Remote control manual

for High Voltage devices with

RS-232, USB, IEEE-488 and Ethernet interfaces

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Remote Control of HPS/LPS, MICC, NHQ/SHQ and THQ devices

The information in this manual applies to the following iseg High Voltage modules:

- HPS/LPS 19” 300 W...3000 W with Firmware 5.28 or higher
- HPS/LPS 19” 10 kW / 3 kW / 1.5 kW with Firmware 1.02 or higher
- HPS/LPS compact with Firmware 1.15 or higher
- THQ with Firmware 2.02 or higher
- NHQ Standard with RS-232 and Firmware 2.08 or higher
- NHQ High Precision with RS-232 and Firmware 3.12 or higher
- SHQ with RS-232 and Firmware 3.11 or higher
- MICC with Firmware 3.00 or higher

These modules are equipped with RS-232, USB, GPIB (IEEE-488) and/or Ethernet interfaces.

Some of these modules also have a CAN interface, which is not described here. For more information, please refer to the device's manual.

If you have suggestions to this manual or further questions, please contact support@iseg-hv.de.

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RS-232 / USB

RS-232

The RS-232 interface is located at a D-SUB-9 connector at the device rear.

The electrical transfer is working indirectly coupled via RxD and TxD related to GND. The D-SUB-9 pin assignment is shown in the following table.

The cable connection to the computer is 1:1 (no zero modem-cable!). If no 9-pole cable is available, then the connections between DTR, DSR and CTS shown in the table have to be made at the Personal computer side.

Signal	High Voltage module		Personal Computer		Connection
RS-232	D-SUB-9	Internal	D-SUB-9	D-SUB-25	3-pol. cable
RxD	2		2	3	
TxD	3		3	2	
GND	5		5	7	
DTR	4		4	20	
DSR	6		6	6	
CTS	8		8	5	

It is, of course also possible to use an USB-serial converter to connect the device to the computer. We recommend the use of FTDI chipset based adapters.

USB

The USB interface is realized with a female USB-B connector at the device rear. On MICC devices, this USB-B connector is located at the Front panel. On EHQ 1 channel devices, the USB is located on the Front panel using a Mini-USB-B connector. Internal, the USB is implemented as an USB serial converter FTDI FT232R.

This device functions as a virtual serial port in PC, and thus can be used with every program that supports a serial port, e. g. a terminal program or LabVIEW.

On Windows, a device driver has to be installed to use the USB interface. This installation is described later in this manual. In Linux the driver is already included in the Linux Kernel 2.6.x.

Programming

The following description applies both to the RS-232 and USB interface.

For devices with different interfaces, please select RS-232/USB interface first. Please refer to the device manual for further information how to do this.

The (virtual) serial interface is set to 9600 bit/s, 8 Bit/character, no parity, 1 Stop bit.

The data transfer is character oriented, while the synchronization in direction "Computer to HV PS unit” (Input direction) is made by echoes. The transfer direction “HV-PS to computer“ (Output direction) is free running.

The command transfer works with ASCII code. Commands are terminated by <CR><LF> ($0D $0A or 13 10). On input side, no leading zeros are needed. Output is fixed format without leading zero.

A minimum time delay of 20 ms between write and read instructions is recommended.

Example with echo:

Computer Tx:	*IDN?<CR><LF>		
Computer Rx:	*IDN?<CR><LF>		iseg Spezialelektronik GmbH […] 5.28<CR><LF>

Programming considerations

1. Clear computers serial input buffer from all remaining characters (read till the input buffer is empty).
2. Send commands one character a time and read back the echo character before sending the next character. If you receive the wrong or no echo, there is probably a communication problem.
3. All commands must be closed with CR+LF combination, which is “\r\n” in C programming language.
4. Wait for receiving the answer. The answer is also closed with CR+LF. It's best to fill a buffer with the incoming characters until receiving the closing CR+LF. It may be necessary to define a timeout, in case communication breaks. Useful timeouts are in the range of 100 ms...500 ms. Also check that you are not overrunning your input buffer.
5. Often you receive integer or rational numbers as answer. They can be converted to int or float data type using the atoi() or atof() function in C programming language.
6. After receiving the answer, the device needs some time to do internal cleanup. Give it approximately 20 ms before sending the next command.

Example

TODO

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GPIB (IEEE-488)

IEEE-488 Interface

The IEEE-488 bus interface is implemented with a NEC 7210 compatible IEEE controller. The following interface functions according to IEC 625 are available:

SH1	Source Handshake:	all functions (no polling)
AH1	Acceptor Handshake:	all functions (no polling)
T6	Talker:	standard equipment
L4	Listener:	standard equipment

To connect the device to the IEEE bus, a Micro-D25 male connector is located at the device rear. An adapter cable with a 24 pin connector following IEEE-488.2 standard is available optional.

Programming

The command transfer works with ASCII code. Commands are terminated by <CR><LF> ($0D $0A or 13 10). In C programming language, the corresponding characters are “\r\n”.

Alternatively, the control line EOI (End or Identify) can be set together with the command’s last character.

A time delay of 5 ms between two IEEE commands is recommended.

Programming example using the National Instruments GPIB API

Our examples were tested with National Instruments PCI and USB GPIB adaptors under Windows XP.

API commands provided by National Instruments GPIB-32.DLL:

ibdev()	open GPIB connection to HV device
ibwrt()	write data to HV device
ibrd()	read data from HV device
ibonl()	close connection

Debugging GPIB communication with NI Spy

GPIB example program:

```
#include <stdio.h>
#include "gpib32.h"

void main(int argc, char *argv[])
{
	char buf[255] = "*IDN?";
	int  dev;

	// ibdev takes six parameters:
	// 1. the GPIB interface board index
	// 2. the GPIB address of the device to talk/listen to
	// 3.
	// 4. a timeout value
	// 5.
	// 6.
	dev = ibdev(0, 17, 0, T100ms, 1, 0);

	ibwrt(dev, buf, strlen(buf)); // talk five characters to the HV device
	ibrd(dev, buf, sizeof(buf)); // listen to answer from device

	printf("%s\n", buf);

	ibonl(dev, 0);
}
```


