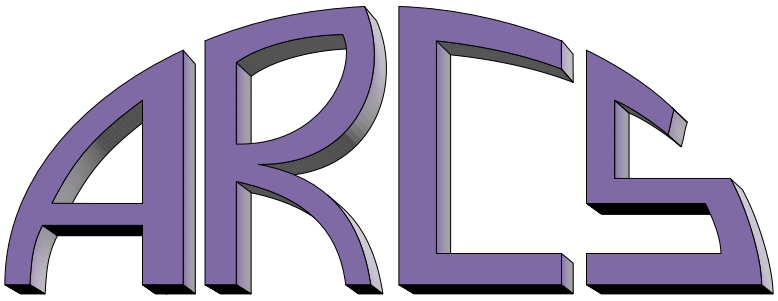


Advanced Realtime Control Systems, Inc.

ARCS LIGHTNING MANUAL
HARDWARE AND SOFTWARE INSTALLATION, VERSION 1.2

04 March 2001

http://www.arcsinc.com

Contents

1 Introduction

This manual provides the installation instructions for the ARCS base product installation.

For a description of ARCS additional product offerings and extended features for control please refer to www.arcsinc.com .

If the platform upon which you are installing is Linux, please also consult ARCS Installation Supplement for Linux for additional instructions and notes specific to software installation on Linux.

2 Hardware and Software Overview

This section provides a very brief description of the hardware and software components contained in ARCS base product installation. Together these components comprise a complete control system. The section also provides a summary of system requirements and recommendations.

For a more detailed overview of ARCS control system, please refer to *ARCS Integrated Development Environment (AIDE) User's Manual.* This is helpful reading, even if you do not plan to use *AIDE*.

2.1 Hardware Overview

The hardware -ARCS Lightning DSP Board -consists of a core computational capability using the Texas Instruments TMS320C31 (40 MHz), a minimum of $128 \times 32kW$ of 0 wait state RAM, and PC ISA Bus communications. There are also a number of I/O components included on-board: 4 or 8 digital-to-analog converters, 4 or 8 optical encoders, 8 analog-to-digital converters, and 32 bits of discrete input/output.

Application code for the hardware can be written in C (recommended) or TI C3x assembly. The code can then be downloaded to the hardware.

2.2 System Requirements

Currently, the following device drivers are available for the ARCS Lightning DSP Board. For updates to the ARCS Lightning Driver list please consult www.arcsinc.com

- Windows NT 4.0 (Intel) Driver. If your hardware host is running Windows NT 4.0 operating system, then you need to install this device driver on the hardware host.
- Linux Driver. If your hardware host is running Linux operating system, then you need to install this device driver on the hardware host.

The hardware uses one ISA bus slot. There are no other requirements imposed by the hardware.

For additional system requirements specific to Linux, please also consult ARCS Installation Supplement for Linux .

ARCS control system is based principally on Java, TCP/IP networking protocol, and Java's distributed computingmodel, *Remote Method Invocation* (RMI).

ARCS software is based on Java. While the software should run on any operating system that has a Java Virtual Machine (JVM), ARCS makes no claims with respect to operating systems it has not explicitly tested on. To date, ARCS software has been explicitly tested on the following JVM supported operating systems: Win32 (e.g. 95, 98, NT), Linux, and Solaris. For an up-to-date list, please consult www.arcsinc.com

The ARCS System has been tested only with the Sun Microsystems, Java 1.1.8. *Any other manufacturer's compatible Java Virtual Machine should be acceptable; however, no testing has been done and A.R.C.S., Inc. makes no claims in this regard.* This system also requires Sun Microsystems's Swing 1.1.1.

The required swing 1.1.1 class file and the JRE 1.1.8 distribution are included with the ARCS base product installation package per Sun Microsystems licensing terms. Information for alternative configurations is provided later in this document.

As with any operating system performance, the faster the CPU and the larger the memory, the better the overall system response time. If, for example, your operating system is Windows NT 4.0, then a Pentium, 200 MHz with 32 MB RAM or similar is advisable.

Any computer that will participate in ARCS Remote mode distributed control should also have TCP/IP (the Internet network protocol) configured.

The win32 computer on which you will develop applications for the ARCS Lightning DSP Board also requires the Texas Instruments Code Generation Tools to build applications.

The required disk space for the complete system on a Window NT platform, for example, is provided in Table 1.

TABLE 1: Disk Space Requirements

Component	Manufacturer	Req'd Disk Space
ARCS Software	A.R.C.S., Inc.	< 10 MB
Java, choose one:		
Java Runtime Environment 1.1	Sun Microsystems	3.0 MB
Java Development Kit 1.1	Sun Microsystems	26.5 MB
TMS320C3x/C4x Code Generation Tools V5.0/5.1	Texas Instruments	4.6/8.6 MB

3 Installation

3.1 Hardware Installation

This section describes how to install the ARCS Lightning DSP Board.

> ◆◆ **Caution:** The ARCS Lightning DSP Board is sensitive to electro-static discharge (ESD). Do take appropriate precautions:
>
> - Do hold the board by the edge.
> - Avoid direct contact with traces, components, and connectors, including the edge connector.
> - Do not handle and store in a high ESD environment (carpeted and/or low humidity areas).
> - Use a grounding strap during handling.

