Magellan™ Motion Processor
Developer's Kit Manual

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Related Documents

Magellan Motion Processor User's Guide

Complete description of the Magellan Motion Processor features and functions with detailed theory of its operation.

Magellan Motion Processor Programmer's Command Reference

Descriptions of all Magellan Motion Processor commands, with coding syntax and examples, listed alphabetically for quick reference.

Magellan Motion Processor Electrical Specifications

Booklets containing physical and electrical characteristics, timing diagrams, pinouts, and pin descriptions of each series:

MC58000 Series, for DC brush, brushless DC, Microstepping, and Pulse & Direction motion processors

MC55000 Series, for Pulse & Direction motion processors

Pro-Motion User's Guide

User's guide to Pro-Motion, the easy-to-use motion system development tool and performance optimizer. Pro-Motion is a sophisticated, easy-to-use program which allows all motion parameters to be set and/or viewed, and allows all features to be exercised.

Other Documents

ION Digital Drive User's Manual

How to install and configure ION Digital Drives.

Prodigy-PCI Motion Card User's Guide

How to install and configure the Prodigy-PCI motion board.

Prodigy-PC/104 Motion Card User's Guide

How to install and configure the Prodigy-PC/104 motion board.

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1. Installation

In This Chapter

The PMD Magellan Motion Processor Developer's Kit is an integrated board/software package that serves as an electrical and software design tool for building Magellan-based systems. The developer's kit supports all members of the Magellan family, as shown below:

Developer's Kit	Magellan Motion Processors supported	Installed Motion Processor	Motors Support
DK58420	MC58420, MC58320, MC58220, MC58120	MC58420	DC brush, brushless DC, pulse & direction, microstepping
DK55420	MC55420, MC55320, MC55220, MC55120	MC55420	Pulse & direction
DK58110	MC58110	MC58110	DC brush, brushless DC, pulse & direction, microstepping
DK55110	MC55110	MC55110	Pulse & direction

All of the above Developer's Kit versions share the same physical PC card as well as the same software CD. They differ in the specific type of chip that is installed in the motion card.

Because the installed chip for each Developer's Kit version supports the maximum number of axes allowed, it can be used to develop systems based on chipsets with fewer axes simply by disabling the unused axes. Alternatively, it is possible to have the Developer's Kit shipped with a different chipset from the same family version (with one, two, or three axes). Contact your PMD representative for details.

1.1 Components List

The Magellan Motion Processor Developer's Kit contains the following components:

5 4-axis PCI-bus Developer's Kit card

6 CD-ROM containing C-Motion, Pro-Motion, and documentation in PDF format

7 100-Pin Connector to dual 50-pin header converter cable (3' length)

8 Documentation:

Magellan Motion Processor Developer's Kit Manual

Magellan Motion Processor User's Guide

Magellan Motion Processor Programmer's Command Reference

Magellan Motion Processor Electrical Specifications (either for MC58000 or MC55000, depending on Developer's Kit ordered)

If any of these components are missing, please contact your PMD representative.

1.2 Software

Two major software packages are provided with the Magellan Motion Processor Developer's Kit cards: Pro-Motion, an interactive Windows-based exerciser program and C-Motion, a C-language library which simplifies the development of motion applications for Magellan Motion Processor Developer's Kit cards.

Pro-Motion is a sophisticated, easy to use exerciser program that allows you to set and view all card parameters, and exercise all card features. Pro-Motion features include:

- Motion oscilloscope graphically displays processor parameters in real-time
- Interactive servo tuning
- Project window for accessing card parameters
- Ability to save and load current settings
- Distance and time units conversion
- Motor-specific parameter setup
- Axis shuttle performs continuous back and forth motion between two positions
- Command window for direct text command entry
- Communications monitor that echoes all commands sent by Pro-Motion to the card.

C-Motion provides a convenient set of callable routines that comprise all of the code required for controlling your Magellan Motion Processor Developer's Kit card. C-Motion includes the following features:

- Axis virtualization
- The ability to communicate to multiple Magellan Motion Processor Developer's Kit cards
- Can be easily linked to any "C/C++" application

1.3 Documentation

There are four manuals specifically associated with the Magellan Developer's Kit cards. A brief description of each is listed below.

Component Part Number	Name	Description
DK5X000UG	Magellan Motion Processor Developer's Kit Manual	This is the first document you will turn to to get started, make connections, and exercise the card. This document will answer questions such as “How do I connect my amplifiers and motors to the card?” and “What jumper options do I set to use the card?” This document also provides a complete electrical description of the card, and a description of the associated software products C-Motion and Pro-Motion.
MC5X000UG	Magellan Motion Processor User’s Guide	This is a functional description of the Magellan Motion Processor, which is the chipset that is at the heart of the Magellan Motion Processor Developer’s Kit cards. This document will answer questions such as, “How do I make a trapezoidal move?” or “How do I load servo parameters?”
MC5X000PR	Magellan Motion Processor Programmer’s Command Reference	This document provides a complete listing of all motion commands supported by the Magellan Motion Processors.
MC58000ES MC55000ES	Magellan Motion Processor Electrical Specifications	This document provides electrical specifications for the Magellan Motion Processors. It includes electrical timing diagrams, mechanical packaging, pin lists, and other hardware-related information.

To download these documents, or request that they be sent to you, visit the PMD website at www.pmdcorp.com or contact your PMD representative.

1.4 Installation Sequence

For a normal installation of a Magellan Motion Processor Developer’s Kit card, you will need to configure your card for the PC system and motor hardware that you will connect it to. Configuration of the Magellan Motion Processor Developer’s Kit cards is described in detail in Section 1.6, “Preparing the Card for Installation.”

Next you will need to connect your system’s motors, encoders, amplifiers, and sensors as desired to operate your motion hardware. A description of the connections that are made for the various Magellan Motion Processor Developer’s Kit cards is found in Section 1.7, “Connection Summary.”

Once this hardware configuration is complete, you should then install the software. Installation of the software is described in Section 1.9, “Software Installation.”

The final step to finish the installation is to perform a functional test of the finished system. This is described in Section 1.10, “First Time System Verification.”

Once all of the above has been accomplished installation is complete, and you are ready to operate the card.

1.5 Required Hardware

To install a Magellan Motion Processor Developer's Kit card you will need the following hardware:

1. The recommended platform is an Intel (or compatible) processor, Pentium or better, one available PCI slot, 5MB of available disk space, 32MB of available RAM, and a CDROM drive. The PC operating system required is Windows 9X/ME/NT/2000/XP.
2. 1 to 4 pulse and direction, PWM, or analog-input amplifiers. The type of amplifier depends on the card type you are using.
3. 1 to 4 step motors or servo motors. These motors may or may not provide encoder position feedback signals depending on the type of card being used. Servo motors must have encoder feedback, while step motors can optionally do so.
4. Additional connectors as required to connect the Magellan Motion Processor Developer's Kit card to the amplifiers and the motors. A single 100-pin header-type connector will be needed to interface to your motion hardware.

1.6 Preparing the Card for Installation

To prepare your card for installation the following user-settable hardware option should be checked.

1.6.1 Resistor Packs

Item	How to Set	Description
Resistor packs RS1, RS2, RS3	Installed *this is the default setting of resistor packs RS1-RS3*	If you are using differential connections leave these resistor packs installed.
	Removed	If you are using single-ended encoder connections, remove the resistor packs.

1.6.2 Motor Type Switch Settings

When using the DK55000 only pulse and direction motors are used, and it is not necessary to set jumpers related to motor type. When using the DK58000 it is possible to support any combination of DC brush, brushless DC, microstepping, and pulse & direction motors all on the same card and dip switches 5 and 6 must be set to indicate the motor type that will be used. When configuring the dip switches and connecting your motors to the Developer's Kit Card, the following information may be helpful:

- *Brushless DC* means the card expects to connect to a brushless DC motor with Hall sensors and an encoder. With this connection, the Developer's Kit card performs the commutation and outputs a multi-phase signal, 2 or 3 phases per axis, to the amplifier.
- *Microstepping* means the card expects to connect to a step motor. With this connection, the Developer's Kit card performs the phasing, and outputs a multi-phase signal, 2 or 3 phases per axis, to a step motor amplifier that can accept this type of output. Quadrature feedback is optional with this type of motor.
- *Pulse and direction* means the card expects to connect to a step motor which uses a standard pulse and direction amplifier. Quadrature feedback is optional with this type of motor.
- *DC Brush* means the cards expects to connect to a DC brush motor with an encoder, or an externally commutated brushless DC motor (amplifier performs commutation). With this motor type the card outputs one phase per axis.

Motor Type Jumper Settings (for DK58000 only)

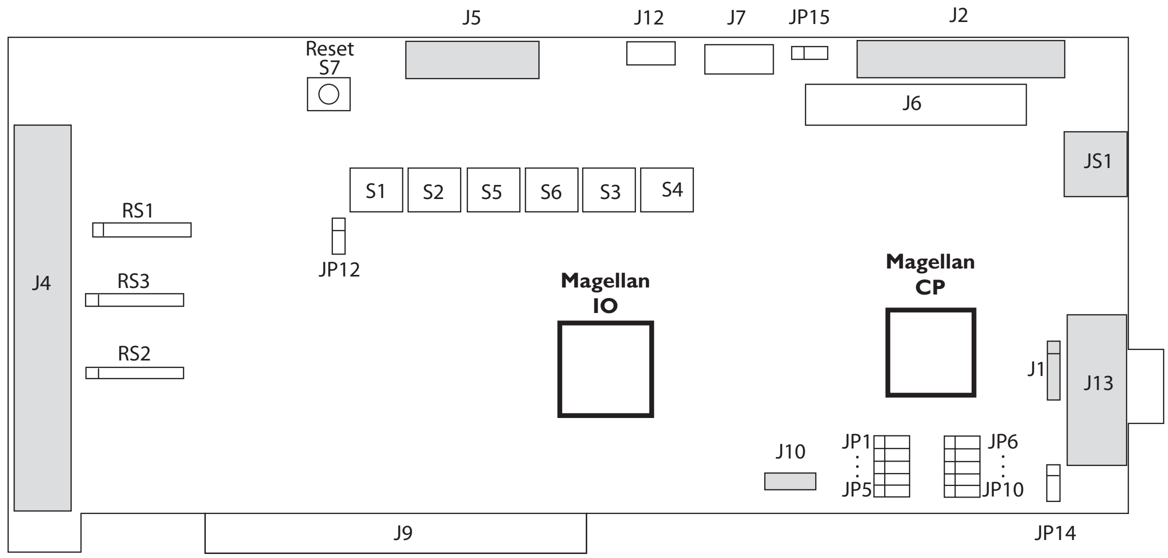
When referring to the table below the switch up position is relative to the bottom of the board where the PCI connector is located. The up position on the switch is marked **on**.

Item	Switches	Description				
Dip switch S5	S5-1	Axis #1 Motor type setting				
	S5-2	Set S5 1-4 dip switches according to the motor type you will be using on axis #1				
	S5-3	5-1	5-2	5-3	5-4	Axis #1
	S5-4	up	up	up	up	Brushless DC (3 phase)
		down	up	up	up	Brushless DC (2 phase)
		up	down	up	up	Microstepping DC (3 phase)
		down	down	up	up	Microstepping DC (2 phase)
		up	up	down	up	Pulse & direction
		down	down	down	up	DC brush (default setting)
Dip switch S5	S5-5	Axis #2 Motor type setting				
	S5-6	Set S5 5-8 dip switches according to the motor type you will be using on axis #2				
	S5-7	5-5	5-6	5-7	5-8	Motor type setting
	S5-8	up	up	up	up	Brushless DC (3 phase)
		down	up	up	up	Brushless DC (2 phase)
		up	down	up	up	Microstepping DC (3 phase)
		down	down	up	up	Microstepping DC (2 phase)
		up	up	down	up	Pulse & direction
		down	down	down	up	DC brush (default setting)
Dip switch S6	S6-1	Axis #3 Motor type setting				
	S6-2	Set S6 1-4 dip switches according to the motor type you will be using on axis #3				
	S6-3	6-1	6-2	6-3	6-4	Motor type setting
	S6-4	up	up	up	up	Brushless DC (3 phase)
		down	up	up	up	Brushless DC (2 phase)
		up	down	up	up	Microstepping DC (3 phase)
		down	down	up	up	Microstepping DC (2 phase)
		up	up	down	up	Pulse & direction
		down	down	down	up	DC brush (default setting)
Dip switch S6	S6-5	Axis #4 Motor type setting				
	S6-6	Set S6 5-8 dip switches according to the motor type you will be using on axis #4				
	S6-7	6-5	6-6	6-7	6-8	Motor type setting
	S6-8	up	up	up	up	Brushless DC (3 phase)
		down	up	up	up	Brushless DC (2 phase)
		up	down	up	up	Microstepping DC (3 phase)
		down	down	up	up	Microstepping DC (2 phase)
		up	up	down	up	Pulse & direction
		down	down	down	up	DC brush (default setting)

Unconnected motors can be left at the default setting of *DC Brush*.

The following diagram shows the location of the resistor packs RS1, RS2, RS3 and the mode jumper, along with other components such as connectors.

Figure 1-1: Location of various board elements



1.7 Connection Summary

The following sections summarize the connections you should make for various motor types.

1.7.1 DC Brush Motors

The following table summarizes connections to the Magellan Developer's Kit card when DC-brush motors are used.

All connections are made through connector J4, the primary 100-pin connector indicated in the figure above. For a detailed list of connections, see Chapter 3, "Magellan Developer's Kit Electrical Specifications."

Signal Category	Signal Description
Encoder input signals: *(per axis)*	A quadrature channel input B quadrature channel input Index pulse channel input
Amplifier output signals: *(per axis, if PWM sign, magnitude used)*	PWM direction PWM magnitude
Amplifier output signals: *(per axis, if PWM 50/50 used)*	PWM magnitude
Amplifier output signals: *(per axis, if analog output used)*	Analog out (DAC output)
Other control signals: *(optional, per axis)*	Home signal input Limit switch inputs AxisIn input AxisOut output
Miscellaneous signals:	Digital GND +5 V (for encoder power)

1.7.2 Brushless DC Motors

The following table summarizes connections to the Magellan Motion Processor Developer's Kit card when brushless DC motors are used. All of these connections are made through connector J4, the primary 100-pin connector. For detailed signal descriptions see Chapter 3, "Magellan Developer's Kit Electrical Specifications."

Signal Category	Signal Description
Encoder input signals: (per axis)	A quadrature channel input B quadrature channel input Index pulse channel input
Amplifier output signals: (per axis, if PWM 50/50 used)	PWM magnitude (phase A) PWM magnitude (phase B) PWM magnitude (phase C)
Amplifier output signals: (per axis, if analog output used)	Analog out (phase A) Analog out (phase B)
Hall inputs:	Hall (phase A) Hall (phase B) Hall (phase C)
Other control signals: (optional, per axis)	Home signal channel input Positive limit switch input Negative limit switch input AxisIn input AxisOut output
Miscellaneous signals:	GND +5 V (for encoder power)

1.7.3 Pulse & Direction Motors

The following table summarizes connections to the Magellan Motion Processor Developer's Kit card when pulse & direction interface step motors are used. All connections are made through connector J4, the primary 100-pin connector, indicated on *figure 1-1, page 12*. For detailed signal descriptions see Chapter 3, "Magellan Developer's Kit Electrical Specifications."

