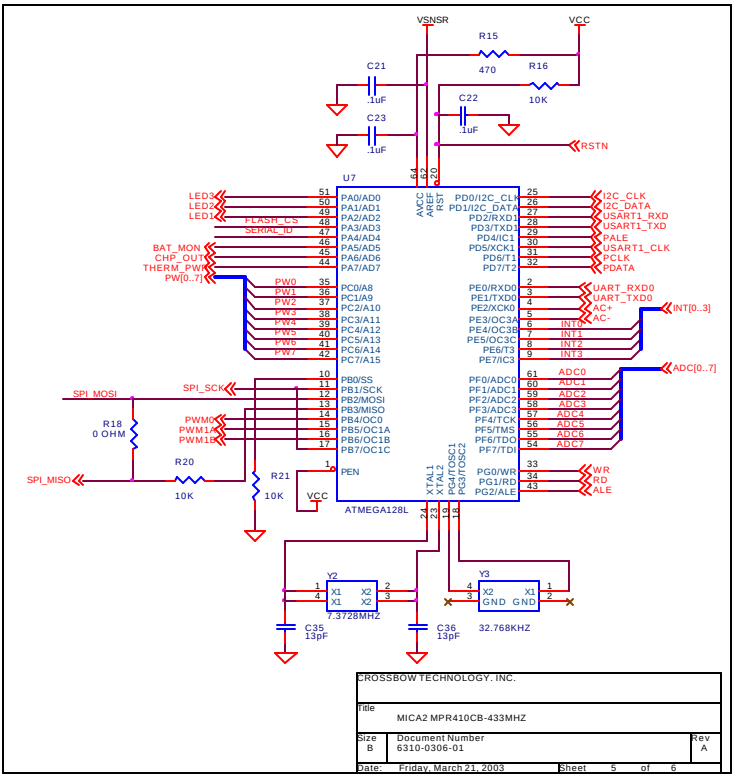


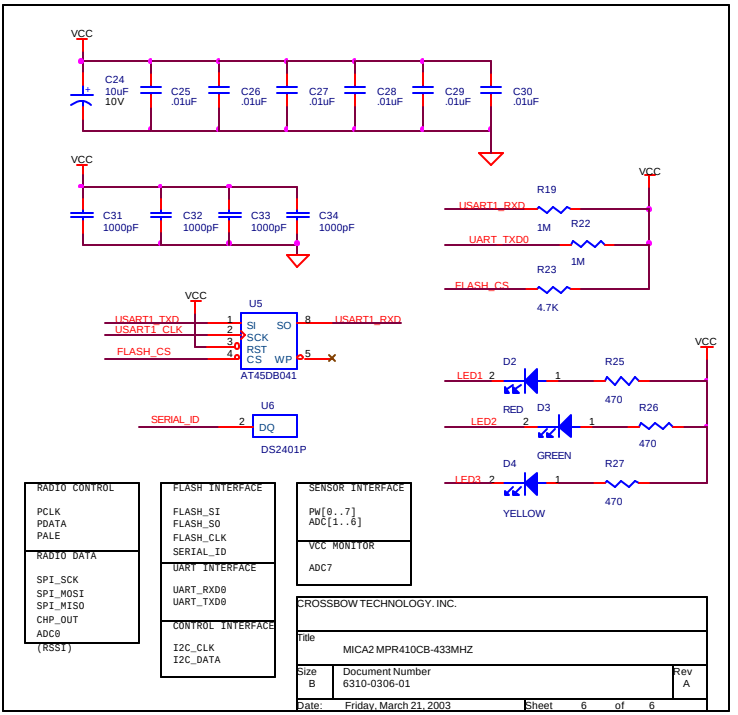

RADIO CONTROL
PCLK
PDATA
PALE
RADIO DATA
SPI_SCK
SPI_MOSI
SPI_MISO
CHP_OUT
ADC0 (RSSI)
AVCC
VCC
C5 0.033uF
C6 .001uF
C7 .001uF
C8 220PF
C9 220PF
C10 0.033uF
C11 .001uF
L1
BEAD-0805
L2
C12
SPI_SCK
R12 10K
SPI_MISO
U3
DIO
DCLK
PCLK
PDATA
PALE
R_BIAS
CC1000
RF_IN
RF_OUT
CHP_OUT
RSSI
XOSC1
XOSC2
C13
L3
C14
L4
L5
MMCX
J5
R14 82.5K
C18 4.7µF
Y4
14.7456MHz
C16 .001uF
R13 27.4K
C17
C15
C19 13pF
C20 13pF
ADC0
R9 1M
R10 1M
R11 1M
PALE
PDATA
DCLK
J3
HDR 2 X 1 X .1
Title
MICA2 MPR410CB-433MHZ
Size B
Document Number 6310-0306-01
Rev A
Date: Friday, March 21, 2003
Sheet 2 of 6


