Application note: Programmble Logic Controller (PLC) based on SC1x3-IEC and SC23-IEC

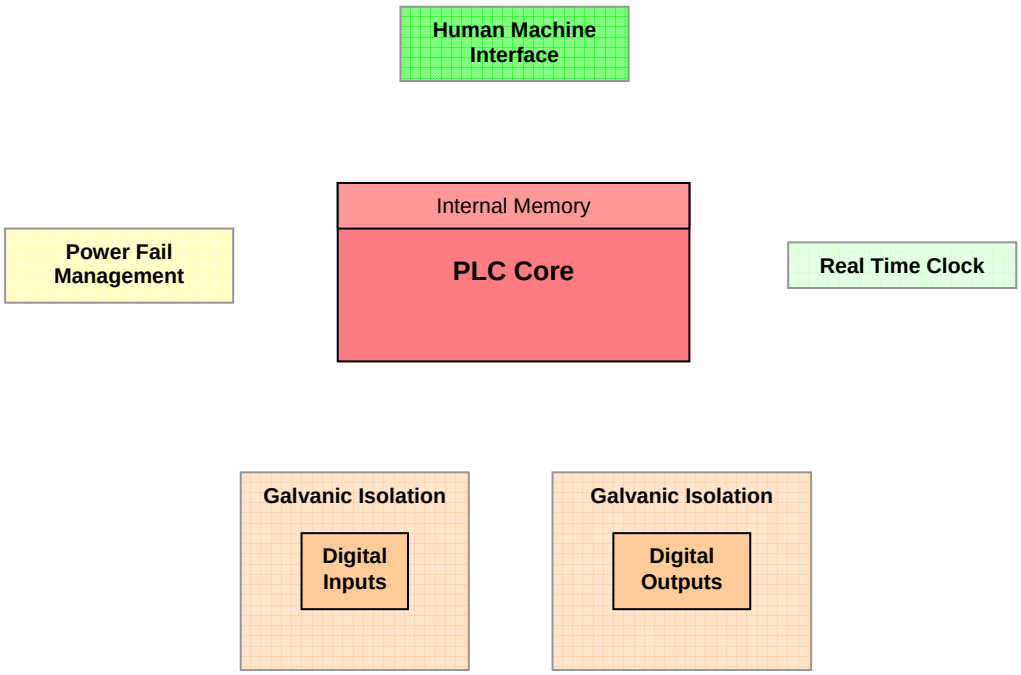
This application note gives a detailed description how to create a programmable logic controller based on the IPC@CHIP® and the CoDeSys programming system. Thereby functionality, requirements and usage is described.

Functionality

A programmable logic controller (PLC) is a device designed for automation of industrial processes. Typical examples for applying a PLC are:

- control of machinery
- production process
- room automation
- process observation

Generally PLCs consist of the microcontroller unit including processor, memory and various hardware interfaces.



Outstanding features of a PLC can include:

- standardized inputs and outputs
- platform independent programming
- industrial temperature range
- power fail management
- non-volatile memory
- real time capability

The programming standardisation with the IEC 61131-3 international standard for PLCs offers portability of the programs between different platform and processor types.

Beck IPC GmbH
Grüninger Weg 24
35415 Pohlheim/Germany
E-Mail: info@beck-ipc.com
www.beck-ipc.com
A member of the Festo group

Requirements

To start up with this application the hardware and software described below are required.

Hardware:

- Any of the IPC@CHIP® development kits and evaluation kits (such as DK61, DK55..) is enough to realize this application. Depending on your further requirements you can choose the product by the required features mentioned in the chart below:

	DK61	DK55
Ethernet	2	1
Serial Interface	2	2
Power Fail Management	yes	yes
Creating own C tasks	yes	yes
Real Time Clock ability	yes	yes
Addressable IOs	yes	no
General PIOs	yes	yes

