EDUCATIONAL PRODUCTS

LAB

REFERENCE

GUIDE

Revision 04.05.04

xiom anufacturing

CONTENTS

1 GETTING STARTED

Axiom Manufacturing thanks you choosing our education products. We have a long list of products and labs ready for class. The following section was designed to help you quickly learn the options, proper setup and operation of the lab equipment.

1.1 Introduction

The experiments covered by this document require a development kit(s) from Axiom Manufacturing. The individual Development Boards comes complete with all necessary instructions, software and drawings necessary to support lab activities.

1.2 Software

Several development board kits are supplied with a free assembler and terminal program. The AxIDE is included as an easy Window's based integrated development environment designed exclusively for use with Axiom HC11 and HC12 development boards. AxIDE also makes uploading programs easy via the COM port. Read your board manual for setting up AxIDE. The HCS08 boards come with a binary monitor for easy operator interface though the serial port.

1.3 Support Software

There are many useful lab programs on the included CD. This CD also contains example software programs to get your code up and running. You can also download the latest software free from our web site at: **http://www.axman.com**.

1.4 Hardware

The following hardware is required:
- Axiom microcontroller development boards. CME11E9 EVBU, CML-9S12C32, CML-9S12DP256 or CME-8GB60.
- Windows based PC

- LAB components

The following hardware is Optional:
- Project board or MCU Project Board

2.0 Care and Setup

Some devices used in these labs are static sensitive and are easily damaged.   Care should be taken when handling these devices. Students should also use caution when installing wires and other devices on the breadboard. Improper insertion can cause damage to the breadboard area. If the breadboard area becomes damaged it may produce erratic or incorrect results from your experiment. Experiments should always be laid out in an 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's development boards are designed to help students quickly and effectively learn the basics of microcontrollers. The labs provided walk the student though the steps of using the development board for its intended purpose; controlling devices. Axiom is continually adding new labs that demonstrate the functionally of each microcontroller. A theory section is included in each lab that explains in detail the theory behind the experiment.

4.0 Procedure

Each lab has a series of step-by-step procedures for the student to follow. Each step is to be completed before moving on to the next step.   The student should go though the steps as many times as necessary to master the subject.

4.1 Description

4.1.1 CME-11E9-EVBU

The CME-11E9-EVBU is a low cost; entry level development package designed to provide similar features of the Motorola EVBU. The board provides MC68HC11E9 Single Chip and Expanded Mode operation with the Buffalo Monitor version 3.4 in the internal EEPROM. Application development is quick and easy with the included DB9 serial cable, Windows Utility Software, Wall-plug Power Supply, manuals and assembler/ compiler. Small applications for Single Chip operation can be installed in the internal EEPROM (512 Bytes) and larger Expanded Bus operation applications can be installed in the external 8k Byte EEPROM for dedicated operation. Most EVBU labs require the unit be operated in single chip mode. In this mode, ports B and C are available for use on several experiments. Internal ram, at location $0100 to $01FF, is used for many example programs. In this mode all external memory on the CME11E9-EVBU is disabled. This prevents use of the LCD port or loading programs to external memory. The LCD lab has the external memory enabled for the LCD experiment only. If the lab requirements include executing programs over 256 bytes in length or use of external memory, the CML12 should be chosen. Interfacing is done using the serial port using AxIDE and Buffalo monitor on board the HC11E9 microcontroller. This board will interface with both Project boards.

Features
• MC68HC11E9 CPU
• 512 Byte RAM and EEPROM
• 16 BIT Timer with 3/4 Capture, 4/5 Compare
• Pulse Counter, 8bit
• 8 Channel 8 BIT A/D
• SPI Serial Port
• SCI Serial Port
• One Serial Port w/ RS232 DB9
• Three I/O Ports (Expanded Mode)
• Port A - 3 in, 3 out, 2 I/O (Timers)
• Port D - 5 I/O (Serial, keypad)
• Port E - 8 in (A/D, keypad)
• Two Additional I/O Ports (Single Chip)
• Port B - 8 out
• Port C - 8 I/O
• Three Configurable Memory Sockets
• 28 - pin JEDEC 8K/32K BYTE
• RAM, EPROM, EEPROM
• Keyboard / SPI interface
• LCD interface (memory mapped)
• Bus Expansion Port w/ 7 Chip Selects
• 3 x 1.5" Solderless Prototype Area
• Supplied with 32K RAM, 8K EEPROM, DB-9 Serial Cable, MC68HC11 Manuals and DOS / Windows Utility CD with Assembler, EEPROM programming, etc.
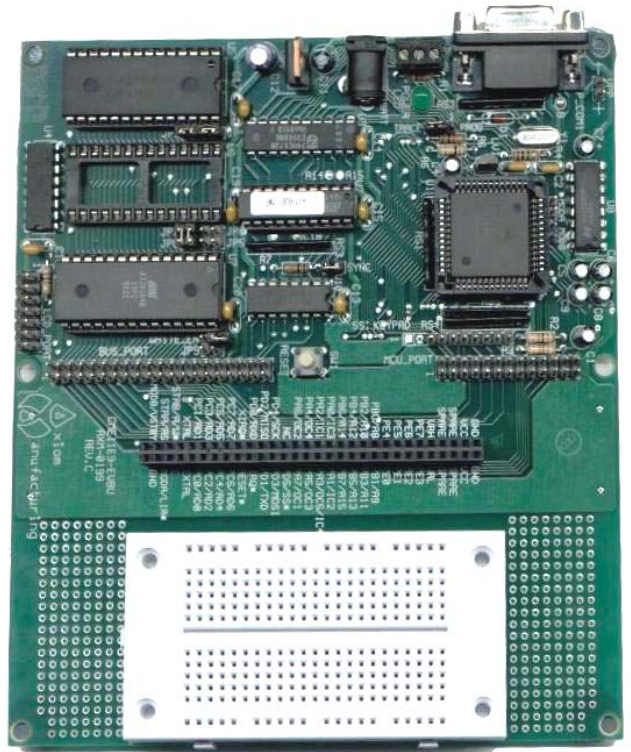
4.1.2 CML-9S12C32

The **CML-12C32** Development Package supports hardware and software development on the Motorola MC9S12C32 MCU. This board may be used as a stand-alone development platform or as an enhanced learning tool when used with the Axiom Manufacturing Project Board. A BDM port (BGND) is provided for higher end tool application use. The Development Kit includes support/Documentation CD, User Manual, and sample software tools.