The ARCS Lightning DSP Board will need to be installed in an available ISA slot after the base address has been selected and set on the card. The first order of business is to select an appropriate address for the card. Windows NT Diagnostics from the Administrative Tools menu can be run to identify I/O port locations which have been claimed and are unavailable. Fig. 1 shows a typical Windows NT Diagnostics screen. In this particular example, the ARCS driver (labeled *arcs01x.sys*) has already been installed.

> ◆◆ **Caution:** Some manufacturer's drivers are not polite about publishing their claim on the I/O space. If after installation the ARCS driver fails to start or another device on the system fails, simply pick a new location and try again. This location can be manually changed without re-installation of the complete software.

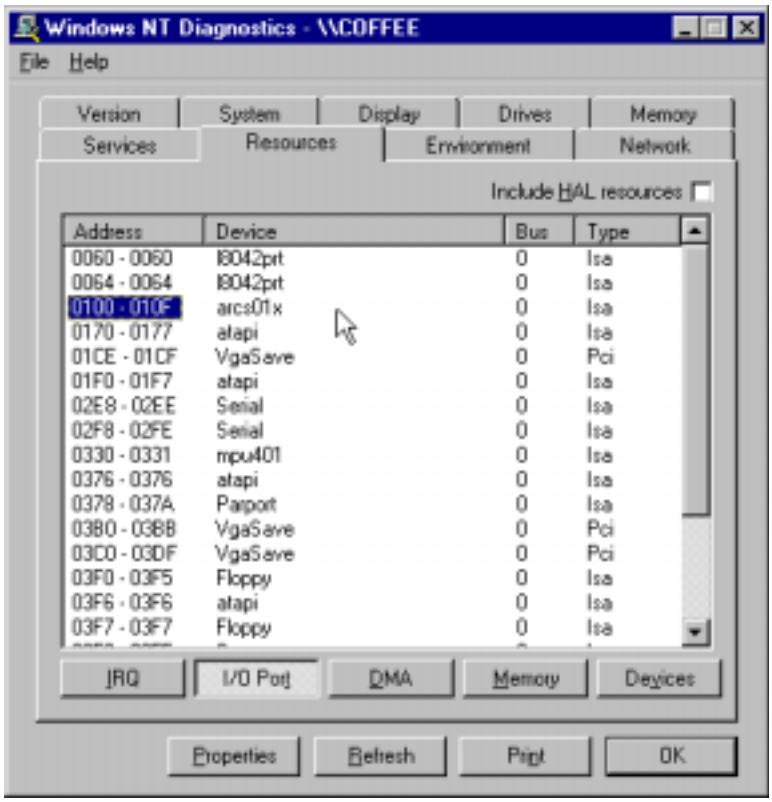


FIGURE 1: Determining claimed I/O ports

The ARCS Lightning DSP Board requires sixteen contiguous locations and the address set on the card and in the software is the base address. For example, Fig. 1 shows that the card uses address $0x0100$ to $0x010F$. The user can also select other available slots, e.g., $0x0300$ to $0x030F$. Although ARCS Lightning DSP Board fully resolves the 16-bit I/O address, the driver address must observe the following rules:

1. The base address always ends with “0”.

2. The allowable range for the base address is from $0x0000$ to $0x0FF0$.

The position of the jumper switches and their relationship to the base address is illustrated in Fig. 2; switches 1-4 control the third most significant digit and switches 5-8 control the second most significant digit. The map-

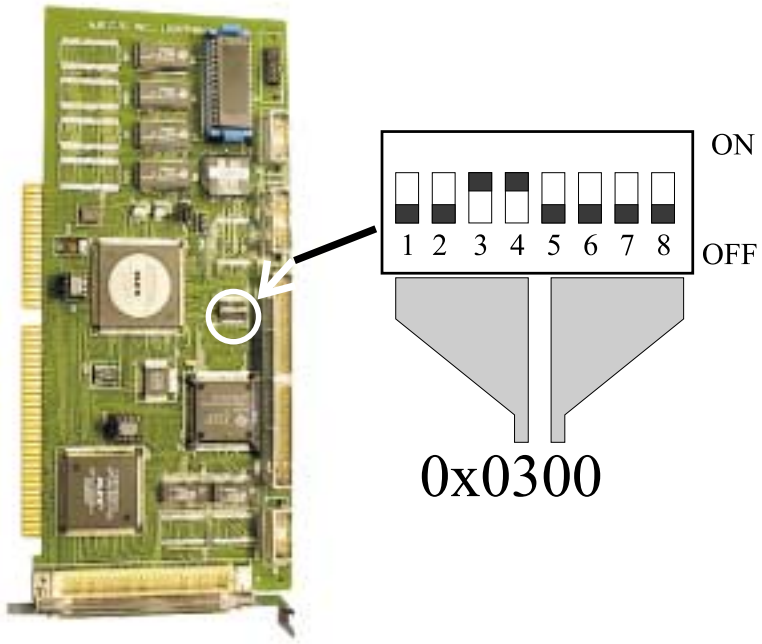


FIGURE 2: Setting the base I/O port address

ping between digits and switch positions is provided in Table 2. Note, the switches in Fig. 1 are shown in the default location.

SW		Value															
		F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
1	5	on	on	on	on	on	on	on	on	off	off	off	off	off	off	off	off
2	6	on	on	on	on	off	off	off	off	on	on	on	on	off	off	off	off
3	7	on	on	off	off	on	on	off	off	on	on	off	off	on	on	off	off
4	8	on	off	on	off	on	off	on	off	on	off	on	off	on	off	on	off

TABLE 2: Jumper Switch Settings

Next, the digital-to-analog (DAC) reference voltages need to be set. These jumpers are indicated in Fig. 3. JP1 controls the reference for channels 0-3 and JP2 controls the reference for channels 4-7, if installed. Please see Sec. 4.2 for details on setting these jumpers.