PW[0..7]
UART_RXD0
UART_TXD0
VSNSR
INT[0..3]
J21
INT3
INT2
INT1
INT0
BAT_MON
LED3
LED2
LED1
RD
WR
ALE
PW7
USART1_CLK
PROG_MOSI
PROG_MISO
SPI_SCK
USART1_RXD
USART1_TXD
I2C_CLK
I2C_DATA
PWM0
PWM1A
AC+
AC-
PW0
PW1
PW2
PW3
PW4
PW5
PW6
ADC7
ADC6
ADC5
ADC4
ADC3
ADC2
ADC1
ADC0
ADC[0..7]
THERM_PWR
THRU1
THRU2
THRU3
RSTN
PWM1B
VCC
HIROSE PLUS
DF9-51P-1V(54)
PIN | NAME | DESCRIPTION
1 | GND | GROUND
2 | VSNSR | SENSOR SUPPLY
3 | INT3 | GPIO
4 | INT2 | GPIO
5 | INT1 | GPIO
6 | INT0 | GPIO
7 | BAT_MON | BATTERY VOLTAGE MONITOR ENABLE
8 | LED3 | LED3
9 | LED2 | LED2
10 | LED1 | LED1
11 | RD | GPIO
12 | WR | GPIO
13 | ALE | GPIO
14 | PW7 | POWER CONTROL 7
15 | USART1_CLK | USART1 CLOCK
16 | PROG_MOSI | SERIAL PROGRAM MOSI
17 | PROG_MISO | SERIAL PROGRAM MISO
18 | SPI_SCK | SPI SERIAL CLOCK
19 | USART1_RXD | USART1 RX DATA
20 | USART1_TXD | USART1 TX DATA
21 | I2C_CLK | I2C BUS CLOCK
22 | I2C_DATA | I2C BUS DATA
23 | PWM0 | GPIO/PWM0
24 | PWM1A | GPIO/PWM1A
25 | AC+ | GPIO/AC+
26 | AC- | GPIO/AC-
CROSSBOW TECHNOLOGY, INC.
Title
MICA2 MPR410CB-433MHZ
Size B
Document Number 6310-0306-01
Rev A
Date: Friday, March 21, 2003
Sheet 3 of 6



PIN	NAME	DESCRIPTION
27	UART_RXD0	UART_0 RECEIVE
28	UART_TXD0	UART_0 TRANSMIT
29	PW0	POWER CONTROL 0
30	PW1	POWER CONTROL 1
31	PW2	POWER CONTROL 2
32	PW3	POWER CONTROL 3
33	PW4	POWER CONTROL 4
34	PW5	POWER CONTROL 5
35	PW6	POWER CONTROL 6
36	ADC7	ADC INPUT 7 - BATTERY MONITOR/JTAG TDI
37	ADC6	ADC INPUT 6 / JTAG TDO
38	ADC5	ADC INPUT 5 / JTAG TMS
39	ADC4	ADC INPUT 4 / JTAG TCK
40	ADC3	ADC INPUT 3
41	ADC2	ADC INPUT 2
42	ADC1	ADC INPUT 1
43	ADC0	ADC INPUT 0 / RSSI MONITOR
44	THERM_PWR	TEMP SENSOR ENABLE
45	THRU1	THRU CONNECT 1
46	THRU2	THRU CONNECT 2
47	THRU3	THRU CONNECT3
48	RSTN	RESET (NEG)
49	PWM1B	GPIO/PWM1B
50	VCC	DIGITAL SUPPLY
51	GND	GROUND




VCC
C24
10uF
10V
C25
.01uF
C26
.01uF
C27
.01uF
C28
.01uF
C29
.01uF
C30
.01uF
C31
1000pF
C32
1000pF
C33
1000pF
C34
1000pF
R19
USART1_RXD
1M
R22
UART_TXD0
1M
R23
FLASH_CS
4.7K
U5
USART1_TXD
USART1_CLK
FLASH_CS
SI
SCK
RST
CS
SO
WP
USART1_RXD
AT45DB041
U6
SERIAL_ID
DQ
DS2401P
D2
LED1
R25
470
RED
D3
LED2
R26
470
GREEN
D4
LED3
R27
470
YELLOW
RADIO CONTROL
PCLK
PDATA
PALE
RADIO DATA
SPI_SCK
SPI_MOSI
SPI_MISO
CHP_OUT
ADC0
(RSSI)
FLASH INTERFACE
FLASH_SI
FLASH_SO
FLASH_CLK
SERIAL_ID
UART INTERFACE
UART_RXD0
UART_TXD0
CONTROL INTERFACE
I2C_CLK
I2C_DATA
SENSOR INTERFACE
PW[0..7]
ADC[1..6]
VCC MONITOR
ADC7
CROSSBOW TECHNOLOGY, INC.
Title
MICA2 MPR410CB-433MHZ
Size
B
Document Number
6310-0306-01
Rev
A
Date:
Friday, March 21, 2003
Sheet
6
of
6

3 MPR500/MPR510 (MICA2DOT)

3.1 Powering the Mote

The MPR500 (916MHz) and MPR510 (433MHz) are battery powered. The form factor of the MPR500 was designed to match up with a single coin cell battery; however any battery combination (AAA, C, D cells) can be used provided that the output is between 2.7 – 3.3VDC.

Care should be used in selecting the battery and its capacity to match the energy needs of the Motes and their deployment mission. Also make sure that the temperature range and associated capacity degradation are looked at prior to deployment. The section below provides some useful guidance on how to predict battery life. The spreadsheet can be found at http://www.xbow.comunder the Support section.

3.2 Radio/Antennae

Care should be taken to provide an antenna that provides proper coverage for the environment expected. Range and performance are strongly affected by choice of antenna and antenna placement within the environment. In addition, care must be taken to ensure compliance with FCC article 15 regulations for intentional radiators. Because of its small physical size, the usual antenna chosen is a length of insulated wire one-quarter wavelength long for the frequency of interest (~3.5 inches at 915 MHz, and ~8 inches at 433 MHz).

Antenna lengths for quarter wavelength whip antennas:

Unit	Whip Antenna Length (inches)
MPR400 (916 MHz)	3.2
MPR410 (433MHz)	6.8

3.3 Data Logger

The MICA2DOT Mote features a 4M-bit serial FLASH for storing data, measurements, and other user-defined information. TinyOS supports a micro file system that runs on top of this FLASH/Logger component. The serial flash device supports over 100,000 Measurement readings.

