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Hardware/Software Manual For the SB-3621X Synchro/Resolver-to-Digital PCI Interface Card

MN-3621XXX-001

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REV G December, 2007
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RECORD OF CHANGE

Revision	Date	Pages	Description
A	10/2000	All	Original Issue
B	10/2000	All	Software/Clerical update
C	10/2001	All	Software/Clerical update
D	04/2002	All	Linux Update
E	08/2003	Various	Function Calls updated, added LabVIEW details, Ordering information, misc edits.
F	06/2005	Various	Software/Clerical update
G	11/2007	Various	LabVIEWSection Removed

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Outside US Technical Support: 1-631-567-5600, ext. 7771

Europe:
44 (1635) 811140 Fax: 44 (1635) 32264

Asia/Pacific:
81 (3) 3814-7688 Fax: 81 (3) 3814-7689

Or by faxing 1-631-567-7358 to the attention of
Motion Feedback Technologies Applications.

Customer support:

1-800-DDC-5757, ext. 7382

Headquarters:

1-800-DDC-5757

Web Site

DDC also has an Internet World Wide Web site, which allows customers to easily download new revisions of software and documentation. The Internet address is www.ddc-web.com

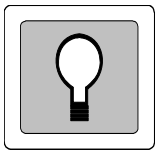
HOW TO USE THIS MANUAL

This manual uses typographical and iconic conventions to assist the reader in understanding the content. This section will define the text formatting and icons used in the rest of the manual. This manual is formatted with a 'Scholar Margin' where many tips, symbols or icons will be located.

Text Usage

- **BOLD**–text that is written in bold letters indicates important information and table, figure, and chapter references.
- ***BOLD ITALIC***–will designate DDC Part Numbers.
- `Courier New`–is used to indicate code examples.
- <…> - Indicates user entered text or commands.

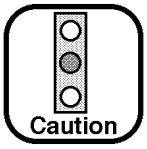
Symbols and Icons



The Idea/Tip icon will be used to identify a handy bit of supplementary information that may be useful to the user.



The Note Icon signifies important supplementary information that will be useful to the user.



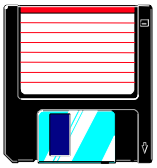
The Caution icon identifies important information that presents a possibility of damage to the product if not heeded.



Much stronger than a Caution, the Warning icon presents information pertaining to hazards that will cause damage to the product and possible injury to the user.



The Reference icon indicates that there is related material in this manual or in another specified document.



The Disk Icon describes information that is related to software.

Special Handling and Cautions

The ***SB-3621X series*** uses state-of-the-art components, and proper care should be used to ensure that the device will not be damaged by Electrical Static Discharge (ESD), physical shock, or improper power surges and that precautions are taken to avoid electrocution.



- Turn off power to the PC and unplug from wall.
- **NEVER** insert or remove card with power turned on.
- Ensure that standard ESD precautions are followed. As a minimum, one hand should be grounded to the power supply in order to equalize the static potential.
- Do not store disks in environments exposed to excessive heat, magnetic fields or radiation.

INTRODUCTION

The ***SB-3621X*** provides intelligent interfacing between a Synchro or Resolver's output and a PCI Bus. The ***SB-3621X*** is packaged on a full-size IBM PC/AT printed circuit board with a PCI bus interface. Features of the board include:

- Plug-and-Play (PnP) compatible for easy installation
- Utilizes six RD-19230 converters
- Software Programmable Resolution (10,12,14 or 16 bits)
- Software Programmable Bandwidth
- On-Board Oscillator option
- Transformer Isolation Available for 60 Hz or 400 Hz
- Turns Counter
- Self Test

Application software has the capability to display position for either six channels of single speed or three channels of two-speed. Included with each ***SB-3621X*** PCI Card is the DDC Toolbox library with example source code that allows users to easily write their own application software for the card.

What is included in this manual?



This manual contains a detailed installation guide for the ***SB-3621X*** PCI Card and a basic overview of the software supplied with the card. Toolbox Library, DLL, and Driver installations for Windows® 95, 98, 2000, Windows NT® and Linux will be covered in this manual.

The library software provides a level of abstraction such that it is not necessary to understand the operation of the chip set. This manual provides an introduction to the library.

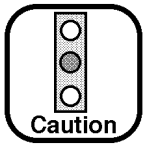
System Requirements

The PC must be configured with a Windows 95, 98, 2000, Windows NT or Linux operating system.

HARDWARE INSTALLATION

Card Installation

The ***SB-3621X*** card is a PCI Target device and may be inserted into any PCI 2.1, or higher, compatible slot. Note that this card only operates on a 5V PCI slot, and not on a 3.3V PCI slot. When installing the card, the following should be observed:



NEVER insert or remove the card with the power turned on.

ALWAYS take proper precautions to guard against static damage. Use a wrist strap if available, or ensure proper static grounding by touching the power supply cover **WITH POWER OFF**.



Insert the card at a slight angle so that the connectors first protrude from the rear opening and then gently press the card into the motherboard connector. Secure with proper hardware.

Make sure that adjacent cabling and wiring do not hinder the airflow around the card.

This card is designed as a Plug-and-Play device and as such, there are no jumpers or switches to be set for address and interrupt selection. **Figure 1** shows a block diagram for the Synchro/Resolver-to-digital PCI Card.

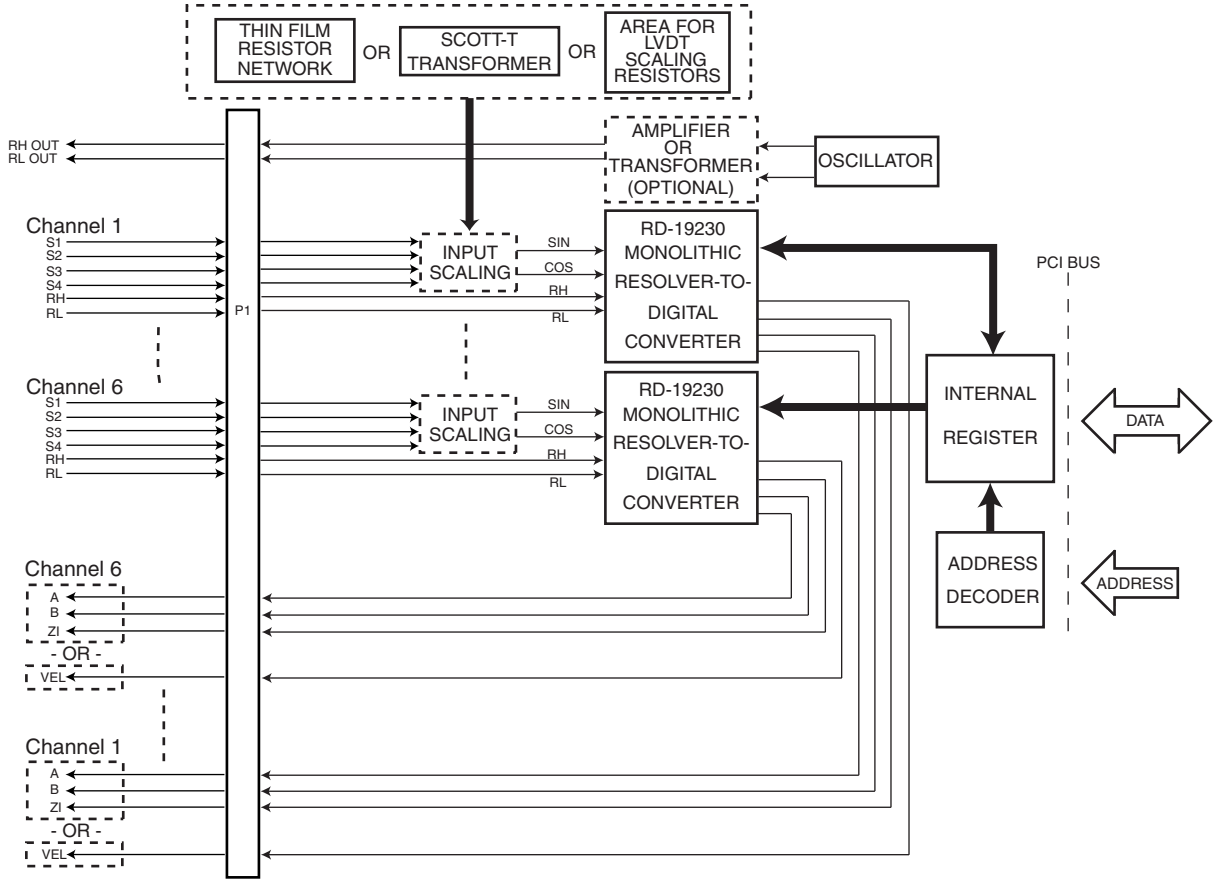


Figure 1. SB-3621X PCI Card Block Diagram

Windows 9x/2000 Driver Installation

After successfully installing the hardware as described in the **Card Installation** section on page 2, install the drivers. For a Windows 9x/2000 operating system continue with the following installation instructions. If you are using Windows NT, refer to page 7 for installation instructions. If you are using Linux, refer to page 7 for installation instructions.

1) Turn on the computer.

2) The **Add New Hardware Wizard** window will appear after boot-up:



Figure 2. Add New Hardware Wizard Screen

3) Click on the **Next** button.



Figure 3. Search For New Driver Screen

4) Click on Search for the best driver for your device.

5) Click on the **Next** button.

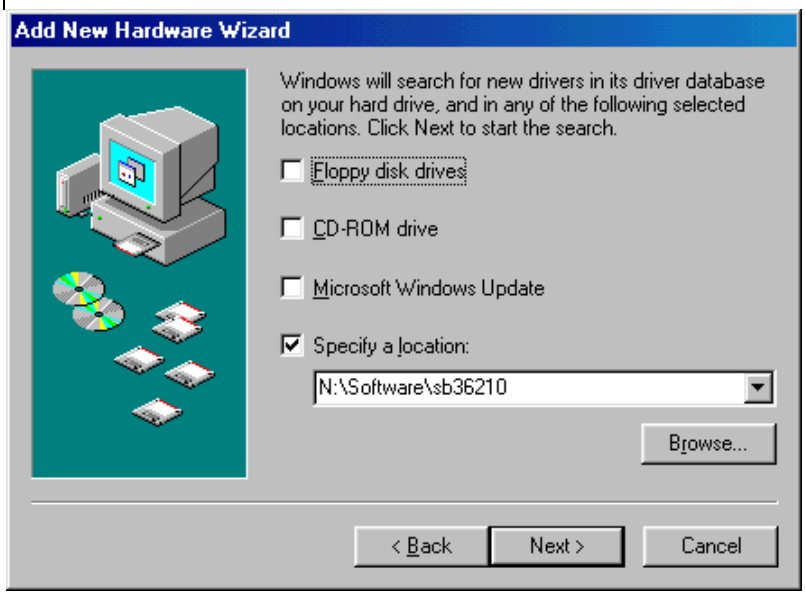


Figure 4. Search This Location For Driver Screen

6) Insert the MFT Software CD into the CD-ROM drive.

7) a) Select the **CD-ROM drive** option to install from CD-ROM.

or

b) Select the **Specify a location** option, and Browse CD to locate the SB-3621X folder.

8) Click on the **Next** button to locate the ***SB-3621X*** device driver.



Figure 5. Install Driver From Location Screen

9) Click on the **Next** button to install the device driver.



Figure 6. Driver Installation Complete Screen

10) Click on the **FINISH** button to confirm the installation.

11) Proceed to the **Hardware Configuration** section on page 10.

Windows NT Driver Installation

After successfully installing the hardware as described in the **Card Installation** section on page 2, install the drivers. For a Windows NT operating system continue with the following installation instructions.

1) Turn on the computer.

2) Insert the MFT CD into the CD drive.

3) The CD will auto start.

4) Select the SB36210 card software to install.

5) Follow any instructions that may appear on the screen. The computer will need to be rebooted for the device driver to run. Once rebooted, proceed to the **Motion Feedback Board Manager** section on page 13.

Linux Driver Installation

Linux is a free Unix-type operating system developed under the GNU General Public License. The source code for Linux is freely available to everyone. Since it's inception in 1991, individuals, university students and companies began distributing Linux with their own choice of packages bound around the original kernel. This is where the concept of the "distribution" was born. This also complicates providing Linux support for our hardware because there are over 150 distributions of Linux. Red Hat Linux is one of the most popular distributions in the world. For this reason we have developed and tested our Linux support on one of the many Red Hat distributions. **This guide was prepared using Red Hat® Linux® 7.2 kernal versions 2.2.16-22.**

To complete the Linux setup, the user should be familiar with basic Linux procedures and commands (mounting, compiling, etc.). View the readme.txt file for the latest installation information. If you are unfamiliar with Linux, try visiting some of these sites for helpful documentation:

- www.ora.com
- www.kernel.org
- www.linux.org
- www.linuxmall.com
- www.amazon.com
- www.ssc.com
- www.linuxhq.com

Documentation can also be found at any of the following major distribution sites for Linux:

- www.redhat.com
- www.caldera.com
- www.debian.org
- www.slackware.com
- www.suse.com

The following installation procedure is also described in the Install.txt and Readme.txt files provided in the *SB3621x_X_Y_Z.TGZ* archive.

1. **Create a new (working) directory called '*synchro*' and go to it.**

   ```
   mkdir synchro
   cd synchro
   ```

2. **Go to super user 'su' (root) mode.**

   ```
   su
   ```

3. **Copy the synchro archive to the working directory and uncompress (TAR/G-ZIP) it.**

   ```
   tar –xzpPf SB3621x_X_Y_Z.TGZ
   ```

4. **Create the shared library links and cache for runtime linking of the synchro library.**

   ```
   /sbin/ldconfig
   ```

5. **As superuser change ownership of all of the files to normal user and then exit superuser mode.**

   ```
   chown –R users.username *
   exit
   ```

6. **As superuser locate the PCI card information by viewing the pci section of the proc kernel interface;**

   ```
   cat/proc/pci
   ```

The Vendor ID is '4ddc', and the Device ID is '0500' for the *SB-36210* card. Make a note of the data listed for the Logical Device #, Vendor ID/Device ID, Bus #, and Device # (or Slot #).

7. **Edit */usr/lib/ddc/DDC_synchro.cfg* to set the correct data for the Logical Device #, Vendor ID/Device ID, Bus #, and Device # (or Slot #) previously noted in step 6. Exit superuser mode.**

Logical Device #	Bus Type	Device ID	Bus #	Slot#	Channel #
0	1	4ddc0500	0	10	0

```
pico /usr/lib/ddc/DDC_synchro.cfg
exit
```



Note: *The bus and channel numbers are not used for the SB-3621x card and should be set to 0. All numbers are in decimal format.*

8. **The driver is distributed as a versioning enabled loadable kernel module, therefore module support (CONFIG_MODULES) and versioning (CONFIG_MODVERSIONS) must be compiled into the kernel in order to use the card and RTL. The driver source is included with the distribution in the event that any kernel symbols or data types are not compatible with the driver binary. Incompatibility is evident when the driver fails to load into the kernel. If a rebuild is required, simply run 'make SB3621.0' in the 'synchro' directory as unprivileged user than copy 'SB3621.0' to '/usr/lib/ddc' as root.**

9. **Loading and unloading of the driver is accomplished by running the appropriate script as superuser. '/usr/sbin/sb3621x_load' will create the required device special files and load the driver into the kernel, and '/usr/sbin/sb3621x_unload' does the reverse. Calls to these scripts can also be made at startup or login time in the runtime command (rc) section of the '/etc' tree, or user startup files, respectively. To gain a better understanding of what the scripts do, it is suggested that the user view them.**

10. **Compile the sample application.**

```
cd synchro
make 3621 test
cd samples
```

11. **Execute the sample application.**

```
./3621_linux
```

After successfully installing the drivers, refer to step 3 in the **Console Application Section** on Page 28.

