

Appendix B

HARDWARE REFERENCE

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This appendix provides notes on several hardware devices used with SIGNAL.

Security Key – General

Technical Background

The SIGNAL security key attaches to the USB port on a PC or Macintosh computer. Users with the older parallel-port security key may exchange it for a USB key for a small charge; contact Engineering Design.

The security key is supported by the **Sentinel System Driver (SSD)** which is installed by the SIGNAL install program. See Chapter 2, "Installing SIGNAL", for general background on the security key.

SSD, SIGNAL and Windows

SIGNAL has used two generations of the Sentinel System Driver (SSD):

- SIGNAL 5 uses SSD v7.5.8 with additional program **Sentinel Advanced Medic** to troubleshoot the SSD.
- SIGNAL 4 used SSD v5.41.1 with additional programs **Sentinel Medic** and **Sentinel System Driver Configuration Utility** to diagnose and configure the SSD.

Windows Vista and later require SSD v7.5.8 or later for all SIGNAL versions. SSD v7.5.8 is provided with SIGNAL 5.05 and later (April 2013). You can also download it from the Engineering Design website at <http://www.engdes.com/support/support.html>

USB Security Key and Docking Stations

SIGNAL may fail to recognize a USB security key on a notebook computer associated with a docking station. Apparently the Sentinel System Driver (SSD) must be installed with the computer detached from the docking station. Try the following approach to correct the problem.

1. **Remove the notebook computer from the docking station.**
2. Uninstall SIGNAL, then manually uninstall the SSD as described below.
3. Reinstall SIGNAL, which will reinstall the SSD.
4. The notebook can now be returned to the docking station.

Note that the "Modify" option on the SSD installer invoked by the SIGNAL installer **does not uninstall the SSD** and will not solve the problem.

Security Key – Current

Sentinel System Driver (SSD) v7.5.8 is the current SIGNAL SSD. This version supports all SIGNAL versions and all Windows versions through Windows 8.

The SSD is normally installed automatically by the SIGNAL installer. Here are instructions in case you need to install it manually.

Note: if the SSD malfunctions, uninstall it before reinstalling. See "Uninstalling the Sentinel System Driver" below.

Installing the SSD

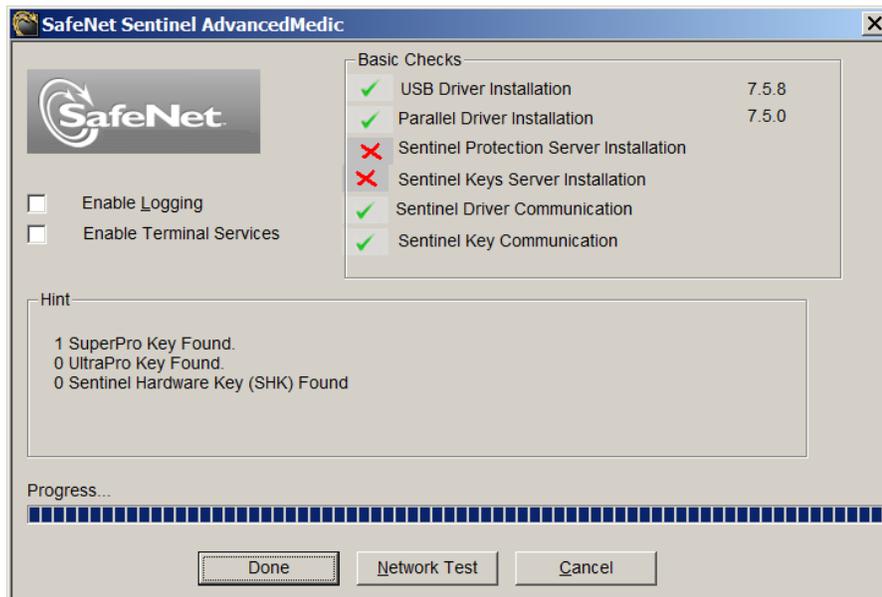
1. Download the SSD from the Engineering Design website at <http://www.engdes.com/support/support.html>

2. Unzip and copy the Sentinel Installer and Sentinel Medic executables to the SIGNAL root directory, such as c:\Program Files\Engineering Design\Signal 5 (WinXP) or c:\Program Files (x86)\Engineering Design\Signal 5 (Win Vista and later).
3. Launch the SSD executable.
4. If the installer detects a previous driver version and suggests an Upgrade, allow that.
5. If no driver is present, select the Complete (not Custom) installation.
6. Approve the installation.
7. Check the installation by running Sentinel Advanced Medic – see below.