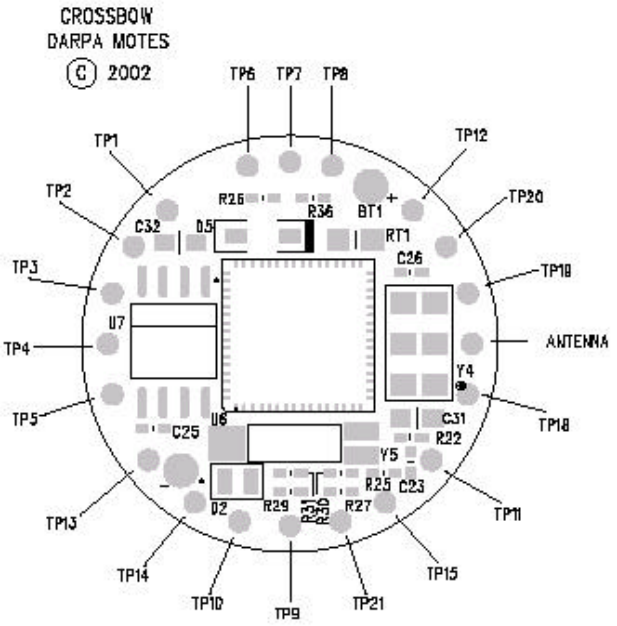
3.4 Expansion Connector

The interface to the MPR500 is through a series of 19 pins spaced around the circumference of the MPR500. They represent a subset of the pins available on the MPR400. They include a set of power control pins, ADC channels, power, ground, some general purpose digital IO, and the serial programming port. For applications with more digital IO, the ADC pins can be reconfigured as Digital Input/Output (but not both!).

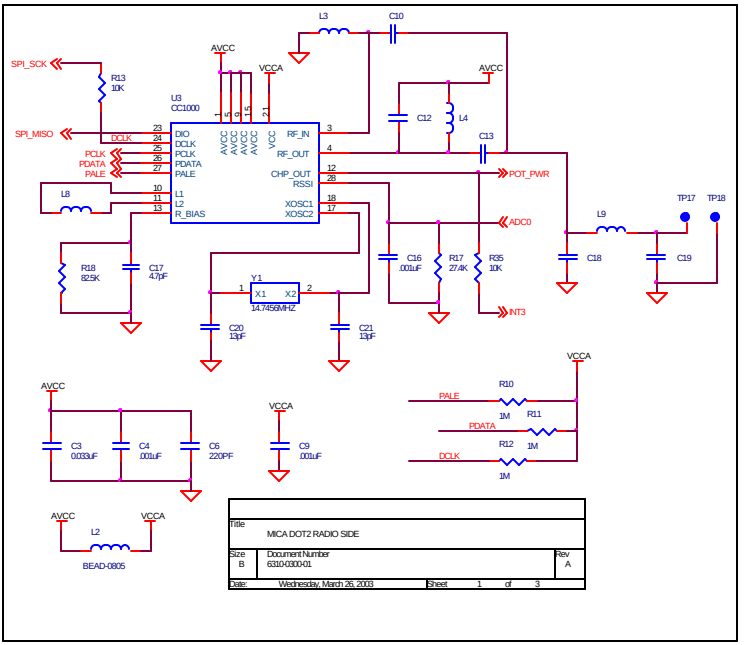
WARNING

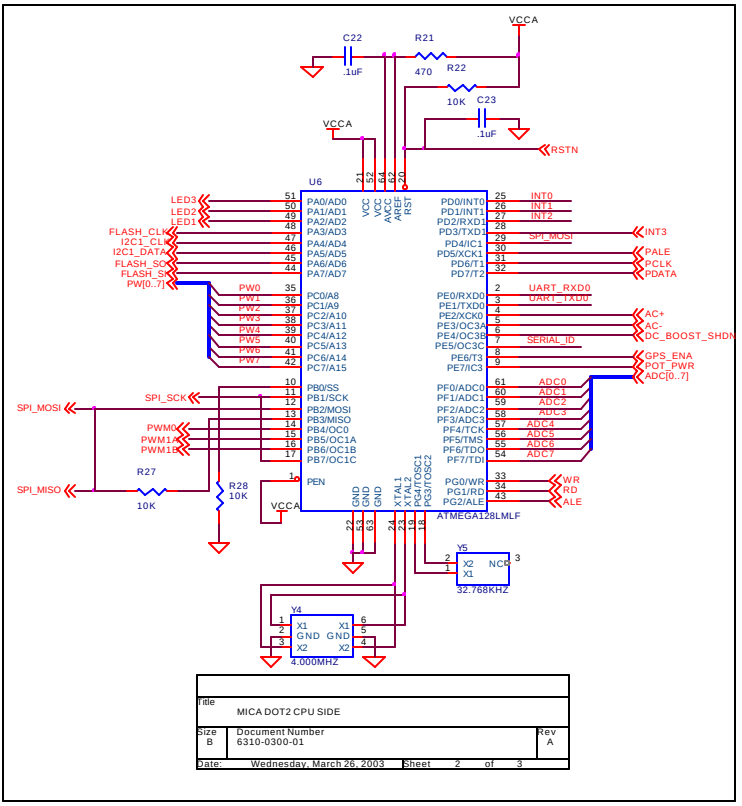
The TP12 SPI_CK Pin is controlled by the Radio. In the majority of applications it should not be used.