Hardware Configuration

The ***SB-3621X*** is a PCI device, and as such does not require jumpers or switches to set the Base address or interrupt values. The job of configuration for Plug-and-Play PCI configuration is performed by the PC BIOS. During the initial power on boot process, the BIOS performs an enumeration of the PCI bus and provides a configuration in the system that satisfies the card requirements. The card provides the BIOS with details of how much memory it requires, and any other operating parameters that the system needs to know by way of configuration registers built into the card. These registers are configured at the factory to contain the optimum values for the operation of the ***SB-3621X***. The ***SB-3621X*** PCI card and software drivers allow for shared interrupts, thus simplifying the installation and reducing the risk of device conflicts.

Once the card has been properly installed, its configuration information is stored to the Windows Registry. The card information stored in the Registry is accessed and controlled through the use of the **Motion Feedback Board Manager** Application. The **Motion Feedback Board Manager** Application can be used to view the status of installed cards, and map an installed card to a device number. In order to access an installed card you **must** assign it a device number.

Proceed to the **Motion Feedback Board Manager** section on page 13.

APPLICATIONS SOFTWARE INSTALLATION

Windows Software Overview

There are several software applications which are used in conjunction with ***SB-3621X*** PCI Cards. These applications are included with your card, and include a Console Application, a Graphical User Interface and a Synchro.dll file.

If you did not receive the application software described on the following pages with your card, please contact DDC customer service.

MOTION FEEDBACK BOARD MANAGER APPLICATION

A MOTION FEEDBACK BOARD MANAGER Application contained in the CONTROL PANEL is used to define each Synchro/Resolver card type in the system and the address for each Synchro/Resolver card. The MOTION FEEDBACK BOARD MANAGER Application is installed in the CONTROL PANEL during the setup.exe installation. The MOTION FEEDBACK BOARD MANAGER Application will route the information to the appropriate routine for the card type selected.

CONSOLE APPLICATION

An executable application using the synchro.dll is included with the ***SB-3621X*** PCI card to demonstrate the capabilities of the card. Upon installation, there will also be source code examples of a program that can be compiled.

SYNCHRO.DLL FILE (FUNCTION CALLS)

The synchro.dll (Dynamic Link Library) has been created to provide a programmer with routines (Function Calls) that perform the low-level read and write functions to the registers on the Synchro/Resolver cards. The **Function Calls** section of this manual describes the routines available from the synchro.dll.

Windows Software Installation

The ***SB-3621X*** PCI Card is supplied with a GUI, a console application, and Runtime Libraries for Windows 95/98 and Windows NT/2000.

The runtime library provides the user with a hardware abstraction layer for the DDC ***SB-3621X*** PCI series Synchro/Resolver-to-Digital Card. This software layer includes routines that dramatically reduce software development time by providing a high level interface to the PCI card.



16-bit operating systems not supported

If you are installing under Windows perform the steps below:

1) Insert the MFT CD into the CD-ROM drive, and allow the CD to auto start.

2) Choose your product (i.e., SB-36210IX).

3) Choose your software (i.e., SB-36210sw).

4) Click on the Install Software icon.

5) Follow the on screen instructions.

6) When the installation is successfully completed, proceed to the **Motion Feedback Board Manager** section to configure the card. See page 13.

MOTION FEEDBACK BOARD MANAGER

Once you have installed the hardware and software, you are now ready to configure the card. Device configuration is performed through the use of the **Motion Feedback Board Manager** Application.

1) Turn on the computer.

2) Click on Windows **START**.

3) Click on **SETTINGS**.

4) Click on **CONTROL PANEL**.

5) Double-click on the **Motion Feedback Board Manager** icon (circled in the screen image below).

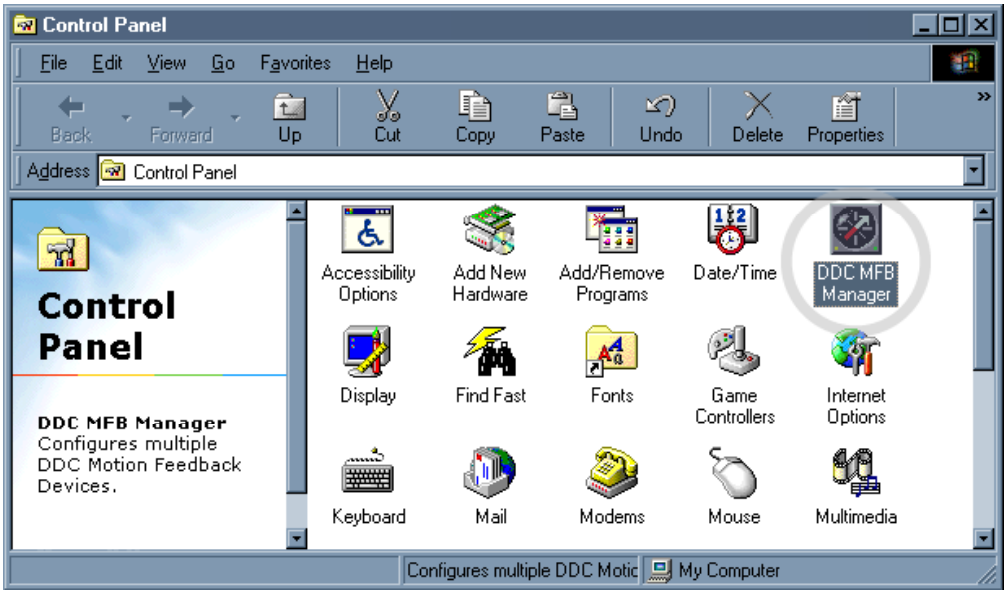


Figure 7. Control Panel window

6) Select **Show installed devices** from the Motion Feedback Devices window to display status information for the installed card(s).

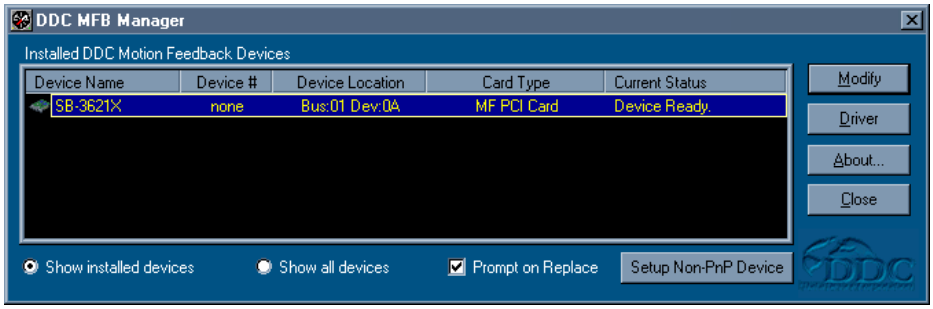


Figure 8. Motion Feedback Devices window

Note: *The **Device #** will default to none. Each card must be assigned to a unique (unused) device number from 0 to 7. Card numbers cannot be shared.*

7) To assign the card to a new Device number, select **Modify** to open up the Modify Device window.



Figure 9. Modify Device window

8) Click on the **Device Number** arrow to open up a pull down window of device number selections.

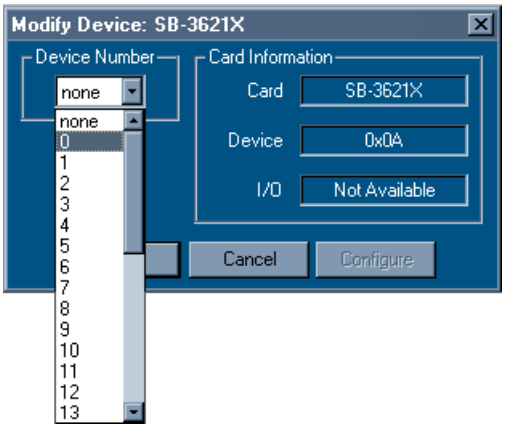


Figure 10. Modify Device pull down menu

9) Select an unused device number from the pull down menu (Currently only device numbers 0 to 7 can be selected).

Note: *If a previously assigned device number is selected, and the* ***Prompt on Replace*** *option is checked on the Motion Feedback Devices menu, the following warning will appear. Clicking on* ***Yes*** *will overwrite the previously assigned device number. If the* ***Prompt on Replace*** *option was not selected, a warning will not be displayed and the new device number will automatically overwrite the previously assigned device number.*

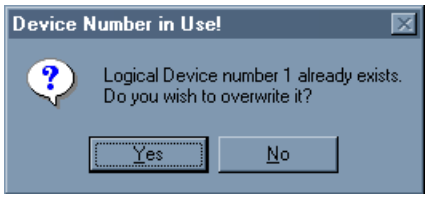


Figure 11. Device Number in Use! warning



Figure 12. Modify Device Window (close)

10) Select **OK** on the Modify Device window to return to the Motion Feedback Devices menu.

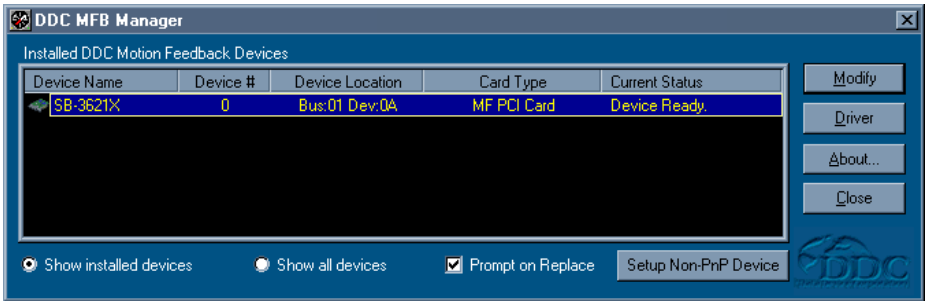


Figure 13. Motion Feedback Devices window (Device # assigned)

Note: *The **Motion Feedback Devices** window should display the device assigned to the selected device number.*

11) To show a log of all devices installed (even if the card is not currently inserted), select **Show all devices** from the **Motion Feedback Devices** window.

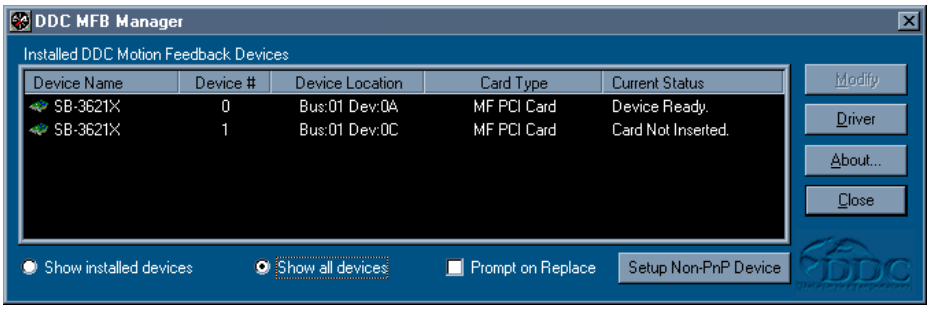


Figure 14. Motion Feedback Devices window (Show all devices)

Note*: The **Motion Feedback Devices** window will display all cards currently installed.*

12) To display the status of the device drivers, select **Driver** from the **Motion Feedback Devices** window. The following Device Driver Information window will be displayed.

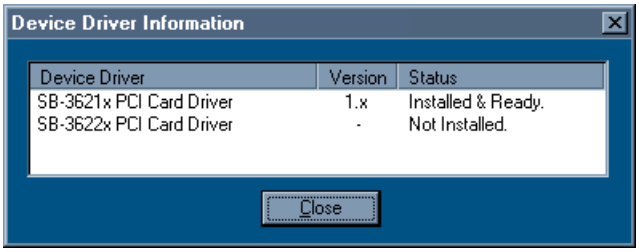


Figure 15. Device Driver Information window

13) Select **Close** to close the Device Driver Information window and return to the Motion Feedback Devices window.

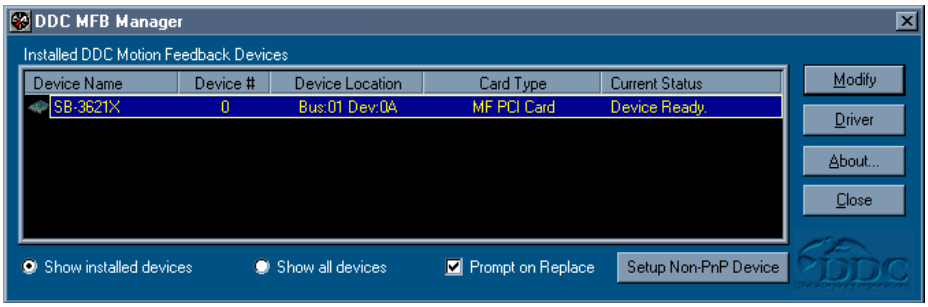


Figure 16. Motion Feedback Devices window (close)

14) Select **Close** to complete the card configuration and close the **Motion Feedback Devices** window. The card is now ready for use.

Graphical User Interface (GUI) Application

The Graphical User Interface allows the user to display and set card parameters in analog, digital and binary formats. Parameters are set and display options are selected using a combination of keyboard and mouse commands according to the chosen format.

1) To access the Graphical User (GUI) Application Interface click on **Start**, **Programs**, **Data Device Corporation**, **SB3621x**, and **SB-3621x Application**, as shown below.