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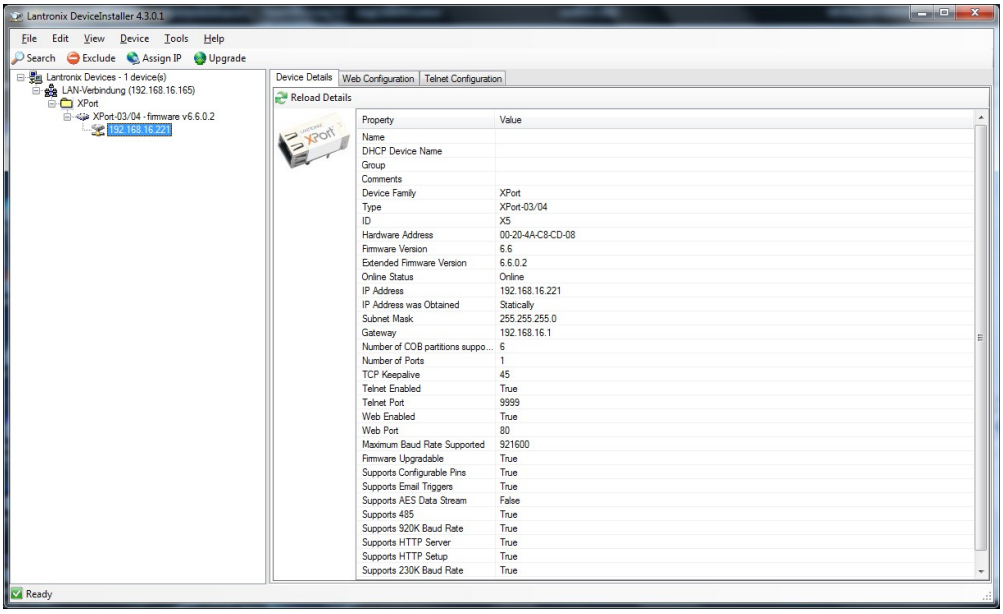
Ethernet

The 100 MBit/s full duplex Ethernet interface is connected via a RJ-45 socket at the device front panel.

The device can be connected to a switch via patch cable. If it shall be connected to a PC directly, a crossover cable has to be used.

The configuration of the Ethernet interface have to be made via the tools of Lantronix company:

http://www.lantronix.com/support/downloads/?p=XPORT



Factory settings are shown in the following table. Please change them according your needs:

IP Address:	192.168.16.221
Network Mask:	255.255.255.0
Default Gateway:	192.168.16.1
Command Port:	10001 (fixed)

The connection can be tested with the ping command
(Start → programs → accessories → command):

```
C:\>ping 192.168.16.221

Ping will done for 192.168.16.211 with 32 bytes data:

Answer from 192.168.16.221: bytes=32 time=4ms TTL=128

Answer from 192.168.16.221: bytes=32 time=4ms TTL=128

Answer from 192.168.16.221: bytes=32 time=4ms TTL=128

Answer from 192.168.16.221: bytes=32 time=4ms TTL=128


Ping statistic for 192.168.16.221 :

Package: sent = 4, received = 4, lost = 0

Time in millisecond:

minimum = 1ms, maximum = 4ms, average = 1ms
```

During communication, the HV unit act as server, the control PC acts as client. The following table shows the principle sequence of communication between PC and HV unit.

Step	Function call	Computer → HV unit	HV unit → Computer
1.	connect()	SYN	
2.			SYN, ACK
3.		ACK	
4.	send()	"*IDN?\r\n"	
5.	recv()		"iseg Spezialelektronik GmbH, MICC[...]\r\n"
6.	closesocket()	FIN, ACK	
7.			FIN, ACK
8.		ACK	

The first three packages establish a TCP-Connection between Computer and HV unit (three way handshake). Fourth step is the inquiry from PC to HV unit. The command is ASCII coded in data field of the TCP packet. The answer is also ASCII coded send to the PC in step 5. Package No. 6 confirms the receipt of the packet and sends a FIN for termination of connection. Step 7 and 8 are the confirmation of termination of connection from HV unit and PC.

The answer from the device may be splitted in more than one TCP frame. Simply collect all incoming frames until you receive “\r\n” or you run in your self defined timeout.

The communication can be monitored with a network sniffer (e. g. Wireshark). Control is done with the instruction sets described in the manual of your HV device. The preferred command set for Ethernet is “SCPI with EDCP”, as you can build longer Frames which reduces Ethernet Overhead.

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Ethernet programming

Simple programming example (without error handling) for communication with the HV device over Ethernet. This program was compiled and tested on Windows XP with Microsoft Visual C++ 6.0, Borland C++ Builder 6.0 and mingw32 (gcc) 4.4.0.

```
#include <stdio.h>
#include <winsock.h>

int main(int argc, char *argv[])
{
	WSADATA     wsadata;
	SOCKET      sock;
	SOCKADDR_IN sockaddr_in;
	int         retcode;
	char        cmd[255] = "*IDN?\r\n";
	char        ans[255] = "";
	char        buf[255];
	char        *crlf;

	// init sockets (Berkeley style, UNIX compatible)
	WSAStartup(2, &wsadata);

	// create TCP socket
	sock = socket(AF_INET, SOCK_STREAM, IPPROTO_TCP);

	// bind socket to dynamic local port
	memset(&sockaddr_in, 0, sizeof(sockaddr_in));
	sockaddr_in.sin_family = AF_INET;             // UDP, TCP
	sockaddr_in.sin_port   = htons(10001);        // remote Port
	sockaddr_in.sin_addr.S_un.S_un_b.s_b1 = 192; // IP address
	sockaddr_in.sin_addr.S_un.S_un_b.s_b2 = 168;
	sockaddr_in.sin_addr.S_un.S_un_b.s_b3 =  16;
	sockaddr_in.sin_addr.S_un.S_un_b.s_b4 = 221;

	// connect to server (three way handshake)
	connect(sock, (SOCKADDR *)&sockaddr_in, sizeof(SOCKADDR_IN));

	// send command to server
	send(sock, cmd, strlen(cmd), 0);

	// read answer from server
	do {
		retcode = recv(sock, buf, sizeof(ans), 0);

		if (retcode > 0) {
			buf[retcode] = 0;
			strcat(ans, buf);
		}

		crlf = strstr(ans, "\r\n");
	} while ( (retcode > 0) && (crlf == 0) );

	if (crlf > 0) {
		*crlf = 0;
	}

	// close socket (three way handshake) and clean up
	closesocket(sock);
	WSACleanup();

	printf("%s\n", ans);

	getchar();

	return 0;
}
```