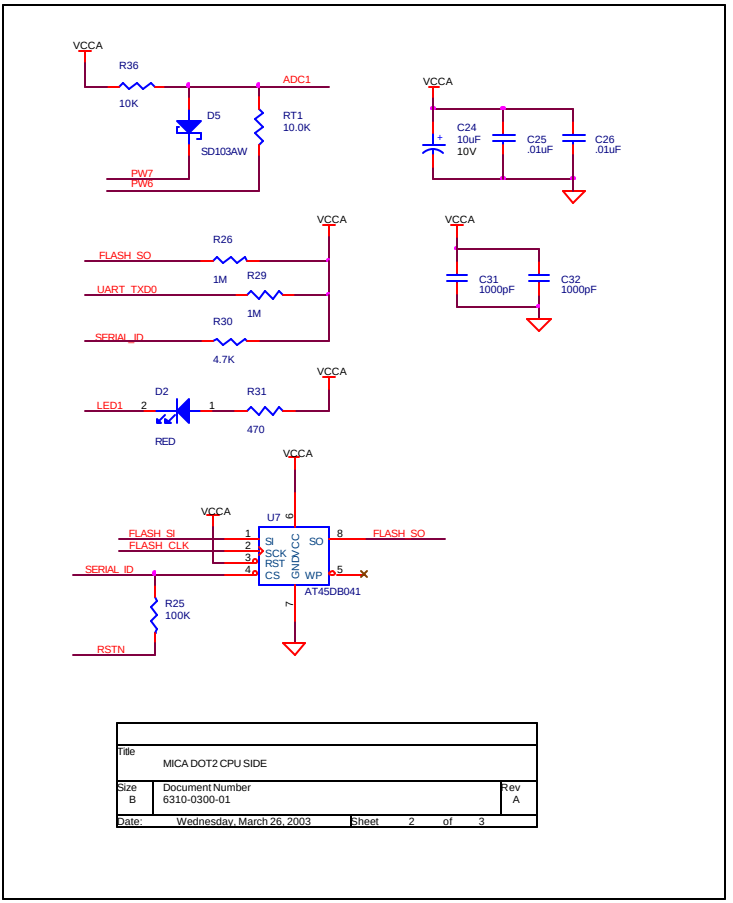
PIN	DESCRIPTION
TP1	GND
TP2	ADC7
TP3	ADC6
TP4	ADC5
TP5	ADC4
TP6	VCC
TP7	PW1
TP8	PW0
TP9	UART_TXD
TP10	UART_RXD
TP11	RESETN
TP12	SPI_CK
TP13	ADC3
TP14	ADC2
TP15	PWM1B
TP18	GND
TP19	INT1
TP20	INT0
TP21	THERM_PWR

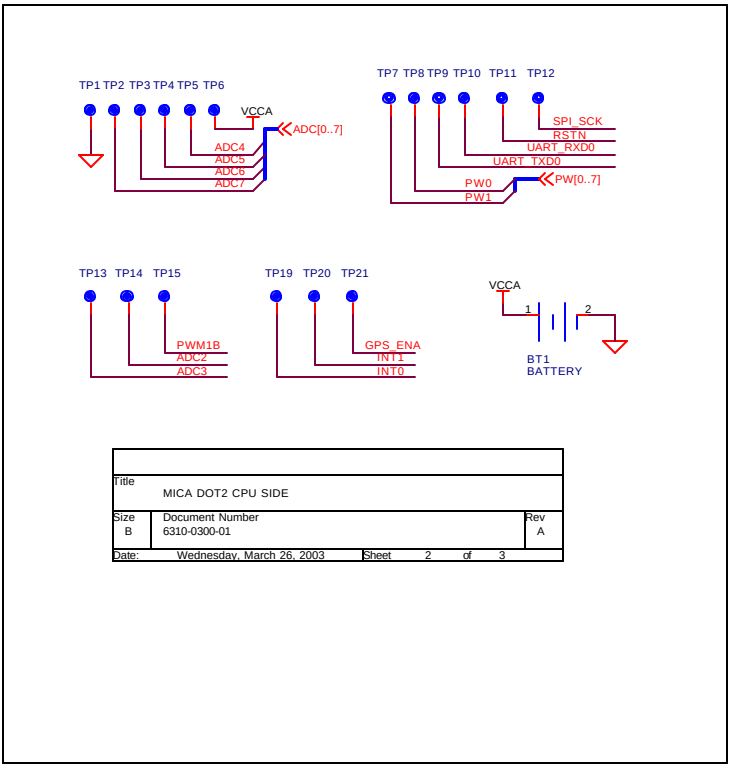

CROSSBOW
DARPA MOTES
© 2002
TP6
TP7
TP8
TP1
TP12
TP2
TP20
R26
R36
BT1
C32
D5
RT1
C26
TP3
TP19
U7
TP4
ANTENNA
Y4
TP5
TP18
C25
U6
C31
R22
Y5
R25
C23
TP13
D2
R29
R31
R30
R27
TP11
TP14
TP15
TP10
TP9
TP21

3.5 Schematics




VCCA
C22
.1uF
R21
470
R22
10K
C23
.1uF
VCCA
RSTN
U6
LED3
LED2
LED1
FLASH_CLK
I2C1_CLK
I2C1_DATA
FLASH_SO
FLASH_SI
PW[0..7]
PW0
PW1
PW2
PW3
PW4
PW5
PW6
PW7
PA0/AD0
PA1/AD1
PA2/AD2
PA3/AD3
PA4/AD4
PA5/AD5
PA6/AD6
PA7/AD7
PC0/A8
PC1/A9
PC2/A10
PC3/A11
PC4/A12
PC5/A13
PC6/A14
PC7/A15
PD0/INT0
PD1/INT1
PD2/RXD1
PD3/TXD1
PD4/IC1
PD5/XCK1
PD6/T1
PD7/T2
PE0/RXD0
PE1/TXD0
PE2/XCK0
PE3/OC3A
PE4/OC3B
PE5/OC3C
PE6/T3
PE7/IC3
INT0
INT1
INT2
SPI_MOSI
INT3
PALE
PCLK
PDATA
UART_RXD0
UART_TXD0
AC+
AC-
DC_BOOST_SHDN
SERIAL_ID
GPS_ENA
POT_PWR
ADC[0..7]
SPI_MOSI
SPI_SCK
SPI_MISO
PWM0
PWM1A
PWM1B
PB0/SS
PB1/SCK
PB2/MOSI
PB3/MISO
PB4/OC0
PB5/OC1A
PB6/OC1B
PB7/OC1C
PF0/ADC0
PF1/ADC1
PF2/ADC2
PF3/ADC3
PF4/TCK
PF5/TMS
PF6/TDO
PF7/TDI
ADC0
ADC1
ADC2
ADC3
ADC4
ADC5
ADC6
ADC7
R27
10K
R28
10K
VCCA
PEN
PG0/WR
PG1/RD
PG2/ALE
WR
RD
ALE
ATMEGA128LMLF
Y5
32.768KHZ
Y4
4.000MHZ
Title
MICA DOT2 CPU SIDE
Size B
Document Number 6310-0300-01
Rev A
Date: Wednesday, March 26, 2003
Sheet 2 of 3


