The Embedded I/O Company

TDRV002-SW-42

VxWorks Device Driver

Multiple Channel Serial Interface

Version 2.7.x

User Manual

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TDRV002-SW-42

VxWorks Device Driver

Multiple Channel Serial Interface

Supported Modules:
- TPMC371
- TPMC372
- TPMC375
- TPMC376
- TPMC377
- TPMC460
- TPMC461
- TPMC462
- TPMC463
- TPMC465
- TPMC466
- TPMC467
- TPMC470
- TCP460
- TCP461
- TCP462
- TCP463
- TCP465
- TCP466
- TCP467
- TCP469
- TCP470
- TXMC375

Issue	Description	Date
1.0	First Issue (TPMC461-SW-42)	July 14, 2004
1.1.0	Driver Name changed to TDRV002	January 18, 2005
1.2.0	Local Loopback Mode and Selftest added	February 28, 2005
1.2.1	File list changed	April 1, 2005
1.3.0	Support for programmable interfaces / modules added, tdrv002DevCreate() parameters changed, new ioctl() function FIOSETINTERFACE	September 28, 2005
1.4.0	TPMC467/TCP467 Support added, correction in description of tdrv002DevCreate() Distribution file list changed Missing description of error codes added Introduction / Installation updated	July 20, 2006
1.4.1	New Address TEWS LLC	October 9, 2006
1.4.2	Address TEWS LLC removed	November 18, 2009
2.0.0	VxBus Driver Support added	January 19, 2010
2.0.1	Configuration Hint added, additional information for self test execution	February 18, 2010
2.0.2	Legacy vs. VxBus Driver modified	March 25, 2010
2.1.0	New debug function tdrv002Show for VxBus support	April 26, 2010
2.2.0	Description and schematic for local loopback added, Support of TPMC377, TPMC470, TCP469, TCP470 added	November 5, 2010
2.2.1	tdrv002Show function modified	February 3. 2011
2.3.0	Function parameters modified for 64-bit compatibility	January 10, 2012
2.4.0	Functions for handshake and modem line support added	February 17, 2012
2.5.0	Function channel identification added, Description of WorkQueue issue	March 8, 2012
2.6.0	New ioctl() function FIOWAITMODEMSTATE, Description of Legacy Driver Include modified	April 17, 2012
2.7.0	Support of TXMC375 added, New ioctl() function FIOSETFIFOTRIGGER	February 26, 2013

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1 Introduction

The TDRV002-SW-42 VxWorks device driver software allows the operation of the supported modules conforming to the VxWorks I/O system specification. This includes a device-independent basic I/O interface with *open*(), *close(), read(), write(),* and *ioctl()* functions and a buffered I/O interface (*fopen()*, *fclose()*, *fprintf()*, *fscanf()*, ...).

Special I/O operation that do not fit to the standard I/O calls will be performed by calling the ioctl() function with a specific function code and an optional function dependent argument.

The TDRV002-SW-42 release contains independent driver sources for the old legacy (pre-VxBus) and the new VxBus-enabled driver model. The VxBus-enabled driver is recommended for new developments with later VxWorks 6.x release and mandatory for VxWorks 64-bit and SMP systems.

The TDRV002 driver includes the following functions supported by the *VxWorks tty driver support library for pre-VxBus systems or the sio driver library for VxBus compatible systems.*

- ring buffering of input and output
- raw mode
- optional line mode with backspace and line-delete functions
- optional processing of X-on/X-off
- optional RETURN/LINEFEED conversion
- optional echoing of input characters
- optional stripping of the parity bit from 8 bit input
- optional special characters for shell abort and system restart

Additionally the following functions are supported (if the channel supports this function):

- select FIFO triggering point
- use 5...8 bit data words
- use 1, 1.5 or 2 stop bits
- optional even or odd parity
- enable/disable hardware handshake (only in FIFO mode)
- control full modem lines
- check and wait for control and modem line states
- changing Baud Rates
- enabling/disabling local loopback mode
- local self-test
- changing I/O interface (only programmable interfaces)

The TDRV002-SW-42 supports the modules listed below:

TPMC371	8 Channel Serial Interface
TPMC372	4 Channel Serial Interface
TPMC375	8 Channel Serial Interface (programmable Interfaces)
TPMC376	4 Channel Serial Interface (programmable Interfaces)
TPMC377	4 Channel Isolated Serial Interface (programmable Interfaces)
TPMC460	16 Channel Serial Interface
continued …	

TPMC461	8 Channel Serial Interface
TPMC462	4 Channel Serial Interface
TPMC463	4 Channel Serial Interface
TPMC465	8 Channel Serial Interface (programmable Interfaces)
TPMC466	4 Channel Serial Interface (programmable Interfaces)
TPMC467	4 Channel Serial Interface (programmable Interfaces)
TPMC470	4 Channel Isolated Serial Interface (programmable Interfaces)
TCP460	16 Channel Serial Interface
TCP461	8 Channel Serial Interface
TCP462	4 Channel Serial Interface
TCP463	4 Channel Serial Interface
TCP465	8 Channel Serial Interface (programmable Interfaces)
TCP466	4 Channel Serial Interface (programmable Interfaces)
TCP467	4 Channel Serial Interface (programmable Interfaces)
TCP469	8 Channel Isolated Serial Interface (programmable Interfaces)
TCP470	4 Channel Isolated Serial Interface (programmable Interfaces)
TXMC375	8 Channel Serial Interface (programmable Interfaces)

In this document all supported modules and devices will be called TDRV002. Specials for a certain devices will be advised.

To get more information about the features and use of supported devices it is recommended to read the manuals listed below.

User manual of the used module
Engineering Manual of the used module
Programmer’s Guide: I/O System – Serial I/O devices
Kernel Programmer’s Guide: I/O System – Serial I/O devices

2 Installation

Following files are located on the distribution media:

Directory path 'TDRV002-SW-42':

TDRV002-SW-42-2.7.0.pdf	PDF copy of this manual
TDRV002-SW-42-VXBUS.zip	Zip compressed archive with VxBus driver sources
TDRV002-SW-42-LEGACY.zip	Zip compressed archive with legacy driver sources
ChangeLog.txt	Release history
Release.txt	Release information

The archive TDRV002-SW-42-VXBUS.zip contains the following files and directories:

Directory path './tews/tdrv002':

tdrv002drv.c	TDRV002 device driver source
tdrv002def.h	TDRV002 driver include file
tdrv002.h	TDRV002 include file for driver and application
Makefile	Driver Makefile
40tdrv002.cdf	Component description file for VxWorks development tools
tdrv002.dc	Configuration stub file for direct BSP builds
tdrv002.dr	Configuration stub file for direct BSP builds
include/tvxbHal.h	Hardware dependent interface functions and definitions
apps/tdrv002exa.c	Example application

The archive TDRV002-SW-42-LEGACY.zip contains the following files and directories:

Directory path './tdrv002':

tdrv002drv.c	TDRV002 Driver Source
tdrv002.h	TDRV002 Application Include File
tdrv002def.h	TDRV002 Driver Include File
tdrv002exa.c	Example Application
tdrv002pci.c	TDRV002 PCI MMU mapping for Intel x86 based targets
include/tdhal.h	Include for hardware dependent functions

For installation the files have to be copied to the desired target directory.

2.1 Legacy vs. VxBus Driver

In later VxWorks 6.x releases, the old VxWorks 5.x legacy device driver model was replaced by VxBus-enabled device drivers. Legacy device drivers are tightly coupled with the BSP and the board hardware. The VxBus infrastructure hides all BSP and hardware differences under a well defined interface, which improves the portability and reduces the configuration effort. A further advantage is the improved performance of API calls by using the method interface and bypassing the VxWorks basic I/O interface.

VxBus-enabled device drivers are the preferred driver interface for new developments.

The checklist below will help you to make a decision which driver model is suitable and possible for your application:

Legacy Driver	VxBus Driver
▪ VxWorks 5.x releases ▪ VxWorks 6.5 and earlier releases ▪ VxWorks 6.x releases without VxBus PCI bus support	▪ VxWorks 6.6 and later releases with VxBus PCI bus ▪ SMP systems (only the VxBus driver is SMP safe!) ▪ 64-bit systems (only the VxBus driver is 64-bit compatible)

TEWS TECHNOLOGIES recommends not using the VxBus Driver before VxWorks release 6.6. In previous releases required header files are missing and the support for 3rd-party drivers may not be available.

2.2 VxBus Driver Installation

Because Wind River doesn't provide a standard installation method for 3rd party VxBus device drivers the installation procedure needs to be done manually.

In order to perform a manual installation extract all files from the archive TDRV002-SW-42-VXBUS.zip to the typical 3rd party directory *installDir/vxworks-6.x/target/3rdparty* (whereas *installDir* must be substituted by the VxWorks installation directory).

