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VSCAN Manual

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1 Installation

VSCAN devices support both Windows and Linux operating systems. The ASCII protocol is used to exchange data and control information with the devices and hence a serial interface is required to enable the communication.

SER-CAN devices don't usually need any driver installation and can be used directly after plugging in. USB-CAN and PCI-CAN both require Windows driver installation from the by-packed CD (modern Linux distributions often include those drivers by default, so no need to install the driver). NET-CAN has only Windows driver, but can be used operating system independent without driver in TCP raw mode. Please read the relevant installation instructions below for your particular device.

For the ease of use ASCII protocol is implemented in vs_can_api library with appropriate API. Linux users can alternatively use SocketCAN driver, that also implements ASCII protocol.

1.1 USB CAN Device

Use the USB driver from the directory *„USB-CAN\Driver"* on the product CD or download it from our company website www.visionsystems.de. If you've done this, you could plug in the adapter in an USB port of your choice. When you will be asked for the driver, you must choose the location of the driver files. The device will be registered and you can use the COM port for your further work (see Figure 1).

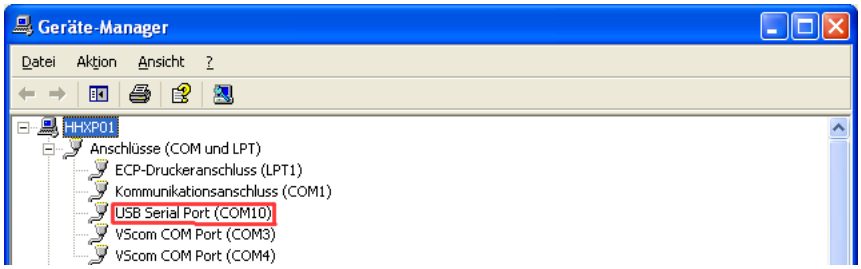


Figure 1: Device Manager

To get a better performance and set every standard baudrate as an alias for 3Mbit (**except 115200**), you must call the script *„regmodify.vbs"* with the desired COM port like this: *„cscript regmodify.vbs COM7"*. The script must be executed with administrative privileges. Please disconnect the device from the system for about 5 seconds after this step and connect again.

Then you can open the COM port of the USB-CAN with any standard baudrate[1] (see Figure 2).

[1] 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 230400, 460800, 921600

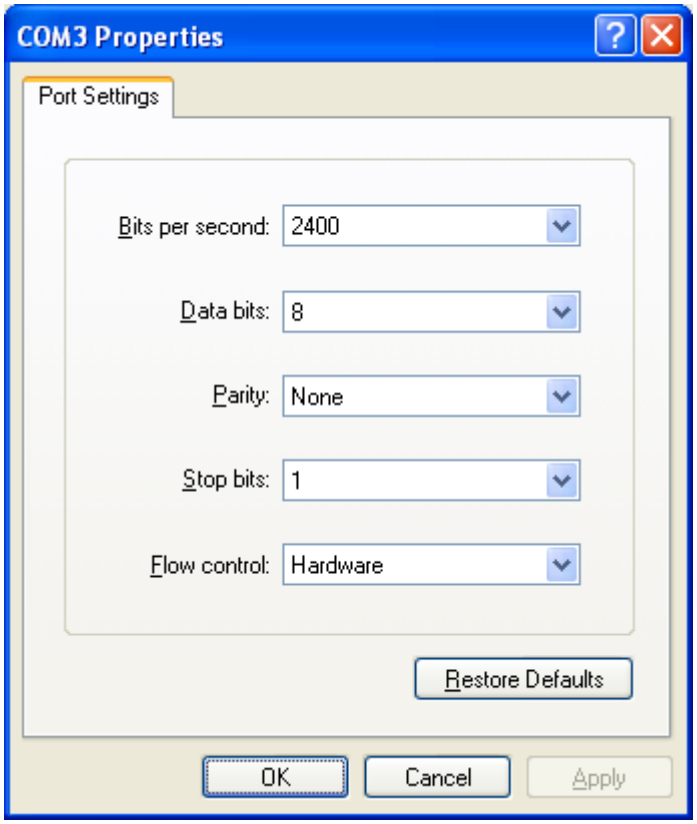


Figure 2: COM Port Properties

For Linux the driver is already available in modern kernel. The device name will be /dev/ttyUSBx.

1.2 Serial CAN Device

To use the serial CAN device you mustn't do anything except for finding a free serial port in your host computer. To get a better performance you should change the port settings to the following parameters (see Figure 3). Reboot to ensure that they were set.

Then you can open the COM port of the SER-CAN with **115200** bps (refer to Section 1.6.2).

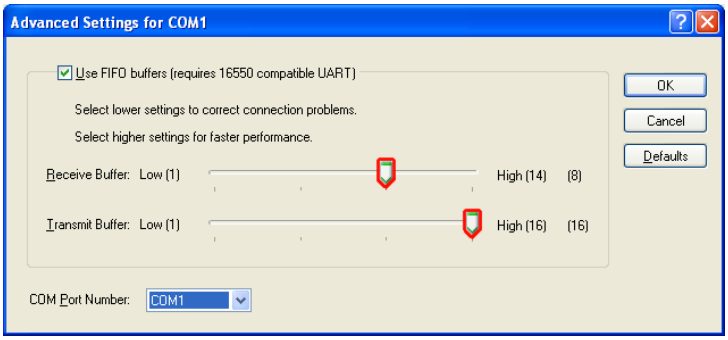


Figure 3: Advanced Settings for COM Port

1.3 PCI-CAN

Use the PCI driver from the directory *„PCI-CAN\Driver"* on the product CD or download it from our company website www.visionsystems.de. If you've done this, you could plug in the card in a free PCI slot of your choice. When you will be asked for the driver, you must choose the location of the driver files. The device will be registered and you can use the COM port for your further work (see Figure 4).

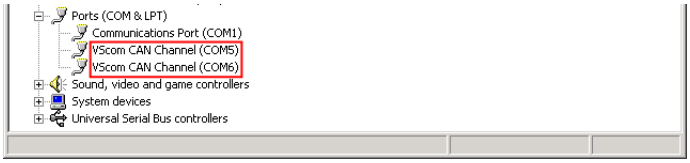


Figure 4: Device Manager

Then you can open the COM port of the PCI-CAN with any standard baudrate - **except 115200** - (see Figure 2).

1.4 Network CAN Device

1.4.1 Operational Modes

NET-CAN provides CAN communication over network. NET-CAN can act either as CAN Server (CAN frames will be exchanged between NET-CAN and application connected via COM port or TCP socket) or as CAN over IP Router (two or more NET-CANs exchange CAN frames between various CAN networks)

CAN Server Mode For CAN Server following approaches are provided:

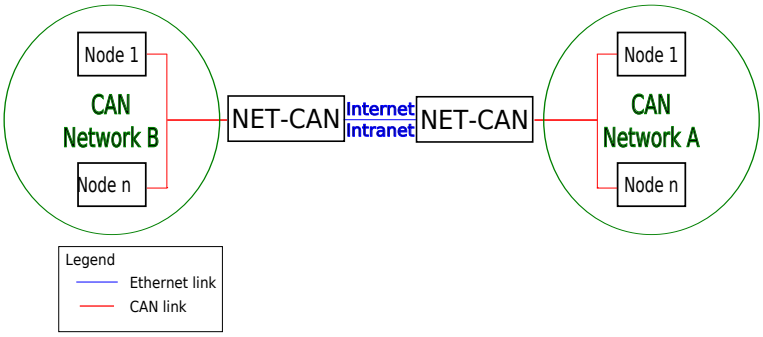
- Driver mode: in this mode the network is transparent for the application. To use this mode installation of the Windows driver is required (please refer to the "NetCom Wireless Serial Device Server User Manual" for installation instructions). After driver installation the new virtual COM port will be available to the system, so NET-CAN can be used in the same way as SER-CAN or USB-CAN. Due to the virtual COM port protocol overhead the performance is lower than by the TCP raw mode. You don't have to set the baudrate and hardware handshake explicitly - it's fixed to 3Mbit and RTS/CTS.
- TCP raw mode: the communication will be handled directly via IP address and port number. In this mode no driver installation is required.

NET-CAN devices can be operated with either ASCII or VSCAN API. For the API there is no difference whether Driver mode or TCP raw mode is used, but due to performance issues TCP raw mode is preferable.

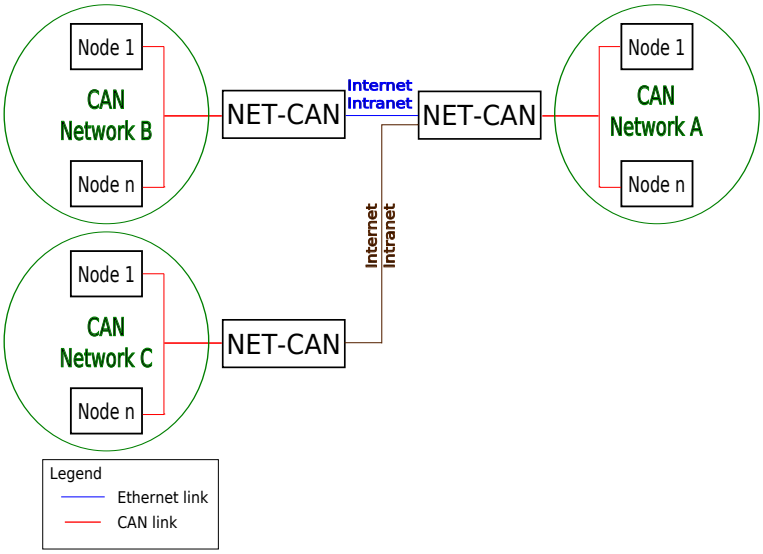
CAN over IP Router In this mode two or more NET-CAN devices are interconnected to enable seamless communication between two or more CAN networks. Figure 5a shows the first case, where two NET-CAN devices act as a tunnel between CAN Network A and B, so all frames sent inside Network A will be transported to Network B and vice versa.

Figure 5b shows extension of the tunnel. In this case additional CAN network can be attached, so that CAN frames sent inside Network A will be transported to both B and C, but CAN Network B and C communicate only with Network A, so frames from Network B could not be seen by Network B and vice versa. See Section 1.4.4 for configuration instructions.

CAN Acceptance Code and Acceptance Mask can be set to filter the CAN frames, so only dedicated frames are passed via TCP link.



(a) Tunnel



(b) 1-to-n

Figure 5: CAN over IP

1.4.2 Configuration Overview

NET-CAN device can be configured in following ways:

- via web interface
- via Telnet
- via NetCom Manager

For Telnet and NetCom Manager configuration refer to the "NetCom Wireless Serial Device Server User Manual".