VCCA
R36
10K
ADC1
D5
SD103AW
RT1
10.0K
PW7
PW6
C24
10uF
10V
C25
.01uF
C26
.01uF
R26
1M
FLASH_SO
R29
1M
UART_TXD0
R30
4.7K
SERIAL_ID
C31
1000pF
C32
1000pF
D2
LED1
R31
470
RED
U7
FLASH_SI
FLASH_CLK
SERIAL_ID
SI
SCK
RST
CS
GND
VCC
SO
WP
AT45DB041
R25
100K
RSTN
Title
MICA DOT2 CPU SIDE
Size
B
Document Number
6310-0300-01
Rev
A
Date:
Wednesday, March 26, 2003
Sheet
2
of
3


TP1 TP2 TP3 TP4 TP5 TP6
VCCA
ADC[0..7]
ADC4
ADC5
ADC6
ADC7
TP7 TP8 TP9 TP10 TP11 TP12
SPI_SCK
RSTN
UART_RXD0
UART_TXD0
PW0
PW1
PW[0..7]
TP13 TP14 TP15
PWM1B
ADC2
ADC3
TP19 TP20 TP21
GPS_ENA
INT1
INT0
VCCA
1
2
BT1
BATTERY
Title
MICA DOT2 CPU SIDE
Size
B
Document Number
6310-0300-01
Rev
A
Date:
Wednesday, March 26, 2003
Sheet
2
of
3

4 MPR300/MPR310 (MICA)

4.1 Powering the Mote

The MPR300/MPR310 is battery powered. The form factor of the MPR300 was designed to match up with two AA batteries; however any battery combination (AAA, C, D cells) can be used provided that the output is between 2.7 – 3.3VDC.

Care should be used in selecting the battery and its capacity to match the energy needs of the Motes and their deployment mission. Also make sure that the temperature range and associated capacity degradation are looked at prior to deployment. The section below provides some useful guidance on how to predict battery life. The spreadsheet can be found at http://www.xbow.comunder the Support section.

4.2 Radio/Antennae

Care should be taken to provide an antenna that provides proper coverage for the environment expected. Range and performance are strongly affected by choice of antenna and antenna placement within the environment. In addition, care must be taken to ensure compliance with FCC article 15 regulations for intentional radiators. Because of its small physical size, the usual antenna chosen is a length of insulated wire one-quarter wavelength long for the frequency of interest (~3.5 inches at 915 MHz, and ~8 inches at 433 MHz).

4.3 Data Logger

The MICA Mote features a 4M-bit serial FLASH for storing data, measurements, and other user-defined information. TinyOS supports a micro file system that runs on top of this FLASH/Logger component. The serial flash device supports over 100,000 Measurement readings. Also on the MICA is a 64-bit serial ID chip.

4.4 Expansion Connector

The expansion connector provides a user interface for additional sensor boards. The connector includes interfaces for power and ground, power control of peripheral sensors, ADC inputs for reading sensor outputs, a UART interface, and I2C interface, general purpose digital I/O, and others.

PIN	DESCRIPTION	PIN	DESCRIPTION
1	GND	27	UART_RXD0
2	VDD_ANALOG	28	UART_TXD0
3	INT3	29	PW0
4	INT2	30	PW1
5	INT1	31	PW2
6	INT0	32	PW3
7	DC_BOOST_SHDN	33	PW4
8	LED3	34	PW5
9	LED2	35	PW6
10	LED1	36	ADC7
11	RD	37	ADC6
12	WR	38	ADC5
13	ALE	39	ADC4
14	PW7	40	ADC3
15	FLASH_CLK	41	ADC2
16	UART_RXD0	42	ADC1
17	UART_TXD0	43	ADC0
18	SPI_CLK	44	LITTLE_GUY_RST
19	FLASH_SO	45	LITTLE_GUY_SPI_CLK
20	FLASH_SI	46	LITTLE_GUY_MISO
21	I2C_BUS1_CLK	47	UART_RXD0
22	I2C_BUS1_DATA	48	RESET
23	PWM0	49	PWM1B
24	PWM1A	50	VCC
25	AC+	51	GND
26	AC-		

4.5 Schematics

Schematics for this Mote design are found at:

http://today.cs.berkeley.edu/tos/hardware/hardware.html

5 MIB300 / MIB500 Interface Boards

5.1 Programming the Mote

The MIB300/MIB500 interface boards are multi-purpose interface boards used in conjunction with the MICA Family of products. They supply power to the devices through an external power adapter option, and provide interfaces for an RS232 serial port and reprogramming port (using the parallel printer interface). The MIB300 can only be used with an external 3V supply, or it can take advantage of the battery power supplied from the mote.

The MIB500 has an on-board regulator that will accept 5 to 15 VDC, and supply a regulated 3V to the MICA. The MIB500 is delivered with a wall power supply. It also has a monitor LEDs that mirror the LEDs on the MICA.

There is a built-in low voltage monitor that disables reprogramming if the power supply voltage is dangerously low. When the proper programming voltage exists – the Green LED adjacent the parallel port is lit – D6. If the voltage goes below 2.95V, the Green LED D6 will turn off, programming is disabled. See Warning on Programming Motes.

The MIB500 also has an interface connector for reprogramming the MICA2DOT.