CML-12C32 Features

- MC9S12C32 MCU
    - 32K byte Flash, 2K byte SRAM
    - SCI and SPI Serial Ports
    - 8-channel, 10 bit, A/D port
    - CAN 2.0 Port
    - 8-channel Timer Module
    - 12 Wakeup Inputs
    - 6 PWM channels
    - 10 Keypad Interrupt Inputs
- 32K x 16 (64K bytes) external SRAM
- 16 MHz crystal oscillator
- 8 MHz bus operation default with Monitor
- 24K MHz optional bus operation with MCU PLL
- COM 1 input port with RS-232 conversion on SCI
- Optional CAN 2.0 interface port, components not installed
- LCD interface port
- Keypad interface port
- Optional Mode jumper
- Auto-start jumper
- Background Debug (BDM) Port – 6 pin standard
- 60 pin, .1" spacing, MCU Port header socket designed to allow easy interface to the Project Board
- 30 pin Bus Port header socket providing access to Port E(7:0) and Latched Address(15:0) signals
- Pushbutton Switches: RESET, 2 user defined
- LED Indicators: RESET, Power, 2 User Defined
- 3.3" x 1.8" Breadboard area with distributed power and ground pins
- AC Power adapter - 120VAC – 9VDC
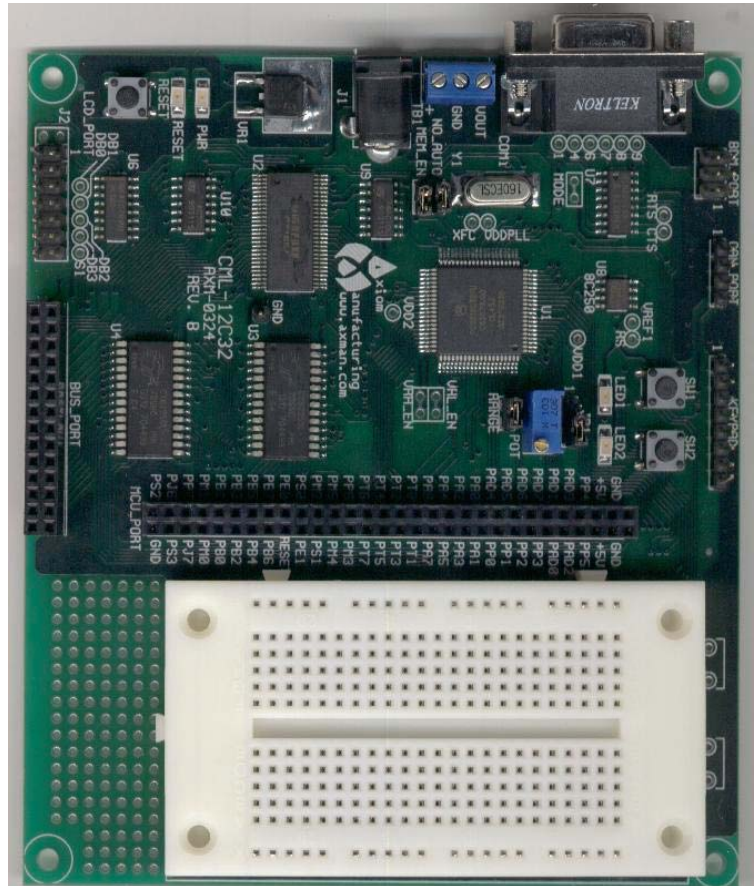
4.1.3 CML-9S12DP256

The CML-9S12DP256 is a low cost development system for the Motorola MC9S12DP256 Microcontroller. The board provides operation in Single-Chip Mode with the Expanded Wide Bus available for expansion and development memory access. The system is supplied with Monitor/Debugger installed with programming support utilities. Features provide for easy selection of operating mode, flash programming, BDM operation, keypad and LCD module connections, and prototyping. All required power supplies and support software are included to complete and program an application. Board is compatible with standard HC12 BDM pods and software compilers that provide an integrated debug interface. User programs can be auto started in internal flash. The board contains more ports for driving more of the labs without having to share port pins. The board contains MON12 monitor in internal flash.

- MC9S12DP256 Features:
- Upward code compatible w/ 68HC11
- 4K Bytes EEPROM
- 256K Byte Flash EEPROM
- 12K Byte SRAM
- 2 Enhanced SCI Ports
- 3 SPI Port (Synchronous Serial)
- 5 CAN 2.0 A or B Interface
- Two 8 Channel 10 Bit Analog Converters
- Background Debug Port
- Enhanced 16 bit Timer w/ 8 channels of capture or compare
- 16 Bit Pulse Accumulator
- 8 PWM Channels
- Two 8 bit Key Wake-up ports
- PLL Clock Oscillator Support
- RTC and COP features
- Up to 91 I/O
- 4Mhz reference oscillator for up to 24MHz operation.

