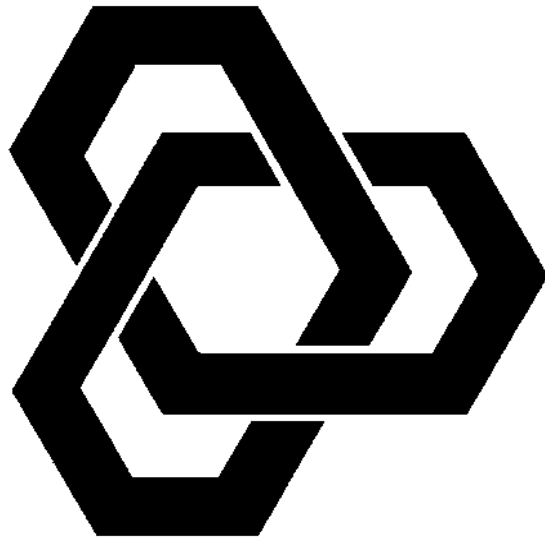


TAMS 9x622 PCI/PCI-Express GPIO Cards



Installation & Operation Instructions

TAMS 9x622 PCI/PCI-Express GPIO Cards Installation & Operating Instructions

Test & Measurement Systems Inc.
750 14th Street SW
Loveland, CO 80537
USA

Telephone	(970) 669 6553
Fax	(970) 669 3090
Web Site	www.tamsinc.com

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General Information

Overview of the TAMS 9X622 GPIO Interface

This guide explains how to install, configure, and utilize enhancements of the TAMS 9x622 GPIO (General Purpose Input Output) interface.

GPIO is a parallel interface that is flexible and allows a variety of custom connections. A PCI/PCI-Express expansion slot is required to accommodate the GPIO interface card.

The TAMS 9x622 card has a rotary DIP switch on the upper edge to set the unique identifier for the card. This is the only switch that needs to be set prior to installing the card. All other configuration is done in software.

This guide also provides an explanation of the configuration process as it relates to the HP/Agilent Standard Instrument Control Library (SICL). A detailed description of the TAMS 9x622's functionality is included to aid in this configuration process.

The TAMS 9x622 provides 16 bit data exchange with peripheral devices that do not support more common interface protocols like PP-IB or RS-232. Connection flexibility is augmented in the TAMS 9x622 GPIO interface by extra status and control lines, a choice of handshake methods, several data-latching options, and selectable data width and polarity.

There are two basic modes for the data IO in the TAMS 9x622 GPIO interface: *Compatibility Mode* and *Enhanced Mode*. The TAMS 9x622 is by default configured in *Compatibility Mode* which is supported by all HP/TAMS GPIO cards. Alternatively, the TAMS 9x622 can be configured with a bi-directional data port and auxiliary control lines (*Enhanced Mode*) which is supported by HP 2074/5 and all TAMS GPIO cards.

Installing the GPIO Interface

This section explains how to install the TAMS 9x622 GPIO interface in the computer. To complete the installation:

1. Make sure the computer power switch is off.
2. Refer to the Owner's Guide of your computer for instructions on opening your computer and installing PCI/PCI-Express boards.
3. The rotary DIP switch on the upper edge of the TAMS 9x622 card should be set to the PCI/PCI-Express slot number the card is going to reside in. If you have multiple TAMS 9x622 cards installed in a single machine, it is important that the rotary DIP switches each be set to a unique number, which is guaranteed if you set the switch to the slot number. (Be sure to note the position of the rotary DIP switch, as you will need to know this when you configure the card.)

4. Install the GPIO interface in the PC by plugging the card into the PCI/PCI-Express slot. Make sure that the card is firmly seated in the slot.
5. Follow the instructions being careful to handle the TAMS 9x622 board only by its metal bracket. Avoid contact with the edge connector. After the board has been plugged in and the retaining screw installed the computer should be reassembled.
6. Prepare and install the GPIO interface cable.

Note: The TAMS 9x622 is a PCI/PCI-Express device. Unlike most EISA and ISA devices a PCI/PCI-Express device does not require an I/O address or IRQ setting. These settings are handled automatically.

Related Software Documentation

Standard Instrument Control Library for Windows

To configure the TAMS GPIO interface for the Agilent Standard Instrument Control Library (HP/Agilent SICL) for Windows, see the “Installing and Configuring the Agilent I/O Libraries” chapter of the *Agilent I/O Libraries Installation and Configuration Guide for Windows*.

To develop Agilent SICL I/O applications for the TAMS card on a PC, see the “Using GPIO with Agilent SICL” chapter of the *Agilent SICL User’s Guide for Windows*. Agilent SICL functions, including those that are GPIO specific, are fully described in the Agilent SICL Reference Manual.

Standard Instrument Control Library for Linux

To configure the TAMS GPIO interface for the Standard Instrument Control Library (SICL) for Linux, see the “Installing and Configuring the I/O Libraries” chapter of the *I/O Libraries Installation and Configuration Guide for Linux*.

To develop SICL I/O applications for the TAMS card on Linux, see the “Using GPIO with SICL” chapter of the *SICL User’s Guide*. SICL functions, including those that are GPIO specific, are fully defined in the *SICL User’s Guide*. The TAMS card also provides functionality enhancements.

BASIC for Linux

The TAMS GPIO interface is supported on version 11.0 and later of TAMS BASIC for Linux.

When the GPIO interface has been configured for SICL, it is also ready to be used from within BASIC for Linux. BASIC users will need to know the SICL Logical Unit Number that has been assigned to the interface during configuration, as this will correspond to the Select Code used to identify the interface in their BASIC programs.

More information for the use of the GPIO interface is found on the TAMS BASIC Documentation CD. Relevant sections are the “Linux Highlights” section of the *BASIC Language Reference*, and the GPIO chapter of the *BASIC Interface Reference* on the CD.

Additional GPIO Documentation Online

Technical articles and other additional GPIO documentation can be found on the TAMS web site: <http://www.tamsinc.com/support/>

tamsgpio Utility

The tamsgpio program allows one to configure and issue reads/writes to the GPIO bus via the 9x622 Windows only card. The manual for this program can be found by clicking through the Start menu at: Programs -> TAMS GPIO -> Documentation -> Tamsgpio manual.

Driver And Software Installation

Driver installation assumes basic knowledge about software installation procedures specific to the platform. Refer to your platform specific operating system documentation or contact your system administrator.

To install the driver and associated software, it is not necessary for the TAMS 9x622 interface card(s) to be present in the system. Configuration, however, requires the card(s) and driver to both be present along with the following referenced packages.

Windows

Important! The Agilent I/O Libraries Suite 16.3 or later must be installed prior to proceeding with the driver installation for the TAMS 9x622. Revisions of I/O Libraries subsequent to 16.3 should also be acceptable. The TAMS 9x622 installer will detect if SICL is not installed and abort the installation. If the Agilent IO libraries are reinstalled it will be necessary to reinstall the 9x622 driver.

Note: The 2.1 driver is only supported on Windows 7 with SP1 or later. To use the 9x622 GPIO on Windows XP, install the 1.4 driver which can be found in the ‘Version 1.4 Installer’ folder of the TAMS 9x622 GPIO Installation CD.

The TAMS 9x622 card and software is NOT a Plug-N-Play device. If the 9x622 card is installed and your computer is rebooted prior to installing the t62622 driver, the *Found New Hardware Wizard* will detect the newly installed 9x622 card. At this point it is best to CANCEL this Wizard (if and only if you have not yet installed the TAMS t62622 driver). Rather use the following method to install the t62622 driver.

1. Check to make sure that the prerequisites as noted above are installed by looking in the *Add or Remove Programs* window under the *Control Panel*. If they are not listed in the *Add or Remove Programs* windows install these packages. Alternatively, do step 2 and if the prerequisites are not installed step 2 will automatically abort.
2. Insert the TAMS 9x622 CD that was shipped with your card in the CD drive. The installer should automatically start, if not, execute the program setup.exe found on this CD.
3. Follow the installation instructions as shown on the screen.

Linux

Note: You must have root permission to install the software. Installation of the TAMS GPIO driver (T82622) also requires that the TAMS I/O Libraries (T82091) are already installed.

1. Insert the installation media into the drive and wait for the busy light to remain off.
2. If your system does not automount the CD-ROM, mount the CD-ROM. To do this you will need to know the device file for your CD-ROM drive and the directory where you wish to mount it. These can vary depending upon your hardware and Linux distribution.

On **Red Hat Enterprise Linux Workstation 3**, this is usually accomplished with

```
/bin/mount /dev/cdrom /mnt/cdrom
```

On later versions of **Red Hat Enterprise Linux Workstation**, this is usually accomplished with

```
/bin/mount /dev/cdrom /media/cdrecorder
```

3. Install the software. There are two ways in which you may do this.

If you wish to install the current version of the TAMS I/O Libraries and all related drivers, including the one for the 9x622, simply run the INSTALL program from the CD-ROM.

```
/media/cdrecorder/INSTALL
```

The exact location will vary depending on where you mounted the CD-ROM in Step 2.

If you already have the TAMS I/O Libraries installed, you may install this driver manually.

```
cd /media/cdrecorder/RHEL4u3.i686
rpm -Uvh T82622-2.0-RHEL4u3.i686.rpm
```

The directory and filename will vary depending on the operating system distribution, processor architecture, and driver revision. Some directories have a 'whichrpm.sh' script in them, which should be used to determine the RPM architecture. In these cases, installation will look more like this. (Note the use of backquotes rather than single quotes.)

```
cd /media/cdrecorder/RH9RHEL3.i686
rpm -Uvh T82622-2.0-RH9RHEL3.`./whichrpm.sh`.rpm
```

4. The T82622 RPM will automatically load the t82622 kernel module and create the necessary device files. Each time you start up your computer after this, the t82622 kernel module will be loaded and related device files will be created.
5. Once the installation is complete, unmount the CD.

```
cd /
/bin/umount /dev/cdrom
```

6. Once the CD is unmounted, remove the media from the drive and store it in a safe place.

In general, the installation procedure places the files in the necessary directories by default. Appendix F is a reference for the Linux systems administrator, who might wish to know where these files are placed.

You will still need to configure the new TAMS GPIO card as a SICL interface card, as covered in the next section.

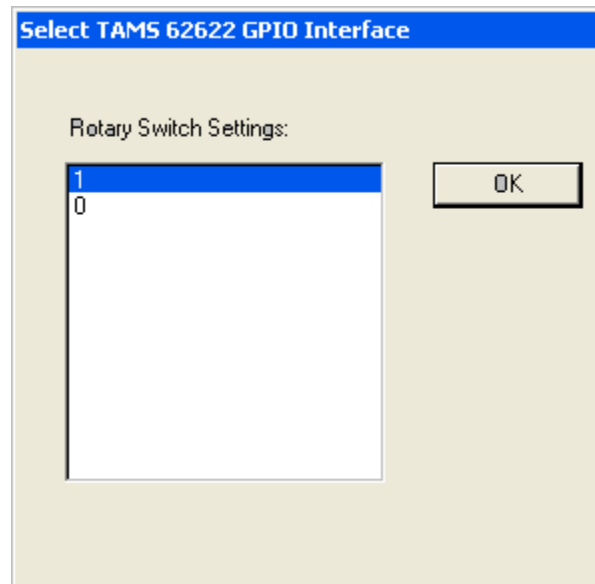
Configuring the Card

32/64-bit Windows 7 & XP

1. Make sure that the TAMS 9x622 card(s) and the t62622 driver are installed and the computer has rebooted. This will cause a default configuration to be setup.
2. Configure the interface by executing the tamsgpio.exe program which may be found by the shortcut under the Start menu: Programs -> TAMS GPIO -> TAMS GPIO Utility.

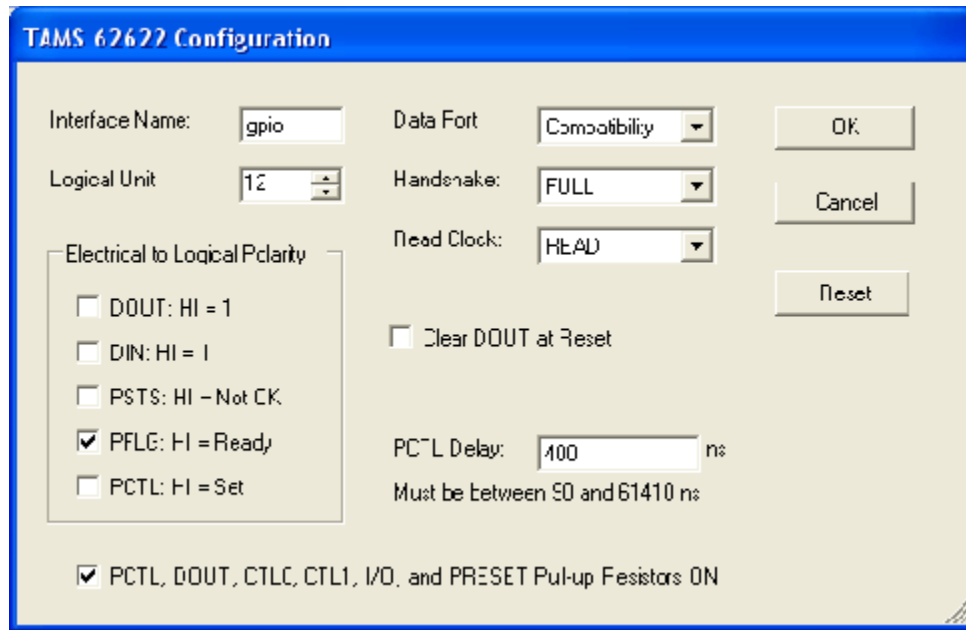
Upon execution, the tamsgpio program will present one of two windows depending on if one or multiple 9x622 cards are installed in your system.

The following window occurs if two or more 9x622 cards are installed on your PC. It allows one to select an interface, based on the settings of the rotary switches on the cards, which tamsgpio will communicate with.



After clicking OK, or if only one 9x622 interface is configured, tamsgpio will bring up the main screen. To change the configuration of your 9x622 card click on the menu item:
Configure -> Interface.

The following screen will be displayed.



Modify any parameters you want to change and then click on OK.

Alternate Windows Configuration Method

An alternative way to configure the TAMS 9x622 card is using the Agilent program iocfg32.exe. Under normal circumstances this method would not be used. However, if for some reason the t62622 driver, upon installation, does NOT setup a default configuration then this method can be used.

1. Configure the interface by executing the iocfg32.exe, which will be located in the C:\Program Files\Agilent\IO Libraries Suite\bin folder.
2. In the “Available Interface Types” list box select “TAMS 9x622 GPIO” and click the configure button.
3. If more than one 9x622 card is present on the system, select the card to configure. (If more than one card is present a select interfaces window will appear. if you have only one card continue to step 5.)
4. Click on OK.
5. Now a window will appear that shows all the 9x622 configuration parameters. Modify or accept default configuration parameters. For context sensitive help click on the Help button or press the F1 key.
6. When you are finished setting the configurable parameters, dismiss the dialog box by clicking the OK button.

Linux

After installation of the driver software and loading of the t82622 kernel module (handled automatically by the RPM package), the SICL configuration file `/etc/opt/sicl/hwconfig.cf` needs to be edited to reflect the new interface card. The version of SICL you are using includes the `/opt/sicl/bin/iosetup` program, this can be used in place of manually editing the `hwconfig.cf` file. You will still want to refer to this section for a description of the fields.)

After configuration, the system does NOT need to be rebooted, nor does the driver module need to be reloaded. However, the SICL `iclear` function should be used after making changes to ensure that the configuration changes have taken effect. See the man page on `iclear` (1).

For further configuration information, see the “Installing and Configuring the I/O Libraries” chapter of the *I/O Libraries Installation and Configuration Guide for Linux*.

For each TAMS 9x622 card that you want to configure in your system, you need to add a line to the `hwconfig.cf` file. While most users do not need to see or use this file directly, having used `iosetup` to make configuration changes, the fields and their respective meanings are important to know to properly use the GPIO card.

The content of each line is as follows:

```
<lu> <name> t82622 <location> <res> <polarity> <mode> <read_clk> <delay>
```

The fields are defined as:

Logical Unit (lu) The SICL Logical Unit number for this interface. This number must be unique for the SICL interfaces currently configured on this machine. A good choice for a logical unit number would be 12.

Symbolic Name (name) The unique SICL symbolic name. A good choice would be “`gpio`”.

Location The unique ID specified by the rotary DIP switch on the TAMS 9x622 being configured. This value is in the range 0-9

Reserved (res) Unused on the px622. Must always be “0”.