After successful installation the TDRV002 device driver is located in the vendor and driver-specific directory *installDir/vxworks-6.x/target/3rdparty/tews/tdrv002.*

At this point the TDRV002 driver is not configurable and cannot be included with the kernel configuration tool in a Wind River Workbench project. To make the driver configurable the driver library for the desired processer (CPU) and build tool (TOOL) must be built in the following way:

(1) Open a VxWorks development shell (e.g. C:\WindRiver\wrenv.exe -p vxworks-6.7)

(2) Change into the driver installation directory
installDir/vxworks-6.x/target/3rdparty/tews/tdrv002

(3) Invoke the build command for the required processor and build tool
make CPU=cpuName TOOL=tool

For Windows hosts this may look like this:

```
C:> cd \WindRiver\vxworks-6.7\target\3rdparty\tews\tdrv002
C:> make CPU=PENTIUM4 TOOL=diab
```

To compile SMP-enabled libraries, the argument VXBUILD=SMP must be added to the command line

```
C:> make CPU=PENTIUM4 TOOL=diab VXBUILD=SMP
```

To build 64-bit libraries, the argument VXBUILD=LP64 must be added to the command line

```
> make TOOL=gnu CPU=CORE VXBUILD=LP64
```

For 64-bit SMP-enabled libraries a build command may look like this

```
> make TOOL=gnu CPU=CORE VXBUILD="LP64 SMP"
```

To integrate the TDRV020 driver with the VxWorks development tools (Workbench), the component configuration file *40tdrv002.cdf* must be copied to the directory *installDir/vxworks-6.x/target/config/comps/VxWorks*.

```
C:> cd \WindRiver\vxworks-6.7\target\3rdparty\tews\tdrv002
C:> copy 40tdrv002.cdf \Windriver\vxworks-6.7\target\config\comps\vxWorks
```

In VxWorks 6.7 and newer releases the kernel configuration tool scans the CDF file automatically and updates the *CxrCat.txt* cache file to provide component parameter information for the kernel configuration tool as long as the timestamp of the copied CDF file is newer than the one of the *CxrCat.txt*. If your copy command preserves the timestamp, force to update the timestamp by a utility, such as *touch*.

In earlier VxWorks releases the CxrCat.txt file may not be updated automatically. In this case, remove or rename the original *CxrCat.txt* file and invoke the make command to force recreation of this file.

```
C:> cd \Windriver\vxworks-6.7\target\config\comps\vxWorks
C:> del CxrCat.txt
C:> make
```

Using the TDRV002 serial channels needs an adaptation of the maximum number of serial ports. (Refer to *2.2.2 Modification of the 'Number of serial ports'*)

After successful completion of all steps above and restart of the Wind River Workbench, the TDRV002 driver can be included in VxWorks projects by selecting the *"TEWS TDRV002 Driver"* component in the *"hardware (default) - Device Drivers"* folder with the kernel configuration tool.

2.2.1 Direct BSP Builds

In development scenarios with the direct BSP build method without using the Workbench or the vxprj command-line utility, the TDRV002 configuration stub files must be copied to the directory *installDir/vxworks-6.x/target/config/comps/src/hwif.* Afterwards the *vxbUsrCmdLine.c* file must be updated by invoking the appropriate make command.

```
C:> cd \WindRiver\vxworks-6.7\target\3rdparty\tews\tdrv002
C:> copy tdrv002.dc \Windriver\vxworks-6.7\target\config\comps\src\hwif
C:> copy tdrv002.dr \Windriver\vxworks-6.7\target\config\comps\src\hwif

C:> cd \Windriver\vxworks-6.7\target\config\comps\src\hwif
C:> make vxbUsrCmdLine.c
```

2.2.2 Modification of the ‘Number of serial ports’

The new number of serial ports must be specified in the configuration tool. By default only the local serial ports (e.g. 2 ports) will be set up. To support the additional TDRV002 ports the value of *‘/hardware/peripherals/serial/SIO/number of serial ports’* (*NUM_TTY*) must be set to the total number of installed serial ports. For example, if there are two local ports and a TPMC461 with 8 ports should be supported the value must be set to 10.

2.3 Legacy Driver Installation

2.3.1 Include Device Driver in VxWorks Projects

For including the TDRV002-SW-42 device driver into a VxWorks project (e.g. Tornado IDE or Workbench) follow the steps below:

(1) Extract all files from the archive TDRV002-SW-42-LEGACY.zip to your project directory.

(2) Add the device drivers C-files to your project.
Make a right click to your project in the 'Workspace' window and use the 'Add Files ...' topic.
A file select box appears, and the driver files in the tdrv002 directory can be selected.

(3) Now the driver is included in the project and will be built with the project.

For a more detailed description of the project facility please refer to your VxWorks User's Guide (e.g. Tornado, Workbench, etc.)

2.3.2 Special Installation for Intel x86 based Targets

The TDRV002 device driver is fully adapted for Intel x86 based targets. This is done by conditional compilation directives inside the source code and controlled by the VxWorks global defined macro **CPU_FAMILY**. If the content of this macro is equal to *I80X86* special Intel x86 conforming code and function calls will be included.

The second problem for Intel x86 based platforms can't be solved by conditional compilation directives. Due to the fact that some Intel x86 BSP's doesn't map PCI memory spaces of devices which are not used by the BSP, the required device memory spaces can't be accessed.

To solve this problem a MMU mapping entry has to be added for the required TDRV002 PCI memory spaces prior the MMU initialization (*usrMmuInit()*) is done.

The C source file **tdrv002pci.c** contains the function *tdrv002PciInit().* This routine finds out all TDRV002 devices and adds MMU mapping entries for all used PCI memory spaces. Please insert a call to this function after the PCI initialization is done and prior to MMU initialization (*usrMmuInit()*).

The right place to call the function *tdrv002PciInit()* is at the end of the function *sysHwInit()* in **sysLib.c** (it can be opened from the project *Files* window).

Be sure that the function is called prior to MMU initialization otherwise the TDRV002 PCI spaces remains unmapped and an access fault occurs during driver initialization.

Please insert the following call at a suitable place in **sysLib.c**:

```
tdrv002PciInit();
```

Modifying the sysLib.c file will change the sysLib.c in the BSP path. Remember this for future projects and recompilations.

2.4 System Resource Requirement

The table gives an overview over the system resources that will be needed by the driver.

Resource	Driver requirement	Devices requirement
Memory	< 1 KB	< 1 KB
Stack	< 1 KB	---
Semaphores	1	1(1)

(1) A semaphore is needed while waiting for a full modem state

The specified requirements are specific to the driver. The VxWorks terminal manager will require extra resources for each device.

Memory and Stack usage may differ from system to system, depending on the used compiler and its setup.

The following formula shows the way to calculate the common requirements of the driver and devices.

*<total requirement> = <driver requirement> + (<number of devices> * <device requirement>)*

The maximum usage of some resources is limited by adjustable parameters. If the application and driver exceed these limits, increase the according values in your project.

2.5 Configuration of FIFO-Trigger-Levels

The FIFO trigger-levels may influence the behavior of the target system. A modification of the FIFO-trigger-levels also means changing the duration of a single interrupt and the number of interrupts that will be generated.

Increasing the receive FIFO-trigger-level will lower the number of generated interrupts, but it will also increase the execution time of a single interrupt function and it may increase the risk of loosing data by FIFO overrun.

Increasing the transmit FIFO-trigger-level will increase the number of generated interrupts, but it will also lower the execution time of a single interrupt function and decrease the chance of gaps in the transmission stream.

Known issue with interrupt execution time

In newer systems (VxWorks 6.x) a long interrupt execution time may lead into work queue overflow, which may result in system crash or error state. If such a situation occurs while a data transfer is in progress there are two ways to solve the problem: first the FIFO-trigger-levels can be adapted to decrease the interrupt execution time, and secondly the Work Queue Size can be increased (value of WIND_JOBS_MAX). Please refer to the VxWorks documentation for description of project configuration.

3 VxBus Driver Support

The TDRV002 will be fully integrated to the VxWorks system and the devices will be automatically created when booting VxWorks.

3.1 Assignment of Port Names

The port names are assigned automatically when the ports are created. The assigned port name will be '/tyCo/<*n*>" where <n> specifies the port number. Generally the first two port numbers ('/tyCo/0', '/tyCo/1') are assigned to system ports and the additional ports on the TDRV002 supported boards will start with port number 2. For example a system with one TPMC462 (4 channels) will assign the following device names:

/tyCo/0	1st system port
/tyCo/1	2nd system port
/tyCo/2	1st channel of TPMC462
/tyCo/3	2nd channel of TPMC462
/tyCo/4	3rd channel of TPMC462
/tyCo/5	4th channel of TPMC462

If there is more than one supported TDRV002 board installed, the assignment of the channel numbers to the boards depends on the search order of the system, but all the channels of one board will follow up in a row. For example a system with one TPMC462 (4 channels) and one TPMC372 (4 channels) may assign the following two device names tables.

	(TPMC462 found first)	*(TPMC372 found first)*
/tyCo/0	1st system port	1st system port
/tyCo/1	2nd system port	2nd system port
/tyCo/2	1st channel of TPMC462	1st channel of TPMC372
/tyCo/3	2nd channel of TPMC462	2nd channel of TPMC372
/tyCo/4	3rd channel of TPMC462	3rd channel of TPMC372
/tyCo/5	4th channel of TPMC462	4th channel of TPMC372
/tyCo/6	1st channel of TPMC372	1st channel of TPMC462
/tyCo/7	2nd channel of TPMC372	2nd channel of TPMC462
/tyCo/8	3rd channel of TPMC372	3rd channel of TPMC462
/tyCo/9	4th channel of TPMC372	4th channel of TPMC462

After booting the available devices can be checked with *devs()*. This function will return a list of all created devices. If fewer devices have been created, please first check the defined maximum number of serial devices. (See *2.2.2 Modification of the 'Number of serial ports'*)

3.2 VxBus Error Codes

There will be just system generated return codes for the 'Basic I/O Functions'. The TDRV002 specific 'Error Codes' described with the functions are not valid for VxBus devices.