Signal Category	Signal Description
Encoder input signals: (optional, per axis)	A quadrature channel input B quadrature channel input Index pulse channel input
Amplifier output signals:	Pulse Direction
Other control signals: (optional, per axis)	AtRest signal output Home signal channel input Positive limit switch input Negative limit switch input AxisIn input AxisOut output
Miscellaneous signals:	GND +5 V (for encoder power)

1.7.4 Microstepping Motors

The following table summarizes connections to the Magellan Motion Processor Developer's Kit card when microstepping-interface step motors are used. All of these connections are made through connector J4, the primary 100-pin connector. For detailed signal descriptions see Chapter 3, "Magellan Developer's Kit Electrical Specifications."

Signal Category	Signal Description
Encoder input signals: (per axis)	A quadrature channel input B quadrature channel input Index pulse channel input
Amplifier output signals: (per axis, if PWM sign, magnitude used)	PWM magnitude (phase A) PWM magnitude (phase B) PWM direction (phase A) PWM direction (phase B)
Amplifier output signals: (per axis, if PWM 50/50 used)	PWM magnitude (phase A) PWM magnitude (phase B)
Amplifier output signals: (per axis, if analog output used)	Analog out (phase A) Analog out (phase B)
Other control signals: (optional, per axis)	Home signal channel input Positive limit switch input Negative limit switch input AxisIn input AxisOut output
Miscellaneous signals:	GND +5 V (for encoder power)

1.8 Applying Power

Once you have installed the Magellan Motion Processor Developer's Kit card in your PC and made the necessary connections to your external amplifiers and motor encoders, hardware installation is complete and the board is ready for operation.

Upon power up, the card will be in a reset condition. In this condition no motor output will be applied. Therefore, the motors should remain stationary. If the motors move or jump, power down the card and check the amplifier and encoder connections. If anomalous behavior is still observed, call PMD for application assistance.

1.9 Software Installation

Included in your developer's kit is a CDROM marked "Developer's Kit Software." This CD contains software to exercise your board and source code that will enable you to develop your own motion applications. The exercise software is designed to work with Windows 95/98/ME or Windows NT/2000/XP.

If you have autorun enabled, the installation process will start when you insert the CDROM. The installation program will guide you through installing the software. Upon completion of the installation process, the following components will be installed:

1 Pro-Motion – an application for communicating to and exercising the installed developer's kit.

2 C-Motion – source code that can be used for developing your own motion applications based on the Magellan Motion Processor. These files are installed in the "C-Motion" folder, a sub-folder of the installation folder.

3 "PDF" versions of the developer's kit manual, programmer's reference and user's guide. The Adobe Acrobat Viewer is required for viewing these files. If the Adobe Acrobat Viewer is not installed on your computer, you can download it from http://www.adobe.com.

4 Reference schematics from the Electrical Specifications manuals. These files are installed in the "Schematics" folder, a sub-folder of the installation folder.

5 Schematics for the Magellan Motion Processor DK board. These files are installed in the "Schematics" folder, a sub-folder of the installation folder.

6 Parts list for the board. The file "Magellan Motion Processor DK LOM.wri" is installed in the "Schematics" folder, a sub-folder of the installation folder.

1.10 First Time System Verification

To verify that the Magellan Motion Processor DK board and Pro-Motion software program have been properly installed, it is useful to have each axis of the system perform a short move. The instructions shown below are a summary. Before executing these commands you should refer to the section of the *Magellan Motion Processor User's Guide* that is relevant to the installed motion processor.

For the Magellan Motion Processor to perform this simple sequence it is necessary to specify two items; the motor amplifier type (PWM sign/mag, PWM 50/50, or analog), and the filter gains. For the Magellan Motion Processor parts it is necessary to specify these two items as well as initialize the Brushless motor.

The following table summarizes this. Note that the step numbers reference specific steps that are detailed in the following sections.

Note that the steps detailed in this section utilize the Command Line mode of Pro-Motion.

Motor Type	Step #	Operation
DC brush	1	Set amplifier type (PWM sign/mag, PWM 50/50, DAC)
	4	Set filter parameters
	6	Make a trajectory move
Brushless DC	1	Set amplifier type (PWM 50/50, DAC)
	2	Initialize commutation
	3	Check commutation
	4	Set filter parameters
	6	Make a trajectory move
Microstepping	1	Set amplifier type (PWM 50/50, DAC)
	5	Set the motor output power
	6	Make a trajectory move
Pulse & direction	6	Make a trajectory move

It is assumed that you will check out each axis of your system one at a time. This being the case, after executing Pro-Motion type one of the axis setting commands (#axis 1, #axis 2, #axis 3, or #axis 4) in the Command window and go through the whole checkout for that axis. Then, to check out other axes, enter a new axis number and check that axis out entirely, etc.

1.10.1 Step #1: Set the Motor Amplifier Type

The motion processor must be told what type of motor output mode to use, PWM sign/mag, PWM 50/50, or DAC. This can be set using the command SetOutputMode. Assuming the axis you want to exercise is #1, you would type in the command “SetOutputMode” followed by the output mode; 0 for DAC, 1 for PWM sign/mag, and 2 for PWM 50/50. For example to specify the output mode as PWM 50/50 the following sequence would be typed in:

```
SetOutputMode 2
```

And this would be followed by an <ENTER> to process the command. Upon successfully accepting this command Pro-Motion will return a prompt “>”. If there is some problem with the command, Pro-Motion will indicate the nature of the error, then will be followed with a “>” prompt.

1.10.2 Step #2: Initialize the Commutation

NOTE: This section applies to brushless DC motors only.

For the motor to be controlled properly, the motion processor must select and possibly initialize the commutation phasing. If you will be using Hall-based commutation then no initialization is necessary. Simply specify this to the motion processor using the command:

```
SetCommutationMode 1
```

No other commands are necessary and you may proceed to step #3.

If you will be commutating using a sinusoidal technique you must initialize the commutation phasing. There are two ways this can be done. You will need to decide whether to initialize using Hall-based or algorithmic methods. See the *Magellan Motion Processor User's Guide* for more information on this.

Each of these two phase initialization methods requires a separate sequence, as follows (note that // indicates a comment and should not be typed in):

Hall-based initialization command sequence:

```
SetMotorType x                  // where x is 0 or 1 depending on type of motor
SetPhaseCounts yyyy             // yyyy is # of encoder counts per electrical cycle
SetPhaseInitializeMode 1        // set phase initialize mode to 'Hall-based'
InitializePhase
```

Algorithmic-based initialization command sequence:

```
SetMotorType x                  // x is 0 or 1 depending on type of motor
SetPhaseCounts yyyy             // yyyy is # of encoder counts per electrical cycle
SetPhaseInitializeMode 0        // set phase initialize mode to 'algorithmic'
SetMotorMode 0                  // places axis in open loop mode, required for algorithmic initialization.
SetPhaseInitializeTime zzzz     // zzzz is # of motion processor cycles to initialize for
SetMotorCommand wwww            // wwww is motor command.
InitializePhase
```

To determine the values of x, yyyy, zzzz, and wwww, refer to the *Magellan Motion Processor User’s Guide* and the *Magellan Motion Processor Programmer’s Command Reference.*

1.10.3 Step #3: Check Commutation

NOTE: This section applies to brushless DC motors only.

After phase initialization has been completed it is useful to check the smoothness of the motor rotation in open loop mode to verify that the motor phasing initialization and commutation is correct. To do this use the following command sequence:

```
SetMotorMode 0              // set axis for open loop operation
SetMotorCommand xxxx        // xxxx is the motor command from 0 to 32,767 to output
Update
```

The "xxxx" value represents the fraction of the value 32,768 of total power that will be applied to the motor. For example a value of 1,000 sends roughly 3 % (1000/32768) of the total power to the motor.

When the motor mode is set off (SetMotorMode 0) the motor is not under servo control. Be aware that the motor may spin rapidly after a motor command value is applied. Use small values and increase slowly.

After this command sequence the motor should smoothly spin in one direction or the other. The motor command is a signed number and the sign controls the rotation direction. When a positive motor command is given the motor should rotate in the positive (increasing encoder counts) direction. If the motor spins roughly, in the wrong direction, or if it moves a short distance and then abruptly stops there may be a problem with the commutation. Check your wiring and re-test. Once the motor is spinning smoothly in both directions under open loop control, re-enable closed-loop servo control by executing the following command:

```
SetMotorMode 1
```

1.10.4 Step #4: Set Filter Parameters

For motion to occur, some amount of feedback gain must be specified. Initially use just a proportional gain with a very low value between 1 and 25. Later you can add integral or derivative gains as well as feedforward gains if desired. The following sequence shows how to set the P, I, and D terms of the filter and how to 'update' them, making them active.

```
SetKp xxxx                  // xxxx is the desired proportional gain
SetKd yyyy                  // yyyy is the desired derivative gain
SetKi zzzz                  // zzzz is the desired integral gain
SetIntegrationLimit aaaa    // aaaa is the desired integration limit
Update                      // make these values active.
```

It is not necessary to specify all 3 gains. Just Kp, followed by an Update can be specified, just a Kd, etc.

When exercising the motor use extreme caution. It is the responsibility of the user to observe safety precautions at all times.

1.10.5 Step #5: Set the Motor Command

NOTE: This section applies to microstepping motors only.

In order for motion to occur, the magnitude of the output must be set. Refer to the *Magellan Motion Processor User's Guide* for more information. A value between 0 and 32,767 represents an amplitude of 0 - 100%. A value of around 5000 should be satisfactory to start with.

Here is the command sequence to use:

```
SetMotorCommand xxxx        // Sets the motor output level
Update                      // execute the move
```

1.10.6 Step #6: Make a Trajectory Move

To test that the motor is being driven properly, set up and execute a small trapezoidal move. Specify a small distance of (for example) 5,000 counts, and a low velocity and acceleration of (for example) 10,000, and 10 respectively. With a cycle time of 400 µSec, these values correspond to roughly 381 counts/sec, and 954 counts/sec^2, respectively.

Whatever profile values you use, be sure that they are safe for your system.

Here is the command sequence to use:

```
SetProfileMode 0        // Sets current profile mode to trapezoidal
SetPosition 5000        // 5000 is the desired destination position
SetVelocity 10000       // 10000 is the desired maximum velocity
SetAcceleration 10      // 10 is the desired acceleration
SetDeceleration 10      // 10 is the desired deceleration
Update                  // execute the move
```

After entering this sequence of commands you should see the axis smoothly move for about 15 seconds (if the suggested values are used and the cycle time of the motion processor is 400 µsec)

If you do not see the axis moving, or if the axis jumps rapidly in one direction or the other, there may be a problem with the board or software settings. Re-check and review the board setup procedures, as well as the exerciser parameter settings.

If you are still having problems after re-checking your system call PMD for applications assistance.

2. Operation

In This Chapter

- Card Function Overview
- Magellan Motion Processor
- Card Specific Functions
- Signal Processing and Hardware Functions

The PMD Magellan Motion Processor Developer's Kit cards are high performance PCI-bus cards that provide motion control for DC brush, brushless DC, and step motors. These cards are based on Magellan Motion Processors which perform motion command interpretation and other real time functions.

The overall card function is divided amongst a number of modules. These modules are indicated in the block diagram below:

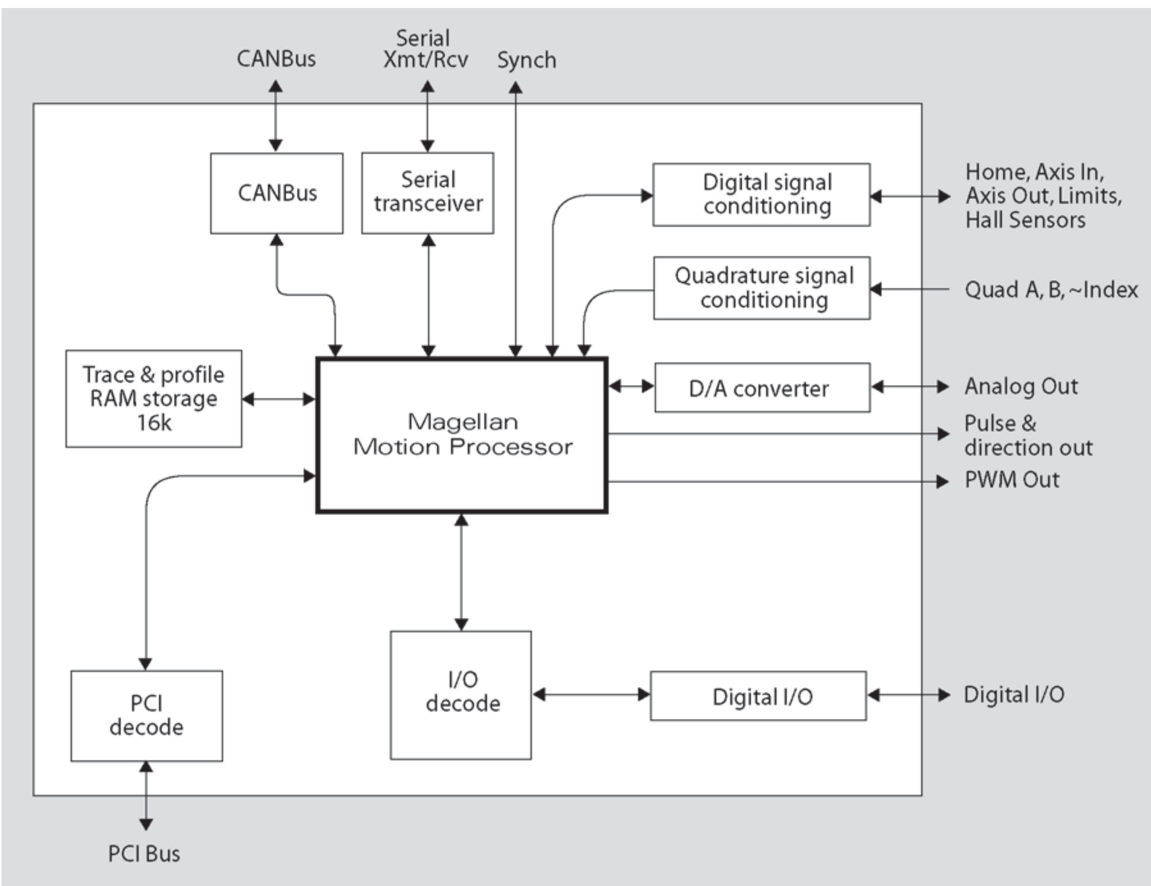


Figure 2-1: Magellan Motion Processor Developer's Kit internal block diagram

2.1 Card Function Overview

Magellan Motion Processor Developer's Kit card resources can be broken into three overall categories:

Magellan Motion Processor functions—These are programmable functions which reside in the motion processor such as profile generation, servo loop closure, and much more. These functions are accessed using Magellan Motion Processor commands, of which there are roughly 150 in total, to allow sophisticated control of the card's overall behavior.

Card-specific functions—These are programmable functions which are controlled by the motion processor using commands ReadIO and WriteIO, but which reside in various portions of the card circuitry. These functions include general purpose digital IO, and other card-specific capabilities.

