

Axiom Manufacturing

Users Manual
for
PROJECT DEVELOPMENT BOARD
AXM-0295



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1 GETTING STARTED

The following section has been designed to help users to quickly learn proper setup and operation of the PROJECT BOARD lab experiments. Please read the entire manual before using the PROJECT BOARD.

1.1 Introduction

The PROJECT Development Board is an easy to use lab platform with the components already installed on board for the lab experiments. It is intended for use with an Axiom Manufacturing CME11E9-EVBU or CML12S-DP256 development board or could be used in a stand alone lab. The components for the labs can be installed on the large solderless breadboard area or the operator may use the on board pre-wired components. Signal points are excessable on several row headers. An expansion port is provided for adding more lab experiments as the need arises. The system comes complete with parts, schematic and instructions. All software, drawings, and manuals are contained on the CD.

1.2 Software

The CD comes with AxIDE, which is an integrated development environment designed exclusively for use with Axiom development boards, providing an interface to programs running on these boards. Example software used on the lab experiments is contained on the CD.

1.3 Support Software

There are many useful programs on the included CD that can make developing projects easier. You can also download the latest software free from our web site at:

<http://www.axman.com>.

1.4 Hardware

The following hardware components are installed:

Buzzer	LEDS
Dac	LED BAR
Comparator	Opto Isolator
4 position Dip Switch	Potentiometer
Heater	Relay
4 x 4 keys 0 thru F	Seven Segment Display
LCD Display	Temperature Sensor
Expand Port	Push button
6.5 x 2.1 solderless breadboard	Socket headers

2.0 Visual

Devices used in this lab are static sensitive and are easy damaged by mishandling. Use caution when installing wires and devices on the breadboard to prevent the bending of leads. Experiments should be laid out in a orderly fashion. Start your lab time with the bench clean and free of metal objects. Leave the lab area in a clean condition by picking up loose parts, wires and small objects.

3.0 Theory

AXIOM MANUFACTURING PROJECT development board is designed for quickly and effectively learning the basics of microcontrollers. This manual along with the lab manuals will walk the student though the steps of using the development board for its intended purpose, controlling devices. This board contains input and output devices that are very commons in appliances, machinery, automobiles, & alarms plus many others. The board can be set up in a parallel , serial, or stand alone mode. In the parallel mode, each pin of the microcontroller directly controls the device on board. A serial mode is provided for controlling each device by using only the SPI port on the microcontroller. This mode can be used for developing expanded I/O for a project where all the port pins are already used. By using the SPI, several slow devices can be controlled without using some of the special function ports. The stand alone mode is provided for users who have special experiments. In this mode, all buffers are disabled, allowing rerouting control signals to devices on board or devices on the proto type

area.

4.0 Procedure

The procedure is arranged in a series of steps for each lab experiment. The procedure is slightly different for the CME11E9-EVBU or CML12S-DP256. Reference the lab for the development board you have connected to your Project board.

5.0 Description

5.1 Components

Buzzer

A audio indicator is mounted on the PROJECT board. This is driven by a driver on board that requires very little current from the microcontroller. CAUTION: The BUZZER is very loud, so turn on for very short periods of time.

DAC

A digital to analog converter is mounted on board. This is a serial only device. JP12 should be in position 1 & 2.

HEATER

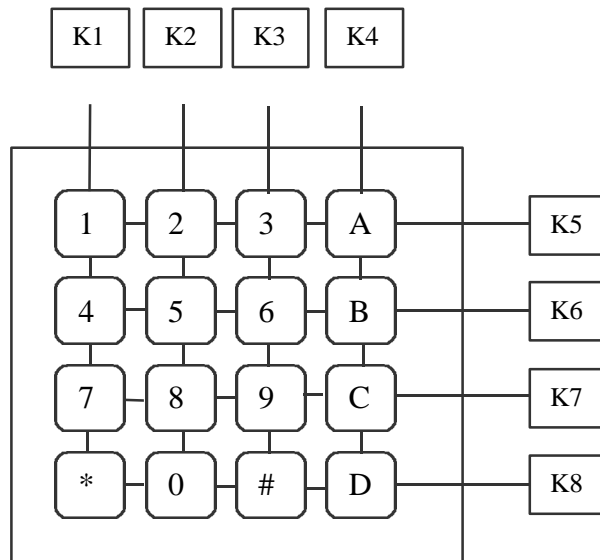
A heat source is mounted on board. This heat source will slowly heat up the temperature sensor.

Keypad

The keypad is a 4x4 matrix of push button switches. The matrix is driven by a nibble (4 bits) on K1 , K2 , K3 , K4. The results of the scan are read as a nibble on K5 , K6 , K7 , K8. In the parallel mode. These bits have pull down resistors and read low when no key is pressed. The Keypad connector may be connected directly to the development board provided JP9 is not installed.

Keypad Port

Pin	Pin	Pin	Pin	Pin	Pin	Pin	Pin
1	2	3	4	5	6	7	8
INPUT	INPUT	INPUT	INPUT	OUTPUT	OUTPUT	OUTPUT	OUTPUT
KEY1	KEY2	KEY3	KEY4	KEY5	KEY6	KEY7	KEY8



Normal Keypad Matrix

LAMP

Lamp test is a push button mounted close to the seven-segment display. Pressing the push button will cause all segments in the seven-segment display to illuminate.

LCD-DISPLAY

LCD-DISPLAY is a 2x16 display. The device is controlled three ways. The first way is by the LCD_PORT. JP10 must not be installed. The second way is by using the SPI port of the microcontroller. JP10 must be in position 1 & 2. The third way is a parallel mode. JP10 must be in position 2 & 3.

LEDS

On board are four LEDs being used for indication during lab experiments. The board contains drivers for these LEDs that require very little current from the microcontroller port.

LED-BAR

The LED-BAR contains four LEDs arranged in a row. The board contains drivers for these LEDs that require very little current from the microcontroller.

PROBE

The PROBE test point on AUX1 port is used for measuring a voltage during lab time.

RELAY

Relay K1 is a DPDT device. One side is connected to LEDs RA and RB. This allows the student a quick view of the state of the relay during lab experiments. The other side of the relay is connected to J1 and EXPAND PORT. This device is controlled by a driver that required very little current from the microcontroller.

SEVEN-SEGMENT

A one digit seven-segment display is mounted on the PROJECT board. Using a four bit BCD value, the display will indicate the value selected. The display can be controlled directly from the microcontroller port with JP9 in position 2 & 3. Also the display can be controlled from the SPI port with JP9 in position 1 & 2.

SW1

Switch Sw1 is a four position slide switch. In the off position, a high logic level is output from each of the four switches. A 10k resistor pulls this level high in the off position. In the ON position, the output is a logic level low. The switch connects ground to the output.

TEMPERATURE

The PROJECT board comes with a fahrenheit temperature sensor. This is connected to the analog port on the microcontroller thru a op-amp.

5.2 OPTIONS and JUMPERS

ENABLE

The ENABLE jumper is installed by default and enables the on board shift registers and buffers. Removing the jumper will disable all on board registers and buffers. The on board devices are free for use on other lab projects.

JP19

Installing JP19 will disable the serial selection on U8 when U7 or U21 are enabled in parallel mode. This is a feature for CML12S only.

SERIAL/PARALLEL

Jumpers JP7 thur JP14 select the register or buffer the user needs enabled. Position 1 & 2 select the SPI serial INTERFACE for controlling on board devices. Position 2 & 3 select the buffers for direct connection of ports to on board devices. Removing the ENABLE jumper will disable all these devices.

JP7 – JP14 Position 1 & 2
Serial Control

Jumper	Enable	Serial Device	Board Display or Sensor
JP7	S0_EN*	U1 595	LED1,LED2,LED3,LED4,BAR1,BAR2,BAR3,BAR4
JP8	S1_EN*	U2 595	DP,RELAY,BUZZER,OPTO1,HEAT,ED1,ED2,ED3
JP9	S2_EN*	U3 595	Seven Segment Keypad (1-4)
JP10	S3_EN*	U4 595	LCD
JP11	S4_EN*	Expand PORT	User
JP12	S5_EN*	U13 DAC	Digital to Analog Convector
JP13	S6_EN*	U10 597	Keypad (5-8) Dip Switch
JP14	S7_EN*	U11 597	CP,PB1,OPTO, Test Inputs

JP7 – JP14 Position 2 & 3
Parallel Control

Jumper	Enable	Serial Device	Board Display or Sensor
JP7	P0_EN*	U5 573	LED1,LED2,LED3,LED4,BAR1,BAR2,BAR3,BAR4
JP8	P1_EN*	U6 573	DP,RELAY,BUZZER,OPTO1,HEAT,ED1,ED2,ED3
JP9	P2_EN*	U7 573	Seven Segment Keypad (1-4)
JP10	P3_EN*	U21 573	LCD
JP11	None	None	None
JP12	None	None	None
JP13	None	None	None
JP14	None	None	None

COMPARATOR

Jumper Jp1 controls the output of the on board comparator. Installing the jumper, connects the output to one of the timer ports.

RANGE

The RANGE jumper is used in association with the potentiometer. With the jumper off, range of the potentiometer is reduced to half. Installing the jumper allows the full range of the potentiometer 0-5 volts.

POWER OPTIONS

The EVBU or CML12S development board may be power by several ways:

- The first option is using the five volts from the PROJECT board as the five volt source of the development board. JP6 must be installed. CAUTION: When using this option, the development board must not be powered by any other source.
- The second is by using the power supply supplied with the development board and the PROJECT board, each using its own supply. CAUTION: JP6 must be disabled.
- The third option is by using the PROJECT board power supply. The power supply is plug into the +VIN jack. The ON/OFF switch will switch the power to the PROJECT board,+VOUT jack, and the PWR terminal. The development board then can be powered from this switched supply of the PROJECT board. CAUTION: JP6 must be disabled.
- Note: The PROJECT board comes with a 9 volt power source. Use only this unit.
- CAUTION: VR1 may become hot if recommended current limits are exceeded. Recommended from the +5 supply on board is 100 ma. Recommended from the +9 supply is 100 ma.

EVBU OPTIONS

Jumpers JP15,JP16,JP17,JP18 switch eight analog signals down to four for the EVBU development board only. See table for information.

Jumper	1 & 2	2 & 3	EVBU
JP15	SW1-1	DAC	PE4
JP16	SW1-2	PROBE	PE5
JP17	SW1-3	TEMP	PE5
JP18	SW1-4	POT1	PE6

5.3 PORTS and CONNECTORS

ANALOG PORT

Dip 1	1	2	AN8
Dip 2	3	4	AN9
Dip 3	5	6	AN10
Dip 4	7	8	AN11
DAC	9	10	KEY5
PR	11	12	KEY6
TEMP	13	14	KEY7
POT1	15	16	KEY8
NC	17	18	
NC	19	20	AGND

The ANALOG PORT provides the analog interface to the CML12S256 development board. Refer to the CML12S256 documentation for exact analog channel.

AUX1 PORT

GND	1
+5V	2
KEY1	3
KEY2	4
KEY3	5
KEY4	6
KEY5	7
KEY6	8
KEY7	9
KEY8	10
DIP1	11
DIP2	12
DIP3	13
DIP4	14
PB1	15
CAN-H	16
CAN-L	17
OPA	18
OPB	19
CP	20

The AUX1 PORT is a single row socket header. It allows access between the solderless breadboard and signals on the PRO.IFCT board.

KEY1, KEY2, KEY3, KEY4, KEY5, KEY6, KEY7, KEY8 are from the key switch matrix.

DIP1, DIP2, DIP3, DIP4 are the outputs of the four position DIP switch.

PB1 is the push button output.

CAN-H and CAN-L are from the CAN connector.

OPA, OPB and CP are the inputs and output of the COMPARATOR.

AUX1 PORT
continued

MISO	21
MOSI	22
SS*	23
SS0*	24
SS1*	25
SS2*	26
PM0	27
PM1	28
PT5	29
PT6	30
TEMP	31
PROBE	32
DAC	33
HEAT	34
GND	35
OPTO1	36
OPTO	37
BUZZER	38
RELAY	39
+5V	40

MISO, MOSI, SS*, SS0*, SS1*, SS2* are the SPI control signals. SCK is on AUX3 port.

PM0 and PM1 are the Can control signals.

PT5 and PT6 are from the timer port.

TEMP is amplified output of the temp sensor.
PROBE is a 2:1 voltage probe.
DAC is the output of onboard DAC.

HEAT is an input to the heater driver.

OPTO1 is an input to the opto driver.
OPTO is the output of the opto device
BUZZER is an input to the buzzer driver.
RELAY is an input to the relay driver.

AUX2 PORT

LCD-DB4	1
LCD-DB5	2
LCD-DB6	3
LCD-DB7	4
RW	5
RS	6
EN	7
LED1	8
LED2	9
LED3	10
LED4	11
BAR1	12
BAR2	13
BAR3	14
BAR4	15
BCD_A	16
BCD_B	17
BCD_C	18
BCD_D	19
DP	20

LCD-DB4, LCD-DB5, LCD-DB6, LCD-DB7 are the data inputs to the LCD. RW, RS, EN are the control signals to the LCD.