Troubleshooting the Security Key

Follow these steps to install the Sentinel Advanced Medic v1.3.1 diagnostic program. This program supports all Windows versions through Windows 8.

1. Create the directory \Safenet\Sentinel Medic in c:\Program Files (WinXP) or c:\Program Files (x86) (Win Vista and later).
2. Execute **Sentinel Advanced Medic 1.3.1.exe** in the SIGNAL installation directory.
3. Click Browse and navigate to the above directory.
4. Click Install to perform the installation.
5. Run **Sam1.3.1.exe** in the above directory. Click Troubleshoot and then Acknowledge twice. A successful driver installation will produce the following screen.



Uninstalling the SSD

To uninstall the Sentinel System Driver, follow these steps:

1. Unplug the security key from the computer.
2. Click Start | Settings | Control Panel | Add/Remove Programs, then select Sentinel System Driver from the list.
3. Restart the system if requested.

Security Key - Legacy

Installing the SSD

Sentinel System Driver (SSD) v5.41.1 was distributed with SIGNAL 4. It **does not support Windows Vista or later**. These instructions are provided for legacy support.

Note: if the SSD malfunctions, uninstall it before reinstalling. See "Uninstalling the Sentinel System Driver" below.

There are two methods for installing SSD v5.41.1. The first uses the Microsoft Installer (MSI), which is included in most Windows 98, 2000, and XP systems. However, this can fail if MSI is absent on your system or the MSI database is corrupted. In that case, use the second approach, "Installation without Microsoft Installer (MSI)".

Note: It should not be necessary to uninstall any previous Sentinel system driver version before installing a new one, because the Sentinel installer will automatically overwrite the older version. If necessary to uninstall the driver, see "Uninstalling the Sentinel System Driver below".

1. Installation using Microsoft Installer (MSI)

This installation uses the Microsoft Installer (MSI), which is included in most Windows 98, 2000, and XP systems. If this approach fails, proceed to the next section, "Installation without Microsoft Installer (MSI)".

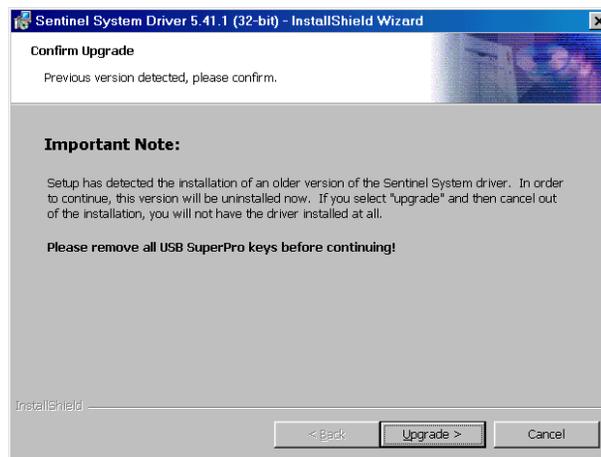
1. Launch RainbowSSDx.xx.x.exe in the SIGNAL root directory, where x.xx.x is the driver version number, for example, RainbowSSD5.41.1.exe.
2. The installer will take one of two paths, depending on whether it finds a Sentinel system driver already present. If the Welcome screen promises to **install** the Sentinel System Driver, then no Sentinel driver was detected – proceed to "Sentinel System Driver not present". If the Welcome screen promises to **modify, repair, or remove** the system driver, a Sentinel driver was detected – skip to "Sentinel System Driver already present".

Sentinel System Driver not present

1. At the Welcome screen click Next.
2. Accept the License Agreement and click Next.
3. At Destination Folder, accept the default folder "c:\Program Files\Rainbow Technologies\Sentinel System Driver\" (note this is **not** the SIGNAL folder) and click Next.
4. At the Setup Type screen, select Complete (not Custom) and click Next.
5. At the next screen (Ready to Install the Program), click Install to install the driver. Then click Finish to exit the installer.