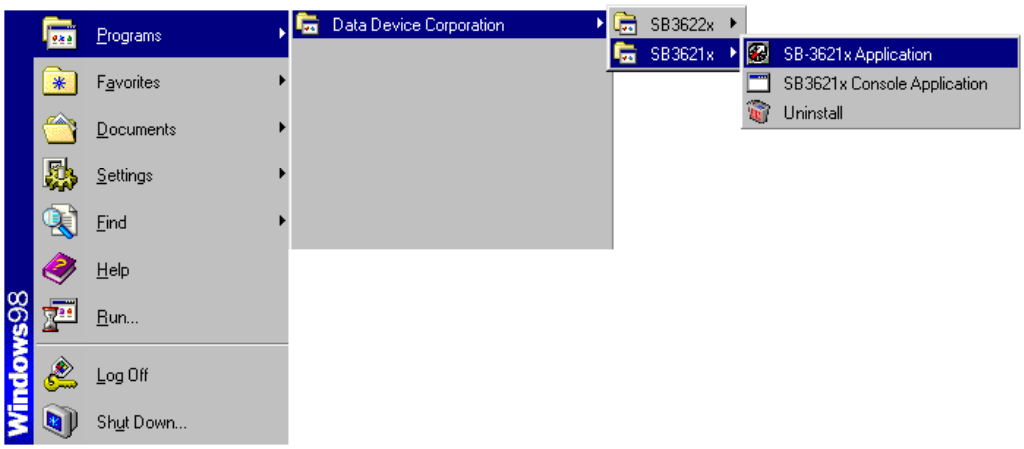


Figure 17. Accessing the GUI Application

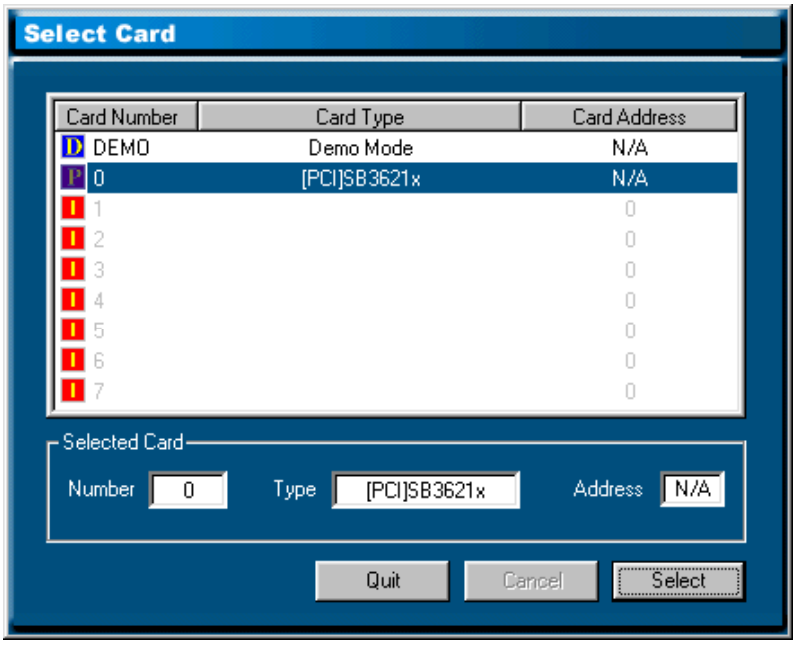


Figure 18. Select Card Screen

2) Select a card from the drop down list, then click **Select**.

Note: *Selecting Demo Mode will open up a demo application screen where input information can be simulated, even if a card is not installed.*

3) When the GUI application is initiated a 45-degree angle is simulated into each channel. If the digital output is correct the Self-Test results will indicate passed as shown below. If a channel is not functioning the Self-Test will return a failed indication.

Note*: If a channel fails Self-Test, the user can still use the Graphical Interface, but the failed channel will not be accessible.*

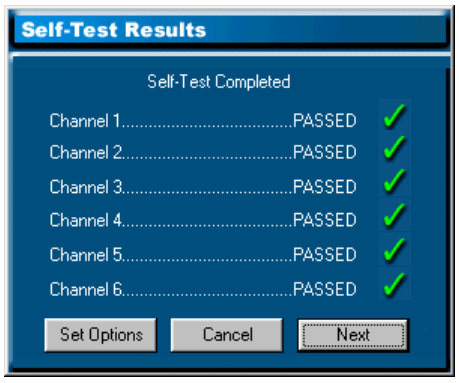


Figure 19. Self-Test Results

4) To set the oscillator amplitude and frequency click **Set Options,** this will open the menu shown below. From this menu the display information can be configured to correspond to the hardware configuration. The model number purchased determines the oscillator range. See the appropriate mV/bit shown below. Select the model number of the card installed then select **OK**.

Note: *For Model # IC contact factory.*

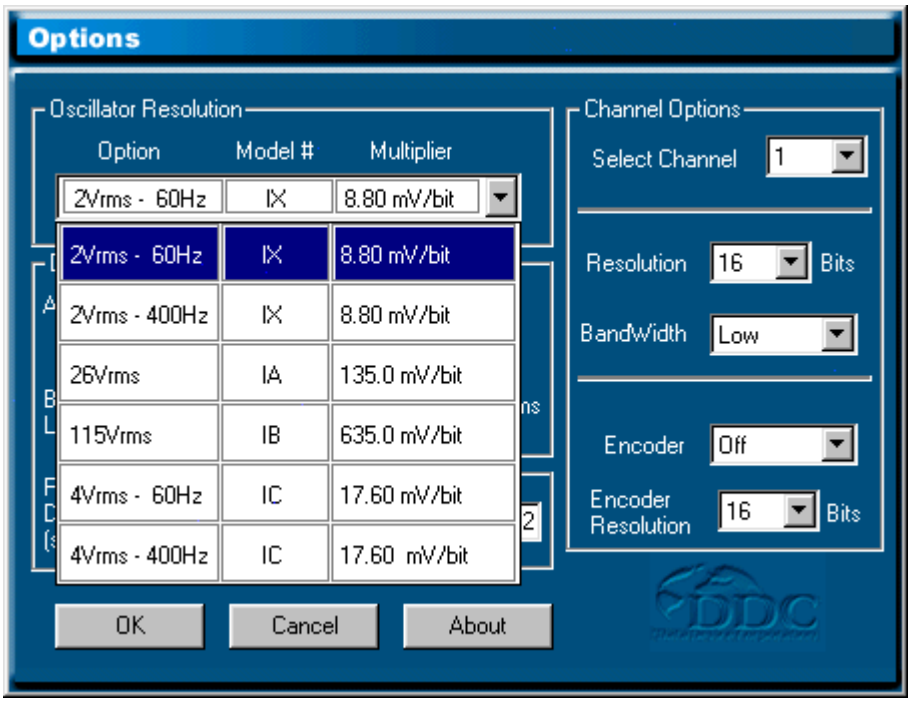


Figure 20. Options Screen – Oscillator Resolution Shown

5) Options for resolution, bandwidth and encoder emulation mode can be selected as shown in the menu below. Channels can be selected individually or they can all be selected. For two-speed applications select the pair of channels along with the two-speed ratio.

6) Once the appropriate oscillator is selected the oscillator amplitude and frequency can be programmed by inputting the values into the Oscillator Settings windows. The Amplitude and Frequency displays will update with the closest system values available.

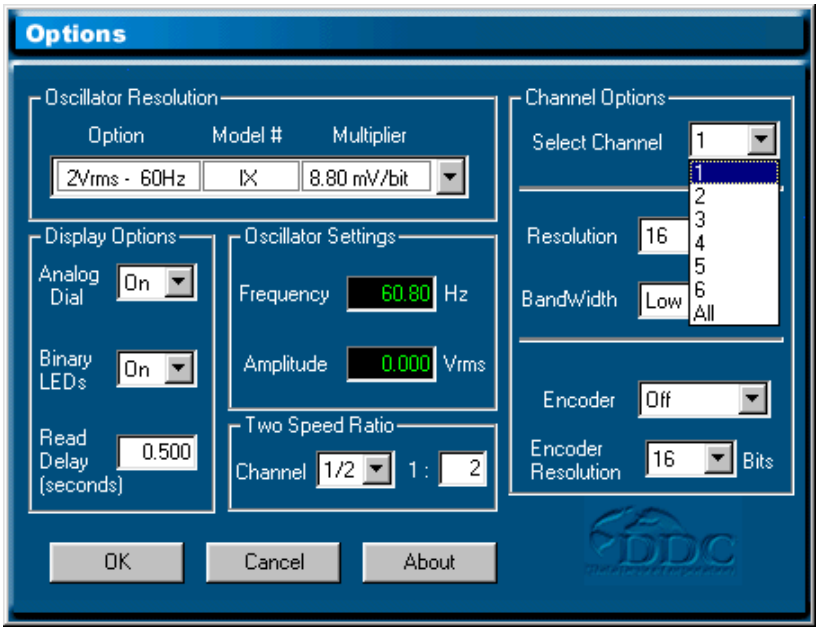


Figure 21. Options Screen - Select Channel Shown

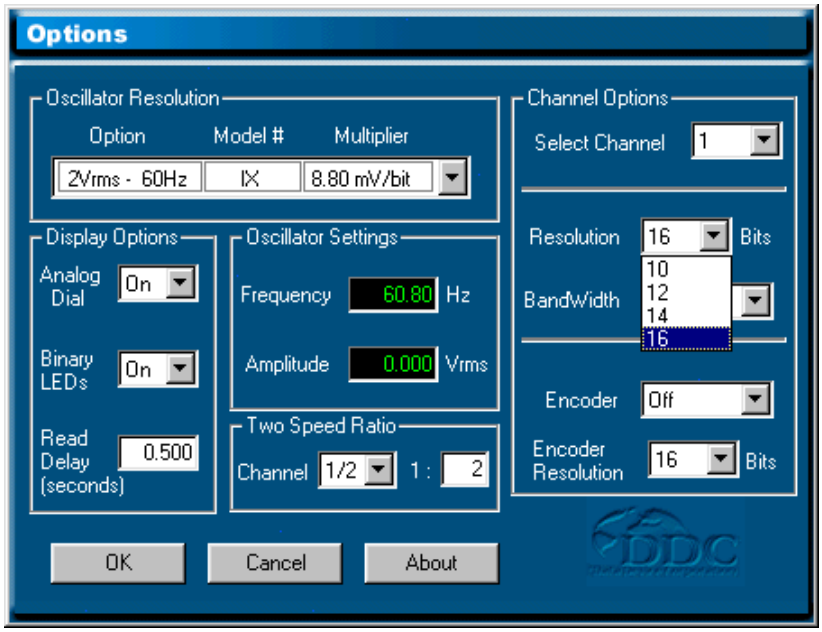


Figure 22. Options Screen - Resolution Shown

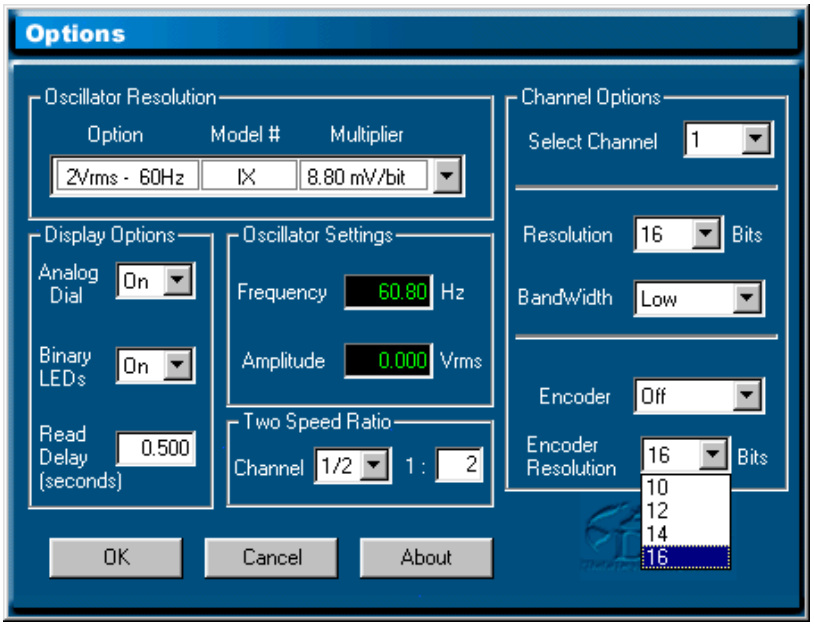


Figure 23. Options Screen – Encoder Output Resolution Shown

7) The Encoder Output Resolution can be set by selecting 10/12/14 or 16 Bit resolution from the drop down menu.

Note: Encoder (A quad B) output resolution must be of equal or lesser value than the resolution set on the card. For example, if the resolution set on the card is 14 bits, the A quad B resolution must be set to 14 bits or less (not 16 bits).

8) The Display Options section enables which type of display is shown in the main screen. The binary display represents the digital angle, (Bit 1 = 180°, Bit 2 = 90°, Bit 3 = 45° etc…). The read delay defines the display update rate.

9) Once the options are selected click on **OK.** The main screen will display angular position, turns count, direction and BIT information.

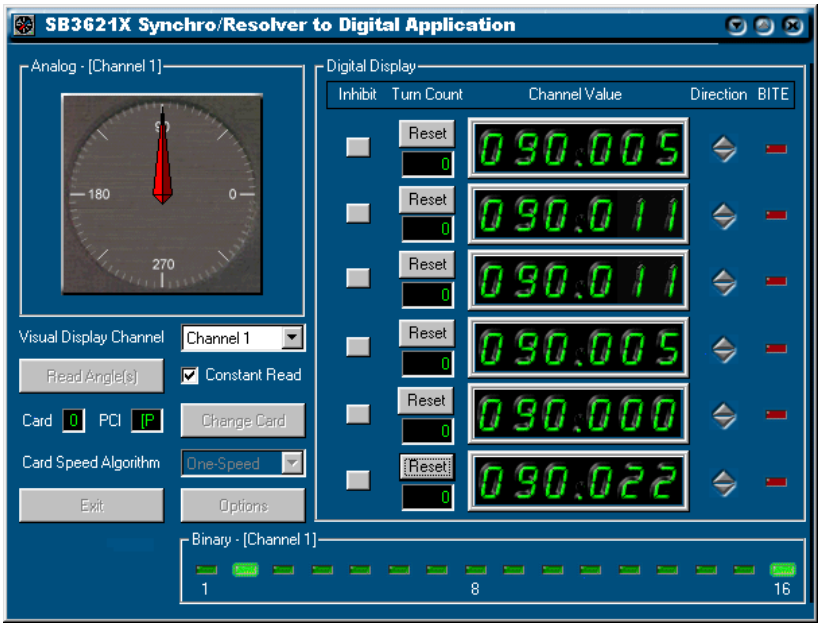


Figure 24. Angular Position Screen – One-Speed

DISPLAY OPTION	EFFECT
Visual Display Channel	Defines which channel is displayed on the Analog and Binary Displays.
Constant Read	Constantly updates all channels.
Card Speed Algorithm	Selects either One-Speed or Two-Speed input mode.
Inhibit	Inhibits the output display.
Turns Count *	Displays the turns count status for each channel. Reset will reset each individual channel's turn count to zero. (*See NOTE)
Direction	Displays the direction of rotation. Up is counterclockwise (angle increasing), Down is clockwise (angle decreasing).
BITE	Reads the status of the BIT output of the R/D converter. The reasons a fault may be indicated in a R/D converter are as follows: 1. The synchro or resolver signals have fallen below the specified voltage amplitude or there are no analog input signals connected to the R/D converter. ***Note:*** *Both SIN and COS signals of the R/D converter must fall below 0.5 Vrms, or else the BIT may only indicate a fault at certain angles.* 2. The synchro or resolver is moving at a rate greater than the R/D converter can accommodate. The dynamic capability of the R/D converter is determined by the bandwidth selection and the resolution (refer to hardware setup). 3. If the error exceeds approximately 100 LSB's. This condition will occur during a large step and reset after the converter settles out.



**** Note:*** *The Encoder must be enabled for the turns counter and the direction to work properly for both the DOS console and the Windows GUI. Encoder (A quad B) resolution must be of equal or lesser value than the resolution set on the card. For example, if the resolution set on the card is 14 bits, the A quad B resolution must be set to 14 bits or less (not 16 bits).*

10) The ***SB-3621X*** series cards can also be used to interface with two-speed resolvers and calculate the combined position between the coarse and fine channels based on the two-speed ratio selected.