Signal processing & hardware functions—A substantial portion of the card provides signal conditioning and other functions associated with non-programmable, signal-related processing.

2.1.1 Standalone Operation

There are two modes of operating the Magellan Developer's Kit Card: through the PCI bus, and in standalone mode. When operating the card through the PCI bus all required power and communication connections are provided by the interface bus itself.

When operating the card in standalone mode, you must use serial or CANbus communications. In addition, you will need to provide power to the card via an external connection, J10. See Section 3.2.6, "Standalone Power Connector (J10)," for a detailed description. Operating the card in standalone can be useful for a number of reasons, including locating the card closer to the motion hardware, and being able to operate several cards simultaneously on a serial multi-drop or CANbus network.

2.2 Magellan Motion Processor

The Magellan Motion Processor pictured in Figure 2-1 is comprised of 2 ICs, a CP (command processor) and an IO (input/output) IC. A summary list of the functions provided by the motion processor is as follows:

- Profile generation
- Motor output signal generation (PWM and analog)
- Quadrature counting, index capture
- Servo loop closure (for DC brush or brushless DC motors only)
- Breakpoint processing
- PLC-function processing (AxisIn and AxisOut signals)
- Trace
- Motion error detection, tracking windows, and at-settled indicator
- Limit switches

Access to the Magellan Developer's Kit card may occur through the PCI port, through the serial port, or through the CANbus. In any case, a complete set of C-Motion function calls, one for each Magellan command, is used to communicate to the card. For a complete list of Magellan commands see the *Magellan Motion Processor Programmer's Command Reference*.

The system on which the Magellan Developer's Kit card is installed can control the card through the pre-compiled program Pro-Motion, or through a program of their own construction, using C-Motion calls as the basic interface. During axis setup, the communications method (PCI-bus, serial port, or CANbus) and other parameters are specified, which allow C-Motion to create a virtualized axis handle, that from then on is the reference for all C-Motion commands.

Available C-Motion commands correspond one-for-one with those listed in the *Magellan Motion Processor Programmer's Command Reference.* All C-Motion commands preface the Magellan command with the letters "PMD," so the Magellan command (for example) SetPosition becomes the C-callable routine.

PMDSetPosition

Example

The following simple example, to set up and execute a simple trapezoidal profile, illustrates just a small part of the overall command set.

```
PMDSetProfileMode(axis_handle, trapezoidal);
PMDSetPosition(axis_handle, position_value);
PMDSetVelocity(axis_handle, velocity_value);
PMDSetAcceleration(axis_handle, acceleration_value);
PMDSetDeceleration(axis_handle, deceleration_value);
PMDUpdate(axis_handle);
```

Two separate manuals describe how the Magellan Motion Processor operates and how it is programmed, the *Magellan Motion Processor User's Guide* and the *Magellan Motion Processor Programmer's Command Reference.*

2.3 Card Specific Functions

Card-specific functions are those functions that are mapped through the motion processor's ReadIO and WriteIO facility, but are implemented in the card circuitry.

Card-specific functions are detailed in this document rather than the *Magellan Motion Processor User's Guide* or the *Magellan Motion Processor Programmer's Command Reference.*

2.3.1 General Purpose Digital IO

In addition to numerous special-purpose digital signals that are input or output to the card such as ***AxisIn, AxisOut, Home, QuadA,*** etc., the Magellan Developer's Kit cards support 8 general-purpose inputs, and 8 general-purpose outputs. These signals provide a convenient way of accessing additional general purpose digital IO. Although access to these signals occurs through the motion processor's ReadIO and WriteIO command, the signals present at these various connections do not directly affect the motion processor's behavior. Thus the motion processor simply passes them through.

ReadIO and WriteIO Commands

The 8 inputs and outputs are read using the ReadIO command and WriteIO command, with an IO address of 0. The table below shows this, along with the bit locations of the input and output signals.

Command	Bit location	Signals
ReadIO 0	0-7	DigitalIn0-7
WriteIO 0	0-7	DigitalOut0-7

To read the 8 general purpose digital I/Os, a ReadIO command is performed at address offset 0. The 16 bit read word returns the current output values (set using the WriteIO command) in bits 0-7. To write new signal values to the 8 digital outputs, a WriteIO command to address offset 0 is sent, and the values on bits 0-7 will be output to the signal connections. The value of bits 8-15 are ignored.

Example

To write a sequence 0xaa to bits 0-7, the C-Motion command PMDWriteIO(axis_handle, 0, 0xaa) is used. Assuming that a signal pattern of 0x55 is present on the 8 input connections, if the command PMDReadIO(axis_handle, 0, &load_reg) is used, load_reg will contain 0x55.

Connections & Associated Signals

The general-purpose IO signals are direct single-signal digital inputs and outputs. There are no associated connections that need to be made for these signals to function properly; however, one or more of the digital grounds must be connected. The default value, upon powerup, for all general-purpose digital outputs is low.

For a complete description of the pinout connections to/from the card, see Chapter 3, "Magellan Developer's Kit Electrical Specifications."

2.3.2 Serial Transceiver

This module and associated signals provide the capability to operate the Magellan Motion Processor Developer's Kit card using an asynchronous serial port, or to allow certain monitoring operations to be performed through the serial port, even while the PCI bus is used to command motion sequences.

Two connectors provide serial port signals from the Developer's Kit card to external devices. J13 is a standard DB-9 connector, and is used for point-to-point serial communications. This connector is designed such that it can directly connect to a PC serial port without a null modem. J1 is a 5-pin connector which is used for multi-drop communications with an external driver card. For more information on external driver cards for multi-drop communications, contact your PMD representative.

Regardless of which connector is used, the following information is useful to select baud rates and set other parameters associated with serial pot communications.

The serial port can be operated at various baud rates from 1,200 to 416,667, and different configurations of stop, start, and parity codes. In addition, three connection modes are provided, point-to-point, multi-drop (address bit mode), and multi drop (idle line mode). The following table shows how these parameters can be set on the card.

Switch block S1 sets the transmission rate, parity, stop bits, and protocol. Switch block S2 selects the device address when using the multi-drop protocol. When referring to the table below, the switch up position is relative to the bottom of the board where the PCI connector is located. The up position on the switch is marked **on**.

		S1-1	S1-2	S1-3	S1-4	S1-5	S1-6	S1-7	S1-8	S2-1
Transmission rate (bits per second)	1200	up	up	up	up					
	2400	down	up	up	up					
	9600	up	down	up	up					
	19200	down	down	up	up					
	57600	up	up	down	up					
	115200	down	up	down	up					
	250000	up	down	down	up					
	416667	down	down	down	up					
Parity	None					up	up			
	Odd					down	up			
	Even					up	down			
Stop bits	1							up		
	2							down		
Protocol	Point-to-point								up	up
	Address bit								up	down
	Idle line								down	down

See Figure 1-1 for locations of switches S1 and S2.

2.3.3 S2: Serial Device Address

Switch block S3 sets the device address for multi-drop protocol systems. When referring to the table below, the switch up position is relative to the bottom of the board where the PCI connector is located. The up position on the switch is marked **on**.

NOTE: S2-2 and S2-3 must be left in the up position.

Multi-drop address selection (S2)

Address	S2-4	S2-5	S2-6	S2-7	S2-8
0	up	up	up	up	up
1	down	up	up	up	up
2	up	down	up	up	up
3	down	down	up	up	up
4	up	up	down	up	up
5	down	up	down	up	up
6	up	down	down	up	up
7	down	down	down	up	up
8	up	up	up	down	up
9	down	up	up	down	up
10	up	down	up	down	up
11	down	down	up	down	up
12	up	up	down	down	up
13	down	up	down	down	up
14	up	down	down	down	up
15	down	down	down	down	up
16	up	up	up	up	down
17	down	up	up	up	down
18	up	down	up	up	down

Multi-drop address selection (S2)

Address	S2-4	S2-5	S2-6	S2-7	S2-8
19	down	down	up	up	down
20	up	up	down	up	down
21	down	up	down	up	down
22	up	down	down	up	down
23	down	down	down	up	down
24	up	up	up	down	down
25	down	up	up	down	down
26	up	down	up	down	down
27	down	down	up	down	down
28	up	up	down	down	down
29	down	up	down	down	down
30	up	down	down	down	down
31	down	down	down	down	down

2.3.4 CANbus Transceiver

In addition to a serial port, it is possible to operate the Magellan Motion Processor Developer's Kit by CANbus. The CANbus interface is useful to communicate to the card when one or more cards co-exist on the same network. In addition, compared to a RS-485 interconnect, CANbus communication is faster and more robust.

The following table shows how to configure the CANbus port. When referring to the table below, the switch up position is relative to the bottom of the board where the PCI connector is located. The up position on the switch is marked **on**.

NOTE: S3-8 and S4-1 through S4-5 should be left in the on position.

Switches		Description								
S3	1-7	Node ID Setting Switches 1-7 of the S3 DIP switch control the CANbus nodeID, allowing the card to be uniquely addressed on the CANbus network. Switches 1-7 are set binary-encoded, with total range of allowed values 0 - 127, and with 1 being least significant, 7 most significant. If a switch is up, it encodes a bit value of 0 and if it is down it encodes a bit value of 1.								
		S3-1	*S3-2*	*S3-3*	*S3-3*	*S3-4*	*S3-5*	*S3-6*	*S3-7*	*NodeID*
		up	up	up	up	up	up	up	up	0
		down	up	up	up	up	up	up	up	1
		up	down	up	up	up	up	up	up	2
		down	down	up	up	up	up	up	up	3
		up	up	down	up	up	up	up	up	4
		down	up	down	up	up	up	up	up	5
		up	down	down	up	up	up	up	up	6
		down	down	down	up	up	up	up	up	7
		. . .								
		down	down	down	down	down	down	down	down	127
S4	8-16	Communication rate. These switches set the CANbus communication rate as follows:								
		S4-6	*S4-7*	*S4-8*	*Baud setting*					
		up	up	up	1,000,000 baud					
		down	up	up	800,000 baud					
		up	down	up	500,000 baud					
		down	down	up	250,000 baud					
		up	up	down	125,000 baud					
		down	up	down	50,000 baud					
		up	down	down	20,000 baud					
		down	down	down	10,000 baud					

NOTE: If the attached CANbus device is the last node on the CAN network, then JP15 should be left in the default position of 2-3 jumpered. If this it is not the last device, then it should be installed with 1-2 jumpered.

C-Motion Commands

CANbus parameters can also be set using C-Motion commands through the CANbus interface or another interface. Although this is not commonly done, it can be useful to test communication ports.

C-Motion Command	Arguments(s)	Description
SetCANMode	axis_handlemask	Sets the CAN mode communication information. The binary word sent *mask* is encoded per the bit field above.
GetCANMode	axis_handle	Gets the CAN mode communication information. The ruturned word is encoded per the bit field described above

Connections & Associated Signals

A special DIN-style 4-pin connector is used to connect to the CANbus port. *Section 5.2.8 CANBUS Connector, page 65* provides a detailed description.

For a complete description of the pinout connections to/from the card, see Chapter 3, "Magellan Developer's Kit Electrical Specifications."

2.3.5 Reset

The Developer's Kit card can be reset manually as well as electrically. To reset the card manually, depress the reset button on the card. This button can be located using Figure 1-1.

Although a reset occurs automatically during power up, a user-initiated reset can also be performed explicitly through the card's PCI-bus interface. There are two methods by which this can be done. They are summarized in the table below:

Method	Type of reset	Description
Reset through motion processor	Soft reset	The C-Motion command PMDReset sends the command Reset to the motion processor, which causes a "soft" reset of the motion processor only. See the *Magellan Motion Processor User's Guide* for more information.
Reset through PCI bus	Hard reset	The C-Motion command PMDHardReset uses the PCI bus to perform a "hard" reset of both the card circuitry and the motion processor. *See table below for more information.* In this context "hard" vs "soft" means decoded externally to the motion processor, or coded through the motion processor. Both types result in the motion processor being reset, however.

After a reset occurs, the motion processor and other related output signals will be driven to known states, depending on the type of reset performed. These are summarized in the table below:

Signal name	Reset condition	
AxisOut1-4	High	
PWMMag1A-4C	DC Brush motor:	Low
	Brushless DC motor:	50/50 High/Low
	Microstepping motor:	Low
PWMSign1A-4B	DC Brush motor:	High
	Brushless DC motor:	Low

Signal name	Reset condition	
	Microstepping motor:	High
DAC1A-DAC4B	0.0 volts	

C-Motion Commands

The available C-Motion callable functions for this feature are:

C-Motion Command	Arguments	Function Description
PMDHardReset	axis_handle	This function causes a “hard”’reset of the motion processor. Unlike all other card-specific commands, this command is processed directly through the PCI card interface.
PMDReset	axis_handle	This function causes a “soft” reset of the motion processor.

2.4 Signal Processing and Hardware Functions

Signal processing and hardware functions are card functions which are not directly user-programmable. These are card characteristics which are encoded in hardware. Primarily this consists of various types of signals. The following sections lists these related groups of signals and provides information that may be helpful when connecting your motion system.

2.4.1 Home, AxisIn, AxisOut, Limits, Hall Sensors

These signals are conditioned by the card, but are output or input directly to the motion processor. The *Magellan Motion Processor User's Guide* explains the functions provided in connection with these various signals. Most of the signals are optional, and are connected depending on the nature of the application being used.

These signals are named ***Home1-4***, ***AxisIn1-4***, ***AxisOut1-4***, ***PosLim1-4*** (positive direction limit input), ***NegLim1-4*** (negative direction limit input), and ***Hall1A-4C*** (12 signals in all).

Connections & Associated Signals

This group of signals are direct single-signal digital inputs to the card, with the exception of ***AxisOut***, which is a single-ended output. There are no associated connections that need to be made for these signals to function properly; however, one or more of the digital grounds must be connected. The default value, upon powerup, for all ***AxisOut*** signals, is high.

For a complete description of the pinout connections to/from the card, see Chapter 3, “Magellan Developer's Kit Electrical Specifications.”

2.4.2 QuadA, QuadB, Index

This group of signals provides position feedback to the controller which is used to track motor position, and for servo motors, to generate a motor command. For DC brush and brushless DC motors, they are required for proper operation. For microstepping or pulse and direction motors, they are optional.

The encoder-processing circuitry provides a multi-pass digital filter of the ***QuadA***, ***QuadB***, and ***Index*** signals for each axis. This provides additional protection against erroneous noise spikes, thereby improving reliability and motion integrity.

These signals are named ***QuadA1+*** through ***QuadB4-*** (16 signals), and ***Index1+*** through ***Index4-*** (8 signals).

Connections & Associated Signals

This group of signals are connected in one of two ways. Single-ended termination means that only one wire per signal is used, while differential (dual) mode means two wires encode each signal (labeled + and -). Differential encoding is generally recommended for the highest level of reliability because it provides greater noise immunity than a single-ended connection scheme.

If single-ended connections are used only the + signal is connected, and the - signal should be left floating. For example, in connecting to the A quadrature input, ***QuadA1+*** connects to the signal, and ***QuadA1-*** is left floating. If differential connections are used, both the + and - signals are used.