Programming the mote is accomplished by connecting the MIB300/MIB500 to the parallel port of the computer, and executing the required programming software – UISP - supplied with the TinyOS install.

WARNING

When programming a MICA2 with the MIB500, turn off the battery switch. For a MICA2DOT, remove the battery before inserting into the MIB500. The MICA2s and MICA2DOTs do not have switching diodes to switch between external and battery power.

WARNING

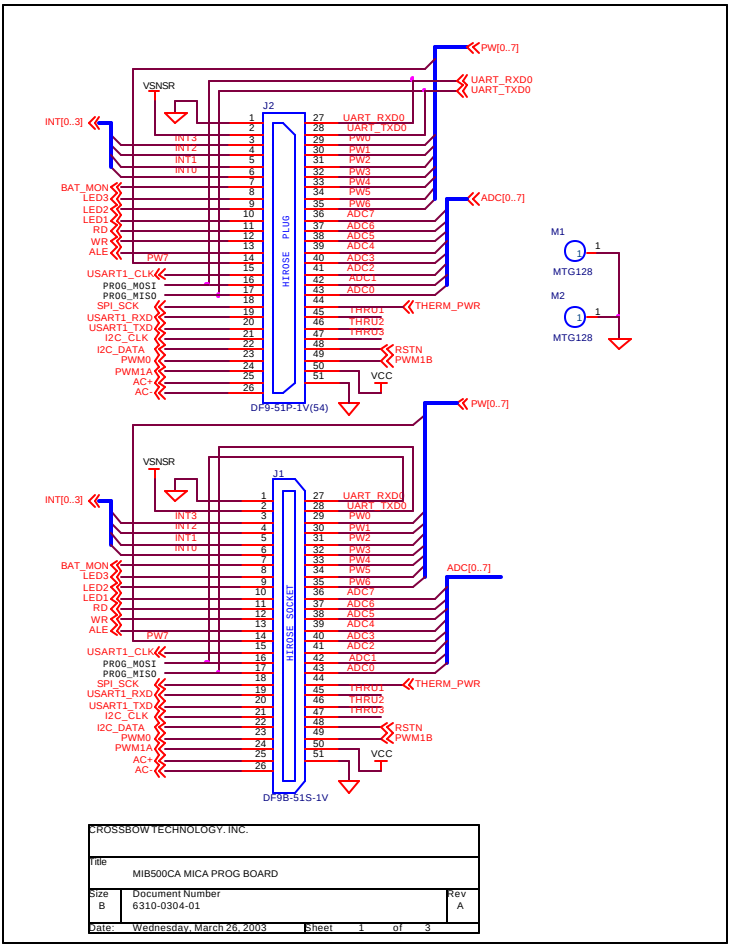
There have been numerous reported difficulties with programming Motes. These include program failure, flash verification errors, and dead Motes. The root cause of these problems is almost always one of two issues – low

programming voltage or UISP problems on the Host PC. A detailed application note is posted at http://www.xbow.com under Support. Please review this application note, if you have trouble programming. Programming the Motes improperly or with a bad UISP install can result in permanent damage to the Mote CPU.

5.2 RS-232 Interface

The RS232 interface is a standard single channel bi-directional interface with a DB9 connector to interface to an external computer. It uses transmit and receive lines only.

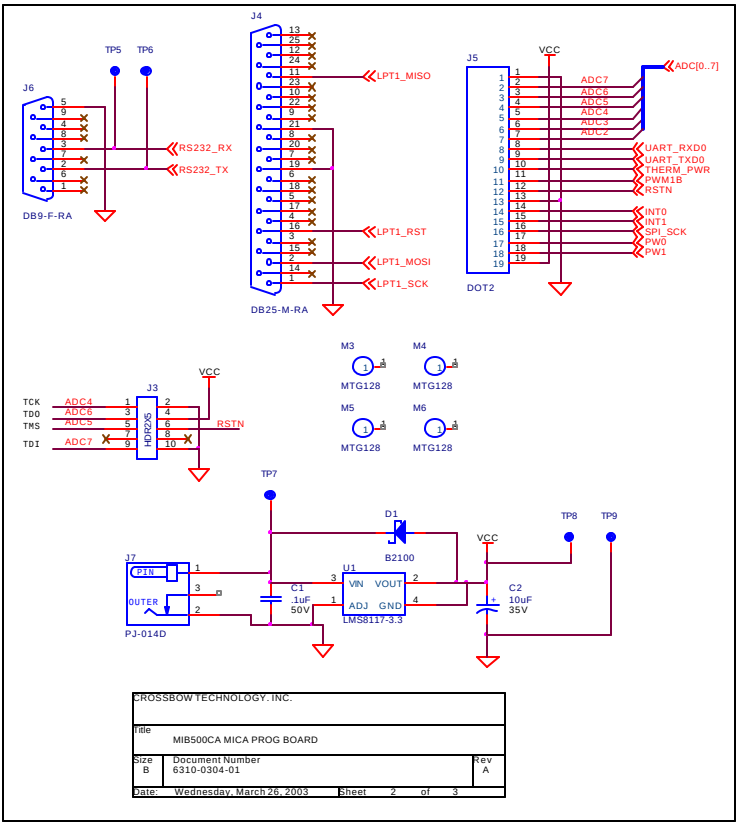
5.3 Schematics

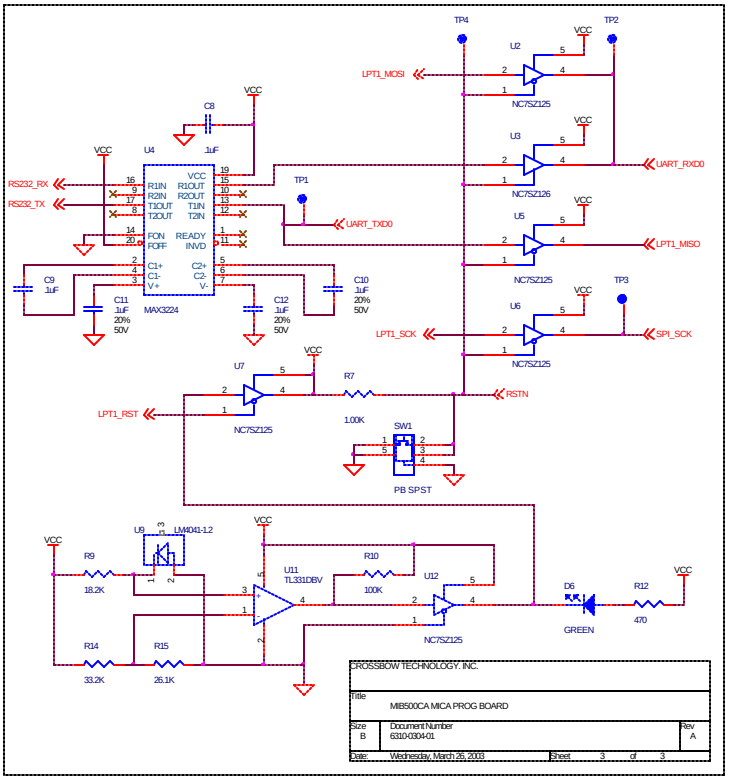


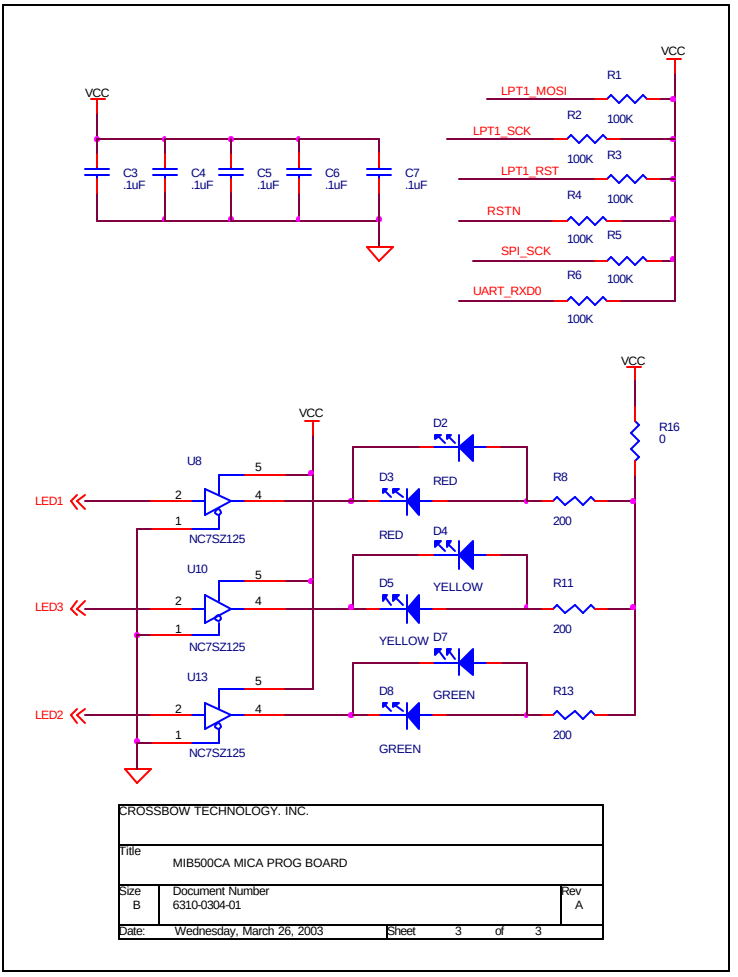
PIN	NAME	DESCRIPTION
1	GND	GROUND
2	VSNSR	SENSOR SUPPLY
3	INT3	GPIO
4	INT2	GPIO
5	INT1	GPIO
6	INT0	GPIO
7	BAT_MON	BATTERY VOLTAGE MONITOR ENABLE
8	LED3	LED3
9	LED2	LED2
10	LED1	LED1
11	RD	GPIO
12	WR	GPIO
13	ALE	GPIO
14	PW7	POWER CONTROL 7
15	USART1_CLK	USART1 CLOCK
16	PROG_MOSI	SERIAL PROGRAM MOSI
17	PROG_MISO	SERIAL PROGRAM MISO
18	SPI_SCK	SPI SERIAL CLOCK
19	USART1_RXD	USART1 RX DATA
20	USART1_TXD	USART1 TX DATA
21	I2C_CLK	I2C BUS CLOCK
22	I2C_DATA	I2C BUS DATA
23	PWM0	GPIO/PWM0
24	PWM1A	GPIO/PWM1A
25	AC+	GPIO/AC+
26	AC-	GPIO/AC-

PIN	NAME	DESCRIPTION
27	UART_RXD0	UART_0 RECEIVE
28	UART_TXD0	UART_0 TRANSMIT
29	PW0	POWER CONTROL 0
30	PW1	POWER CONTROL 1
31	PW2	POWER CONTROL 2
32	PW3	POWER CONTROL 3
33	PW4	POWER CONTROL 4
34	PW5	POWER CONTROL 5
35	PW6	POWER CONTROL 6
36	ADC7	ADC INPUT 7 - BATTERY MONITOR/JTAG TDI
37	ADC6	ADC INPUT 6 / JTAG TDO
38	ADC5	ADC INPUT 5 / JTAG TMS
39	ADC4	ADC INPUT 4 / JTAG TCK
40	ADC3	ADC INPUT 3
41	ADC2	ADC INPUT 2
42	ADC1	ADC INPUT 1
43	ADC0	ADC INPUT 0 / RSSI MONITOR
44	THERM_PWR	TEMP SENSOR ENABLE
45	THRU1	THRU CONNECT 1
46	THRU2	THRU CONNECT 2
47	THRU3	THRU CONNECT3
48	RSTN	RESET (NEG)
49	PWM1B	GPIO/PWM1B
50	VCC	DIGITAL SUPPLY
51	GND	GROUND