11) If the two-speed option is selected the main screen will display the Coarse, Fine and Combined position information on the Digital displays, and the Combined position information on the Analog display. Two-speed allows resolutions of greater than 16 bit to be achieved. For 2-Speed Theory (See calculate 2-speed (Appendix A) for details) review the following DDC documents:

The RD/RDC applications manual system design section, RD/RDC manual and the Synchro/Resolver Conversion Handbook. Both of these documents can be downloaded from the DDC website at www.ddc-web.com.

Note: A quad B does not have any combining function when used in 2-speed mode.

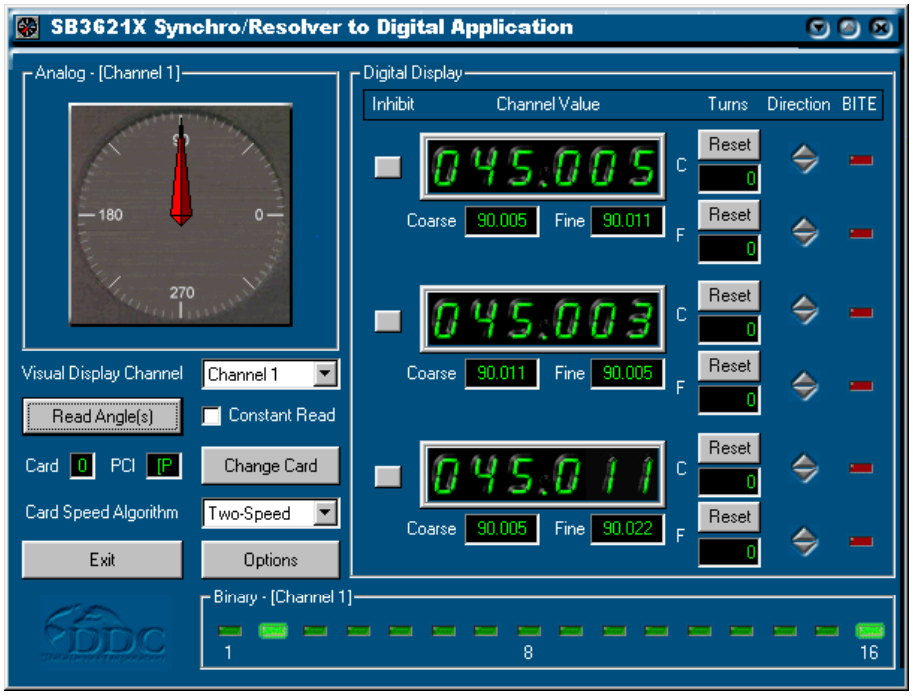


Figure 25. Angular Position Screen – Two-Speed

12) To exit the application screen, select **Exit**. The following warning will be displayed. Click on **Yes** to exit.

Note: *Option settings will be saved upon exit from the Application menu. These settings will remain active from one session to the next, provided that you do not change the logical device number or remove the card.*

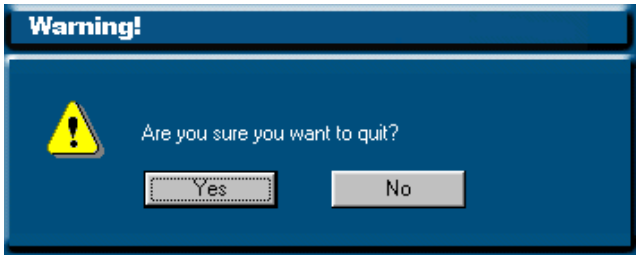


Figure 26. Exit Warning

Console Application

Note: *For Linux installations refer to the readme.txt file supplied with the Linux software.*

The Console Application is an easy to use application that enables engineers and maintenance personnel to test and maintain Synchro/Resolver systems. This program allows easy access to data analysis of Synchro/Resolver outputs. Some features include:

- Self test
- Angle position data
- Inhibit data
- Change bandwidth and resolution
- Reset counters
- Change to encoder mode
- Change oscillator amplitude and frequency

The underlying source code for the Console Application is provided as an example program and is located at C:\Program Files\Data Device Corp\SB-3621x\3621x.cpp .

1) To access the console application click on **Start, Data Device Corp, SB 3621X** and **SB 3621X Console Application**, as shown below.

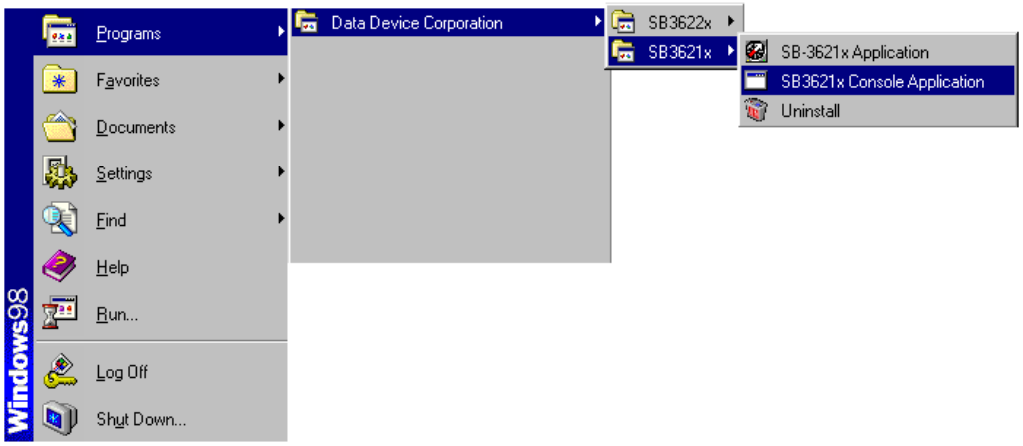


Figure 27. Accessing the Console Application

2) This will launch the console application. The console application provides an easy method to evaluate angle position information and run self-test.

3) Enter the card number of the ***SB-3621X*** card and hit **Enter**. This will start the self-test mode. The self-test results will indicate if the card is functioning properly.

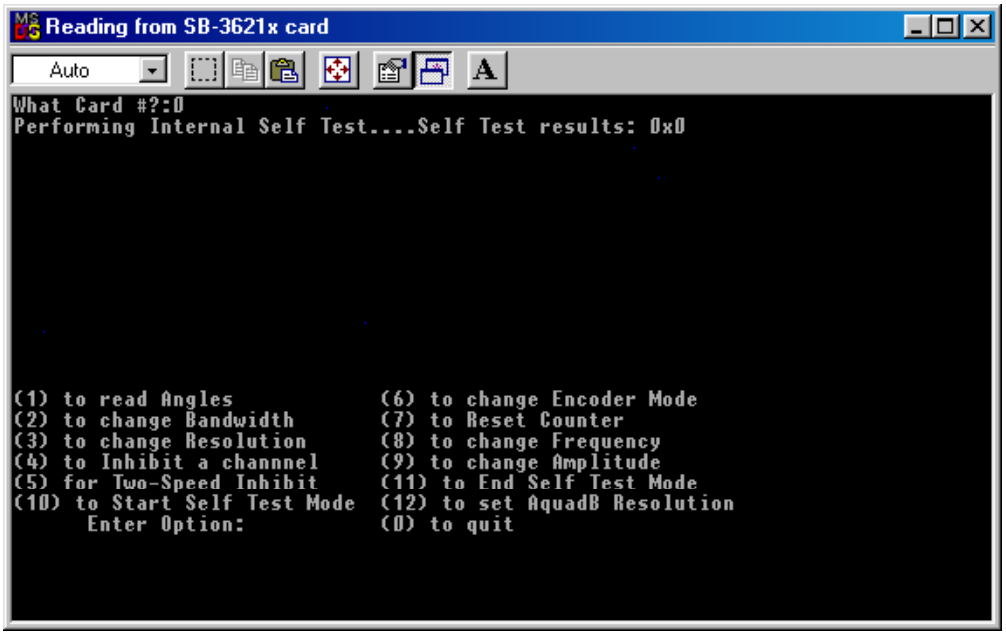


Figure 28. Console Application Function Select Screen

4) The self-test results will be displayed on the second line of text. A response of 0x0 indicates that the card has passed self-test, with a simulated input angle of 45 degrees and that each converter is working correctly.

The Self-Test Result Codes

RESULT CODE	DESCRIPTION
0 x 99	Card did not initialize
0 x 20	Ch 1 failed
0 x 10	Ch 2 failed
0 x 08	Ch 3 failed
0 x 04	Ch 4 failed
0 x 02	Ch 5 failed
0 x 01	Ch 6 failed
0 x 3f	All channels on the card failed
0 x 0	All channels passed self-test on power up

Register Format

		Ch 1	Ch 2	Ch 3	Ch 4	Ch 5	Ch 6
0	0	0	0	0	0	0	0

READ ANGLE INFORMATION

1) Type the code for the desired operation in the **Enter Option:** field (1 to read Angles), and hit **Enter**.

2) The test results for the selected operation will be displayed in the console application screen.

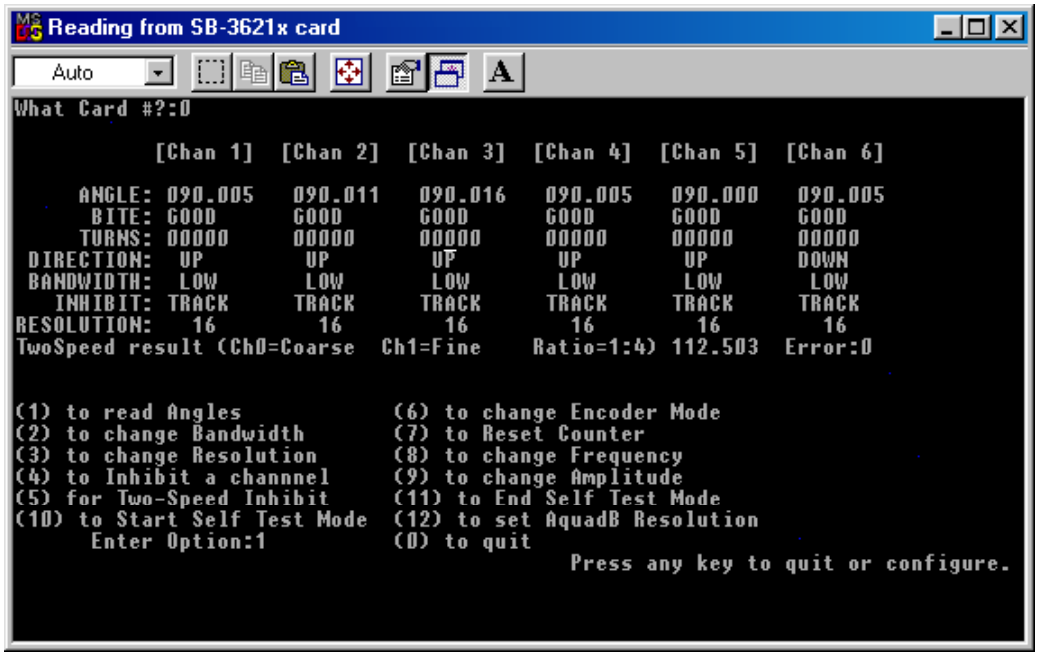


Figure 29. Console Application Test Results for Read Operation

3) The following information is displayed for a read Angles operation. This example is for a card with six channels installed.

ANGLE:
Channels 1 to 6 position information is continuously updated for monitoring. Enter (1) to read angles.

BITE:
Channels 1 to 6 BIT (Built-in-test) flag is displayed to insure data is valid. A BIT will occur if there is a Loss of Signal (ALL inputs), Loss of reference or if the error exceeds 100 LSB's.

TURNS:
Monitors number of turns for channels 1 to 6. Enter (7) to reset counters.

DIRECTION:
Monitors channels 1 to 6 ("Up" = increasing angle, and "Down" = decreasing angle).

BANDWIDTH:
Monitors channels 1 to 6 ("Low" = low bandwidth, and "High" = high bandwidth). Enter (2) to change bandwidth.

INHIBIT:
Monitors inhibit status for channels 1 to 6 ("Inh" indicates data inhibited, "Track" indicates data is tracking). Enter (4) to inhibit a channel.

RESOLUTION:
Monitors resolution for channels 1 to 6. Enter (3) to change resolution. (Options 10, 12, 14 or 16 bits).

Encoder Mode Information:
Provides A quad B outputs (0 for “Off” and 1 for “On”). Enter (6) to change encoder mode. Enter (12) to change A quad B (encoder) resolution.



Note: *The Encoder must be enabled for the turns counter and the direction to work properly for both the DOS console and the Windows GUI. Encoder (A quad B) resolution must be of equal or lesser value than the resolution set on the card. For example, if the resolution set on the card is 14 bits, the A quad B resolution must be set to 14 bits or less (not 16 bits).*

SET OSCILLATOR FREQUENCY

1) Enter (8) to change frequency.

2) To change the Oscillator frequency, enter the bit multiplier. The bit multiplier, which is an integer, is determined by the following formula:

Frequency = (bit multiplier) X (Hz/bit)

Board Type	Output Scaling (Hz/bit)	Examples	Bit Multiplier	Resultant Frequency	Bit Multiplier Range
60 Hz	7.6 Hz/bit	60.8 Hz = (8) X (7.6)	8	60.8 Hz	8 - 255
		402.8 Hz = (53) X (7.6)	53	402.8 Hz	
400 Hz	57.8 Hz/bit	404.6 Hz = (7) X (57.8)	7	404.6 Hz	6 - 255
		2023.0 Hz = (35) X (57.8)	35	2023.0 Hz	

SET AMPLITUDE

1) Enter (9) to change Amplitude

2) To change the Oscillator amplitude, enter the bit multiplier. The bit multiplier, which is an integer, is determined by the following formula:

Amplitude = (bit multiplier) X (mV/bit)

Model Number	Output Scaling (mV/bit)	Examples	Bit Multiplier	Resultant Amplitude	Bit Multiplier Range
IX	8.8 mVrms/bit	1.0032 Vrms = (114) X (.0088)	114	1.0032 Vrms	0 - 255
IA	135.0 mVrms/bit	26.0550 Vrms = (193) X (.135)	193	26.0550 Vrms	0 - 255
IB	635.0 mVrms/bit	115.5700 Vrms = (182) X (.635)	182	115.5700 Vrms	0 - 210
*IC	17.6 mVrms/bit	4.0128 Vrms = (228) X (.0176)	228	4.0128 Vrms	0 - 255

** **Note:** Consult factory for IC option. (minimum orders apply)*

FUNCTION CALLS

Software routines for the SB-3621X *S/R-to-Digital PCI Interface Card.*

The following list contains all of the pertinent Function Calls required by the user. Any Function Calls contained within the Synchro.h file that are not listed here are available from the factory upon request.

char* WINAPI Initialize (int card)

DESCRIPTION

Opens and reads from the REGISTRY to get the card type. Performs a string comparison with the card type to branch to the appropriate card-specific routine. Closes REGISTRY when finished. Returns the card type from the given card number, for error checking.

INPUT DATA

Card = an integer between 0 and 7 for the card of interest. The card number is set in the MOTION FEEDBACK BOARD MANAGER.