Windows USB driver installation

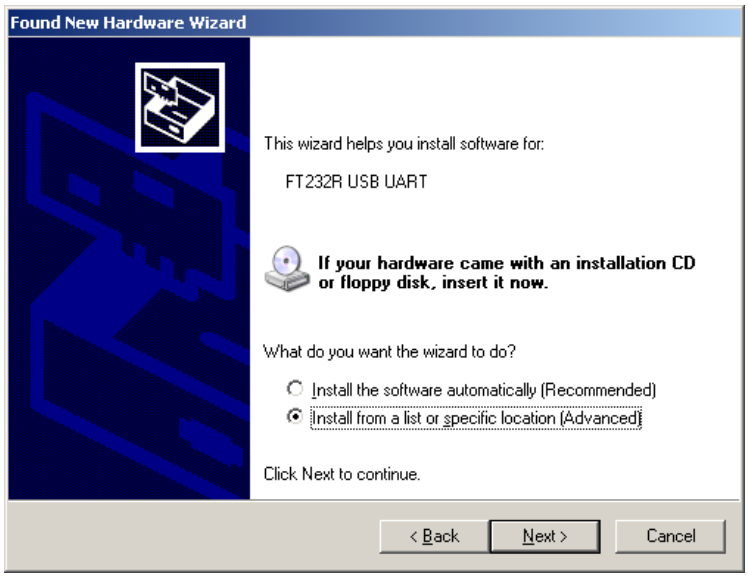
The FTDI VCP driver (Virtual COM Port) is available for download at:

http://www.iseg-hv.com → Download → Software → USB driver for THQ/EHQ/HPS

The following steps are necessary for installation:

1. Extract the FTDI driver “CDM 2.04.16 WHQL Certified.zip“, e. g. to C:\Temp\
2. Connect the HV device to the computer via USB
3. The “Found new Hardware” wizard appears.
   Please choose “No, not this time” in the first dialog and then click Next.

4. Choose “Install from a list or specific location” in the next dialog and then click Next:



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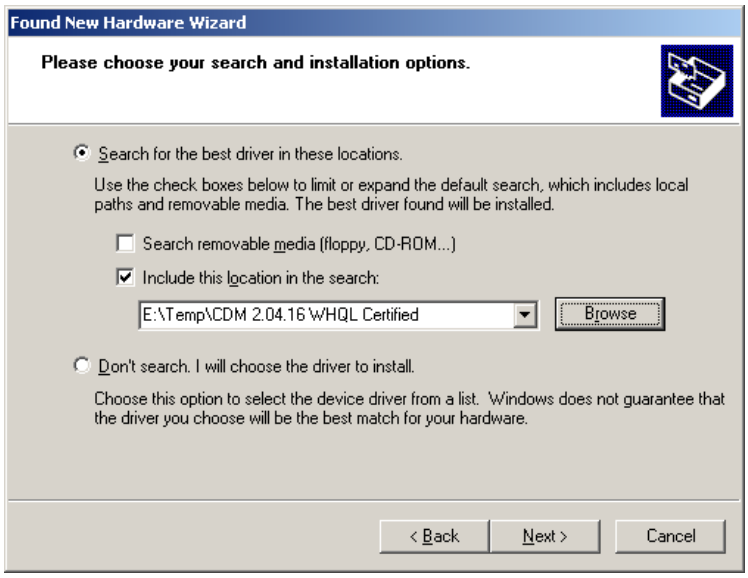
5. Please choose the directory you extracted the driver and click Next:



6. After some copying you get the final dialog:

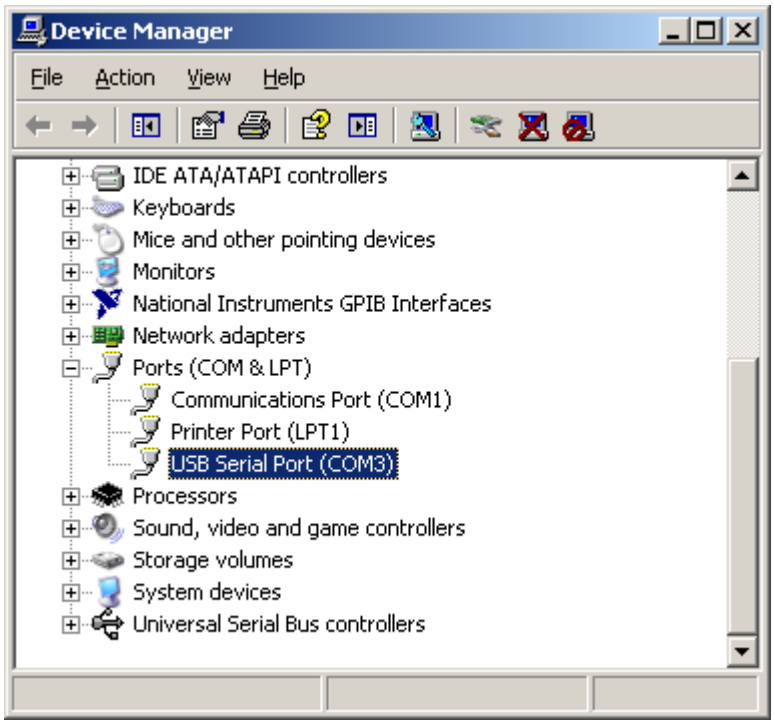
It may be necessary to repeat the steps 3 to 6, before the device can be used
(the first time, a bus driver is installed, the second time, the virtual COM port driver is installed).

Determine the serial USB interface with Device Manager

Start the Windows Device Manager with:

Start → Settings → Control Panel → System → Device Manager

All HV devices with USB interface get an “USB Serial Port” assigned in section Ports (COM & LPT), in this case COM3. You can communicate with the device over this virtual COM port.