Before continuing, please fill in Table 3 with the settings you have chosen for future reference.

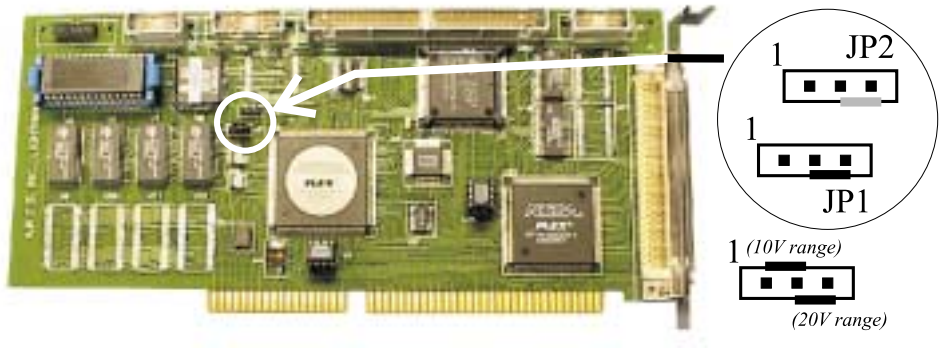


FIGURE 3: Setting the DAC voltage references

SW1	1	2	3	4	5	6	7	8
Default (0×0300)	0	0	1	1	0	0	0	0
Position (_____)	__	__	__	__	__	__	__	__
JP1	Short				Range			
Default	2-3				20V			
Actual	_____				_____			
JP2	Short				Range			
Default	2-3 or N/A				20V or N/A			
Actual	_____				_____			

TABLE 3: Actual Card Settings

Now, the settings are complete. Install the board into the target computer, using an available ISA card slot. Note, the board is longer than the standard half-length card. Carefully verify that there will not be any interference between the card and the surrounding area of the chosen ISA slot to avoid damage to the board, the target computer or both. Carefully seat the card, close the computer, reapply power, and proceed to the software installation.

3.2 Software Installation

This section covers installation of the ARCS software and, briefly, Sun Microsystems' Java Runtime Environment. If you are installing on a Linux system, you may skip this section and refer to the ARCS Installation Supplement for Linux.

The win32 computer on which the executable application code is produced will also require the TMS320C3x/C4x Code Generation Tools, Version 5.0/5.1. Please consult the TI documentation for installation instructions. The tools installation can be done before or anytime after installation of the ARCS software. There are additional recommendations on the TI Tools software in Sec. 3.4.

> ◆◆ **Caution:** Administrator privileges will be needed to install the device drivers for the ARCS Lightning DSP Board .

SOFTWARE INSTALLATION STEPS

1. Run ***setup.exe*** on the installation CD. If you are doing the install on a Windows NT computer, please make sure you have Administrator privileges.
2. After the initialization screens, you will be prompted for the target directory for the installation as shown in Fig. 4.
3. You will be asked for the install type, as shown in Fig. 5.
    - **Typical** install should be used unless this computer is **NOT** the Hardware Host. Typical installs all the ARCS software components on this computer. You will be prompted later to install the Java Run-time Environment.
    - **Compact** install is identical to Typical except it does not install the ARCS documentation and example files.

FIGURE 4: Choosing the target directory

- **Custom** install allows you to select the ARCS software components to be installed, as illustrated in Fig. 6. Custom ***must*** be chosen if the computer is NOT the hardware host, i.e., if this computer will not be housing the ARCS Lightning DSP Board. You will be prompted later to install the Java Run-time Environment.

  In general, if you are using **Custom** install, you probably are not doing this install on the hardware host computer. In that case, you will just want to select the *Controlling Client* component; the *DSP files* component-if you will be doing application development on this computer; and the *Documentation* component-if you want the documentation.

  Additional notes about the selectable components in Custom:

  - *Controlling Client* requires *ARCSware classes*. If you select the former you will automatically get the latter.
  - *Hardware Host* requires *ARCS Lightning Drivers*, If you select the former you will automatically get the latter.
  - *Hardware Host* requires *ARCSware classes*. If you select the

FIGURE 5: Install type

former you will automatically get the latter.

FIGURE 6: Install component selection for Custom type

> **Note:** Installation on a computer that does ***NOT*** house the ARCS Lightning DSP Board should always choose custom installation. Make sure to deselect *Hardware Host* and *ARCS Lightning Drivers*, in that order.

4. The program folder for the various batch files is determined, shown in Fig. 7. These batch files are only suitable for the Java Runtime Environment so if you are planning to use another manufacturer's

java virtual machine (JVM), please consult their documentation for configuration information.

FIGURE 7: Program folder

5. This step applies only to Typical, Compact, or Custom-with ARCS Lightning Drivers selected- installs:

   You will now need to provide the hardware base address which was set when the ARCS Lightning DSP Board was installed. Note, if the address you supply here is incorrect, this can be easily fixed manually any time after the install has been completed. In Fig. 8, the factory default setting is being used.

6. You will be asked to provide the target hardware (ARCS Lightning DSP Board) memory configuration as shown in Fig. 9. This information is used if this computer will be used to generate code for the ARCS Lightning DSP Board. This information is used to make final adjustments to the link command file: *applink.cmd*. This file can also be adjusted after installation. The ARCS Lightning Programmer's Reference contains more details on this item.