RETURNED DATA

The routine will return a string of characters that are all caps.

EXAMPLE CODE

Code	Result/Returned Data

`char* CardName;`
 	
`CardName = Initialize(0);`
	`Returns card type for card #0`

int WINAPI End_SelfTest (int Card)

DESCRIPTION

This function will exit the card from Self-Test mode, allowing the card to track angles normally.

INPUT DATA

Card = an integer between 0 and 7 for the card of interest. The card number is set in the MOTION FEEDBACK BOARD MANAGER.

RETURNED DATA

This routine will return a 0x99 if the card was not initialized. Otherwise the card will return a (1) if Self-Test was successfully exited.

EXAMPLE CODE

Code	Result/Returned Data

`int End;`
 	
`End = End_SelfTest(1);`
	`Exits Self Test for card #1, and returns a 1 if properly exited Self Test mode.`

int WINAPI Get_Card_Type (int Card)

DESCRIPTION

This routine reads the Registry and returns the value of the card at that location. Can be used to error check the card number a user has chosen.

INPUT DATA

Card = An integer between 0 and 7 for the card of interest. The card number is set in the MOTION FEEDBACK BOARD MANAGER.

RETURNED DATA

This routine will return the type of card installed and assigned to Card.
Valid Values:
[PCI]SB3620x
[PCI]SB3621x
[PCI]SB3622x
.

EXAMPLE CODE

Code	Result/Returned Data
`Get_Card_Type(0)`	`Returns the card type of card 0.`

int WINAPI Get_DLL_Version (void)

DESCRIPTION

This routine returns the current version of the synchro.dll. Can be displayed in applications, and helps to maintain version control.

INPUT DATA

There is no input data for this routine.

RETURNED DATA

This routine will return version number of the synchro.dll.

EXAMPLE CODE

Code	Result/Returned Data
`Get_DLL_Version(void)`	`Returns the card version of the synchro.dll`

int WINAPI Get_Last_Error (char *ErrorMsg)

DESCRIPTION

This routine returns the last error that occurred, and clears the error code to 0. Can be called frequently, if needed.

INPUT DATA

ErrorMsg	A char pointer that will hold the last error message.

RETURNED DATA

ErrorMsg — A int that represents the last error message.

Values	Description:
0	No Error
1	Could not open Registry
2	Card Type is invalid
3	Card not Initialized
4	Invalid Direction
5	Could not open Device
6	Could not close Device
7	Invalid Channel
8	Invalid Option
9	Invalid Range
10	Missing Parameters
11	Invalid Error Code

EXAMPLE CODE

Code	Result/Returned Data
`Get_Last_Error(char *ErrorMsg)`	`No Error`

int WINAPI Read_Bandwidth (int Card, int Channel)

DESCRIPTION

Returns the bandwidth for given channel.

INPUT DATA

Card = an integer between 0 and 7 for the card of interest. The card number is set in the MOTION FEEDBACK BOARD MANAGER.

Channel = an integer between 0 and 5 for the channel of interest.

RETURNED DATA

This routine returns the Bandwidth as an integer. 0 = “High”, 1 = “Low”

EXAMPLE CODE

Code	Result/Returned Data

`int Bandwidth;`
 	
`Bandwidth = Read_Bandwidth(2,2);`
	`Reads the bandwidth (as an integer) of card #2, channel 2.`

int WINAPI Read_Bite (int card, int channel)

DESCRIPTION

This routine will read the status of the BIT output of the R/D converter. The reasons a fault may be indicated in a R/D converter are as follows:

The synchro or resolver signals have fallen below the specified voltage amplitude or there are no analog input signals connected to the R/D converter.

Note: Both SIN and COS signals of the R/D converter must fall below 0.5 Vrms, so the BIT may only indicate a fault at certain angles.

The synchro or resolver is moving at a rate greater than the R/D converter can accommodate. The dynamic capability of the R/D converter is determined by the bandwidth selection and the resolution (refer to hardware setup).

The error exceeds approximately 100 LSB's. This condition will occur during a large step and reset after the converter settles out.

INPUT DATA

Card = an integer between 0 and 7 for the card of interest. The card number is set in MOTION FEEDBACK BOARD MANAGER.

RETURNED DATA

This routine returns the Bite as an integer.

EXAMPLE CODE

Code	Result/Returned Data

`int Bite;`
 	
`Bite = Read_Bite(2,1);`
	`Returns Bite status for card #2, channel 1.`

int WINAPI Read_Counter (int Card, int Channel)

DESCRIPTION

Reads the Turns counter of a channel and returns the value.

INPUT DATA

Card = an integer between 0 and 7 for the card of interest. The card number is set in the MOTION FEEDBACK BOARD MANAGER.

Channel = an integer between 0 and 5 for the channel of interest.

RETURNED DATA

This routine returns the turns count of a channel (range = 0x0000 to 0xFFFF).

EXAMPLE CODE

Code	Result/Returned Data

`int Counter;`
 	
`Counter = Read_Counter(0,2);`
	`Returns the turns count of card #0, channel 2.`

int WINAPI Read_Direction (int Card, int Channel)

DESCRIPTION

Returns the direction for given channel.

INPUT DATA

Card = an integer between 0 and 7 for the card of interest. The card number is set in the MOTION FEEDBACK BOARD MANAGER.

Channel = an integer between 0 and 5 for the channel of interest.

RETURNED DATA

This routine returns the direction of a channel as an integer.
1 = “Up”, 0 = “Down”

EXAMPLE CODE

Code	Result/Returned Data

`int Direction;`
 	
`Direction = Read_Direction(6,4);`
	Returns the direction (as an integer) for card #6, channel 4.

int WINAPI Read_Encoder (int Card, int Channel)

DESCRIPTION

Returns the Encoder Mode for given channel.

INPUT DATA

Card = an integer between 0 and 7 for the card of interest. The card number is set in the MOTION FEEDBACK BOARD MANAGER.

Channel = an integer between 0 and 5 for the channel of interest.

RETURNED DATA

This routine returns the value of the Encoder for a given channel as an integer.
0 = “On”, 1= “Off”

EXAMPLE CODE

Code	Result/Returned Data

`int Encoder;`
 	
`Encoder = Read_Encoder(5,3);`
	Returns the encoder mode (as an integer) for card #5, channel 3.

int WINAPI Read_Inhibit (int Card, int Channel)

DESCRIPTION

Reads the channel specified, and returns either a “0” (inhibited) or a “1” (uninhibited). If a 9 is returned, the card was not initialized properly.

INPUT DATA

Card = an integer between 0 and 7 for the card of interest. The card number is set in the MOTION FEEDBACK BOARD MANAGER.

Channel = an integer between 0 and 5 for the channel of interest.

RETURNED DATA

This routine returns the status of the inhibit bit for a given channel. If the inhibit status is 9 then the card was not initialized.

EXAMPLE CODE

Code	Result/Returned Data

`int Inhibit;`
 	
`Inhibit = Read_Inhibit(0,5);`
	`Returns the status of the inhibit bit (as an integer) for card #0, channel 5.`

int WINAPI Read_Resolution (int Card, int Channel)

DESCRIPTION

Reads the given channel, and returns the current resolution.
If bits are: 16 Resolution is 16
If bits are: 14 Resolution is 14
If bits are: 12 Resolution is 12
If bits are: 10 Resolution is 10

INPUT DATA

Card = an integer between 0 and 7 for the card of interest. The card number is set in the MOTION FEEDBACK BOARD MANAGER.

Channel = an integer between 0 and 5 for the channel of interest.

RETURNED DATA

This routine returns an integer that represents the current resolution of a channel as either 10,12,14, or 16 bits. If a 9 is returned than there was an error with the initialization of the card.

EXAMPLE CODE

Code	Result/Returned Data

`int Resolution;`
 	
`Resolution = Read_Resolution(4,3);`
	`Returns the current resolution (as an integer) for card #4, channel 3.`

int WINAPI SelfTest (int Card)

DESCRIPTION

The ***SB3621X*** card has a self-test feature. By setting a register to 1's, the card will go into Self-Test mode, and all angles should read 45 degrees. If any channel does not display 45 degrees (+/- 1 degree), that channel does not pass. If all channels fail, a 0x3F is returned. If only channel 0 fails, a 0x20 is returned. If a 0x99 is returned, the card was not initialized, and therefore the Self-Test was not performed.

INPUT DATA

Card = an integer between 0 and 7 for the card of interest. The card number is set in MOTION FEEDBACK BOARD MANAGER.

RETURNED DATA

This routine returns the Hex equivalent of the channels that fail as an integer. The "0" bit is the most significant bit, and the 6th bit is the least significant bit.
Register format

		Ch 0	Ch 1	Ch 2	Ch 3	Ch 4	Ch 5
0	0	0	0	0	0	0	0

0 x 99 is returned if the card did not initialize.
0 x 20 = Ch 0 fails
0 x 10 = Ch 1 fails
0 x 08 = Ch 2 fails
0 x 04 = Ch 3 fails
0 x 02 = Ch 4 fails
0 x 01 = Ch 5 fails
0 x 3F = all channels on the card failed.
0 x 00 = all the channels passed the initialization of the card.

EXAMPLE CODE

Code	Result/Returned Data

`int Test;`
 	
`Test = SelfTest(0);`
	`Returns the Hex equivalent of which channels (if any) on card #0 fail self test.`

int WINAPI Start_SelfTest (int Card)

DESCRIPTION

For debugging and testing purposes, the Start Self Test routine allows the user to enter Self Test mode, without completing the entire test.

INPUT DATA

Card = an integer between 0 and 7 for the card of interest. The card number is set in the MOTION FEEDBACK BOARD MANAGER.

RETURNED DATA

This routine will return a 0x99 if the card did not initialize. Otherwise the card will return a (1) if Self-Test is started.

EXAMPLE CODE

Code	Result/Returned Data

`int Start;`
 	
`Start = Start_SelfTest(1);`
	`Returns a 1 if in Self-Test.`

long WINAPI Read_Angle (int Card, int Channel)

DESCRIPTION

Using the given channel, the appropriate register is selected, and the thirty-two bits are read from the register. No conversion is done in this routine.

INPUT DATA

Card = an integer between 0 and 7 for the card of interest. The card number is set in the MOTION FEEDBACK BOARD MANAGER.

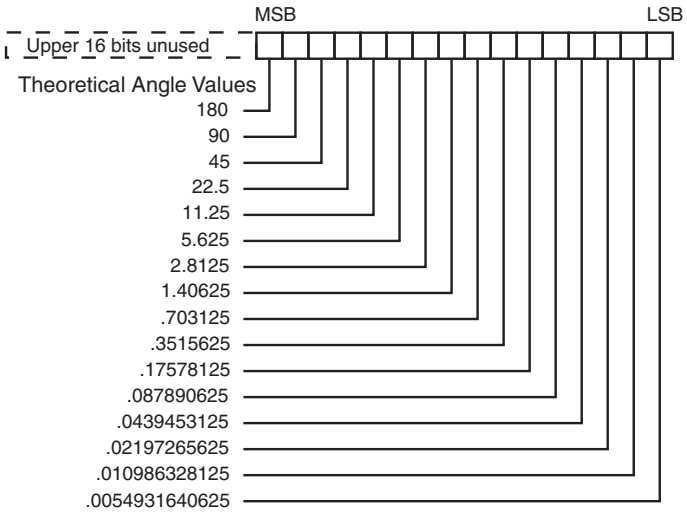
Channel = an integer between 0 and 5 for the channel of interest.

RETURNED DATA

This routine returns the angle of a given channel as a 32 bit long integer (range = 0x0000 to 0xFFFF).

EXAMPLE CODE

Code	Result/Returned Data
`Read_Angle(3,5);`	`Returns the angle (as a 32 bit long integer) for card #3, channel 5.`



$$\text{Angle} = \frac{\text{Reading X 360}}{2^{16}}$$

void WINAPI Close (int Card)

DESCRIPTION

Closes the device driver. Writes default values to card.

INPUT DATA

Card = an integer between 0 and 7 for the card of interest. The card number is set in the MOTION FEEDBACK BOARD MANAGER.

RETURNED DATA

This routine does not return any data.

EXAMPLE CODE

Code	Result/Returned Data
`Close(7);`	`Closes the device driver for card #7.`

void WINAPI Program_Amplitude (int Card, int Amplitude)

DESCRIPTION

This routine allows the user to change the amplitude of the oscillator. Since there is only one oscillator on the card, the channel does not have to be selected.

INPUT DATA

Card = an integer between 0 and 7 for the card of interest. The card number is set in the MOTION FEEDBACK BOARD MANAGER.

Amplitude = an integer between 0 and 255 that corresponds to a bit multiplier. The product of the bit multiplier and the output scaling represents the true amplitude.

To change the Oscillator amplitude, enter the bit multiplier. The bit multiplier, which is an integer, is determined by the following formula.

Amplitude = (bit multiplier) X (mV/bit)

Model Number	Output Scaling (mV/bit)	Examples	Bit Multiplier	Resultant Amplitude	Bit Multiplier Range
IX	8.8 mVrms/bit	1.0032 Vrms = (114) X (.0088)	114	1.0032 Vrms	0 - 255
IA	135.0 mVrms/bit	26.0550 Vrms = (193) X (.135)	193	26.0550 Vrms	0 - 255
IB	635.0 mVrms/bit	115.5700 Vrms = (182) X (.635)	182	115.5700 Vrms	0 - 210
*IC	17.6 mVrms/bit	4.0128 Vrms = (228) X (.0176)	228	4.0128 Vrms	0 - 255

*** Note:** Consult factory for IC option (minimum orders apply)

Amplitude = (Bit Multiplier) X (mVrms/bit)
Amplitude = (114) * (8.80 mVrms/bit)
Amplitude = 1.0032 Vrms

RETURNED DATA

This routine does not return any data.

EXAMPLE CODE

Code	Result/Returned Data
`Program_Amplitude(7,193);`	`Assuming card #7 is a model type IA (135.0 mv/bit), the oscillator amplitude of card #7 will be set to 26.0550 V.`

void WINAPI Program_Bandwidth (int Card, int Channel, int Bandwidth)

DESCRIPTION

Programs channel bandwidth for either “High” or “Low”. Error checking is performed, appropriate bits are masked, and the new value is written to the card.

INPUT DATA

Card = an integer between 0 and 7 for the card of interest. The card number is set in the MOTION FEEDBACK BOARD MANAGER.

Channel = an integer between 0 and 5 for the channel of interest.

Bandwidth = an integer that is either a 0 or a 1.
0 = (High) and 1 = (Low)

RETURNED DATA

This routine does not return any data.

EXAMPLE CODE

Code	Result/Returned Data
`Program_Bandwidth(6,0,1);`	`Sets the bandwidth of card #6, channel 0 to low.`

void WINAPI Program_Encoder (int Card, int Channel, int Encoder)

DESCRIPTION

Turns the Encoder on a channel either “On” or “Off”. Error checking is performed, appropriate bits are masked, and the new value (0 or 1) is written to the card.

INPUT DATA

Card = an integer between 0 and 7 for the card of interest. The card number is set in the MOTION FEEDBACK BOARD MANAGER.

Channel = an integer between 0 and 5 for the channel of interest.

Encoder = an integer which is either a “0” (turns Encoder On), or a “1” (turns Encoder Off).