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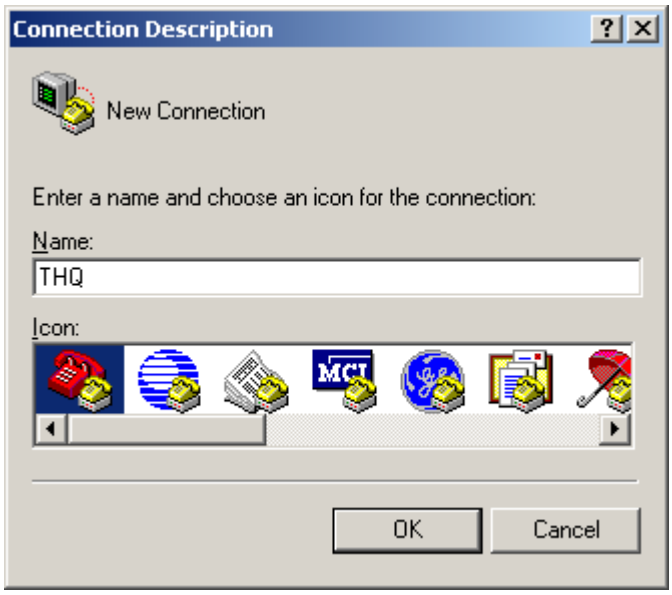
Control Software

Windows HyperTerminal

HyperTerminal is included in Windows 2000 and XP and can be started with:

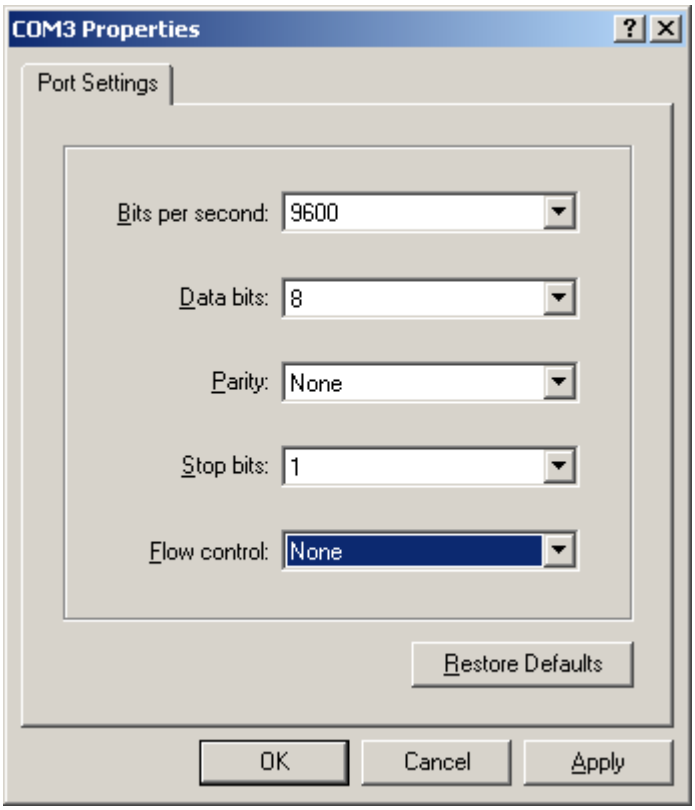
Start → Programs → Accessories → Communications →HyperTerminal

Create a new connection with menu „File → New Connection“, name it e. g. “THQ” and click OK.



The following dialog appears. Choose your (virtual) serial port and click OK:

As next step, please enter the interface parameters in the following dialog:

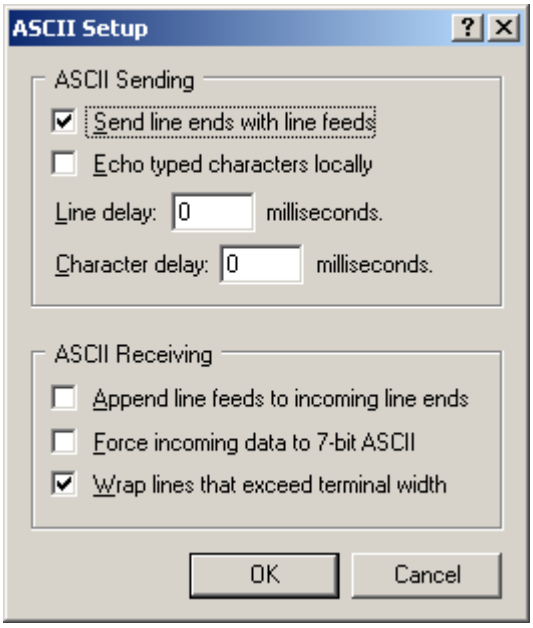


After clicking OK, the interface setup is finished. As last step, in menu:

File → Properties → Settings → ASCII Setup

the setting “Send line ends with line feeds” must be checked to close every command with CR+LF (see following picture).

Please note, that this setting does not apply to the Enter key on the numeric keypad, so please don't use the numeric keypad Enter key.



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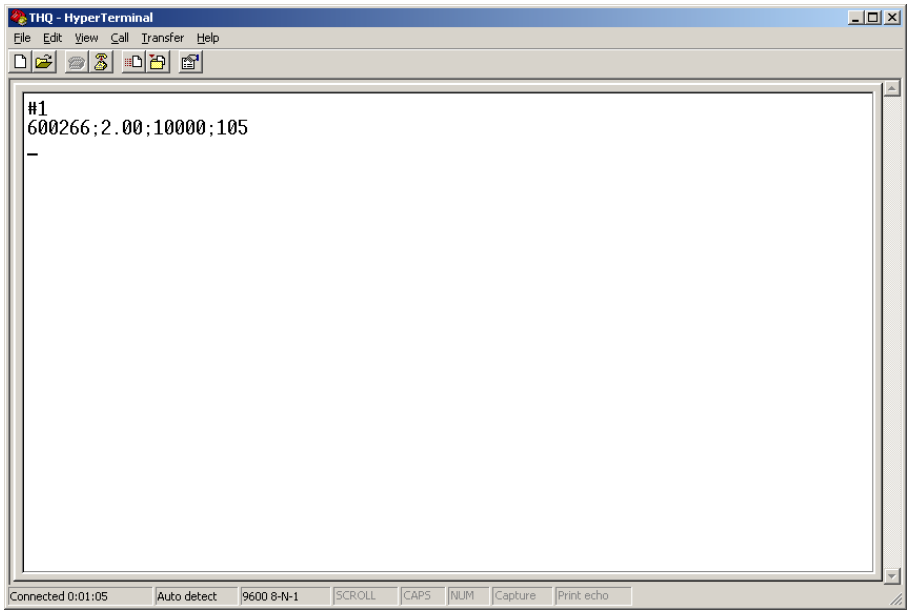

One advantage of HyperTerminal is, that the echo is directly visible. Each character typed on the keyboard is transmitted over the serial line to the high voltage device, received there and sent back as echo to the computer, where it is shown on the screen. So if you see the characters you type, you know the serial connection is OK.