Differential or single-ended termination must be selected through resistor pack installation. (See table in Section 1.6.1, "Resistor Packs," for details.) Note that all quadrature and index connections should be in either single-ended or differential mode. It is not possible to mix on a signal-by-signal basis.

When using the system with differential connections, if desired, the polarity of the differential signal can be reversed by swapping the + and - connections. This may be useful for altering the motor and/or encoder direction; however, this same function can also be accomplished through commands to the motion processor. See the *Magellan Motion Processor User's Guide,* for more information.

Associated connections that are supported by the card are the +5V output signals. These are provided as a convenience, as they are generally connected to a corresponding input on the encoder, to power its circuitry. As was the case for the digital input signals, one or more of the digital grounds must also be connected.

For a complete description of the pinout connections to/from the card, see Chapter 3, "Magellan Developer's Kit Electrical Specifications."

2.4.3 Analog Input

The ***Analog0-7*** signals provide general purpose input of 8 analog signals. If connected, the voltages present at these various connections do not directly affect the motion processor's behavior. However they can be read through the motion processor, and thus provide a convenient way of bringing in analog signal levels that may be acted upon by the user's application code located on the PC. These signals are read using the Magellan command ReadAnalog. In conjunction with the ***Analog0-7*** signals, the user must also provide a number of other signals that provide analog reference scaling to the Magellan Motion Processor. These signals are summarized in the table below:

Signal name	Function
AnalogRefLow	Provides minimum allowed analog voltage input signal. Has an allowed range of 0 to 3.3V. Generally connected to 0 volts.
AnalogRefHigh	Provides maximum allowed analog voltage input signal. Has an allowed range of 0 to 3.3V, but must be greater than ***AnalogRefLow***. Generally connected to 3.3 volts.
AnalogGND	Provides ground return for reference and analog input signals

All of the analog signals described in this section are directly connected to the corresponding pins on the Magellan Motion Processor. For more information on reading the value of these analog inputs, see the *Magellan Motion Processor User's Guide.*

Connections & Associated Signals

For analog voltages to be read correctly, in addition to the analog signals ***Analog0-7*** themselves, ***AnalogRefLow, AnalogRefHigh***, and ***AnalogGND*** must be connected. See the preceding table for more information.

2.4.4 Pulse and Direction

For pulse & direction motors these signals provide a stream of pulse and direction data, compatible with a wide variety of off-the-shelf step motor amplifiers. These signals are directly generated by the Magellan motion processor. For more information on output waveforms, pulse rates, and related information, see the *Magellan Motion Processor User's Guide,* "Open Loop Stepper Control."

These signals are named *pulse1-4, direction1-4*.

The default value, upon powerup, for all pulse & direction output signals is high.

Connections & Associated Signals

This group of signals are direct single-signal digital outputs. There are no associated connections that need to be made for these signals to function properly; however, one or more of the digital grounds must be connected.

For a complete description of the pinout connections to/from the card, see Chapter 3, "Magellan Developer's Kit Electrical Specifications."

2.4.5 PWM Out

For servo or microstepping motors these signals provide PWM (pulse width modulated) motor command signals when the motor output mode is set to **PWMSignMagnitude** or **PWM5050Magnitude**. See the *Magellan Motion Processor User's Guide* for complete information. The number of signals per axis varies depending on the motor type being connected to, the number of phases that the motor has, and the motor drive method (sign/magnitude or 50/50). Chapter 3, "Magellan Developer's Kit Electrical Specifications," has complete connection tables for various motor configurations.

These signals are named *PWMMag1A-4C* (12 signals) and *PWMSign1A-4B* (8 signals).

Connections & Associated Signals

This group of signals are direct single-signal digital outputs. There are no associated connections that need to be made for these signals to function properly; however, one or more of the digital grounds must be connected.

For a complete description of the pinout connections to/from the card, see Chapter 3, "Magellan Developer's Kit Electrical Specifications."

2.4.6 Motor Command

For servo or microstepping motors, these signals contain the analog motor command when the motor output mode is set to DAC (digital to analog converter). These signals vary between -10V and +10V. See the *Magellan Motion Processor User's Guide* for more information. The number of signals per axis varies depending on the motor type being connected to.

These signals are named *DAC1A - DAC4B* (8 signals).

Connections & Associated Signals

For analog voltages to be output correctly, *GND* (motor command ground) must be connected.

For a complete description of the pinout connections to/from the card, see Chapter 3, "Magellan Developer's Kit Electrical Specifications."

3. Magellan Developer's Kit Electrical Specifications

3

In This Chapter

- Magellan Configuration Switch Blocks
- Magellan Connectors
- Outputs to Motor Amplifiers
- Encoder Inputs

Figure 3-1 shows the locations of the principal components of the developer's kit board. The component side of the board is shown, with the PCI slot connector at the bottom. All component locations in this manual refer to this orientation. In Figure 3-1, the motion processor's CP chip and IO chip are identified for reference. All other components of interest to the user are identified by their board label:

- Switch blocks S1 and S2 set the serial interface configuration and multi-drop address
- Switch blocks S3 and S4 set the CANbus interface configuration
- Switch blocks S5 and S6 select the motor type (used with MC58000 family products only)
- Resistor Packs RS1-RS3 select whether single-ended or differential encoder are connected
- Reset Signal Source JP12 selects the correct reset signal based on PCI-bus or standalone operation
- Jumper JP15 selects whether CANbus node is last in the network
- Connectors J1, J2, J4, J5, J10, J13 and JS1 provide connections to and from external components

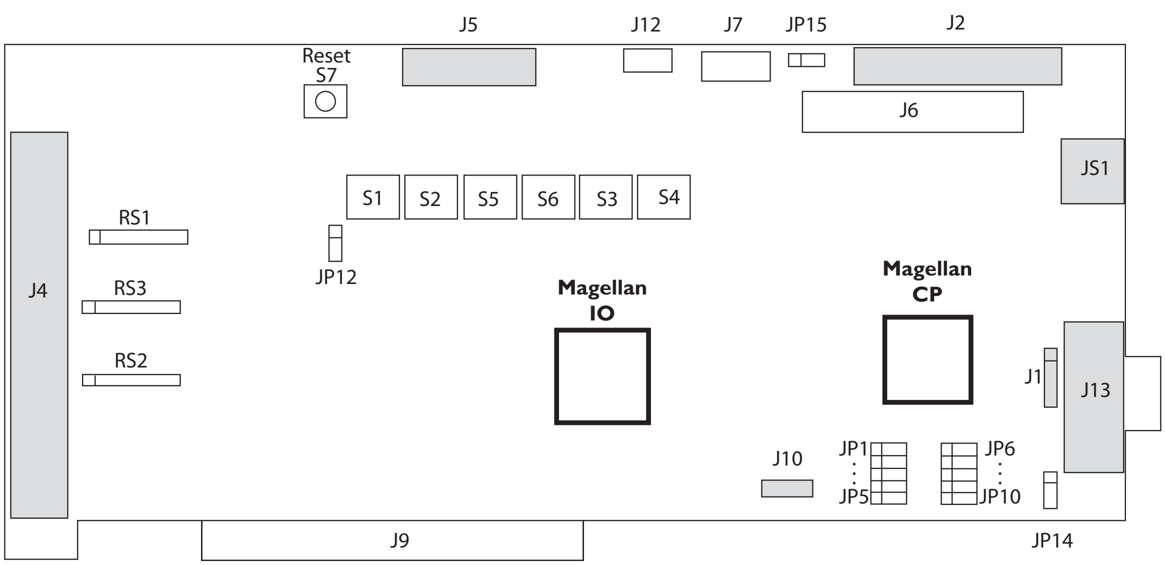


Figure 3-1: Location of various board elements

3.1 Magellan Configuration Switch Blocks

These switch blocks are oriented horizontally on the developer's kit board; on is up.

3.1.1 S1: Serial Transmission Parameters

Switch block S1 sets the transmission rate, parity, stop bits, and protocol. Switch block S2 selects the device address when using the multi-drop protocol. When referring to the table below, the switch up position is relative to the bottom of the board where the PCI connector is located. The up position on the switch is marked **on.**

		S1-1	S1-2	S1-3	S1-4	S1-5	S1-6	S1-7	S1-8	S2-1
Transmission rate (bits per second)	1200	up	up	up	up					
	2400	down	up	up	up					
	9600	up	down	up	up					
	19200	down	down	up	up					
	57600	up	up	down	up					
	115200	down	up	down	up					
	250000	up	down	down	up					
	416667	down	down	down	up					
Parity	None					up	up			
	Odd					down	up			
	Even					up	down			
Stop bits	1							up		
	2							down		
Protocol	Point-to-point								up	up
	Address bit								up	down
	Idle line								down	down

3.1.2 S2: Serial Device Address

Switch block S3 sets the device address for multi-drop protocol systems. When referring to the table below, the switch up position is relative to the bottom of the board where the PCI connector is located. The up position on the switch is marked **on**.

NOTE: S2-2 and S2-3 must be left in the up position.

Multi-drop address selection (S2)

Address	S2-4	S2-5	S2-6	S2-7	S2-8
0	up	up	up	up	up
1	down	up	up	up	up
2	up	down	up	up	up
3	down	down	up	up	up
4	up	up	down	up	up
5	down	up	down	up	up
6	up	down	down	up	up
7	down	down	down	up	up
8	up	up	up	down	up

Multi-drop address selection (S2)					
Address	S2-4	S2-5	S2-6	S2-7	S2-8
9	down	up	up	down	up
10	up	down	up	down	up
11	down	down	up	down	up
12	up	up	down	down	up
13	down	up	down	down	up
14	up	down	down	down	up
15	down	down	down	down	up
16	up	up	up	up	down
17	down	up	up	up	down
18	up	down	up	up	down
19	down	down	up	up	down
20	up	up	down	up	down
21	down	up	down	up	down
22	up	down	down	up	down
23	down	down	down	up	down
24	up	up	up	down	down
25	down	up	up	down	down
26	up	down	up	down	down
27	down	down	up	down	down
28	up	up	down	down	down
29	down	up	down	down	down
30	up	down	down	down	down
31	down	down	down	down	down

3.1.3 CANbus Transceiver

The following table shows how to configure the CANbus port. When referring to the table below, the switch up position is relative to the bottom of the board where the PCI connector is located. The up position on the switch is marked **on**.

NOTE: S3-8 and S4-1 through S4-5 should be left in the on position.

Switches		Description								
S3	1-7	Node ID Setting Switches 1-7 of the S3 DIP switch control the CANbus nodeID, allowing the card to be uniquely addressed on the CANbus network. Switches 1-7 are set binary-encoded, with total range of allowed values 0 - 127, and with 1 being least significant, 7 most significant. If a switch is up, it encodes a bit value of 0 and if it is down it encodes a bit value of 1.								
		S3-1	*S3-2*	*S3-3*	*S3-3*	*S3-4*	*S3-5*	*S3-6*	*S3-7*	*NodeID*
		up	up	up	up	up	up	up	up	0
		down	up	up	up	up	up	up	up	1
		up	down	up	up	up	up	up	up	2
		down	down	up	up	up	up	up	up	3
		up	up	down	up	up	up	up	up	4
		down	up	down	up	up	up	up	up	5
		up	down	down	up	up	up	up	up	6
		down	down	down	up	up	up	up	up	7
		. . .								
		down	down	down	down	down	down	down	down	127

Switches		Description			
S4	8-16	Communication rate. These switches set the CANbus communication rate as follows:			
		S4-6	*S4-7*	*S4-8*	*Baud setting*
		up	up	up	1,000,000 baud
		down	up	up	800,000 baud
		up	down	up	500,000 baud
		down	down	up	250,000 baud
		up	up	down	125,000 baud
		down	up	down	50,000 baud
		up	down	down	20,000 baud
		down	down	down	10,000 baud

NOTE: If the attached CANbus device is the last node on the CAN network, then JP15 should be left in the default position of 2-3 jumpered. If this it is not the last device, then it should be installed with 1-2 jumpered.

3.1.4 Motor Type Switch Settings

When using the DK55000 only pulse and direction motors are used, and it is not necessary to set jumpers related to motor type. When using the DK58000 it is possible to support any combination of DC brush, brushless DC, microstepping, and pulse & direction motors all on the same card and dip switches 5 and 6 must be set to indicate the motor type that will be used. When configuring the dip switches and connecting your motors to the Developer's Kit Card, the following information may be helpful:

- *Brushless DC* means the card expects to connect to a brushless DC motor with Hall sensors and an encoder. With this connection, the Developer's Kit card performs the commutation and outputs a multi-phase signal, 2 or 3 phases per axis, to the amplifier.
- *Microstepping* means the card expects to connect to a step motor. With this connection, the Developer's Kit card performs the phasing, and outputs a multi-phase signal, 2 or 3 phases per axis, to a step motor amplifier that can accept this type of output. Quadrature feedback is optional with this type of motor.
- *Pulse and direction* means the card expects to connect to a step motor which uses a standard pulse and direction amplifier. Quadrature feedback is optional with this type of motor.
- *DC Brush* means the cards expects to connect to a DC brush motor with an encoder, or an externally commutated brushless DC motor (amplifier performs commutation). With this motor type the card outputs one phase per axis.

Motor Type Jumper settings (for DK58000 only)

When referring to the table below the switch up position is relative to the bottom of the board where the PCI connector is located. The up position on the switch is marked **on.**

Item	Switches	Description				
Dip	S5-1	Axis #1 Motor type setting				
switch	S5-2	Set S5 1-4 dip switches according to the motor type you will be using on axis #1				
S5	S5-3	5-1	5-2	5-3	5-4	Axis #1
	S5-4	up	up	up	up	Brushless DC (3 phase)
		down	up	up	up	Brushless DC (2 phase)
		up	down	up	up	Microstepping DC (3 phase)
		down	down	up	up	Microstepping DC (2 phase)
		up	up	down	up	Pulse & direction
		down	down	down	up	DC brush (default setting)

Item	Switches	Description				
Dip switch S5	S5-5 S5-6 S5-7 S5-8	Axis #2 Motor type setting Set S5 5-8 dip switches according to the motor type you will be using on axis #2				
		5-5	5-6	5-7	5-8	Motor type setting
		up	up	up	up	Brushless DC (3 phase)
		down	up	up	up	Brushless DC (2 phase)
		up	down	up	up	Microstepping DC (3 phase)
		down	down	up	up	Microstepping DC (2 phase)
		up	up	down	up	Pulse & direction
		down	down	down	up	DC brush (default setting)
Dip switch S5	S6-1 S6-2 S6-3 S6-4	Axis #3 Motor type setting Set S6 1-4 dip switches according to the motor type you will be using on axis #3				
		6-1	6-2	6-3	6-4	Motor type setting
		up	up	up	up	Brushless DC (3 phase)
		down	up	up	up	Brushless DC (2 phase)
		up	down	up	up	Microstepping DC (3 phase)
		down	down	up	up	Microstepping DC (2 phase)
		up	up	down	up	Pulse & direction
		down	down	down	up	DC brush (default setting)
Dip switch S5	S6-5 S6-6 S6-7 S6-8	Axis #4 Motor type setting Set S6 5-8 dip switches according to the motor type you will be using on axis #4				
		6-5	6-6	6-7	6-8	Motor type setting
		up	up	up	up	Brushless DC (3 phase)
		down	up	up	up	Brushless DC (2 phase)
		up	down	up	up	Microstepping DC (3 phase)
		down	down	up	up	Microstepping DC (2 phase)
		up	up	down	up	Pulse & direction
		down	down	down	up	DC brush (default setting)

Unconnected motors can be left at the default setting of *DC brush*.