Sentinel System Driver already present

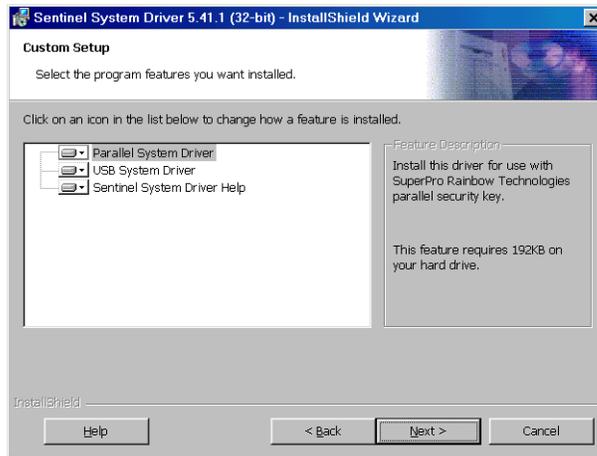
1. If a Confirm Upgrade screen appears, click Upgrade to approve the upgrade.



2. At the Welcome screen click Next.
3. At Program Maintenance, select Modify and click Next.



4. At Custom Setup, use the default settings, which will install the Parallel System Driver, USB System Driver, and Sentinel System Driver Help. Click Next.



5. At Ready to Modify the Program, click Install to install the driver. Restart the system if asked, with one exception: **do not restart the system if the key installer has been launched by the SIGNAL installation program**, because this would abort the SIGNAL installer.
6. Click Finish to exit the installer.

2. Installation without Microsoft Installer (MSI)

This installation does not use the Microsoft Installer (MSI), and may be needed if MSI is absent or corrupted on your system.

1. Launch RainbowSSDx.xx.xnonMSI.exe in the SIGNAL root directory, where x.xx.x is the driver version number, for example, RainbowSSD5.41.1nonMSI.exe.
2. At the WinZip Self-Extractor screen, specify the temporary destination folder c:\sigkey and click Unzip. WinZip should unzip 19 files into that folder. Click OK and Close to close the self-extractor.
3. Click Start | Run and enter either "c:\sigkey\win_9x\sentw9x.exe /usb" for Windows 95/98 or "c:\sigkey\win_nt\setupx86.exe /usb" for Windows 2000 and XP.
4. At the next screen, select Functions | Install Sentinel Driver as shown.



5. In the next dialog, click OK to confirm the setup path, which should be either "c:\sigkey\win_9x" for Windows 95/98 or "c:\sigkey\win_nt\i386" for Windows 2000 and XP.

6. Setup should install the driver and report success. Restart your system if asked, for example:



7. Delete the c:\sigkey directory.

Uninstalling the SSD

To uninstall the Sentinel System Driver, follow these steps:

1. Unplug the security key from the computer.
2. Click Start | Settings | Control Panel | Add/Remove Programs, then select Sentinel System Driver from the list.
3. Restart the system if requested.

Troubleshooting the Security Key

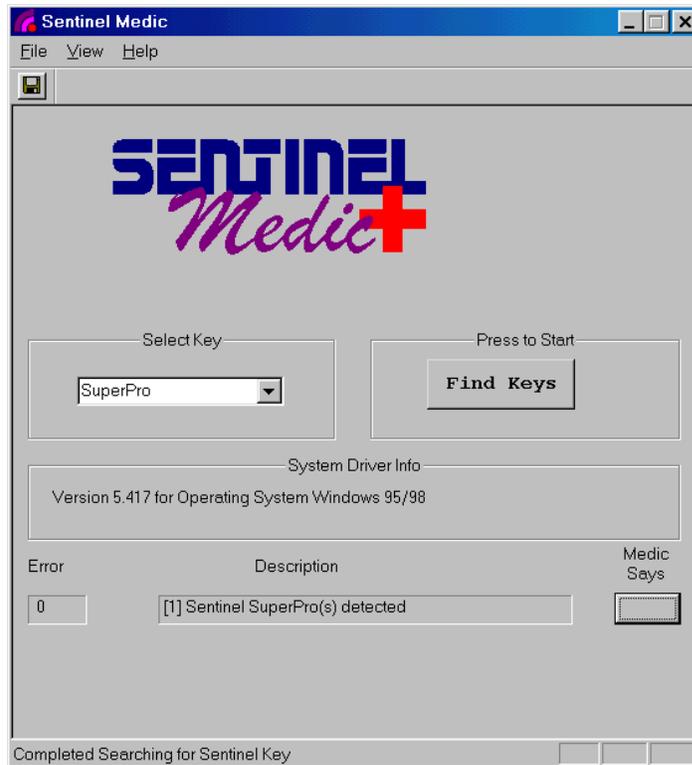
This section contains instructions for troubleshooting the legacy Sentinel System Driver (SSD) v5.41.1. This driver was used with SIGNAL 4.