7. You will be asked to specify the default working directory, as shown in Fig. 10 The working directory will be the default root directory for project files, source code, executables, data acquisitions files, etc.

FIGURE 8: Hardware Base Address

FIGURE 9: Target Hardware Memory Configuration

Each ARCS user on this computer can have their own working directory or you can have the users share the working directory. Please see Sec. 3.6 for further information on configuring for multiple ARCS users.

The installation program constructs a configuration file called *arcsware.props.*. *arcsware.props* will reference the working directory.

8. You will be asked for the root directory of your TI tools installation.

9. The installation program will provide a summary of your options and

FIGURE 10: Working directory

settings; an example is shown in Fig. 11. Pressing *Next* will proceed with the installation and *Back* will allow the options to be adjusted.

If you choose to adjust your options, the summary will contain a history of the options you selected, with the last entries reflecting the current options.

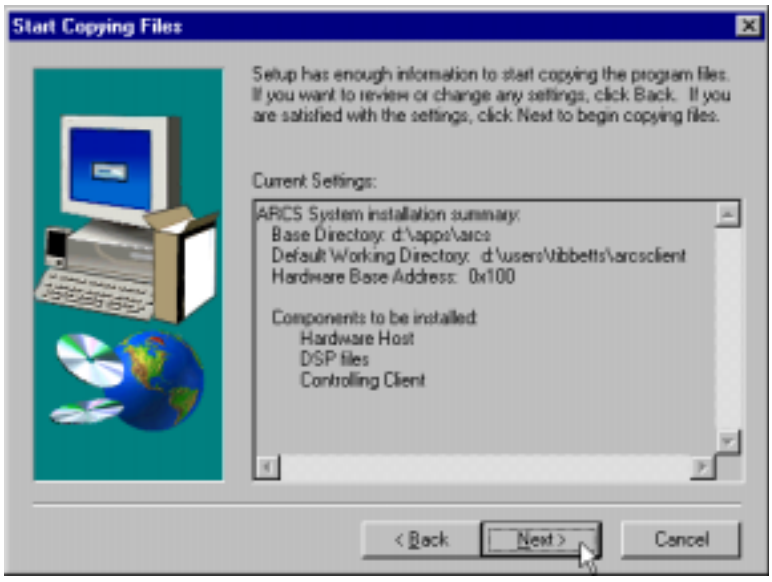


FIGURE 11: Installation summary

10. You will be prompted (Fig. 12) for installation of the JRE 1.1.8.. You

should press *Yes* unless you already have installed this or are planning on using JDK (Java Development Kit). If you choose to install JRE, you will be guided through Sun's standard installation.

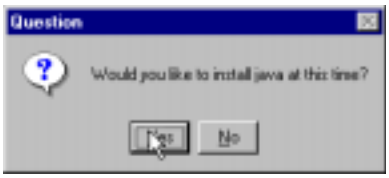


FIGURE 12: Java Installation Query

11. Before leaving the installation program, it is recommended that you select to read the README file and then press *Finish*.

12. The installation program is finished but there are a few more steps you must complete prior to running the system:

    (a) Place the configuration file, *arcsware.props*, in each user's *home* directory. This file has been built during the installation process and is located in the installation directory you specified in Step 2.

    > **Note:** IMPORTANT: Please read Sec. 3.7 regarding setting up home directory

    Note: *arcsware.props* contains initialization variables such as a reference to the working directory you specified in Step 7. The contents of this file can be modified later with a text editor or from within *AIDE*.

    (b) Start the device driver. This can be done by rebooting the computer or by following the steps outlined below.

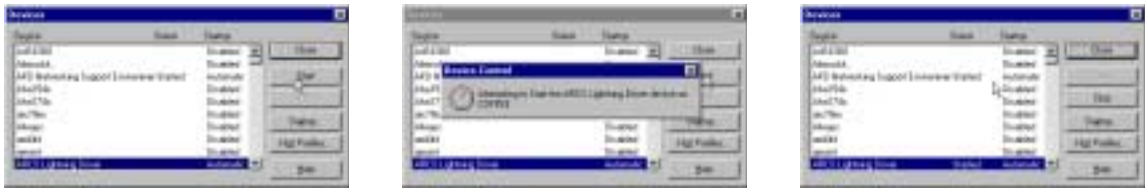
    (c) Install the TI Code Generation Tool Set if you will be developing code for the ARCS Lightning DSP Board on this computer. Please see Sec. 3.4 for further information.

Starting the device driver manually:

First, open the Devices applet on the Control Panel, indicated by the mouse pointer in Fig. 13.

FIGURE 13: Control Panel

Highlight the entry, *"ARCS Lightning Driver"*, and press `Start`, as shown in Fig. 14a.



(A) Initiating (B) Attempting OS load (C) Successful

FIGURE 14: Manually starting the device driver

The system will attempt to start the device driver. This will be indicated by the "Device Control" panel shown in Fig. 14b.

If the device is successfully started, the Devices panel will now look like Fig. 14c. If there is a failure, a specific error dialog will be shown. The error is likely to be the result of a conflict with another device in the system. Please see Sec. 3.1 for help in resolving the problem.

Starting AIDE

Now, that the installation has been completed, you are ready to run the system. If you have installed the JRE, the system can be started as illustrated in Fig. 15. Otherwise, see the notes on Java issues and *ARCS Integrated Development Environment User's Manual.*

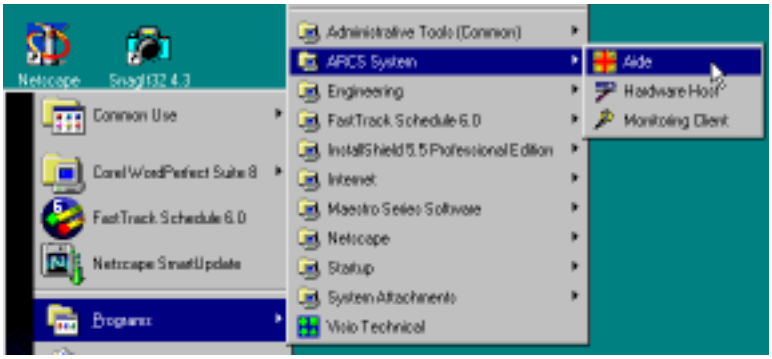


FIGURE 15: Running the registry editor

3.3 Changing the I/O Base Port

The base I/O address of the card can be changed without reinstalling the system. First, run *Regedt32.exe* as shown in Fig. 16.

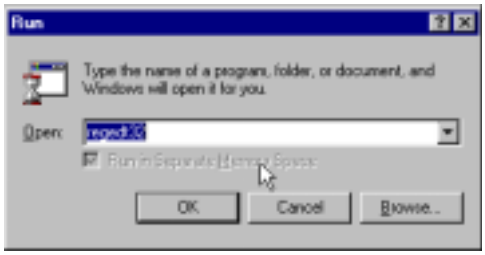


FIGURE 16: Running the registry editor

◆◆ **Caution:** Exercise care when editing the registry. You can break components of your system or **TRASH** your entire system. It is **ALWAYS** good to have a current *Emergency Repair Disk (ERD)* on hand to recover from a serious error.

Next, open the hive (one of the windows) HKEY_LOCAL_MACHINE and then open the following key (one of the folders):

SYSTEM/CurrentControlSet/Services/arcs01x/Parameters/Device0

This is shown in Fig. 17.

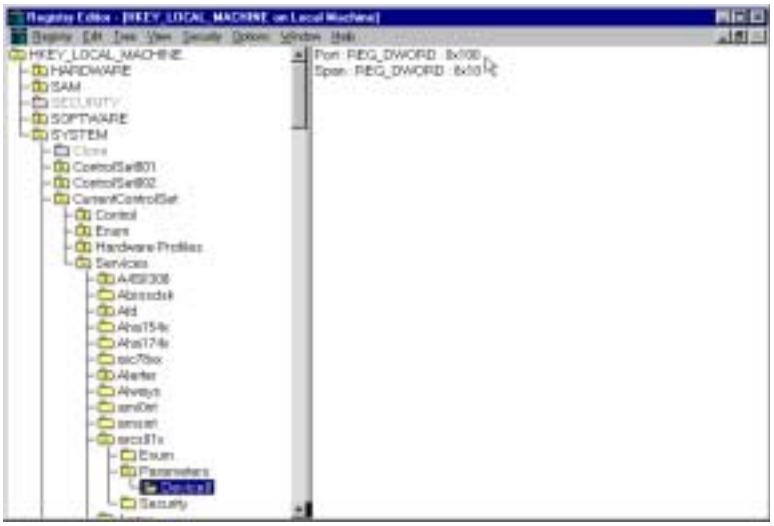


FIGURE 17: ARCS driver registry entries

Now, modify the **Port** value as indicated in Fig. 18 and make the corresponding switch position change on the card.

◆◆ **Caution:** Power down the machine to open the cabinet to avoid safety hazards and to make changes to the address dip switch.

After the modification is complete, manually stop and then start the device driver. Manually stopping the driver is similar to the manual start operation described previously.

FIGURE 18: Modifying the base address entry

3.4 TI Code Generation Tools

Installation of the TI Code Generation Tools (purchased separately) is accomplished with the familiar InstallShield package. You are free to adjust the settings as you wish without difficulty for the ARCS system. There is one setting which does require some attention: the location of environment variable (**NT only**). The setting is shown in Fig. 19. The default for these settings is for the current user. This is acceptable *ONLY* if the account in which the installation is being done is the only account in which the tools (either stand-alone or from within the *AIDE*) will be run. If this is not the case, it is advisable that ***HKEY_LOCAL_MACHINE*** be chosen. The choice can be changed in the future (by the system administrator) by editing the "System Variables" and "User Variables" under *Settings* ➜*Control Panel* ➜*System Properties* ➜*Environment.*

3.5 Java-related Items

The ARCS system ships with JRE 1.1.8 for your convenience. It is not, however, a requirement that the system be run with JRE 1.1.8. For exam-

FIGURE 19: TI Tools Installation: environment variables

ple, a development environment is required to build a custom application. In this event, the “CLASSPATH” variable will need to include the file “arcsware.jar” and, if not included elsewhere, swingall.jar from Swing1.1.1. Both of these files can be found in *ARCS_ROOT/lib*. Please consult your development environment for setting the variable.

3.6 Configuring for Multiple ARCS users

Once you have completed the software installation instructions in Sec. 3.2, you do not need to execute the installation program again to add more ARCS users for this computer. Simply do the following for each additional new user on this computer:

1. Place a copy of the configuration file, *arcsware.props*, in the new user's *home* directory. Recall, *arcsware.props* was built during the installation process (see Step 2 under Sec. 3.2). This file contains references to the working directory as described in Step 7 under Sec. 3.2.