LED1, LED2, LED3, LED4 are the inputs to the drivers that control the LEDs. BAR1, BAR2, BAR3, BAR4 are the inputs to the drivers that control the LED BAR.

BCD_A, BCD_B, BCD_C, BCD_D, DP are the inputs to the drivers that control the SEVEN SEGMENT display.

AUX3 PORT

S4_EN*	1
EMISO	2
MOSI	3
TICK	4
PT6	5
PT5	6
SPARE1	7
C3	8
C4	9
SCK	10
AN8	11
AN9	12
R4	13
R3	14
C1	15
C2	16
ED1*	17
SDO	18
GND	19
+5	20

MOSI, EMISO, SCK, S4_EN*, SDO allow a SPI device on the EXPAND PORT.

TICK, PT6, PT5 are timer ports on the microcontroller.

C3, C4 are selected as CAN or SCI.
R3, R4 are selected as HC11 or HC12 ports.

AN8, AN9 are analog input ports.

ED1 is high current open collector driver.

EXPAND PORT

S4_EN*	1
EMISO	2
MOSI	3
TICK	4
PT6	5
PT5	6
SPARE1	7
C3	8
C4	9
SCK	10
AN8	11
AN9	12
R4	13
R3	14
C1	15
C2	16
ED1*	17
+5	18
GND	19
+9	20

MOSI, EMISO, SCK, S4_EN*, SDO allow a SPI device on the EXPAND PORT.

TICK, PT6, PT5 are timer ports on the microcontroller.

C3, C4 are selected as CAN or SCI.
R3, R4 are selected as HC11 or HC12 ports.

AN8, AN9 are analog input ports.

ED1 is high current open collector driver.

CML12 INTERFACE

+5E	1	2	GND
	3	4	
	5	6	
	7	8	
	9	10	
	11	12	GND
+5E	13	14	GND
	15	16	
RXD1	17	18	TXD1
	19	20	

RXD1 and TXD1 are the second SCI channel.

CML12 INTERFACE CONTINUED

	21	22	U21_EN
KWJ6	23	24	KWJ7
PB0	25	26	PI13
SS2*	27	28	PI12
SS0*	29	30	SS1*
PI8	31	32	U7_EN
PM0	33	34	PM1
PI6	35	36	PI7
PI4	37	38	PI5
SCK	39	40	SS*

U21_EN enables U21 for LCD interface in parallel mode. U7_EN enables U7 for seven-segment and keypad.

KWJ6 and KWJ7 are key wait up ports. PM0 and PM1 CAN control lines.

PB0 is output of the push button.

SS0*, SS1*, SS2*, SCK, SS* are SPI control.

PI4, PI5, PI6, PI7 are signals from the microcontroller that control LED-BAR.

CML12 INTERFACE
CONTINUED

MISO	41	42	MOSI
+5E	43	44	GND
PI10	45	46	PI9
PI3	47	48	PI2
PI1	49	50	PI0
PI16	51	52	PI17
PI18	53	54	PI19
PI11	55	56	PT5
PT6	57	58	TICK
+5E	59	60	GND

MISO and MOSI are SPI control.

PI0, PI1, PI2, PI3 are used for controlling LEDs.
PI9 controls the relay.
PI10 controls the buzzer.
PI11 controls the opto isolator.
PI16, PI17, PI18 and PI19 are the BCD digits.
PT5, PT6 and TICK are timer ports.

EVBU INTERFACE

GND	1	2	
	3	4	
	5	6	
	7	8	
PI16	9	10	PI17
PI18	11	12	PI19
PI8	13	14	PI10
PI12	15	16	PI9
	17	18	
	19	20	

PI8 controls the decimal point.
PI9 controls the relay.
PI10 controls the buzzer.
PI12 controls the heater.
PI16, PI17, PI18, PI19 are the BCD digit.

EVBU INTERFACE
CONTINUED

	21	22	MISO
MOSI	23	24	SCK
SS*	25	26	
TICK	27	28	SS0*
SS1*	29	30	SS2*
PI11	31	32	PA2
PA1	33	34	PB1
PI7	35	36	PI6
PI5	37	38	PI4
PI3	39	40	PI2

MISO, MOSI, SCK, SS0*, SS1*, SS2* are SPI control signals.

TICK is a timer port.

PI2 and PI3 control two of the LEDs.
PI4, PI5, PI6, and PI7 control the LED-BAR.
PI11 controls the opto isolator.

PB1 is the push button.
PA1 and PA2 are not used.

EVBU INTERFACE *CONTINUED*

PI1	41	42	PI0
KEY5	43	44	PE4
KEY6	45	46	PE5
KEY7	47	48	PE6
KEY8	49	50	PE7
	51	52	
	53	54	
	55	56	
	57	58	+5E
GND	59	60	GND

PI0 and PI1 control two of the LEDs.

KEY5, KEY6, KEY7, KEY8 are the output of the key matrix and input to the EVBU analog channels.

PE4, PE5, PE6, and PE7 are analog channels on the EVBU.

6.0 BUILDING LAB

6.1 EVBU & PROJECT BOARD

6.1.1 HARDWARE

- CME11E9-EVBU
- PROJECT BOARD
- 60 pin cable
- Power Adapter
- Windows PC

6.1.2 SOFTWARE

- AXIDE

6.1.3 ASSEMBLY

- Turn ON_OFF switch on PROJECT board to OFF position.
- Connect CME11E9-EVBU P4 port to PROJECT board EVBU port using the 60 pin cable.
- Connect P_COM1 port on EVBU to the serial port on PC.
- Connect power adapter dc output to +VIN on PROJECT board.
- Enable JP6 on PROJECT board. Note: This will power the EVBU from the PROJECT board, do not power the EVBU from another source without removing JP6.
- Plug power adapter AC plug into AC power.
- Turn ON_OFF switch to ON position. Verify POWER LED is lit. Turn ON_OFF switch to OFF if LED fails to light. Turn ON_OFF switch to OFF position.

6.2 CML12 & PROJECT BOARD

6.2.1 HARDWARE

- CML12
- PROJECT BOARD
- 60 pin cable
- 20 pin cable
- Power Adapter
- Windows PC

6.2.2 SOFTWARE

- AXIDE

6.2.3 ASSEMBLY

- Turn ON_OFF switch to OFF position.
- Connect CML12 MCU_PORT to PROJECT board CML12 port using the 60 pin cable.
- Connect CML12 ANALOG_PORT to PROJECT board ANALOG_PORT using the 20 pin cable.
- Connect the P_COM1 port on the CML12 to the serial port on the PC.
- Connect the power adapter dc output to +VIN on the PROJECT board.
- Enable JP6 on PROJECT board. Note: This will power the CML12 from the PROJECT board, do not power the CML12 from another source without removing JP6.
- Plug power adapter AC plug into AC power
- Turn ON_OFF switch to ON position. Verify POWER LED is lit. Turn ON_OFF switch to OFF if LED fails to light. Turn ON_OFF switch to OFF position.

7.0 TROUBLESHOOTING

7.1 EVBU or CML12

The EVBU or CML12 development system is fully tested and operational before shipping. If it fails to function properly, consult the troubleshooting section of your user manual.

7.2 PROJECT BOARD

7.2.1 POWER

The power supply should be plugged into the wall plug. The dc power plug should be plugged into the +VIN jack. With the power switch in the ON position, the POWER LED should be lit. If the LED is not lit, verify +9 volts on +V and +5 on the PWR terminal with the power switch on. Disconnect all connections on the breadboard to PROJECT board and verify power.

7.2.2 DEVICES INOPERATIVE

Check your jumpers settings again the device you are trying to control. Is it set for proper mode, SPI control or parallel control.

8.0 Tips and Suggestions

Following are a number of tips, suggestions and answers to common questions that will solve most problems users have with the PROJECT board lab system. You can download the latest software from the Support section of our web page at:

8.1 HARDWARE

The hardware is a reliable system of electronic parts and connectors. Care should be taken when installing jumper wire. Use jumper wire in good condition, this will prevent it from breaking off inside connectors. Do place metal objects on the board or otherwise short out any of the components.

8.2 LAB MANUALS

There are different lab manuals for HC11 EVBU and HC12 CML12 boards. On the same thought, there are different lab manuals for SPI control and parallel control. Example: KEY1P KEY would be the name of the lab, one would mean HC11 and P would mean parallel. Example: KEY2S KEY would be the name fo the lab, two would mean HC12 and S would mean SPI.

8.3 SOFTWARE

Software is included on the CD for each lab experiment. Use these as an example for building your own test programs.