3.3 Default Configuration

The driver will create the port with the following default configuration:

- 9600 Baud
- 8 Data- and 1 Stopbit
- FIFO enabled (Triggerlevels: Rx = 56 – Tx = 8)

Ports supporting a programmable interface (e.g. TPMC465) will startup with a disabled interface. Before using the port it must be configure with the corresponding ioctl-function (*FIOSETINTERFACE*).

For further information of setting the FIFO-trigger-levels, please refer to 2.5 Configuration of FIFO-Trigger-Levels.

3.4 Compatibility to pre-VxBus Applications

A driver and device installation after system start like it has been common in pre-VxBus systems is no longer required. Therefore all legacy system I/O functions are obsolete. These functions are implemented to keep the driver compatible to older driver versions. The obsolete functions only check if the driver is already installed or devices are present. The functions do not guarantee full compatibility because port name assignment and the search order of the modules have changed.

4 Legacy I/O System Functions

This chapter describes the driver-level interface to the I/O system. The purpose of these functions is to install the driver in the I/O system, add and initialize devices.

The legacy I/O system functions are only relevant for the legacy TDRV002 driver. For the VxBus-enabled TDRV002 driver, the driver will be installed automatically in the I/O system and devices will be created as needed for detected modules.

4.1 tdrv002Drv

NAME

tdrv002Drv() - installs the TDRV002 driver in the I/O system.

This function is not necessary for systems supporting VxBus. It is a dummy function which checks if the driver is installed. It has been implemented to keep the application compatible to the legacy version.

SYNOPSIS

```
#include “tdrv002.h”

STATUS tdrv002Drv
(
        void
)
```

DESCRIPTION

This function searches for devices on the PCI bus and installs the TDRV002 driver in the I/O system.

A call to this function is the first thing the user has to do before adding any device to the system or performing any I/O request.

EXAMPLE

```
#include  "tdrv002.h”
STATUS    result;

/*---------------------
  Initialize Driver
  ---------------------*/
result = tdrv002Drv();
if (result == ERROR)
{
     /* error handling */
}
```

RETURNS

OK or ERROR. If the function fails an error code will be stored in *errno*.

ERROR CODES

The error codes are stored in *errno* and can be read with the function *errnoGet()*.

Error code	Description
S_tdrv002Drv_NOMEM	Driver cannot allocate memory
S_tdrv002Drv_NXIO	No device found

SEE ALSO

VxWorks Programmer’s Guide: I/O System

4.2 tdrv002DevCreate

NAME

tdrv002DevCreate() – Adds TDRV002 device to the system and initializes the device hardware with the specified configuration

SYNOPSIS

```
#include "tdrv002.h"

STATUS tdrv002DevCreate
(
      char                    *name,
      int                     glbChanNo,
      int                     rdBufSize,
      int                     wrtBufSize,
      TDRV002_CHANCONF        *devConf
)
```

DESCRIPTION

This routine creates a device on a specified serial channel that will be serviced by the TDRV002 driver.

This function must be called before performing any I/O request to this device.

This function is not necessary for systems supporting VxBus. It is a dummy function which checks if the device is installed. It has been implemented to keep the application compatible to pre-VxBus versions. All parameters except of *glbChanNo* will be ignored.

PARAMETER

name

This string specifies the name of the device that will be used to identify the device, for example for *open()* calls.

glbChanNo

This index number specifies the device to add to the system.
The index number depends on the search priority of the modules. The modules will be searched in the following order:

TPMC371-10, -11, -12,	TPMC372-xx,	TPMC375-xx,
TPMC376-xx,	TPMC377-xx,	
TPMC460-xx,	TPMC461-xx,	TPMC462-xx,
TPMC463-xx,	TPMC465-xx,	TPMC466-xx,
TPMC467-xx,	TPMC470-xx,	
TCP460-xx,	TCP461-x,	TCP462-xx,
TCP463-xx,	TCP465-xx,	TCP466-xx,
TCP467-xx,	TCP469-xx,	TCP470-xx,
TXMC375-xx		

If modules of the same type are installed the channel numbers will be assigned in the order the VxWorks *pciFindDevice()* function will find the devices.

Example: (A system with 2x TPMC461-10, 1x TPMC372-10, 1x TPMC372-11) will assign the following device indices:

Module	Device Index
TPMC372-10	0 ... 3
TPMC372-11	4 … 7
TPMC461-10 (1st)	8 … 15
TPMC461-10 (2nd)	16 … 23

For VxBus support this is the only used parameter.

The *glbChanNo* specifies the SIO-port- number including non TDRV002 ports. Normally there are two local SIO-ports configured to the system and than the TDRV002-ports will follow. That means the first TDRV002 port will be specified with *glbChanNo* set to 2.

The module and port enumeration depends on the VxWorks system. It is not made by the driver and the description of the port ordering above is not valid for the VxBus version of the driver.

See also the chapter *3.1 Assignment of Port Names*

rdBufSize

This value specifies the size of the receive software FIFO. (For further information of setting the FIFO-trigger-levels, please refer to 2.5 Configuration of FIFO-Trigger-Levels.)

wrtBufSize

This value specifies the size of the transmit software FIFO. (For further information of setting the FIFO-trigger-levels, please refer to 2.5 Configuration of FIFO-Trigger-Levels.)

devConf

This parameter points to a structure (*TDRV002_CHANCONFIG*) containing the default configuration of the channel. (This function will be used for reconfigurations).

```
typedef struct
{
        unsigned int        baudrate;
        unsigned int        comPara;
        unsigned char       rxFSize;
        unsigned char       txFSize;
        int                 options;
} TDRV002_CHANCONFIG;
```

baudrate

Selects the initial baud rate of the channel. (Allowed values depend on hardware)

comPara

This value is a field of ORed definitions, specifying the channel setup. One value of every group must be ORed into the value.

Number of data bits:

TDRV002_DATABIT_5	word length = 5 bit
TDRV002_DATABIT_6	word length = 6 bit
TDRV002_DATABIT_7	word length = 7 bit
TDRV002_DATABIT_8	word length = 8 bit

Length of stop bit:

TDRV002_STOPBIT_1	stop bit length = 1 bit
TDRV002_STOPBIT_1_5	stop bit length = 1.5 bit, (only data length 5)
TDRV002_STOPBIT_2	stop bit length = 2 bit, (only data length 6, 7, 8)

Parity mode:

TDRV002_PARITY_NO	parity is disabled
TDRV002_PARITY_ODD	odd parity is used
TDRV002_PARITY_EVEN	even parity is used
TDRV002_PARITY_MARK	a mark parity bit is used
TDRV002_PARITY_SPACE	a space parity bit is used

Hardware handshake:

TDRV002_HWHS_DISABLE	hardware handshake is disabled
TDRV002_HWHS_ENABLE	hardware handshake is enabled (only if FIFO is enabled)

FIFO mode:

TDRV002_FIFO_DISABLE	Hardware FIFO is disabled
TDRV002_FIFO_ENABLE	Hardware FIFO is enabled. Receiver and transmitter trigger level must be set in rxFSize and txFSize.

Local loopback mode:

TDRV002_LOCALLOOP_DISABLE	Disable local loopback mode
TDRV002_LOCALLOOP_ENABLE	Enabled local loopback mode

Interface configuration (only valid for programmable I/O interfaces):
(A combination of the flags below must be specified to configure the interface)

TDRV002_TRANS_RS485_RS232_SEL	RS485/RS232# configuration pin
TDRV002_TRANS_HDPLX_SEL	HDPLX configuration pin
TDRV002_TRANS_RENA_SEL	RENA configuration pin
TDRV002_TRANS_RTERM_SEL	RTERM configuration pin
TDRV002_TRANS_TTERM_SEL	TTERM configuration pin
TDRV002_TRANS_SLEWLIMIT_SEL	SLEWLIMIT configuration pin
TDRV002_TRANS_SHDN_SEL	SHDN configuration pin
TDRV002_AUTO_RS485_SEL_ENABLE	enable Auto RS485 Operation mode of XR17D15x

The function of the interface configuration pins can be found in the corresponding hardware User Manual.