The following diagram shows the location of the resistor packs RS1, RS2, RS3 and the mode jumper, along with other components such as connectors.

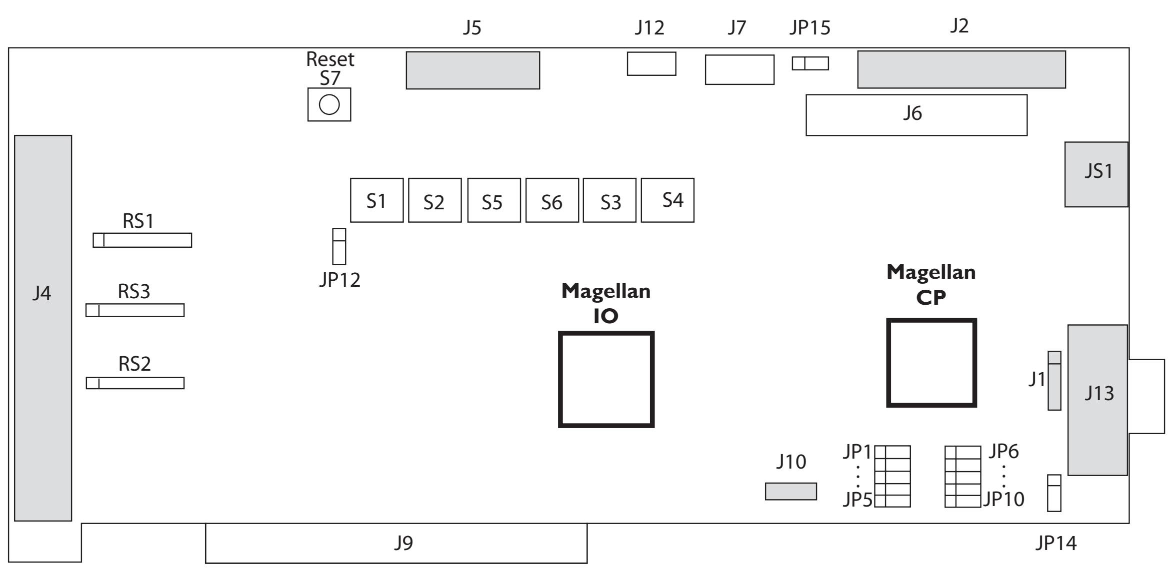


Figure 3-2: Location of resistor packs and key components

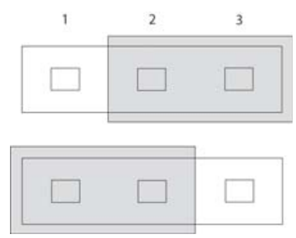
3.1.5 Resistor Packs

To prepare your card for installation the following user-settable hardware option should be checked:

Item	How to set	Description
Resistor packs -	Installed this is the default setting of resistor packs RS1-RS3	If you are using differential connections leave these resistor packs installed.
RS1, RS2, RS3	Removed	If you are using single-ended encoder connections, remove the resistor packs.

3.1.6 Reset Signal Source (JP12)

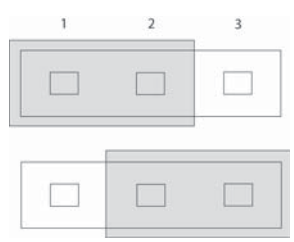
The Magellan Motion Processor Developer's Kit supports two different reset signals depending on whether the board is installed in a computer or in stand-alone operation with external power. The figure below shows how the JP12 jumper should be installed to select the reset signal. Shading indicates the location of the jumper. For more information on operating in standalone mode, see *section 2.1.1, Standalone Operation, page 22*.



3.1.7 CANbus Termination Jumper (JP15)

If you are using the Magellan Developer's Kit card with a CANbus network, then the CANbus Termination Jumper (JP15) should be set.

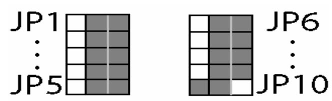
Jumper 1-2 if this card is not the last node on the network, and jumper 2-3 (default jumpering) if card is the last (or only) node on network. See diagram below for more details.



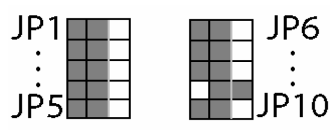
3.1.8 Device Type Selection Jumpers (JP1-JP10)

These jumpers are used to select signal connection paths appropriate for the type of Magellan Motion Processor that is installed. These jumpers are set correctly at the factory and should not be changed unless a motion processor is installed that requires alternate settings.

Jumper positions for the MC58110 and MC55110



Jumper positions for the MC58x20 and MC55x20



3.2 Magellan Connectors

This section describes the pinouts for the following cable connectors on the Magellan Motion Processor Developer's Kit card (shaded areas in diagram below):

J1	5-pin serial communication connector
J2	16-pin analog input connector
J4	100-pin main connector containing encoder input, Hall input, AxisIn signals, AxisOut signals, Motor output signals, and limit switch inputs
J5	20-pin user-defined digital I/O connector
J10	4-pin 5v power connector
J13	9-pin DB-9 serial port connector
JS1	4-pin CANbus connector

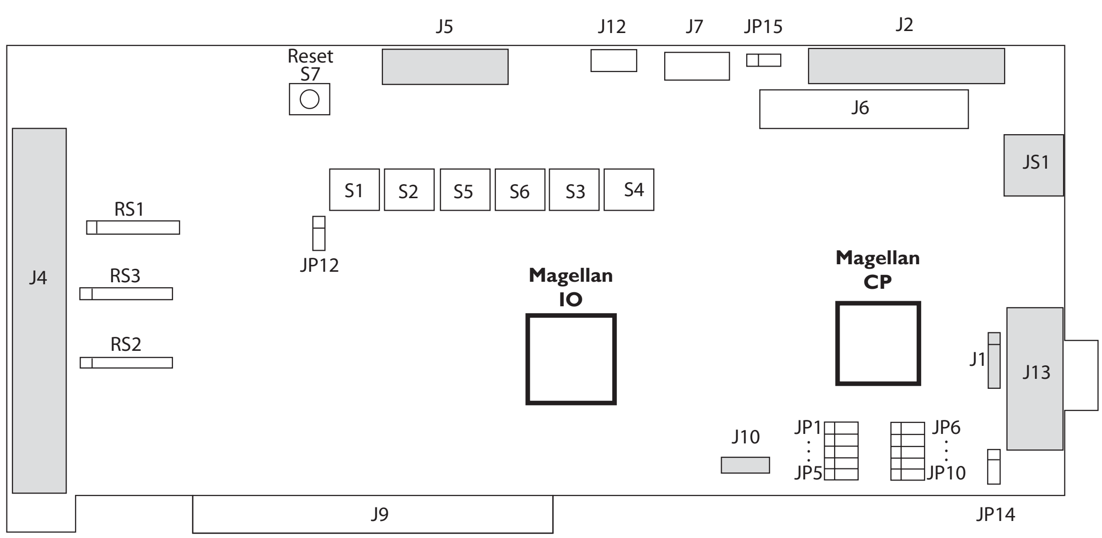


Figure 3-3: Connector locator

3.2.1 Serial Communications Connector (J1)

J1 is a 5-pin single row header (0.1" spacing).

NOTE: Connector J1 is used with multi-drop serial communications. Connector J13 is used with serial point-to-point communications. See Section 2.3.2, "Serial Transceiver," for more information.

Pin number	Signal name
1	SrlXmt (CP pin 44)
2	SrlRcv (CP pin 43)
3	SrlEnable (CP pin 99)
4	GND
5	Vcc

3.2.2 Analog Input Connector (J2)

This is a 16-pin header (2x13, 0.1" spacing).

Pin number	Signal name	Pin number	Signal name
1	Analog0	9	AnalogRefHigh
2	Analog1	10	AnalogRefLow
3	Analog2	11	AnalogGND
4	Analog3	12	AnalogGND
5	Analog4	13	AnalogVcc
6	Analog5	14	~HostIntrpt*
7	Analog6	15	Gnd*
8	Analog7	16	Vcc*

*~HostIntrpt, along with Gnd and Vcc are connected to the corresponding pins on the Magellan Motion Processor. They can be used to externalize the ~HostIntrpt signal from the Magellan Motion Processor if this is desired.

3.2.3 Motion Peripherals Connector (J4)

For use with 2-IC Magellan Processor Developer Kits (DK58420, DK55420)

This is a 100-pin high-density connector (2x50, 0.05" spacing). The accompanying cable assembly supplied with your developer's kit consists of two 36" flat ribbon cables terminating together at one end in the matching 100-pin connector. At the other end, each ribbon terminates in a 50-pin header (2x25, 0.1" spacing). The ribbons are labeled Hdr1 and Hdr2. Pins 1-50 on Hdr1 connect to pins 1-50 of J4. Pins 1-50 of Hdr2 connect to pins 51-100 of J4.

Header 1 (to J4 pins 1-50)				Header 2 (to J4 pins 51-100)			
Pin	Signal name	Pin	Signal name	Pin	Signal name	Pin	Signal name
1	QuadA1+	26	QuadA2+	1	QuadA3+	26	QuadA4+
2	QuadA1-	27	QuadA2-	2	QuadA3-	27	QuadA4-
3	QuadB1+	28	QuadB2+	3	QuadB3+	28	QuadB4+
4	QuadB1-	29	QuadB2-	4	QuadB3-	29	QuadB4-
5	Index1+	30	Index2+	5	Index3+	30	Index4+
6	Index1-	31	Index2-	6	Index3-	31	Index4-
7	Vcc (encoder)	32	Vcc (encoder)	7	Vcc (encoder)	32	Vcc (encoder)
8	GND (encoder)	33	GND (encoder)	8	GND (encoder)	33	GND (encoder)
9	Hall1A	34	Hall2A	9	Hall3A	34	Hall4A
10	Hall1B	35	Hall2B	10	Hall3B	35	Hall4B

Header 1 (to J4 pins 1-50)				Header 2 (to J4 pins 51-100)			
11	Hall1C	36	Hall2C	11	Hall3C	36	Hall4C
12	GND (Hall)	37	GND (Hall)	12	GND (Hall)	37	GND (Hall)
13	PosLim1	38	PosLim2	13	PosLim3	38	PosLim4
14	NegLim1	39	NegLim2	14	NegLim3	39	NegLim4
15	Home1	40	Home2	15	Home3	40	Home4
16	AxisIn1	41	AxisIn2	16	AxisIn3	41	AxisIn4
17	AxisOut1	42	AxisOut2	17	AxisOut3	42	AxisOut4
18	PWMMagA1/Pulse1	43	PWMMagA2/Pulse2	18	PWMMagA3/Pulse3	43	PWMMagA4/Pulse4
19	PWMMagB1	44	PWMMagB2	19	PWMMagB3	44	PWMMagB4
20	PWMMagC1/ PWMsignB1/ AtRest1	45	PWMMagC2/ PWMsignB2/ AtRest2	20	PWMMagC3/ PWMsignB3/ AtRest3	45	PWMMagC4/ PWMsignB4/ AtRest4
21	PWMsignA1/ Direction1	46	PWMsignA2/ Direction2	21	PWMsignA3/ Direction3	46	PWMsignA4/ Direction4
22	DACA1*	47	DACA2*	22	DACA3*	47	DACA4*
23	DACB1*	48	DACB2*	23	DACB3*	48	DACB4*
24	GND (DAC)	49	GND (DAC)	24	GND (DAC)	49	GND (DAC)
25	N.C.	50	N.C.	25	N.C.	50	N.C.

NOTE:
Unused signals may be left unconnected.
Each converter cable has labels to indicate HDR1 and HDR2.

For use with single-IC Magellan Processor Developer Kits (DK58110, DK55110)

This is a 100-pin high-density connector (2x50, 0.05" spacing). The accompanying cable assembly supplied with your developer's kit consists of two 36" flat ribbon cables terminating together at one end in the matching 100-pin connector. At the other end, each ribbon terminates in a 50-pin header (2x25, 0.1" spacing). The ribbons are labeled Hdr1 and Hdr2. Pins 1-50 on Hdr1 connect to pins 1-50 of J4. Pins 1-50 of Hdr2 connect to pins 51-100 of J4.

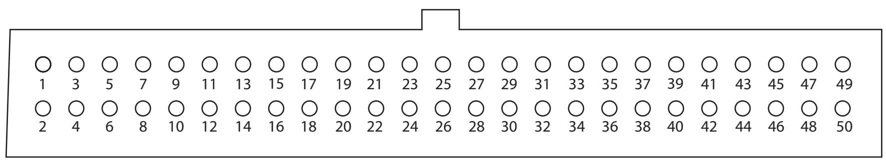
Header 1 (to J4 pins 1-50)				Header 2 (to J4 pins 51-100)			
Pin	Signal name	Pin	Signal name	Pin	Signal name	Pin	Signal name
1	QuadA1+	26	N.C.	1	N.C.	26	N.C.
2	QuadA1-	27	N.C.	2	N.C.	27	N.C.
3	QuadB1+	28	N.C.	3	N.C.	28	N.C.
4	QuadB1-	29	N.C.	4	N.C.	29	N.C.
5	Index1+	30	N.C.	5	N.C.	30	N.C.
6	Index1-	31	N.C.	6	N.C.	31	N.C.
7	Vcc (encoder)	32	N.C.	7	N.C.	32	N.C.
8	GND (encoder)	33	N.C.	8	N.C.	33	N.C.
9	Hall1A	34	N.C.	9	PWMSign1B	34	N.C.
10	Hall1B	35	N.C.	10	PWMMag1C	35	N.C.
11	Hall1C	36	N.C.	11	N.C.	36	PWMMag1A/Pulse1
12	GND (Hall)	37	N.C.	12	N.C.	37	N.C.
13	PosLim1	38	N.C.	13	N.C.	38	N.C.
14	NegLim1	39	N.C.	14	N.C.	39	N.C.
15	Home1	40	N.C.	15	N.C.	40	N.C.
16	AxisIn1	41	N.C.	16	PWMMag1B/ AtRest1	41	N.C.
17	AxisOut1	42	N.C.	17	N.C.	42	PWMSign1A/ Direction1/SPIEnable

Header 1 (to J4 pins 1-50)				Header 2 (to J4 pins 51-100)			
18	N.C.	43	N.C.	18	N.C.	43	N.C.
19	N.C.	44	N.C.	19	N.C.	44	N.C.
20	N.C.	45	N.C.	20	N.C.	45	N.C.
21	N.C.	46	N.C.	21	N.C.	46	N.C.
22	DACA1	47	N.C.	22	N.C.	47	N.C.
23	DACB1	48	N.C.	23	N.C.	48	N.C.
24	GND (DAC)	49	N.C	24	N.C.	49	N.C.
25	N.C.	50	N.C.	25	N.C.	50	N.C.

3.2.4 Connector Pin Layout

The following diagram shows the pin layout for the two 50-pin header cables used with the Magellan board.

Figure 3-4: Bottom view of 50-pin header connector



For testing purposes, this connector can be mated with a terminal block. PMD suggests Phoenix Contact (http://www.phoenixcon.com/), part number FLKM 50 (Digi-Key part number 2281089-ND).

3.2.5 User-defined Digital IO Connector (J5)

These general-purpose IO signals source up to 4mA and can sink up to 8mA. These pins are accessed using the Magellan commands ReadIO/WriteIO.

This is a 20-pin header (2x10, 0.1" spacing).

Pin number	Signal name	Pin number	Signal name
1	PrlIn0	10	PrlOut4
2	PrlOut0	11	PrlIn5
3	PrlIn1	12	PrlOut5
4	PrlOut1	13	PrlIn6
5	PrlIn2	14	PrlOut6
6	PrlOut2	15	PrlIn7
7	PrlIn3	16	PrlOut7
8	PrlOut3	17, 19	GND
9	PrlIn4	18, 20	Vcc

3.2.6 Standalone Power Connector (J10)

This is a green 2-connection terminal block.

Pin number	Signal name
1	+5 Vcc
2	GND

3.2.7 Serial Port Connector (J13)

This is a male DB-9 connector.

NOTE: Connector J1 is used with multi-drop serial communications. Connector J13 is used with serial point-to-point communications. See Section 2.3.2, "Serial Transceiver," for more information.

Pin number	Signal name
1	No connection
2	Serial Transmit
3	Serial Receive
4	No connection
5	Gnd
6	No connection
7	No connection
8	No connection
9	No connection

3.2.8 CANbus Connector (JS1)

This is a 4-pin mini-DIN connector.

Pin number	Signal name
1	CANH
2	CANL
3	GND
4	No connection

3.3 Outputs to Motor Amplifiers

The Magellan Motion Processor Developer's Kit supports four types of output to the motor amplifiers:

DAC	Analog signals from the on-board D/A converters
PWM 50/50	Pulse-width modulated square-wave signals with a 50% duty cycle
PWM sign-magnitude	Pulse-width modulated signals with definable duty cycle and direction
Pulse & direction	Step-motor output digital pulse and direction signals

These outputs should be connected from the designated J4 pins to the appropriate amplifier inputs, as shown in the following tables. The names of the input pins may vary among amplifiers; common names are shown.

3.3.1 DK58420

Brushed Servo Motors

			J4 connection (Header-pin)			
	Signal name	*Amplifier input*	*Axis 1*	*Axis 2*	*Axis 3*	*Axis 4*
DAC	DACA*n*	Ref+ or V+	Hdr1-22	Hdr1-47	Hdr2-22	Hdr2-47
	GND*n*	Ref- or Gnd	Hdr1-24	Hdr1-49	Hdr2-24	Hdr2-49
PWM sign/magnitude	PWMMagA*n*	PWM magnitude	Hdr1-18	Hdr1-43	Hdr2-18	Hdr2-43
	PWMSignA*n*	PWM direction	Hdr1-21	Hdr1-46	Hdr2-21	Hdr2-46

3.3.2 Brushless Servo Motors

			J4 connection (Header-pin)			
	Signal name	*Amplifier input*	*Axis 1*	*Axis 2*	*Axis 3*	*Axis 4*
DAC	DACA*n*	Ref1+ or V1+	Hdr1-22	Hdr1-47	Hdr2-22	Hdr2-47
	DACB*n*	Ref2+ or V2+	Hdr1-23	Hdr1-48	Hdr2-23	Hdr2-48
	GND*n*	Ref- or Gnd	Hdr1-24	Hdr1-49	Hdr2-24	Hdr2-49
PWM 50/50	PWMMagA*n*	PWM phase 1	Hdr1-18	Hdr1-43	Hdr2-18	Hdr2-43
	PWMMagB*n*	PWM phase 2	Hdr1-19	Hdr1-44	Hdr2-19	Hdr2-44
	PWMMagC*n*	PWM phase 3	Hdr1-20	Hdr1-45	Hdr2-20	Hdr2-45

3.3.3 Microstepping Motors

			J4 connection (Header-pin)			
	Signal name	*Amplifier input*	*Axis 1*	*Axis 2*	*Axis 3*	*Axis 4*
DAC	DACA*n*	Ref+ or V+	Hdr1-22	Hdr1-47	Hdr2-22	Hdr2-47
	GND*n*	Ref- or Gnd	Hdr1-24	Hdr1-49	Hdr2-24	Hdr2-49
PWM sign/magnitude	PWMMagA*n*	PWM magnitude	Hdr1-18	Hdr1-43	Hdr2-18	Hdr2-43
	PWMSignA*n*	PWM direction	Hdr1-21	Hdr1-46	Hdr2-21	Hdr2-46
	PWMMagB*n*	PWM magnitude	Hdr1-19	Hdr1-44	Hdr2-19	Hdr2-44
	PWMSignB*n*	PWM direction	Hdr1-20	Hdr1-45	Hdr2-20	Hdr2-45

3.3.4 DK58420 and DK55420

Pulse & Direction Motors

		J4 connection (Header-pin)			
Signal name	*Amplifier input*	*Axis 1*	*Axis 2*	*Axis 3*	*Axis 4*
Pulse *n*	Pulse or step	Hdr1-18	Hdr1-43	Hdr2-18	Hdr2-43
Direction *n*	Direction	Hdr1-21	Hdr1-46	Hdr2-21	Hdr2-46

3.3.5 DK58110

Brushed Servo Motors

			J4 connection (Header-pin)
	Signal name	*Amplifier input*	*Axis 1*
DAC	DACA1	Ref+ or V+	Hdr1-22
	GND	Ref- or Gnd	Hdr1-24
PWM sign/magnitude	PWMMag1A	PWM magnitude	Hdr2-36
	PWMSign1A	PWM direction	Hdr2-42

3.3.6 Brushless Servo Motors

			J4 connection (Header-pin)
	Signal name	*Amplifier input*	*Axis 1*
DAC	DACA1	Ref1+ or V1+	Hdr1-22
	DACB1	Ref2+ or V2+	Hdr1-23
	GND	Ref- or Gnd	Hdr1-24
PWM 50/50	PWMMag1A	PWM phase 1	Hdr2-36
	PWMMag1B	PWM phase 2	Hdr2-16
	PWMMag1C	PWM phase 3	Hdr2-10

3.3.7 Microstepping Motors

			J4 connection (Header-pin)
	Signal name	*Amplifier input*	*Axis 1*
DAC	DACA1	Ref+ or V+	Hdr1-22
	DACB1	Ref- or Gnd	Hdr1-24
PWM sign/magnitude	GND	PWM magnitude	Hdr2-36
	PWMMag1A	PWM direction	Hdr2-42
	PWMMag1B	PWM magnitude	Hdr2-16
	PWMMag1C	PWM direction	Hdr2-9

3.3.8 DK58110 and DK55110

Pulse & Direction Motors

		J4 connection (Header-pin)
Signal name	*Amplifier input*	*Axis 1*
Pulse1	Pulse or step	Hdr2-36
Direction1	Direction	Hdr2-42

3.4 Encoder Inputs

Resistor packs RS1 - RS3

These three resistor packs are at the left end of the developer's kit board, next to the 100-pin connector J4. When using differential encoders, leave these packs in place. When using open-ended encoders, remove all three packs and connect encoder signals to the positive encoder input only. The negative input can be left unconnected. Encoder connections are shown below.

Encoder connections when using differential encoder input

Signal	J4 pin connections			
	Axis 1	Axis 2	Axis 3	Axis 4
QuadAn+	Hdr1-1	Hdr1-26	Hdr1-51	Hdr1-76
QuadAn-	Hdr1-2	Hdr1-27	Hdr1-52	Hdr1-77
QuadBn+	Hdr1-3	Hdr1-28	Hdr1-53	Hdr1-78
QuadBn-	Hdr1-4	Hdr1-29	Hdr1-54	Hdr1-79
Indexn+	Hdr1-5	Hdr1-30	Hdr1-55	Hdr1-80
Indexn-	Hdr1-6	Hdr1-31	Hdr1-56	Hdr1-81
Vcc	Hdr1-7	Hdr1-32	Hdr1-57	Hdr1-82
GND	Hdr1-8	Hdr1-33	Hdr1-58	Hdr1-83

Encoder connections when using single-ended encoder input

Signal	J4 pin connections			
	Axis 1	Axis 2	Axis 3	Axis 4
QuadAn	Hdr1-1	Hdr1-26	Hdr1-51	Hdr1-76
QuadBn	Hdr1-3	Hdr1-28	Hdr1-53	Hdr1-78
Indexn	Hdr1-5	Hdr1-30	Hdr1-55	Hdr1-80
Vcc	Hdr1-7	Hdr1-32	Hdr1-57	Hdr1-82
GND	Hdr1-8	Hdr1-33	Hdr1-58	Hdr1-83

3.5 Environmental and Electrical Ratings

All ratings and ranges are for both the IO and CP chips.

Dimensions	4.25" x 9.25", PCI Adapter
Storage Temperature	-40 °C to 125 °C
Operating Temperature	0 °C to 70 °C*
Power Consumption	1A @ 5V; 83mA @ 12V
Supply Voltage Limits	-0.3V to +7.0V
Supply Voltage Operating Range	4.75V to 5.25V
Analog Output Range	-10.0V to 10.0V
Analog Input Range	0.0V to 5.0V
Digital Output Range	0.0V to 3.3V

3.6 PLX PCI Chip Information

The Developer's Kit utilizes the PCI 9030 interface chip from PLX technology. For information on the operation of this device please refer to the PLX documentation available from http://www.plxtech.com/.

The following table lists the relevant PLX local configuration register values. For further information refer to the PLX documentation.

Space	Range	Remap	Descriptor	ChipSelect
0 (DPRAM)	0FFFC000	00000001	00402081	00008001
1 (CP)	0FFFFFE1	00010001	00410080	00010011

The following variables are used to access each space.

PCI_IOSPACE0_BASE = Second memory range as reported by the OS
PCI_IOSPACE1_BASE = Second IO range as reported by the OS

Dual_port_RAM= PCI_IOSPACE0_BASE

PMD_data_port = PCI_IOSPACE1_BASE + 0
PMD_cmd_status_port= PCI_IOSPACE1_BASE + 2

If the OS (Operating System) is MS Windows, the assigned IO spaces can be viewed in Device Manager/PMD PCI DK1/Resources.

4. Reference Schematics

4

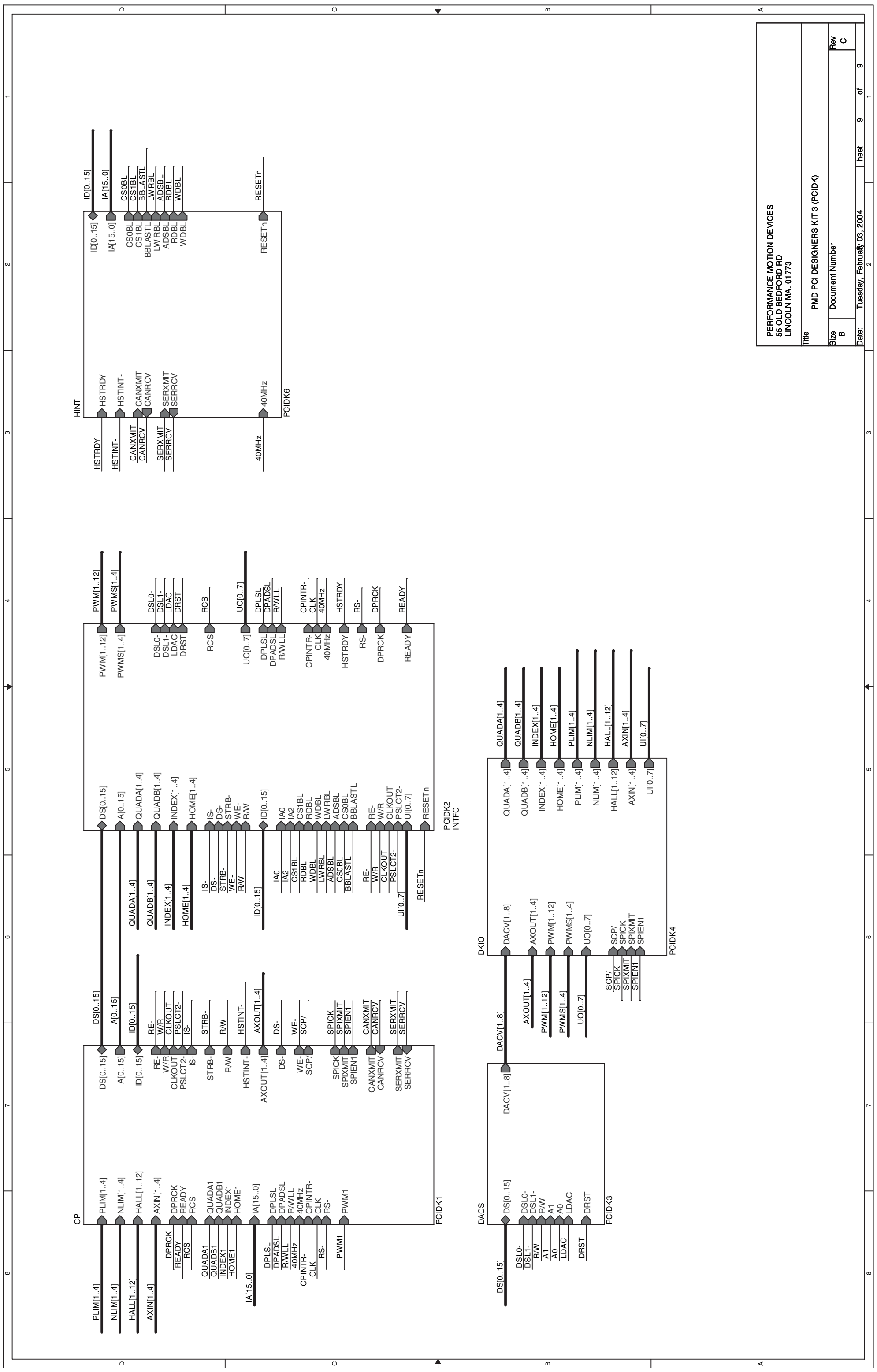
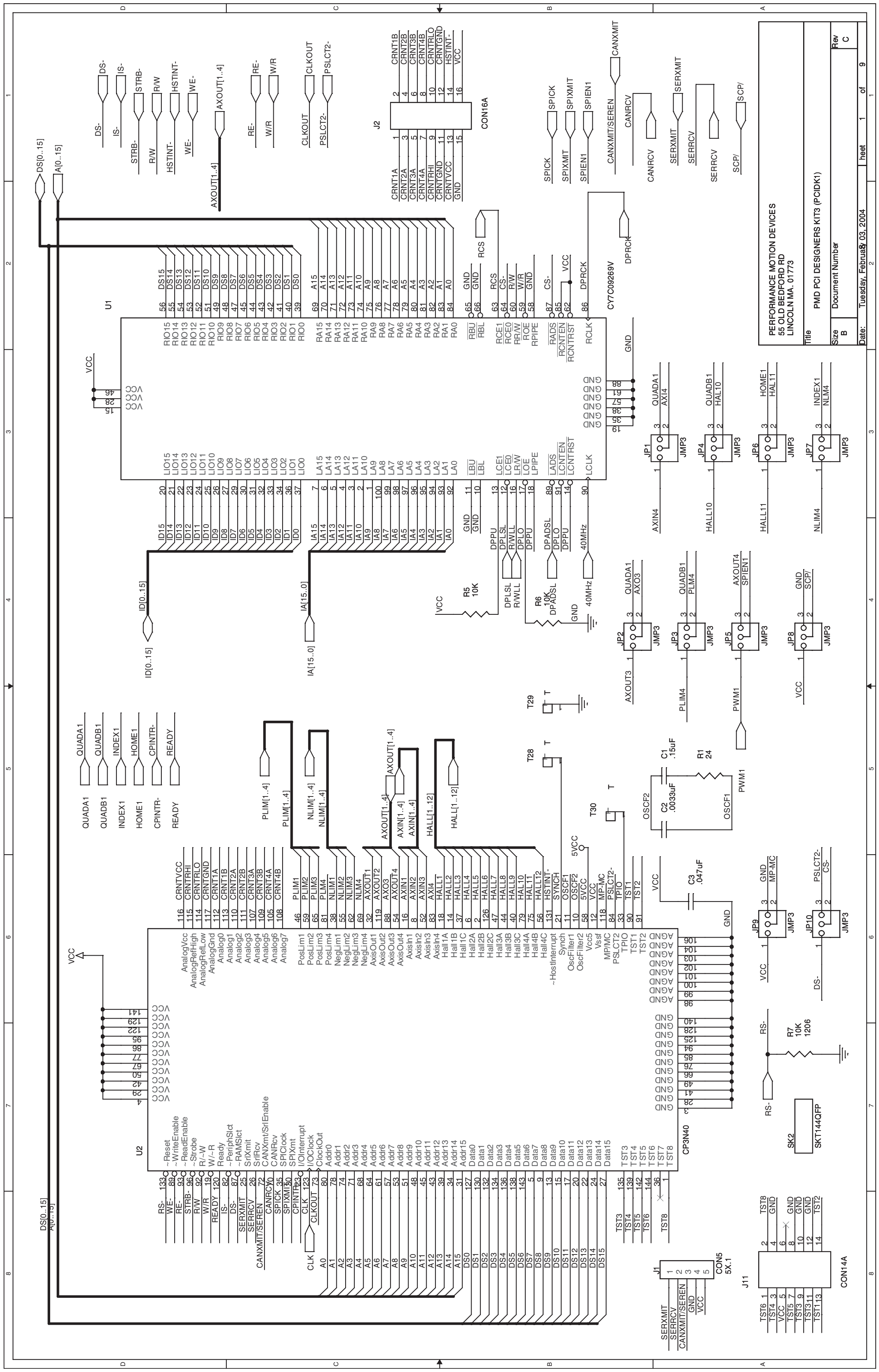


Figure 4-1: Developer's Kit overview schematic

Figure 4-2: Magellan Motion Processor CP and DPRAM schematic



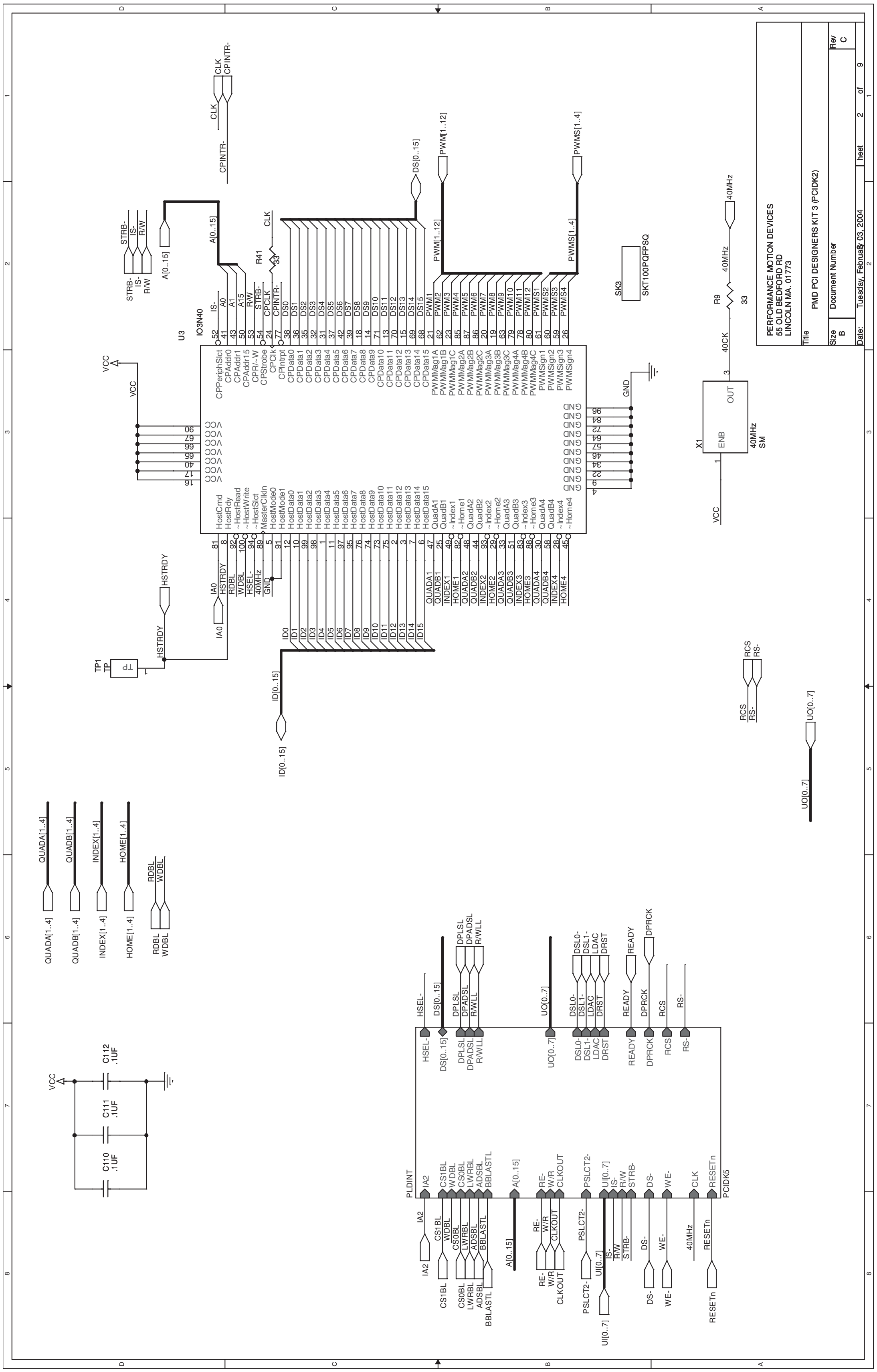
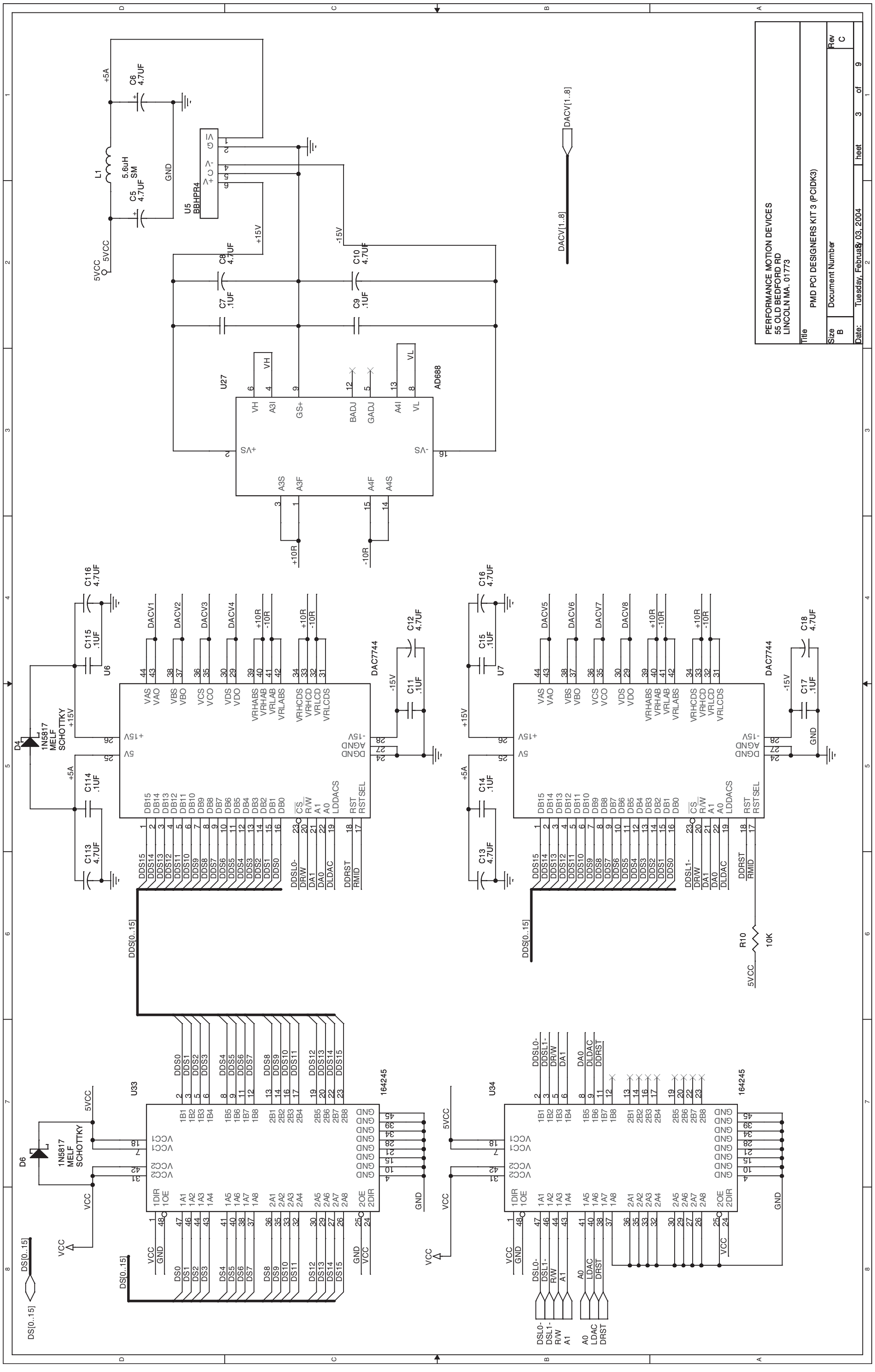


Figure 4-3: Developer's Kit I/O schematic

Figure 4-4: Developer's Kit DAC amplifiers schematic



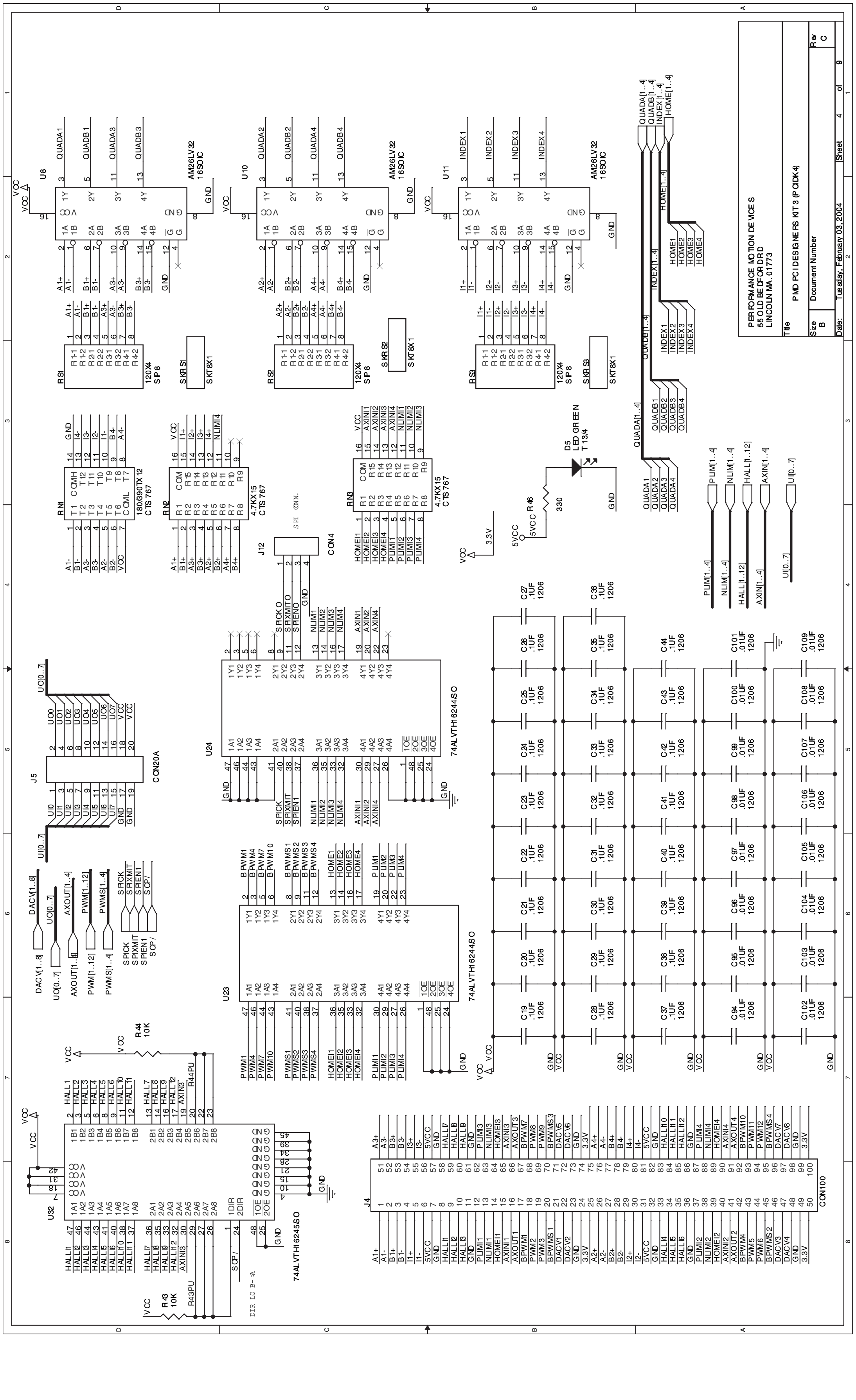
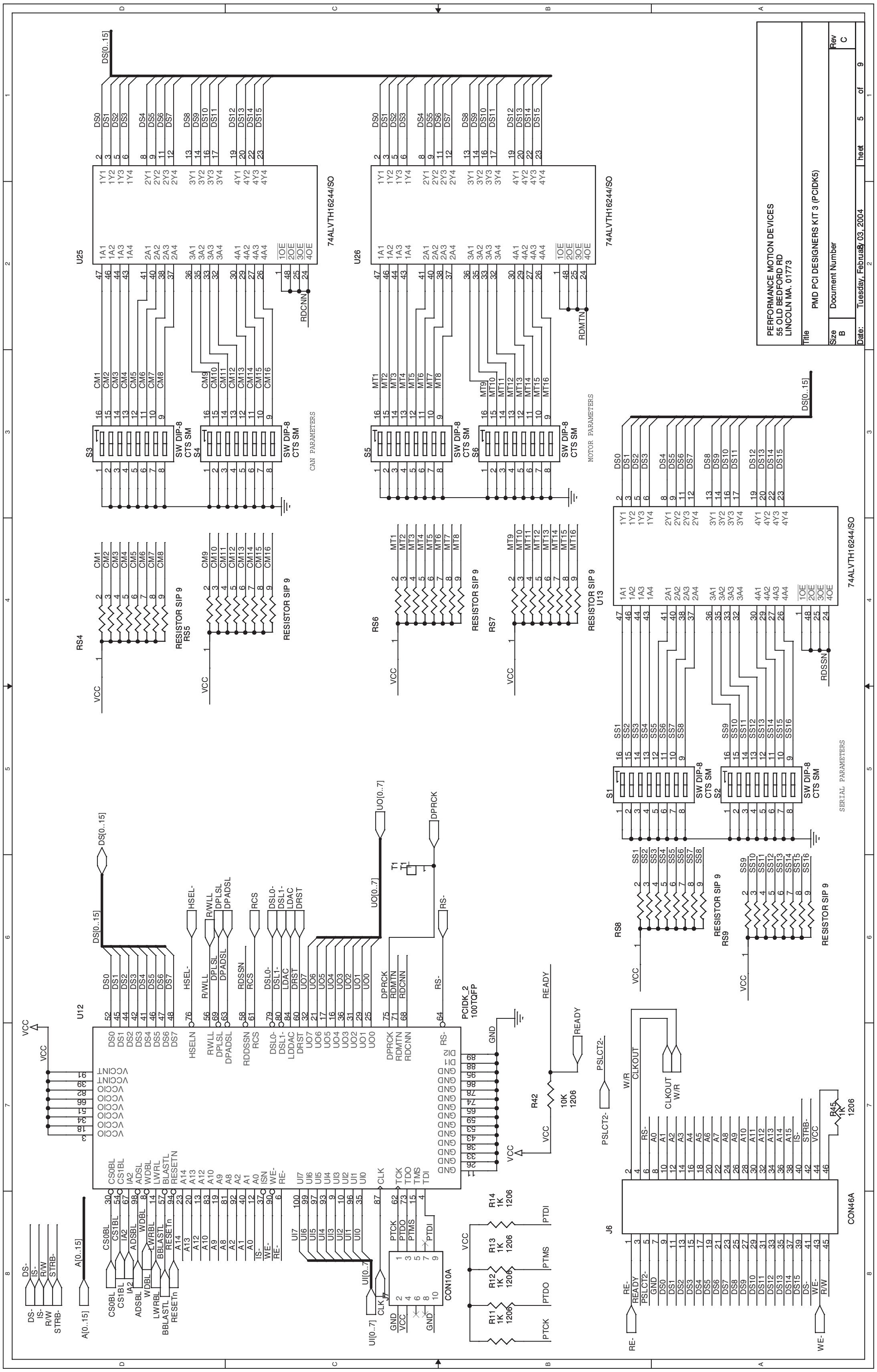


Figure 4-5: Developer's Kit connector and quadrature schematic

Figure 4-6: Developer's Kit PLD schematic



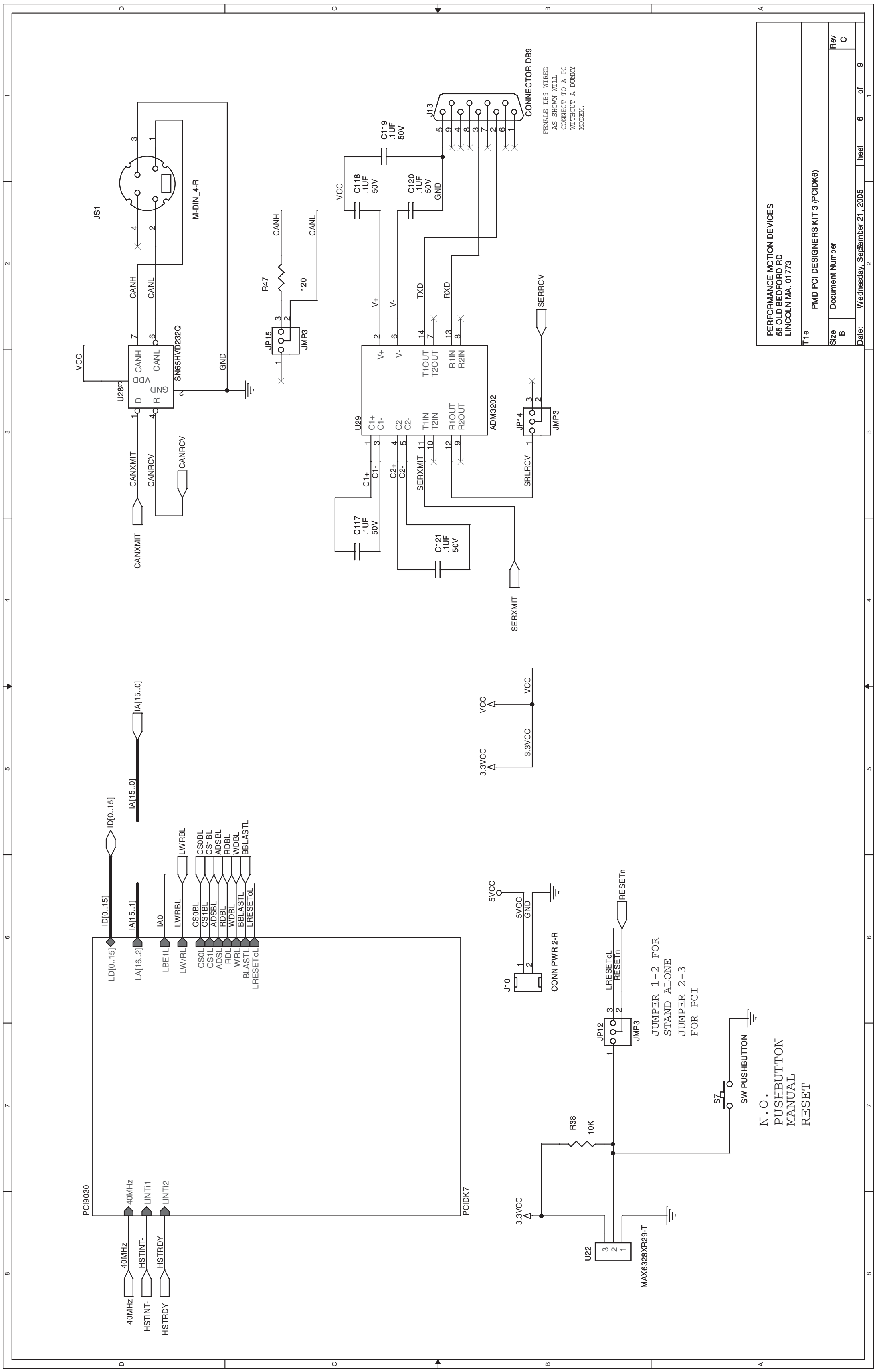
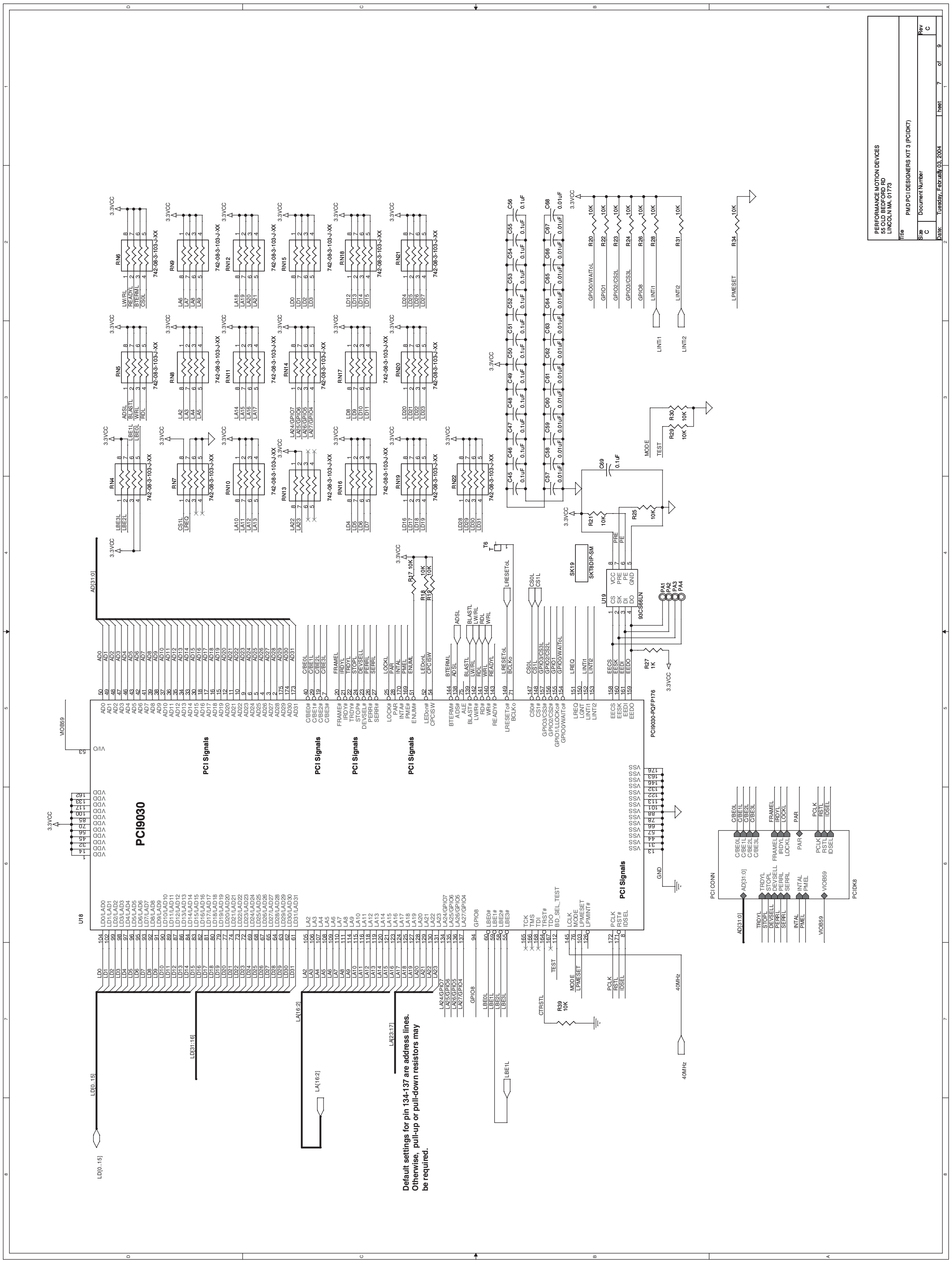


Figure 4-7: Developer's Kit transceivers schematic

Figure 4-8: Developer's Kit PLX9030 schematic



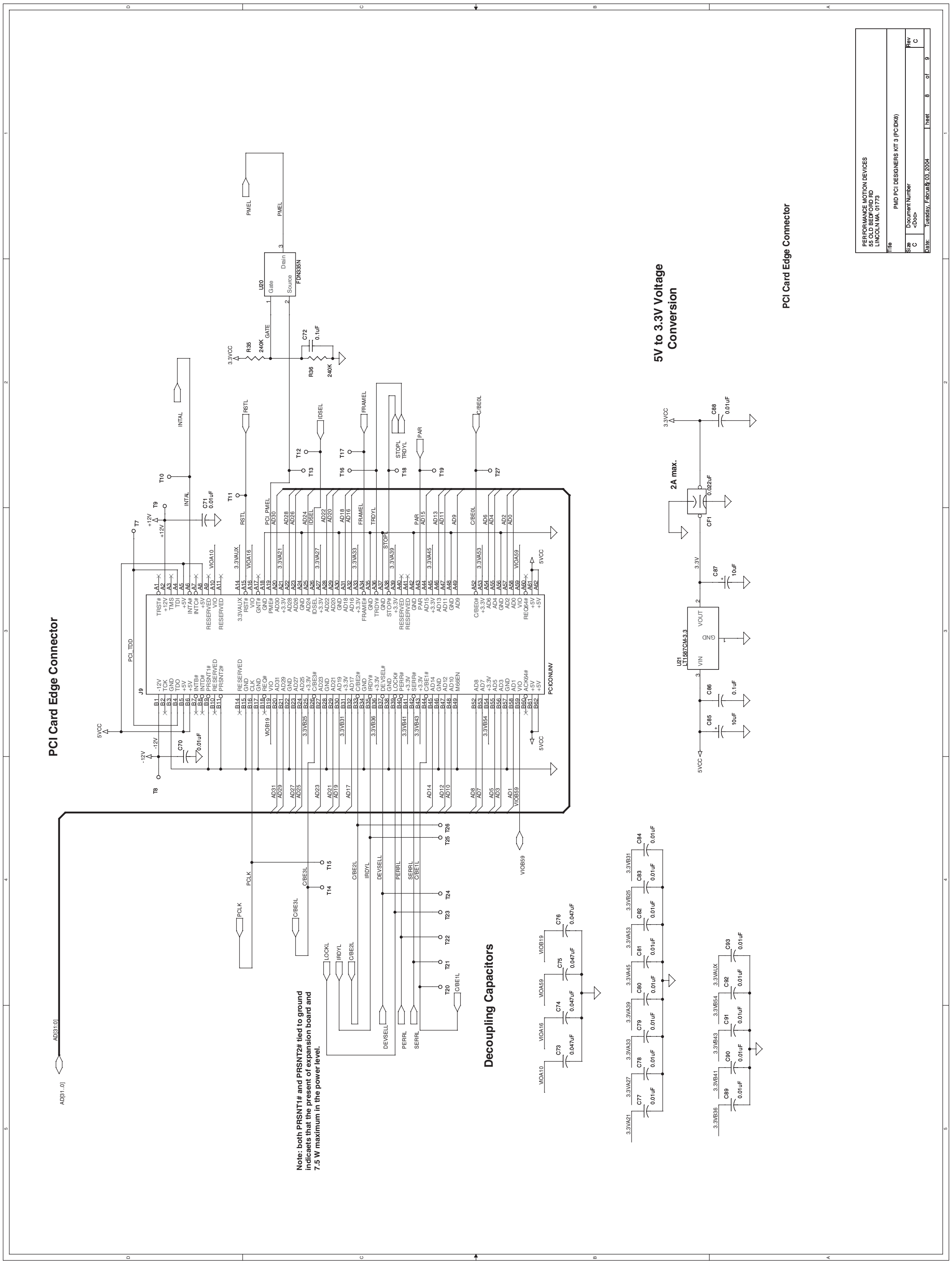


Figure 4-9: Developer's Kit PCI edge connector schematic

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For additional information, or for technical assistance, please contact PMD at (781) 674-9860.

You may also e-mail your request to support@pmdcorp.com

Visit our website at http://www.pmdcorp.com

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