- To troubleshoot a **new installation of a new SIGNAL security key** (or a key known to be working) follow the complete steps below, as instructed.
- If your **key was functioning but has suddenly stopped**, the key driver may have become corrupted or the key may have failed. Perform steps 1, 2, and 3. Step 4 should not be relevant if the key has been working at any time on the system.
- If your key trouble involves a notebook computer installed in a docking station, **remove the notebook from the docking station**. Then uninstall the Sentinel System Driver (SSD) as described below and reinstall SIGNAL in order to reinstall the SSD.

To contact Engineering Design about key problems, send the **complete SIGNAL error message**, either by copying the message contents manually or by capturing the screen to an image file. To do the latter, see "Saving the Screen to an Image File" in Appendix G, "Support".

1. Run Sentinel Medic

Begin troubleshooting by running Sentinel Medic, a diagnostic program which reports the status of the Sentinel system driver and key installation.



1. Launch Sentinel Medic by double-clicking on SentMed.exe in the SIGNAL root directory (normally c:\Program Files\Engineering Design\Signal 5).
2. Select SuperPro under Select Key, click Find Keys, and check the value in the Error window.
3. **Error value = 0:** An error value of 0 (as shown in the figure) indicates that the Sentinel system driver is properly installed and has recognized the security key. If error value = 0 but SIGNAL reports a security key error, contact Engineering Design.
4. A non-zero error value indicates problems with the system driver, key installation, or the key itself. See the Description window for a description or click Medic Says for an explanation. Then select one of the following steps.
5. **Error value = -60 (or other values):** If Sentinel Medic indicates that the Sentinel system driver is not installed (typically, error value = -60), go to section 2, "Install Sentinel system driver", to install or reinstall the Sentinel driver. Then run Sentinel Medic again and if this error persists, contact Engineering Design.
6. **Error value = -3 or -9:** If Sentinel Medic returns a value of -3 (key not found) or -9 (port not found), the Sentinel driver is properly installed but the driver does not recognize the physical key. Possible causes include: key loose or missing, key defective, port disabled or unconfigured, or port malfunctioning. **Port errors may be reported as key errors.** Go to section 3, "Verify the Sentinel key is present", then for new installations, continue on to section 4, "Configure the security key communication port". Then run Sentinel Medic again.

2. Reinstall the Sentinel System Driver

Reinstall the Sentinel System Driver per the instructions in "Installing the Sentinel System Driver" below.