There are predefined values of the interface configuration described in the hardware manual, you can just OR the predefined value instead of a list of configuration flags. Below is a list of the values:

TDRV002_INTF_OFF	interface disabled
TDRV002_INTF_RS232	RS232
TDRV002_INTF_RS422	RS422 (Multidrop / Full duplex)
TDRV002_INTF_RS485FDM	RS485 (Full duplex master)
TDRV002_INTF_RS485FDS	RS485 (Full duplex slave)
TDRV002_INTF_RS485HD	RS485 (Half duplex)

rxFSize

Specifies the HW receiver trigger level if the HW FIFO is enabled. Allowed values depend on the HW FIFO size. (1..64 for TPMCxxx and TCPxxx, or 1..256 for TXMCxxx)

txFSize

Specifies the HW transmitter trigger level if the HW FIFO is enabled. Allowed values depend on the HW FIFO size. (1..64 for TPMCxxx and TCPxxx, or 1..256 for TXMCxxx)

options

Selects the initial VxWorks driver options. (Please refer to VxWorks manuals)

EXAMPLE

```
#include  "tdrv002.h”

STATUS              result;
TDRV002_CHANCONF    tdrv002conf;

/*-------------------------------------------------------
  Create the device "/tyCo/2" on channel 0
     read and write buffer sizes of 1024 byte.
     Baudrate:      115200Baud
     Databits:      8
     Stopbits:      1
     Parity:        off
     Handshake:     off
     FIFOs:         enabled
     Rx Trigger:    more than 30 characters in FIFO
     Tx Trigger:    less than 10 characters in FIFO
     Local Loop:    off
     Options:       raw mode
     I/O interface:RS232
  -------------------------------------------------------*/
tdrv002conf.baudrate =  115200;
tdrv002conf.comPara =   TDRV002_DATABIT_8  |
                        TDRV002_STOPBIT_1  |
                        TDRV002_PARITY_NO  |
                        TDRV002_HWHS_DISABLE    |
                        TDRV002_FIFO_ENABLE     |
                        TDRV002_LOCALLOOP_DISABLE    |
                        TDRV002_INTF_RS232;
tdrv002conf.rxFSize =   30;
tdrv002conf.txFSize =   10;
tdrv002conf.options =   10;

result = tdrv002DevCreate ("/tyCo/2", 0, 1024, 1024, &tdrv002conf);
if (result == OK)
{
     /* Device successfully created */
}
else
{
     /* Error occurred when creating the device */
}
```

RETURNS

OK or ERROR. If the function fails an error code will be stored in *errno*.

ERROR CODES

The error codes are stored in *errno* and can be read with the function *errnoGet()*.

Error code	Description
S_tdrv002Drv_NODRV	The TDRV002 driver is not installed
S_tdrv002Drv_NODEV	Specified device not found
S_tdrv002Drv_EXISTS	The specified device has already been created
S_tdrv002Drv_ILLINTF	Illegal interface specified
S_tdrv002Drv_ILLBAUD	Illegal default baud rate specified
S_tdrv002Drv_ILLPARAM	Illegal parameter specified
S_tdrv002Drv_MODENOTSUPP	Unsupported default mode specified
S_tdrv002Drv_CONFERR	Configuration error (specified flags exclude each other)

SEE ALSO

VxWorks Programmer's Guide: I/O System

4.3 tdrv002PciInit

NAME

tdrv002PciInit() – Generic PCI device initialization

SYNOPSIS

```
void tdrv002PciInit
(
        void
)
```

DESCRIPTION

This function is required only for Intel x86 VxWorks platforms. The purpose is to setup the MMU mapping for all required TDRV002 PCI spaces (base address register) and to enable the TDRV002 device for access.

The global variable *tdrv002Status* obtains the result of the device initialization and can be polled later by the application before the driver will be installed.

Value	Meaning
> 0	Initialization successful completed. The value of tdrv002Status is equal to the number of mapped PCI spaces
0	No TDRV002 device found
< 0	Initialization failed. The value of (tdrv002Status & 0xFF) is equal to the number of mapped spaces until the error occurs. Possible cause: Too few entries for dynamic mappings in sysPhysMemDesc[]. Remedy: Add dummy entries as necessary (syslib.c).

This function is only supported for the TDRV002 legacy version. It must not be used with the VxBus version.

EXAMPLE

```
extern void tdrv002PciInit();

tdrv002PciInit();
```

5 Basic I/O Functions

5.1 open

NAME

open() - open a device or file.

SYNOPSIS

```
int open
(
        const char   *name,
        int          flags,
        int          mode
)
```

DESCRIPTION

Before I/O can be performed to the TDRV002 device, a file descriptor must be opened by invoking the basic I/O function *open().*

PARAMETER

name

Specifies the device which shall be opened.
For the legacy driver version, the name specified in *tdrv002DevCreate()* must be used.
For the VxBus driver version the system assigned device name must be used. (See also *3.1 Assignment of Port Names*)

flags

Not used

mode

Not used

EXAMPLE

```
int       fd;

/*------------------------------------------
  Open the device named "/tyCo/2" for I/O
  ------------------------------------------*/
fd = open("/tyCo/2", 0, 0);
if (fd == ERROR)
{
     /* error handling */
}
```

RETURNS

A device descriptor number or ERROR. If the function fails an error code will be stored in *errno*.

ERROR CODES

The error code can be read with the function *errnoGet()*.

The error code is a standard error code set by the I/O system (see VxWorks Reference Manual.

SEE ALSO

ioLib, basic I/O routine - *open()*

5.2 close

NAME

close() – close a device or file

SYNOPSIS

```
STATUS close
(
        int             fd
)
```

DESCRIPTION

This function closes opened devices.

PARAMETER

fd

This file descriptor specifies the device to be closed. The file descriptor has been returned by the *open()* function.

EXAMPLE

```
int         fd;
STATUS      retval;

/*----------------
  close the device
  ----------------*/
retval = close(fd);
if (retval == ERROR)
{
     /* error handling */
}
```

RETURNS

OK or ERROR. If the function fails, an error code will be stored in *errno*.

ERROR CODES

The error code can be read with the function *errnoGet()*.

The error code is a standard error code set by the I/O system (see VxWorks Reference Manual).

SEE ALSO

ioLib, basic I/O routine - close()

5.3 read

NAME

read() – read data from a specified device.

SYNOPSIS

```
int read
(
        int          fd,
        char         *buffer,
        size_t       maxbytes
)
```

DESCRIPTION

This function can be used to read data from the device.

PARAMETER

fd

This file descriptor specifies the device to be used. The file descriptor has been returned by the *open()* function.

buffer

This argument points to a user supplied buffer. The returned data will be filled into this buffer.

maxbytes

This parameter specifies the maximum number of read bytes (buffer size).

EXAMPLE

```
#define   BUFSIZE   100

int            fd;
char           buffer[BUFSIZE];
int            retval;

…
```

…

```
/*-----------------------------
  Read data from TDRV002 device
  -----------------------------*/
retval = read(fd, buffer, BUFSIZE);
if (retval != ERROR)
{
     printf(“%d bytes read\n”, retval);
}
else
{
     /* handle the read error */
}
```

RETURNS

Number of bytes read or ERROR. If the function fails an error code will be stored in *errno*.

ERROR CODES

The error code can be read with the function *errnoGet()*.

The error code is a standard error code set by the I/O system (see VxWorks Reference Manual.

SEE ALSO

ioLib, basic I/O routine - read()

5.4 write

NAME

write() – write data from a buffer to a specified device.

SYNOPSIS

```
int write
(
        int         fd,
        char        *buffer,
        size_t      nbytes
)
```

DESCRIPTION

This function can be used to write data to the device.

PARAMETER

fd

This file descriptor specifies the device to be used. The file descriptor has been returned by the *open()* function.

buffer

This argument points to a user supplied buffer. The data of the buffer will be written to the device.

nbytes

This parameter specifies the number of bytes to be written.

EXAMPLE

```
int             fd;
char            buffer[] = “Hello World”;
int             retval;

…
```

…

```
/*------------------------------
  Write data to a TDRV002 device
  ------------------------------*/
retval = write(fd, buffer, strlen(buffer));
if (retval != ERROR)
{
     printf("%d bytes written\n", retval);
}
else
{
     /* handle the write error */
}
```

RETURNS

Number of bytes written or ERROR. If the function fails an error code will be stored in *errno*.

ERROR CODES

The error code can be read with the function *errnoGet()*.

The error code is a standard error code set by the I/O system (see VxWorks Reference Manual).

SEE ALSO

ioLib, basic I/O routine - write()

5.5 ioctl

NAME

ioctl() - performs an I/O control function.

SYNOPSIS

```
#include “tdrv002.h”

int ioctl
(
        int                     fd,
        int                     request,
        TDRV002_IOCTL_ARG_T     arg
)
```

DESCRIPTION

Special I/O operation that do not fit to the standard basic I/O calls (read, write) will be performed by calling the ioctl() function.

PARAMETER

fd

This file descriptor specifies the device to be used. The file descriptor has been returned by the *open()* function.

request

This argument specifies the function that shall be executed. The TDRV002 device driver uses the standard *tty driver support library tyLib*. For details of supported *ioctl* functions see *VxWorks Reference Manual*: tyLib and *VxWorks Programmer's Guide*: I/O System. Following additional functions are defined:

Function	**Description**
FIODATABITS	Set length of data word
FIOSTOPBITS	Set length of the stop bit
FIOPARITY	Set parity checking mode
FIOHWHS	Enable/Disable hardware handshake mode
FIOSETBREAK	Set/Release Break
FIOSETMODEM	Sets specified modem control lines
FIOSETCLEARMODEM	Clears specified modem control lines
FIOGETMODEM	Returns the state of the modem control lines
FIOWAITMODEMSTATE	Wait for a specified state on modem or control line
…	

…	
FIORECONFIGURE	Reconfigure device with the default parameters
FIOSTATUS	Get state of the device
FIOLOCALLOOP	Enable/Disable local loopback mode
FIOLOCALSELFTEST	Execute a local self test
FIOSETINTERFACE	Change the programmable I/O interface
FIOCHANNELINFO	Returns information regarding the specified channel

arg

This parameter depends on the selected function (request). How to use this parameter is described below with the function.