Open your Webbrowser for the web interface configuration. Type the address of the NET-CAN server in the address line . Type the standard address *„http://192.168.254.254"* for example. You may do this on any operating system you prefer.

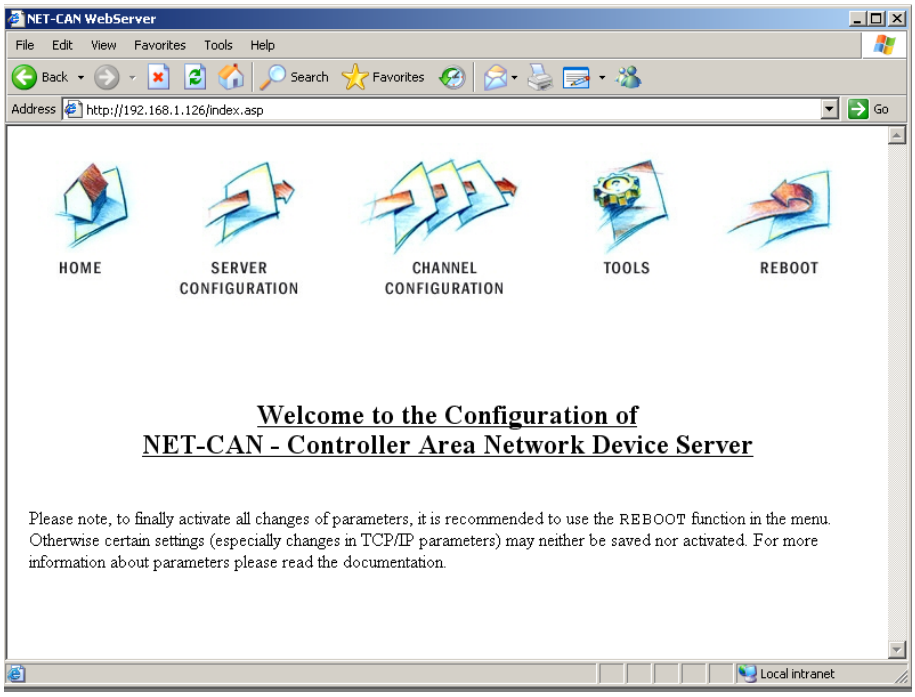


Figure 6: Web Interface for Configuration

The NET-CAN welcomes you with its "Home" screen (see Figure 6). Click on the icon for your desired option. In many menus you'll see a blue question mark. This is a symbol for help. Click it to get a short explanation, informing about the function of this parameter. Some other settings require a reboot to save and activate them. Whenever this situation occurs, the NET-CAN requests for a Reboot (see Figure 7).

You can instantly reboot or do that later when the configuration is finished.

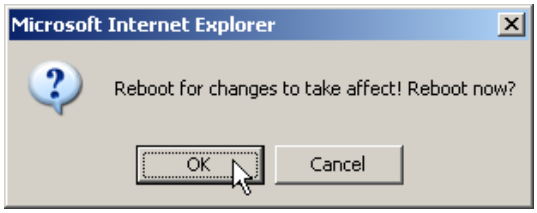


Figure 7: Web Interface Request to Reboot

1.4.3 Webbrowser Server Configuration

The *Server Configuration* is a very long menu (see Figure 8). There is basic server information (see Figure 8a), the server parameters related to the IP-configuration (see Figure 8b), the section for wireless communication (NET-CAN 120 WLAN only) (see Figure 8c), the section for encrypted communication (see Figure 8d), Password settings (see Figure 8e), and finally the configuration for date and time (see Figure 8f).

Information about the selected NET-CAN is displayed as *Server Info*. Starting with the *Server Type*, this is the model of the NET-CAN, followed by the version of Software and Hardware. This will give a rough overview, which features are implemented, or need an upgrade of the firmware. The *Serial Nr.* is important to identify the device you are configuring right now. For further information the *UpTime* is listed. *Contact* and *Location* are user-defined information. They may later help to find the device in the installation, and the person responsible for management.

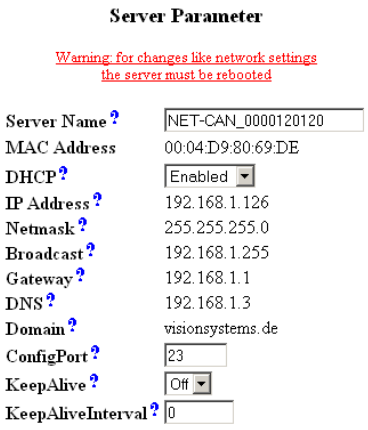
The *Server Parameter* allow configuration of the NET-CANs name and of course all parameters in IP-settings. Generally it is used as information, e.g. in the NetCom Manager program or in SNMP.

Manual changes of IP parameters are only available with *DHCP* set as Disabled. When DHCP is not used, enter *IP Address* and *Netmask*, as well as the *Broadcast* address. *Gateway* is required, if there are Routers in the network. DNS is used to access other stations by name. The *ConfigPort* is used to access the NET-CAN for administration via Telnet. It is suggested to use the standard value for Telnet, TCP port number 23. However it may be changed for different purposes. This does not change the function of the Telnet menus.

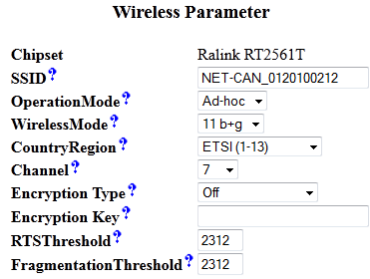
KeepAlive is an intrinsic function of the TCP/IP protocol. If used it causes network traffic, but connection problems are detected earlier. In a LAN this is usually not a problem. However, if used via DialUp connections this may cause problems. If this functions is used, you must define an interval in seconds. NET-CAN has a better chance to react on network problems, or failed hosts. Even dropping an old connection may be useful in certain environments.

For detailed information about further Server Configuration options please refer to the "NetCom Wireless Serial Device Server User Manual".

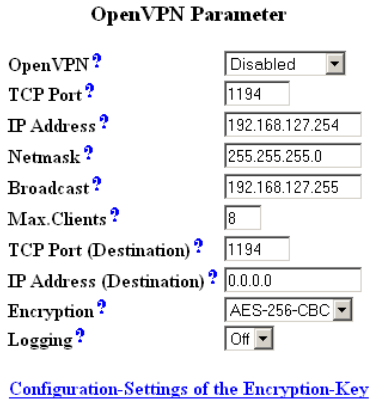
(a) Server Info



(b) Server Parameter

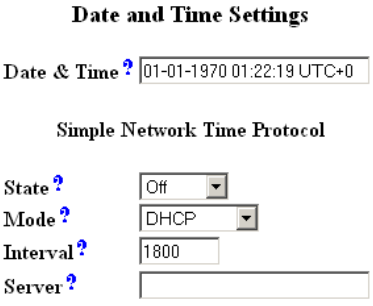


(c) Wireless Parameter



(d) OpenVPN Parameter

(e) Authentication



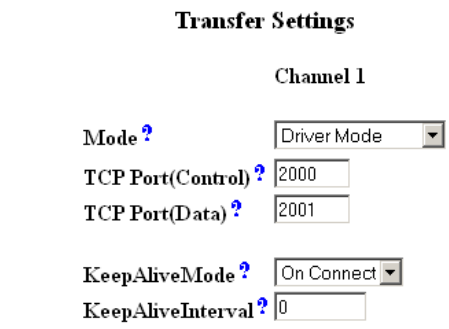
(f) Date and Time Settings

Figure 8: Server Configuration

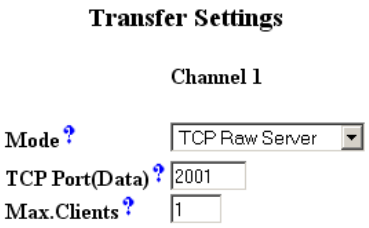
1.4.4 Webbrowser Channel Configuration

NET-CAN can be operated in following modes (see Figure 9):

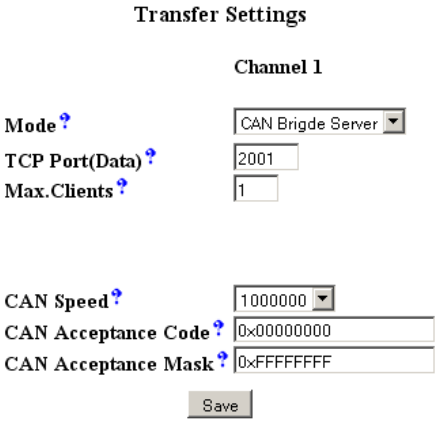
- Driver Mode - Only very few parameters have a function in *Driver Mode* (see Figure 9a). NET-CAN is operating as a Server. It accepts two connections per CAN channel. One connection is used to transmit the serial data, this is the TCP Port(Data). And the other is used to transmit control information, TCP Port(Control). This control connection is mostly used to request the status of the virtual serial port. Software may intend to change serial parameters like baudrate or parity, such requests are honoured. However they are ignored, because the serial parameters are fixed in the NET-CAN. The NET-CAN can check if the connected Client is still alive. This may be done, when a second Client wants to establish a connection (On Connect). It may also be done in regular intervals (Polling).
- TCP Raw Server - As TCP Raw Server NET-CAN operates very simple (see Figure 9b). It only waits for incoming data connections in Raw IP mode. As with the Driver Mode only the data connection is defined. You can connect multiple times to the NET-CAN also from different machines.
- CAN Bridge Server - Configures server side of the CAN over IP Router functionality. In this mode NET-CAN waits for incoming connections. Max. Clients value defines how many CAN Bridge Clients can connect to the server. CAN Speed sets the appropriate baudrate of the attached CAN network. Acceptance Code and Mask allow CAN frame filtering so only the dedicated frames pass over TCP link (See Figure 9c).
- CAN Bridge Client - Configures client side of the CAN over IP Router functionality. In this mode NET-CAN connects to the other NET-CAN in the CAN Bridge Server Mode. CAN Speed sets the appropriate baudrate of the attached CAN network. Acceptance Code and Mask allow CAN frame filtering so only the dedicated frames pass over TCP link (See Figure 9d).



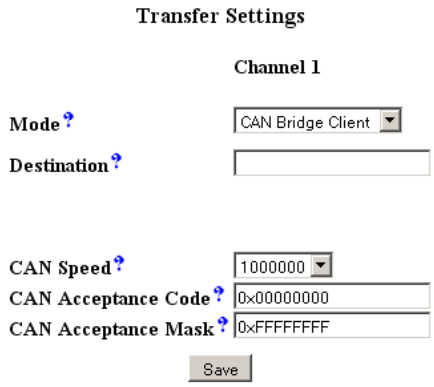
(a) Driver Mode



(b) TCP Raw Server



(c) CAN Bridge Server



(d) CAN Bridge Client

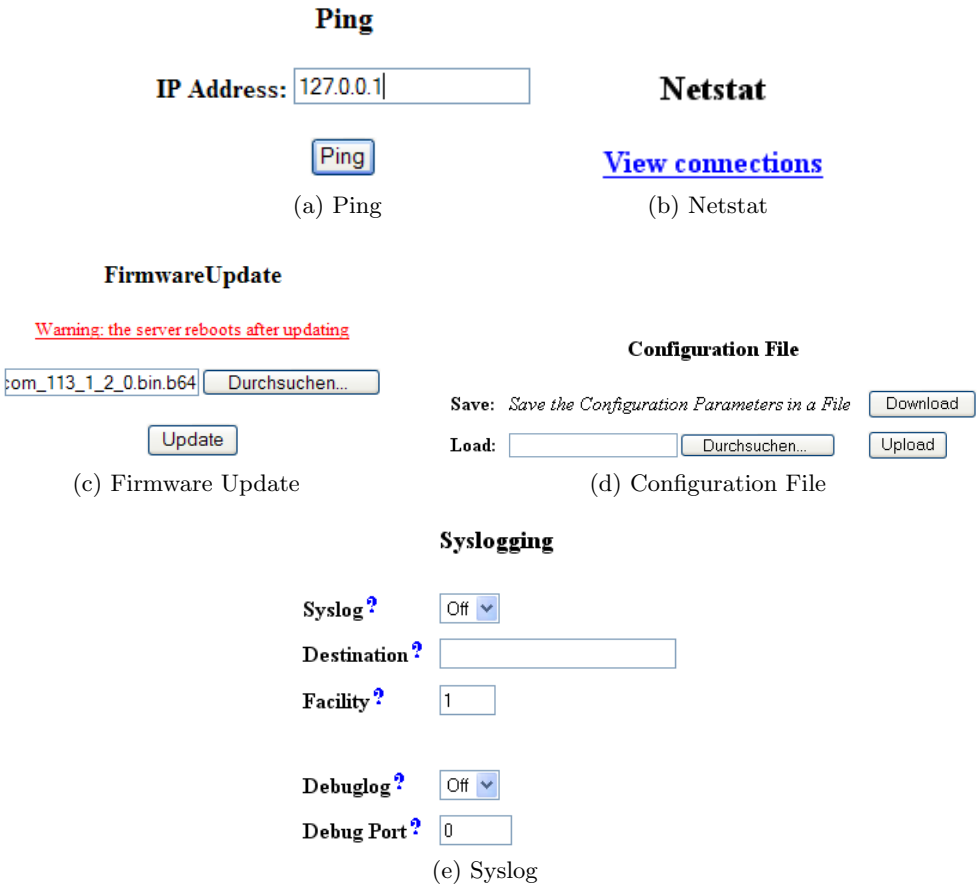
Figure 9: Channel Configuration

1.4.5 Webbrowser Tools

The available tools are (see Figure 10):

- *The Ping* utility will be used to check if a station is available (see Figure 10a). Enter the IP-Address or the name of a station in the field, and click the *Ping* button. The network connection is checked by sending certain ICMP data packages. If the target responds, the network between the NET-CAN and the target is operational. The time required for an echo depends on the speed of the network. In a typical Ethernet this is only very few Milliseconds, while it can be several seconds throughout the Internet.
- *The Netstat* utility will be used to monitor TCP connections (see Figure 10b). Use Netstat to see the actual status of NET-CAN IP Ports. This is a standard tool for network debugging. A *Foreign Address* of 0.0.0.0 is listed when NET-CAN is waiting for an incoming connection (`LISTEN`). If the value is not 0.0.0.0, the connection is either active (`ESTABLISHED`) or closed (`TIMEWAIT`).

- *The Firmware Update* option is used to update the firmware (see Figure 10c). To upload a new version of the firmware, put the name of the file in the field. Your Webbrowser may allow to search for the file. Click on the "Update" button. While loading the file is checked. If it is valid, it is stored in the Flash Memory. When the upload is finished, NET-CAN will Reboot.
- *The Saving of Configuration to / Loading from a file* option will be used to manage NET-CAN configuration (see Figure 10d). It is possible to save the actual configuration to a text file. Of course it is also possible to load the saved configuration into a NET-CAN.
- *The Syslog* option will be used to send logging information to the syslog facility (see Figure 10e). Syslogging requires a server the information is sent to. Facility allows to select the data sent to that server.
- *The DebugLog* option will be used to show logging information via TCP connection (see Figure 10e). For this kind of logging the NET-CAN behaves as the server. Open a TCP connection to the configured port, and receive all information generated.



(a) Ping

(b) Netstat

(c) Firmware Update

(d) Configuration File

(e) Syslog

Figure 10: Tools

1.4.6 Factory Settings

NET-CAN provides DIP-switches to set setting back to their defaults. Please refer to the Table 1 for possible switches settings. After setting the settings back, the DIP-switches must be returned to the „CAN Operation" position.

Operation Mode	**S1**	**S2**	**S3**	**S4**
CAN Operation	OFF	OFF	OFF	OFF
Factory Settings	OFF	OFF	OFF	ON

Table 1: Switches

1.5 Linux Installation (SocketCAN)

SocketCAN[2] is a set of open source CAN drivers and a networking stack contributed by Volkswagen Research to the Linux kernel. As of Linux kernel 2.6.38 ASCII protocol (slcan) will be also supported. To use it you'll first need to install can-utils from project's git[3] repository[4].

For USB CAN device, that is attached to `/dev/ttyUSB0` device, execute following commands:

```
stty -F /dev/ttyUSB0 ispeed 3000000 ospeed 3000000
slcan_attach -o -s8 /dev/ttyUSB0
slcand ttyUSB0
ifconfig slcan0 up
```

You'll get your USB CAN operated at 1MBit/s, with `candump` and `cansend` you can make first send/receive tests.

For Network CAN devices (NET-CAN) you'll first need to create a symbolic link to it via `socat`. Assume your NET-CAN has following IP address: 192.168.254.254. So the needed commands are:

```
socat pty,link=/dev/netcan0,raw tcp:192.168.254.254:2001&
slcan_attach -o -s8 /dev/netcan0
slcand netcan0
ifconfig slcan0 up
```

[2] http://en.wikipedia.org/wiki/Socketcan
[3] Git
[4] SocketCAN git repository

1.6 General Information

1.6.1 LED Status

The red error LED lights up, when a bus error occur. And the green data LED is on, when a frame was sent to or received from the bus.

1.6.2 Baud-rates and Handshake

Ensure you've set the handshake to RTS/CTS (hardware) when you open the port!

Device	Baud-rate	Handshake
USB-CAN	3 Mbit	RTS/CTS
NET-CAN	3 Mbit	RTS/CTS
SER-CAN	115200 kbit	RTS/CTS
PCI-CAN	3 Mbit	RTS/CTS

1.6.3 Pin-out of the 9 Pin D-Sub Connector

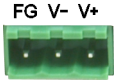
Pin	Signal	Description
1	CAN_V+	100mA @ 5V to drive the transceiver or optocouplers (optional)
2	CAN_L	CAN_L bus line (dominant level is low)
3	CAN_GND	CAN ground
4	-	reserved
5	-	reserved
6	GND	ground (optional)
7	CAN_H	CAN_H bus line (dominant level is high)
8	-	reserved
9	CAN_V+	like pin 1

1.6.4 Termination Resistors

The USB CAN, serial CAN and network CAN devices have no termination resistors inside. It's up to you to choose the correct combination and values for your topology.

1.6.5 Terminal Block Power (NET-CAN Devices)

The Terminal Block power connector receives positive voltage on the right (V+) pin. The center (V-) pin connector is negative, which is connected to GND and the case. GND is the same as Field GND (FG), so the standard adapter does not connect to this pin.



2 Application Programming Interface

2.1 Introduction

The Application Programming Interface (API) gives you the right tools to use all of the functions that the VSCAN devices provide. It will make your life much easier to build your own CAN controlling software with these functions, than to implement your application directly on top of the ASCII protocol.

For Windows, the only thing you must do, is to copy the dynamic link library (vs_can_api.dll), the linker input file (vs_can_api.lib) and header file (vs_can_api.h) into your project directory. Include the header in your source code and add the vs_can_api.lib to your project configuration.

For Linux, you must copy the library (libvs_can_api.so) to your global libraries path and add it to your compilation parameters. You must also include the header file (vs_can_api.h) in your source file.

For other operating systems like MacOS you'll have to implement ASCII protocol yourself.

All functions and data structures are explained in the next sub-sections.

You can also use our API library with programming languages other than C/C++. To do so you'll have to learn how to import the functions from our library to your application. To ease this task wrapper for following programming languages will be provided together with VSCAN_API_x_y_z.zip under Wrapper\Languages:

- C#
- VisualBasic.NET
- Delphi
- LabVIEW
- more to come

2.2 Functions

2.2.1 VSCAN_Open

The VSCAN_Open function opens the CAN channel.

```
VSCAN_HANDLE VSCAN_Open(CHAR *SerialNrORComPortORNet, DWORD Mode);
```

Parameters:

SerialNrORComPortORNet

[in] A char pointer with one of the following values.

- VSCAN_FIRST_FOUND - the first device found will be opened
- Serial number of the specific device
- COM port or CAN name where the device is located
- IP address and port number of the device

Mode

[in] The mode in which the CAN channel shall be opened.

- VSCAN_MODE_NORMAL - the normal operation mode
- VSCAN_MODE_LISTEN_ONLY - the listen only mode, in which no CAN interaction will be done from the controller
- VSCAN_MODE_SELF_RECEPTION - the self reception mode, in which the device receives also the frames that it sends. *The firmware version must be 1.4 or greater and the DLL version 1.6 or greater.*

Examples:

```
handle = VSCAN_Open(VSCAN_FIRST_FOUND, VSCAN_MODE_NORMAL);               // Windows, Linux
handle = VSCAN_Open("123456", VSCAN_MODE_LISTEN_ONLY);                  // Windows, Linux
handle = VSCAN_Open("COM3", VSCAN_MODE_NORMAL);                          // Windows, WinCE
handle = VSCAN_Open("/dev/ttyUSB0", VSCAN_MODE_NORMAL);                  // Linux
handle = VSCAN_Open("/dev/can0", VSCAN_MODE_LISTEN_ONLY);                // Linux on Alena (CAN on local b
handle = VSCAN_Open("192.168.254.254:2001", VSCAN_MODE_SELF_RECEPTION);  // Windows, WinCE, Linux
```

2.2.2 VSCAN_Close

The `VSCAN_Close` function will close the CAN channel.

```
VSCAN_STATUS VSCAN_Close(VSCAN_HANDLE Handle);
```

Parameters:

`Handle`

[in] The handle of the CAN device, which shall be closed.

Example:

```
status = VSCAN_Close(handle);
```

2.2.3 VSCAN_Ioctl

You can get and set special information and commands of the CAN device with the `VSCAN_Ioctl` function.

```
VSCAN_STATUS VSCAN_Ioctl(VSCAN_HANDLE Handle, DWORD Ioctl, VOID *Param);
```

Parameters:

`Handle`

[in] The handle of the CAN device, which should be used.

`Ioctl`

[in] Tells the function which of the following ioctl should be called.

`Param`

[in, out] A pointer to the data for the ioctls which are listed below.

VSCAN_IOCTL_SET_DEBUG

You can set the debug verbosity with this ioctl. The higher the debug level the more debug information you get. The `VSCAN_HANDLE` can be `NULL`.

Possible debug levels are:

- VSCAN_DEBUG_NONE *(no debug information)*
- VSCAN_DEBUG_LOW *(errors from the VSCAN API)*
- VSCAN_DEBUG_MID *(information from the VSCAN API)*
- VSCAN_DEBUG_HIGH *(errors from system functions)*

Example:

```
status = VSCAN_Ioctl(NULL, VSCAN_IOCTL_SET_DEBUG, VSCAN_DEBUG_HIGH);
```

VSCAN_IOCTL_SET_DEBUG_MODE

You can set the debug mode with this ioctl. It is possible to log the error to the standard error console output (default value) or to save it in a log file. The log file will be saved in the directory from which your application is running and will be named *„vs_can_api.log"*. The `VSCAN_HANDLE` can be `NULL`.

The debug mode defines are:

- VSCAN_DEBUG_MODE_CONSOLE
- VSCAN_DEBUG_MODE_FILE

Example:

```
status = VSCAN_Ioctl(NULL, VSCAN_IOCTL_SET_DEBUG_MODE, VSCAN_DEBUG_MODE_FILE);
```

VSCAN_IOCTL_GET_API_VERSION

You can request the API version number with this ioctl. Therefore you must commit a pointer of the type VSCAN_API_VERSION to the function. *The DLL version must be 1.6 or greater.*

Example:

```
status = VSCAN_Ioctl(handle, VSCAN_IOCTL_GET_API_VERSION, &version);
```

VSCAN_IOCTL_GET_HWPARAM

This ioctl gives you the possibility to get the hardware parameters (serial number, hardware and software version) of the device. Therefore you must commit a pointer of the type VSCAN_HWPARAM to the function.

Example:

```
status = VSCAN_Ioctl(handle, VSCAN_IOCTL_GET_HWPARAM, &hwparam);
```

VSCAN_IOCTL_SET_SPEED

With this ioctl you can set the speed of your CAN device. The following speed values are supported:

- VSCAN_SPEED_1M
- VSCAN_SPEED_800K
- VSCAN_SPEED_500K
- VSCAN_SPEED_250K
- VSCAN_SPEED_125K
- VSCAN_SPEED_100K
- VSCAN_SPEED_50K
- VSCAN_SPEED_20K

Example:

```
status = VSCAN_Ioctl(handle, VSCAN_IOCTL_SET_SPEED, VSCAN_SPEED_1M);
```

VSCAN_IOCTL_SET_BTR

This ioctl gives you the possibility to configure the speed registers manually (bus timing registers). Therefore you must commit a structure from the type VSCAN_BTR. For more information on this registers, please take a look at the SJA1000 datasheet from NXP Semiconductors or at the following website: www.port.de

Example:

```
VSCAN_BTR btr = { .Btr0 = 0x00, .Btr1 = 0x14 }; // for 1Mb/s

status = VSCAN_Ioctl(handle, VSCAN_IOCTL_SET_BTR, &btr);
```

VSCAN_IOCTL_SET_FILTER_MODE

This ioctl let you set the desired filter mode for the acceptance code and mask. You can switch between single and dual filter mode. For more informations, please take a look at the SJA1000 datasheet from NXP Semiconductors. *The firmware version must be 1.4 or greater and the DLL version 1.6 or greater.*

Example:

```
status = VSCAN_Ioctl(handle, VSCAN_IOCTL_SET_FILTER_MODE, VSCAN_FILTER_MODE_DUAL);
```

VSCAN_IOCTL_SET_ACC_CODE_MASK

You can set the acceptance code and acceptance mask register with this ioctl. This gives you the possibility to filter for special frame types you want to receive. Therefore you must commit a structure from the type VSCAN_CODE_MASK. The VSCAN devices work in single filter mode. For more information on this specific registers, please take a look at the SJA1000 datasheet from NXP Semiconductors.

Example:

```
VSCAN_CODE_MASK codeMask;

// will receive the ids between 0x300 and 0x3ff
codeMask.Code = 0x6000;
codeMask.Mask = 0x1ff0;

status = VSCAN_Ioctl(handle, VSCAN_IOCTL_SET_ACC_CODE_MASK, &codeMask);

// receive all frames on the CAN bus (default)
codeMask.Code = VSCAN_IOCTL_ACC_CODE_ALL;
codeMask.Mask = VSCAN_IOCTL_ACC_MASK_ALL;

status = VSCAN_Ioctl(handle, VSCAN_IOCTL_SET_ACC_CODE_MASK, &codeMask);
```

VSCAN_IOCTL_GET_FLAGS

To get extended status and error flags use this ioctl. Commit a DWORD(32bit) pointer as the `Param` argument. The bit flags and their equivalent macro names are:

- Bit 0: VSCAN_IOCTL_FLAG_RX_FIFO_FULL
- Bit 1: VSCAN_IOCTL_FLAG_TX_FIFO_FULL
- Bit 2: VSCAN_IOCTL_FLAG_ERR_WARNING
- Bit 3: VSCAN_IOCTL_FLAG_DATA_OVERRUN
- Bit 4: VSCAN_IOCTL_FLAG_UNUSED
- Bit 5: VSCAN_IOCTL_FLAG_ERR_PASSIVE
- Bit 6: VSCAN_IOCTL_FLAG_ARBIT_LOST
- Bit 7: VSCAN_IOCTL_FLAG_BUS_ERROR

Take a look at the SJA1000 datasheet from NXP Semiconductors, if you want more information on what's behind bit 2 to 7.

Example:

```
DWORD flags;

status = VSCAN_Ioctl(handle, VSCAN_IOCTL_GET_FLAGS, &flags);
```

VSCAN_IOCTL_SET_TIMESTAMP

You can set on and off the time-stamp functionality with this ioctl. If you switch it on, every received frame will have a valid time-stamp value in the VSCAN_MSG structure. The time base is in milliseconds and will be overrun after 60 seconds (timestamps between 0-60000ms).

Example:

```
status = VSCAN_Ioctl(handle, VSCAN_IOCTL_SET_TIMESTAMP, VSCAN_TIMESTAMP_ON);
```

VSCAN_IOCTL_SET_BLOCKING_READ

This ioctl will set theVSCAN_Read function to blocking mode (default is unblock).

Example:

```
status = VSCAN_Ioctl(handle, VSCAN_IOCTL_SET_BLOCKING_READ, VSCAN_IOCTL_ON);
```

2.2.4 VSCAN_Read

To read one or more CAN frames from the CAN bus, you must use the `VSCAN_Read` function. The read mode of this function is set to non-blocking mode per default. This means that `VSCAN_Read` will return immediately - even when there are no frames at the moment. To make the `VSCAN_Read` blocking, use the ioctlVSCAN_IOCTL_SET_BLOCKING_READ - then it will return only if frames were received.

```
VSCAN_STATUS VSCAN_Read(VSCAN_HANDLE Handle, VSCAN_MSG *Buf, DWORD Size, DWORD *Read);
```

Parameters:

`Handle`

[in] The handle of the CAN device, which should be used.

`Buf`

[in] A pointer to one element or an array of the structure VSCAN_MSG.

`Size`

[in] The number of the array elements in `Buf`.

`*Read`

[out] A pointer to a DWORD that will receive the real number of the frames read.

Example:

```
VSCAN_MSG msgs[10];
DWORD read;

status = VSCAN_Read(handle, msgs, 10, &read);
```

2.2.5 VSCAN_SetRcvEvent

With the VSCAN_SetRcvEvent function you can set an event which will be set when a frame arrives. There are different versions for Windows and Linux. *The DLL version must be 1.6 or greater.*

```
// Windows Prototype:
VSCAN_STATUS VSCAN_SetRcvEvent(VSCAN_HANDLE Handle, HANDLE Event);
// Linux Prototype:
VSCAN_STATUS VSCAN_SetRcvEvent(VSCAN_HANDLE Handle, sem_t *Event);
```

Parameters:

Handle

[in] The handle of the CAN device, which should be used.

Event

[in] In Windows an event handle of the type HANDLE and in Linux a pointer to the sem_t union.

Windows Example:

```
// don't forget your own error handling for the API and system functions
// for further informations on these functions take a look at the MSDN

HANDLE hEvent;
DWORD dwRetCode;

hEvent = CreateEvent(NULL, FALSE, FALSE, NULL);

VSCAN_SetRcvEvent(handle, hEvent);

dwRetCode = WaitForSingleObject(hEvent, INFINITE);

switch(dwRetCode)
{
    case WAIT_OBJECT_0 :
        // a CAN frame arrived
        break;
    default:
        // probe for error
}

CloseHandle(hEvent);
```

Linux Example:

```
// don't forget your own error handling for the API and system functions
// take also a look at sem_trywait, sem_timedwait and the rest of the sem_* functions

sem_t sem;
int retCode;

retCode = sem_init(&sem, 0, 0);

VSCAN_SetRcvEvent(handle, &sem);

retCode = sem_wait(&sem);

// a CAN frame arrived

retCode = sem_destroy(&sem);
```

2.2.6 VSCAN_Write

With the `VSCAN_Write` function you can write one or more frames to the CAN bus. The frames will be buffered and send out after some time - this time can grow up to one time slice of the scheduler (Windows = ˜16ms and Linux = ˜10ms). If you want to send the frames immediately, you must call the functionVSCAN_Flush.

```
VSCAN_STATUS VSCAN_Write(VSCAN_HANDLE Handle, VSCAN_MSG *Buf, DWORD Size, DWORD *Written);
```

Parameters:

`Handle`

[in] The handle of the CAN device, which should be used.

`Buf`

[in] A pointer to one element or an array of the structure VSCAN_MSG.

`Size`

[in] The number of the array elements in `Buf`.

`*Written`

[out] A pointer to a DWORD that will receive the number of frames written.

Example:

```
VSCAN_MSG msgs[10];
DWORD written;

msgs[0].Flags = VSCAN_FLAGS_EXTENDED;
msgs[0].Id = 100;
msgs[0].Size = 1;
msgs[0].Data[0] = 0x1B;

// we will send ten frames with the same data
// to the ids 100-109
for (i = 1; i < 10; i++)
{
    memcpy(msgs + i, &msgs[0], sizeof(msgs[0]));
    msgs[i].Id++;
}

status = VSCAN_Write(handle, msgs, 10, &written);
```

2.2.7 VSCAN_Flush

The VSCAN_Flush function will send all frames immediately out to the CAN bus.

```
VSCAN_STATUS VSCAN_Flush(VSCAN_HANDLE Handle);
```

Parameters:

Handle

[in] The handle of the CAN device, whose data should be flushed.

Example:

```
status = VSCAN_Flush(handle);
```

2.2.8 VSCAN_GetErrorString

The `VSCAN_GetErrorString` function retrieves the associated human readable error string.

```
VOID VSCAN_GetErrorString(VSCAN_STATUS Status, CHAR *String, DWORD MaxLen);
```

Parameters:

`Status`

[in] The status for which the error string should be retrieved.

`String`

[out] A pointer of a string array which will receive the error string.

`MaxLen`

[in] The maximum possible length of the error string (without the terminating zero).

Example:

```
VSCAN_STATUS status = VSCAN_ERR_NO_DEVICE_FOUND;
char string[33];

VSCAN_GetErrorString(status, string, 32);

printf(string);
```

2.3 Types and Structures

2.3.1 VSCAN_HANDLE

```
typedef int VSCAN_HANDLE;
```

This type definition holds the handle of an opened CAN channel. In this case the value is greater than zero. Otherwise the value is equal to one of the type definition VSCAN_STATUS.

2.3.2 VSCAN_STATUS

```
typedef int VSCAN_STATUS;
```

The type definition VSCAN_STATUS can have one of the following status value.

- **VSCAN_ERR_OK** - indicates that everything is okay
- **VSCAN_ERR_ERR** - indicates a general error
- **VSCAN_ERR_NO_DEVICE_FOUND** - indicates that no CAN device was found with the specific functions
- **VSCAN_ERR_SUBAPI** - indicates that an error occurred in a subordinated library
- **VSCAN_ERR_NOT_ENOUGH_MEMORY** - indicates that there is not enough memory to complete the function
- **VSCAN_ERR_NO_ELEMENT_FOUND** - indicates that there is no requested element available (e.g. from an input buffer)
- **VSCAN_ERR_INVALID_HANDLE** - indicates that the handle which is used is not valid (e.g. CAN channel closed)
- **VSCAN_ERR_IOCTL** - indicates that an ioctl request failed; ensure that you've used the right parameter values
- **VSCAN_ERR_MUTEX** - indicates that there was a problem with a used mutex in the VSCAN API (e.g. timeout)
- **VSCAN_ERR_CMD** - indicates that there was a problem to complete a given command on the CAN device

2.3.3 VSCAN_API_VERSION

This structure holds the version information of the API.

```
typedef struct
{
    UINT8  Major;
    UINT8  Minor;
    UINT8  SubMinor;
} VSCAN_API_VERSION;
```

2.3.4 VSCAN_HWPARAM

This structure holds the values of the hardware parameters.

```
typedef struct
{
    UINT32 SerialNr;
    UINT8  HwVersion;
    UINT8  SwVersion;
    UINT8  HwType;
} VSCAN_HWPARAM;
```

The `SerialNr` element comprised the unique serial number reserved for this device. The `HwVersion` holds the revision of the CAN hardware and in the opposite `SwVersion` the actual software version of the firmware. The upper four bits of these variables hold the major and the lower four the minor number. And `HwType` retrieves the type of CAN hardware (e.g. Serial, USB, Net).

2.3.5 VSCAN_MSG

The structure is used for the information of each CAN frame which will be received or transmitted.

```
typedef struct
{
    UINT32 Id;
    UINT8  Size;
    UINT8  Data[8];
    UINT8  Flags;
    UINT16 Timestamp;
} VSCAN_MSG;
```

The element `Id` holds the identifier of the standard or extended CAN frame. The width of the data bytes is saved in the `Size` element and the maximum eight data bytes itself in `Data`. The member `Flags` is a bit-mask to retrieve or set some of these special flags: `VSCAN_FLAGS_STANDARD` - is set when this message is a standard frame, `VSCAN_FLAGS_EXTENDED` - this bit is set in the case of an extended frame and the `VSCAN_FLAGS_REMOTE` bit could be set, when it was or should be a remote request frame. The `Timestamp` element holds the time-stamp of the received frame, when this special function is activated over the ioctl VSCAN_IOCTL_SET_TIMESTAMP. If a frame was received with a time-stamp, also the flag `VSCAN_FLAGS_TIMESTAMP` is set in the member `Flags`.

2.3.6 VSCAN_BTR

This structure is used for the setting of the bus timing register.

```
typedef struct
{
    UINT8 Btr0;
    UINT8 Btr1;
} VSCAN_BTR;
```

The elements `Btr0` and `Btr1` implements the values for the bus timing register one and two. For more information read the chapter 2.2.3 or take a look at the SJA1000 datasheet from NXP Semiconductors.

2.3.7 VSCAN_CODE_MASK

The structure stores the acceptance filter code and filter mask.

```
typedef struct
{
    UINT32 Code;
    UINT32 Mask;
} VSCAN_CODE_MASK;
```

The structure member Code stores the acceptance code and Mask the acceptance mask. For more information see chapter 2.2.3 or take a look at the SJA1000 datasheet from NXP Semiconductors.

3 ASCII Command Set

3.1 Introduction

The ASCII command set gives you the possibility to use the VSCAN device even with a simple terminal program. This makes it very easy for you, to send some frames by hand or to sniff the frames on the CAN bus in a simple human readable view. It will also be possible to use such a simple semantic in a scripting system (e.g. Linux bash-script).

Every binary data will be sent and received by their ASCII hexadecimal equivalents. The return values of all functions will be `CR (ASCII 13)` if the function succeeds or `BELL (ASCII 7)` if the function fails. Some functions have extended return values, but this will be described per function in the command description.

The received frames will be send directly to your ASCII communication channel - e.g. serial port or network connection.

3.2 Commands

3.2.1 Open the CAN Channel

The CAN channel will be opened with the command `O[CR]`, `L[CR]` or `Y[CR]`. The difference between these three types is, that the second command will open the channel in a listen only mode, in which no bus interaction will be done from the controller. The last command will open the channel in a self reception mode, in which the device will also receive the frames that it sents *(only available in firmware version 1.4 or greater)*. Before you will use one of the commands, you should setup a bus timing with the command `S` or `s`. *Anyway, the last configured bit rate is stored in the device and used as the standard bus timing at power up.*

Examples:

Open the channel in normal operation mode.

```
O[CR]
```

Open the channel in the listen only mode.

```
L[CR]
```

Open the channel in the self reception mode.

```
Y[CR]
```

3.2.2 Close the CAN Channel

The CAN channel will be closed with the command `C[CR]`. The command is only active if the CAN channel is open.

Example:

```
C[CR]
```

3.2.3 Setup the Bus Timing (Standard)

The bus timing will be setup-ed with the command `Sn[CR]`. You can only use this command if the CAN channel is closed.

Parameters:

`n`

Could be one of the following values:

- 1 - 20 KBit
- 2 - 50 KBit
- 3 - 100 KBit
- 4 - 125 KBit
- 5 - 250 KBit
- 6 - 500 KBit
- 7 - 800 KBit
- 8 - 1 MBit

Example:

Configure a bus timing of 1 MBit.

```
S8[CR]
```

3.2.4 Setup the Bus Timing (Advanced)

A more user defined bus timing could be configured with the command `sxxyy[CR]`. As with the standard bus timing command above, you can only use it when the CAN channel is closed.

Parameters:

`xx`

This is the hex value of the bit timing register 0.
For more information please take a look at the SJA1000 datasheet from NXP Semiconductors.

`yy`

This is the hex value of the bit timing register 1.

Example:

Configure a bus timing of 100 KBit.

```
s041C[CR]
```

3.2.5 Transmitting a Standard Frame

Transmitting a standard frame (11bit) over the CAN bus will be done with `tiiildd[0-8]`. The return value will be `z[CR]` or the normal error byte (`BELL`). As you can imagine, this command is only available when the CAN channel is open.

Parameters:

`iii`

Standard frame (11bit) identifier.

`l`

Data length (0-8)

`dd[0-8]`

Data bytes in hex. The number of the bytes must be equal with the data length field.

Example:

Sending a frame with id 0x111 and three data bytes 0x10, 0x20, 0x30.

```
t1113102030[CR]
```

3.2.6 Transmitting a Standard Remote Request Frame

Transmitting a standard remote frame (11bit) over the CAN bus will be done with `riiil`. The return value will be `z[CR]` or the normal error byte (`BELL`). This command is only available when the CAN channel is open.

Parameters:

`iii`

Standard frame (11bit) identifier.

`l`

Data length (0-8)

Example:

Sending a remote request frame with id 0x111 and request 3 data bytes.

```
r1113[CR]
```

3.2.7 Transmitting an Extended Frame

Transmitting an extended frame (29bit) over the CAN bus will be done with `Tiiiiiiiildd[0-8]`. The return value will be `Z[CR]` or the normal error byte (`BELL`). The command is only available when the CAN channel is open.

Parameters:

`iiiiiiii`

Extended frame (29bit) identifier.

`l`

Data length (0-8)

`dd[0-8]`

Data bytes in hex. The number of the bytes must be equal with the data length field.

Example:

Sending an extended frame with id 0x111 and three data bytes 0x10, 0x20, 0x30.

```
T00000111 3102030[CR]
```

3.2.8 Transmitting an Extended Remote Request Frame

Transmitting an extended remote request frame (29bit) over the CAN bus will be done with `Riiiiiiiil`. The return value will be `Z[CR]` or the normal error byte (`BELL`). The command is only available when the CAN channel is open.

Parameters:

`iiiiiiii`

Extended frame (29bit) identifier.

`l`

Data length (0-8)

Example:

Sending an extended remote request frame with id 0x111 and a request for 3 data bytes.

```
R00000111 3[CR]
```

3.2.9 Set Time-Stamps

The time-stamp command will set the time-stamp functionality on received frames on or off. This command will only function, when the CAN channel is closed.

Example:

Will set time-stamps on or off.

```
Z1[CR]
Z0[CR]
```

3.2.10 Set Filter Mode

The command `D1[CR]` switch on the dual filter mode and with `D0[CR]` you switch over to the single filter mode. For more information please take a look at chapter 2.2.3. This command is only available if the CAN channel is closed. *The firmware version must be 1.4 or greater.*

Example:

Will set dual or single filter mode.

```
D1[CR]
D0[CR]
```

3.2.11 Set Acceptance Code and Mask Register

With the acceptance code command `Mxxxxxxxx[CR]` and mask register command `mxxxxxxxx[CR]`, you have the choice to filter for specific CAN messages directly on the CAN controller side. For more information please take a look at chapter 2.2.3. This command is only available if the CAN channel is closed.

Example:

We will filter for all standard frames between 0x300 and 0x3ff.

```
M00006000[CR]
m00001ff0[CR]
```

3.2.12 Get Status Flags

To get the status bits when an error occurred, you must use the command `F[CR]`. . For more information on the bit-mask please take a look at chapter 2.2.3. The command is only available if the CAN channel is open.

Example:

Retrieve the status bits as a hexadecimal value. The return value will be formatted like this: `Fxx[CR]`

```
F[CR]
```

3.2.13 Get Version Information

To retrieve the current hard- and software version of the device, you must use the command `V[CR]`. The command is always available and will return the versions formatted like this: `Vxxyy[CR]`. The hardware version is coded in the `xx` (major and minor version) and the software version in the `yy` (also coded as major and minor).

Example:

Retrieving the versions.

```
V[CR]
```

3.2.14 Get Serial Number

With the command `N[CR]` you will retrieve the serial number of the device. This command is always active and will return the decimal serial number like this: `N12345678[CR]`.

Example:

Retrieving the serial number.

```
N[CR]
```

3.2.15 Get Extra-Information

You can retrieve extra information with the command `I[CR]`. The command is always available and will return the values of the bus timing registers, the acceptance code and mask register values, the counter of the arbitration lost interrupt, the arbitration lost capture register, the status register and the value of the error code capture register of the CAN chip. For more information please take a look at the SJA1000 datasheet from NXP Semiconductors.

Example:

Retrieving the extra-information.

```
I[CR]
```

4 Tools

4.1 Firmware-Update

For every VSCAN device you can use our tool vs_fw_update.exe. It will determine the type of device and will use the correct baudrate. If it did not, you can set the baudrate explicitly.

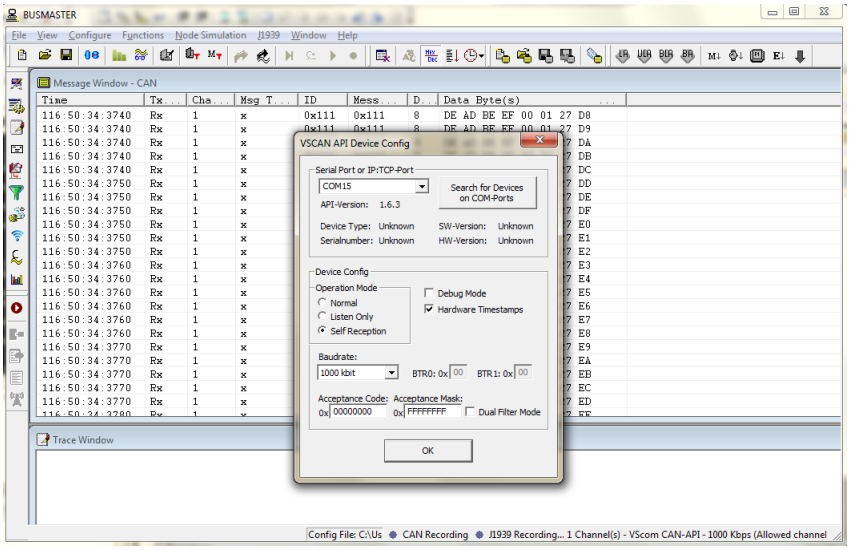
SER-CAN: *vs_fw_update.exe COMx vs_can_1_6.bin 115200*

Other devices: *vs_fw_update.exe COMx vs_can_1_6.bin 3000000*

For the NET-CAN you should use the base64 web-frontend update file (e.g. net-can_110_1_2_1.bin.b64), to update also the main network firmware in the device.

4.2 Busmaster

You can download the Busmaster software for our devices from our website. For additional help and questions, please take a look at the Busmaster website.



4.3 CANHacker

CANHacker is a tool for analyzing and transmitting frames on the CAN bus under MS Windows OS. The Figure 11 will show you how the settings must be configured for the VSCAN devices.

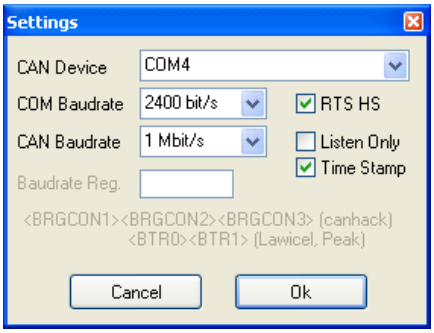


Figure 11: CANHacker Settings

4.4 Wireshark

Wireshark[5] is a well-known network packet sniffer. It is now possible to sniff via Socket-CAN interface (Linux only) and parse CAN frames (Linux/Windows) . Figure 12 shows frames captures via USB-CAN device (`/dev/ttyUSB0` attached as `slcan0`).

[5] www.wireshark.org

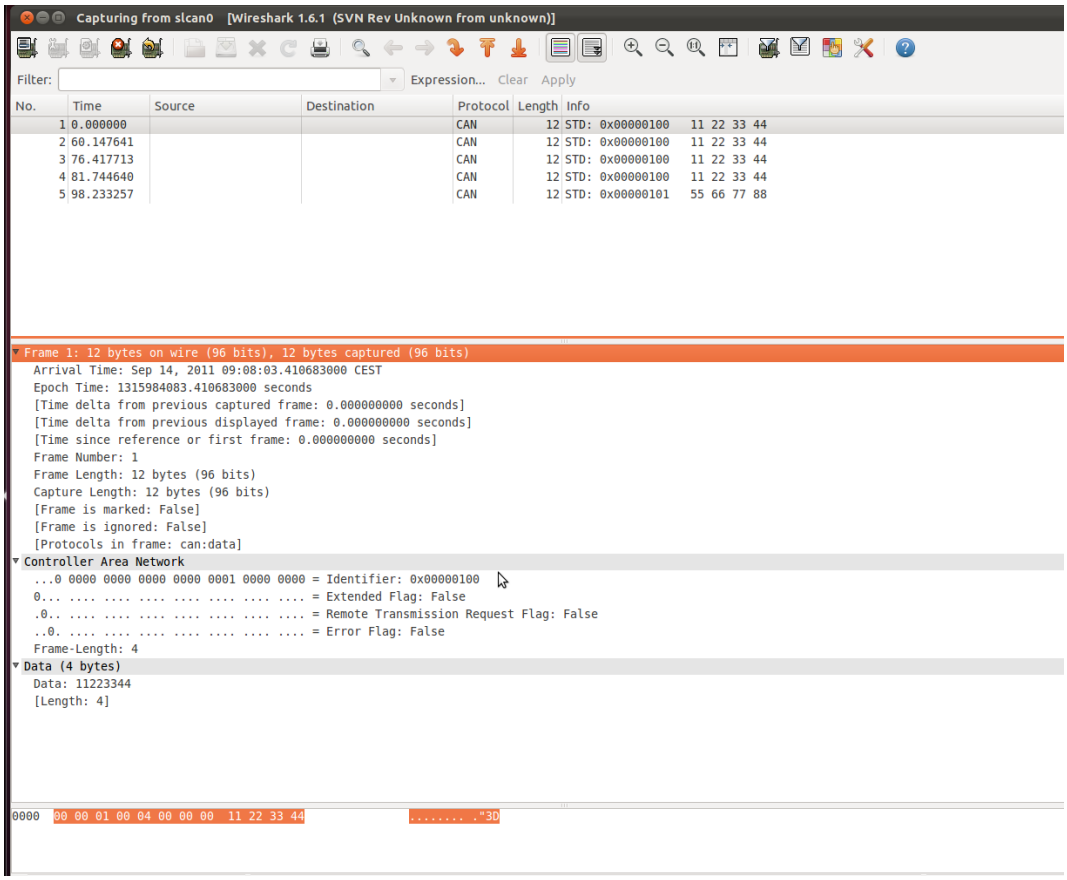


Figure 12: Wireshark

4.5 CANopen

4.5.1 Introduction

CANopen is a CAN-based higher layer protocol. It was developed as a standardized embedded network with highly flexible configuration capabilities. CANopen was designed for motion-oriented machine control networks, such as handling systems. By now it is used in various application fields, such as medical equipment, off-road vehicles, maritime electronics, railway applications or building automation.

CANopen unburdens the developer from dealing with CAN-specific details such as bit-timing and implementation-specific functions. It provides standardized communication objects for real-time data, configuration data as well as network management data.[6]

One of the protocol implementations is the CanFestival Project (www.canfestival.org) . It is an Open Source (LGPL and GPL) CANopen framework and is part of the Beremiz Project (www.beremiz.org), an Open Source framework for automation. CanFestival focuses on providing an ANSI-C platform independent CANopen stack that can be implemented as master or slave nodes on PCs, Real-time IPCs, and Micro-controllers. VScom devices will be already supported in the latest CanFestival version.

Wireshark can be used to capture and analyze CANopen traffic since version 1.7.1 (see Section 4.4).

4.5.2 Running Example

You'll find a small CanFestival example on the supplied CD showing the communication between master and slave nodes. Following baudrates are supported: 20K, 50K, 100K, 125K, 250K, 500K and 1M. To execute this example decompress one of the following archives:

- CANopen_example_win32.zip for Windows
- CANopen_example_linux.tar.bz2 for Linux

Under Windows connect two VScom CAN devices - for example two USB-CAN devices installed as `COM10` and `COM11`. Open two command windows and change to the directory where the CANopen examples were extracted to and execute

```
TestMasterSlave -s COM10 -S 125K -M none -l libcanfestival_can_vscom.dll
```

in the first window and

```
TestMasterSlave -m COM11 -M 125K -S none -l libcanfestival_can_vscom.dll
```

in the second. Figure 13 shows the output messages of both nodes.

Under Linux connect two VScom CAN devices - for example two USB-CAN devices installed as `/dev/ttyUSB0` and `/dev/ttyUSB1`. Open two terminal windows and change to the directory where CANopen examples were extracted to and execute

[6] For more information see the website of CAN in Automation organization www.can-cia.org

```
export LD_LIBRARY_PATH=.
./TestMasterSlave -s „/dev/ttyUSB0” -S 125K -M none -l ./libcanfestival_can_vscom.so
```

in the first window and

```
export LD_LIBRARY_PATH=.
./TestMasterSlave -m „/dev/ttyUSB1” -M 125K -S none -l ./libcanfestival_can_vscom.so
```

in the second. Figure 14 shows the output messages of both nodes.

4.5.3 Compilation Instructions

CanFestival is stored in a Mercurial[7] repository. To get CanFestival source code execute:

```
hg clone http://dev.automforge.net/CanFestival-3/
cd CanFestival-3
```

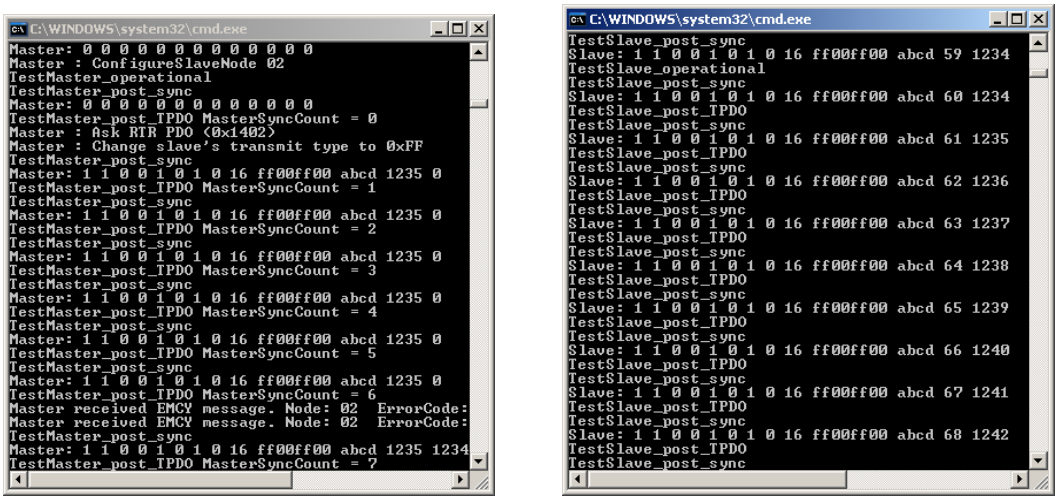
Configure and compile the library and examples:

```
./configure --can=vscom
make
```

The TestMasterSlave is located under `examples/TestMasterSlave/` and the vscom library is located under `drivers/can_vscom/`.

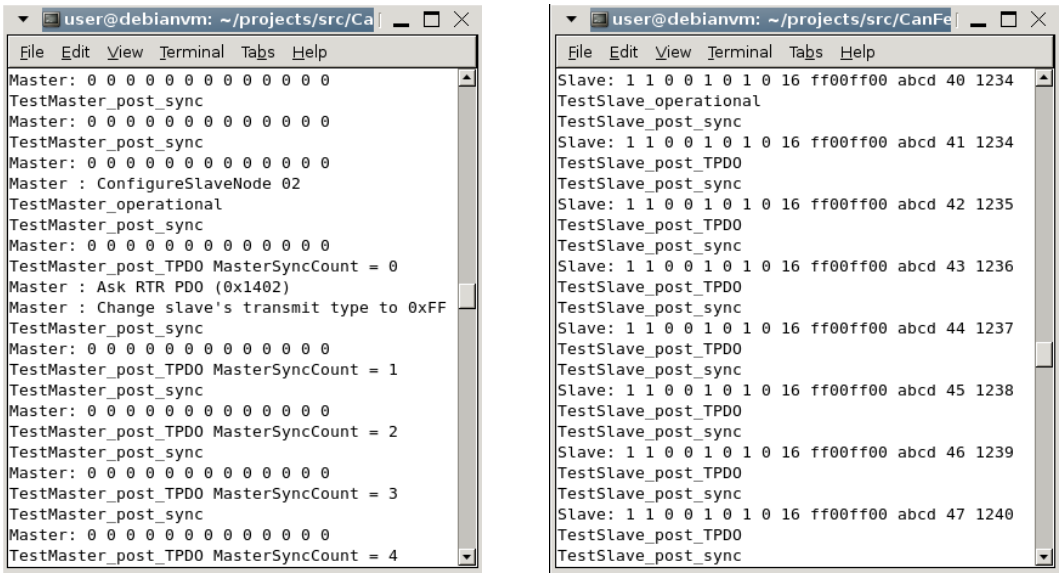
For detailed information about these examples and about using CanFestival in your project refer to the `doc/` folder.

[7] Mercurial



(a) Master (b) Slave

Figure 13: TestMasterSlave under Windows



(a) Master (b) Slave

Figure 14: TestMasterSlave under Linux

4.6 Wrapper DLL System

In Linux operating system any application software may use CAN bus adapters from different manufacturers, without modifying the program. An official CAN API named SocketCAN exists for the Linux Kernel.
In Windows systems the situation is different. There is neither an API from Microsoft[8], nor a widely accepted de-facto standard used by manufacturers. All products come with a proprietary driver to access the CAN bus adapter. On top is a set of libraries for application programmers, encapsulating the hardware in higher layer function sets. Application software tailored to use one set of libraries binds the application to certain CAN bus hardware. Those libraries come in the form of DLLs.

VScom provides a system of wrapper DLLs. They provide the possibility to use any VSCAN product as a replacement of products from other manufacturers, when those are given a set of DLLs. The wrapper DLLs use the same name as the original set. They provide the same functions used by the application software, so the existing software shall not notice that exchange.

Installation: Copy the desired wrapper DLL over the original API DLL in your program directory, thus replacing the version from the other manufacturer. It may be useful to create a backup copy before doing so. You must also copy the latest VSCAN-API (vs_can_api.dll) into the same directory.

Configuration: If you want to specify a special configuration for the mapping of a VSCAN product, you can do this over a configuration file (vscan.ini). When there is no configuration file available, the wrapper API uses the first VSCAN product which will be found in the PC. You can also get extra debug informations when you configure the debug option for the CAN channel in the configuration file. The debug output will be saved in a file called vs_can_api.log in the program directory.

Configuration File Example:

```
[CAN_1.dll]
Port = "COM5"                    ; VSCAN device over a (virtual) COM port
debug = 0

[CAN_2.dll]
Port = "192.168.254.254:2001"    ; mapping to VS-NET-CAN over IP and TCP port (raw mode)
debug = 1                        ; debug output is switched on (vs_can_api.log)
```

Note: In this example CAN_1.dll and CAN_2.dll are just sample text. Replace the text in the brackets with the name of the DLL used by your application. So if in reality the names are XCAN_USB.dll and yCAN_PCI.dll, use those names for the section titles.
The wrapper DLL finds the desired configuration by searching for a section, which is titled by the DLLs name. The set of wrapper DLLs usually provides a sample configuration file.

Currently available are DLLs for the Light API from PEAK-System Technik GmbH.

[8] See serial ports, manufacturers use the Windows API, products are interchangeable.

4.7 ZOC

ZOC (see Figure 15) is a powerful terminal program which has good logging functionality and will also let you make connections over the network (telnet client).

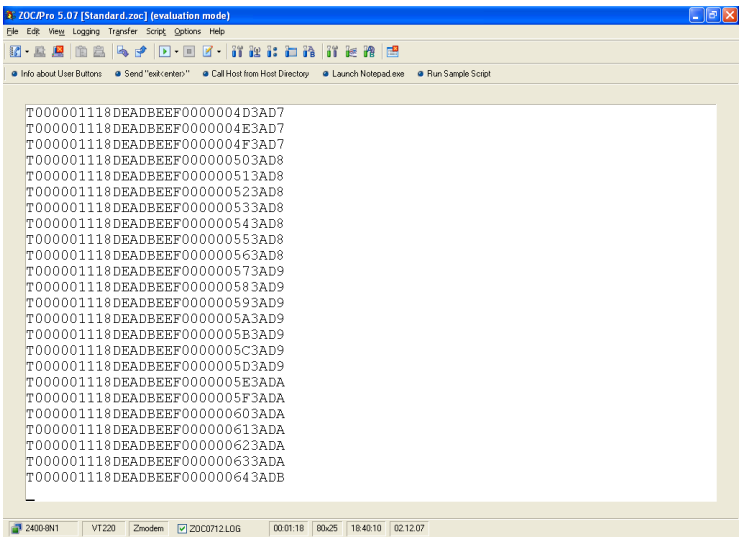
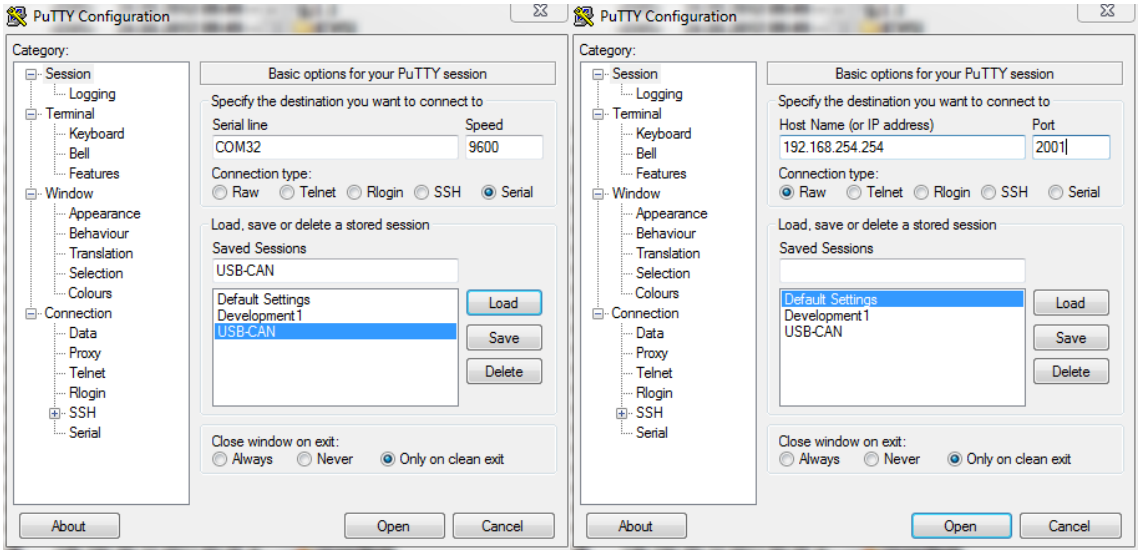


Figure 15: ZOC

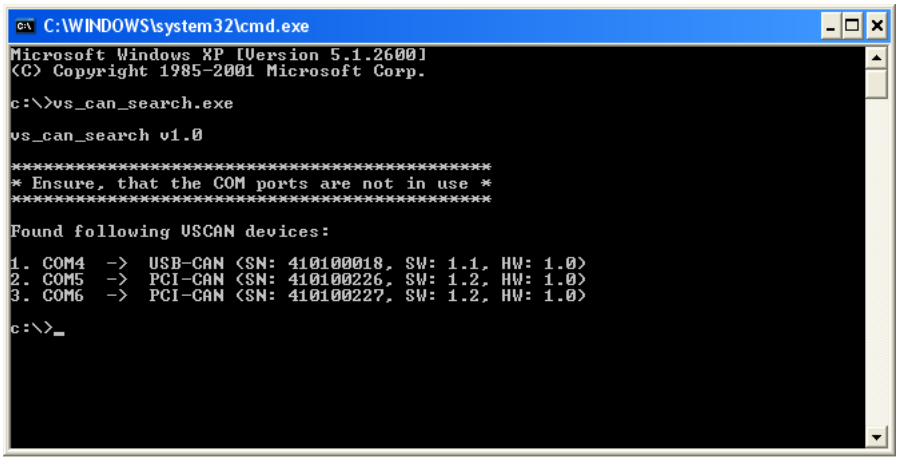
4.8 putty

With putty (http://www.chiark.greenend.org.uk/~sgtatham/putty/) you can both talk to the serial interface based devices like SER-CAN, USB-CAN and PCI-CAN and to the network based devices like NET-CAN.



4.9 vs_can_search

This tool search for VSCAN devices on every COM port. You can also get extra debug informations with the parameter„-d[1-3]" - eg. *„vs_can_search.exe -d3"*.



4.10 LabVIEW

LabVIEW (short for Laboratory Virtual Instrumentation Engineering Workbench) is a platform and development environment for a visual programming language from National Instruments. This section shows one possible way to use vs_can_api.dll with LabVIEW. Specially prepared example (see Figure 16) can be found on the product CD[9]. It lets the user to send and read CAN frames after opening the channel with appropriate bitrate.

You can send CAN frames using the left panel. After configuring your CAN frame just press „Write On/Off" Button and frames will be sent each second. The incoming frames will be shown on the right panel one per second if any available.

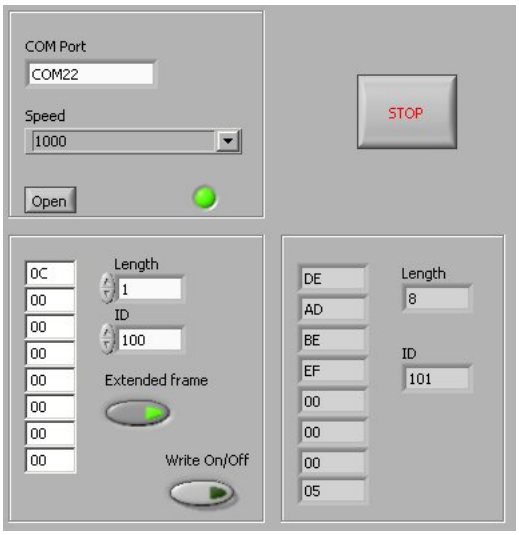


Figure 16: Example Application

4.10.1 Open CAN Channel

The OpenChannel.vi has following input parameters:

- COM Port string
- speed as a number between 1 and 8 (as in Section 3.2.3).

Output parameters:

- return error code of VSCAN_Open() or VSCAN_Ioctl() routines
- CAN channel handle.

[9] see VSCAN_API_x_y_z.zip\Wrapper\Languages\LabVIEW

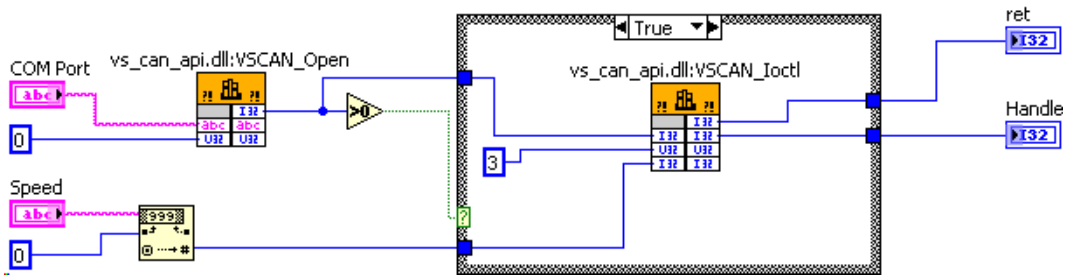


Figure 17: Open CAN Channel

4.10.2 Read CAN Frame

The CanRead.vi has following input parameter:

- handle

Output parameters:

- return code value
- VSCAN_MSG structure
- number of read bytes

CanRead.vi is designed to read one CAN frame per call. To read more bytes at once, the buffer must be increased.

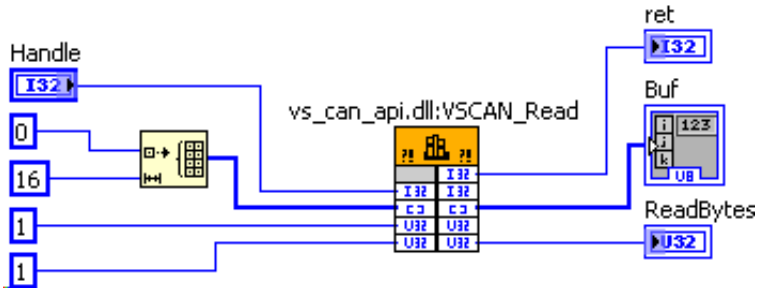


Figure 18: Read CAN Frame

4.10.3 Write CAN Frame

The CanWrite.vi has following input parameters:

- handle
- parts of the VSCAN_MSG structure

Output parameters:

- return code value
- number of written bytes

The VSCAN_Write call is followed directly by VSCAN_Flush call, so the CAN frame will be sent immediately

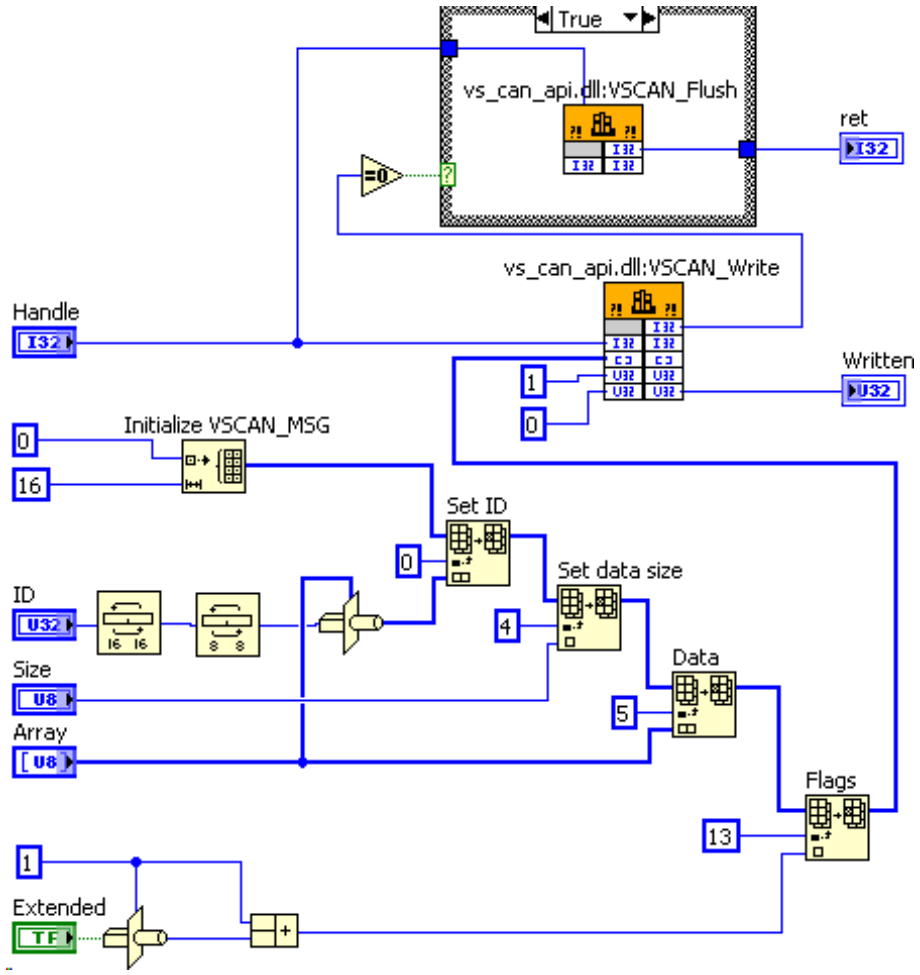
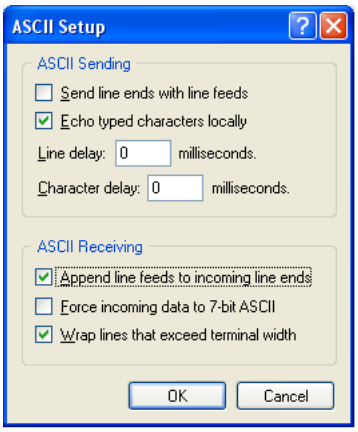


Figure 19: Write CAN Frame

5 Frequently Asked Questions

All output from the CAN adapter will be written in one line in HyperTerminal?

You must configure the right settings and switch on "**Append line feeds to incoming line ends**":



I've updated the driver of my USB-CAN, but the alias baudrate 9600 is not functioning anymore?

There is a VBScript in the driver package, which must be called for each installed virtual USB-CAN COM port:

cscript regmodify.vbs COM<x>

After executing the script USB-CAN must be disconnected for about 5 seconds and then connected again in order to use the baudrate aliases. Then you can open the port with any standard baudrate - **except 115kbps!**