3. Verify the Sentinel key is present

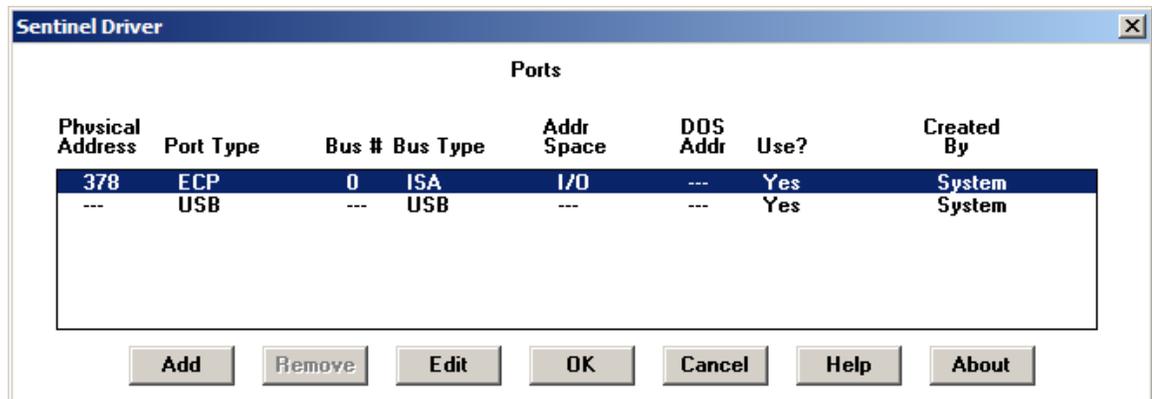
If Sentinel Medic returns a value of -3 or -9, then the Sentinel driver is installed but does not recognize the physical key. Possible causes include: key loose or missing, key defective, port disabled or unconfigured, or port malfunctioning. Port errors may be reported as key errors. Follow these steps:

1. Make sure the key is present and firmly plugged in. Shut down the computer, unplug the key, firmly replug it, then start up the system again. (This is for diagnostic purposes – normally the key can be plugged and unplugged with power on.)
2. If the error persists and this is a **new installation**, proceed to section 4, "Configure the communication port used by the security key".
3. If the error persists and you have already performed the steps in section 4, the key may have failed. Send the **complete SIGNAL error message** to Engineering Design, either by copying the message contents manually or by capturing the screen to an image file. To do the latter, see "Saving the Screen to an Image File" in Appendix G, "Support".

4. Configure the security key communication port

If Sentinel Medic returns a value of -3 or -9 and the key is present and known to be working (such as a new key), then the Sentinel driver may not recognize the parallel or USB port to which the key is attached. **This is common in computers manufactured in 2001 and later.** This can be true, even though a printer on the parallel port functions correctly. Follow these steps:

1. Launch the Sentinel system driver Configuration Utility by double-clicking on SetupSysDriver.exe in the directory c:\Program Files\Rainbow Technologies\Sentinel System Driver.
2. Click Configure Driver. This will list all the parallel and USB ports currently recognized by the Sentinel system driver. In the figure, one parallel (ECP) port and one USB port are detected. The Windows 95/98 display has fewer columns.



3. Confirm that the port to which the key is attached (parallel or USB) is listed. Parallel ports will typically be shown with a Port Type of ECP or IBM AT. A Bus Type of ISA is normal, even on a PCI-based computer.

4A. Try a different communication port

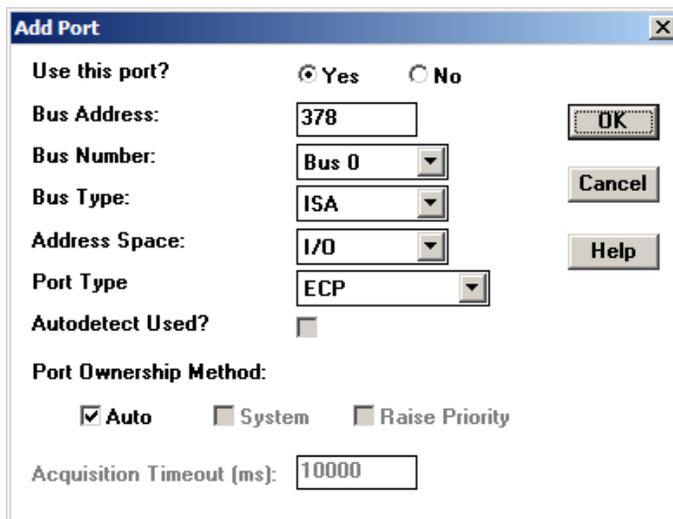
If the display shows any port of the required type (e.g., parallel port), try attaching the key to that port. Return to step 1 and run Sentinel Medic again.

4B. Add a communication port to the Sentinel system driver

If the parallel port to which the key is attached is not listed, you must manually add that port to the Sentinel system driver. Follow these steps. If you have already performed this step, proceed to the next section, "Enable the communication port in the computer BIOS".

Caution: the following requires technical computer skills, or the computer can be rendered inoperative.

1. Click Start | Settings | Control Panel | System | Device Manager in Windows 95/98 or Start | Settings | Control Panel | System | Hardware | Device Manager in Windows 2000/XP.
2. For parallel ports, open Ports (COM and LPT), select the LPT1 port, R-click and select Properties | Resources. Read the **base address** of the port, which is the beginning of the specified address range, normally 378 hex. For example, if the range is "0378 - 037A", the base address is 378. If several different address ranges are listed, use the lowest.
3. Run the Sentinel system driver Configuration Utility, click Configure Driver (see the figure above), then click Add.
4. Under Bus Address, enter the base address (in hex) obtained from Device Manager, for example 378. If you are configuring a parallel port, set the port type to ECP (first choice) or IBM AT (second choice), or if you have examined the computer BIOS (as described below), select the Port Type closest to the parallel port type listed in the BIOS. Use defaults for other settings, such as "Bus 0" for Bus Number, "ISA" for Bus Type, and "I/O" for Address Space, as shown in the figure. The Windows 95/98 display omits some of these items.



5. Click OK to add this port to the Sentinel system driver, OK to approve the change, and OK to return to the Configuration Utility main screen. Click Configure Driver again to confirm that the port has been added.
6. Exit the Configuration Utility and restart the computer.
7. Return to step 1 above and run Sentinel Medic again to confirm that the key is detected.

4C. Enable the communication port in the computer BIOS

If communication port is recognized or has been successfully added but the driver still does not recognize the key, the port may be disabled in the computer BIOS. Follow these steps.

Caution: the following requires technical computer skills, or the computer can be rendered inoperative.

1. Open the computer BIOS settings screen – typically, by holding down a particular key such as F1 during boot. See the computer hardware guide. Then locate the port and make sure it is enabled. If the BIOS allows the user to select port type, for a parallel port select ECP (first choice) or IBM AT (second choice).
2. After enabling the port, you **must uninstall and reinstall the Sentinel system driver** in order to detect the new port configuration. Then restart the computer, return to step 1, and run Sentinel Medic again.

DT2821 Analog I/O Board

The DT2821 family includes four 12-bit boards - the 2821 and 21EZ (50 kHz), 2821-F (150 kHz), and 2821-G (250 kHz) - and one 16-bit board, the 2823 (100 kHz). In the following, "**DT2821**" refers to the entire DT2821 family. The DT21EZ is the successor to the 50 kHz DT2821, and the two are interchangeable.

Board Configuration

Following is configuration information for DT2821 boards. All I/O boards supplied by Engineering Design are shipped fully configured for SIGNAL, so the following information is provided for users who obtain these boards from other sources, or need to alter these boards in some way. For complete details, see the DT2821 Technical Manual.

SIGNAL uses factory default settings on DT2821 family boards, with the single exception that the DT2821, which is shipped single-ended, must be rejumped to differential for use with the Engineering Design I/O Panel. This change is already made on all boards supplied by Engineering Design. User-designed I/O cable/panels may employ either differential or single-ended mode, transparent to the SIGNAL software, as long as the I/O board and panel match. SIGNAL assumes the following factory-default settings for signal range and coding:

Input range = ± 10 Volts bipolar

Output range = ± 10 Volts bipolar

12-bit binary coding = Offset binary:	-10 Volts	→ 0
	+10 Volts	→ 4095
16-bit binary coding = Two's complement:	-10 Volts	→ -32768
	+10 Volts	→ +32768

Board Specifications

DT2821 boards provide 8 **differential** or 16 **single-ended** input channels. Engineering Design boards are supplied with differential inputs, for better noise immunity, and the Engineering Design I/O Panel is wired for the differential setting. These boards also provide 2 independent differential output channels. SIGNAL assumes an input and output **voltage range** of +/- 10 Volts when converting digitized data to numerical voltages and vice versa.

Binary resolution is the number of bits used to encode input and output voltages. The number of bits limits the board's accuracy and dynamic range, which is the ratio of the loudest to softest sounds that can be encoded. 12-bit boards are most common. Boards provide a maximum **accuracy** of $\pm 1/2$ bit, which can be degraded by electronic noise and non-linearities, so a 12-bit board with a voltage range of ± 10 Volts provides an accuracy of $= \pm 1/2 * 20 \text{ Volts} / 2^{12} = \pm 2.44 \text{ mVolts}$. Boards provide a **dynamic range** of $20 \log_{10}$ [binary range], which is roughly 6 db times the number of bits, so a 12-bit board provides a dynamic range of 72 db and a 16-bit board provides 96 db.

Board Reconfiguration

DT2821 board parameters can be altered by the technically experienced user, to change performance or avoid conflicts with other boards. Three hardware settings in particular - binary coding, base address, and interrupt level - can be altered by changing jumpers on the I/O board, then altering board properties in the DT-Open Layers driver (see Appendix C, "I/O Hardware Installation"). See the DT2821 Hardware Manuals for jumper settings.

Binary Coding

Factory default **binary coding** on the DT2821 is **bipolar offset binary**, meaning that -10, 0, and +9.9995 Volts are encoded as 0 [0000 hex], 2048 [0800 hex], and 4095 [0FFF hex], respectively. This coding is assumed by SIGNAL. On the DT2821, binary coding can be changed to **two's complement**, for compatibility with other programs. Two's complement would encode the above voltages as 2048 [0800 hex], 0 [0000 hex], and 2047 [07FF hex], respectively. **However, the two's complement coding option on the DT2821 is not currently supported by SIGNAL 4.** On the 16-bit DT2823 and DT2827 boards, two's complement rather than offset binary is the default coding. See the coding tables in the Appendix of the DT2821 Technical Manual for details of different coding schemes.

Base Address

Factory default **base address** for the DT2821 is 240 hex, extends through 24F hex, and can be altered within the range 200 - 3E0. Recommended alternate is 380 hex. See the base address jumper table in the DT2821 Hardware Manual. To alter the base address of DT2821 to 380 hex, (1) change the four address jumpers on the I/O board (W15 - W18) from [In In Out In] to [Out Out In In], and (2) add or alter the **ADBASE** setting in C:\SIGNAL\SIGNAL.CFG:

ADBASE=380

Interrupt (IRQ) Level

Factory default **interrupt (IRQ) level** for the DT2821 is IRQ15, and SIGNAL allows the alternates IRQ5 and IRQ10. IRQ10 is the recommended alternate. To change the interrupt level on the DT2821 from IRQ15 to IRQ10, (1) move the interrupt jumper on the I/O board from W28 to W27, and (2) alter board properties in the DT-Open Layers driver (see Appendix C, "I/O Hardware Installation").

DMA Channel

The DT2821 uses DMA channels 5 and 6. These channels should not be changed.

A/D Gain

DT2821 boards provide an on-board programmable input gain of 1, 2, 4, or 8. This can be set from the SIGNAL command line using the **ACGAIN** parameter.

Acquisition and Playback Triggering

Acquisition and playback on DT2821 boards can be initiated immediately or by an external TTL trigger signal, as specified by the **ACTRIG** and **PLTRIG** parameters.

Maximum Input/Output Sample Rate

DT2821 boards provide the following maximum input sample rates. Recall that useful signal bandwidth is (by SIGNAL convention) 40% of sample rate, and that this maximum sample is divided by the number of input channels acquired.

<u>Board</u>	<u>Max Input Sample Rate</u>	<u>Max Output Sample Rate</u>
DT2821	50 kHz	50 kHz
DT2821-F	150 kHz	130 kHz
DT2821-G	250 kHz	130 kHz
DT2823 / DT2827	100 kHz	100 kHz

These boards also provide two independent output channels, with output capabilities as shown. Note that maximum output sample rate is less than maximum input rate, and less than the maximum output rate available SIGNAL 3.

Digital I/O Signals

The DT2821 boards provide multiple digital input/output lines in TTL format. SIGNAL supports several digital control signals that accompany analog I/O activity. These are described in Chapter 9, "Acquisition and Playback".

DT2821 Diagnostics

If your analog I/O system appears to be malfunctioning, first check your signal source and all cables and instruments leading to or from the I/O board, including the SIGNAL I/O cable and panel. Remove any non-essential components and if possible exchange the others one by one. If you still suspect the board itself, then run the Data Translation diagnostics on the board. Instructions are provided in the Application Note, "Analog I/O Board Diagnostics".