RETURNS

OK or ERROR. If the function fails an error code will be stored in *errno*.

ERROR CODES

The error code can be read with the function *errnoGet()*.

SEE ALSO

ioLib, basic I/O routine - ioctl()

5.5.1 FIOBAUDRATE

This I/O control function sets up a new baudrate. The function specific control parameter **arg** specifies the new baudrate.

EXAMPLE

```
#include “tdrv002.h”

int                 fd;
int                 retval;


/*---------------------
  Set baud rate to 9600
  ---------------------*/
retval = ioctl(fd, FIOBAUDRATE, 9600);
if (retval != ERROR)
{
     /* function succeeded */
}
else
{
     /* handle the error */
}
```

ERROR CODES

Error Code	**Description**
S_tdrv002Drv_SELFTESTBUSY	Self test mode is active for the device
S_tdrv002Drv_ILLBAUD	Illegal baud rate specified

5.5.2 FIODATABITS

This I/O control function sets the data word length. The function specific control parameter **arg** specifies the length of the data word. The following values are defined:

Value	Description
TDRV002_DATABIT_5	word length = 5 bit
TDRV002_DATABIT_6	word length = 6 bit
TDRV002_DATABIT_7	word length = 7 bit
TDRV002_DATABIT_8	word length = 8 bit

EXAMPLE

```
#include "tdrv002.h"

int                 fd;
int                 retval;


/*-------------------------------------
  Set channel to a word length of 7 bit
  -------------------------------------*/
retval = ioctl(fd, FIODATABITS, TDRV002_DATABIT_7);
if (retval != ERROR)
{
     /* function succeeded */
}
else
{
     /* handle the error */
}
```

ERROR CODES

Error Code	Description
S_tdrv002Drv_SELFTESTBUSY	Self test mode is active for the device
S_tdrv002Drv_ILLPARAM	Illegal data word length specified

5.5.3 FIOSTOPBITS

This I/O control function sets the length of the stop bit. The function specific control parameter **arg** specifies the length of the stop bit word. The following values are defined:

Value	Description
TDRV002_STOPBIT_1	stop bit length = 1 bit
TDRV002_STOPBIT_1_5	stop bit length = 1.5 bit, (only data length 5)
TDRV002_STOPBIT_2	stop bit length = 2 bit, (only data length 6, 7, 8)

EXAMPLE

```
#include “tdrv002.h”

int                fd;
int                retval;


/*----------------------------------------
  Set channel to a stop bit length of 1 bit
  ----------------------------------------*/
retval = ioctl(fd, FIOSTOPBITS, TDRV002_STOPBIT_1);
if (retval != ERROR)
{
     /* function succeeded */
}
else
{
     /* handle the error */
}
```

ERROR CODES

Error Code	Description
S_tdrv002Drv_SELFTESTBUSY	Self test mode is active for the device
S_tdrv002Drv_ILLPARAM	Illegal data stop bit length specified

5.5.4 FIOPARITY

This I/O control function sets the parity mode. The function specific control parameter **arg** specifies the new parity mode. The following values are defined:

Value	Description
TDRV002_PARITY_NO	parity is disabled
TDRV002_PARITY_ODD	odd parity is used
TDRV002_PARITY_EVEN	even parity is used
TDRV002_PARITY_MARK	a mark parity bit is used
TDRV002_PARITY_SPACE	a space parity bit is used

EXAMPLE

```
#include “tdrv002.h”

int                 fd;
int                 retval;


/*---------------------------
  Configure channel no parity
  ---------------------------*/
retval = ioctl(fd, FIOPARITY, TDRV002_PARITY_NO);
if (retval != ERROR)
{
     /* function succeeded */
}
else
{
     /* handle the error */
}
```

ERROR CODES

Error Code	Description
S_tdrv002Drv_SELFTESTBUSY	Self test mode is active for the device
S_tdrv002Drv_ILLPARAM	Illegal parity mode specified

5.5.5 FIOHWHS

This I/O control function enables or disables the hardware handshake. The function specific control parameter **arg** specifies if the hardware handshake shall be enabled or disabled. The following values are defined:

Value	Description
TDRV002_HWHS_DISABLE	hardware handshake is disabled
TDRV002_HWHS_ENABLE	hardware handshake is enabled (only if FIFO is enabled)

EXAMPLE

```
#include “tdrv002.h”

int                 fd;
int                 retval;


/*--------------------------
  Disable hardware handshake
  --------------------------*/
retval = ioctl(fd, FIOHWHS, TDRV002_HWHS_DISABLE);
if (retval != ERROR)
{
     /* function succeeded */
}
else
{
     /* handle the error */
}
```

ERROR CODES

Error Code	Description
S_tdrv002Drv_SELFTESTBUSY	Self test mode is active for the device
S_tdrv002Drv_ILLPARAM	Illegal handshake mode specified
S_tdrv002Drv_MODENOTSUPP	The hardware does not support the specified mode

5.5.6 FIOSETBREAK

This I/O control function sets or resets break state on transmit line. The function specific control parameter **arg** specifies the state on transmit line. The following values are defined:

Value	Description
TDRV002_BREAK_SET	Set break on transmit line(s)
TDRV002_BREAK_RESET	Reset break on transmit line(s)

EXAMPLE

```
#include “tdrv002.h”

int                 fd;
int                 retval;


/*-----------------------
  Set break on Tx line(s)
  -----------------------*/
retval = ioctl(fd, FIOSETBREAK, TDRV002_BREAK_SET);
if (retval != ERROR)
{
     /* function succeeded */
}
else
{
     /* handle the error */
}
```

ERROR CODES

Error Code	Description
S_tdrv002Drv_SELFTESTBUSY	Self test mode is active for the device
S_tdrv002Drv_ILLPARAM	Illegal parameter specified

5.5.7 FIOSETMODEM

This I/O control function sets the specified modem and handshake lines into active state. The function specific control parameter **arg** is an ORed value and specifies the lines that shall be set. The following values are defined:

Value	Description
TDRV002_MCTL_RTS	Set RTS line into active state
TDRV002_MCTL_DTR	Set DTR line into active state

The supported handshake and modem lines depend on the used TDRV002 board, port number and interface. Which handshake and modem lines are supported can be found in the User Manual of the TDRV002 supported module.

EXAMPLE

```
#include “tdrv002.h”

int                 fd;
int                 retval;


/*--------------
  Set DTR active
  --------------*/
retval = ioctl(fd, FIOSETMODEM, TDRV002_MCTL_DTR);
if (retval != ERROR)
{
     /* function succeeded */
}
else
{
     /* handle the error */
}
```

ERROR CODES

Error Code	Description
S_tdrv002Drv_SELFTESTBUSY	Self test mode is active for the device
S_tdrv002Drv_MODENOTSUPP	The specified handshake or modem line is not supported

5.5.8 FIOCLEARMODEM

This I/O control function sets the specified modem and handshake lines into passive state. The function specific control parameter **arg** is an ORed value and specifies the lines that shall be reset. The following values are defined:

Value	Description
TDRV002_MCTL_RTS	Set RTS line into passive state
TDRV002_MCTL_DTR	Set DTR line into passive state

The supported handshake and modem lines depend on the used TDRV002 board, port number and interface. Which handshake and modem lines are supported can be found in the User Manual of the TDRV002 supported module.

EXAMPLE

```
#include “tdrv002.h”

int                 fd;
int                 retval;


/*----------------------
  Set RTS and DTR active
  ----------------------*/
retval = ioctl(fd, FIOCLEARMODEM, (TDRV002_MCTL_RTS | TDRV002_MCTL_DTR));
if (retval != ERROR)
{
     /* function succeeded */
}
else
{
     /* handle the error */
}
```

ERROR CODES

Error Code	Description
S_tdrv002Drv_SELFTESTBUSY	Self test mode is active for the device
S_tdrv002Drv_MODENOTSUPP	The specified handshake or modem line is not supported

5.5.9 FIOGETMODEM

This I/O control function returns the state of the modem and control lines of the device. The function specific control parameter **arg** points to a buffer (unsigned int) the status will be returned. The returned status is an OR'ed value of the following flags:

Value	Description
TDRV002_MCTL_RTS	If set RTS is in active state
TDRV002_MCTL_DTR	If set DTR is in active state
TDRV002_MCTL_CTS	If set CTS is in active state
TDRV002_MCTL_DSR	If set DSR is in active state
TDRV002_MCTL_RI	If set RI is in active state
TDRV002_MCTL_CD	If set CD is in active state

The supported handshake and modem lines depend on the used TDRV002 board, port number and interface. Which handshake and modem lines are supported can be found in the User Manual of the TDRV002 supported module.

This function always returns the state of all handshake and modem lines as they are shown by the controller even if they are not available for the specified port.