Polarity The logic polarity of various interface lines. Each bit controls the polarity of one function:

```
0b<Pullup><Data Out><Data In><PSTS><PFLG><PCTL>.
```

PCTL:

0 = "Low = Set"

1 = "High = Set"

PFLG:

0 = "Low = Ready"

1 = "High = Ready"

PSTS:

0 = "Low = Not Ok"

1 = "High = Not Ok"

Data In/Data Out:

0 = "Low = 1"

1 = "High = 1"

Pullup:

0=do NOT enable pullup resistors

1=DO enable them

Mode A 2-digit hexadecimal number that configures handshake and data port mode. The most significant digit configures the data port.

HP 98622 compatibility mode:

0 = No DOUT clear at reset

1 = Clear DOUT at reset

Enhanced (bi-directional DINs) data port:

2 = No DOUT clear at reset

3 = Clear DOUT at reset

The least significant digit selects the PFLG/PCTL handshake mode.

0 = Full handshake

1 = Pulse handshake

2 = Async-Write/Pulse-Read handshake

For example, 0x10 specifies compatibility mode with DOUT cleared on reset and full handshaking.

Read Clock (read_clk) Determines when data input registers are latched. The first hex digit is for the upper (most significant) byte. Second hex digit is for the lower byte. Valid values for each digit are:

0 = when register is read (approx 500 ns after the handshake is initiated)

1 = when PFLG transitions to 'busy'

2 = when PFLG transitions to 'ready'

Delay The delay (settling time) from data output to PCTL set:

0 = 200 nanoseconds

1 = 400 nanoseconds

2 = 700 nanoseconds

3 = 1.2 microseconds

4 = 2 microseconds

5 = 5 microseconds

6 = 10 microseconds

7 = 50 microseconds

The t82622 driver provides an alternative delay configuration method. The delay may be expressed in nanoseconds or in microseconds in hwconfig.cf. If the delay is expressed in nanoseconds the decimal value representing that delay should be suffixed with "ns". If the delay is expressed in microseconds the decimal value representing delay should be suffixed with "us".

A decimal point is allowed. The minimum delay is 30ns and maximum delay is 61.41us.
Examples: 150ns, 2500ns (same as 2.5us), 1.15us, 50us.

Configuration changes take effect when the first process does the first `iopen()` on the GPIO card. To ensure this happens, make sure no processes are running that use the I/O libraries when the configuration of the card is changed.

It is not necessary to reboot or to reload the driver kernel module for changes to take effect.

It is safest to perform an `iclear` on the interface after modifying its configuration to guarantee that it is in a known state.

Technical Information

The appendixes provide a detailed, functional description of the TAMS 9x622 GPIO interface. You will need to understand this information in order to set the appropriate configuration values for the TAMS 9x622. This information should also be helpful when you are preparing and installing the GPIO cable.

After you have read the appendixes and decided how you want to configure the TAMS 9x622, refer to your software documentation to configure your I/O application software for the TAMS 9x622. (See the “Related Software Documentation” section of this guide.)

The appendixes contains the following information:

- Connector Pinouts
- Data Lines
- Peripheral Information Lines:
 - ◆ Peripheral Control and Peripheral Flag Handshake Lines (PCTL and PFLG)
 - ◆ Input/Output Direction Control Line (I/O)
 - ◆ Peripheral Status Line (PSTS)
 - ◆ Peripheral Reset Line (P_RESET)
 - ◆ External Interrupt Request Line (EIR)
 - ◆ Control Output Lines (CTL0 and CTL1)
 - ◆ Status Input Lines (STI0 and STI1)
- Direct Memory Access (DMA)

Simple IO via the `tamsgpio` Utility (Windows Only)

This program has been mentioned previously since it allows one to configure the TAMS 9x622 card. However, it also has the capability to perform reads and writes to the TAMS 9x622 card and any GPIO bus connected thereto.

The tamsgpio program can be run by clicking under the Start menu at: Programs -> TAMS GPIO -> TAMS GPIO Utility

Since a GPIO system often has a custom configuration of the software and hardware connected to the bus, this program is very handy to test out a given configuration. As described previously, the 9x622 card and driver can be configured via this utility and then simple reads and writes to your GPIO bus/device can be done from this utility. If the GPIO system installation and configuration is correct then the reads and writes will complete normally. Typically, GPIO must have devices (one is the 9x622) on both ends of the bus (i.e. cable) for a read or write to complete on the bus. However, the ASYNC handshake mode can be used if no device is connected to the GPIO bus besides the 9x622.

For more details about tamsgpio launch the manual by clicking under the Start menu at: Programs -> TAMS GPIO -> Documentation -> Tamsgpio Manual.

Appendix A: General Specifications

PCI/PCI-Express implementation: revision 2.3, 32 bit, 33 Mhz

Card voltage and current requirements (PCI/PCI-Express)

- +5 volts, $\pm 5\%$, at 450 ma max (plus current sourced from pin 50)
(changing pullup resistors may increase max current draw on +5)
- +3.3 volts, $\pm 10\%$, at 1 ma max

PCI/PCI-Express signaling voltage:

- 3.3 or 5 volts, universal keying

Dimensions:

- 4.75 by 4.00 inches, exclusive of PCI/PCI-Express bracket

Weight:

- 4.0 oz.

Operating environment:

- 0 to 40 degrees C
- 10 to 90% RH, non-condensing

Storage environment:

- 20 to 70 degrees C
- 5 to 95% RH

Maximum Current Sourced by Card:

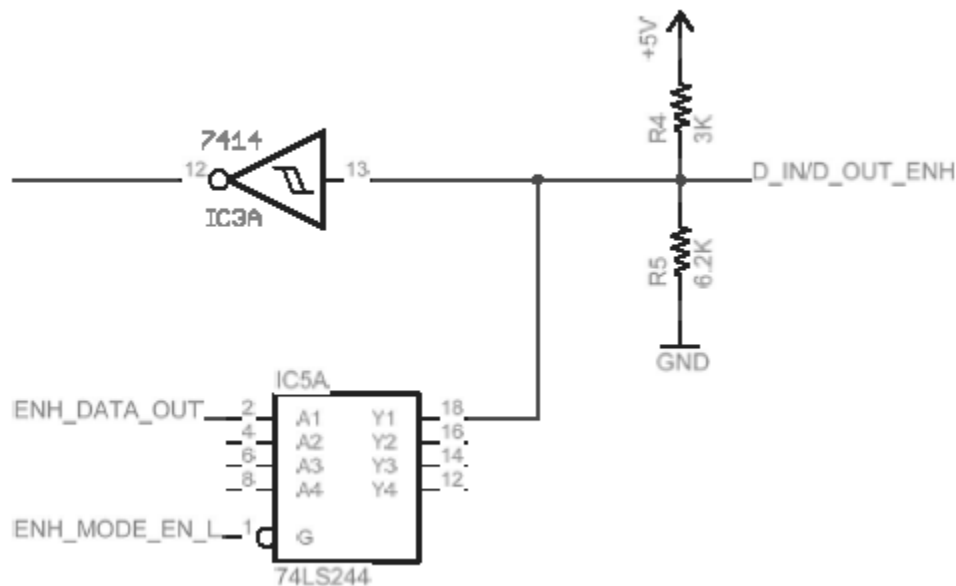
- .75 amps from pin 50 of I/O connector.

Appendix B: Input Circuitry

There are two types of inputs to the card, the DIN lines, and the control lines. The DIN lines are input-only in compatibility mode, and bi-directional in enhanced mode. The input control lines are always input-only. The diagram below shows typical circuitry for the DIN lines, the control lines are similar but do not include the 74LS244 type of driver.

As inputs, the lines are biased at approximately 3.3 volts to provide a high level. Schmitt trigger logic is used to help reduce problems from slow transitions, or noisy environments. When these lines are driven as outputs (only during enhanced mode), they can source 15 ma and sink 24 ma. Since these are implemented with TTL logic, the input voltage range is 0-5 volts.

If these inputs are receiving signals from a long cable, note that the high impedance of the circuitry provides no significant termination of the lines. It may be necessary to provide termination between the cable and the s2622 card in order to achieve good signal integrity. See the GPIO support section of the TAMS website for additional information on using long cables.



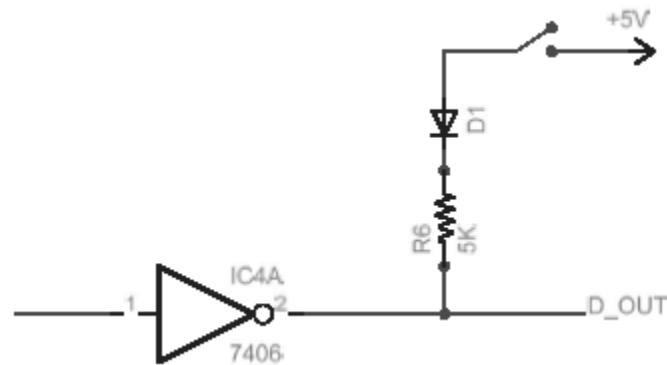
Typical input line/enhanced line circuitry (DIN_x).
Input control lines similar, but without the 74LS244.
(PFLG, PSTS, ST_0, ST_1, EIR)

Appendix C: Output Circuitry

A typical output line from the card is shown below. The driver is open-collector TTL, with 40 ma pulldown capability and 30 volt max voltage rating. As a convenience, there are 5K pullup resistors to +5 volts provided. These can be switched on and off under software control. They are also socketed, to allow easy reconfiguration if the external circuitry requires. If they are re-inserted, be careful to observe the polarity markings.

The blocking diodes are rated at greater than 30 volts, so the on-board resistors can safely be left installed if the outputs are pulled up to greater than 5 volts by external circuitry. Care must be taken to insure that the voltage on the outputs does not exceed 30 volts due to transmission line effects from a cable, or inductive kickback from switched loads.

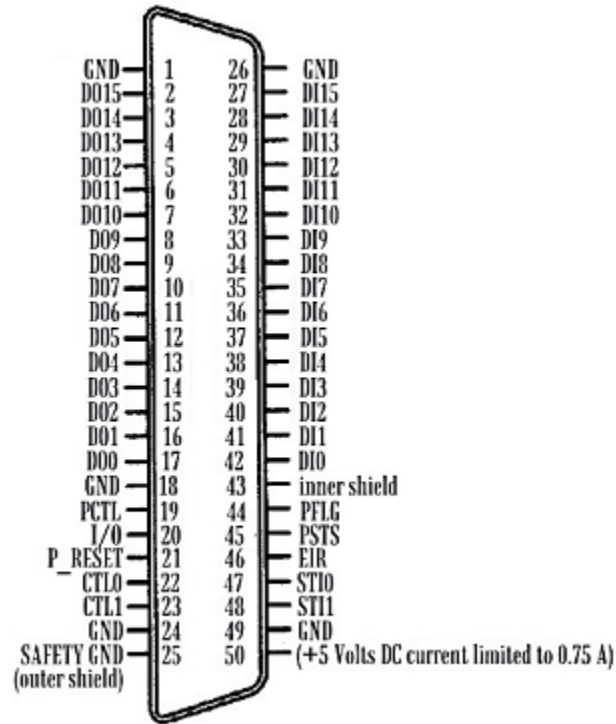
The pullup resistors are 12 pin SIP style, installed in J1-J4. If driving long cables, signal quality constraints may require lower value resistors to provide adequate current sourcing. Never use less than 120 ohms, due to current constraints of the drivers. One suitable source for 120 ohm resistor packs is Bourns, PN 4612X-102-121LF, four per card. These are ‘isolated’ resistors, not ‘bussed’ or ‘common’. See the GPIO Support section of the TAMS website for more information on using long cables.



Example circuitry for output lines.
(DOUT_x, PCTL, CTL_0, CTL_1, I/O, P_RESET)

Appendix D: Connector Pinouts

The following figure shows you the Pinouts on the TAMS 9x622 GPIO interface connector.



TAMS 9x622 GPIO Connector Pinouts

Appendix E: Wiring

Data Lines

There are 32 data lines on the TAMS 9x622: 16 designated as data input, and 16 designated as data output. Color codes are provided for TAMS 622-001 GPIO cable and HP 5061-4209 GPIO cable.

Label	Line(s)
DI0 through DI15	Data Input
DO0 through DO15	Data Output
PCTL and PFLG	Peripheral Control and Peripheral Flag handshake
IO	Input/Output direction control
PSTS	Peripheral Status
P_RESET	Peripheral Reset
EIR	External Interrupt Request
CTL0 and CTL1	Control Output
STI0 and STI1	Status Input
PIN 50	+5 Volts DC current limited to 0.75 A

Data Input Lines

The 16 data input lines are labeled DI0 through DI15. The following table lists the connector pin numbers and cable wire color codes for the data input lines.

Label	Pin No.	622-001	5061-4209
DI0	42	White on Grey	Black
DI1	41	Brown on Blue	Brown
DI2	40	White on Violet	Red
DI3	39	White on Blue	Orange
DI4	38	White on Green	Yellow
DI5	37	White on Yellow	Green
DI6	36	White on Orange	Blue
DI7	35	White on Pink	Violet
DI8	34	Brown on Green	White/Brown/Red
DI9	33	Brown on Yellow	White/Brown/Orange
DI10	32	Brown on Orange	White/Brown/Yellow
DI11	31	Brown on Pink	White/Brown/Green
DI12	30	Tan on Grey	White/Red/Orange
DI13	29	Tan on Violet	White/Red/Yellow
DI14	28	Tan on Blue	White/Red/Green
DI15	27	Tan on Green	White/Red/Blue

Data Input Lines

Data Output Lines

The 16 data output lines are labeled DO0 through DO15. The following table lists the connector pin numbers and wire color codes for the data output lines.

Label	Pin No.	622-001	5061-4209
DO0	17	Grey on White	White/Black
DO1	16	Blue on Brown	White/Brown
DO2	15	Violet on White	White/Red
DO3	14	Blue on White	White/Orange
DO4	13	Green on White	White/Yellow
DO5	12	Yellow on White	White/Green
DO6	11	Orange on White	White/Blue
DO7	10	Pink on White	White/Violet
DO8	9	Green on Brown	White/Orange/Yellow
DO9	8	Yellow on Brown	White/Orange/Green
DO10	7	Orange on Brown	White/Orange/Blue
DO11	6	Pink on Brown	White/Orange/Violet
DO12	5	Grey on Tan	White/Yellow/Green
DO13	4	Violet on Tan	White/Yellow/Blue
DO14	3	Blue on Tan	White/Yellow/Violet
DO15	2	Green on Tan	White/Yellow/Gray

Data Output Lines

Peripheral Information Lines

The following table lists the connector pin numbers and wire color codes for the peripheral information lines.

Label	Pin No.	622-001	5061-4209
GRD	1	Yellow on Tan	
GRD	18	Violet on Brown	
PCTL	19	Tan on White	White/Grey
IO	20	Grey on Brown	White/Black/Brown
P_RESET	21	Orange on Pink	White/Black/Red
CTL0	22	Brown on Tan	White/Red/Violet
CTL1	23	Pink on Tan	White/Red/Grey
GRD	24	Brown on White	
Safety GRD	25	Orange on Tan	
GRD	26	Tan on Yellow	
Safety GRD	42	Brown on Violet	
PFLG	44	White on Tan	Grey
PSTS	45	Brown on Grey	White/Black/Grey
EIR	46	Pink on Orange	White/Brown/Grey
STI0	47	Tan on Brown	White/Brown/Blue
STI1	48	Tan on Pink	White/Brown/Violet
GRD	49	White on Brown	
+5 (fused)	50	Tan on Orange	

Peripheral Information Lines

Appendix F: Linux File Locations

The installation procedure for Red Hat Linux places files in the following directories :

File	Location	Description
t82622.so	/opt/sicl/lib	SICL shared Tulip library
t82622.o t82622.ko	/lib/modules/<kernel versions>kernel/drivers/char	Kernel driver module
t82622	/etc/init.d	Stop/start script for (un)loading the kernel module and (un)creating the device files
s95t82622 k05t82622	/etc/rc[345].d	Link to /etc/init.d/t82622
t82622.n	/dev	Special file for card with ID n

Appendix G: Differences between the TAMS 9x622 & HP2074

TAMS 9x622 PCTL delay.

The TAMS 9x622 is much more flexible than earlier GPIO interfaces. With the HP 2074/5 interface a user has a choice of one of eight delay time values. The gaps between those values are significant and prevent performance optimization. The TAMS 9x622 accepts values directly in nanoseconds. The range extends from 30 nanoseconds to 61410 nanoseconds (61.41 microseconds) allowing optimal transfer performance according to the length of cable used. In addition, the time specified is applied with accuracy at any mode of transfer, while other available GPIO interfaces add as much as 500 ns when different modes are used. This caused users to configure more PCTL time than actually required in order to compensate for worst possible transfer mode cases.

The TAMS 9x622 PCTL delay is configurable by running the tamsgpio.exe utility (Windows), or it may be changed at any time from within an application by a call to `igpioctrl(id, I_GPIO_PCTL_DELAY, <val>)` where `<val>` could be one of eight HP 2074/5 compatible values, or directly a value in nanoseconds between 30 and 61410 inclusive.

The eight (0-7) of HP 2074/5 compatible values are interpreted as follows:

0 - 200ns, 1 - 400ns, 2 - 700ns, 3 - 1.2us, 4 - 2us, 5 - 5us, 6 - 10us, 7 - 50us.

The PCTL delay is the delay between data being driven out on the DOUT lines, and PCTL being asserted to the 'set' state to begin the handshake.

Booting after configuring is not required

When the TAMS 9x622 PCI/PCI-Express GPIO card is configured via the tamsgpio.exe interface configuration it does not require rebooting to take effect.; it immediately takes effect for the tamsgpio utility.

Normally, changes take effect when a session on a newly configured interface is started for the first time within a process.

Care should be taken when a running application uses the TAMS 9x622 interface while it is being configured.

If, for example, a polarity is changed on an interface while an application uses it, it may take effect in the middle of a transfer causing undesired effects. However, no fatal effects like system crash or device hang could be caused.

Note: On Windows, rebooting is required only once after t62622 driver installation.

Appendix H: TAMS GPIO SICL Extensions

All of the TAMS GPIO SICL extension functions are implemented by using the header file `tamsgpio.h` and the standard SICL functions `igpioctrl` and `igpiostat`.

These two functions are described below:

IGPIOCTRL

Supported sessions: **interface**

Affected by functions: **ilock, itimeout**

C Syntax

```
#include <sicl.h>
#include <tamsgpio.h>
```

```
int igpioctrl (id, request, setting);
```

```
INST id;
int request;
unsigned long setting;
```

Visual Basic Syntax

```
Function igpioctrl
(ByVal id As Integer, ByVal request As Integer,
ByVal setting As Long)
```

IGPIOSTAT

Supported sessions:.....**interface**

C Syntax

```
#include <sicl.h>
#include <tamsgpio.h>
```

```
int igpiostat (id, request, &result);
```

```
INST id;
int request;
unsigned long result;
```

Visual Basic Syntax

```
Function igpiostat
(ByVal id As Integer, ByVal request As Integer, ByVal result as
Long)
```

The following are all the TAMS GPIO SICL extensions and some examples of how to use them.

TAMS 9x622 PCTL delay

The TAMS 9x622 PCTL delay function provides an extended PCTL delay control that was not available before the x1622. Besides the standard 0-7 values for delay used with HP cards, the delay of the TAMS 9x622 may be set directly in nanoseconds.

Examples:

Setting the PCTL delay to 50000ns

```
igpioctrl(id, I_GPIO_PCTL_DELAY, 7)
or
igpioctrl(id, T_GPIO_DLY_TM, 50000)
```

Reading the PCTL delay in nanoseconds

```
igpiostat(id, T_GPIO_DLY_TM, &dtm)
```

Legal values are 30 to 61410 ns. The value configured in 'iocfg32.exe' is used, unless overwritten by an igpioctrl call.

TAMS 9x622 Filtering

This feature controls the filtering time for DIN[0..15], PCTL, STI0, STI1 and EIR lines for glitch rejection. Filtering is always enabled.

T_GPIO_FLT_TM sets the time in nanoseconds. No individual lines can be controlled. Since the PCTL handshake line is filtered to the same extent as the data lines, the setup time during a read does not change when filtering is increased.

Examples:

Using **T_GPIO_FLT_TM**

Set filtering to 1 microsecond

```
igpioctrl(id, T_GPIO_FLT_TM, 1000)
```

Read the time set for filtering in nanoseconds

```
igpiostat(id, T_GPIO_FLT_TM, &ftm)
```

Legal values are 0 to 1860 ns, where 0 ns provides no filtering. This is the default.

TAMS 9x622 Polarity

This function allows the setting of detailed polarity for DIN, STI0, STI1, and EIR. The polarity of nineteen lines (DIN[0..15], STI[0..1] and EIR) can be controlled independently. It enables interrupt control of either rising or falling edge of a line level transition.

For DIN lines interpretation and implementation of the polarity is identical to the standard GPIO DIN polarity as described in the SICL manuals.

For the STI and EIR lines, standard GPIO does not provide polarity configuration. This is a TAMS 9x622 extension to the GPIO.

To maintain maximum compatibility with the standard GPIO, the following rules apply:

- ◆ For STI and EIR lines, if polarity is set to 0, their behavior is fully compatible with standard GPIO cards. If set to 1, polarity is reversed for these lines.
- ◆ For DIN lines, 9x622 extensions allow users to set polarity for each line independently. Setting the DIN polarity with standard GPIO SICL `igpioctrl(id, I_GPIO_POLARITY, setting)` is still supported and will cause setting or clearing of all the DIN polarity lines with a single call. This is because the standard allows only for all the DIN polarity to be set at a time. This guarantees backwards compatibility.

Examples:

Setting polarity for only DIN6 and EIR lines

```
igpioctrl(id, T_GPIO_POL, T_GPIO_DIN06 | T_GPIO_EIR)
```

Reading back the polarity setting

```
igpiostat(id, T_GPIO_POL, &pol);
```

TAMS 9x622 Latching

This function allows latching the levels of the lines to be enabled in the three different groups (**DIN[0..15], STI0, STI1, and EIR lines**). The time at which the latching occurs depends upon the polarity of the line being latched. The latched lines can be cleared using the `T_GPIO_LAT_CL` request.

- ◆ polarity set to 0, the latch will occur on a LO to HI (logically) transition.
- ◆ polarity set to 1, the latch will occur on a HI to LO (logically) transition.

This function has three different request codes:

- ◆ **T_GPIO_LAT_EN** controls which group of lines are enabled for latching, DIN[0..15], STI0, STI1, and/or EIR.
- ◆ **T_GPIO_LAT_RD** lets you read the latched lines.
- ◆ **T_GPIO_LAT_CL** clears the latched lines.

Windows Examples:

Read latched lines

```
igpiostat(id, T_GPIO_LAT_RD, &lat)
```

Clear latched lines

```
igpioctrl(id, T_GPIO_LAT_CL, lat)
```

Linux Examples:

Enable T82622_DIN06 and T82622_EIR

```
igpioctrl(id, T_GPIO_LAT_EN, T_GPIO_DIN06 | T_GPIO_EIR)
```

Read what lines are enabled for latching

```
igpiostat(id, T_GPIO_LAT_EN, &len)
```

Read back what lines are latched

```
igpiostat(id, T_GPIO_LAT_RD, &lat)
```

Clear latched lines

```
igpioctrl(id, T_GPIO_LAT_CL, lat)
```

TAMS 9x622 line interrupt

This function controls which lines can cause an interrupt. **Interrupts on level transitions on DIN[0..15], STI[0..1] and EIR lines** can be controlled individually. When the interrupt occurs depends upon the polarity:

- If the polarity is set to 0, the interrupt occurs on logical LO to HI transitions
- If the polarity is set to 1, the interrupt occurs on logical HI to LO transitions.

If one or more interrupts occur, the interrupt handler is called with the “reason” parameter equal to I_INTR_GPIO_T82622 and the “sec” parameter is the mask of the lines that caused the interrupt.

The mask is always a subset of the following:

T_GPIO_DIN | T_GPIO_STI | T_GPIO_EIR | T_GPIO_RDY

Examples:

Enabling DIN4 line to interrupt

```
igpioctrl(id, T_GPIO_INT_EN, T_GPIO_DIN04)
```

Checking what lines can interrupt

```
igpiostat(id, T_GPIO_INT_EN, &int)
```

TAMS 9x622 Pull-up

T_GPIO_PUL controls if DOUT[0..15], CTL[0..1], PCTL, I/O, and PRESET lines are pulled up with 5K resistors to +5V. There is no control for individual lines. All lines are controlled at the same time. The SIP packs can be removed or changed by users.

Examples:

Turn all pull-ups ON

```
igpioctrl(id, T_GPIO_PUL, 1)
```

Check if pull-ups are on

```
igpiostat(id, T_GPIO_PUL, &pull)
```

Turn pull-ups OFF

```
igpioctrl(id, T_GPIO_PUL, 0)
```

TAMS 9x622 Board ID

The 9x622 is equipped with a rotary switch. The user sets this switch. The purpose is identification of each GPIO board on a system with multiple GPIO cards. This feature is especially useful if multiple boards are residing on a PCI/PCI-Express bridge since some PCI/PCI-Express bridges do not provide a reliable way for PCI/PCI-Express slot identification.

This switch has no effect on the GPIO functionality itself.

The user would set the switch position to a unique value for each card on the system and then can read its value by using the request **T_GPIO_CID** to check which physical card has an opened session.

Examples:

Get the switch value

```
igpiostat(id, T_GPIO_CID, &swID)
```

TAMS 9x622 DOUT read

The **T_GPIO_DOUT** reads the value of the DOUT lines. The value read is not affected by the DOUT polarity.

Example:

Get the DOUT value

```
igpiostat(id, T_GPIO_DOUT, &dout)
```

TAMS 9x622 Macros

The following is a table with all of the defines passed to the TAMS 62622 SICL extension functions that you can use. Individual bits could be passed to select specific line(s).

TAMS 9x622 SICL extension function defines

T_GPIO_DIN	0x0000FFFF	DIN[0..15] 16 bits
T_GPIO_DIN_L	0x000000FF	DIN[0..7] 8 bits
T_GPIO_DIN_U	0x0000FF00	DIN[8..15] 8 bits
T_GPIO_STI	0x00030000	STI[0..1] 2 bits
T_GPIO_EIR	0x00040000	EIR 1 bit
T_GPIO_RDY	0x00080000	RDY 1 bit
T_GPIO_MORE	0x00100000	used inside driver only
T_GPIO_ALL	0x000FFFFF	all of above 20 bits

Individual bits for DIN and STI

T_GPIO_DIN00	0x00000001
T_GPIO_DIN01	0x00000002
T_GPIO_DIN02	0x00000004
T_GPIO_DIN03	0x00000008
T_GPIO_DIN04	0x00000010
T_GPIO_DIN05	0x00000020
T_GPIO_DIN06	0x00000040
T_GPIO_DIN07	0x00000080
T_GPIO_DIN08	0x00000100
T_GPIO_DIN09	0x00000200
T_GPIO_DIN10	0x00000400
T_GPIO_DIN11	0x00000800
T_GPIO_DIN12	0x00001000
T_GPIO_DIN13	0x00002000
T_GPIO_DIN14	0x00004000
T_GPIO_DIN15	0x00008000
T_GPIO_STI0	0x00010000
T_GPIO_STI1	0x00020000

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In the event of malfunction or failure attributable directly to faulty material and/or workmanship, TAMS will at its option, repair or replace the defective product or components, to whatever extent it shall deem necessary to restore the product or component, to proper operating condition. TAMS may at its option repair or replace, a defective unit with a new or refurbished unit.

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TAMS 9x622 PCI/PCI-Express GPIO Interface

Printed in USA E02.25.2013

Part # 9x622-90001