Linux USB driver installation

The USB driver is already included in Kernel series 2.6 and should be loaded automatically when connecting the device over USB to the computer. The driver provides a virtual serial port /dev/ttyUSB0 (or increasing number when using more then one device) that can be accessed with a Terminal program (e. g. CuteCom).

The following `dmesg` output shows how the device is recognized and the ftdi_sio driver is loaded:

```
[234.496011] usb 1-2: new full speed USB device using uhci_hcd and address 2
[234.694884] usb 1-2: configuration #1 chosen from 1 choice
[234.704371] usb 1-2: New USB device found, idVendor=0403, idProduct=6001
[234.704376] usb 1-2: New USB device strings: Mfr=1, Product=2, SerialNumber=3
[234.704380] usb 1-2: Product: FT232R USB UART
[234.704382] usb 1-2: Manufacturer: FTDI
[234.704385] usb 1-2: SerialNumber: A60075cx
[234.807627] usbcore: registered new interface driver usbserial
[234.807649] usbserial: USB Serial support registered for generic
[234.807679] usbcore: registered new interface driver usbserial_generic
[234.807683] usbserial: USB Serial Driver core
[234.816739] usbserial: USB Serial support registered for FTDI USB Serial Device
[234.816774] ftdi_sio 1-2:1.0: FTDI USB Serial Device converter detected
[234.816805] ftdi_sio: Detected FT232RL
[234.816855] usb 1-2: FTDI USB Serial Device converter now attached to ttyUSB0
[234.816872] usbcore: registered new interface driver ftdi_sio
[234.816876] ftdi_sio: v1.4.3:USB FTDI Serial Converters Driver
```

If the driver is not loaded automatically, you can try “modprobe ftdi_sio” with root rights.

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CuteCom

CuteCom is a graphical Qt 4 based terminal program for Linux/UNIX. It can be downloaded at

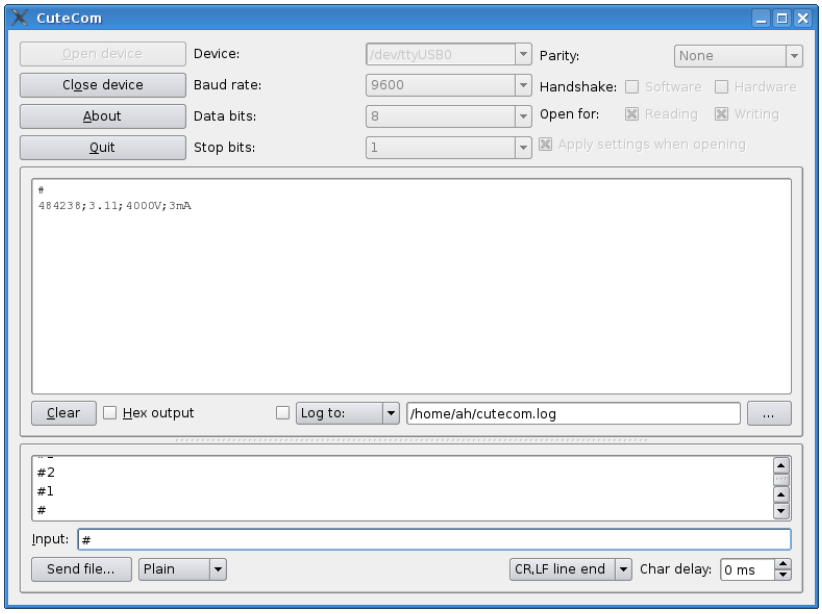
http://cutecom.sourceforge.net

or installed directly by the packet manager of your Linux distribution.

The following settings are needed to connect to iseg HV devices with RS-232 or USB port:

- Device: /dev/ttyS0 (RS-232) or /dev/ttyUSB0 (USB) or other port number
- Baud rate: 9600
- Data bits: 8
- Stop bits: 1
- Parity: None
- Handshake: None
- Line end: CR,LF

Now the serial interface can be opened by „Open device”. You can then test the communication with the device:



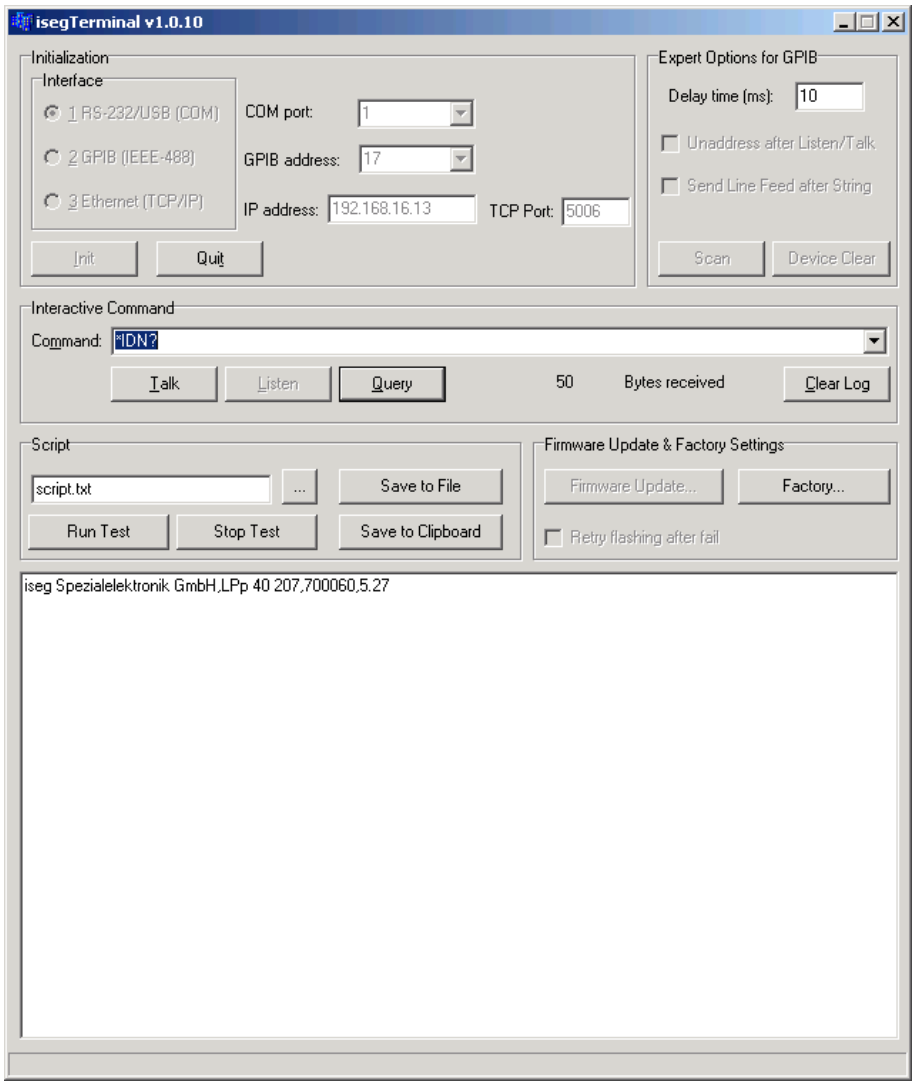
isegTerminal

isegTerminal is a Windows program to control iseg high voltage devices over RS-232, USB, GPIB (IEEE-488) or Ethernet interfaces using their ASCII command sets.

This program can be downloaded at:

http://www.iseg-hv.com → Downloads → Software → isegTerminal

The main window looks as in the following picture:



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Communication

For serial communication, choose “1 RS-232/USB” in the Interface List and select the COM-Port you connected your iseg device to. The List of COM ports is filled at startup, so connect USB devices before starting isegTerminal. With a click on Init, the serial port is opened and you can send commands to your device by clicking the Query button (or simply pushing the Enter key).

The answer from the device is shown in the output window.

For detailed command set descriptions, please see the documentation for the specific device. The following commands are used for device identification query:

- HPS, LPS, MICC, EHQ[1]: “*IDN?”
- SHQ, NHQ, EHQ[2]: “#”
- THQ: “#1” (channel 1), “#2” (channel 2), “#3” (channel 3)

Communication over GPIB or Ethernet is also simple.

For GPIB select “2 GPIB (IEEE-488)” and then the GPIB address of your device. If you don't know the address, you can use the “Scan” button which queries all devices on the bus.

For Ethernet select “3 Ethernet (TCP/IP)” and then enter the IP address of you device. Check the TCP port according to your devices manual.

Scripting

isegTerminal is able to send text files with commands to the HV device. This works as entering the commands consecutive in the command window. The complete script is executed in a loop until a “STOP” command is found.

There are several commands that are interpreted as Script control:

- STOP — stops a script at this point
- SLEEP — waits for a specific time in milliseconds (use a tabulator between SLEEP and the wait time)
- SDC — sends a “Selected device clear” to the device (GPIB only)

1 EHQ in SCPI mode

2 EHQ in DCP compatibility mode

A free programming environment for Windows

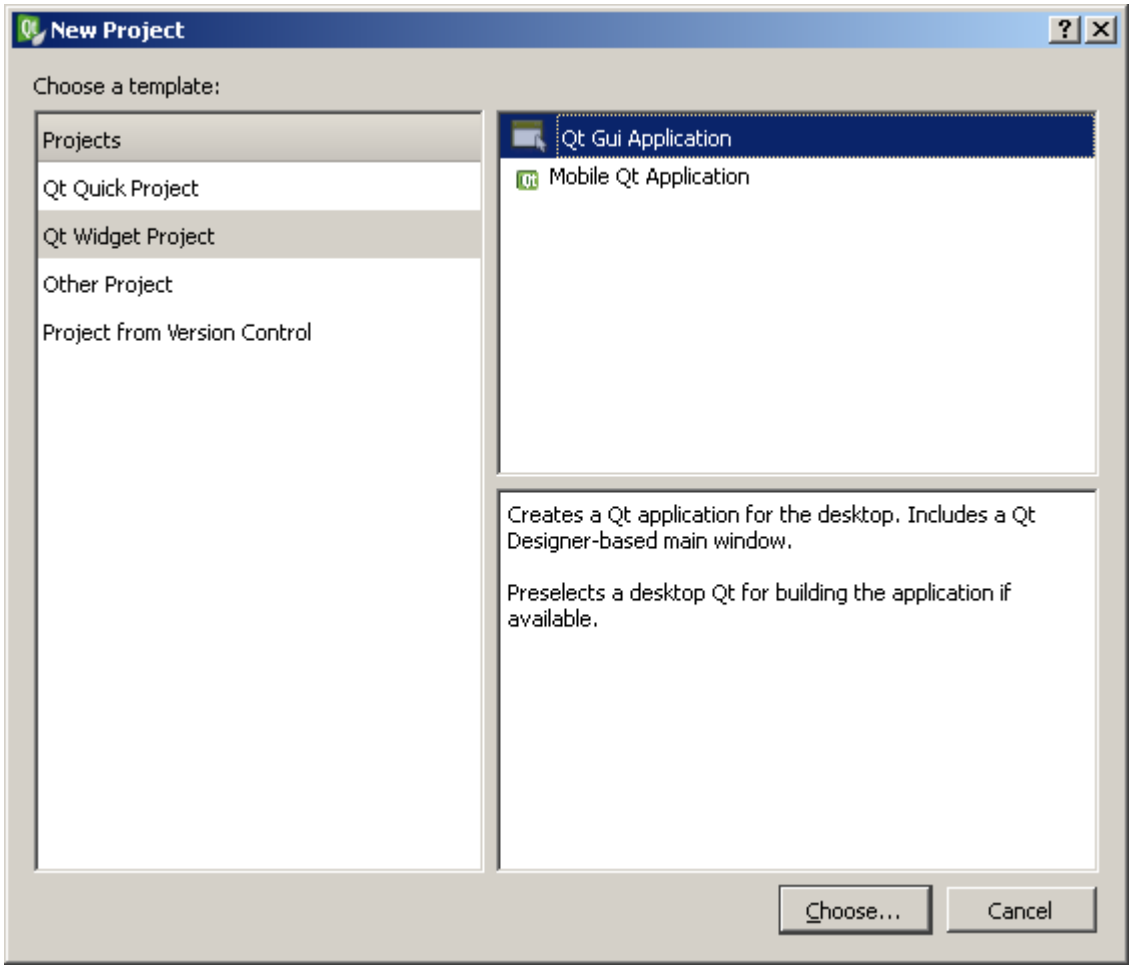
For Windows C/C++ development we recommend the Qt SDK by Nokia http://www.qt.nokia.com which consists of the Library Qt for platform-independent C++ development, the mingw32 (gcc) compiler and a comfortable Integrated Development Environment (IDE) called Qt Creator. You can, of course, also use all these tools under Linux.