EXAMPLE

```
#include “tdrv002.h”

int                 fd;
int                 retval;
unsigned int        modStat;

/*---------------------
  Get modem line status
  ---------------------*/
retval = ioctl(fd, FIOGETMODEM, (TDRV002_IOCTL_ARG_T)&modStat);
if (retval != ERROR)
{    /* check CTS state */
     if (modStat & TDRV002_MCTL_CTS)
     {
          /* CTS is active */
     }
}
else
{
     /* handle the error */
}
```

5.5.10 FIOWAITMODEMSTATE

This I/O control function returns the state of the modem and control lines of the device if one of the specified states occurs, it will return immediately if a state already matches. The function specific control parameter **arg** points to a supplied buffer (TDRV002_WAITMODEM_BUFFER).

The supported handshake and modem lines depend on the used TDRV002 board, port number and interface. Which handshake and modem lines are supported can be found in the User Manual of the TDRV002 supported module.

This function always returns the state of all handshake and modem lines as they are shown by the controller even if they are not available for the specified port.

The function can wait for states on all the handshake and modem lines even if they are not available for the specified port. The value will not change by external changes, but it may be used if local loopback is enabled.

```
typedef struct
{
    unsigned int        lineMask;
    unsigned int        lineTargetState;
    int                 timeout;
    unsigned int        modemState;
} TDRV002_WAITMODEM_BUFFER;
```

lineMask

This parameter specifies the observed modem and status lines. If one of the specified lines has the specified state or it changes into it the function will return. The mask is an OR'ed value of the following flags:

Value	Description
TDRV002_MCTL_CTS	If set observe CTS state
TDRV002_MCTL_DSR	If set observe DSR state
TDRV002_MCTL_RI	If set observe RI state
TDRV002_MCTL_CD	If set observe CD state

lineTargetState

This parameter specifies the desired states of the modem and status lines. This value is an OR'ed value of the following flags:

Value	Description
TDRV002_MCTL_CTS	If set an active CTS line will be signaled, if not set an passive CTS line will be signaled.
TDRV002_MCTL_DSR	If set an active DSR line will be signaled, if not set an passive DSR line will be signaled.
TDRV002_MCTL_RI	If set an active RI line will be signaled, if not set an passive RI line will be signaled.
TDRV002_MCTL_CD	If set an active CD line will be signaled, if not set an passive CD line will be signaled.

timeout

This value specifies the time (in unit ticks) the function is willing to wait for a specified state before it returns with an error. A value of WAIT_FOREVER means wait for ever.

modemState

The returned value shows the current state of the modem and status lines. The returned status is an OR'ed value of the following flags:

Value	**Description**
TDRV002_MCTL_RTS	If set RTS is in active state
TDRV002_MCTL_DTR	If set DTR is in active state
TDRV002_MCTL_CTS	If set CTS is in active state
TDRV002_MCTL_DSR	If set DSR is in active state
TDRV002_MCTL_RI	If set RI is in active state
TDRV002_MCTL_CD	If set CD is in active state

EXAMPLE

```
#include “tdrv002.h”

int                         fd;
int                         retval;
TDRV002_WAITMODEM_BUFFER    waitBuf;

/*------------------------------------------------
  Wait for an active DTR line or a passive CTS line
  ------------------------------------------------*/
waitBuf.lineMask        = TDRV002_MCTL_DTR | TDRV002_MCTL_CTS;
waitBuf.lineTargetState = TDRV002_MCTL_DTR;
waitBuf.timeout         = 1000;
retval = ioctl(fd, FIOWAITMODEMSTATE, (TDRV002_IOCTL_ARG_T)&waitBuf);
if (retval != ERROR)
{    /* check DTR state */
     if (waitBuf.modemState & TDRV002_MCTL_DTR)
     {
          /* DTR is active */
     }
     if (waitBuf.modemState & TDRV002_MCTL_CTS)
     {
          /* CTS is active */
     }
}
else

…
```

```
…

{
    /* handle the error */
}
```

ERROR CODES

Error Code	Description
S_tdrv002Drv_SELFTESTBUSY	Self test mode is active for the device
S_tdrv002Drv_ILLPARAM	A specified parameter is not allowed (lineMask == 0?)
S_tdrv002Drv_BUSY	An other task is already waiting for modem line status

5.5.11 FIORECONFIGURE

This I/O control function resets the device to the default configuration. The function specific control parameter **arg** is not used for this function.

EXAMPLE

```
#include “tdrv002.h”

int                 fd;
int                 retval;


/*--------------------------
  Reconfigure serial channel
  --------------------------*/
retval = ioctl(fd, FIORECONFIGURE, 0);
if (retval != ERROR)
{
     /* function succeeded */
}
else
{
     /* handle the error */
}
```

ERROR CODES

Error Code	Description
S_tdrv002Drv_SELFTESTBUSY	Self test mode is active for the device

5.5.12 FIOSTATUS

This I/O control function returns the state of the device. The function specific control parameter **arg** points to a buffer (unsigned int) the status will be returned. The returned status is an OR'ed value of the following flags:

Value	Description
TDRV002_STATUS_FRAMINGERR	This bit is set if a framing error has been detected since the last call.
TDRV002_STATUS_PARITYERR	This bit is set if a parity error has been detected since the last call.
TDRV002_STATUS_OVERRUNERR	This bit is set if an overrun error has been detected since the last call.
TDRV002_STATUS_PENDBREAK	This bit is set if a break signal has been detected since the last call.

EXAMPLE

```
#include "tdrv002.h"

int                 fd;
int                 retval;
unsigned int        inStat;


/*------------------
  Get receive status
  ------------------*/
retval = ioctl(fd, FIOSTATUS, (TDRV002_IOCTL_ARG_T)&inStat);
if (retval != ERROR)
{
     /* function succeeded */
     if (inStat & TDRV002_STATUS_FRAMINGERR)
     {
          /* Framing error occurred */
     }
}
else
{
     /* handle the error */
}
```

5.5.13 FIOLOCALLOOP

This I/O control function enables or disables the local loop back mode. For a description of the local loopback wiring, refer to 6.2 Internal Loopback.

The function specific control parameter **arg** specifies if the local loop back shall be enabled or disabled. The following values are defined:

Value	Description
TDRV002_LOCALLOOP_DISABLE	Local loopback mode is disabled
TDRV002_LOCALLOOP_ENABLE	Local loopback mode is enabled

EXAMPLE

```
#include “tdrv002.h”

int                 fd;
int                 retval;


/*---------------------------
  Disable local loopback mode
  ---------------------------*/
retval = ioctl(fd, FIOLOCALLOOP, TDRV002_LOCALLOOP_DISABLE);
if (retval != ERROR)
{
     /* function succeeded */
}
else
{
     /* handle the error */
}
```

ERROR CODES

Error Code	Description
S_tdrv002Drv_SELFTESTBUSY	Self test mode is active for the device
S_tdrv002Drv_ILLPARAM	Illegal parameter specified

5.5.14 FIOLOCALSELFTEST

This I/O control function executes a local selftest of the specified device. The local loopback mode will be used to check the communication and all local I/O signals (RxD/TxD/RTS/CTS/DTR/DSR/RI/CD) are used. For a description of the local loopback wiring, refer to 6.2 Internal Loopback. The function can be executed with application supplied Rx/Tx buffers or with driver allocated buffers. The function will return a status if the test has been executed.

The function specific control parameter **arg** points to a supplied buffer (TDRV002_LOCALSELFTEST_BUFFER). The following values are defined:

```
typedef struct
{
        char                *transmitBuffer;
        int                 transmitSize;
        char                *receiveBuffer;
        int                 receiveSize;
        int                 receiveCount;
        unsigned int        status;
} TDRV002_LOCALSELFTEST_BUFFER;
```

transmitBuffer

This is a pointer to a buffer with data that should be transmitted with the local loopback test. This allows the application to check the transmitted data and select the content and size of the test data.

transmitSize

This argument specifies the size of the transmitBuffer. If this argument is set to 0 or to a negative value the driver will allocate a buffer and create test data automatically. If automatically allocated buffers are used, the parameters transmitBuffer, receiveBuffer, receiveSize and receiveCount will be ignored.

receiveBuffer

This is a pointer to a buffer that will return the locally transmitted data. This buffer can be used to compare received and transmitted data.

receiveSize

This argument specifies the size of the receive buffer. The size of the receive buffer must be at least as big as the transmit buffer.

receiveCount

This is the count of characters that have been received during the selftest. The returned value should be the same as transmitSize.

status

This is a bit-field specifying the found problems. The status is an OR'ed value of the following flags:

Status Flag	Description
TDRV002_STATUS_LS_TXRX	Problem with TxD/RxD communication
TDRV002_STATUS_LS_RTSCTS	Problem with RTS/CTS connection
TDRV002_STATUS_LS_DTRDSR	Problem with DTR/DTS connection
TDRV002_STATUS_LS_RI	Problem with RI states
TDRV002_STATUS_LS_CD	Problem with CD states

EXAMPLE

```
#include "tdrv002.h"

int                                fd;
int                                retval;
TDRV002_LOCALSELFTEST_BUFFER       selftestBuf;
char                               txBuf[128] = …;
char                               rxBuf[150];


/*--------------------------------------------------------
  Execute local selftest with application supplied buffers
  --------------------------------------------------------*/
selftestBuf.transmitBuffer   = txBuf;
selftestBuf.transmitSize     = 128;
selftestBuf.receiveBuffer    = rxBuf;
selftestBuf.receiveSize      = 150;
selftestBuf.receiveCount     = 0;
retval = ioctl(fd, FIOLOCALSELFTEST, (TDRV002_IOCTL_ARG_T)&selftestBuf);
if (retval != ERROR)
{
     /* function succeeded */
     if (selftestBuf.status)
     {
          /* Check status flags */
     }
     else
     {
          /* No problems found */
     }
}
…
```

```
…

else
{
     /* handle the error */
}

…

/*-----------------------------------------------
  Execute local Selftest with internal buffers
  -----------------------------------------------*/
selftestBuf.transmitSize = 0;
retval = ioctl(fd, FIOLOCALSELFTEST, (TDRV002_IOCTL_ARG_T)&selftestBuf);
if (retval != ERROR)
{
     /* function succeeded */
     if (selftestBuf.status)
     {
          /* Check status flags */
     }
     else
     {
          /* No problems found */
     }
}
else
{
     /* handle the error */
}
```

ERROR CODES

Error Code	Description
S_tdrv002Drv_SELFTESTBUSY	Self test mode is active for the device
S_tdrv002Drv_NOMATCHBUF	Receive buffer is smaller than the transmit buffer

5.5.15 FIOSETINTERFACE

This I/O control function sets a new I/O interface configuration. This function is only usable for devices supporting a programmable I/O interface. The function specific control parameter **arg** specifies the new configuration of the programmable transceivers. (Only allowed for channels supporting a programmable I/O interface) A combination of the flags below must be specified to configure the interface.