   > ✍ **Note:** IMPORTANT: Please read Sec. 3.7 regarding setting up home directory

2. If you want the new user to share the same working directory and other initialization variables, then you do not need to do anything further.

3. If you want the new user to have her or his own working directory, then modify the new user's *arcsware.props* file as appropriate. Remember to create the directories you name in that file if they do not yet exist.

3.7 Home Directory Environment Variables

JRE looks for **two** environmental variables in order to locate a user's home directory: (1) HOMEDRIVE which specifies the drive name of the home path and (2) HOMEPATH which specifies the directory path for the home directory. Consequently, you need to set up both environment variables for each ARCS user. For example, suppose the home directory of the user is "C:\user". Then you want to set HOMEDRIVE variable to "C:" and then set HOMEPATH variable to "\user".

4 Hardware Reference

The ARCS Lightning DSP Board with the connectors labeled is shown in Fig. 20. The functionality and use of these connectors are provided in Table 4.

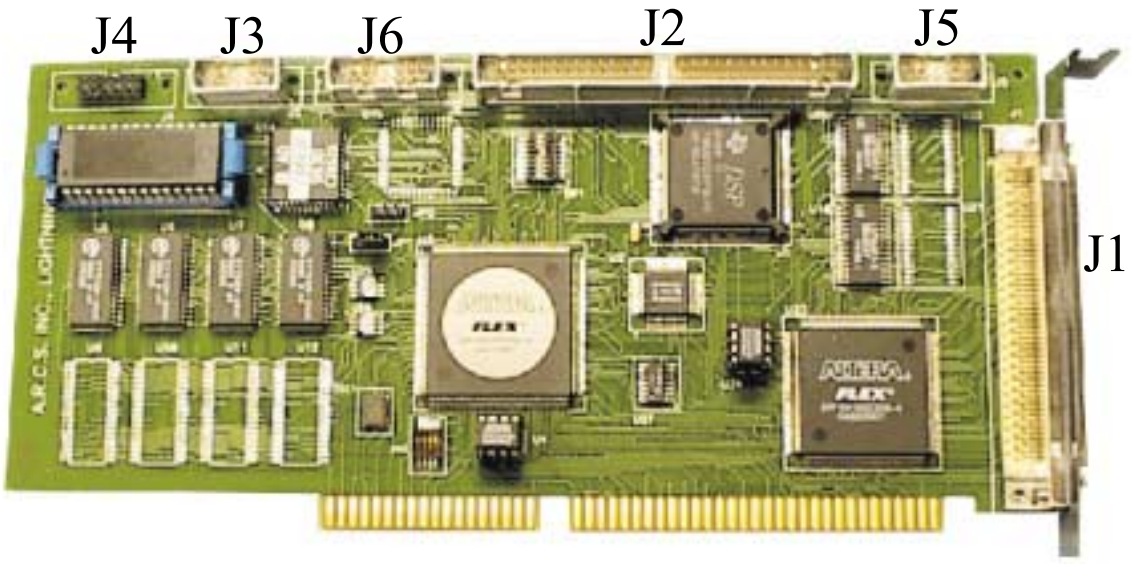


FIGURE 20: Connector Locations.

Ref.	Function	Use/Availability
J1	I/O connector	Use mating ARCS cable or similar
J2	Card expansion bus	See following notes (Sec. 4.9)
J3	JTAG	ARCS use only
J4	Emulator Port	For use with TI XDS510 Emulator
J5	Development	ARCS use only
J6	Development	ARCS use only

TABLE 4: Connectors

4.1 Memory Configuration

The memory configuration is given in Table 5. A.R.C.S., Inc. places the kernel in the first `0x1000` memory block available on-board. For example, `0x60000` through `0x60fff` is not available on boards with either 128k or 640k memory options.

TABLE 5: Memory Configuration

Description	Address Location		Availability
	Start	End	
On-board, block A	`0x60000`	`0x7ffff`	128k/640k boards
On-board, block B	`0x80000`	`0xbffff`	512k/640k boards
On-processor	`0x809800`	`0x809fc0`	All

The ARCS Lightning DSP Board has been designed so that the kernel provided by A.R.C.S., Inc. can be replaced easily. The EPROM is a $512k \times 8$ device (AMD AM27C512-120PC, or similarly) which provides 64kWords of DSP stored program space. Please contact A.R.C.S., Inc. for further information and details on this feature.

4.2 Digital-to-Analog Converters

All models of the ARCS Lightning DSP Board have either 4 or 8 analog output channels. Table 6 summarizes the analog output capabilities.

Each block of four independent channels (for example, channels 0-3) are implemented with a single Digital-to-Analog Converter (DAC). However, each group of four channels share a common, on-board voltage reference. Table 7 shows the possible output capabilities based on the choice of reference voltage and assuming a “full gain” setting.

TABLE 6: DAC - Key Parameters

Parameter	Value
Load Resistance	2kΩ min
Resolution	12 bit
Settling Time	10μSec
Gain Error	± 7 L.S.B.
Offset Error	± 3 L.S.B.
Linearity Error	$\pm \frac{3}{4}$ L.S.B.

TABLE 7: DAC Voltage reference

Jumpers	Range (V)	Resolution (mV/bit)	DAC Capabilities	
			Unipolar	Bipolar
1-2	10.0	2.441	0.0V - +9.998V	-5.0V - +4.998V
2-3	20.0	4.883	0.0V - +10.0V	-10.0V - +9.995V

4.3 Analog-to-Digital Converters

All models of the ARCS Lightning DSP Board have 8 analog input channels using a single analog to digital converter (ADC). Table 8 summarized the analog input capabilities.

TABLE 8: ADC - Key Parameters

Parameter	Value
Input Resistance	15kΩ min
Range	± 10.0 V
Resolution	12 bit
Gain Error	± 3 L.S.B.
Offset Error	± 4 L.S.B.
Linearity Error	$\pm \frac{3}{4}$ L.S.B.
Conversion Time	1.6 μSec
Track/Hold Acquisition Time	0.6 μSec

4.4 Encoder Counters

All models of the ARCS Lightning DSP Board have either 4 or 8 encoder counter channels. Please note that the encoder input signals have **NOT** been electrically isolated. Most systems will not require any isolation; however, it is the user's responsibility to determine if there is a need and to implement if required. Table 9 summarized the encoder capabilities.

TABLE 9: Encoder Counter - Key Parameters

Parameter	Value
Range	24 bit
Modes	Quadrature (1×, 2×, 4×), Non-Quad
Clk. Freq.	Quad: 20.0 MHz, Non-Quad: 20.0 MHz
Qual. Input Freq.	Quad: 6.3 MHz, Non-Quad: N/A
Input Type	single-ended/differential
Low Input	0.8 V_{max}
High Input	2.0 V_{min}
Input Range	-0.3/+5.1 V
Input Current	$\pm$10 μA

4.5 Discrete Input/Output

All models of the ARCS Lightning DSP Board have 32 discrete input/outputs (DIO). The DIO's are arranged in 2 16-bit words. Each DIO is programmable to be either a DI or a DO. Due to this flexibility, it is the **user's responsibility** to provide **ALL** necessary electrical isolation. Table 10 summarized the DIO capabilities.

4.6 I/O Connector

All on-board I/O is carried out by a single connector, 3M N102AO-52E2VC or equivalent. A.R.C.S., Inc.provides a standard interface cable or users

TABLE 10: DIO - Key Parameters

Parameter	Value
Low Input	0.8 V_{max}
High Input	2.0 V_{min}
Input Range	-0.3/+5.1 V
Input Current	$\pm$10 μA

(A) Inputs

Parameter	Value
Low Output	0.45 V_{max}
High Output	2.4 V_{min}
Output Current	$\pm$10 mA

(B) Outputs

are free to develop there own application-specific interface. The pin assignments are provided in Table 11.

Table 11: I/O connector

Pin #	Signal	Pin #	Signal	Pin #	Signal	Pin #	Signal
1	DAC_0	51	DAC_2	26	DAC_1	76	DAC_3
2	DAC_4	52	DAC_6	27	DAC_5	77	DAC_7
3	ADC_0	53	ADC_2	28	ADC_1	78	ADC_3
4	ADC_4	54	ADC_6	29	ADC_5	79	ADC_7
5	+5V	55	+12V	30	-12V	80	GND
6	$ENC\_A_0^+$	56	$ENC\_B_0^+$	31	$ENC\_A_0^-$	81	$ENC\_B_0^-$
7	$ENC\_I_0^+$	57	$ENC\_A_1^+$	32	$ENC\_I_0^-$	82	$ENC\_A_1^-$
8	$ENC\_B_1^+$	58	$ENC\_I_1^+$	33	$ENC\_B_1^-$	83	$ENC\_I_1^-$
9	$ENC\_A_2^+$	59	$ENC\_B_2^+$	34	$ENC\_A_2^-$	84	$ENC\_B_2^-$
10	$ENC\_I_2^+$	60	$ENC\_A_3^+$	35	$ENC\_I_2^-$	85	$ENC\_A_3^-$
11	$ENC\_B_3^+$	61	$ENC\_I_3^+$	36	$ENC\_B_3^-$	86	$ENC\_I_3^-$
12	$ENC\_A_4^+$	62	$ENC\_B_4^+$	37	$ENC\_A_4^-$	87	$ENC\_B_4^-$
13	$ENC\_I_4^+$	63	$ENC\_A_5^+$	38	$ENC\_I_4^-$	88	$ENC\_A_5^-$
14	$ENC\_B_5^+$	64	$ENC\_I_5^+$	39	$ENC\_B_5^-$	89	$ENC\_I_5^-$
15	$ENC\_A_6^+$	65	$ENC\_B_6^+$	40	$ENC\_A_6^-$	90	$ENC\_B_6^-$
16	$ENC\_I_6^+$	66	$ENC\_A_7^+$	41	$ENC\_I_6^-$	91	$ENC\_A_7^-$
17	$ENC\_B_7^+$	67	$ENC\_I_7^+$	42	$ENC\_B_7^-$	92	$ENC\_I_7^-$

Pin #	Signal	Pin #	Signal	Pin #	Signal	Pin #	Signal
18	DIO^0_{00}	68	DIO^0_{02}	43	DIO^0_{01}	93	DIO^0_{03}
19	DIO^0_{04}	69	DIO^0_{06}	44	DIO^0_{05}	94	DIO^0_{07}
20	DIO^0_{08}	70	DIO^0_{10}	45	DIO^0_{09}	95	DIO^0_{11}
21	DIO^0_{12}	71	DIO^0_{14}	46	DIO^0_{13}	96	DIO^0_{15}
22	DIO^1_{00}	72	DIO^1_{02}	47	DIO^1_{01}	97	DIO^1_{03}
23	DIO^1_{04}	73	DIO^1_{06}	48	DIO^1_{05}	98	DIO^1_{07}
24	DIO^1_{08}	74	DIO^1_{10}	49	DIO^1_{09}	99	DIO^1_{11}
25	DIO^1_{12}	75	DIO^1_{14}	50	DIO^1_{13}	100	DIO^1_{15}

4.7 Extended Discrete I/O

Four channel boards may be ordered with an extended DIO option. The following table (Table 12) provides a description of the signal changes. The “Notation” column is the signal names shown on the standard A.R.C.S., Inc.terminal interface board, **INTF-1000-TERM**.