This allows you to compile and extend most of the examples without buying any expensive development software.

At the time this document was created, the Qt SDK 2010.05 in combination with Qt Creator 2.2.0 was used.

Create a new project with Qt Creator

Start Qt Creator and choose “Create Project” in the Welcome screen. The following dialogue appears:



For our Hello world application, select “Qt Widged Project” → “Qt Gui Application” and click button “Choose...”.

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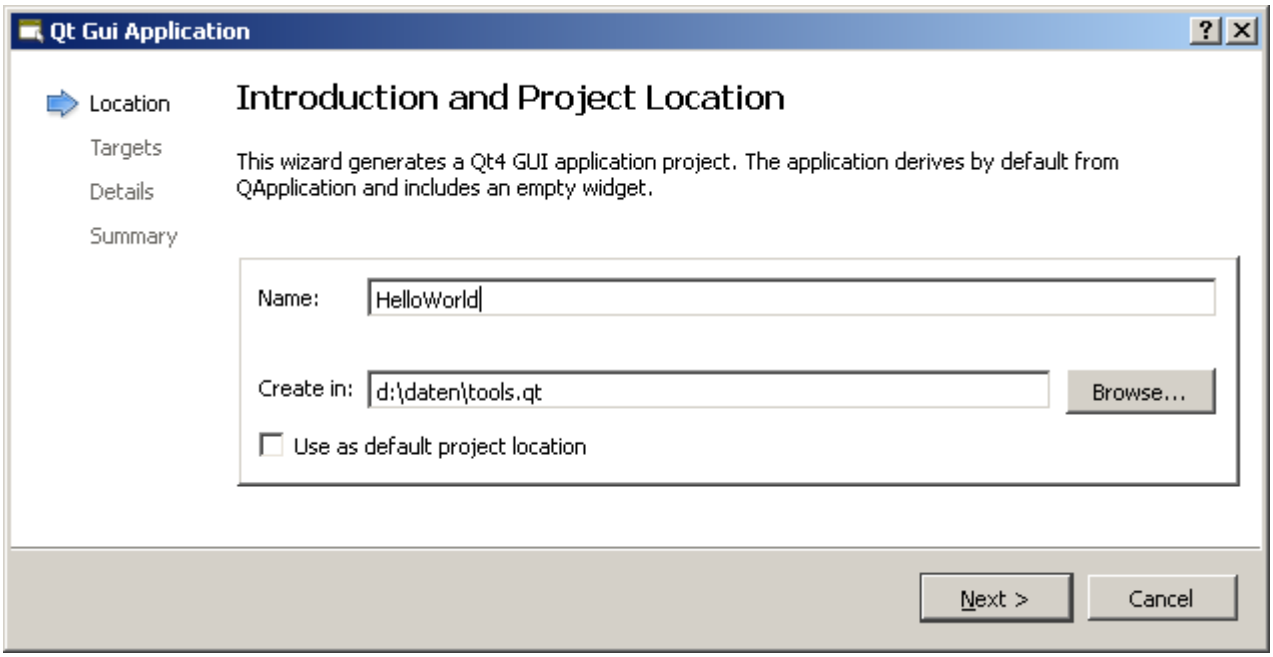
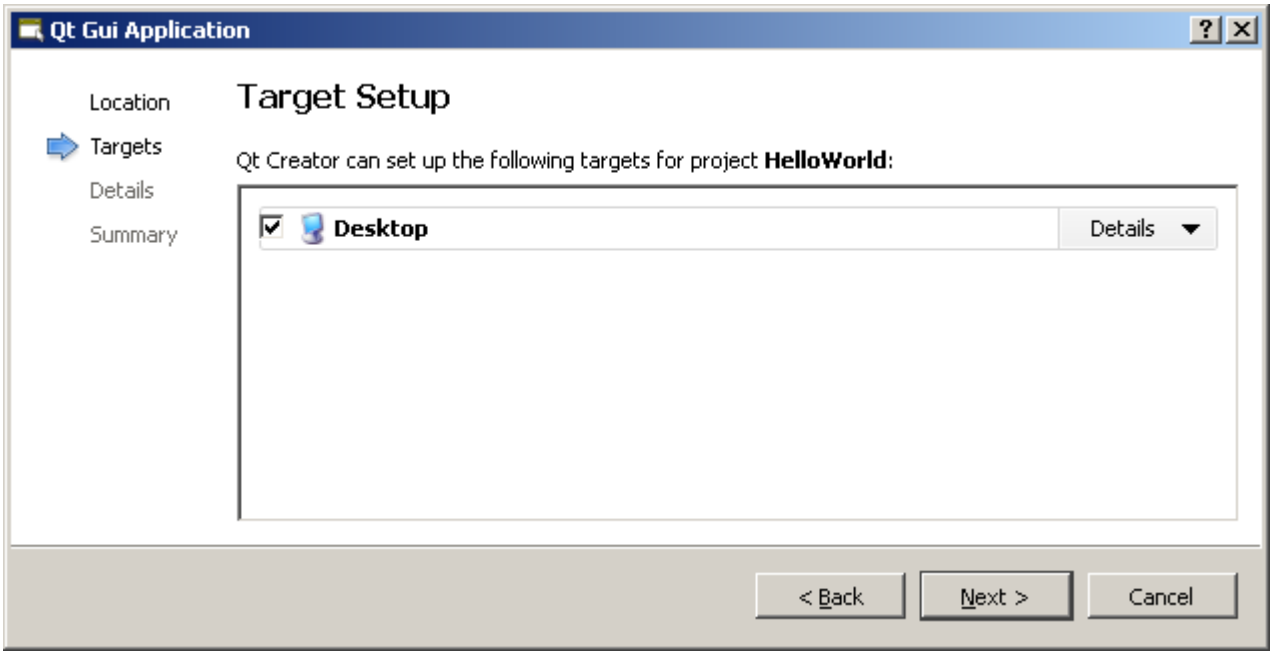
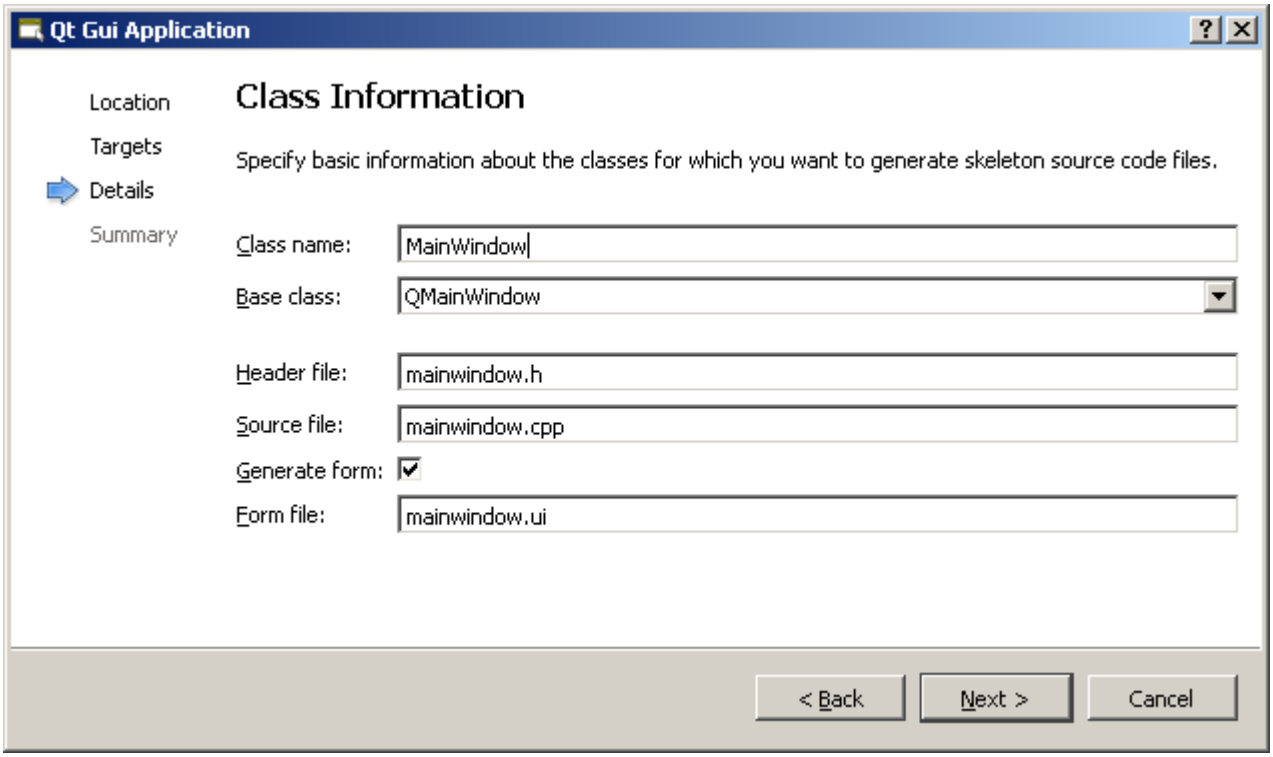
Choose a new for this new project e. g. “HelloWorld” and choose the base folder where the project should be created. Then choose button “Next >”.