RETURNED DATA

This routine does not return any data.

EXAMPLE CODE

Code	Result/Returned Data
`Program_Encoder(4,4,0);`	`Turns the encoder of card #4, channel 4, on.`

void WINAPI Program_Encoder_Resolution (int Card, int Channel, int Resolution)

DESCRIPTION

Programs the A quad B resolution of a channel to 10,12,14 or 16 bits. Error checking is performed, appropriate bits are masked, and the new value is written to the card.

INPUT DATA

Card = an integer between 0 and 7 for the card of interest. The card number is set in the MOTION FEEDBACK BOARD MANAGER.

Channel = an integer between 0 and 5 for the channel of interest.

*** Resolution:**
10 = 10 bit resolution
12 = 12 bit resolution
14 = 14 bit resolution
16 = 16 bit resolution



Note: *Encoder (A quad B) resolution must be of equal or lesser value than the resolution set on the card. For example, if the resolution set on the card is 14 bits, the A quad B resolution must be set to 14 bits or less (not 16 bits).*

RETURNED DATA

This routine does not return any data.

EXAMPLE CODE

Code	Result/Returned Data
`Program_Encoder_Resolution(0,0,16);`	`Sets the resolution of card #0, channel 0, to 16 bits.`

void WINAPI Program_Frequency (int Card, int Frequency)

DESCRIPTION

This routine allows the user to change the operating frequency of the card oscillator.

INPUT DATA

Card = an integer between 0 and 7 for the card of interest. The card number is set in the MOTION FEEDBACK BOARD MANAGER.

Frequency = an integer between 0 and 255 that corresponds to a bit multiplier. The product of the bit multiplier and the output scaling represents the true frequency.

To change the Oscillator frequency, enter the bit multiplier. The bit multiplier, which is an integer, is determined by the following formula.

Frequency = (bit multiplier) X (Hz/bit)

Board Type	Output Scaling (Hz/bit)	Examples	Bit Multiplier	Resultant Frequency	Bit Multiplier Range
60 Hz	7.6 Hz/bit	60.8 Hz = (8) X (7.6)	8	60.8 Hz	8 - 255
		402.8 Hz = (53) X (7.6)	53	402.8 Hz	
400 Hz	57.8 Hz/bit	404.6 Hz = (7) X (57.8)	7	404.6 Hz	6 - 255
		2023.0 Hz = (35) X (57.8)	35	2023.0 Hz	



Note: *Model IB uses 60 Hz multiplier*

RETURNED DATA

This routine does not return any data.

EXAMPLE CODE

Code	Result/Returned Data
`Program_Frequency(5,53);`	`Assuming card #5 is a 60 Hz type, the oscillator of card #5 will be set to 402.8 Hz.`

void WINAPI Program_Inhibit (int Card, int Channel, int Control)

DESCRIPTION

Programs the Inhibit mode of a channel to “0” or “1”. A “0” inhibits the channel, and a “1” uninhibits the channel. This function only inhibits one channel at a time. For multiple channel inhibiting, use the Twospeed_Inhibit routine. Error checking is performed, appropriate bits are masked, and the new value is written to the card.

INPUT DATA

Card = an integer between 0 and 7 for the card of interest. The card number is set in the MOTION FEEDBACK BOARD MANAGER.

Channel = an integer between 0 and 5 for the channel of interest.

Control = an integer that is either a “0” (for inhibit), or a “1” (for uninhibit).

RETURNED DATA

This routine does not return any data.

EXAMPLE CODE

Code	Result/Returned Data
`Program_Inhibit(0,1,0);`	`Inhibits Card #0, channel 1.`

void WINAPI Program_Resolution (int Card, int Channel, int Resolution)

DESCRIPTION

Programs the resolution of a channel to 10,12,14 or 16 bits. Error checking is performed, appropriate bits are masked, and the new value is written to the card.

INPUT DATA

Card = an integer between 0 and 7 for the card of interest. The card number is set in the MOTION FEEDBACK BOARD MANAGER.

Channel = an integer between 0 and 5 for the channel of interest.

Resolution:
10 = 10 bit resolution
12 = 12 bit resolution
14 = 14 bit resolution
16 = 16 bit resolution

RETURNED DATA

This routine does not return any data.

EXAMPLE CODE

Code	Result/Returned Data
`Program_Resolution(0,0,16);`	`Sets the resolution of card #0, channel 0, to 16 bits.`

void WINAPI Reset_Counter (int Card, int Channel)

DESCRIPTION

Resets the Turns counter of a channel to zero.

INPUT DATA

Card = an integer between 0 and 7 for the card of interest. The card number is set in the MOTION FEEDBACK BOARD MANAGER.

Channel = an integer between 0 and 5 for the channel of interest.

RETURNED DATA

This routine does not return any data.

EXAMPLE CODE

Code	Result/Returned Data
`Reset_Counter(0,2);`	`Resets the turns count of card #0, channel 2 to zero.`

void WINAPI Twospeed_Inhibit (int Card, int Channels)

DESCRIPTION

This procedure allows the user to inhibit any combination of channels, simultaneously. The channels to be inhibited can be selected by OR'ing constants, that identify each channel, together (Inhibit0, Inhibit1, Inhibit2,… Inhibit5).
Note: Any channels not included in the inhibit string will be uninhibited.

Ch0 (0x04) = SB3621x_INHIBIT0
Ch1 (0x08) = SB3621x_INHIBIT1
Ch2 (0x10) = SB3621x_INHIBIT2
Ch3 (0x20) = SB3621x_INHIBIT3
Ch4 (0x40) = SB3621x_INHIBIT4
Ch5 (0x80) = SB3621x_INHIBIT5
All channels = SB3621x_INHIBITall

INPUT DATA

Card = an integer between 0 and 7 for the card of interest. The card number is set in the MOTION FEEDBACK BOARD MANAGER.

Channels = an integer which represents the channels that will be inhibited.

RETURNED DATA

This routine does not return any data.

EXAMPLE CODE

Code	Result/Returned Data
`Twospeed_Inhibit(0,0x0C);`	Inhibits Card #0, channels 0 and 1, uninhibits channels 2 through 5.
`Twospeed_Inhibit(0, SB3621x_INHIBIT0|SB3621x_INHIBIT1);`	Inhibits Card #0, channels 0 and 1, uninhibits channels 2 through 5.
`Twospeed_Inhibit(0,0x0);`	Uninhibits Card #0, channels 0 through 5.

Example: Inhibiting channels 0 and 1

Channels = SB3621x_INHIBIT0 | SB3621x_INHIBIT1
Channels = 0x04 | 0x08
Channels = 0x0C

WORD WINAPI Read_Angle_WORD (int Card, int Channel)

DESCRIPTION

Using the given channel, the appropriate register is selected, and the sixteen bits are read from the register. No conversion is done in this routine.

INPUT DATA

Card = an integer between 0 and 7 for the card of interest. The card number is set in the MOTION FEEDBACK BOARD MANAGER.

Channel = an integer between 0 and 5 for the channel of interest.

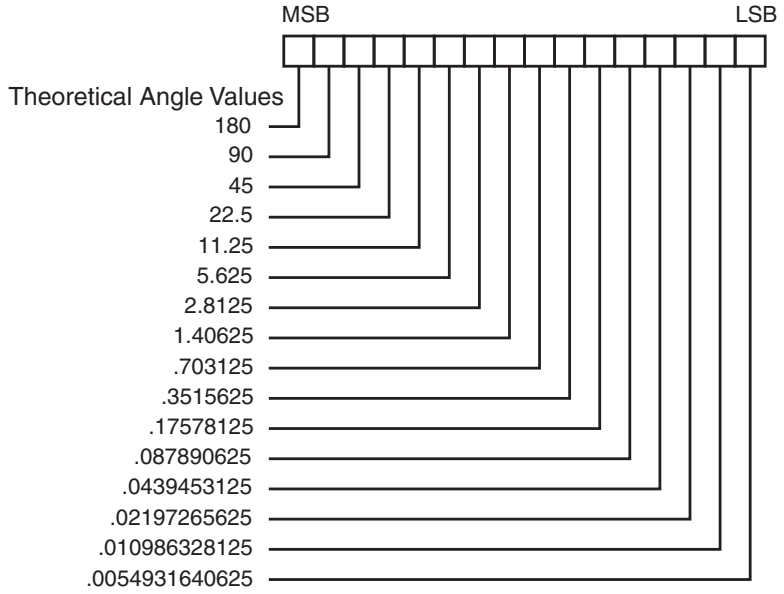
RETURNED DATA

This routine returns the angle of a given channel as a WORD (range = 0x0000 to 0xFFFF).

EXAMPLE CODE

Code	Result/Returned Data

`WORD Angle;`
 	
`Angle = Read_Angle_WORD(3,5);`
	`Returns the angle (as a WORD) for card #3, channel 5.`



$$\text{Angle} = \frac{\text{Reading X 360}}{2^{16}}$$

WORD WINAPI Read_Converter (int Card, int Channel)

DESCRIPTION

This routine will first set the inhibit of the channel to a logic "0" (freeze data), read the output of the R/D converter of the channel of interest, and then release the inhibit (set it to logic "1" - track data).

INPUT DATA

Card = an integer between 0 and 7 for the card of interest. The card number is set in the MOTION FEEDBACK BOARD MANAGER.

Channel = an integer between 0 and 5 for the channel of interest.

RETURNED DATA

This routine will return the digital data from the channel of interest in the form of a WORD (range = 0x0000 to 0xFFFF).

EXAMPLE CODE

Code	Result/Returned Data

`WORD Converter;`
 	
`Converter = Read_Converter(5,0);`
	`Returns the output (as a WORD) of card #5, channel 0.`

APPENDIX A

Table 1. Transformer Specifications

Option #	P/N	Transformers	Type	Freq (Hz)*	In (Vrms)*	Out (Vrms)**	AngAcc***	Length (in)	Width (in)	Height (in)
Input X5	52035	52035	S-R	400	90	2	1	0.81	0.61	0.3
Input X6	52039	24012, 24013	Synchro	60	90	2	1	1.1	1.14	0.42
Input X7	52036	52036	R-R	400	11.8	2	1	0.81	0.61	0.3
Input X8	52034	52034	S-R	400	11.8	2	1	0.81	0.61	0.3
Ref X5, 7, 8	B-426	B-426	Reference	400	115	3.4	N/A	0.81	0.61	0.32
Ref X6	24133	24013	Reference	60	115	3/6****	N/A	1.125	1.125	0.42

Notes:

1. *±10% Frequency (Hz) and Line to Line input voltage (Vrms) tolerances
2. ** 2Vrms Output Magnitudes are –2Vrms ±0.5% full scale
3. *** Angle Accuracy (Max Minutes)
4. **** 3Vrms to ground or 6Vrms differential (±3% full scale)
5. Dimensions are for each individual main and teaser
6. 60 Hz Synchro transformers are active (requires ±15 VDC power supplies)
7. 400 Hz transformer temperature range: -55° to +125°C
8. 60 Hz transformer temperature ranges: -55° to +125°C, 0 to +70°C

Table 2. Dynamic Characteristics

TYPE		60 Hz NOMINAL				400 Hz NOMINAL			
RESOLUTION (bits)		10	12	14	16	10	12	14	16
BANDWIDTH (Hz)	Low	*	*	15		*	*	100	
	High	45		**	**	300		**	**
TRACKING RATE (rps)		32	8	2	.5	320	80	20	5
SCALE FACTOR (Volts/rps)		.125	.5	2	8	.0125	.05	.2	.8

*Not recommended - Low bandwidths in low resolutions may induce spin around and the part will not settle

**High bandwidths in high resolutions may be used with carrier frequencies above 1.5 kHz

Table 3. Velocity Characteristics

PARAMETER	UNITS	TYPICAL	MAX./MIN.
POLARITY			
Voltage Range	V	4.0	
VOLTAGE SCALING			
(resolution dependent)	RPS/V	Typical TR (See Table 2)	
SCALE FACTOR			
Error	%	10	20 (max.)
Scale Factor TC	PPM/ deg C	100	200 (max.)
Reversal Error	%	1	2 (max.)
Linearity	% output	0.5	1 (max.)
Zero Offset	mV	5	15 (max.)
Zero Offset TC	uV/ deg C	15	30 (max.)
Load	k Ohms		10 (min.)

Mating Connector

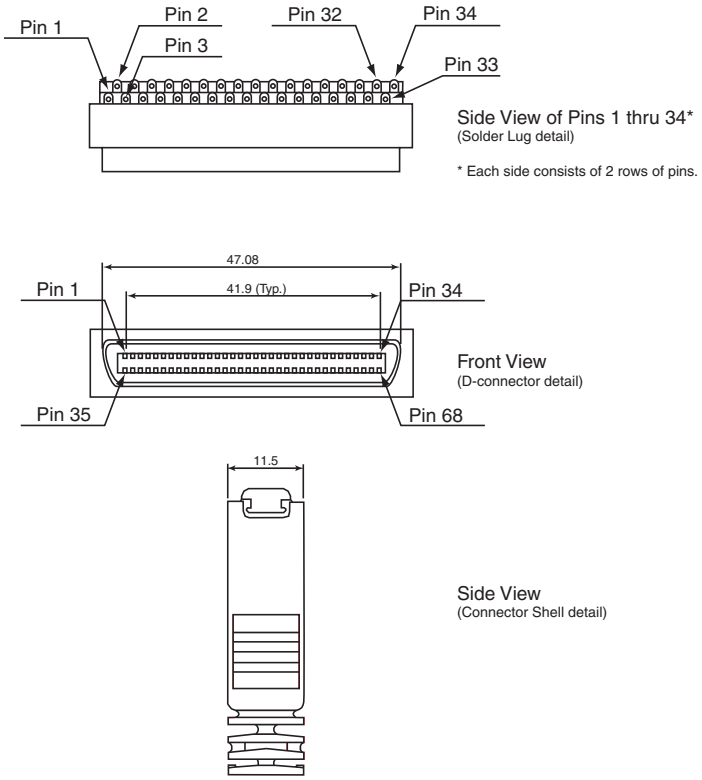


Figure 30. Mating Connector

P/N: Acon HPBW-3168-10S-N-KV3 or alternate
HPBW-3168-10S-N-KV7 (Includes shell and hood)

APPENDIX B

Card Pinouts

This section describes the pinouts for the card. The card has one connector, a 68 pin mini D connector. The pinouts for this mating connector are shown in Table 4.

Note: *All ground returns are connected to the chassis ground.*

Table 4. SB-3621X Pinouts

PIN	NAME	PIN	NAME
1	B ch 1 (VEL 5)	35	A ch 1 (VEL 3)
2	ZI ch 1 (VEL 4)	36	ZI ch 2(VEL 1)
3	B ch 2 (VEL 6)	37	A ch 2 (VEL 2)
4	B ch 3	38	A ch 3
5	ZI ch 3	39	ZI ch 4
6	B ch 4	40	A ch 4
7	B ch 5	41	A ch 5
8	ZI ch 5	42	ZI ch 6
9	B ch 6	43	A ch 6
10	N/C*	44	A GND 6
11	S1 6	45	S3 6
12	S2 6	46	S4 6
13	RL 6	47	RH 6
14	N/C*	48	A GND 5
15	S1 5	49	S3 5
16	S2 5	50	S4 5
17	RL 5	51	RH 5
18	N/C*	52	A GND 4
19	S1 4	53	S3 4
20	S2 4	54	S4 4
21	RL 4	55	RH 4
22	N/C*	56	A GND 3
23	S1 3	57	S3 3
24	S2 3	58	S4 3
25	RL 3	59	RH 3
26	PWR-GND	60	A GND 2
27	S1 2	61	S3 2
28	S2 2	62	S4 2
29	RL 2	63	RH 2
30	PWR-GND	64	A GND 1
31	S1 1	65	S3 1
32	S2 1	66	S4 1
33	RL 1	67	RH 1
34	RH OUT	68	RL OUT

Note: *N/C* – Do not connect or wire to these pins!*

Signal Connections

Synchro Mode Connect S1, S2, S3

S1 = X
S2 = Z
S3 = Y

Resolver Mode Connect

S3 = +SIN
S1 = -SIN
S2 = +COS
S4 = -COS

Single ended mode connections.

When using 2v single ended configurations, S1 and S4 on card connector are no-connect. Use associated analog ground per output channel for S1 and S4 resolver outputs used.

