

TLE7241E Evaluation Board

Constant Current Control IC

Automotive Power



Never stop thinking.

TLE7241E Evaluation Board

Revision History: **2006-07-05** **V1.1**

V1.1

Previous Version:

[illegible]

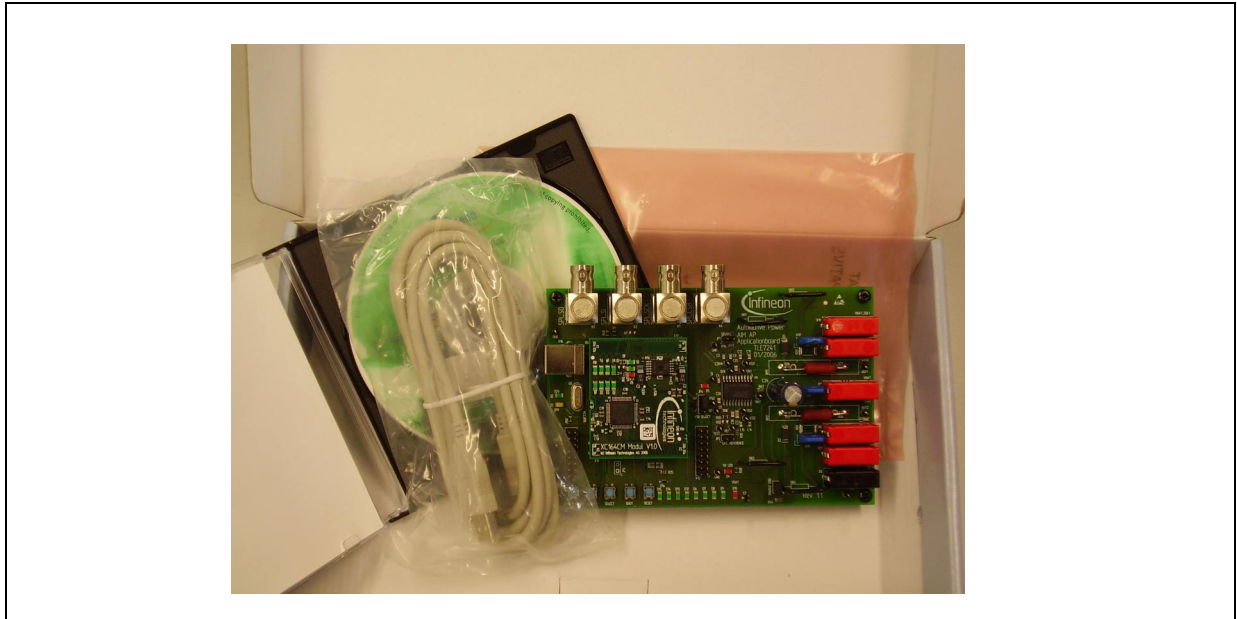
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1 Hardware Description

1.1 Packing List

The following items are included in the TLE7241E Evaluation Kit:

- Evaluation board (PCB)
- CD with documentation and software
- USB cable



1.2 Overview of the TLE7241E Evaluation Kit

This evaluation kit shows the performance of TLE7241E, a precise 2 channel low-side constant current driver in Smart Power Technology (SPT).

The IC regulates current flowing through an attached load using hysteretic current control. When using a 1 Ohm external shunt the range of output current is approximately 0 to 1.2 A with a resolution of 1.2 mA.

The TLE7241E has embedded protection, diagnosis, and configurable functions. Diagnostic information and configuration settings are accessed via a standard SPI interface.

Benefit of the TLE7241E Evaluation Kit:

1. Allows rapid evaluation of the TLE7241E with little time and cost investment by the customer. All necessary hardware and components required for an evaluation are included.
2. Software can control the TLE7241E without a deep understanding of the communication protocol and SPI command structure.
3. Custom command sequences can be programmed and executed in real time. This feature can be used, for example, to sweep the solenoid current at a controlled rate for solenoid pressure versus current characterization.

1.3 Board Overview

The TLE7241E Evaluation board consists of a TLE7241E Constant Current Control IC, a XC164CM Microcontroller (μ C) and a FT232BM (FTDI) USB-to-serial converter. To getting started pretty fast the board comes along with all needed additional external components (eg. voltage regulators).

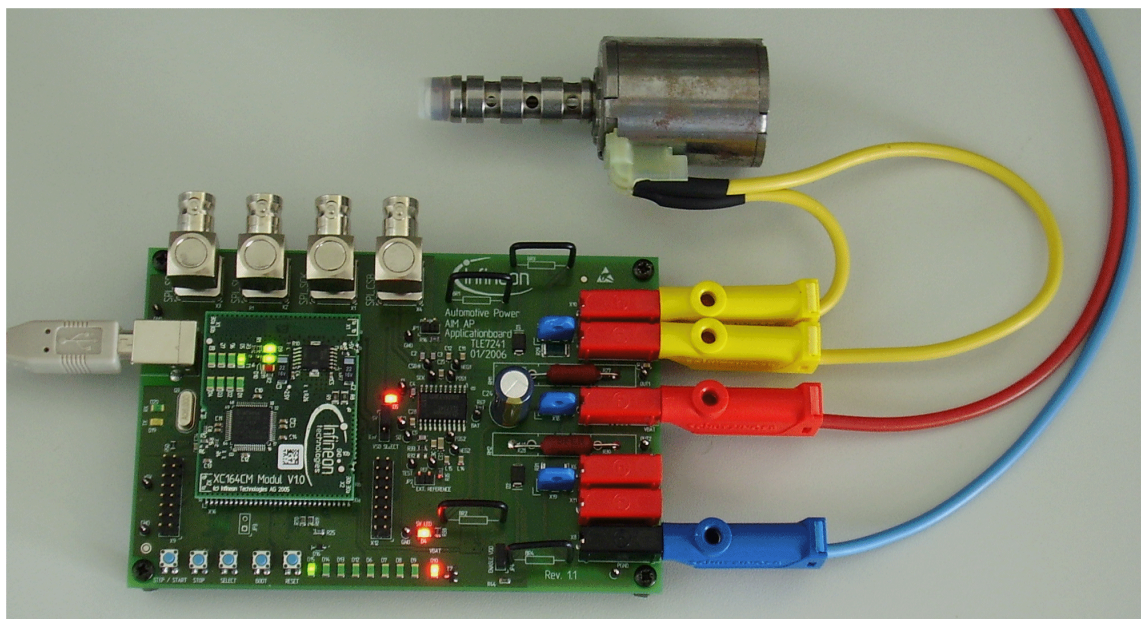


Figure 1 TLE7241E Evaluation board, top view

1.3.1 Simplified Schematic

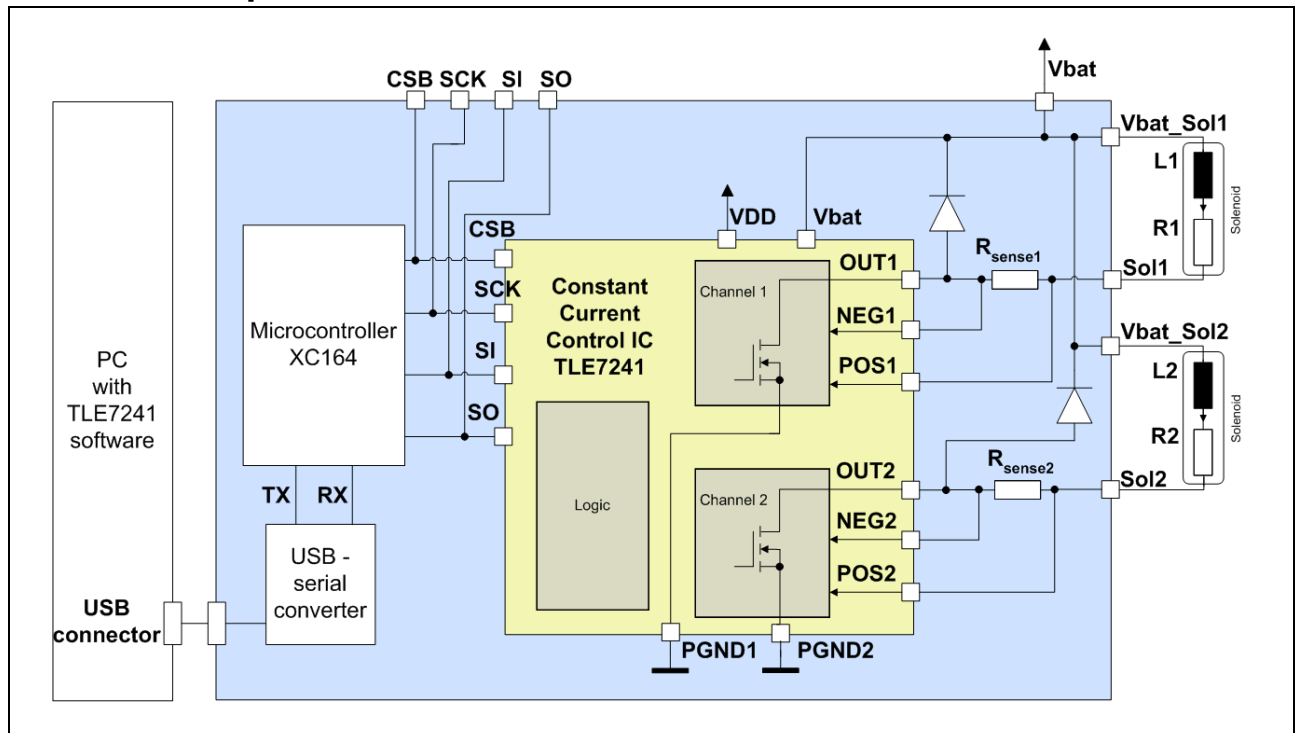


Figure 2 Simplified Schematic

1.3.2 Connectors and Plugs

Power Plugs

Plug	Description
PGND	Power-GND. To avoid ground-shift via the GND wire from supply to PCB, please use the plug on the PCB as reference node for external signal sources
VBat	Power Supply voltage. Nominal 12V. Maximum operation voltage 9 to 17V. Absolute Maximum Rating -40V to 40V
Vbat_Solx	Power plug to connect the load to Vbat
Solx / OUTx	Output to connect the load

USB Plug

With this plug the personal computer (PC) communication is realized.

BNC Plugs

There are 4 BNC connectors on the board. An Oscilloscope can be connected to monitor the SPI commands between μ C and TLE7241E. These connectors can be used also to control the TLE7241E via an external signal generator.

2 Getting Started

This section describes how to start working with the TLE7241E Evaluation board.

PC System Requirements: NT, 2000 or XP

2.1 Connecting the board

1. Supply the board

Connect a voltage source with 12V to the connectors VBat (+) and PGND (-) of the board. The current consumption should be about 200mA. Please check the jumpers on the TLE7241E Evaluation board. JP1, JP2, JP4 and JP6 (5 V setting) should be mounted (closed). The power jumper X17, X18 and X19 should also be "inserted".

If the board is properly supplied, LED D4, LED D5, LED D10 on the TLE7241E Evaluation board will flash. LED D9 and LED D10 will flash on the XC164CM Modul. In addition to this, LED D15 on the TLE7241E Evaluation board and LED D5 on the XC164CM Modul will blink.

2. Connect USB cable

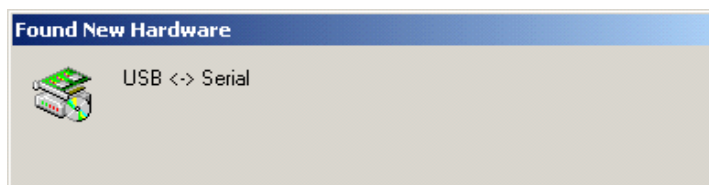
Connect the USB cable to the USB connector on the TLE7241E Evaluation board and to the PC.

2.2 Installing PC software

2.2.1 Install driver

To enable USB communication with the board, a device driver has to be installed (FTDI USB-serial-chip).

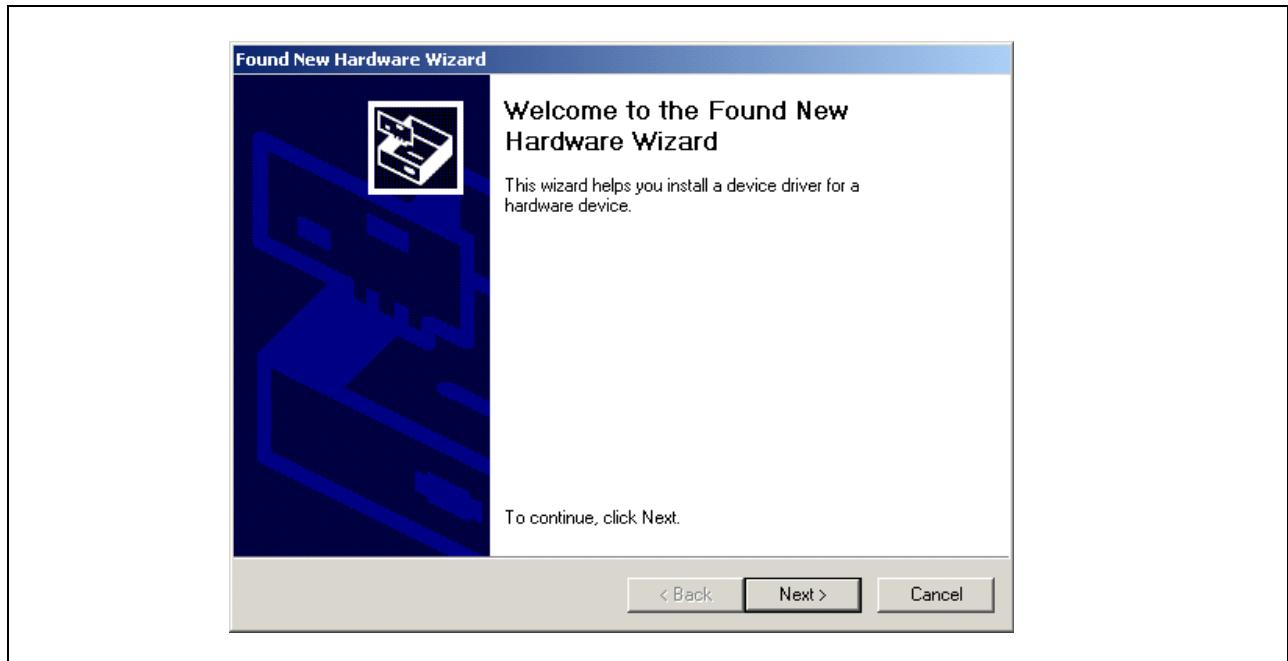
After connecting the USB cable the "Found New Hardware"- window will appear.



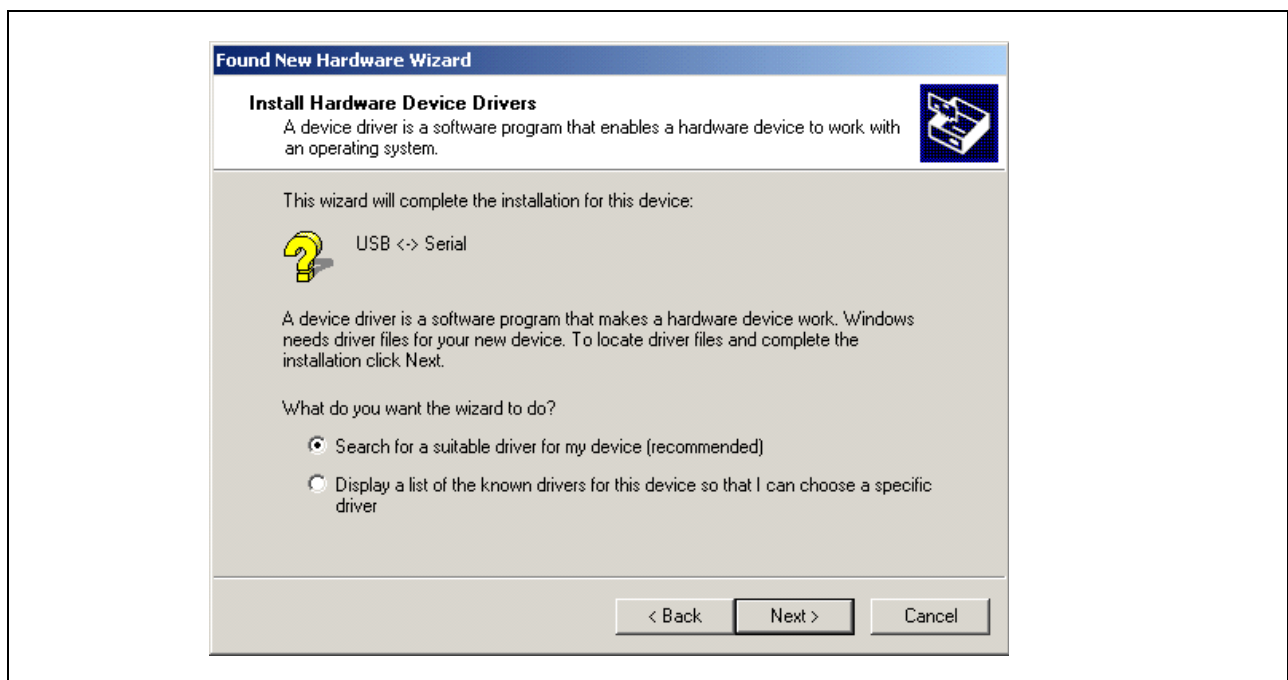
The "Found New Hardware Wizard" starts.

Insert the CD into the CD-ROM drive of the computer.

Click "Next".

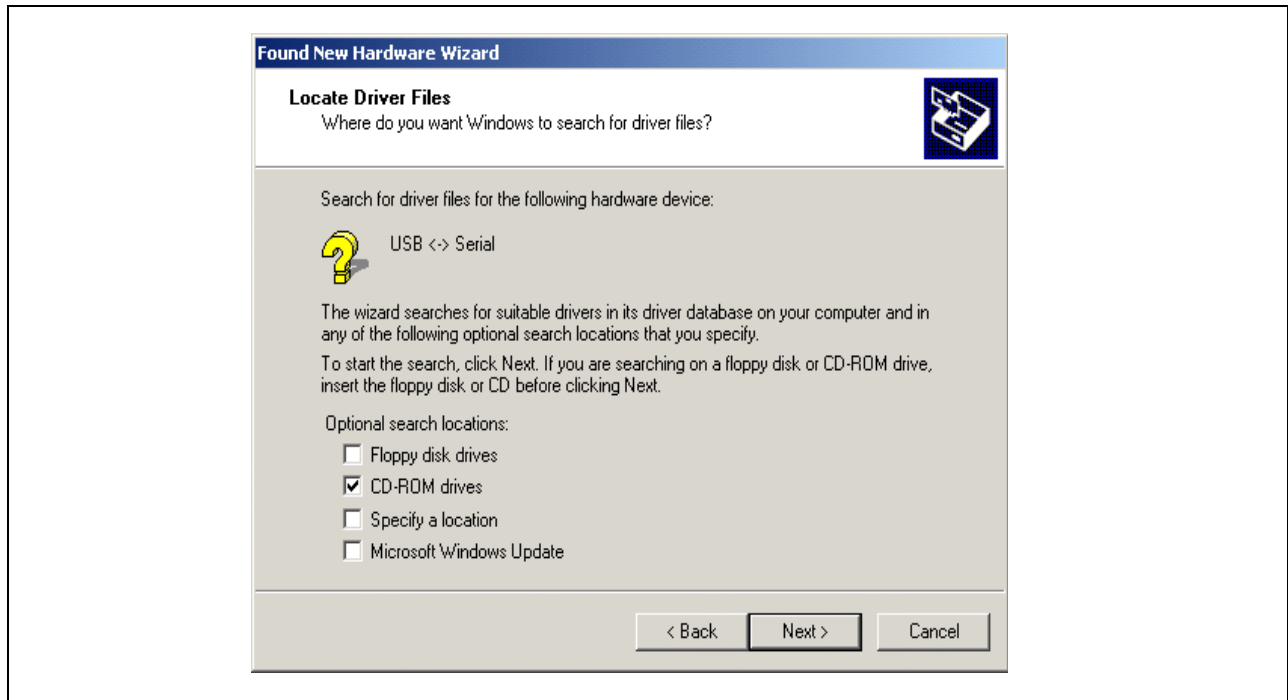


Select "Search for a suitable driver for my device (recommended)" and click "Next".



Getting Started

The driver files are located on the CD- ROM. Select "CD- ROM drives" and click "Next".

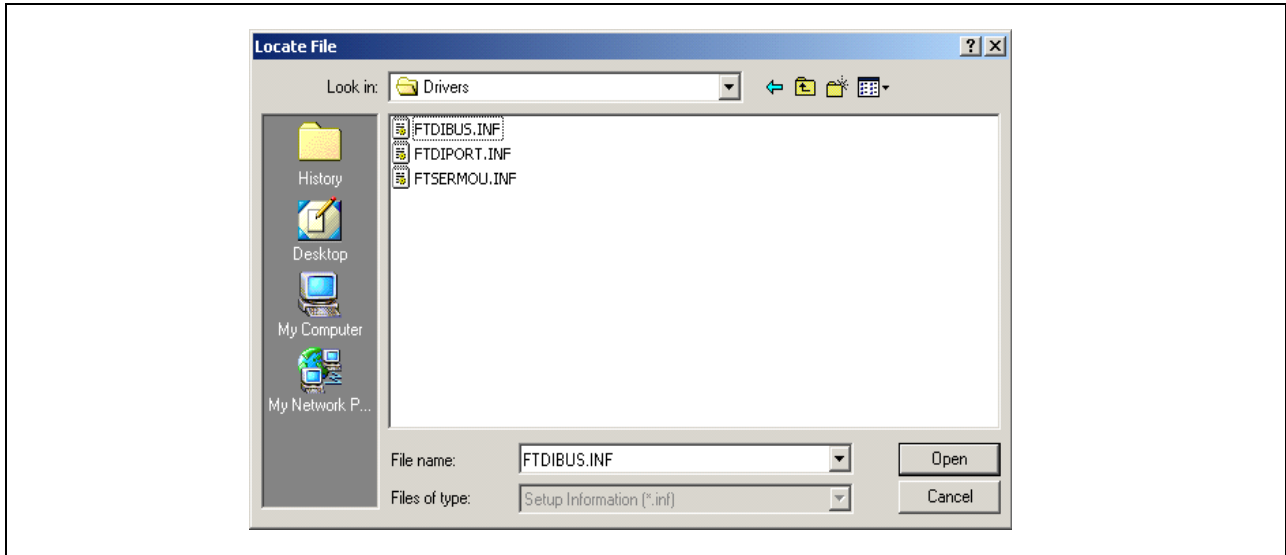


Specify the path to the driver files. Click "Browse".



Getting Started

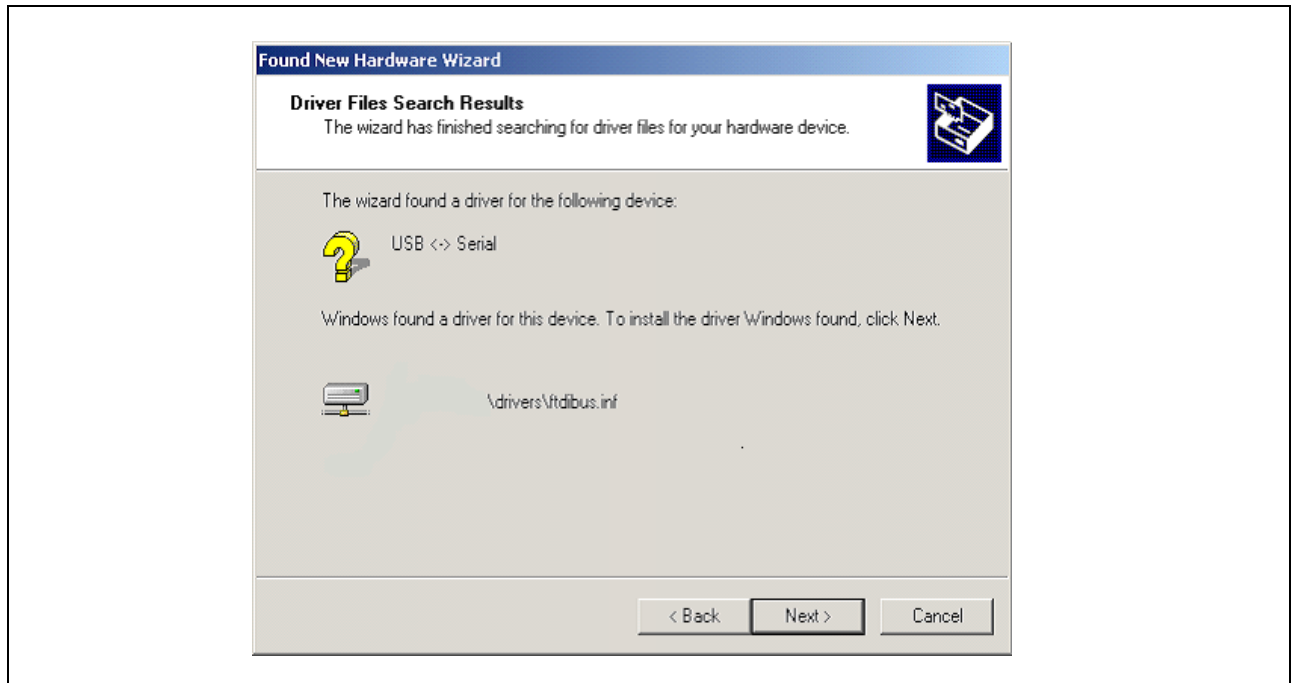
Browse to the CD-ROM directory, change to the directory “drivers” and click on “Open”.



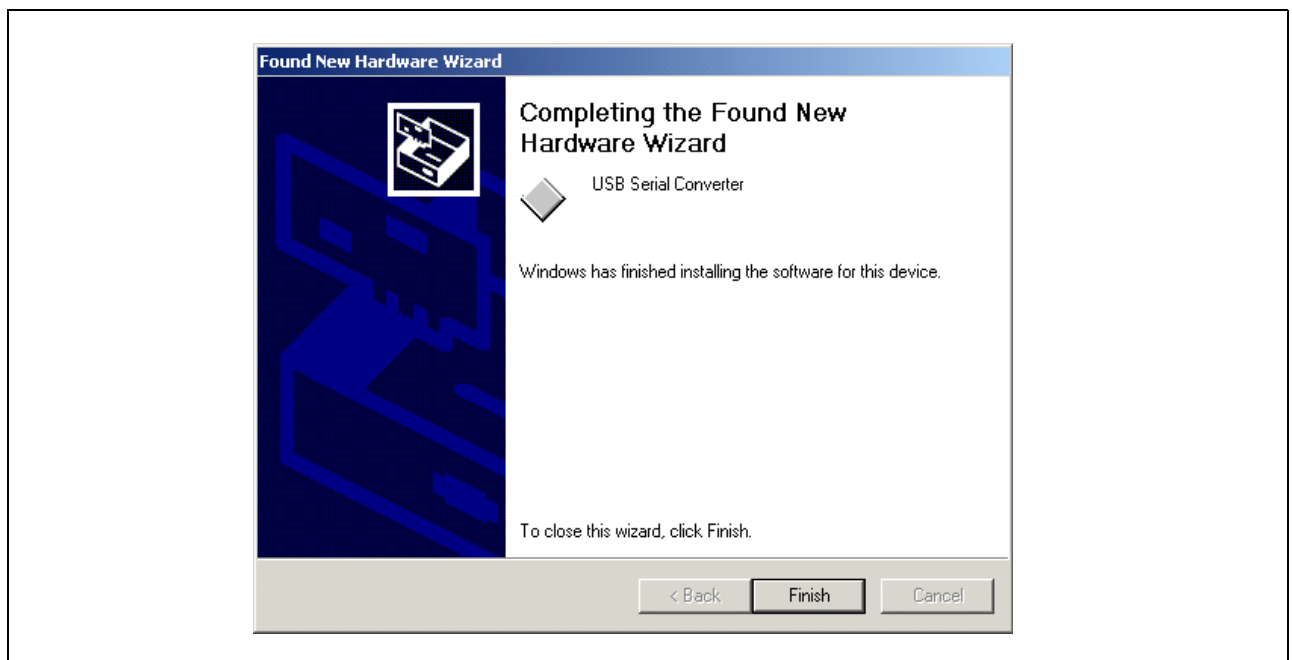
Click “OK”.



Click “Next”.



Click “Finish”.



Sometimes a second installation window opens, please proceed in the same way as shown above ([Chapter 2.2.1](#)).

2.2.2 Install software

The TLE7241E Evaluation Board is intended to be used in conjunction with the PC-software “Infineon TLE7241_SPI_1_9”. Current version during creation of this document is 1_9. This software is included on the CD.

The PC sends serial commands over a USB cable to the board. The USB-to-serial converter provides standard R232 signals to the μ C. The μ C processes the commands. It acts as SPI master, the TLE7241E as SPI slave. Diagnosis from the TLE7241E diagnosis will be received by the controller and sent back to the PC.

Installation Instructions

1. Insert the TLE7241E Evaluation Board CD into the CD-ROM drive of the computer and change to the folder: *Installer*
2. Start the file *setup.exe*
3. Follow the instructions of the setup program.

Note: Administrator permission for the PC is required for successful installation.

2.3 Starting the TLE7241E software

After installation, the software can be started via *Start -> Programs -> Infineon TLE7241_SPI -> TLE7241_SPI_1_9*.

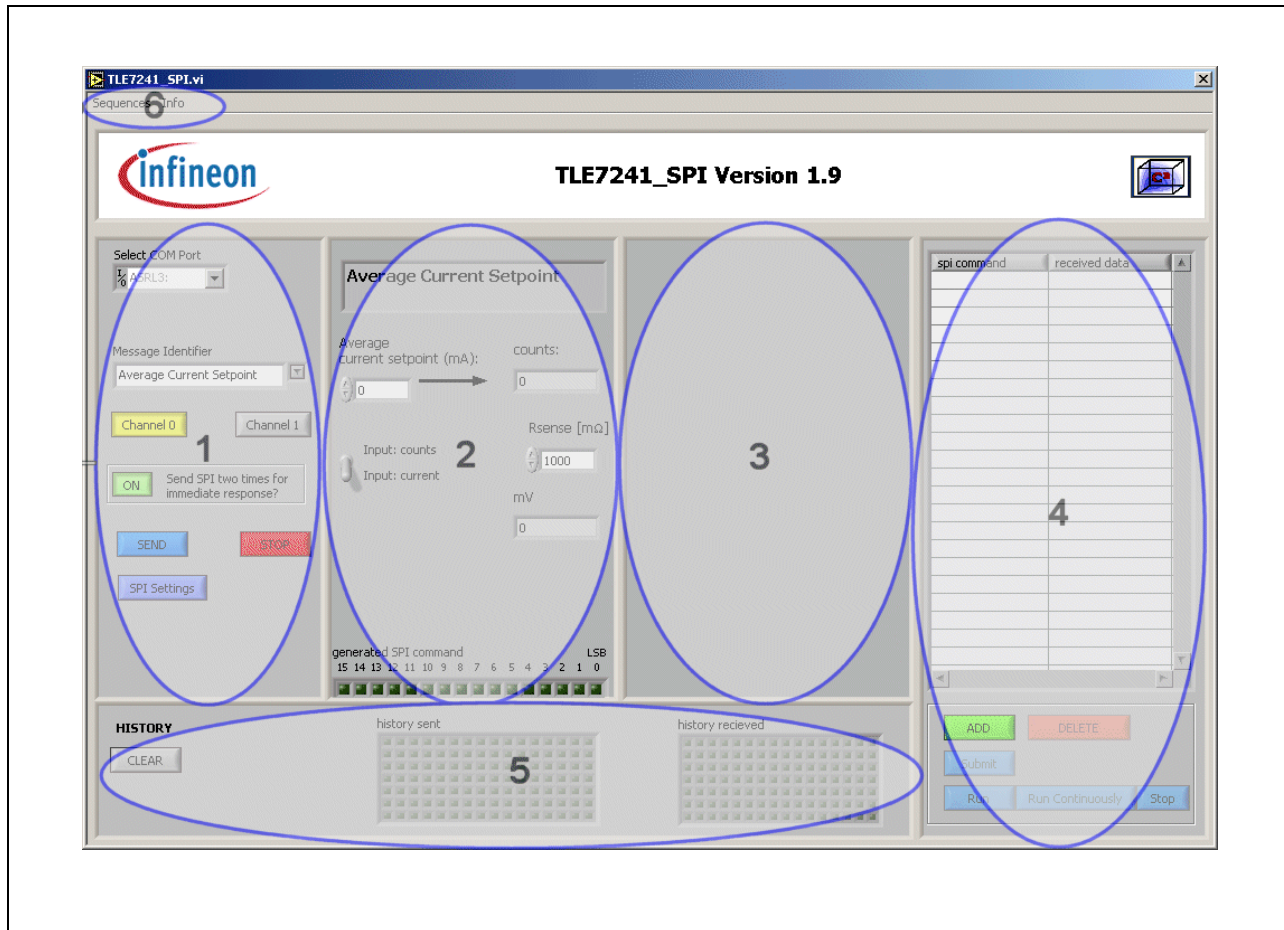
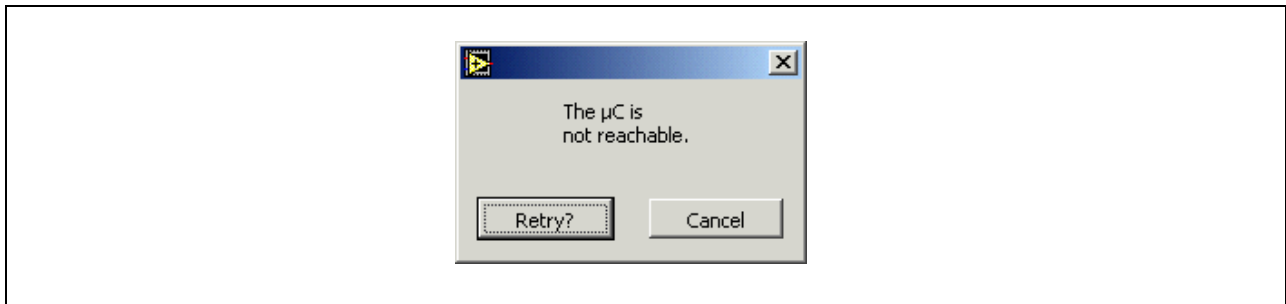


Figure 3 User interface screen

Section	Description
1	In this section the communication port can be selected, commands to send can be chosen and single commands can be transmitted
2	By changing the command in the “Message Identifier” message box in section 1, different options will be displayed. The “generated SPI command” indicator helps to see which SPI word will be sent by clicking on the “SEND” button
3	After sending a command, the received diagnosis will be shown in this section

Section	Description
4	In this section sequences of commands can be created, submitted to the controller and the received diagnosis can be observed. A sequence will be started by clicking the “Run” or the “Run Continuously” button
5	History of previously sent commands
6	In this section the actual sequence can be saved and previous stored sequence can be loaded. Also some program information is available in this section

After starting the software a pop-up window similar to that one shown below can appear. Click “Cancel”.



During driver installation ([Chapter 2.2.1](#)) a driver was installed to create a virtual COM port on the PC. The software tries to connect to COM 3 during the first start. If the connection was not successful the pop-up window shown above will appear. The correct COM port has to be selected now.

Note: Within this software COM3 is sometimes called ASLR3:. Change the port for example to ASLR2: for COM2 or to ASLR4: for COM4,...

If the software could connect to the board successfully the pop-up window will not be visible after pushing the “SEND” button and the LED D9 on the TLE7241E Evaluation board will flash.

The installation is finished now. Proceed to [Chapter 3](#).

3 Application Examples

3.1 Program a load current to see the accuracy of the TLE7241E

1. Connect an ohmic and inductive load in series between the Sol1 / OUT1 and the Vbat_Sol1 plug. Suggested values for R and L: $R = 50\Omega$, $L = 10\text{mH}$.
2. Write "200" in the "Average current setpoint (mA)" field (section 2) to program a load current of 200mA. Because the Rsense resistor on the TLE7241E Evaluation board is 1000mOhm, it is not necessary to change the default setting.
3. Click the "SEND" button, a similar picture as shown below should appear. In section 3 the SPI response of the TLE7241E can be observed.

Note: By pushing the "SEND" button the LED D8 on the TLE7241E Evaluation board will flash for a short while.

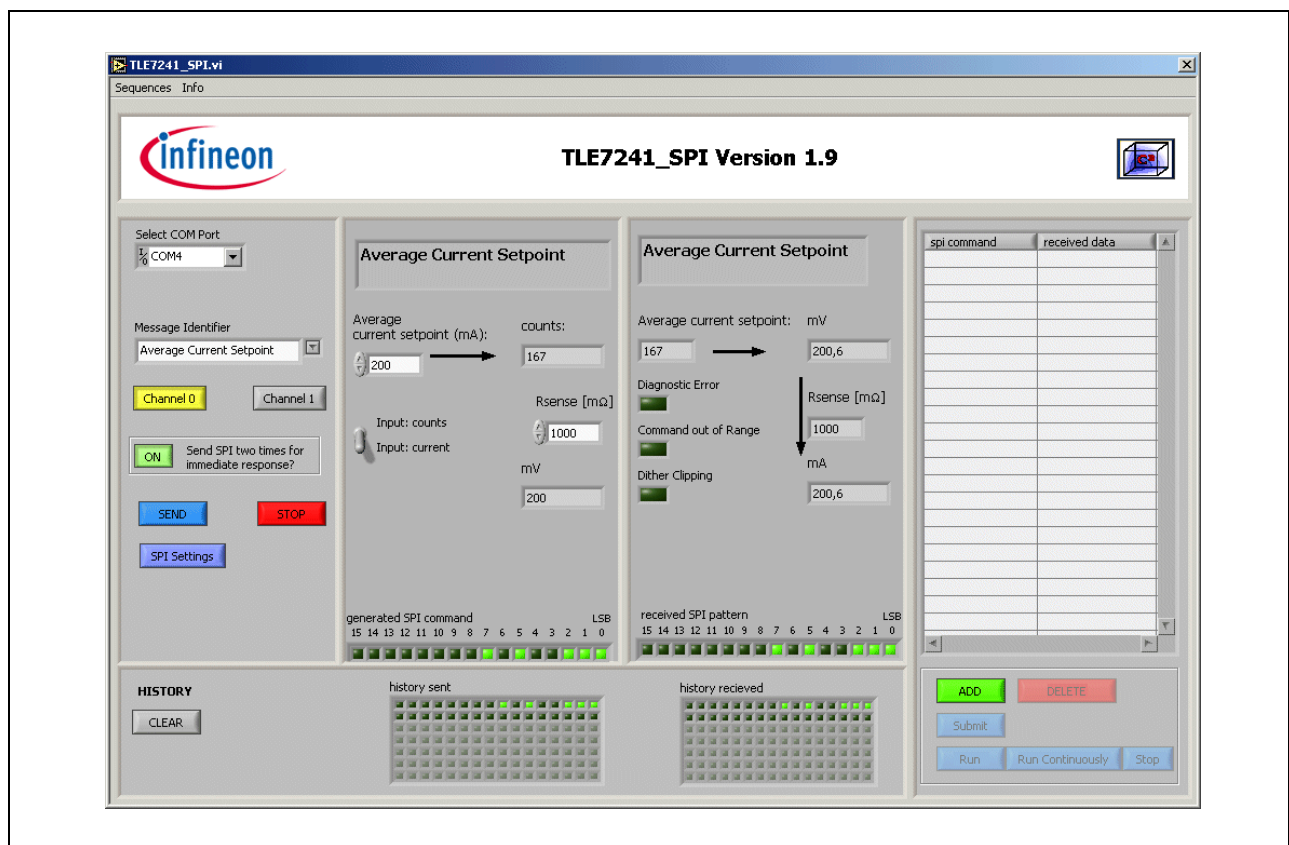


Figure 4 User Interface screen - program a load current

Observe the SPI communication signals between the μ C and the TLE7241E

1. Connect an oscilloscope to the BNC connectors of the TLE7241E Evaluation board. Alternatively, a oscilloscope with voltage probes connected to the test points (CSB, SCK, SI, SO) next to the TLE7241E can be used.

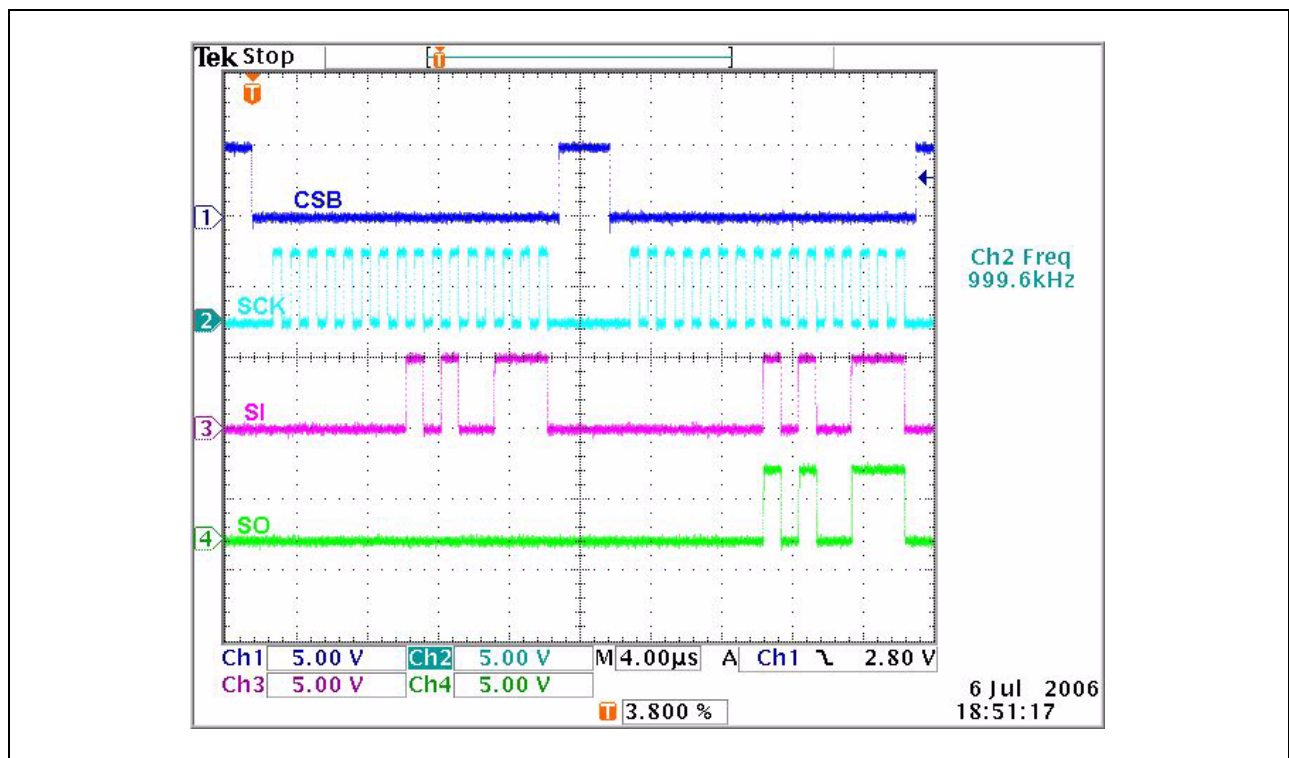


Figure 5 TLE7241E SPI communication

On the screen above it can be seen that the same command was sent two times. The software sends the command two times automatically.

Reason: The TLE7241E always sends the diagnosis word requested during the previous SPI command. The second SO word includes the requested diagnosis word. This diagnosis word is also displayed in the user interface of the Infineon TLE7241_SPI_1_9 software, section 3 (see [Figure 4](#)). In the case shown above both SO diagnosis words are the same (because the same command was sent before).

Note: This software feature can be disabled by changing the status of the “Sending SPI two times for immediate response” button from “Yes” to “No”.

See the TLE7241E current control behavior

1. Connect an oscilloscope voltage probe to the test point OUT1 to monitor its voltage
2. Connect an oscilloscope current probe to the cable connected with the load.

Application Examples

- For more precise DC measurements, connect a high precision Multimeter (for example Keithley 2001) in the load current path. Such a multimeter is necessary to monitor the load current with high accuracy (0.1 %).

Note: Also the voltage drop at the shunt resistor Rsense1 can be measured. However, please be aware that this resistor is floating. If the voltage drop referenced to a fixed potential should be measured, please use the additional 0.1 Ohm shunt resistor R29 (see schematic in [Chapter 4](#)). To use this feature remove the power jumper X17 to access the resistor. Connect the measurement equipment instead of this jumper. Resistor R29 is connected “High-Side”, which means that one end of the resistor is connected to Vbat. So the voltage drop over this resistor can be measured easily with a differential multimeter.

An oscilloscope screen similar to the example below can be observed.

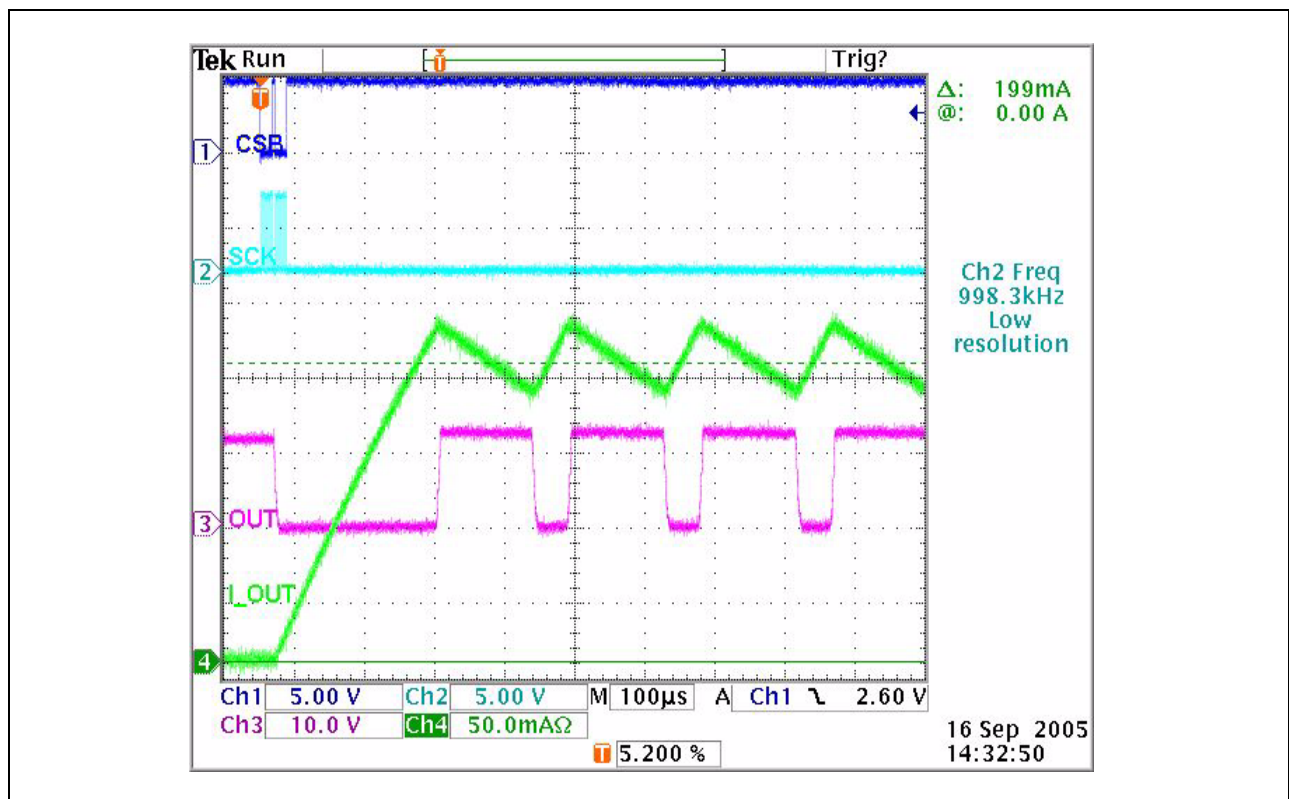


Figure 6 Current control behavior

If the same command will be sent again the current will not rise again as shown above (because the current is already programmed to 200mA).

How to reset the current to 0mA again:

- Program 0mA using the “Average current setpoint (mA)” field or
- Push the reset button on the TLE7241E Evaluation board. This causes two actions:
 1. Resets the μ C

Note: This action does not reset the TLE7241E

2. The μ C will program a load current of 0 mA on both channels automatically after coming out of a reset condition

3.2 Programming a sequence

With this software it is possible to program sequences in the memory of the μ C. Own sequences can be created by pushing the “Add” button in the TLE7241E user interface (section 4 in [Figure 3](#)). An example sequence can be found on the CD, see description below.

1. Click “Sequences” and then “Load” (section 6 in [Figure 3](#))
2. Browse to the folder “sequences” on the CD
3. Select the file with the name TLE7241_step.seq and Click “Ok”. The sequence will be loaded in section 4.
4. Click “Submit” to transfer the sequence to the memory of the μ C
5. Click “Run” to command the μ C to begin sending the sequence to the TLE7241E

Note: After the sequence has started, it cannot be interrupted. It must be completed before being allowed to start again.

During the sequence runs real time behavior between the μ C and the TLE7241E can be assumed. After the sequence has completed, all diagnosis words stored in the memory of the μ C will be sent to the PC and displayed in section 4.

To test the diagnosis disconnect the load and Click “Run”. Check the response on the command “General Configuration”. The “Open load or Short To Ground” indicator in section 3 will flash.

Note: Please do not disconnect the load during a high load current is programmed. This can cause voltage spikes on the supply line which can reset the FT232BL USB-to-serial converter. Under unlucky circumstances the PC software will crash by this effect.

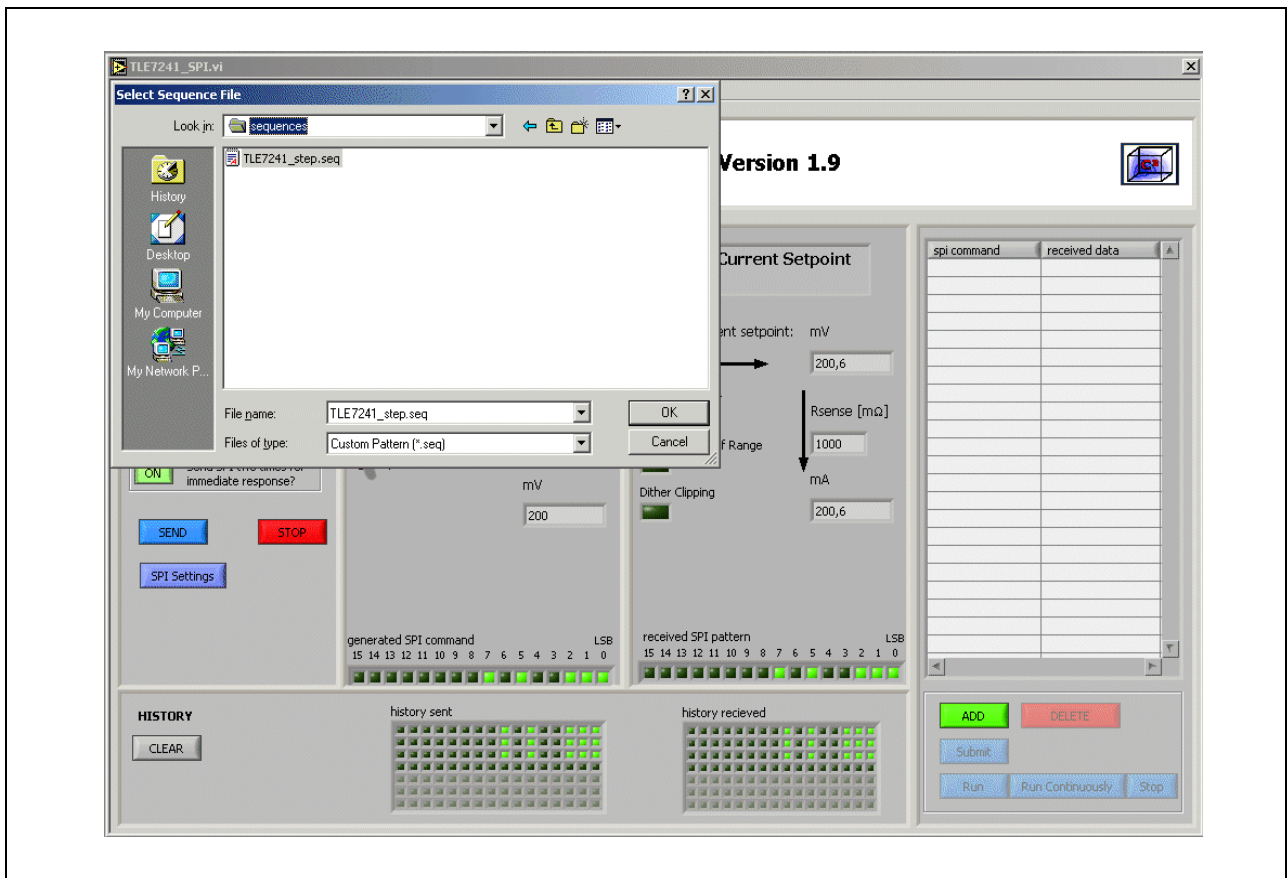


Figure 7 User interface screen - loading a sequence

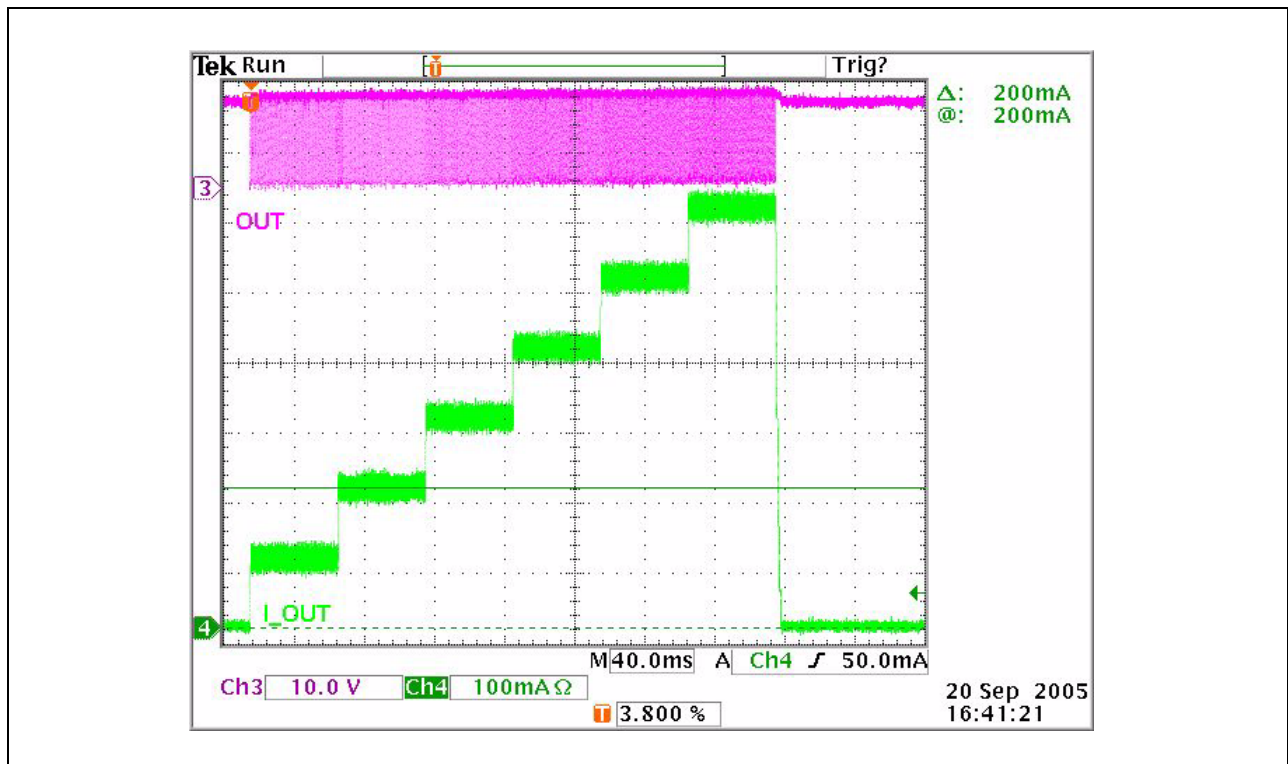


Figure 8 Load current during example sequence

Every current step in [Figure 8](#) has a duration of 50 ms. This is the default value after starting the software. It can be changed by clicking the button “SPI settings”. It is also possible to change the SPI speed here. The values have to be read as described below.

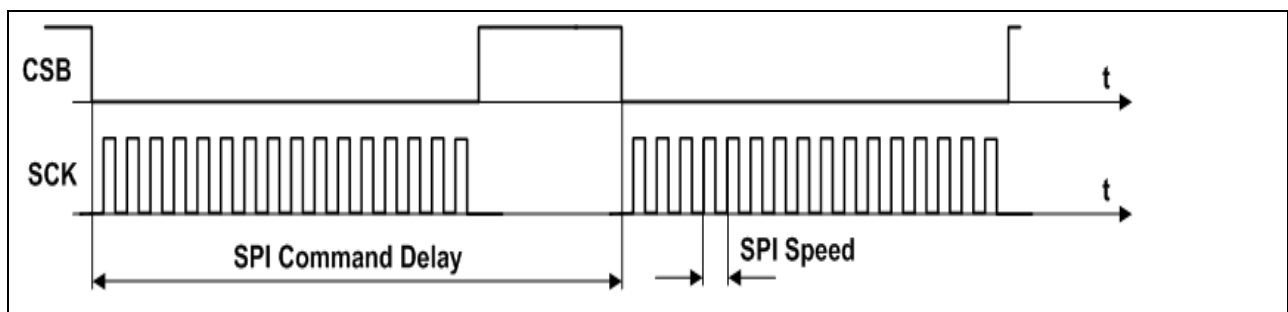
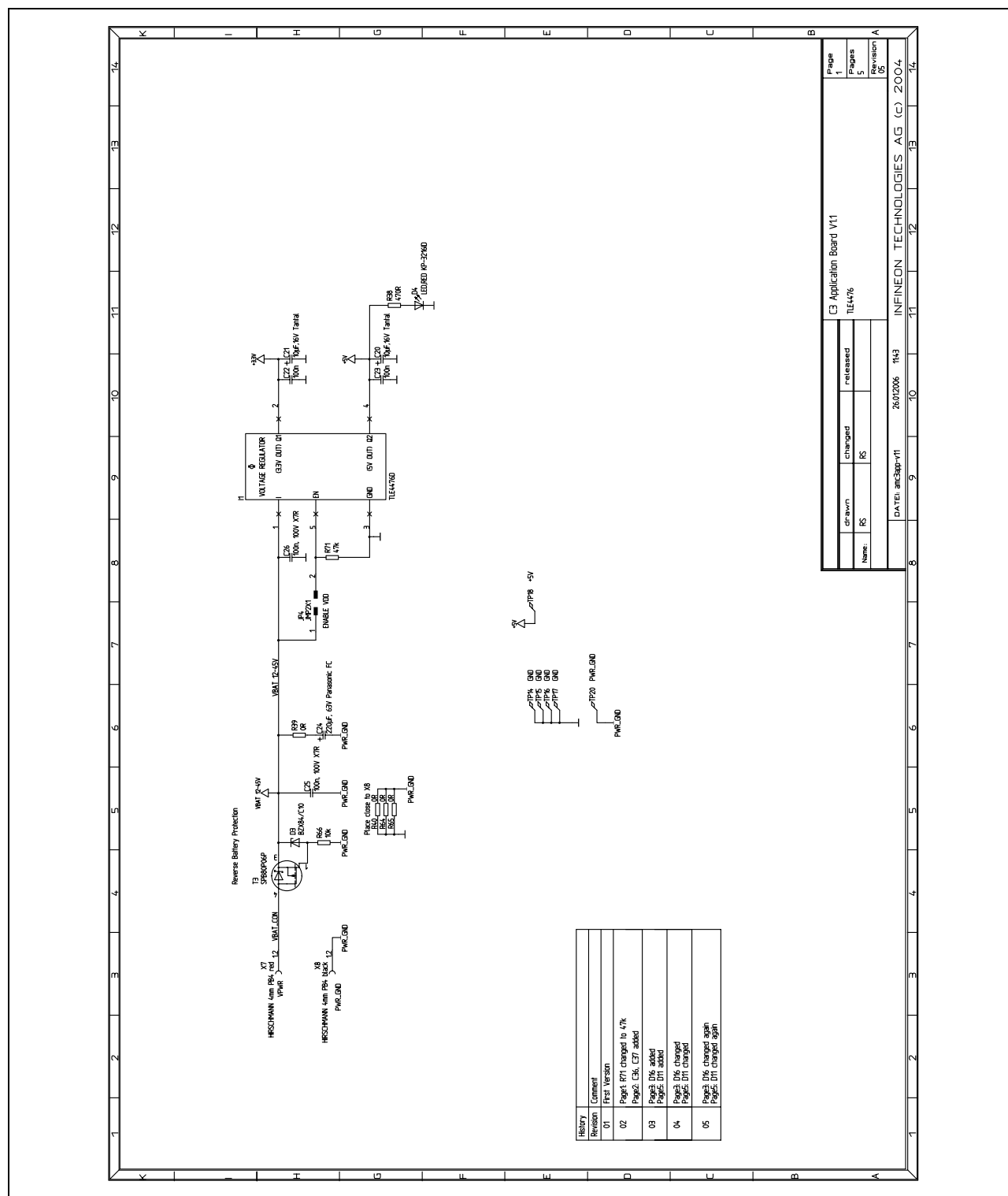
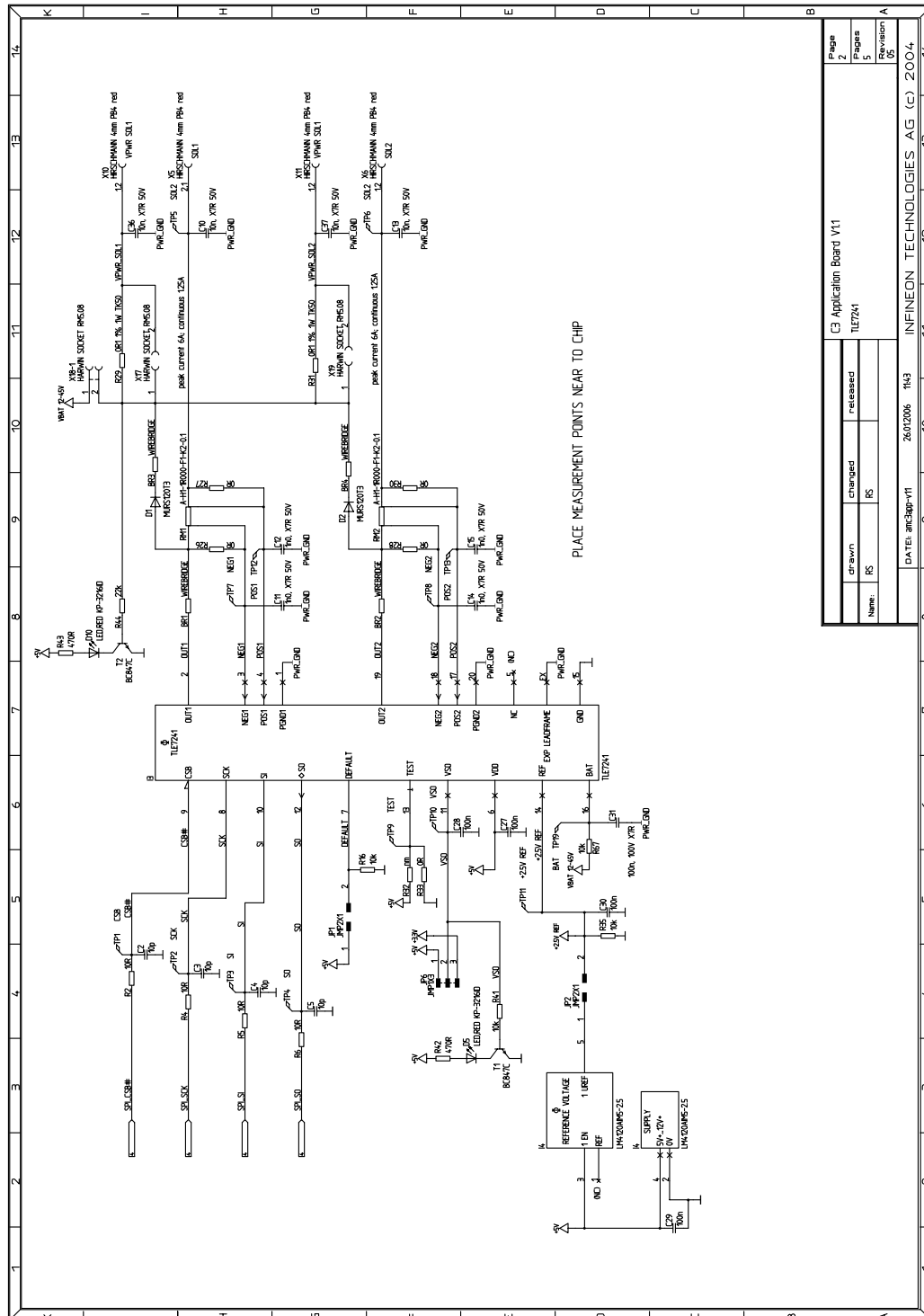


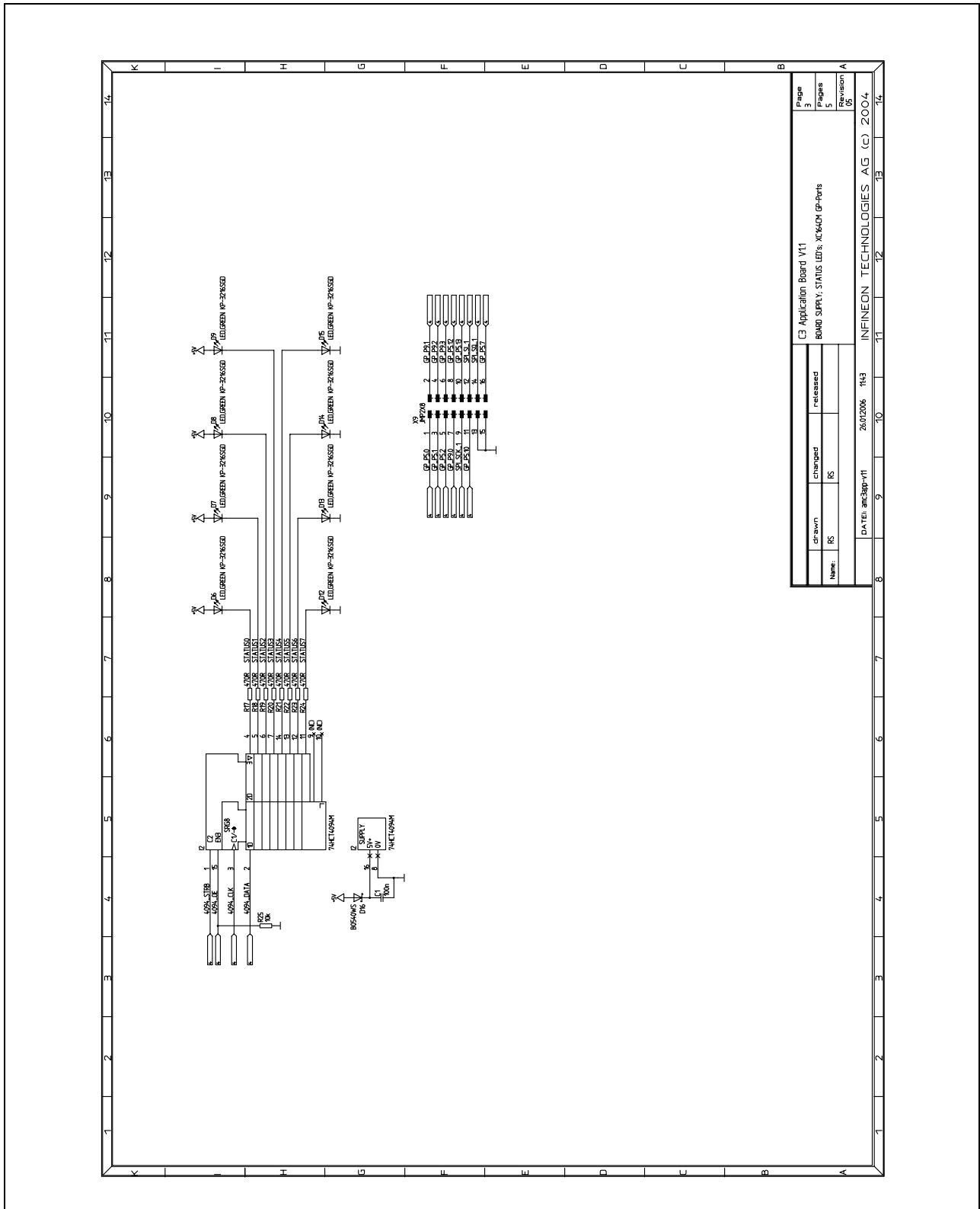
Figure 9 Setting SPI Speed and SPI Command Delay

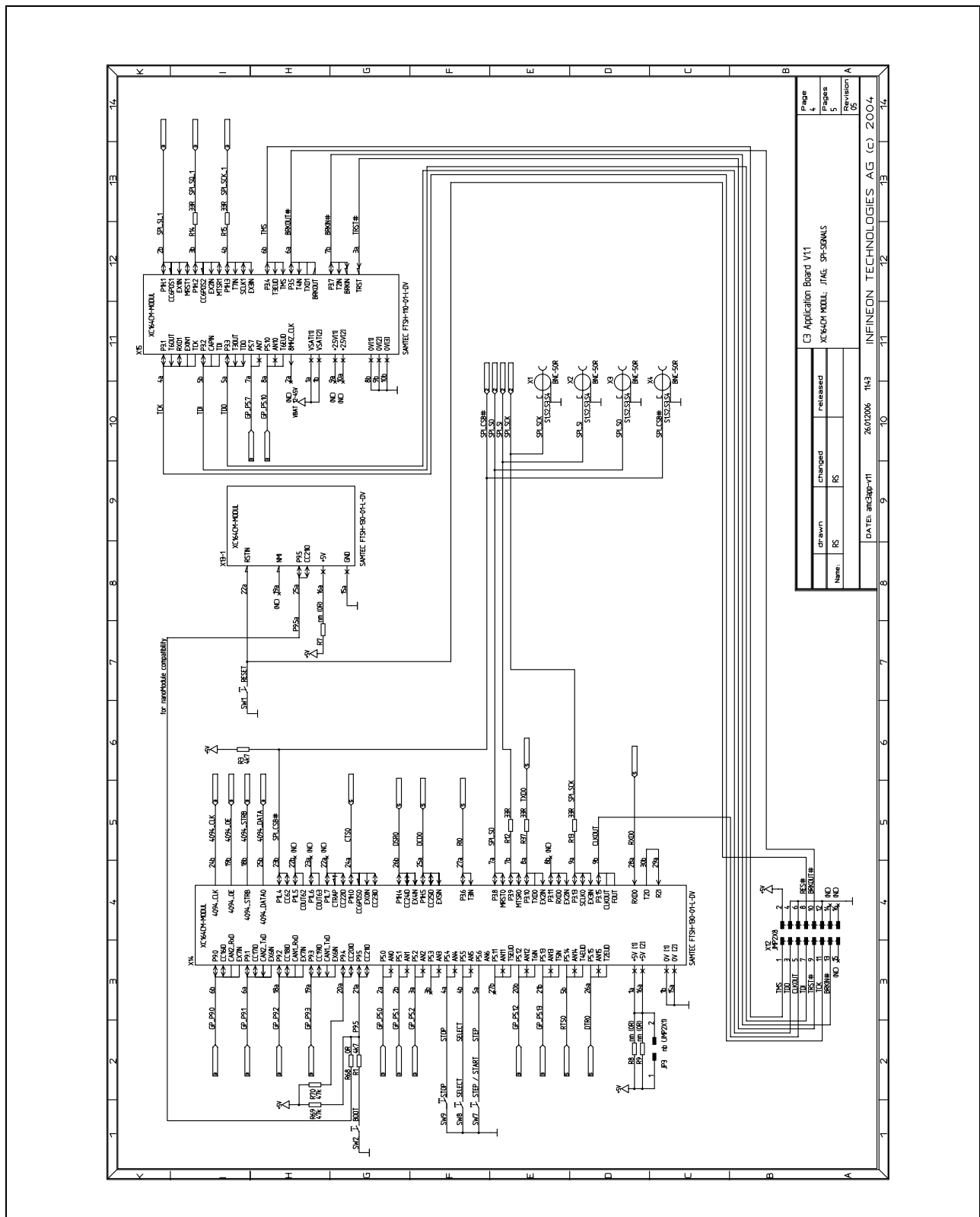
4 Schematic

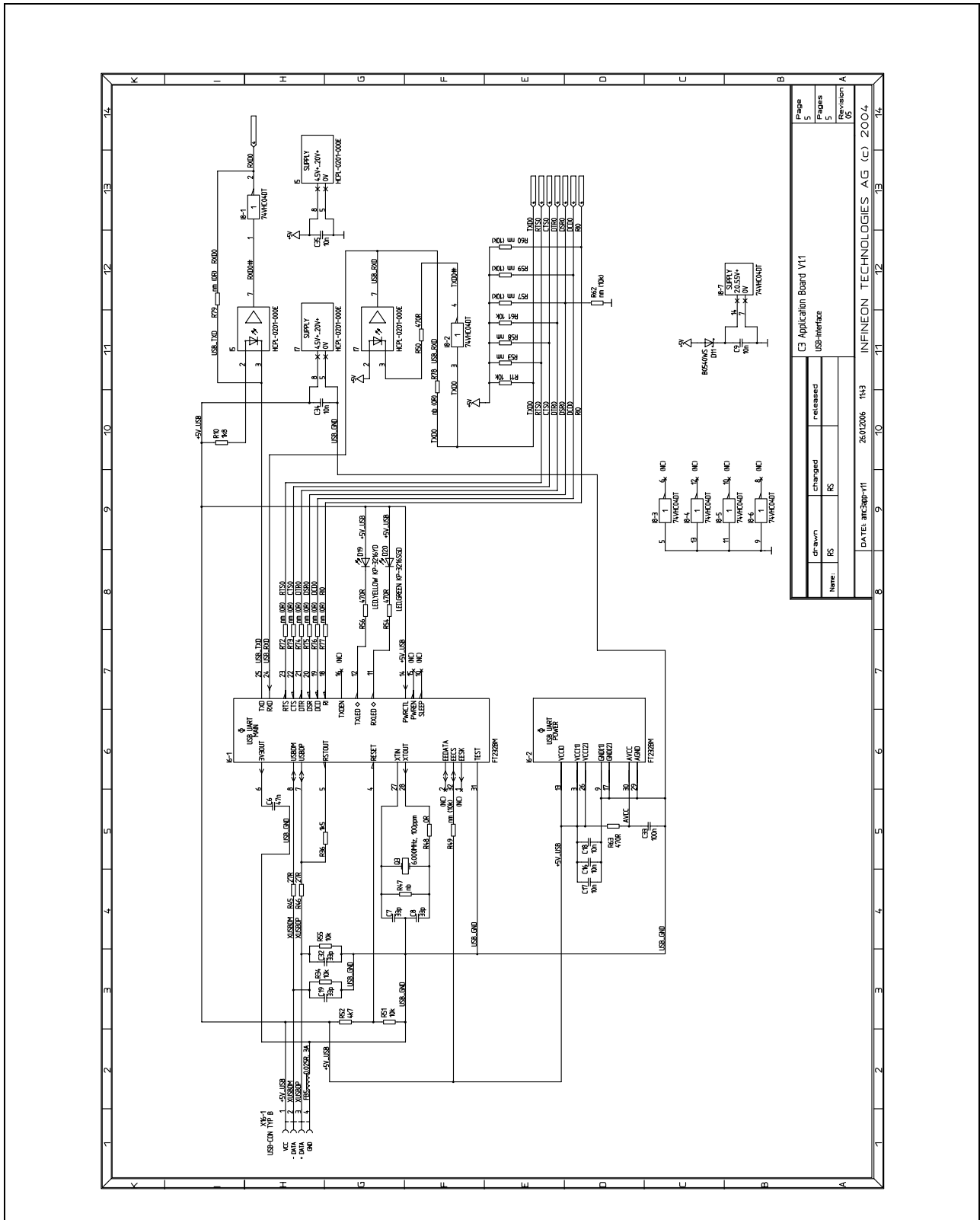
4.1 Application Board TLE7241E 01/2006



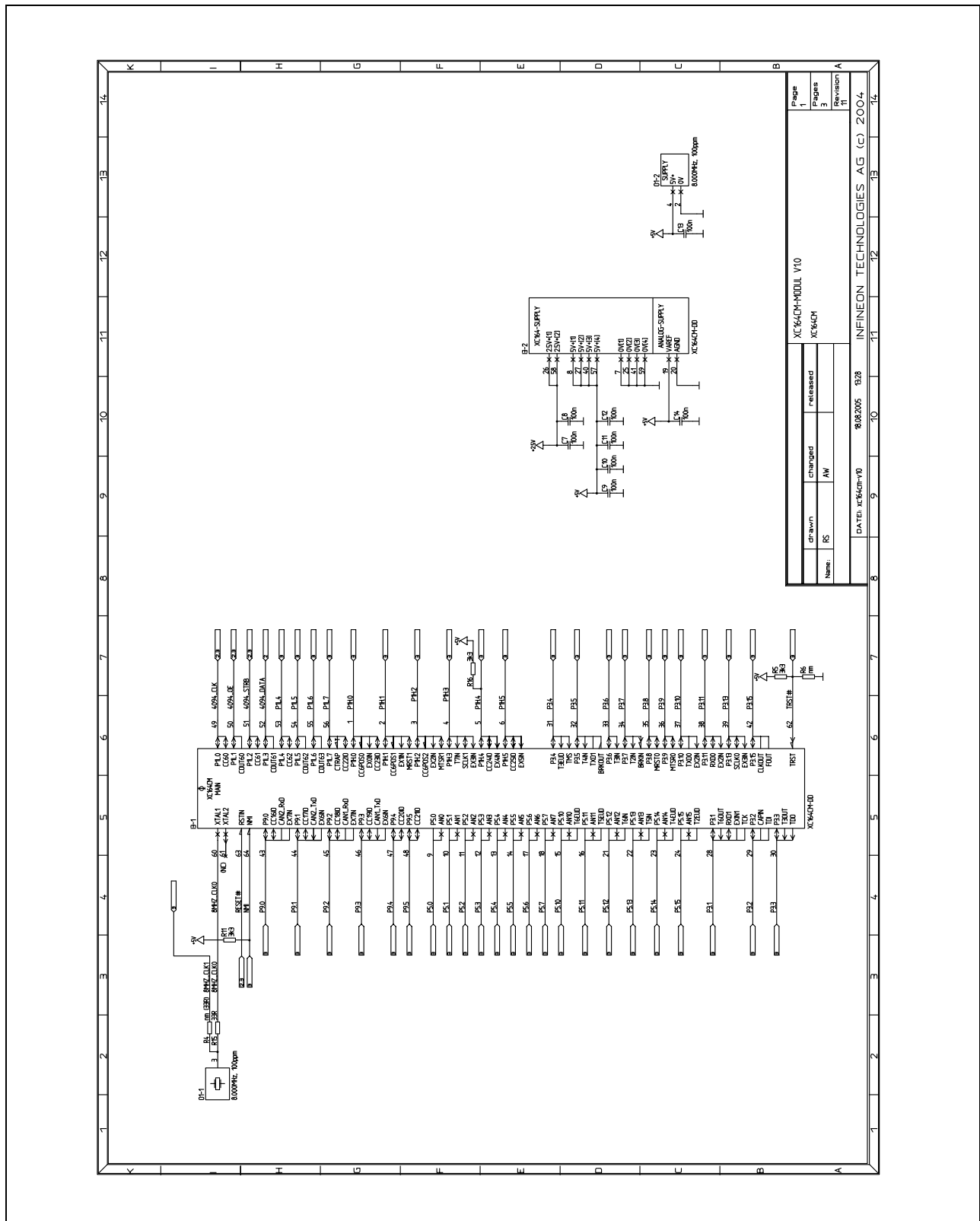


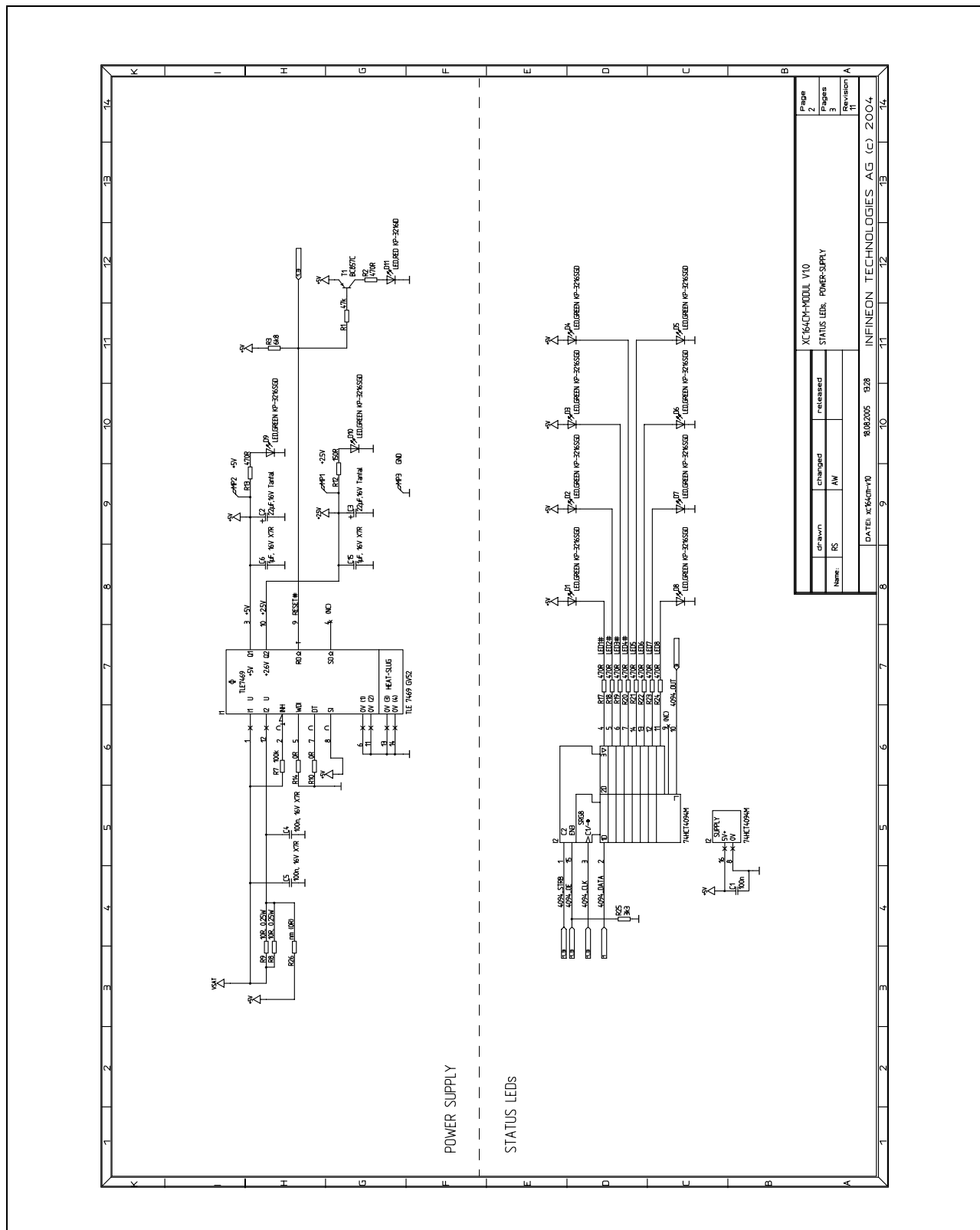


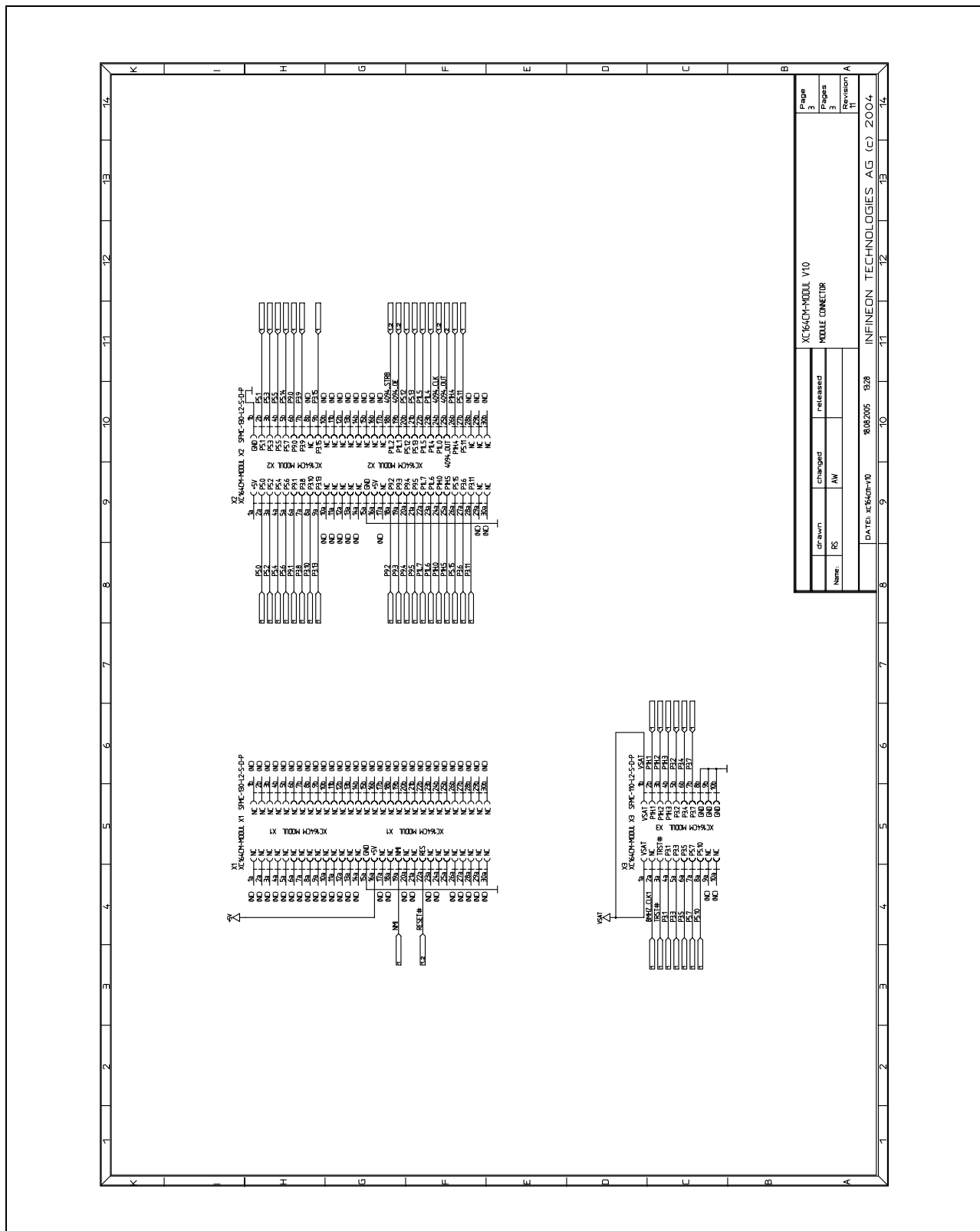




4.2 XC164CM Modul







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