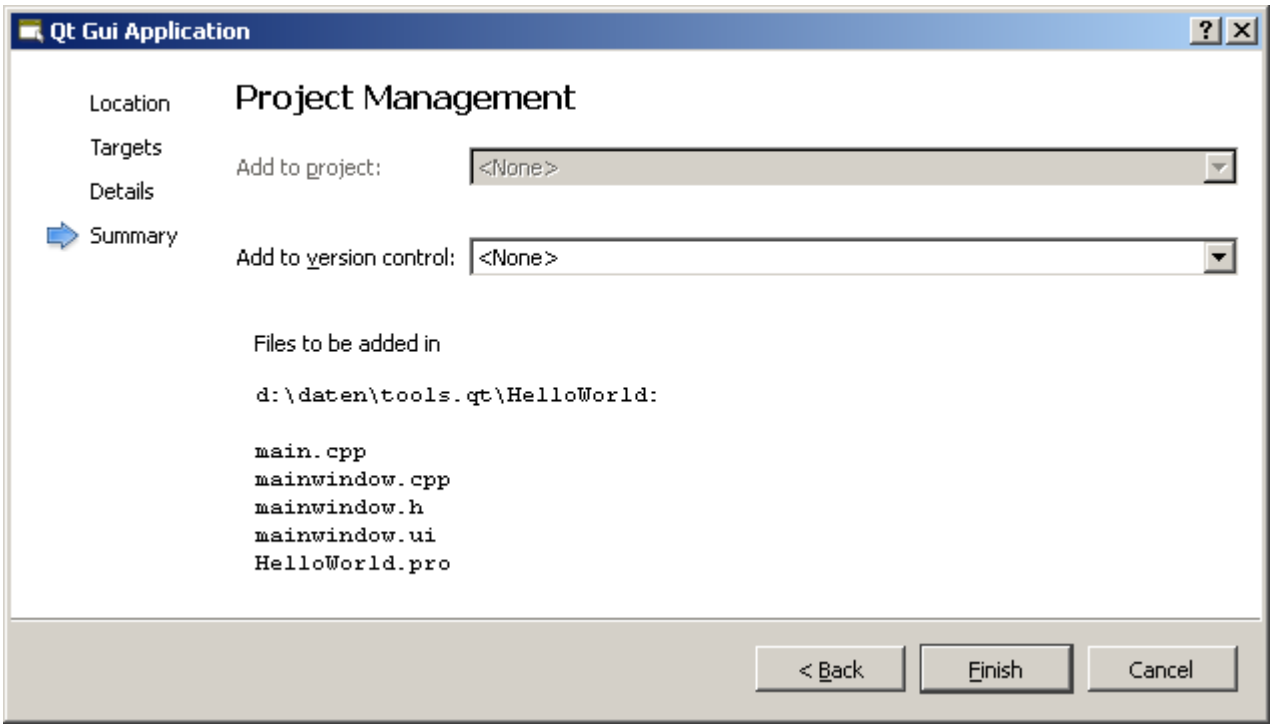
In next dialogue, simply choose “Next >”:



You can also choose “Next >” in this dialogue:



In the last dialogue, you can setup a version control environment for your project or simply click finish to create the project:



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The following screen appears: