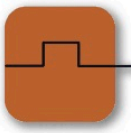
MX Educational Target

User Manual

Revision History

Date	Description
2011-03-29	Initial release.



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1. Introduction

Thank you for purchasing the MX Educational Target. This module, when combined with a member of the MX Module Series, provides a powerful, low-cost, development environment. This environment is equally useful to beginners just starting out or to professionals who require a rapid prototyping environment.

The MX Module series is a family of compact (65x50mm), robust, pre-engineered modules. A complete rapid prototyping environment is easily obtained when considering the off-the-shelf targets available from Stratford Digital and the pre-verified application stub projects.

These modules are pre-engineered to be ready to insert into your end application. Unlike most rapid prototyping system, engineering details like ESD, signal and power integrity, and minimal power consumption are already designed in.

Each module in the MX Series conforms to this specification to allow for maximum inter-changing between the modules. The mating board (called a target) will be able to accept any module that conforms to this specification. This allows for the ability to scale processing power, high-speed connectivity solutions, and memory resources by simply switching out the module in the end application.

1.1. Module Models

The MX Educational Target comes in two different variations.

MX-TARGET-EDU	MX Educational Target with basic population items
MX-TARGET-EDU-FULL	MX Educational Target with all items populated

Table 1 :: MX-TARGET-EDU Model Options

Figure 1 (below) indicates the items that are only populated on the full model.

1.2. Package Contents

The MX Educational Target will be shipped with the following items:

- MX Educational Target (p/n MX-TARGET-EDU or MX-TARGET-EDU-FULL)
- Warranty Certificate and Support Contact Information Sheet

1.3. Key Hardware Features

The MX Educational Target includes these key features as indicated in Figure 1 (below):

1. Analog Input Screw Terminal*
2. Status LED's
3. Buttons
4. RS232 Channel 1
5. UART 1/2 Data Signal Screw Terminal*
6. RS232 Channel 2
7. RS232 1/2 Configuration Jumpers
8. I2C Bus Channel 1 Expansion Connector
9. I2C Bus Channel 2 Expansion Connector*
10. Module ID
11. SPI Bus Expansion Connector
12. RS232 Channel 3*
13. UART 3/4 Data Signal Screw Terminal*
14. RS232 3/4 Configuration Jumpers*
15. RS232 Channel 4*
16. Input Power Connector
17. Input Current Sense Jumper
18. MX Module Socket
19. JTAG Connector*
20. CAN Bus Expansion Connector*
21. Reset Button
22. Breadboard Area

* Only populated on MX-TARGET-EDU-FULL

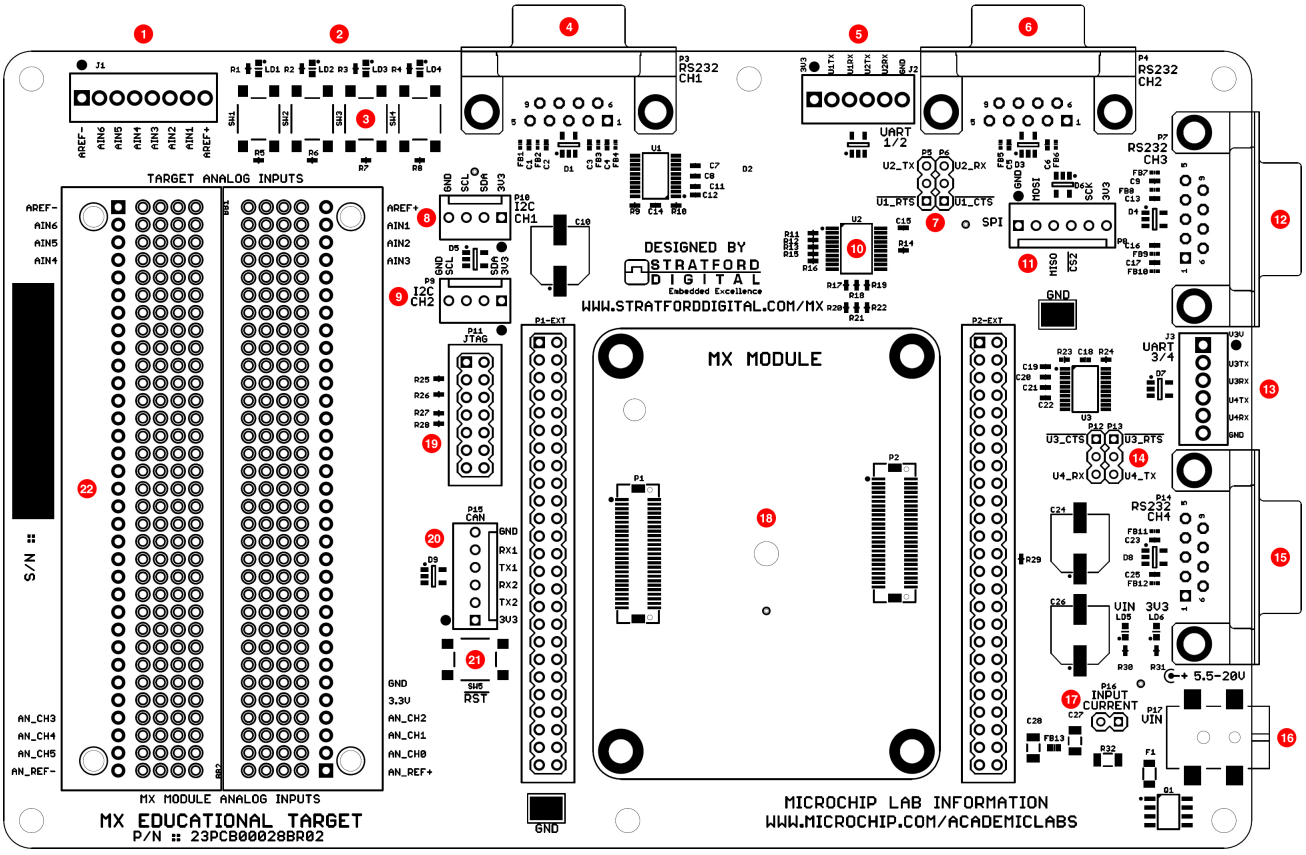

Figure 1 :: MX Educational Target Features

2. Hardware Features

This section describes the key hardware features of this board as illustrated in Figure 1 (above).

2.1. Analog Input Screw Terminal

A screw terminal connector (J1) is available to bring external signals into the analog breadboard area. These connector pins are hardwired to specific rows of the breadboard as indicated on the silk screen of the PCB.

Note: Although the signals in the breadboard area are primarily intended for analog inputs many of the microcontrollers on the MX modules can configure the associated pins as digital I/O. As a result, digital signals can be routed through the breadboard area in certain circumstances.

J1 Pin	Signal
1	AREF+
2	AIN1
3	AIN2
4	AIN3
5	AIN4
6	AIN5
7	AIN6
8	AREF-

Table 2 :: Analog Screw Terminal Pinout

2.2. Status LED's

These LED's are connected to directly to the DIG3..DIG0 pins of the MX Interface. Table 3 (below) describes the connection of these status LED's.

LED	Signal	Color
LD1	DIG3	Green
LD2	DIG2	Green
LD3	DIG1	Green
LD4	DIG0	Green

Table 3 :: Status LED Connections

2.3. Buttons

These momentary switches are connected to signals DIG4..DIG7 of the MX Interface. These signals are pulled up to 3.3V and when engaged the buttons will pull the signal to GND.

Table 4 (below) describes the connection of these buttons.

LED	Signal
SW1	DIG7
SW2	DIG6
SW3	DIG5
SW4	DIG4

Table 4 :: Button Connections

2.4. RS232 Channel 1

This DB9 connector (P3) is wired as a standard RS232 DTE port. Section 2.7 (below) describes how to configure this port to use hardware handshaking signals.

Use a standard DB9 Female-Female NULL Modem RS232 Cable to connect to a PC or other DTE port.

2.5. UART 1/2 Data Signal Screw Terminal

This port (J2) allows for convenient connection to external embedded systems that use data-level UART signaling. For maximum flexibility this port can also provide power to the external circuit.

Table 5 (below) describes the pinout of this connector.

J2 Pin	Signal
1	3.3V
2	U1_TX
3	U1_RX
4	nU1_RTS/U2_TX
5	nU1_CTS/U2_RX
6	GND

Table 5 :: UART 1/2 Data Signal Screw Terminal Pinout

2.6. RS232 Channel 2

This DB9 connector (P4) is wired as a standard RS232 DTE port. Section 2.7 (below) describes how to configure this port. If hardware handshaking is used on RS232 Channel 1 then this port cannot be used.

Use a standard DB9 Female-Female NULL Modem RS232 Cable to connect to a PC or other DTE port.

2.7. RS232 1/2 Configuration Jumpers

Jumpers on P5 and P6 configure the RS232 Channels 1 and 2. Channel 1 handshaking and Channel 2 data signals are multiplexed so only one can be chosen. Table 6 and Table 7 (below) describe the configuration options.

P5 Jumper Position	Signal
1-2	nU1_RTS
2-3	U2_TX

Table 6 :: P5 Jumper Position

P6 Jumper Position	Signal
1-2	nU1_CTS
2-3	U2_RX

Table 7 :: P6 Jumper Position

2.8. I2C Bus Channel 1 Expansion Connector

This port (P10) allows for convenient connection to communicate with external embedded systems that use the I2C communication protocol. For maximum flexibility this port can also provide power to the external circuit.

Table 8 (below) describes the pinout of this connector.

P10 Pin	Signal
1	3.3V
2	SDA
3	SCL
4	GND

Table 8 :: I2C Bus Channel 1 Expansion Connector Pinout

2.9. I2C Bus Channel 2 Expansion Connector

This port (P9) allows for convenient connection to communicate with external embedded systems that use the I2C communication protocol. For maximum flexibility this port can also provide power to the external circuit.

Table 9 (below) describes the pinout of this connector.

P9 Pin	Signal
1	3.3V
2	SDA
3	SCL
4	GND

Table 9 :: I2C Bus Channel 2 Expansion Connector Pinout

2.10. Module ID

This target board contains an I/O expander chip (Microchip MCP23S08) that allows the module microcontroller to dynamically query the target board ID and revision via the SPI bus. This allows for the module application code to be able to modify the program flow based on the exact target that is used. This can address bug fixes or functional improvements in the system over time while maintaining one microcontroller image.

The target board ID is fixed as "10000". Custom targets should modify that value so the module application can distinguish between different targets that may be connected.

The target board revision is "000" when sent from the factory. If the target is modified Table 10 (below) shows the revision resistor configuration required to allow the microcontroller to be able to distinguish between revisions.

Note: DNP means **D**o **N**ot **P**opulate.

Revision	R20	R17	R21	R18	R22	R19
000	DNP	1K	DNP	1K	DNP	1K
001	DNP	1K	DNP	1K	10K	DNP
010	DNP	1K	10K	DNP	DNP	1K
011	DNP	1K	10K	DNP	10K	DNP
100	10K	DNP	DNP	1K	DNP	1K
101	10K	DNP	DNP	1K	10K	DNP
110	10K	DNP	10K	DNP	DNP	1K
111	10K	DNP	10K	DNP	10K	DNP

Table 10 :: Target Revision Resistor Configuration

2.11. SPI Bus Expansion Connector

This port (P8) allows for convenient connection to communicate with external embedded systems that use a SPI communication protocol. For maximum flexibility this port can also provide power to the external circuit.

Table 11 (below) describes the pinout of this connector.

P8 Pin	Signal
1	3.3V
2	SPI_SCK
3	nSPI_CS2
4	SPI_MISO
5	SPI_MOSI
6	GND

Table 11 :: SPI Bus Expansion Connector Pinout

2.12. RS232 Channel 3

This DB9 connector (P7) is wired as a standard RS232 DTE port. Section 2.14 (below) describes how to configure this port.

Use a standard DB9 Female-Female NULL Modem RS232 Cable to connect to a PC or other DTE port.

2.13. UART 3/4 Data Signal Screw Terminal

This port (J3) allows for convenient connection to external embedded systems that use data-level UART signaling. For maximum flexibility this port can also provide power to the external circuit.

Table 12 (below) describes the pinout of this connector.

J3 Pin	Signal
1	3.3V
2	U3_TX
3	U3_RX
4	nU3_RTS/U4_TX
5	nU3_CTS/U4_RX
6	GND

Table 12 :: UART 3/4 Data Signal Screw Terminal Pinout

2.14. RS232 3/4 Configuration Jumpers

Jumpers on P12 and P13 configure the RS232 Channels 3 and 4. Channel 3 handshaking and Channel 4 data signals are multiplexed so only one can be chosen. Table 13 and Table 14 (below) describe the configuration options.

P13 Jumper Position	Signal
1-2	nU3_RTS
2-3	U4_TX

Table 13 :: P13 Jumper Position

P12 Jumper Position	Signal
1-2	nU3_CTS
2-3	U4_RX

Table 14 :: P12 Jumper Position

2.15. RS232 Channel 4

This DB9 connector (P14) is wired as a standard RS232 DTE port. Section 2.14 (above) describes how to configure this port. If hardware handshaking is used on RS232 Channel 3 then this port cannot be used.

Use a standard DB9 Female-Female NULL Modem RS232 Cable to connect to a PC or other DTE port.

2.16. Input Power Connector

System power is provided on connector P17. This input is reverse-polarity protected and is also fused with a resettable 2A fuse.

P17 accepts mating connectors with a 2.1mm diameter pin and an outside diameter of 5.5mm. The mating connector needs to be wired as "center-positive".

The acceptable voltage range is 5V to 20V, which matches the MX Interface Specification.

2.17. Input Current Sense Jumper

P16 is a 2-pin header that can be used to measure the input current used by the application. P16 is connected in parallel with a 0.1Ω power resistor (R32) thus the input current can be calculated using Ohm's Law by measuring the voltage across P16.

With larger current draws R16 may create a noticeable drop in input voltage. Placing a jumper across P16 eliminates this voltage drop.

2.18. MX Module Socket

All modules in the MX Module Series will fit into this socket. This interface is described in the MX Interface Specification Document found at www.stratforddigital.com/mx.

2.19. JTAG Connector

The port (P11) allows connection of a standard JTAG programmer/emulator. This can aid in system development and debugging.

Table 15 (below) describes the pinout of this connector.

P11 Pin	Signal
1	—
2	GND
3	TDI
4	GND
5	TDO
6	GND
7	TMS
8	GND
9	TCK
10	GND
11	nRST
12	GND
13	—
14	3.3V

Table 15 :: JTAG Connector Pinout

2.20. CAN Bus Expansion Connector

This port (P15) allows for convenient connection to communicate with external embedded systems that use the CAN bus. Both CAN busses that are part of the MX Interface are present in this connector. For maximum flexibility this port can also provide power to the external circuit.

Table 16 (below) describes the pinout of this connector.

P15 Pin	Signal
1	3.3V
2	CAN2_TX
3	CAN2_RX
4	CAN1_TX
5	CAN2_TX
6	GND

Table 16 :: CAN Bus Expansion Connector Pinout

2.21. Reset Button

This button is hard-wired to the master reset signal of the MX Module Interface. Pressing it will force a hard reset of the microcontroller.

2.22. Breadboard Area

This built-in, solderless breadboard area allows for easy prototyping of various circuits. This area is an array of 33 rows of 2 5-pin columns. All 5 pins of each column are connected to each other.

There are some rows that are pre-wired to specific board resources. These rows are labeled on the PCB silkscreen. This includes the analog input screw terminal, the analog pins of the MX Interface, and board 3.3V and GND. These pre-wired rows allow many usable circuits to be prototyped without the need for any soldering.

Appendix A :: Schematics

Figure 2, Figure 3, and Figure 4 (below) show the schematic sheets for the MX Educational Target board.

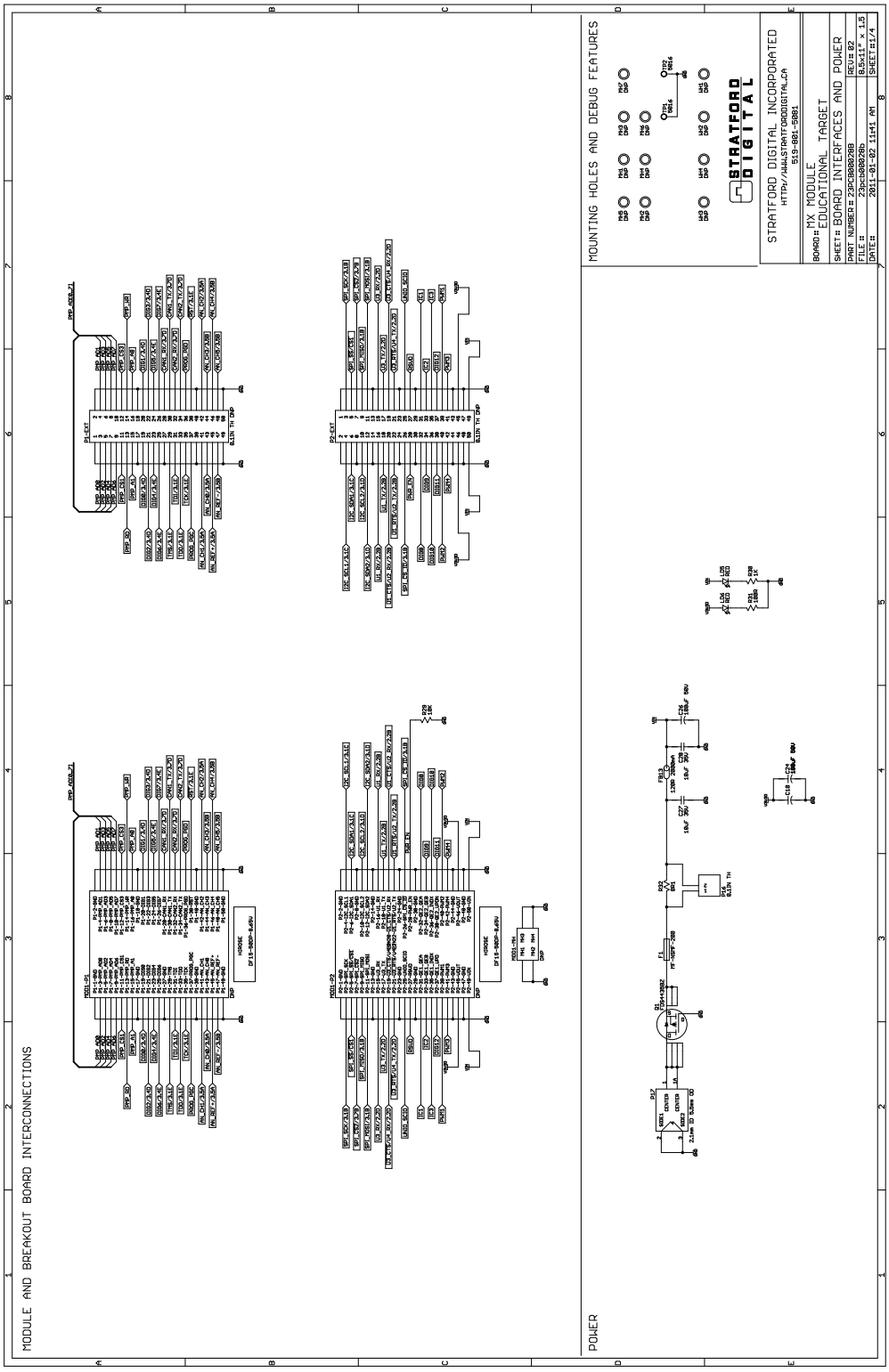

Figure 2 :: MX Educational Target Schematic Sheet 1

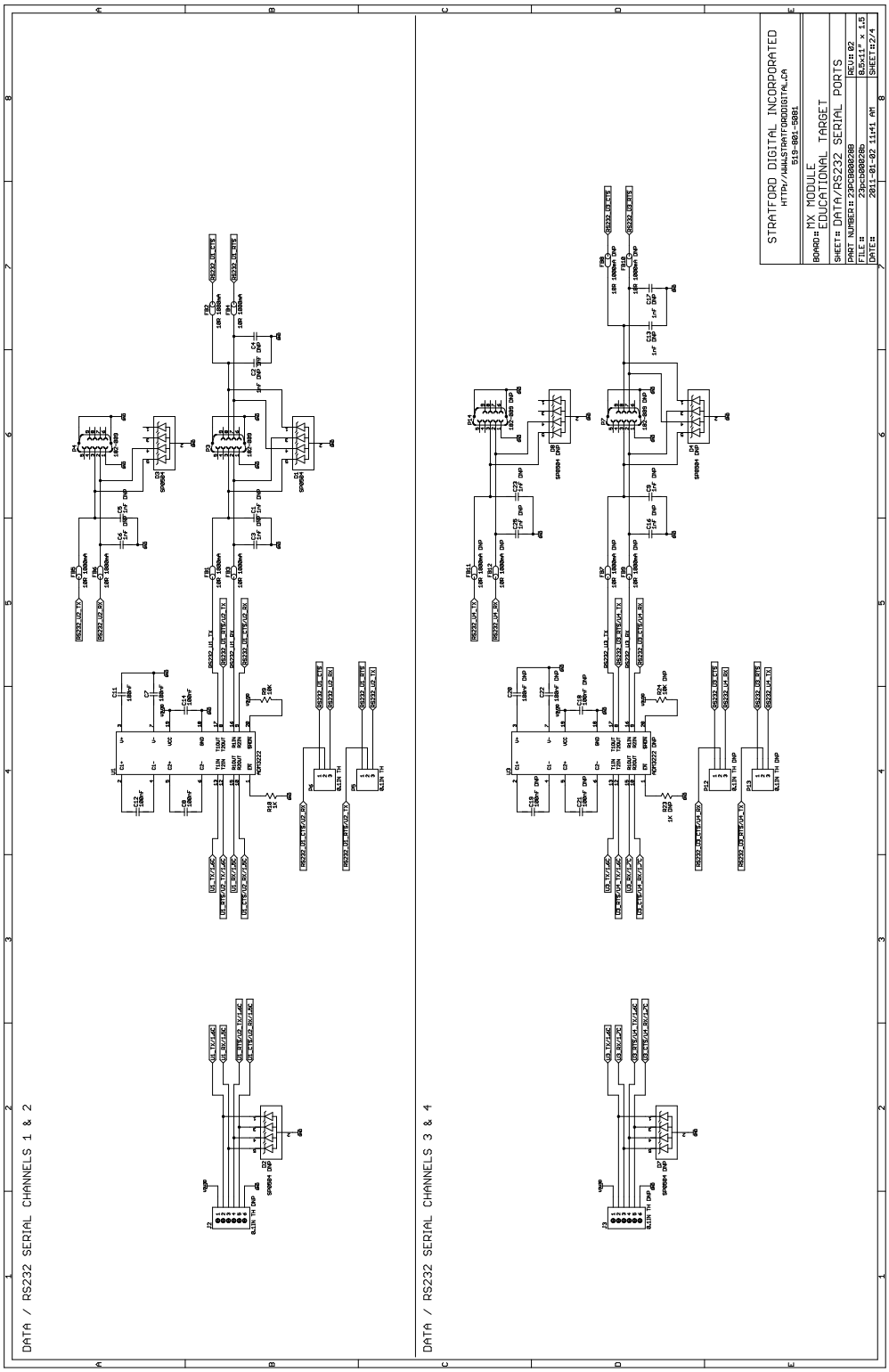

Figure 3 :: MX Educational Target Schematic Sheet 2

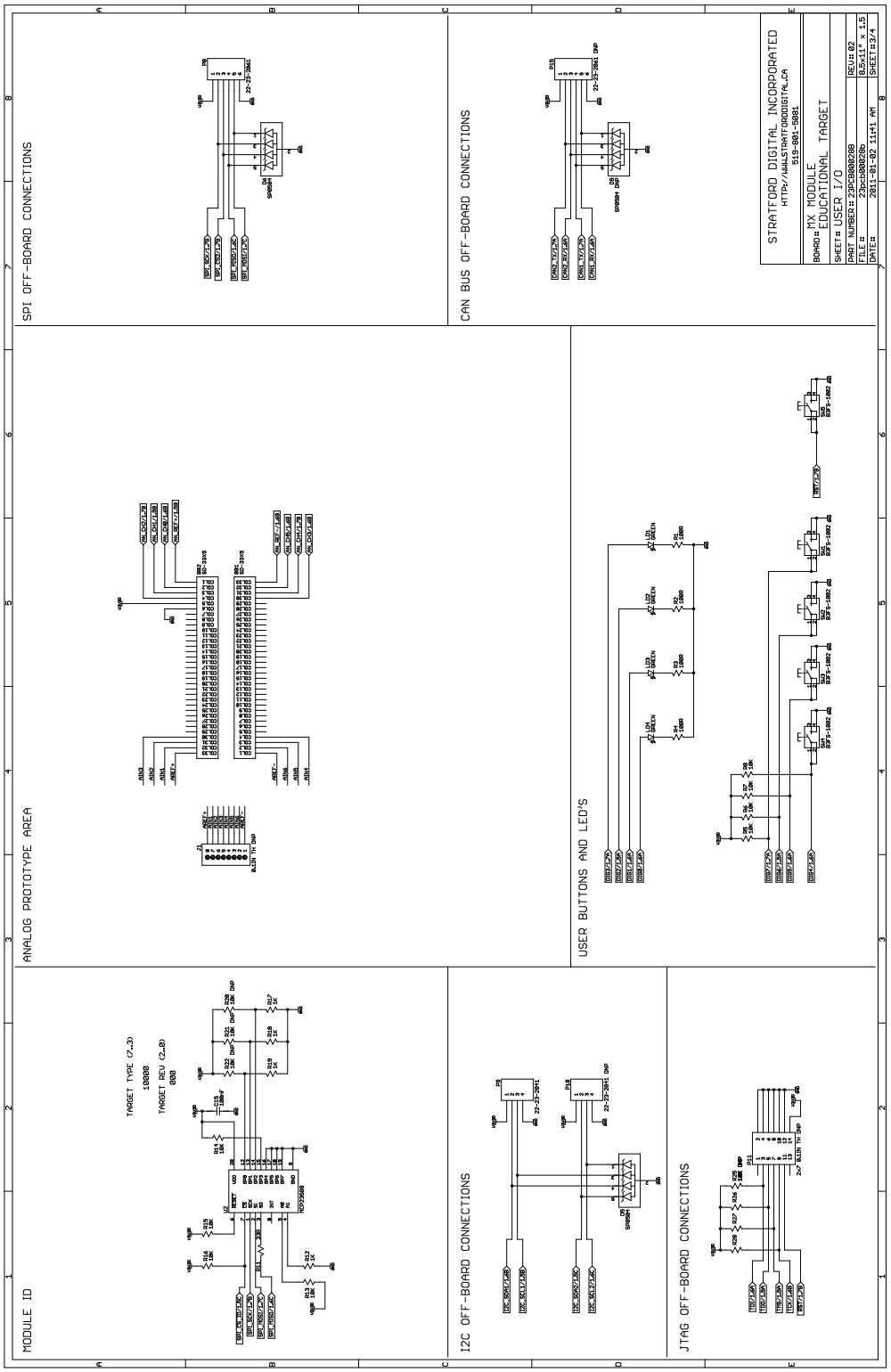

Figure 4 :: MX Educational Target Schematic Sheet 3

This manual and all MX Module documentation and related materials are

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