DT2821 I/O Panel and Cable

The Engineering Design I/O Cable and Panel allow the user to physically connect external devices, such as microphones, tape recorders, and speakers to the analog I/O board inside the computer. The I/O Panel provides industry-standard BNC connectors for all analog connections. The I/O Panel is a passive connection device, containing no electronics. It provides the following connections:

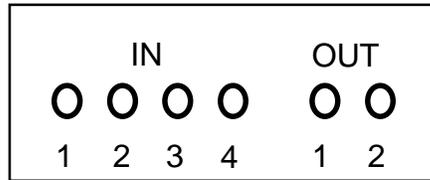
<u>Quantity</u>	<u>Label</u>	<u>Function</u>
4	IN	Analog Input, Differential
2	OUT	Analog Output, Differential
1	TRIG	Acquisition / Playback Trigger
1	DIO	Digital Control Line
1	CPU	50-pin CPU connector

The I/O Cable connects the I/O Panel to the analog I/O board inside the computer.

Normally, sound sources, such as microphones and tape player outputs, are connected to the I/O panel inputs, while sound monitors, such as speakers and tape recorder inputs, are connected to the I/O panel outputs. SIGNAL begins processing at input and output channel 1, so a one-channel acquisition or playback should be accessed at channel 1 on the I/O Panel. The following sections describe the connections on the I/O Panel.

I/O Panel, Front

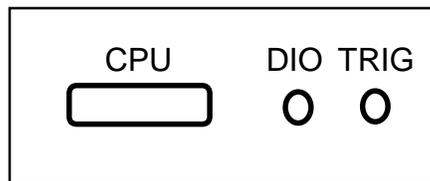
The front of the I/O Panel provides four analog input channels at the BNC connectors labeled **IN 1,2,3,4**, and two analog output channels at the BNC connectors labeled **OUT 1,2**.



I/O Panel, Rear

The rear of the I/O panel connects to the analog I/O board through the **CPU** connector. The I/O cable is attached to this connector.

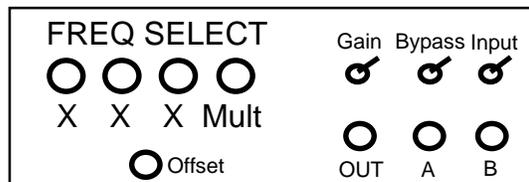
Digital control signals generated by acquisition and playback are available at the **DIO** connector, which is connected to DIO_0, bit 0 on the DT2821 analog I/O board. An external TTL trigger signal (for triggered acquisition and playback) may be applied to the **TRIG** connector, which is connected to the EXT_TRIG input on the DT2821 board.



Frequency Devices 900/901 Anti-Alias Filter

An anti-alias filter (AAF) is a low-pass filter that reduces the bandwidth of analog signals entering or leaving **SIGNAL**, to prevent the generation of spurious spectral energy during acquisition and playback. The recommended anti-alias filter for **SIGNAL** is the Frequency Devices model 900 or 901. This filter provides an 8th order (48 db/octave) Butterworth filter attenuation. The filter also provides switchable 0 / +10 / +20 db gain, which is quite useful for amplifying low-amplitude signals before acquiring them. Maximum filter frequency is 30 KHz for the model 901 and 50 KHz for the model 900, and maximum attenuation is > 60 db.

Following is a diagram of the 900/901 instrument panel:



Input signals should be connected to **A**, and output signals are received at **OUT**.

Filter cut-off frequency is specified as three decimal digits times a decade multiplier. These are set by the four rotary switches under **FREQ SELECT**. Thus, for a cutoff of 12 KHz (= 120 times 100), set the three digit dials to 1,2,0 and the decade dial to 100.

Other filter switches should be set as follows:

- Set **Input** switch to "A" (middle position)
- Set **Bypass** switch to "OUT" (= "no bypass")
- Set **Gain** switch to 0 db (increase to 10 or 20 as necessary)

Finally, the 900/901 allows the user to adjust the DC level or **offset** of the signal. This adjustment should be zeroed before use, as described in Chapter 9, "Acquisition and Playback". Offset can be used to compensate for minor DC errors in the sound source. Any offset errors in the signal are amplified by the **Gain** setting.