Value	Description
TDRV002_TRANS_RS485_RS232_SEL	RS485/RS232# configuration pin
TDRV002_TRANS_HDPLX_SEL	HDPLX configuration pin
TDRV002_TRANS_RENA_SEL	RENA configuration pin
TDRV002_TRANS_RTERM_SEL	RTERM configuration pin
TDRV002_TRANS_TTERM_SEL	TTERM configuration pin
TDRV002_TRANS_SLEWLIMIT_SEL	SLEWLIMIT configuration pin
TDRV002_TRANS_SHDN_SEL	SHDN configuration pin
TDRV002_AUTO_RS485_SEL_ENABLE	enable Auto RS485 Operation mode of XR17D15x

The function of the interface configuration pins can be found in the corresponding hardware User Manual.

There are predefined values of the interface configuration described in the hardware manual, you can just OR the predefined value instead of a list of configuration flags. Below is a list of the values:

Value	Description
TDRV002_INTF_OFF	interface disabled
TDRV002_INTF_RS232	RS232
TDRV002_INTF_RS422	RS422 (Multidrop / Full duplex)
TDRV002_INTF_RS485FDM	RS485 (Full duplex master)
TDRV002_INTF_RS485FDS	RS485 (Full duplex slave)
TDRV002_INTF_RS485HD	RS485 (Half duplex)

EXAMPLE

```
#include “tdrv002.h”

int                 fd;
int                 retval;


/*---------------------------------------
  Set I/O interface for RS485 half duplex
  ---------------------------------------*/
retval = ioctl(fd, FIOSETINTERFACE, TDRV002_INTF_RS485HD);
if (retval != ERROR)
{
     /* function succeeded */
}
else
{
     /* handle the error */
}
```

ERROR CODES

Error Code	Description
S_tdrv002Drv_SELFTESTBUSY	Self test mode is active for the device
S_tdrv002Drv_NOTSUPP	The device has no programmable I/O interface
S_tdrv002Drv_ILLINTF	The specified interface type is not supported by the device
S_tdrv002Drv_ILLBAUD	The specified interface type can not support the current baud rate
S_tdrv002Drv_MODENOTSUPP	Handshake mode is not supported for the specified interface type

5.5.16 FIOSETFIFOTRIGGER

This I/O control function sets up the FIFO trigger levels, which shall be used for the specified channel. For a description of the controller's FIFO depth and possible values for the trigger level, please refer to the corresponding hardware user manual.

The function specific control parameter **arg** points to a supplied buffer (TDRV002_FIFOCONFIG).

```
typedef struct
{
        unsigned char       rxFSize;
        unsigned char       txFSize;
        int                 fifoEnable;
} TDRV002_FIFOCONFIG;
```

rxFSize

This value specifies the trigger level of the receive FIFO. The controller will generate receive interrupts if the specified level is reached in the hardware receive FIFO. Depending on the used UART controller's FIFO size, the value can be set to values between 0 and 64, or between 0 and 128.

txFSize

This value specifies the trigger level of the transmit FIFO. The controller will generate transmit interrupts if the number of data in the hardware transmit FIFO falls below specified level. Depending on the used UART controller's FIFO size, the value can be set to values between 0 and 64, or between 0 and 128.

fifoEnable

This argument specifies if the FIFO shall be enabled or disabled. If the FIFO is disabled the previous parameters are not used and there will be no FIFO for the specified channel. Because of the risk of data loss, if FIFO is disabled, it is recommended to disable the FIFO only in special and well checked cases. The values below must be used:

Value	**Description**
TDRV002_FIFO_DISABLE	Disable FIFO functionality
TDRV002_FIFO_ENABLE	Enable FIFO functionality

EXAMPLE

```
#include "tdrv002.h"

int                fd;
int                retval;
TDRV002_FIFOCONFIG fifoConf;

fifoConf.rxFSize        = 32;
fifoConf.txFSize        = 24;
fifoConf.fifoEnable     = TDRV002_FIFO_ENABLE;

/*---------------------------------------
  Set FIFO trigger levels
     Receive = 32, Transmit = 24
  ---------------------------------------*/
retval = ioctl(fd, FIOSETFIFOTRIGGER, (TDRV002_IOCTL_ARG_T)&fifoConf);
if (retval != ERROR)
{
     /* function succeeded */
}
else
{
     /* handle the error */
}
```

ERROR CODES

Error Code	Description
S_tdrv002Drv_SELFTESTBUSY	Self test mode is active for the device
S_tdrv002Drv_ILLPARAM	Illegal parameter specified

5.5.17 FIOCHANNELINFO

This I/O control function returns information regarding the specified channel. The returned information contains information about the board where the channel is located. The function will also return information about the PCI-bus location where the controller of the channel can be found. This information may be helpful to find a special channel in the system and to assign a physical channel to a logical device.

The function specific control parameter **arg** passes a pointer to an information structure (TDRV002_CHANNEL_INFO_BUFFER) where the information will be filled in.

```
typedef struct
{
        int                                     channelNo
        struct tdrv002_board_info           board;
        struct tdrv002_controller_info          controller;
} TDRV002_CHANNEL_INFO_BUFFER;
```

channelNo

This value returns the serial channel number. For example: the function will return 7 for "/tyCo/7".
The legacy driver will return the number at the end of the device name as described above, but if there is no number at the end of the device (e.g. "/ser/A"), the function will return a driver internal channel count.

board

This structure (struct tdrv002_board_info) contains board information that belongs to a specified channel.

```
struct tdrv002_board_info
{
        int                 channelNo;
        unsigned int        boardId;
        unsigned int        boardVariant;
        int                 boardIndex;
};
```

channelNo

This value returns the channel number of the board where the channel is located. The returned number will match the channel number assigned in the User Manual.

boardId

This value returns a unique ID, which identifies the used board type. The list below shows a list of the returned board IDs, defined in tdrv002.h:

Board Id	**Board Type**
TDRV002_CHANINFO_TPMC371	TPMC371-xx
TDRV002_CHANINFO_TPMC372	TPMC372-xx
TDRV002_CHANINFO_TPMC375	TPMC375-xx
TDRV002_CHANINFO_TPMC376	TPMC376-xx
TDRV002_CHANINFO_TPMC377	TPMC377-xx
TDRV002_CHANINFO_TPMC460	TPMC460-xx
TDRV002_CHANINFO_TPMC461	TPMC461-xx
TDRV002_CHANINFO_TPMC462	TPMC462-xx
TDRV002_CHANINFO_TPMC463	TPMC463-xx
TDRV002_CHANINFO_TPMC465	TPMC465-xx
TDRV002_CHANINFO_TPMC466	TPMC466-xx
TDRV002_CHANINFO_TPMC467	TPMC467-xx
TDRV002_CHANINFO_TPMC470	TPMC470-xx
TDRV002_CHANINFO_TCP460	TCP460-xx
TDRV002_CHANINFO_TCP461	TCP461-xx
TDRV002_CHANINFO_TCP462	TCP462-xx
TDRV002_CHANINFO_TCP463	TCP463-xx
TDRV002_CHANINFO_TCP465	TCP465-xx
TDRV002_CHANINFO_TCP466	TCP466-xx
TDRV002_CHANINFO_TCP467	TCP467-xx
TDRV002_CHANINFO_TCP469	TCP469-xx
TDRV002_CHANINFO_TCP470	TCP470-xx
TDRV002_CHANINFO_TXMC375	TXMC375-xx

boardVariant

This value returns the board variant. The returned number specified the *xx* in the board name, e.g. TPMC461-*xx*.

boardIndex

This value returns the index of the specified board. If just one TDRV002 board is used, this index will always be 0, but if more than one TDRV002 board with the same boardId installed, the index value returned is the index for PCI-search (The index is depends on the search order of the BSP).

controller

This structure (struct tdrv002_controller_info) contains information that belongs to the controller and the specified channel which describes the location of the controller and channel on PCI-bus.

```
struct tdrv002_controller_info
{
     int                 pciBusNo;
     int                 pciDeviceNo;
     int                 pciFunctionNo;
     int                 controllerPort;
};
```

pciBusNo

This PCI bus number the channels controller is located at.

pciDeviceNo

This PCI device number the channels controller is located at.

pciFunctionNo

This PCI function number the channels controller is located at.

controllerPort

This value specifies the channel index within the controller, as assigned in the documentation of the controller chip.