CROSSBOW TECHNOLOGY. INC.		
Title: MIB500CA MICA PROG BOARD		
Size: B	Document Number: 6310-0304-01	Rev: A
Date: Wednesday, March 26, 2003	Sheet 1 of 3	


J4
TP5
TP6
J6
LPT1_MISO
RS232_RX
RS232_TX
DB9-F-RA
LPT1_RST
LPT1_MOSI
LPT1_SCK
DB25-M-RA
J5
VCC
ADC[0..7]
ADC7
ADC6
ADC5
ADC4
ADC3
ADC2
UART_RXD0
UART_TXD0
THERM_PWR
PWM1B
RSTN
INT0
INT1
SPI_SCK
PW0
PW1
DOT2
M3
M4
M5
M6
MTG128
MTG128
MTG128
MTG128
J3
VCC
TCK
TDO
TMS
TDI
ADC4
ADC6
ADC5
ADC7
HDR2X5
RSTN
TP7
D1
B2100
TP8
TP9
VCC
J7
PIN
OUTER
PJ-014D
C1
1uF
50V
U1
VIN
VOUT
ADJ
GND
LMS8117-3.3
C2
10uF
35V
CROSSBOW TECHNOLOGY, INC.
Title
MIB500CA MICA PROG BOARD
Size
B
Document Number
6310-0304-01
Rev
A
Date:
Wednesday, March 26, 2003
Sheet
2
of
3


TP4
TP2
VCC
U2
LPT1_MOSI
NC7SZ125
C8
1uF
U3
UART_RXD0
NC7SZ126
U4
RS232_RX
RS232_TX
R1IN
R2IN
T1OUT
T2OUT
VCC
R1OUT
R2OUT
T1IN
T2IN
FON
FOFF
READY
INVD
C1+
C1-
V+
C2+
C2-
V-
MAX3224
TP1
UART_TXD0
U5
LPT1_MISO
C9
1uF
C10
1uF
20%
50V
C11
1uF
20%
50V
C12
1uF
20%
50V
TP3
U6
LPT1_SCK
SPI_SCK
U7
R7
LPT1_RST
RSTN
1.00K
SW1
PB SPST
U9
LM4041-1.2
R9
18.2K
U11
TL331DBV
R10
100K
U12
D6
GREEN
R12
470
R14
33.2K
R15
26.1K
CROSSBOW TECHNOLOGY, INC.
Title
MIB500CA MICA PROG BOARD
Size
B
Document Number
6310-0004-01
Rev
A
Date:
Wednesday, March 26, 2003
Sheet
3
of
3


VCC
C3 .1uF
C4 .1uF
C5 .1uF
C6 .1uF
C7 .1uF
R1
LPT1_MOSI
100K
R2
LPT1_SCK
100K
R3
LPT1_RST
100K
R4
RSTN
100K
R5
SPI_SCK
100K
R6
UART_RXD0
100K
U8
U10
U13
NC7SZ125
LED1
LED3
LED2
D2
D3
RED
D4
D5
YELLOW
D7
D8
GREEN
R8
R11
R13
200
R16
0
CROSSBOW TECHNOLOGY. INC.
Title
MIB500CA MICA PROG BOARD
Size
B
Document Number
6310-0304-01
Rev
A
Date:
Wednesday, March 26, 2003
Sheet
3
of
3

6 Warranty and Support Information

6.1 Customer Service

As a Crossbow Technology customer you have access to product support services, which include:

- Single-point return service
- Web-based support service
- Same day troubleshooting assistance
- Worldwide Crossbow representation
- Onsite and factory training available
- Preventative maintenance and repair programs
- Installation assistance available

6.2 Contact Directory

United States:	Phone:	1-408-965-3300 (7 AM to 7 PM PST)
	Fax:	1-408-324-4840 (24 hours)
	Email:	techsupport@xbow.com
Non-U.S.:	refer to website	www.xbow.com

6.3 Return Procedure

6.3.1 Authorization

Before returning any equipment, please contact Crossbow to obtain a Returned Material Authorization number (RMA).

Be ready to provide the following information when requesting a RMA:

- Name
- Address
- Telephone, Fax, Email
- Equipment Model Number
- Equipment Serial Number
- Installation Date
- Failure Date
- Fault Description

6.3.2 Identification and Protection

If the equipment is to be shipped to Crossbow for service or repair, please attach a tag TO THE EQUIPMENT, as well as the shipping container(s), identifying the owner. Also indicate the service or repair required, the problems encountered, and other information considered valuable to the service facility such as the list of information provided to request the RMA number.

Place the equipment in the original shipping container(s), making sure there is adequate packing around all sides of the equipment. If the original shipping containers were discarded, use heavy boxes with adequate padding and protection.

6.3.3 Sealing the Container

Seal the shipping container(s) with heavy tape or metal bands strong enough to handle the weight of the equipment and the container.

6.3.4 Marking

Please write the words, "***FRAGILE, DELICATE INSTRUMENT***" in several places on the outside of the shipping container(s). In all correspondence, please refer to the equipment by the model number, the serial number, and the RMA number.

6.3.5 Return Shipping Address

Use the following address for all returned products:

Crossbow Technology, Inc.
41 Daggett Drive
San Jose, CA 95134
Attn: RMA Number (XXXXXX)

6.4 Warranty

The Crossbow product warranty is one year from date of shipment.

Crossbow Technology, Inc.
41 Daggett Drive
San Jose, CA 95134
Phone: 408.965.3300
Fax: 408.324.4840
Email: info@xbow.com
Website: www.xbow.com