TABLE 12: Extended DIO Connections

Signal	Pin #	Notation	Signal	Pin #	Notation
DIO^2_{00}	62	$ENC\_B^+_4$	DIO^2_{01}	12	$ENC\_A^+_4$
DIO^2_{02}	87	$ENC\_B^-_4$	DIO^2_{03}	37	$ENC\_A^-_4$
DIO^2_{04}	14	$ENC\_B^+_5$	DIO^2_{05}	63	$ENC\_A^+_5$
DIO^2_{06}	39	$ENC\_B^-_5$	DIO^2_{07}	88	$ENC\_A^-_5$
DIO^2_{08}	65	$ENC\_B^+_6$	DIO^2_{09}	15	$ENC\_A^+_6$
DIO^2_{10}	90	$ENC\_B^-_6$	DIO^2_{11}	40	$ENC\_A^-_6$
DIO^2_{12}	17	$ENC\_B^+_7$	DIO^2_{13}	66	$ENC\_A^+_7$
DIO^2_{14}	42	$ENC\_B^-_7$	DIO^2_{15}	91	$ENC\_A^-_7$
DIO^3_{00}	13	$ENC\_I^+_4$	DIO^3_{01}	38	$ENC\_I^-_4$
DIO^3_{02}	64	$ENC\_I^+_5$	DIO^3_{03}	89	$ENC\_I^-_5$
DIO^3_{04}	16	$ENC\_I^+_6$	DIO^3_{05}	41	$ENC\_I^-_6$
DIO^3_{06}	67	$ENC\_I^+_7$	DIO^3_{07}	92	$ENC\_I^-_7$

4.8 External Connections and Power Considerations

The +5V supply is rated for 250 mA maximum. If this current is not sufficient or this voltage level is inappropriate for various external devices in use for a given application, an external power will need to be provided. Fig. 21 shows the key wiring elements for an auxiliary power supply. Follow these guidelines.

1. Only draw 250 mA from the ARCS equipment. The standard configuration is fused (on the terminal board, INTF-1000-TERM, use Littelfuse 273.250 or equivalent). If the standard is not being used, it is the user's responsibility to fuse and protect the ARCS equipment.

2. Tie the grounds together. A floating ground can result in extreme noise or equipment damage.

3. DO NOT tie the output voltages together. This rule applies even if the auxiliary power supply is also +5V. Violating this rule is likely to result in equipment damage.

4. Although not shown on the auxiliary power supply, it is advisable to provide a fuse or circuit breaker.

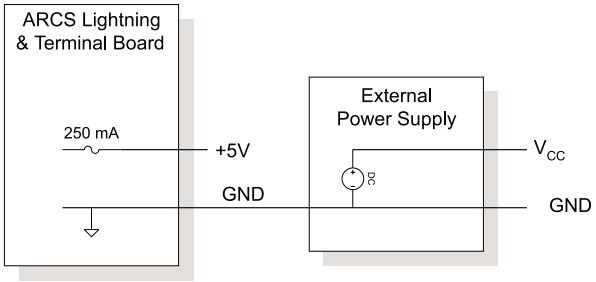


FIGURE 21: Auxiliary Power Supply

4.9 Expansion Bus

An expansion bus is provided with a Thomas&Betts 636-6027 (or equivalent), with the pin assignments given in Table 13.

Table 13: Expansion connector

Pin #	Type	Designator	Pin #	Type	Designator
1	Data Bus	D_{00}	31		D_{30}
2		D_{01}	32		D_{31}
3		D_{02}	33	Address Bus	A_{00}
4		D_{03}	34		A_{01}
5		D_{04}	35		A_{02}
6		D_{05}	36		A_{03}
7		D_{06}	37		A_{04}
8		D_{07}	38		A_{05}
9		D_{08}	39		A_{06}
10		D_{09}	40		A_{07}
11		D_{10}	41		A_{08}
12		D_{11}	42		A_{09}
13		D_{12}	43		A_{10}
14		D_{13}	44		A_{11}
15		D_{14}	45		A_{12}
16		D_{15}	46		A_{13}
17		D_{16}	47		A_{14}
18		D_{17}	48		A_{15}
19		D_{18}	49		A_{16}
20		D_{19}	50		A_{17}
21		D_{20}	51		A_{18}
22		D_{21}	52		A_{19}
23		D_{22}	53		A_{20}
24		D_{23}	54		A_{21}

Pin #	Type	Designator	Pin #	Type	Designator
25		D_{24}	55		A_{22}
26		D_{25}	56		A_{23}
27		D_{26}	57	Control Lines	$\overline{DSP\_STRB}$
28		D_{27}	58		DSP_H1
29		D_{28}	59		DSP_RD/$\overline{WR}$
30		D_{29}	60		$\overline{RDY\_EXT}$

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