EXAMPLE

```
#include “tdrv002.h”

int                          fd;
int                          retval;
TDRV002_CHANNEL_INFO_BUFFER  channelInfo

/*----------------------
  Read board information
  ----------------------*/
retval = ioctl(fd, FIOCHANNELINFO, (TDRV002_IOCTL_ARG_T)&channelInfo);
if (result != ERROR)
{
     printf("Get Channel Board Information successfully executed\n");
     printf("    Channel-Name: %s%d\n", TDRV002_DEVICENAME,
          channelInfo.channelNo);

…
…

    printf("    Board: %s%d-%02d - Board Index: %d\n",
         boardTypeList[(channelInfo.board.boardId >> 12) & 0xF],
         channelInfo.board.boardId & 0xFFF,
         channelInfo.board.boardVariant,
         channelInfo.board.boardIndex);
    printf("           Channel number on board: %d\n",
         channelInfo.board.channelNo);
    printf("    Controller: PCI-Location: [%d/%d/%d]\n",
         channelInfo.controller.pciBusNo,
         channelInfo.controller.pciDeviceNo,
         channelInfo.controller.pciFunctionNo);
    printf("           Local channel number on controller: %d\n",
         channelInfo.controller.controllerPort);
}
else
{
    /* handle the error */
}
```

6 Appendix

6.1 Debugging Driver and Devices

Driver start-up of the TDRV002 is mainly executed at a time which does not allow the output debug messages. Therefore we have implemented a function that displays some information about driver and devices.

```
void tdrv002Show
(
    void
)
```

The function is only available if the VxBus driver is used.

The function will display the following information:
- start up errors (if occurred)
- list of boards which has been probed by the driver and position of the boards on PCI bus
- list of created TDRV002 devices and assignment to the boards
- some statistics to the TDRV002 devices and their configuration

For example, the function can be called from the VxWorks shell to display the information.

Below is an example output for installed TPMC467-10 and TPMC461-12:

```
-> tdrv002Show
Probed Modules:
    [0] TPMC467: Bus=4, Dev=1, DevId=0x01d3, VenId=0x1498, Init=OK,
vxDev=0x492608
    [1] TPMC461: Bus=4, Dev=2, DevId=0x01cd, VenId=0x1498, Init=OK,
vxDev=0x492708

Associated Devices:
    [0] TPMC467:
        Channel 0:    /tyCo/2
        Channel 1:    /tyCo/3
        Channel 2:    /tyCo/4
        Channel 3:    /tyCo/5
    [1] TPMC461:
        Channel 0:    /tyCo/6
        Channel 1:    /tyCo/7
        Channel 2:    /tyCo/8
        Channel 3:    /tyCo/9
        Channel 4:    /tyCo/10
        Channel 5:    /tyCo/11
        Channel 6:    /tyCo/12
        Channel 7:    /tyCo/13
…
```

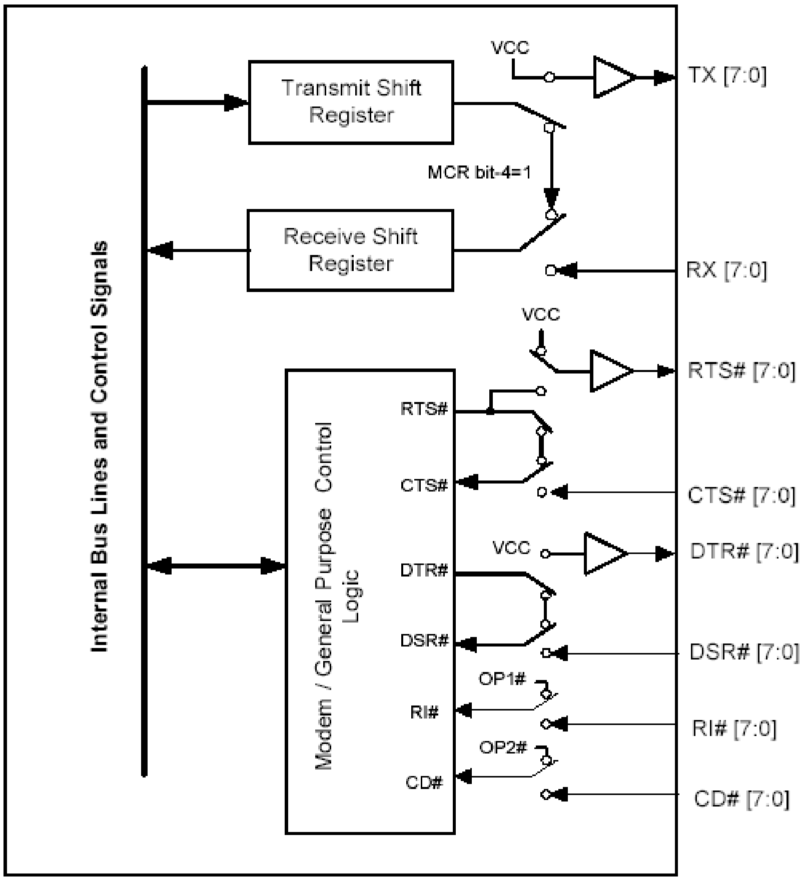
```
…

Device Statistics:
    /tyCo/2:
        Interrupt Count     = 733
        Transmitted Chars   = 20480
        Received Chars      = 20480
        Error Count         = 0
        Configuration:
            Interface       = RS232 (programmable)
            max. Baudrate   = 44236800
            Baudrate        = 115200
            Data/Stopbits   = 8/1
            Parity          = None
            Local-Loopback  = enabled
    /tyCo/3:
        Interrupt Count     = 0
        Transmitted Chars   = 0
        Received Chars      = 0
        Error Count         = 0
        Configuration:
            Interface       = RS485 (HD) (programmable)
            max. Baudrate   = 44236800
            Baudrate        = 9600
            Data/Stopbits   = 8/1
            Parity          = None
            Local-Loopback  = disabled
    /tyCo/4:
        Interrupt Count     = 0
        Transmitted Chars   = 0
        Received Chars      = 0
        Error Count         = 0
        Configuration:
            Interface       = OFF (programmable)
    /tyCo/5:
        Interrupt Count     = 0
        Transmitted Chars   = 0
        Received Chars      = 0
        Error Count         = 0
        Configuration:
            Interface       = OFF (programmable)

…
```

```
…

    /tyCo/6:
        Interrupt Count     = 0
        Transmitted Chars   = 0
        Received Chars      = 0
        Error Count         = 0
        Configuration:
            Interface       = RS232
            max. Baudrate   = 0
            Baudrate        = 9600
            Data/Stopbits   = 8/1
            Parity          = None
            Local-Loopback  = disabled
    /tyCo/7:
        Interrupt Count     = 0
        Transmitted Chars   = 0
        Received Chars      = 0
        Error Count         = 0
        Configuration:
            Interface       = RS232
            max. Baudrate   = 0
            Baudrate        = 9600
            Data/Stopbits   = 8/1
            Parity          = None
            Local-Loopback  = disabled

…    (continues for /tyCo/8 to /tyCo/13)
```

6.2 Internal Loopback

The internal loopback mode connects output lines with input lines of the corresponding channel. This allows testing the software and general board access without any external wiring.

If internal loopback is enabled, all I/O lines can be used regardless if they are supported by board I/O or not.



6.3 Additional Error Codes

If the device driver creates an error the error codes are stored in the *errno*. They can be read with the VxWorks function *errnoGet()* or *printErrno().*

These error codes are only available when using the TDRV002 legacy driver.

Symbol Name	Value	Description
S_tdrv002Drv_NXIO	0x04610001	No supported devices found
S_tdrv002Drv_NODRV	0x04610002	Driver not installed
S_tdrv002Drv_NOMEM	0x04610003	Allocating memory failed
S_tdrv002Drv_BUSY	0x04610004	Driver is busy, devices are open, or an other already blocks function
S_tdrv002Drv_NODEV	0x04610005	Channel number is not valid
S_tdrv002Drv_EXISTS	0x04610006	Device already created
S_tdrv002Drv_ILLBAUD	0x04610007	Invalid baud rate specified, refer to your hardware manual
S_tdrv002Drv_ILLPARAM	0x04610008	An invalid parameter value specified
S_tdrv002Drv_MODENOTSUP	0x04610009	Mode not supported, the hardware does not support the mode, refer to your hardware manual
S_tdrv002Drv_CONFERR	0x0461000A	Configuration is not allowed (hardware handshake is only supported with enabled FIFO)
S_tdrv002Drv_SELFTESTBUS	0x0461000B	Self test failed
S_tdrv002Drv_NOMATCHBUF	0x0461000C	Self test recognized differences between sent and received data
S_tdrv002Drv_ILLINTF	0x0461000D	Specified interface is invalid
S_tdrv002Drv_NOTSUPP	0x0461000E	Function is not supported