

PCD-E12

REFERENCE MANUAL

for Revision 0 boards

MANUAL Revision 0.3

Copyright 2002. EMAC Inc.

UNAUTHORIZED COPYING, DISTRIBUTION, OR MODIFICATION PROHIBITED

EMAC, inc.
EQUIPMENT MONITOR AND CONTROL
2390 EMAC Way, Carbondale, Illinois 62901
World Wide Web: <http://www.emacinc.com>
Phone: (618) 529-4525 Fax: (618) 457-0110

DISCLAIMER

EMAC Inc. does not assume any liability arising out of the application or use of any of its products or designs. Products designed or distributed by EMAC Inc. are not intended for, or authorized to be used in, applications such as life support systems or for any other use in which the failure of the product could potentially result in personal injury, death or property damage.

If EMAC Inc. products are used in any of the aforementioned unintended or unauthorized applications, Purchaser shall indemnify and hold EMAC Inc. and its employees and officers harmless against all claims, costs, damages, expenses, and attorney fees that may directly or indirectly arise out of any claim of personal injury, death or property damage associated with such unintended or unauthorized use, even if it is alleged that EMAC Inc. was negligent in the design, documentation or manufacture of the product.

EMAC Inc. reserves the right to make changes to any products with the intent to improve overall quality, without further notification.

FCC COMPLIANCE

EMAC's PCD series of PC daughtercards are classified as sub-assemblies per FCC CST bulletin, No. 62, May 1984. The bulletin states that sub-assemblies are not themselves subject to the FCC rules. Only the end product is directly subject to the rules.

TECHNICAL SUPPORT

Please refer technical support issues to <http://www.emacinc.com/support/>

INTRODUCTION

The PCD-E12 Analog and Digital I/O Daughter Board adds expanded I/O capability to the PCM-53E52 SBC. It adds the following features:

- Motorola HS12 processor.
- An additional RS-232 port.
- 24 Digital I/O lines in a standard 50 pin I/O Rack compatible header.
 - 8 are high current sink outputs which also have 8 bit resolution PWM capability.
 - 8 have 16 bit resolution PWM capability.
- 16 channels of A/D with 10-bit resolution (0 to 5V).
- Keypad interface for decoding 3x4, 4x4, 5x4 or 6x4 matrix keypads.

Optional features

- Additional 8 channels of 12-bit resolution A/D (0 to 5V)
- 4 channels of D/A with 12-bit resolution (0 to 5V)
- RS-422/485 serial port

The PCD can also be custom programmed by EMAC (contact a salesperson for details). Some features that are available in custom programmed applications:

- SPI port that can be used in master or slave mode
- I2C port
- CAN 2.0B port
- LCD interface which can drive character or graphic type displays
- RS-232 and RS-485 ports with configurable protocol and standard baud rates up to 230kbaud and higher non-standard baud rates.
- Additional PWM channels.
- 21 additional I/O lines available .
 - 11 available if LCD interface is not needed.
 - 10 available if keypad interface is not needed.
- 16 additional input lines available if the 10 bit A/Ds are not needed.
- DAC waveform generator/sequencer.
- Up to 14 edge triggered interrupt inputs.
 - 6 available if keypad interface is not needed.
 - 8 available if the 8 channels of 16 bit resolution PWM capability is not needed.
- Larger matrix keypad decoder.
- Stepper motor driver.
- Quadrature decoder(s).
- Mouse driver.
- Stand-alone operation (operation without PCM-53E52).
- Direct desktop PC connection via RS-232 port
- Stand-alone multi-node network.
 - RS-458 network.
 - CAN 2.0B network.

DIGITAL I/O

PX0-PX7 (Block 0, Port 0)

These are abbreviated B0P0 in the diagram. Each line of PX0-PX7 is individually capable of sinking 500mA, and the driver package power dissipation limit is typically 0.93W. Each line is capable of withstanding an open circuit voltage of up to 26V. B0P0 is not configurable and is set up as output only. These port lines can only be controlled using the PWM control functions. To activate or deactivate a line, set the PWM percentage to 100 or 0, respectively.

PX8-PX15 (Block 0, Port 1)

These pins are referenced in the C drivers as block 0, port 1 (abbreviated B0P1 in the diagram). Each port line can be individually configured as an input or output.

PX16-PX23 (Block 0, Port 2)

These pins are referenced in the C drivers as block 0, port 2 (abbreviated B0P2 in the diagram). Each port line can be individually configured as an input or output.

PWM

Each line of B0P0 is an 8 bit PWM output and each line of B0P1 can be individually configured as a 16 bit PWM output. The 16 PWM channel numbers referred to in the C drivers correspond to the respective PXX number shown in the diagram.

HDR3		
50	49	
GND	o o	VCC
GND	o o	PX0 B0P0.0
GND	o o	PX1 B0P0.1
GND	o o	PX2 B0P0.2
GND	o o	PX3 B0P0.3
GND	o o	PX4 B0P0.4
GND	o o	PX5 B0P0.5
GND	o o	PX6 B0P0.6
GND	o o	PX7 B0P0.7
GND	o o	PX8 B0P1.0
GND	o o	PX9 B0P1.1
GND	o o	PX10 B0P1.2
GND	o o	PX11 B0P1.3
GND	o o	PX12 B0P1.4
GND	o o	PX13 B0P1.5
GND	o o	PX14 B0P1.6
GND	o o	PX15 B0P1.7
GND	o o	PX16 B0P2.0
GND	o o	PX17 B0P2.1
GND	o o	PX18 B0P2.2
GND	o o	PX19 B0P2.3
GND	o o	PX20 B0P2.4
GND	o o	PX21 B0P2.5
GND	o o	PX22 B0P2.6
GND	o o	PX23 B0P2.7
	2	1

ANALOG I/O

DAC0-DAC3

These correspond to the 4 channels of the optional 12 bit DAC (digital to analog convertor). A value of 0x000 to 0xFFF output to a DAC will produce a 0 to 5V output, respectively.

B1A0-B1A7

These correspond to the 8 channels of the optional 12 bit ADC (referred to as block 1 in the C drivers). A 0V to 5V signal applied to any of these channels will result in a digital conversion of 0x000 to 0xFFF, respectively.

B0A0-B0A15

These correspond to the 16 channels of the 10 bit ADC (referred to as block 0 in the C drivers). A 0V to 5V signal applied to any of these channels will result in a digital conversion of 0x000 to 0x3FF, respectively.

HDR5		
40	39	
DAC3	o o	DAC2
DAC1	o o	DAC0
GND	o o	GND
B1A7	o o	B1A6
B1A5	o o	B1A4
GND	o o	GND
B1A3	o o	B1A2
B1A1	o o	B1A0
GND	o o	GND
B0A15	o o	B0A14
B0A13	o o	B0A12
GND	o o	GND
B0A11	o o	B0A10
B0A9	o o	B0A8
GND	o o	GND
B0A7	o o	B0A6
B0A5	o o	B0A4
GND	o o	GND
B0A3	o o	B0A2
B0A1	o o	B0A0
	2	1

KEYPAD INTERFACE

The PCD decodes a keypad according to the "RETURN VALUES" table. A connection between an X and Y pin will produce the ASCII value as shown in the table. For example a connection between X2 and Y3 will produce the ASCII character 'N'. The "4x4" and "3x4" columns show the proper method of connecting EMAC's 4x4 and 3x4 keypads.

HDR 1	4x4	3x4	RETURN VALUES TABLE						
1				X1	X2	X3	X4	X5	X6
o X6									
o X5									
o X4	1								
o X3	2	1	Y1-	A	B	C	D	E	F
o X2	3	2							
o X1	4	3	Y2-	G	H	I	J	K	L
o Y4	5	4							
o Y3	6	5	Y3-	M	N	O	P	Q	R
o Y2	7	6							
o Y1	8	7	Y4-	S	T	U	V	W	X
o GND	9	8							
11									

RS-232 PORT

The current version of the firmware has a fixed baud rate of 9600, with 8 data bits, no parity, 1 stop bit and no hardware flow control.

HDR6	
1	2
n.c.	o o n.c.
RX	o o RTS
TX	o o CTS
n.c.	o o n.c.
GND	o o n.c.
9	10
n.c. = no connect	

USING THE PCD-E12 WITH THE PCM-53E52 IN LINUX

The standard EMAC Linux distribution for the PCM-53E52 contains an application program called PCDConsol which demonstrates the various functions of the PCD-E12. This program has 2 layers, The application layer and the wrapper functions.

The application layer contains all of the menus and the user interface. It is meant to be an example of a high level interface to the PCD-E12. The next level down, the wrapper layer, contains the functions called by the application layer. These functions make calls to the Linux PCD-E12 driver by opening certain character devices that are created at boot time. The wrapper functions have been designed to provide a portable interface between drivers in different operating systems, and are meant to provide easy way to develop OEM code for the PCD-E12.

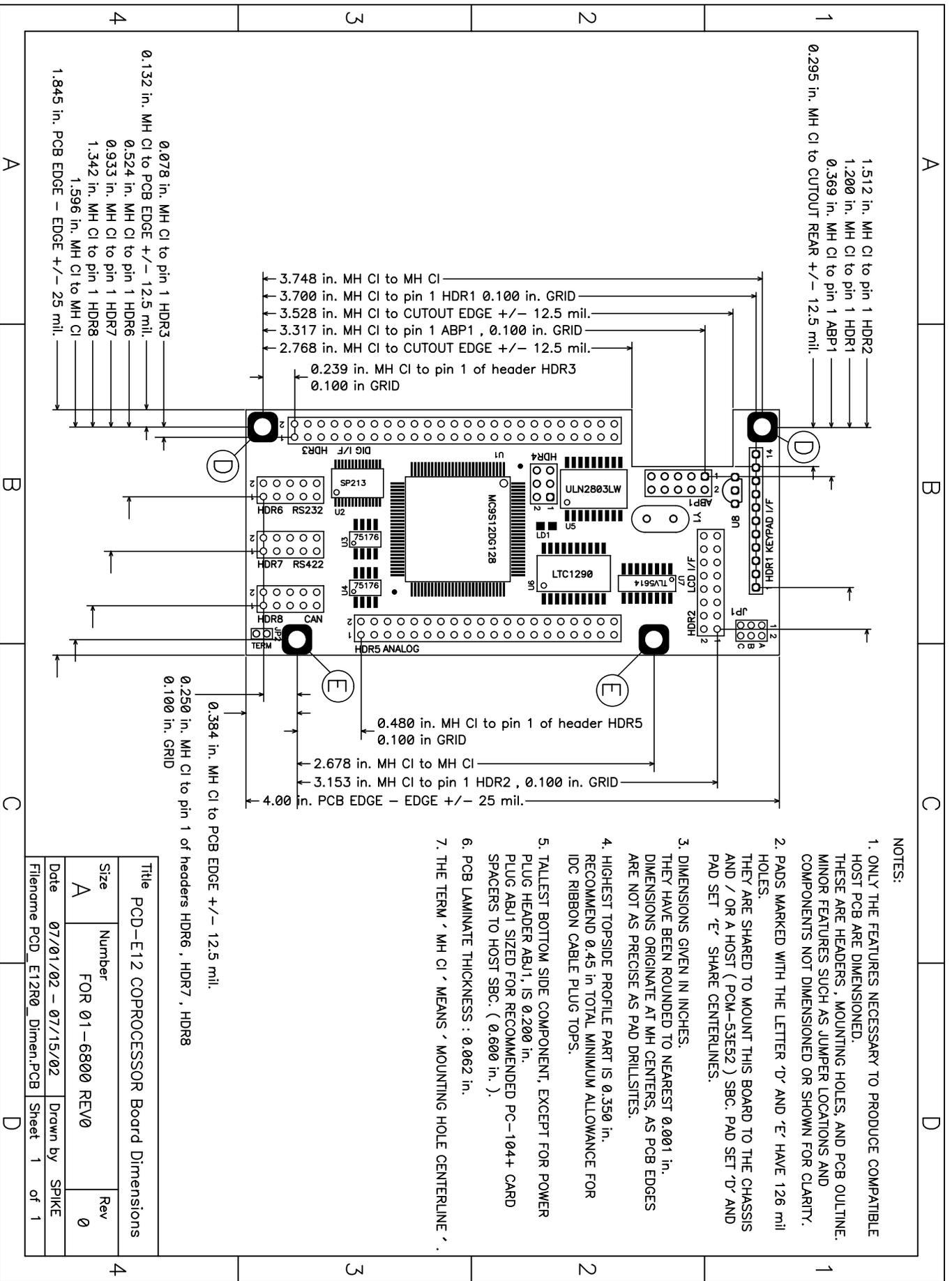
Running PCDConsol from the SIB Configuration Menu

The SIB configuration menu starts on any successful root login, and contains an option to run the PCDConsol program. Typing "d" or "D" will start the application and exiting the application will return the user to the configuration menu.

Running PCDConsol from the Bash Prompt

For those not familiar with Bash, programs within the path can be executed simply by typing their name into the prompt. Since the application is located in the /usr/bin, which is within the path, the root user can run it at any time by typing "PCDConsol" and hitting enter.

By default the application is only executable by the root user, but this could be changed with chmod (ie. `chmod 777 /usr/bin/PCDConsol`).



NOTES:

1. ONLY THE FEATURES NECESSARY TO PRODUCE COMPATIBLE HOST PCB ARE DIMENSIONED. THESE ARE HEADERS, MOUNTING HOLES, AND PCB OUTLINE. MINOR FEATURES SUCH AS JUMPER LOCATIONS AND COMPONENTS NOT DIMENSIONED OR SHOWN FOR CLARITY.
2. PADS MARKED WITH THE LETTER 'D' AND 'E' HAVE 126 mil HOLES. THEY ARE SHARED TO MOUNT THIS BOARD TO THE CHASSIS AND / OR A HOST (PCM-53E52) SBC. PAD SET 'D' AND PAD SET 'E' SHARE CENTERLINES.
3. DIMENSIONS GIVEN IN INCHES. THEY HAVE BEEN ROUNDED TO NEAREST 0.001 in. DIMENSIONS ORIGINATE AT MH CENTERS, AS PCB EDGES ARE NOT AS PRECISE AS PAD DRILLSITES.
4. HIGHEST TOPSIDE PROFILE PART IS 0.350 in. RECOMMEND 0.45 in TOTAL MINIMUM ALLOWANCE FOR IDC RIBBON CABLE PLUG TOPS.
5. TALLEST BOTTOM SIDE COMPONENT, EXCEPT FOR POWER PLUG HEADER ABU1, IS 0.200 in. PLUG ABU1 SIZED FOR RECOMMENDED PC-104+ CARD SPACERS TO HOST SBC. (0.600 in.).
6. PCB LAMINATE THICKNESS : 0.062 in.
7. THE TERM ' MH CI ' MEANS ' MOUNTING HOLE CENTERLINE '.

Title PCD-E12 COPROCESSOR Board Dimensions			
Size A	Number FOR 01-6800 REV0	Rev 0	
Date 07/01/02 - 07/15/02	Drawn by SPIKE	Sheet 1	of 1
Filename PCD_E12R0_Dimen.PCB			

C FUNCTION DEFINITIONS

BOOL PCDInitialize(void); //passed parameters (0)

Pre: The PCD Driver Driver must be Closed

Post:

The PCD Driver will be initialized upon Returning (TRUE)(1)
(SUCCESS)

The PCD Driver will not be initialized upon Returning (FALSE)(0)
(FAILURE)

Description:

A Call to this function will initialize the PCD Device Driver

BOOL PCDOpen(void); //passed parameters (0)

Pre: The Device must be Closed.
The Device must be Initialized

Post:

The PCD Driver will be open upon Returning (TRUE)(1)
(SUCCESS)

The PCD Driver will not be open upon Returning (FALSE)(0)
(FAILURE)

Description:

A successful return from this function will result in the
open state of the PCD and make it available for Read/Write
operations.

BOOL PCDClose(void); //passed parameters (0)

Pre: PCD must be Open.
PCD must be Initialized

Post:
The PCD Driver will be closed upon Returning (TRUE)(1)
(SUCCESS)

The PCD Driver will not be closed upon Returning (FALSE)(0)
(FAILURE)

Description:
A successful return from this function will result in the
closed state of the PCD and free driver allocated memory.

ULONG PCDGetKeypad(PUCHAR pTargetBuffer, //((unsigned char *) to
//array of characters or
//unsigned char string
//name

ULONG BufferLength); //unsigned long number of
//bytes to receive from
//keypad

Pre: PCD must be Open.
PCD must be Initialized

Post:
Returns a unsigned long number of bytes that was put into
pTargetBuffer

Description
This function gets a user-defined number of data bytes from
the keypad and puts the data into the pTargetBuffer.

```
WORD PCDGetA2DPort(int Block,          //Block 0 selects 10 bit A/D.  
int Channel);                          //Block 1 selects optional 12 bit A/D  
                                        //Block 0 channel range is 0 to 15  
                                        //Block 1 channel range is 0 to 7
```

Pre: PCD must be Open.
PCD must be Initialized

Post: PCD Returns a 16 bit unsigned short integer representing
the user defined Block and Channel.

Description: The PCD Driver returns a 16 bit unsigned short integer
representing the user selected Block and Channel.

```
BOOL PCDSetD2APort(int Block,          //Block 0  
int Channel,                          //Channels 0-3  
int DigitalValue);                    //0-0x3FF
```

Pre: PCD must be Open.
PCD must be Initialized

Post: The PCD Driver successfully set Block, Channel upon Returning
(TRUE)(1)(SUCCESS)

The PCD Driver failed to set Block, Channel upon Returning
(FALSE)(0)(FAILURE)

Description: This function sets the analog output of the selected DAC channel.

BOOL PCDSetDigitalConfig(int PortMask); //PortMask 0-65,535

Pre: PCD must be Open.
PCD must be Initialized

Post: Port Mask was set upon Returning (TRUE)(1)
(SUCCESS)

Port Mask was not set upon Returning (FALSE)(0)
(FAILURE)

Description:
Bits 0 to 15 of PortMask correspond directly to digital lines PX8 to PX23, respectively. A bit set to 1 configures the respective digital line as an output and a bit set to 0 makes it an input.

BYTE PCDGetDigitalPort(int Block, //Block 0
int Port, //Ports 1-2
BYTE Value); //Value 8-bit

Pre: PCD must be Open.
PCD must be Initialized.
PCD Digital Port Direction must be Set

Post: The PCD Driver Returns Byte for Block and Port

Description:
This function currently supports one Block and two Ports.
A modification will be made to output pins only.
Port 0 Currently Not Supported

BOOL PCDSetDigitalPort(int Block, //Block 0
int Port, //Ports 1, 2
BYTE Value); //Value 8-bit

Pre: PCD must be Open.
PCD must be Initialized.

Post: The PCD Driver successfully loaded Block, Port, Value upon
Returning (TRUE),(1),(SUCCESS).

The PCD Driver failed to load Block, Port, Value upon
Returning (FALSE),(0),(FAILURE).

Description:
This function currently supports one Block and two Ports.
A modification will be made to output pins only.
Port 0 Currently Not Supported

```
BOOL PCDSendSerialPort(PUCHAR pSourceBytes,    //(unsigned char *) to
                                                    //array of characters or
                                                    //unsigned char string
                                                    //name

ULONG NumberOfBytes);                          //unsigned long number of
                                                    //bytes to send to serial
                                                    //port
```

Pre: PCD must be Open.
PCD must be Initialized

Post: The PCD Driver successfully sent user defined number of bytes and load them from the pSourceBytes Buffer upon Returning (TRUE)(1)(SUCCESS)
The PCD Driver failed to send user defined number of bytes and load them from the pSourceBytes Buffer upon Returning (FALSE)(0)(FAILURE)

Description:
This function gets a user-defined number of data bytes from the PCD serial port and puts the data into the pTargetBuffer.

```
BOOL PCDGetSerialPort(PUCHAR pTargetBuffer,    //(unsigned char *) to
                                                    //array of characters
                                                    //or unsigned char
                                                    //string name

ULONG BufferLength);                          //unsigned long number of
                                                    //bytes to receive from
                                                    //serial port
```

Pre: PCD must be Open.
PCD must be Initialized

Post: The PCD Driver successfully received user defined number of bytes and loaded them into the PTargetBuffer upon Returning (TRUE)(1)(SUCCESS)
The PCD Driver failed to receive user defined number of bytes and load them into the PTargetBuffer upon Returning (FALSE)(0)(FAILURE)

Description:
This function gets a user-defined number of data bytes from the PCD serial port and puts the data into the pTargetBuffer.

```
BOOL PCDSetsPWMPort(int Channel, //Channels 0-15
int Frequency, //Frequency 0-100 (kHz)
int DutyCycle, //DutyCycle 0-100 (%)
int Delay); //Delay 0-65,535 (Milliseconds)
```

Pre: PCD must be Open.
PCD must be Initialized

Post:
upon Returning (TRUE)(1)
(SUCCESS)

upon Returning (FALSE)(0)
(FAILURE)

Description:
This function sets the Frequency, Duty Cycle, Delay for the
Channel PWM