APPENDIX C

Assembly Drawings

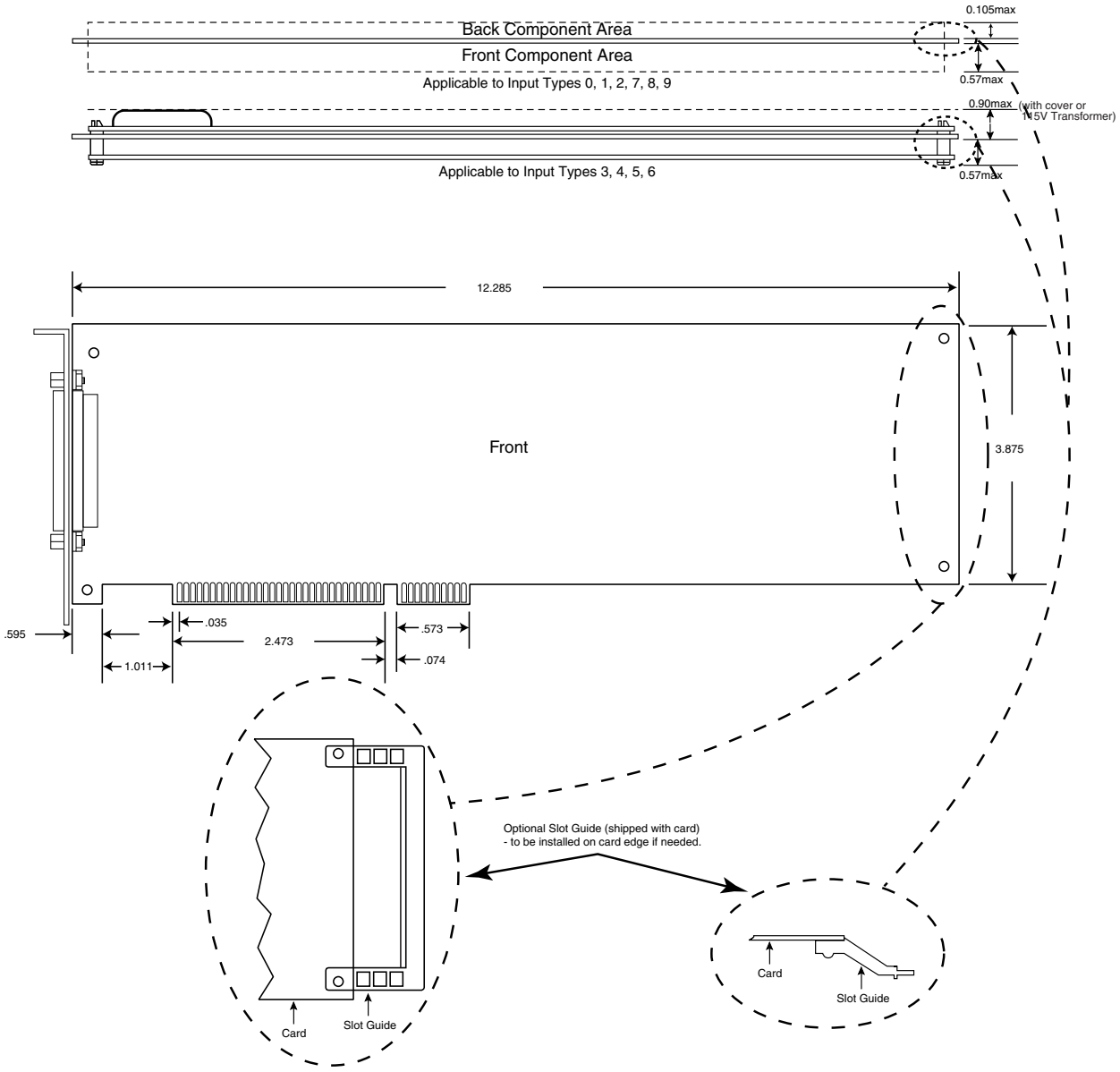


Figure 31. Mechanical Outline

Note: SB-36213\4\5\6 *require two slots.*

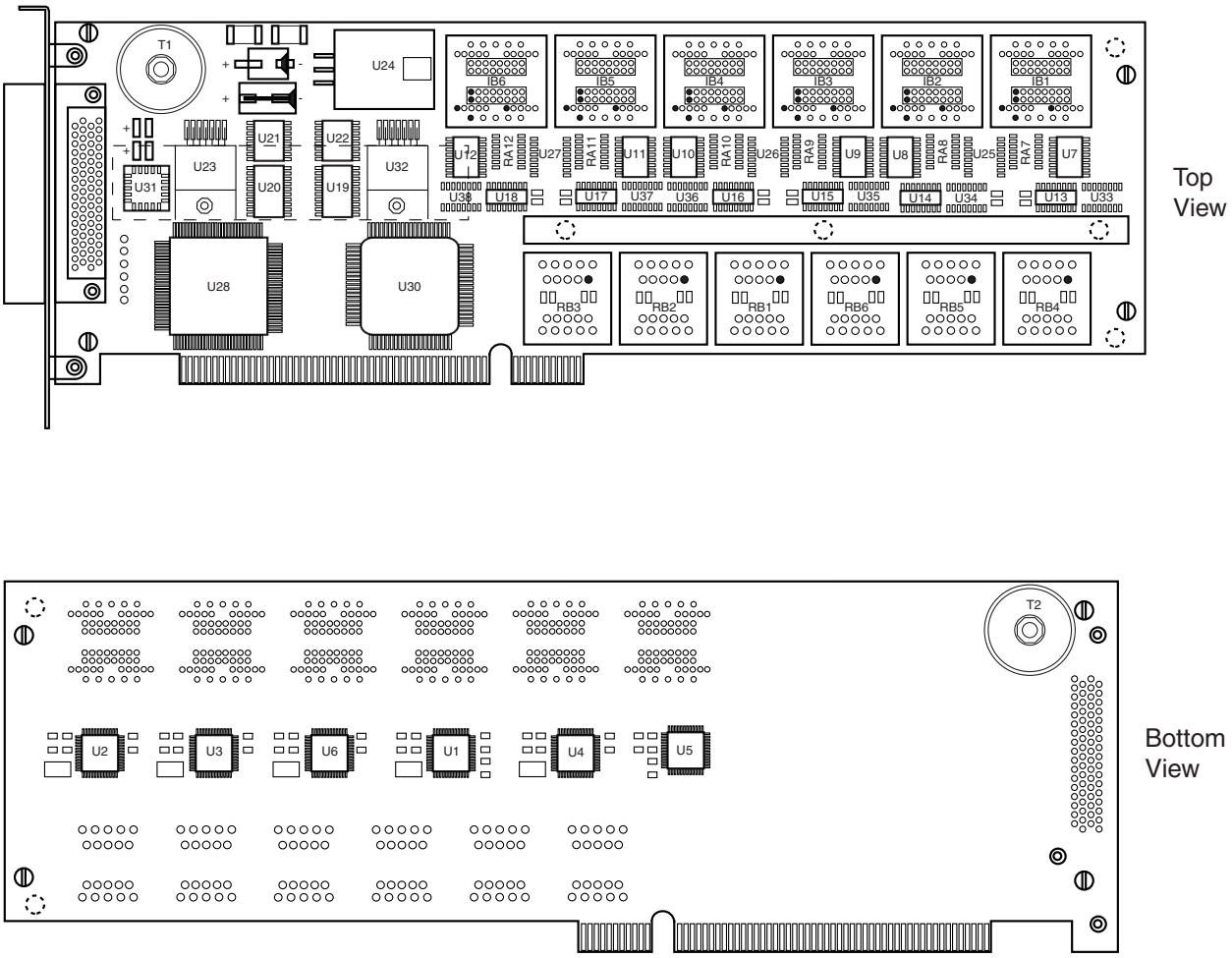


Figure 32. SB-3621X Card Assembly

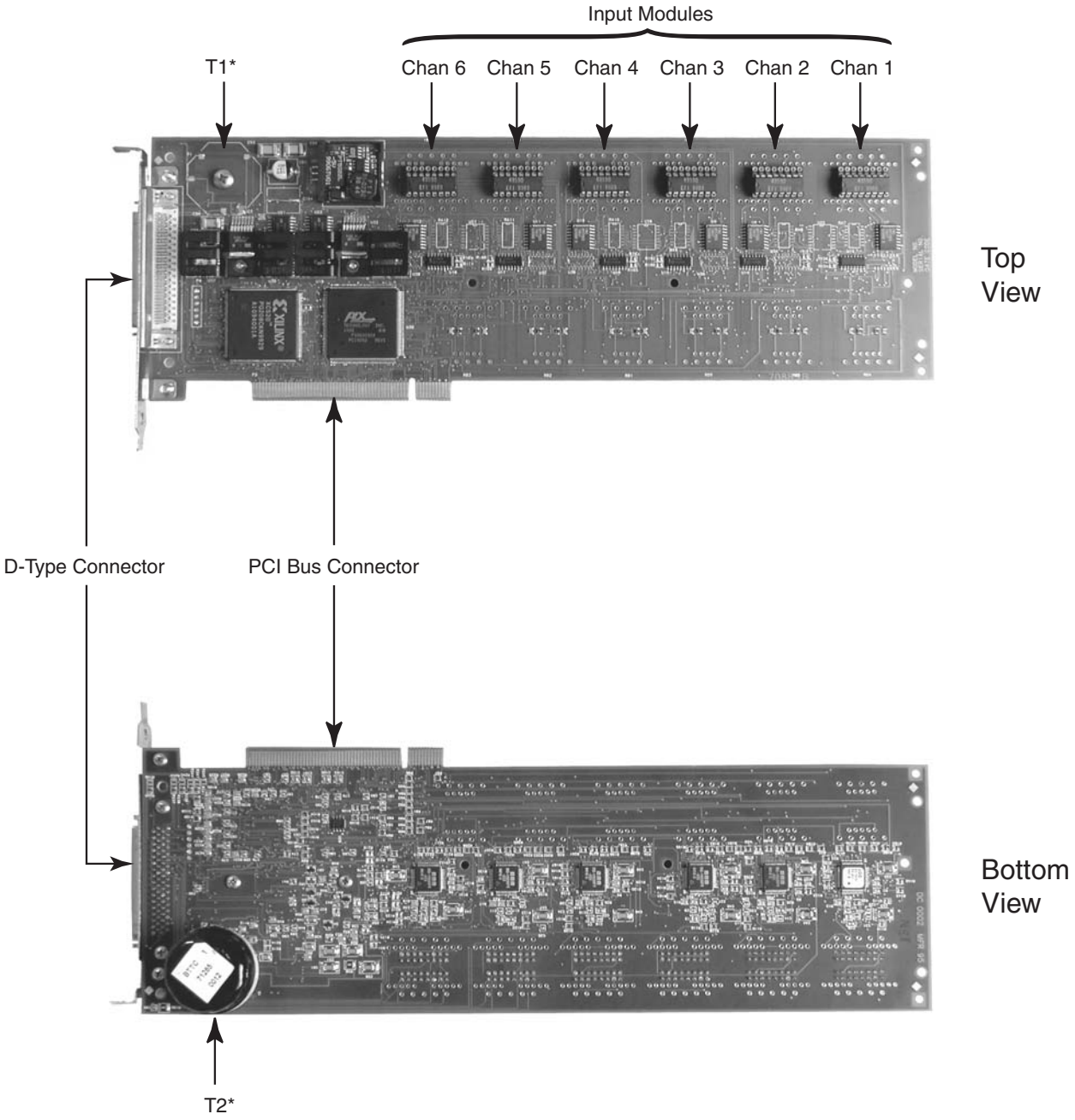


Figure 33. SB-3621X Solid State Input Card Photos

***Note:** For Reference only. T1 and T2 configuration depends upon card Oscillator type.*

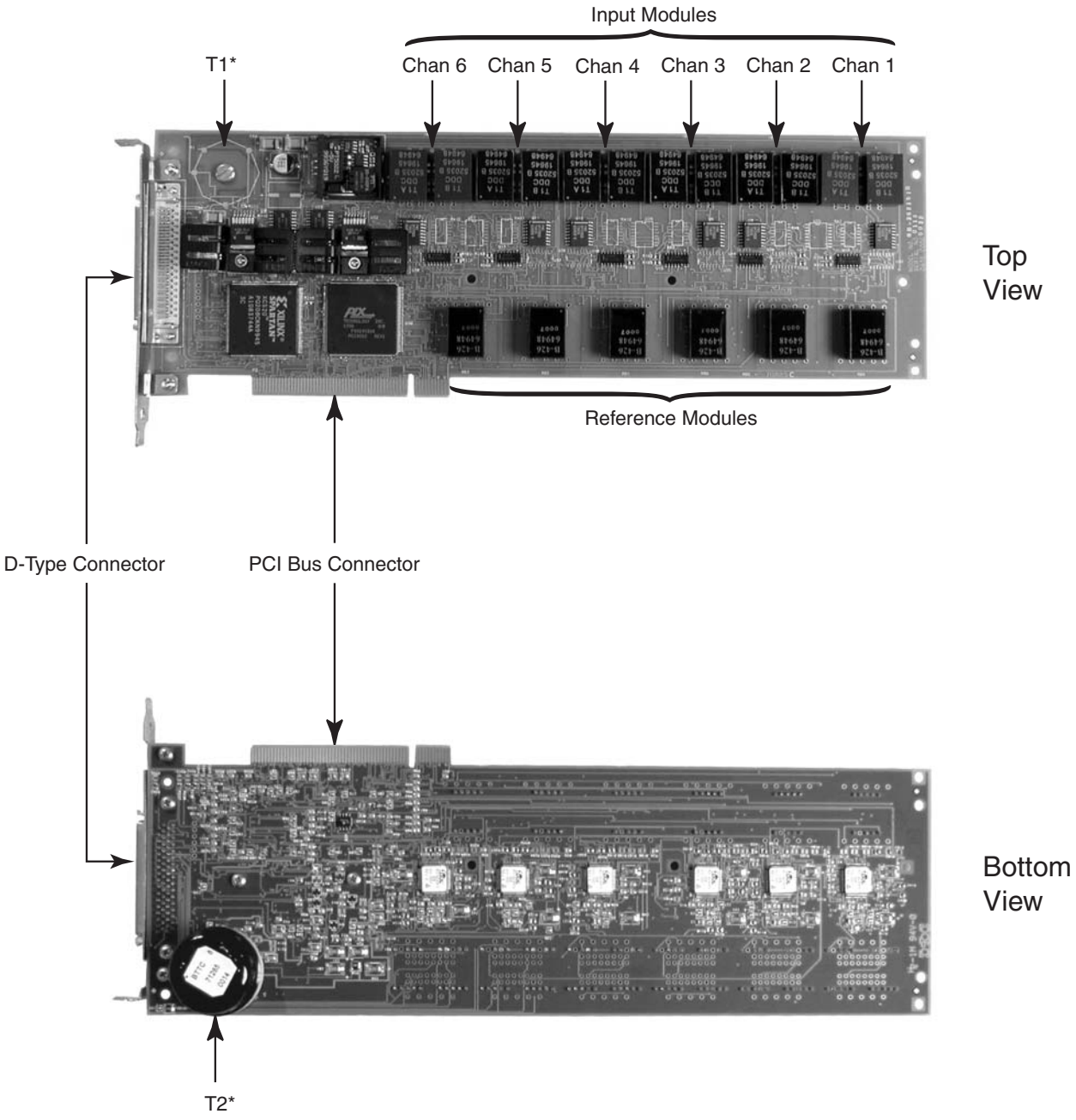


Figure 34. SB-36215 Transformer Isolation Input Card Photos

***Note:** For Reference only. T1 and T2 configuration depends upon card Oscillator type.*

APPENDIX D

Signal Input Configuration

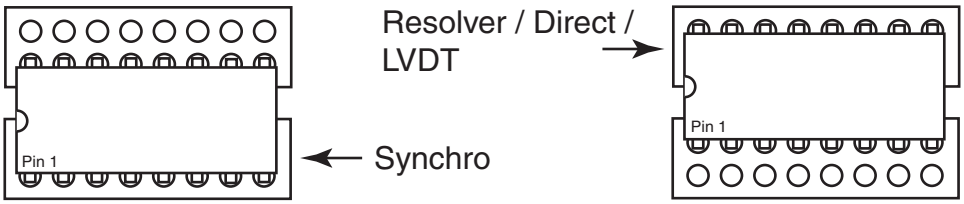


Figure 35. Synchro or Resolver/Direct Input Signal Configuration

The Synchro or Resolver/Direct input options are created by factory installation of thin-film resistor networks within socket locations on the card (refer to **Figure 35**). **Table 5** lists the resistor network and location for each input option.

Table 5. Signal Input Configuration

INPUT TYPE	THIN FILM RESISTOR NETWORK	LOCATION
2V Direct	DDC – 55688-1	Upper Sockets
11.8V Resolver	DDC - 49530	Upper Sockets
11.8V Synchro	DDC - 49530	Lower Sockets
90V Synchro	DDC - 49590	Lower Sockets

Linear / Rotary Variable Differential Transformer (LVDT / RVDT)

The SB-3621XIX can also be used for a linear or rotary variable differential transformer (LVDT or RVDT). When using the LVDT option (SB-36219IX), the scaling resistors must be installed by the user (see **Figure 36**, **Figure 37**, and **Figure 38**). Refer to **Figure 36** for component header installation. The op amps shown in **Figure 37** and **Figure 38** are already installed on card.

This card uses the RD-19230 converter. For detailed LVDT scaling information see the RD-19230 data sheet available on the DDC Web site library (www.ddc-web.com).

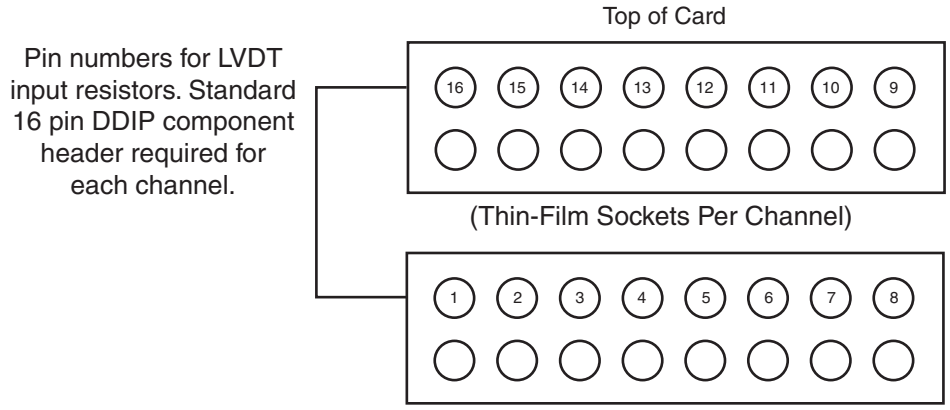


Figure 36. LVDT Input Signal Configuration

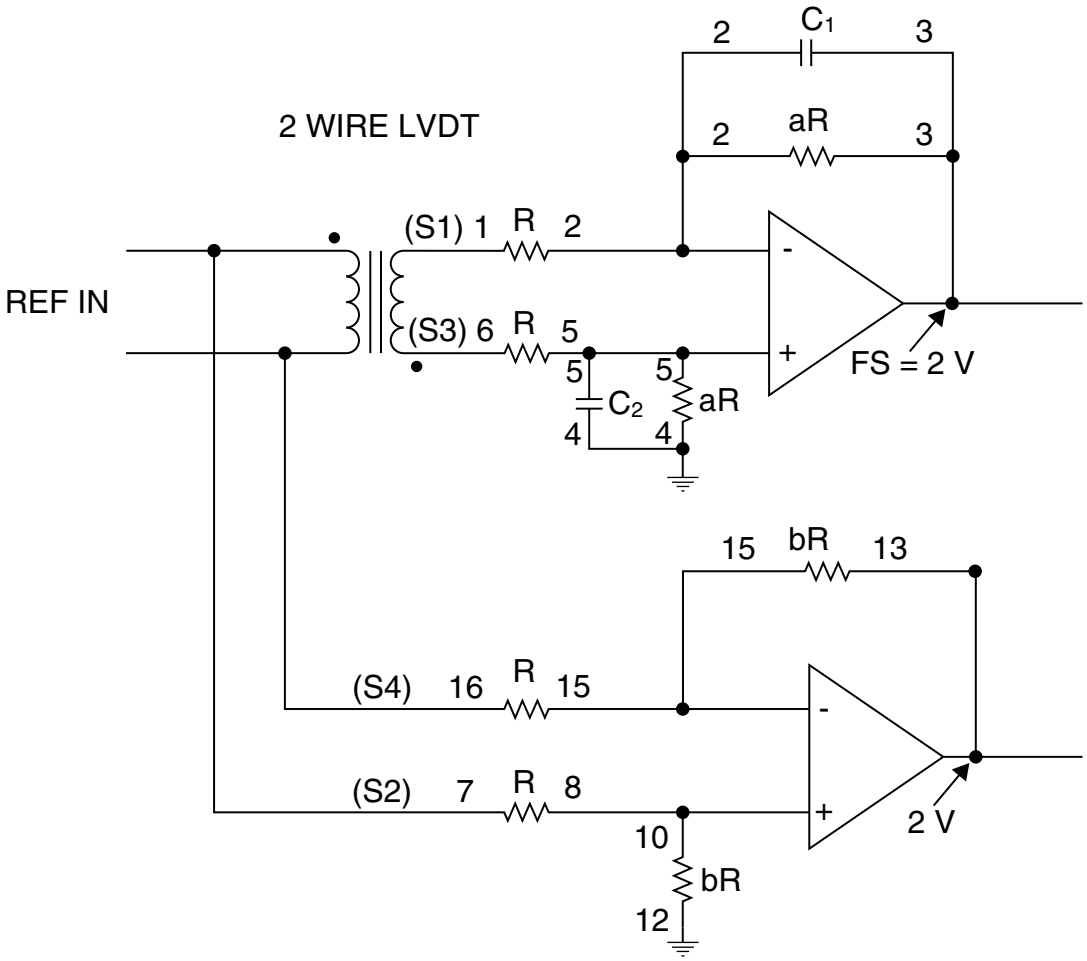
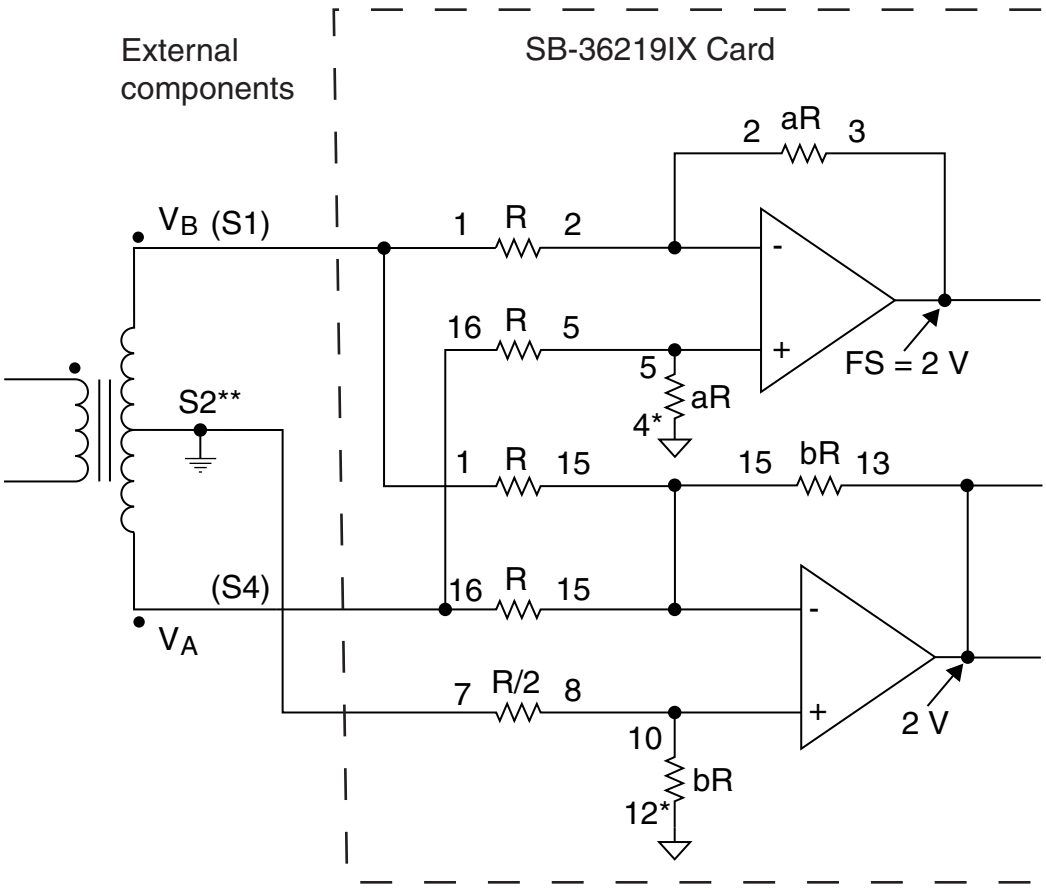


Figure 37. 2-Wire LVDT Direct Input with Component Header Pin Numbers

(see **Figure 35**)



Notes: * Pins 4 and 12 are common grounds on card. No wiring required.
** S2 ground is the user's system ground, and not card ground providing that the difference between the system ground and card ground is not greater than the common mode range of the input amplifiers.

Figure 38. 3-Wire LVDT Scaling Circuit with Component Header Pin Numbers

(see Figure 35)

APPENDIX E

Input and Output Options

Table 6. Oscillator Type

REFERENCE #	REFERENCE TYPE	T1	T2
X	Single Ended Drive (0.5mA max)	–	–
A	1.5VA Drive, 26Vrms Transformer Isolation (60mA max)	X	–
B	1.5VA Drive, 115Vrms Transformer Isolation (13mA max)	–	X

Table 7. Input Type

INPUT #	INPUT TYPE	INPUT MODULES	REFERENCE MODULES
0	2V Direct – 400Hz	2V Thin Film	–
1	11.8V L-L Synchro – 400Hz	11.8V Thin Film	–
2	11.8V L-L Resolver – 400Hz	11.8V Thin Film	–
3	90V L-L Synchro – 400Hz	90V Thin Film	–
4	90V L-L Synchro – 60Hz	90V Thin Film	–
5	90V L-L Synchro – 400Hz w/Transformer Isolation	90V S-R Scott-T Transformer	115V to 3.4V, 400Hz Transformer
6	90V L-L Synchro – 60Hz w/Transformer Isolation	90V Active Scott-T Transformer	Active Transformer
7	11.8V L-L Resolver – 400Hz w/Transformer Isolation	11.8V R-R Scott-T Transformer	115V to 3.4V, 400Hz Transformer
8	11.8V L-L Synchro – 400Hz w/Transformer Isolation	11.8V S-R Scott-T Transformer	115V to 3.4V, 400Hz Transformer

GLOSSARY

Accuracy**.....***A measurement deviation from a calibrated standard.*

AGND**.....***Analog Ground.*

BW (Bandwidth) **.....***The frequency band in which a system can process information. Also known as the 3dB point.*

BIT (Built-in test) **.....***Digital output that will indicate if a fault condition exists.*

Carrier Frequency **.....***Reference or excitation frequency required by the synchro or resolver device and the converter.*

Coarse Angle**.....***In a two-speed system, the reading from the synchro or resolver with a 1:1 ratio.*

Differential**.....***Input signal that is with respect to another signal (S3-S1), but not to ground.*

Direct Input (sin/cos)**.....***Input signal that is with respect to ground.*

Fine Angle**.....***In a two-speed system, the reading from the resolver with a 1:N ratio, where N >1.*

GND **.....***Digital Ground.*

J-lead**.....***The lead of a device that is J- or hooked-shaped.*

Line-to-Line Voltage**.....***The measurement (in Vrms) between two signals.*

Measured Angle **.....***The analog synchro or resolver signals representing a position that is converted to a digital word or angle.*

Reference **.....***Excitation for synchro or resolver device and converter.*

Resolution **.....***Number of bits available for measurement or simulation.*

Resolver**.....***Type of transducer whose four-wire output has a direct relationship to the angular position of the shaft. A resolver contains two output windings 90° out of phase.*

RPS(Revolutions per second) **.....***A unit of measure for velocity or tracking rate.*

Simulated Angle**.....***The digital word or angle to be converted into analog signals representing a synchro or resolver positioned at that angle.*

Speed Ratio **.....***The ratio of coarse to fine in a two-speed system.*

Synchro **.....***Type of transducer with a three-wire output having a direct relationship to the angular position of the shaft. A synchro contains three output windings 120° out of phase.*

Tracking rate**.....***A velocity or speed at which the converter can monitor the changes of the signal output.*

Type II Tracking**.....***A type of servo control loop.*

Velocity**.....***The rate of a change in position for a certain time interval.*

Vrms**.....***Root-mean-square, or effective voltage (Vp x* $1/\sqrt{2}$ *).*

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