- External Memory: 256K Bytes (128K x 16) SRAM
- COM1 Port – HC12 SCI0 w/ RS232 and DB9S connector
- COM2 Port – HC12 SCI1 w/ RS232 and 3 pin header
- INDICATORS – Power and RESET.
- BUS-PORT – 40 Pin Socket Header
- MCU I/O PORT - 60 pin Socket Header
- Analog Port – 20 pin Socket Header
- CAN PORT – CAN 0 I/O with 1M Baud Transceiver
- LCD Module and Keypad Ports
- Solderless Prototype Area and Connections
- Easy Power Connection and Tap points
- Back Ground Debug (BDM) Port – 6 Pin standard
- 7 to 25VDC input to 5V Power Supply. Operating Power: 60 ma @5V
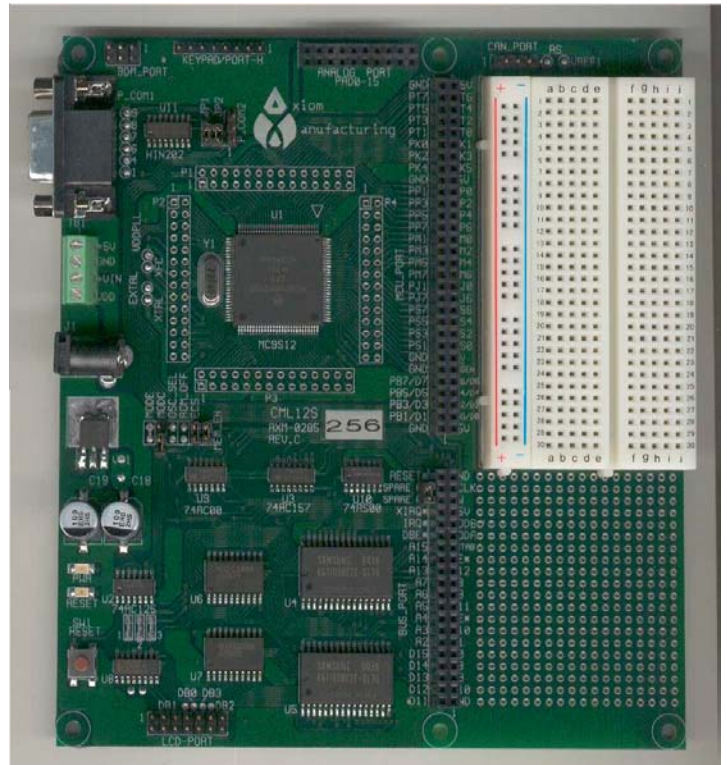
4.1.4 CME-8GB60

This board is unique; it has several lab components installed on board. The components are a LCD, buzzer, LEDS, switches, push buttons. The processor is a GB60 with 4k internal ram and 60k internal flash. The M9S08GB60 comes with the internal binary monitor installed.

- M9S08GB60 CPU 6
- 60K Byte Flash
- 4K Bytes Ram
- 56 I/O lines (64 pins)
- 5 channel TPM 2 Timer
- 3 channel TPM 1 Timer
- 8 Channel 10 BIT A/D
- SPI and IIC Serial Ports
- 2 x SCI Serial Ports
- Key Wake-up Ports
- BDM Port
- Clock generator w/ PLL up to 40Mhz operation
- 4MHz reference Crystal oscillator Clock oscillator
- Optional Regulated +3.3V and 5V power supplies
- COM1 Serial Port w/ RS232 DB9-S Connector COM2 Serial Port w/ RS232 DB9-S Connector or RS422/485 connector.
- ON/OFF switch w/ Power Indicator
- User Components Provided
- 4 LED Indicators (PTF0-3)
- 4-position DIP switch (PTB4-7)
- 4 Push Switches (PTA4-7)
- 2x16 character LCD Module (PTG3-7, PTE6-7)
- Buzzer (PTD0)
- MCU Port connector provides all digital I/O.
- Analog Port connector provides analog inputs or PTB outputs.
- Large 2" x 5" Prototype Area
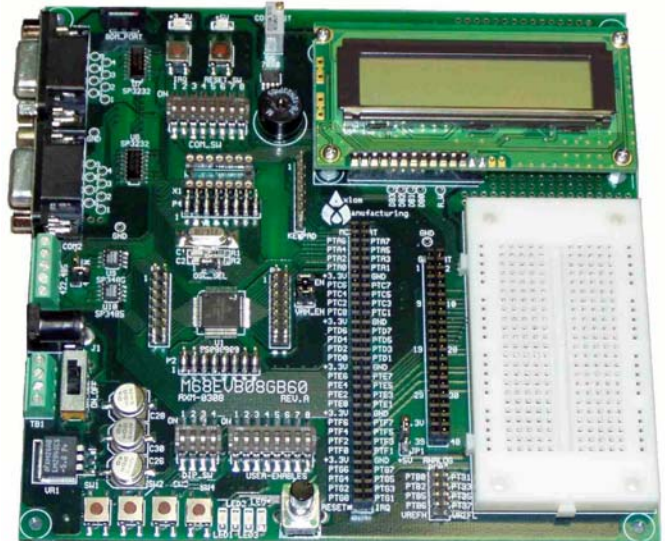
4.1.5 PROJECT BOARD

The Axiom Project Board provides an application platform for numerous interfaces and simple control loops operable by most microcontrollers. Device interfaces are controlled either by a 3 wire synchronous serial interface (SPI / QSPI) or by parallel connections to the host microcomputer I/O ports. Direct 60 pin cable connections for the MCU port are available for the Axiom CME-11E9-EVBU, CME-12C32 and CML-9S12DP256 development boards. Option and I/O headers provide varied application of the devices on the Project Board and access points for expansion on the large breadboard area. Breadboard area connections are made simply by installing 22GA solid wire into the headers and breadboard.

Project Board Features:

- LCD Module: 2 x 16 character
- Key Switches: 16 keys, 4 x 4 matrix
- Digital to Analog Converter (DAC): 12 bits, 0 - 5V output
- Potentiometer (POT): Precision 20 turn, 0 - 5V output
- LED indicators: 4 total
- DIP Switch: 4 positions
- Temperature Sensor: (Fahrenheit only), Buffered
- Heat source
- Push Button Switch
- Optoisolator: Darlington transistor output
- Relay: DPDT or dual form C
- Seven Segment Display (one digit)
- Light Bar: 4 element
- Buzzer
- Opamp / Comparator: Single stage
- Expansion Ports
- Solderless Breadboard: 6.5"X2.1"

Specifications:

Power In: Regulated +9VDC with On/ Off Switch
Current: 100ma typical @9VDC
Size: 9.5" X 6.5"
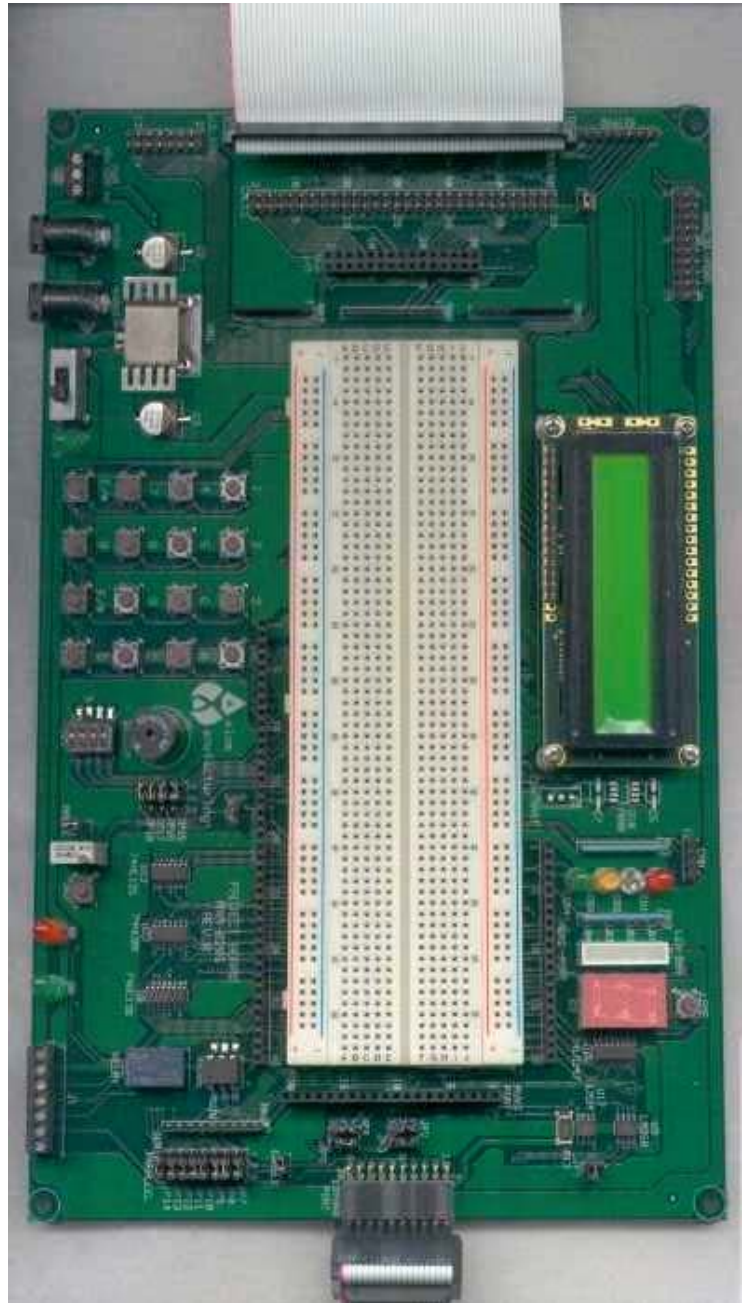
4.1.5.1 Project Board Reasons to Buy

- Dependable Axiom Manufacturing Quality
- Quick Setup and User Friendly
- Low Cost, Affordable!
- Supports HC11 or HC12
- All in one, EVBU and CML12S labs written for use with Project board
- No need for extra components. No lost parts. No broken wires.
- Large Proto-Area, Make your own custom labs
- Stand Alone Platform, Easy Components access
- Expandable, Design custom add-on mini-projects
- Four Display Types (LCD,LEDS, LED-BAR, 7-Segment)
- Three Input types (4x4 key matrix, Push Button, Dip Switch)

4.1.6 MCU PROJECT BOARD

Low cost project board. See Axiom Manufacturing for details
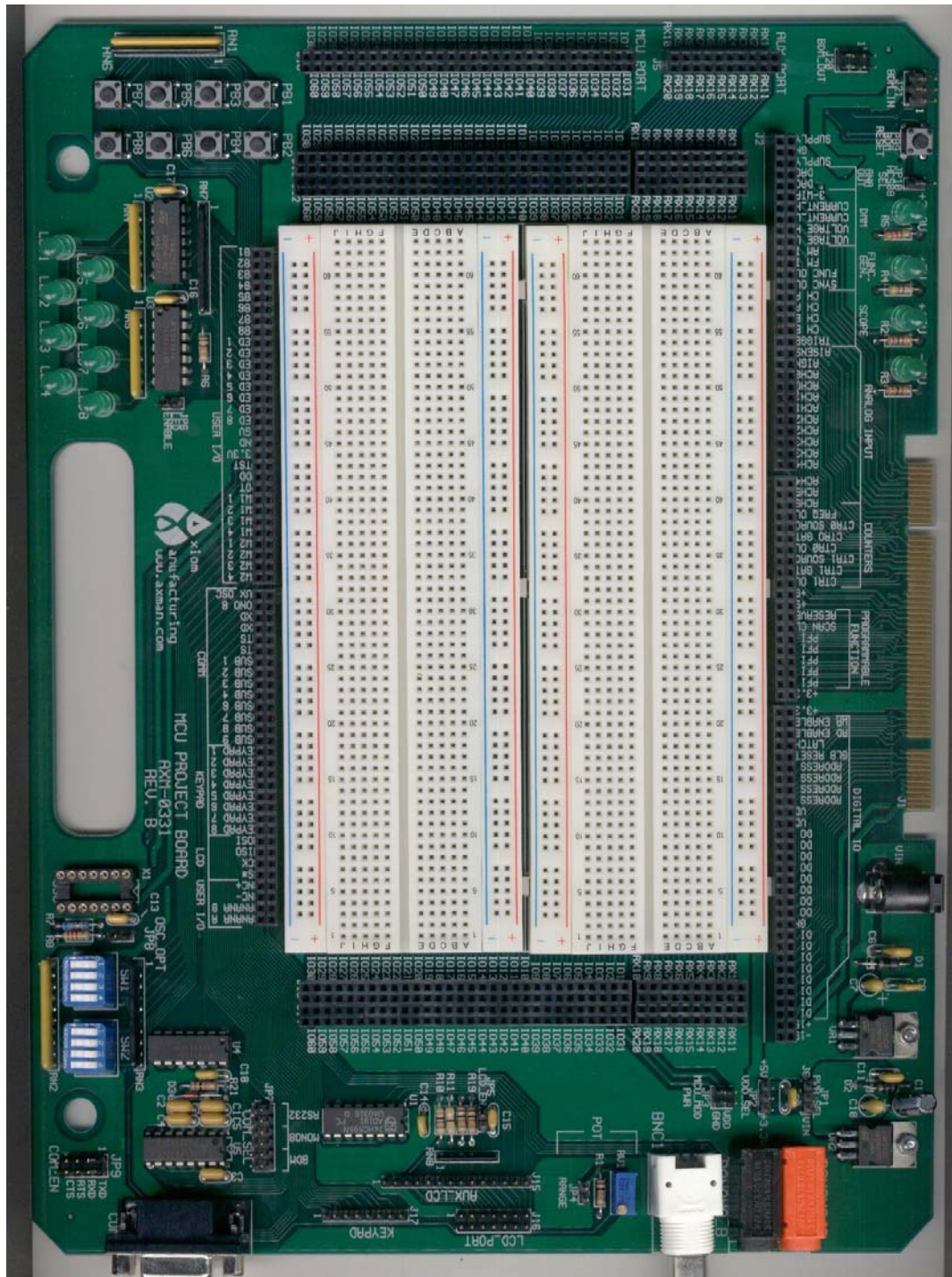
4.1.7 Modules

RG60
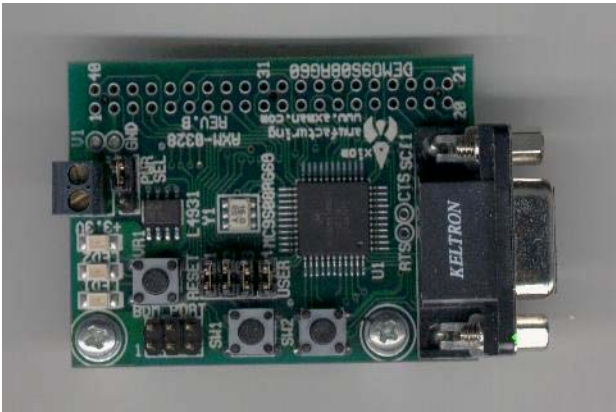
C32
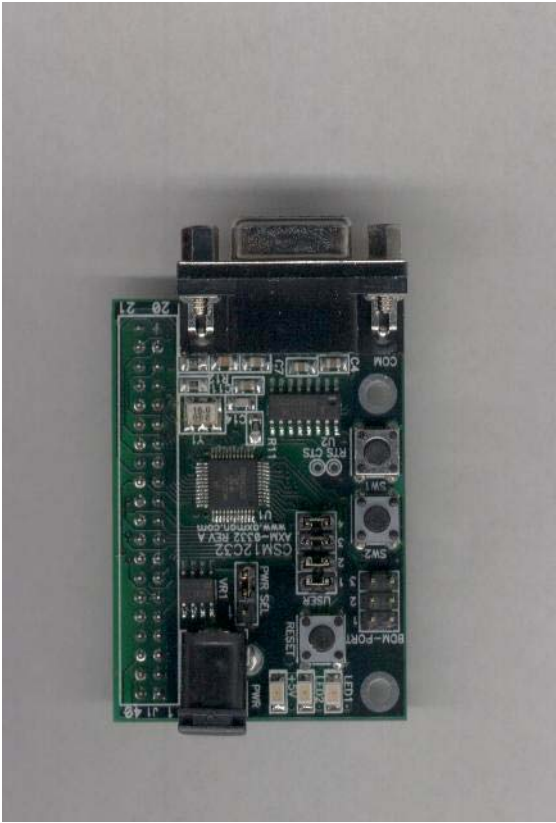
56F801
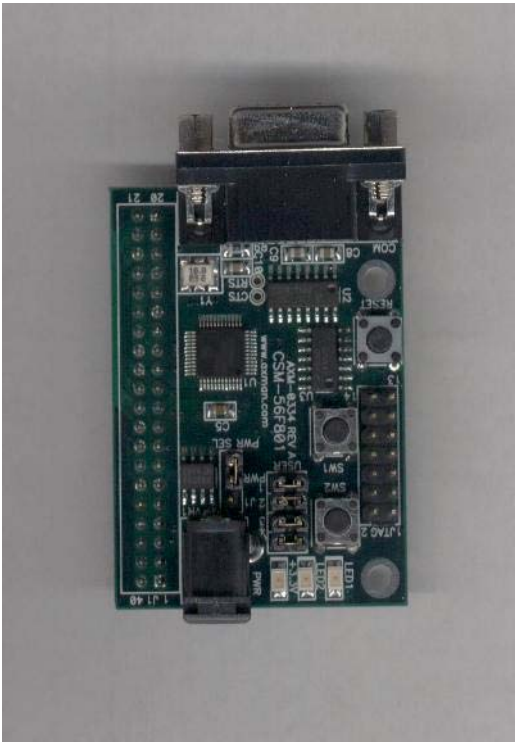
4.2 Lab Selection Choices

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┌─────────────────┐
│     Start       │
│  Lab Selection  │
└─────────────────┘
         │
         ▼
       ╱╲                  Yes    ┌──────────────────────────────┐
      ╱    ╲ ─────────────────────▶│ Project Board Table 10       │
     ╱ Stand ╲                     │ MCU Project Board Table 11   │
     ╲ Alone ╱                     └──────────────────────────────┘
      ╲ Lab ╱
       ╲╱
         │ No
         ▼
       ╱╲                  Yes    ┌──────────────────────────────┐
      ╱    ╲ ─────────────────────▶│   CME-11E9 EVBU Table 1      │
     ╱ HC11 ╲                      │        And/or                │
     ╲      ╱                      │   Project Board Table 4      │
      ╲    ╱                       │   MCU Project Board TBD      │
       ╲╱                          └──────────────────────────────┘
         │ No
         ▼
       ╱╲                  Yes    ┌──────────────────────────────┐
      ╱    ╲ ─────────────────────▶│  CML-9S12DP256 Table 3       │
     ╱ HC12 ╲                      │   CML-12C32 Table 2          │
     ╲      ╱                      │        And/or                │
      ╲    ╱                       │  Project Board Table 5,6     │
       ╲╱                          │ MCU Project Board Table 7,8  │
         │ No                      └──────────────────────────────┘
         ▼
       ╱╲                  Yes    ┌──────────────────────────────┐
      ╱    ╲ ─────────────────────▶│    CME-8GB60 Table 9         │
     ╱ HCS  ╲                      └──────────────────────────────┘
     ╲  08  ╱
      ╲    ╱
       ╲╱
         │
         ▼
┌─────────────────┐
│    Future       │
│   Products      │
└─────────────────┘
```

- Choose the correct microcontroller by reading the description of each board in the description section.

- Choose between using add-on components in the breadboard area or adding one of the PROJECT boards (CME-11E9-EVBU, CML-12C32, and CML-9S12DP256 only) with components already mounted. CME-8GB60 already contains several components but components can be added in breadboard area.

- Decide which lab experiments to follow such as LEDS, KeyPad. Print the lab manuals using the file name under the column 'File'. All lab manuals have a descriptive file name; example Key1DP is KeyPad on a HC11 connected to the PROJECT board.

- Follow the instructions given in the lab manual. The lab will reference the source and S19 file if used in the lab experiment.

4.3 Conclusion

Axiom Manufacturing is your source for a complete line of Motorola microcontroller based educational products. Whether your nee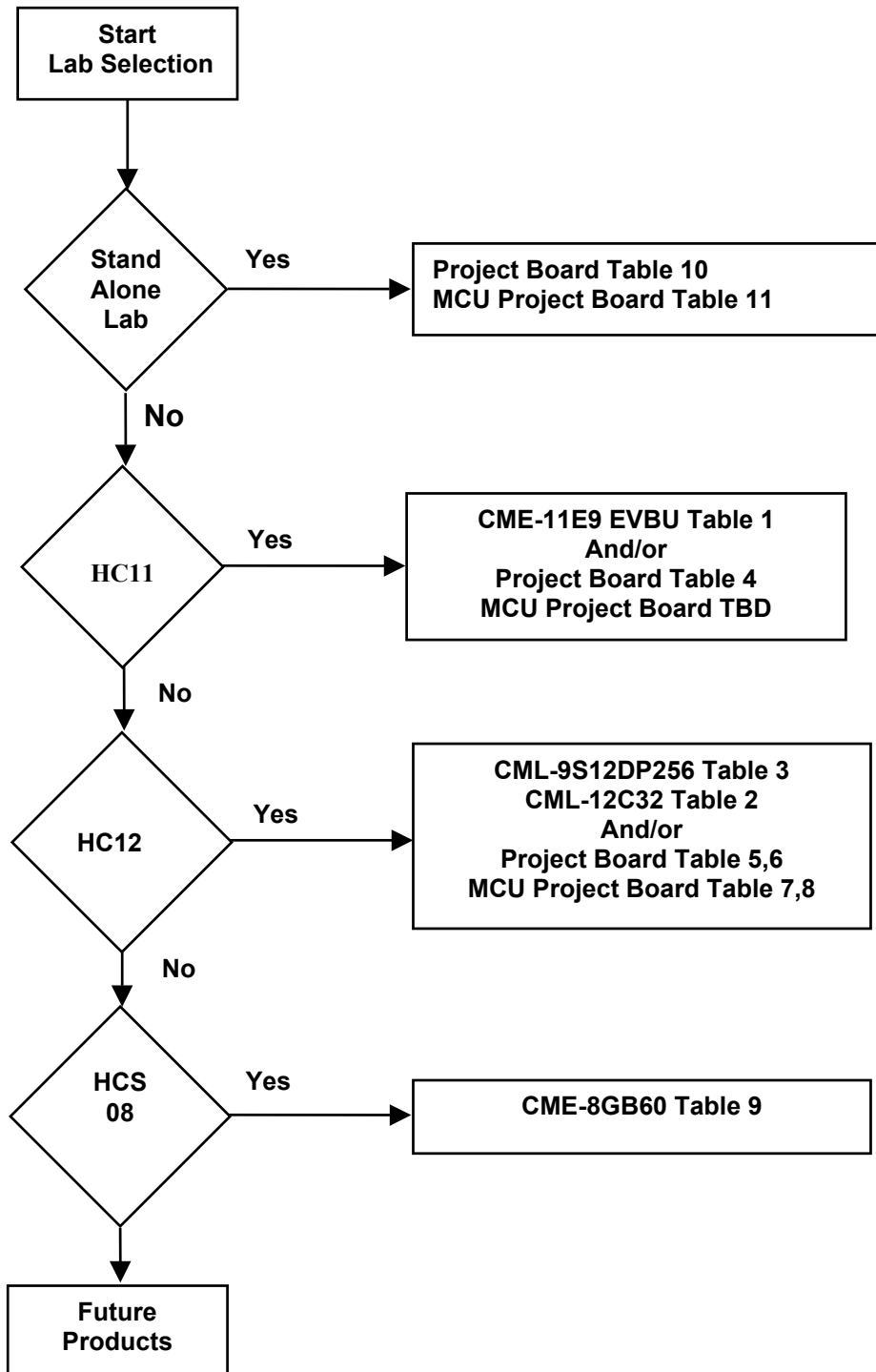d is a HC08, HCS08, HC11, HC12, or HCS12 based product, we have a kit to fit your need. Some customers have even used some of our MPC555 products.

5.0 Reference Tables

The following tables are arranged by the hardware used. The EVBU or CML12 can be used as stand alone or with a PROJECT BOARD. The CME-8GB60 is stand-alone only. The lab manuals are listed with source and .S19 file. The first letters of the file name give the name of the lab. Brackets [ ] means lab is written but not released at this time. < > Means lab is planned for the future.

Example: LEDS   2   A   P

Name

Micro-Controller
1 = HC11
2 = DP256 HC12
6 = GB60
C = C32   HC12

Port Type
A = Analog
D = Direct
E = Expanded
P = PWM
S = SPI

Options
P = PROJECT Board
M = MCU PROJECT Board
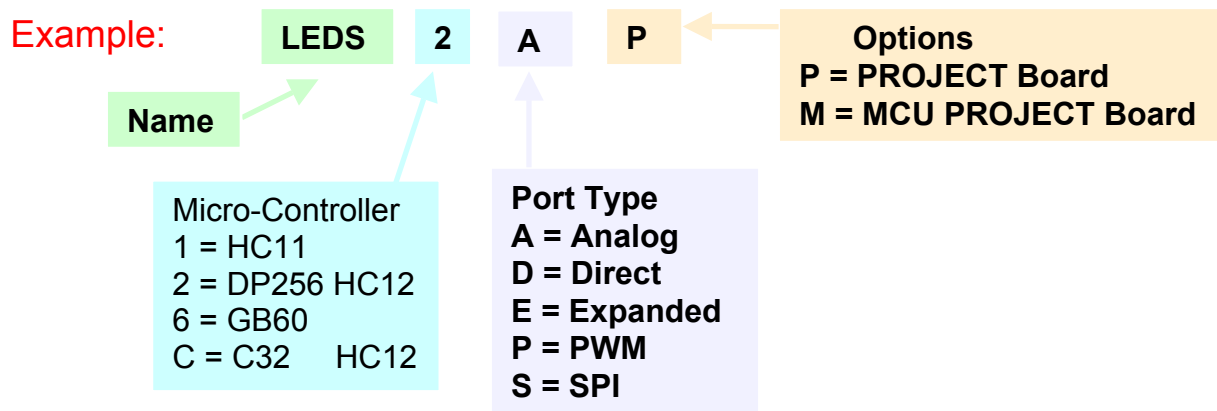
6.0 Tables

6.1 Table 1 CME-11E9-EVBU Labs

Lab Manual	File	Source	S19
DIP Switch	HC11_DIP1D.PDF	DIP1D.ASM	DIP1D.S19
[Keypad]	KEY1D.PDF	SCAN1D.ASM	SCAN1D.S19
[LEDS]	LEDS1D.PDF	LEDS1D.ASM	LEDS1D.S19
[LED BAR]	LEDB1D.PDF	LEDB1D.ASM	LEDB1D.S19
[LCD Display]	LCD1E.PDF	LCD1E.ASM	LCD1E.S19
Potentiometer	HC11_POT1A.PDF	POT1A.ASM	POT1A.S19
Push Button	HC11_PshB1D.PDF	PSHB1D.ASM	PSHB1D.S19
7-Segment	HC11_7Segdisplay.PDF	7-SEG1D.ASM	7-SEG1D.S19
Temperature	HC11_Temp.PDF	TEMP1A.ASM	TEMP1A.S19

6.2 Table 2 CML-12C32 Labs

Lab Manual	File	Source	S19
DIP Switch	DIPCD.PDF	DIPCD.ASM	DIPCD.S19
<Keypad>	KEYCD.PDF	KEYCD.ASM	KEYCD.S19
LEDS	C32_LEDSCD.PDF	LEDSCD.ASM	LEDSCD.S19
<LED BAR>	LEDBCD.PDF	LEDBCD.ASM	LEDBCD.S19
< LCD >	LCDCS.PDF	LCDCS.ASM	LCDCS.S19
< Potentiometer >	POTCA.PDF	POTCA.ASM	POTCA.S19
<Push Button>	PSHBCD.PDF	PSHBCD.ASM	PSHBCD.S19
Seven-Segment	C32-7SEGDISPLAY.PDF	7-SEGCD.ASM	7-SEGCD.S19
Temperature	C32_TEMP.PDF	TEMPCA.ASM	TEMPCA.S19

6.3 Table 3 CML-9S12DP256 Labs

Lab Manual	File	Source	S19
DIP Switch	Hc12_DIP2D.PDF	DIP2D.ASM	DIP2D.S19
[Keypad]	KEY2D.PDF	KEY2D.ASM	KEY2D.S19
LEDS	Hc12_LEDS2D.PDF	LEDS2D.ASM	LEDS2D.S19
[LED BAR]	LEDB2D.PDF	LEDB2D.ASM	LEDB2D.S19
[LCD]	LCD2S.PDF	LCD2S.ASM	LCD2S.S19
[Potentiometer]	POT2A.PDF	POT2A.ASM	POT2A.S19
Push Button	HC12_Push2D.PDF	PSHB2D.ASM	PSHB2D.S19
Seven-Segment	Hc12_7Segdisplay.PDF	7-SEG2D.ASM	7-SEG2D.S19
Temperature	HC12_TEMP.PDF	TEMP2A.ASM	TEMP2A.S19

6.4 Table 4 CME-11E9-EVBU & PROJECT Labs

Lab Manual	File	Source	S19
<Buzzer>	BUZ1DP.PDF	BUZ1DP.ASM	BUZ1DP.S19
DIP Switch	DIP1DP.PDF	DIP1D.ASM	DIP1D.S19
Keypad	KEY1DP.PDF	SCAN1D.ASM	SCAN1D.S19
LEDS	LEDS1DP.PDF	LEDS1D.ASM	LEDS1D.S19
LED BAR	LEDB1DP.PDF	LEDB1D.ASM	LEDB1D.S19
Potentiometer	POT1AP.PDF	POT1A.ASM	POT1A.S19
<Push Button>	PUSHB1DP.PDF	PUSHB1DP.ASM	PUSHB1DP.S19
< Relay >	RELAY1PP.PDF	RELAY1D.ASM	RELAY1D.S19
7-Segment	7-SEG1DP.PDF	7-SEG1D.ASM	7-SEG1D.S19
< Temperature >	TEMP1AP.PDF	TEMP1A.ASM	TEMP1A.S19
<Simple DC Motor>	SMOT1D.PDF	SMOT1D.ASM	SMOT1D.ASM

6.5 Table 5 CML-9S12C32 & PROJECT Board Labs

Lab Manual	File	Source	S19
<Buzzer>	BUZCDP.PDF	BUZCDP.ASM	BUZCDP.S19
< DIP Switch >	DIPCD.PDF	DIPCD.ASM	DIPCD.S19
< Keypad >	KEYCD.PDF	KEYCD.ASM	KEYCD.S19
[LEDS]	LEDSCD.PDF	LEDSCD.ASM	LEDSCD.S19
< LED BAR >	LEDBCD.PDF	LEDBCD.ASM	LEDBCD.S19
< LCD >	LCDCSP.PDF	LCDCSP.ASM	LCDCSP.S19
< Potentiometer >	POTCA.PDF	POTCA.ASM	POTCA.S19
< Push Button >	PSHBCD.PDF	PSHBCD.ASM	PSHBCD.S19
< Seven-Segment >	7-SEGCD.PDF	7-SEGCD.ASM	7-SEGCD.S19
< Temperature >	TEMPCA.PDF	TEMPCA.ASM	TEMPCA.S19
<Simple DC Motor>	SMOTCD.PDF	SMOTCD.ASM	SMOTCD.ASM
<Servo>	TBD	TBD	TBD
<Stepper Unipolar>	TBD	TBD	TBD

6.6 Table 6 CML-9S12DP256 & PROJECT Board Labs

Lab Manual	File	Source	S19
<Buzzer>	BUZ2DP.PDF	BUZ2DP.ASM	BUZ2DP.ASM
DIP Switch	DIP2DP.PDF	DIP2D.ASM	DIP2D.S19
[Keypad]	KEY2DP.PDF	SCAN2D.ASM	SCAN2D.S19
[LCD]	LCD2SP.PDF	LCD2SP.ASM	LCD2SP.S19
LEDS	LEDS2DP.PDF	LEDS2D.ASM	LEDS2D.S19
LED BAR	LEDB2DP.PDF	LEDB2D.ASM	LEDB2D.S19
[Potentiometer]	POT2AP.PDF	POT2A.ASM	POT2A.S19
[Push Button]	PSHB2DP.PDF	PSHB2DP.ASM	PSHB2DP.S19
[Relay]	RELAY2DP.PDF	Relay2D.ASM	RELAY2D.S19
Seven-Segment	7-SEG2DP.PDF	7-SEG2D.ASM	7-SEG2D.S19
[Temperature]	TEMP2AP.PDF	TEMP2A.ASM	TEMP2A.S19
<Simple DC Motor>	SMOT2D.PDF	SMOT2D.ASM	SMOT2D.ASM
<Servo>	TBD	TBD	TBD
<Stepper Unipolar>	TBD	TBD	TBD

6.7 Table 7 CML-9S12C32 & MCU Project Labs

Lab Manual	File	Source	S19
< DIP Switch >	DIP2DP.PDF	DIP2D.ASM	DIP2D.S19
< Keypad >	KEY2DM.PDF	SCAN2D.ASM	SCAN2D.S19
< LCD >	LCDCSM.PDF	LCDCSM.ASM	LCDCSM.ASM
< LEDS >	LEDS2DM.PDF	LEDS2DM.ASM	LEDS2DM.S19
< LED BAR >	LEDB2DM.PDF	LEDB2DM.ASM	LEDB2DM.S19
< Potentiometer >	POT2AP.PDF	POT2A.ASM	POT2A.S19
< Push Button >	PSHB2DM.PDF	PSHB2DM.ASM	PSHB2DM.S19
< Seven-Segment >	7-SEG2DM.PDF	7-SEG2DM.ASM	7-SEG2DM.S19
< Temperature >	TEMP2AM.PDF	TEMP2AM.ASM	TEMP2AM.S19
< Voice Recorder >	TBD	TBD	TBD

6.8 Table 8 CML-9S12DP256 & MCU PROJECT Labs

Lab Manual	File	Source	S19
< DIP Switch >	DIP2DP.PDF	DIP2D.ASM	DIP2D.S19
< Keypad >	KEY2DP.PDF	SCAN2D.ASM	SCAN2D.S19
< LCD >	LCD2SM.PDF	LCD2SM.ASM	LCD2SM.S19
LEDS	LEDS2DM.PDF	LEDS2DM.ASM	LEDS2DM.S19
< LED BAR >	LEDB2DP.PDF	LEDB2D.ASM	LEDB2D.S19
< Potentiometer >	POT2AP.PDF	POT2A.ASM	POT2A.S19
< Push Button >	PSHB2DP.PDF	PSHB2DP.ASM	PSHB2DP.S19
< Seven-Segment >	7-SEG2DP.PDF	7-SEG2D.ASM	7-SEG2D.S19
< Temperature >	TEMP2AP.PDF	TEMP2A.ASM	TEMP2A.S19
< Voice Recorder >	TBD	TBD	TBD

6.9 Table 9 CME-8GB60 Labs

Lab Manual	File	Source	S19
<Buzzer>	BUZ6D.PDF	BUZ6D.ASM	BUZ6D.S19
<DIP Switch>	DIP6D.PDF	DIP6D.ASM	DIP6D.S19
[LEDS]	LEDS6D.PDF	LEDS6D.ASM	LEDS6D.S19
<LCD>	LCD6D.PDF	LEDS6D.ASM	LEDS6D.S19
< Potentiometer >	POT6A.PDF	POT6A.ASM	POT6A.S19
<Push Button>	PSHB6D.PDF	PSHB6D.ASM	PSHB6D.S19

6.10 Table 10 Project Board Labs

Lab Manual	File	Source	S19
Over_Temp_Alarm	OTUT.PDF	N/A	N/A
< Voice Recorder >	TBD	TBD	TBD

6.11 Table 11 MCU Project Board Labs

Lab Manual	File	Source	S19
Over_Temp_Alarm	TBD	TBD	TBD
< Voice Recorder >	TBD	TBD	TBD

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                    ┌─────────────────────────────┐
                    │    Educational Products     │
                    └─────────────────────────────┘
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HC11 Family	HC08 Family	HC12 Family
Hardware CME-11E9-EVBU Lab Experiments **Keypad** **LEDS** **LCD** **LED BAR** **7-Segment** **Potentiometer**	Hardware CME-8GB60 Lab Experiments **Buzzer** **Dip Switch** **LEDS** **LCD** **Potentiometer** **Push Buttons**	Hardware CML-9S12DP256 CML-12C32 Lab Experiments **Keypad** **LEDS** **LCD** **LED BAR** **7-Segment** **Potentiometer**

```
                    ┌─────────────────────────────┐
                    │          Optional           │
                    │                             │
                    │       Project Board         │
                    │     MCU Project Board       │
                    └─────────────────────────────┘
```

7.0 Notes