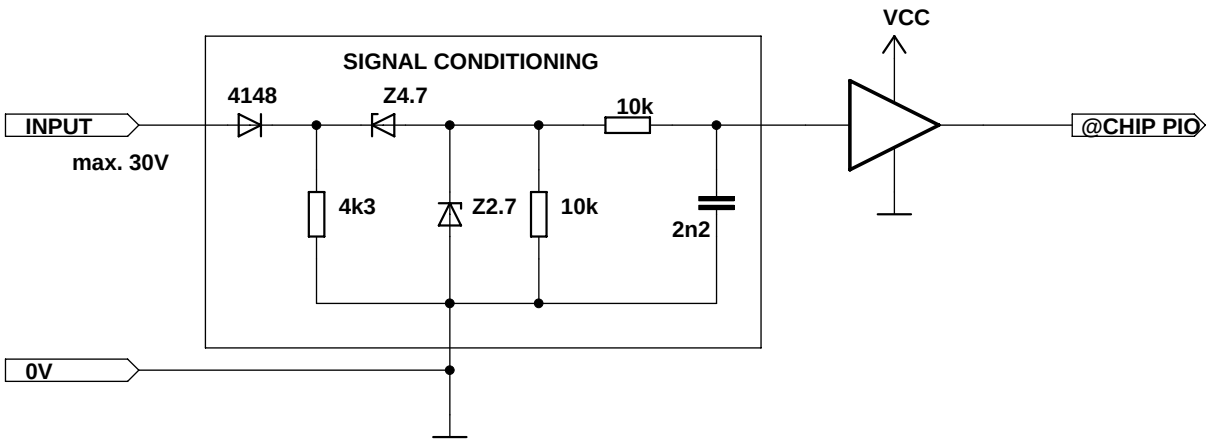
Software:

- @CHIPTOOL
- CoDeSys@CHIP-SDK Edition 10.2007 Release
- CoDeSys v2.3 programming system for IPC@CHIP

Peripheral Hardware Requirements

This chapter describes what is needed to build the periphery of PLC designs.

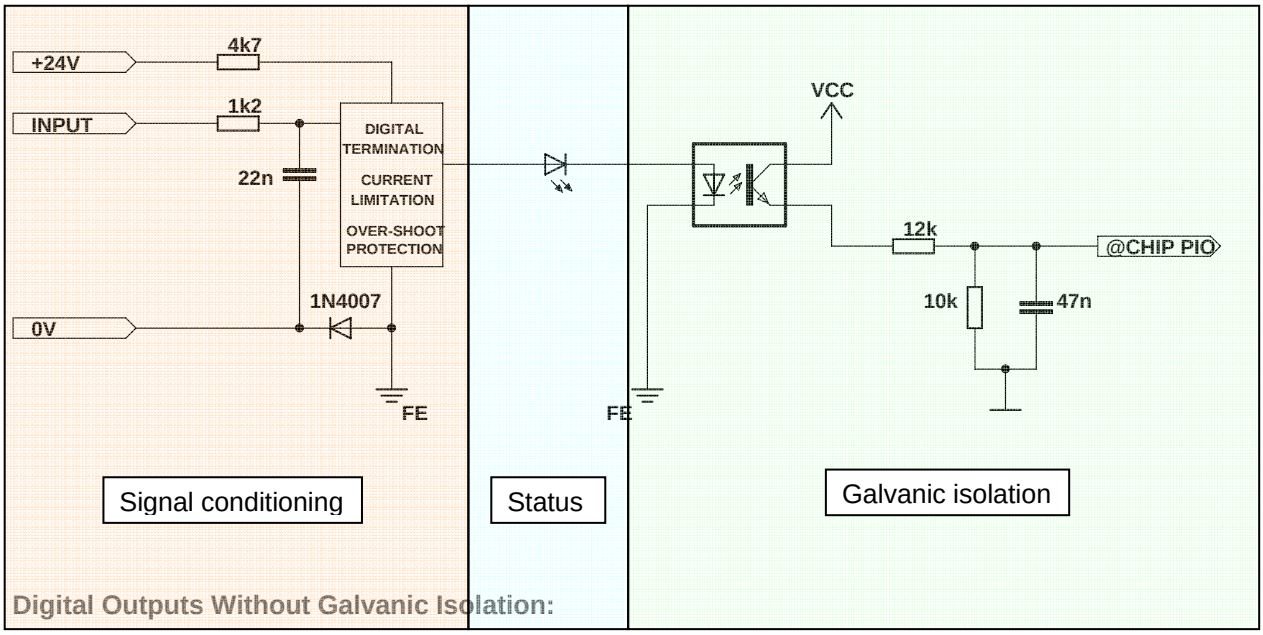
Digital Inputs Without Galvanic Isolation:



Beck IPC GmbH
Grüninger Weg 24
35415 Pohlheim/Germany
E-Mail: info@beck-ipc.com
www.beck-ipc.com
A member of the Festo group

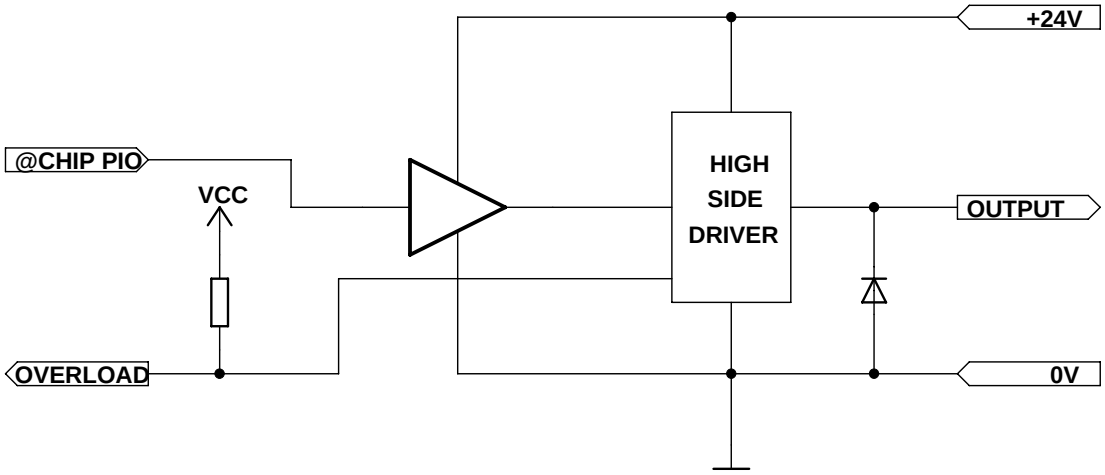
Digital Inputs With Galvanic Isolation:

PLCs are often used in an industrial environment. To protect the PLC from transient voltages or equalizing current due to different mass potentials a galvanic isolation can help reducing those problems.
There are some integrated devices that provide a termination for the digital signal plus the feature of current limitation and overshoot protection. As an example there is the CLT3-4BT6 from ST.



Digital Outputs Without Galvanic Isolation:

If there is no galvanic isolation needed, the following schematic provides a simple way to switch 24 V PLC levels. For protection against inductive load a freewheeling diode is use like GL34G from Vishay.

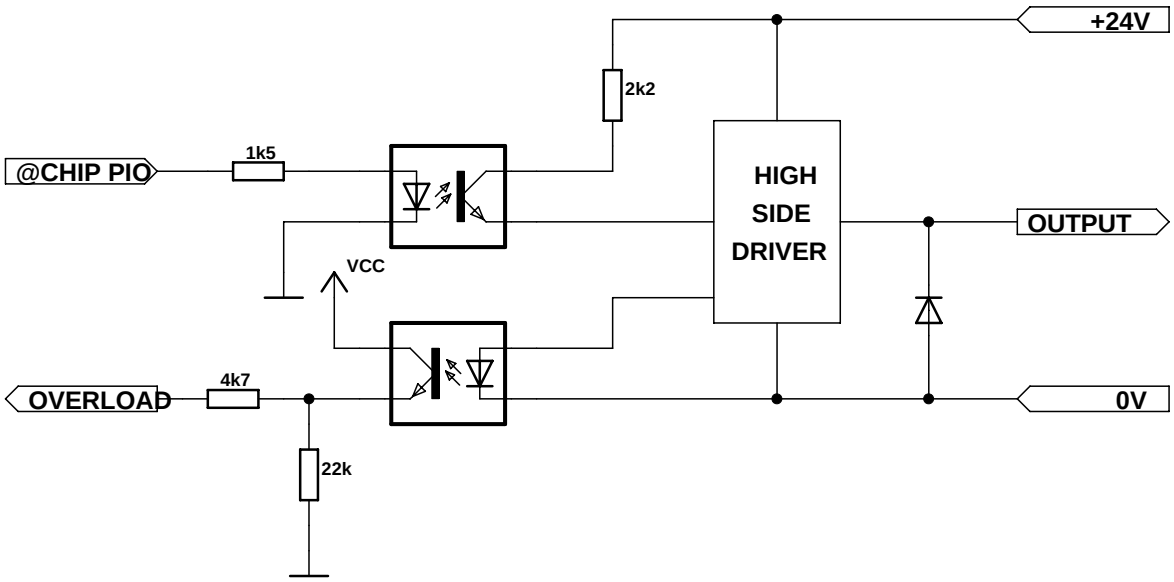


For the high side driver a device like the ST Micro VN330 can be applied.

Beck IPC GmbH
Grüninger Weg 24
35415 Pohlheim/Germany
E-Mail: info@beck-ipc.com
www.beck-ipc.com
A member of the Festo group

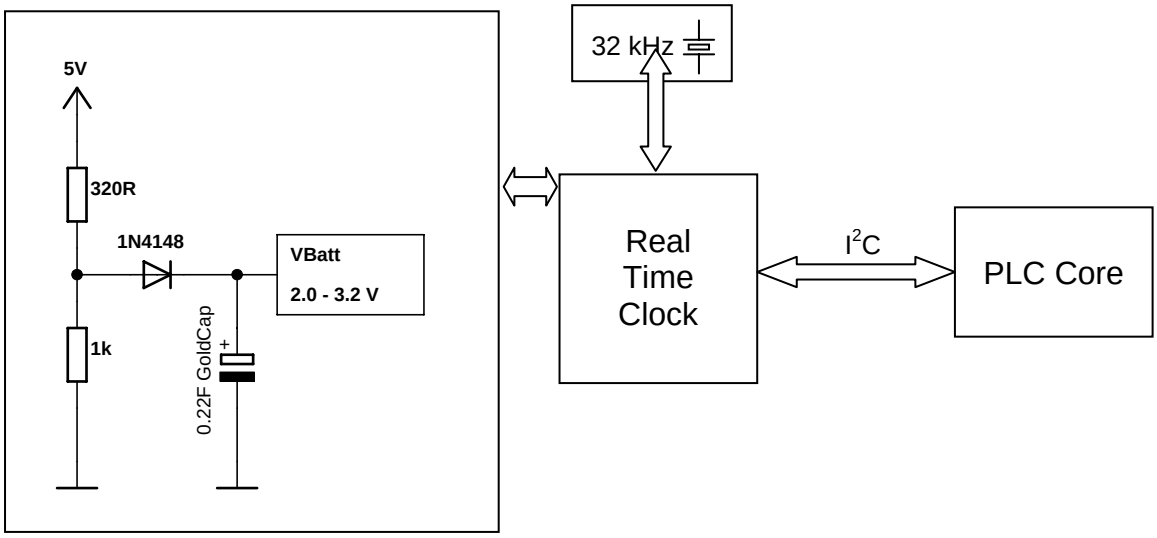
Digital Outputs With Galvanic Isolation:

PLCs are often used in an industrial environment. To protect the PLC from transient voltages or equalizing current due to different mass potentials a galvanic isolation can help reducing those problems.



Real Time Clock:

In a PLC a real time clock is used to provide the system with a time measurement which is independent from power supply. In case of a loss of power in the system the RTC keeps up the time information. This can be especially helpful, if there is a loss of power in the system which is datestamping the files.
For example, we take the Maxim DS1307 device, which can be connected via the I^2C interface. In case the 5 V power supply falls below the level of 3.2 V, the RTC is powered by the attached capacitor or battery. Time can be recovered through the RTC via I^2C when the power is up again.



Power Fail Management:

The IPC@CHIP® has a built-in power fail management. In case of a power outage, the data in the retain area of the IPC@CHIP® are saved to the flash when an power fail interrupt occurs. For simulation, the IPC@CHIP® boards have an power fail interrupt simulator pressing the "PFI" button on each board. Please refer to the SC23 hardware manual and the SC1x3 hardware manual respective for the needed power supply capacitor for power fail management in a real environment.

Installation

PC Software Installation:

- Install CoDeSys on your PC. It is recommended to download the latest version from the Beck IPC download center.
- Extract the IPC@CHIP® plc.zip software archive and enter the subdirectory of your IPC@CHIP® board (e.g. DK61_PLC).
- Install the corresponding Target Support Package from the executing the install.bat in the TSP directory. The TSP directory can be found within the folder with the same name as the .xml file

Before you install this application on your IPC@CHIP® you have to configure the contoller.

IPC@CHIP® Configuration:

- Install the @CHIPTOOL.
- Connect power supply and ethernet cable to your IPC@CHIP® board. Your development PC must be also connected to the same ethernet.
- Start the @CHIPTOOL. After some seconds the @CHIPTOOL shows your IPC@CHIP®.
- Open the pop-up menu with a right mouse click on your IPC@CHIP® and choose ‘IP Configuration’.
- Configure your IPC@CHIP®. For further information to the IP configuration please ask your network administrator.

IPC@CHIP® Software Installation:

- Open the @CHIPTOOL pop-up menu with a right mouse click on your IPC@CHIP® and choose ‘FTP’.
- Enter username (by default ‘ftp’) and password (by default ‘ftp’) and click on ‘Connect’
- Enter the Image_a directory. The Image_a is contained within the subdirectory of your IPC@CHIP® board
- Download all files of the Image_a directory to the IPC@CHIP®.
- Close the @CHIPTOOL FTP-Client Window.
- Reboot your IPC@CHIP® (power-down and power-up).

Run

Now your IPC@CHIP® PLC device is read for use.

First time start:

- Start CoDeSys and open the PLC.pro project file for the corresponding board (e.g. DK61). The IEC_PLC folder is contained within the subdirectory of your IPC@CHIP® board.
- Select the menu point Online-Communication Parameters and choose either the connection from an unused serial port on your PC via nullmodem cable using the settings baudrate: 38400, no parity, 1 stop bit, no Motorola byte order and no flow control. Plug in the nullmodem cable to the COM0(EXT)

Beck IPC GmbH
Grüninger Weg 24
35415 Pohlheim/Germany

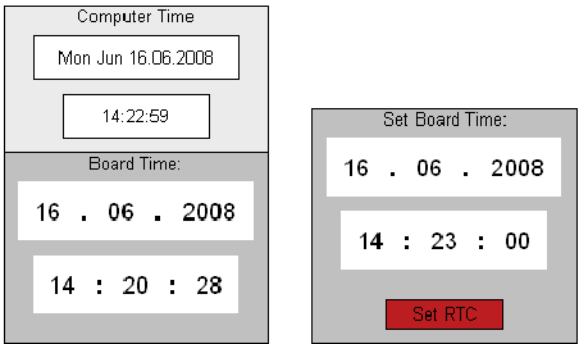
E-Mail: info@beck-ipc.com
www.beck-ipc.com
A member of the Festo group

serial interface of the DK60, respectively COM2 for the DB54. Alternatively choose the connection over ethernet with the right address of your IPC@CHIP, port: 1200, TargetId: 0 and no Motorola byteorder. You can look up and set the address within @CHIPTOOL.

- Select the menu point Online-Login
- If asked to download the new program, press yes
- Select the menu point Online-Create boot project
- Select the menu point Online-Run
- Select the menu point Online-Logout

Using the real time clock:

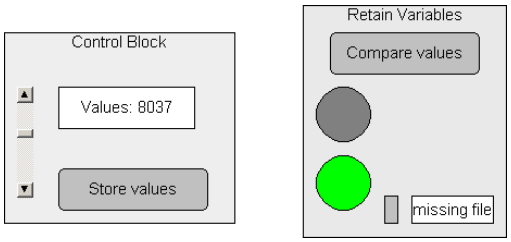
- Select the menu point Online-Login
- Enter the actual date and time in the right box and press "Set RTC". This will set the real time clock attached to the IPC@CHIP®'s I^2C interface and synchronize the internal clock.



- Select the menu point Online-Logout
- Press the PFI button on your IPC@CHIP board to emulate a power outage
- After waiting a few seconds for the IPC@CHIP to boot-up, select the menu point Online-Login again. The time in the Board Time box should have remained as the actual time.

Using the power fail management:

- Select the menu point Online-Login
- Use the bar on the left of the control block to write a value to the retain memory, which will keep its value at a power fail
- Store a reference value for comparison after power fail in a file to the IPC@CHIP®'s internal flash drive by pressing the button "Store values"
- Check that the values of the retain memory and the stored value in the file are equal by pressing the "Compare values" button. The green light should be lit. If the "missing file" indicator flashes along with the red light, there is a problem writing a file to the c's flash drive. Check for free memory on that drive then.



- Select the menu point Online-Logout
- Press the PFI button on your IPC@CHIP® board to emulate a power outage
- After waiting a few seconds for the IPC@CHIP® to boot-up, select the menu point Online-Login again
- The green light should be lit, when pressing the button "Compare values" showing that the retain variables have preserved their values during the power outage

Beck IPC GmbH
Grüninger Weg 24
35415 Pohlheim/Germany
E-Mail: info@beck-ipc.com
www.beck-ipc.com
A member of the Festo group

Using the Outputs:

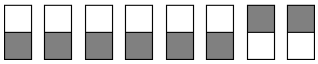
- Select the menu point Online-Login
- With the "+" and "-" bar, the outputs can be switched

LEDs

Using the Inputs:

- Select the menu point Online-Login
- The switch setting of the IPC@CHIP® board is shown within the switch bar

Switches



Links

http://www.beck-ipc.com

http://www.beck-ipc.com/gettingstarted

http://forum.beck-ipc.com

Beck IPC GmbH
Grüninger Weg 24
35415 Pohlheim/Germany

E-Mail: info@beck-ipc.com
www.beck-ipc.com
A member of the Festo group