Software installation
and configuration
IEC-line series
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1. **Installing the software**

The main tool is the programming environment **CoDeSys V2.3** that is an advanced PC-based software developed in Germany by an independent company, the 3S-Smart Software Solutions, and used by more than 250 manufacturers of PLC, industrial PC and boards for automation. CoDeSys can be downloaded, after a simple registration, on [www.codesys.com](http://www.codesys.com) and used without restrictions on PLC of IEC-line series.

The **IEC-line** package setup includes all the tools needed to use the OVERDIGIT PLC and I/O modules. In the package there are also several examples of programming and documentation of all products.

The setup of CoDeSys must be executed first because the IEC-line package provides for the completion of CoDeSys with all supporting files relating to the PLC of IEC-line series.
1.1. **Installing CoDeSys**

To install CoDeSys tool must be run the setup program **CoDeSys_v239xx.exe** (xx current version) of the installation package.

Confirm all the installation steps until the window for the selection of components to install. The installation package includes some auxiliary tools some of which can be used under specific license.

It is recommended to install only the CoDeSys programming environment, whose license is included in the PLC, the Gateway Server and the OPC server:

![InstallShield Wizard](image)

After installation, a folder is created in the Start menu of desktop, which also includes the CoDeSys main manual in PDF format:

![CoDeSys V2.3](image)

Additional manuals in PDF format are available in CoDeSys installation path:

C:\Programs\3S Software\CoDeSys V2.3\Documents\English

1.2. **Installing IEC-line**

CoDeSys is a development environment for IEC61131-3 programming designed to be used independently of the particular PLC. This is why it has been widely used in the world and has been adopted by many manufacturers of automation equipment.

This tool has all the functions of development, testing, documentation and maintenance of the IEC program. Also comes with extensive documentation, both online and PDF format, with detailed information on IEC61131-3 language and several programming examples.

To the standard structure of CoDeSys must be added everything related to the specific PLC to use, so now you must install the “target” that is a synonymous of a PLC device.
A target for its operation requires two sets of files:

1. **TSP (Target Support Package)** installed on PC
2. **RTS (Run Time System)** installed on PLC

The **Target Support Package** is a set of files that must be installed on Personal Computers to inform CoDeSys about the specific characteristics of the target. With the installation of the TSP some files are added in special folders of the CoDeSys installation path which provide the tools to work with the specific device.

In particular, are installed the configuration files for the PLC resources, the library files for the management of specific parts of the target and the online help files integrated in the CoDeSys menu.

To install TSP must be run the setup program **IEC-line_V239xxx.exe** (xxx current version) of the installation package:

![Setup screen](image)

Follow the instructions of the setup Wizard until the end of the installation process.

With the IEC-line package will be installed all the TSP files under the Targets folder of CoDeSys standard installation. The **Overdigit/IEC-line** subfolder will be created (under Programs folder of PC) containing all the documentation, example programs, a backup copy of RTS files (already pre-installed on PLC) and other files and programs to support the use of IEC-line series. The setup program also installs the **CHIPTOOL** program that allows access and management of the PLC using some utilities (such as FTP client) to be used in particular for the RTS software update.

The **Run Time System** consists of a set of files that must be installed on the device to make it work as a PLC. Normally this is not necessary because **RTS files are already installed on the device**. Only in the case of software update may be necessary the replacing of these files. In the following, a brief description of main parts of RTS.
The main executable file is the RTS program of PLC (for example WP240_RTS.EXE), that runs the
device as PLC programmable with CoDeSys. This file must be present on the FLASH disk (in
"A:\SYSTEM") and its execution must be started at power-on by the AUTOEXEC.BAT file.
In the "A:\SYSTEM" folder there are also some executable files for disks driver and USB auxiliary
programming port (also these exe files are called by the AUTOEXEC.BAT) and some utility and
support applications.
In the root directory "A:\" two very important files are stored.
The first is the CHIP.INI file for general configuration of the system that contains several sections,
each with specific parameters. The file contains the preinstalled optimal parameters for many
applications. However, generally must be redefined the addresses for Ethernet network connection
and any username and password for access. For this purpose, a graphical user interface, based on
the PLC Web server, configures the main parameters.
The second is the AUTOEXEC.BAT file that lists the programs to launch automatically when the CPU
is powered on. It allows you to install the drivers of external hard-disks (USB memory and SD card),
the driver of the USB port (to define a virtual COM for CoDeSys programming), to execute some
support applications and finally the RTS program as PLC engine.
Finally, it is necessary the "A:\PLC_PRG" folder for storing all files of the IEC application program
developed with CoDeSys and executed by RTS.
A complete files/folders copy of standard setup for the target is available in the "Disk_A_image"
folder of the specific PLC under the installation on PC of the IEC-line package.
2. Configuring the PLC

The PLC configuration options are stored in the CHIP.INI file, located in the root folder of disk A. This configuration file is of text type and thus can be viewed and edited directly by an editor after a FTP connection with the PLC (server) using a PC (client). However, the PLC is equipped with a preinstalled set of Web pages that allow direct access to the configuration parameters through a simple and descriptive user interface. To access the configuration pages, managed by the ADMIN.EXE application (started by autoexec.bat), just type in the browser the network address of the device followed by “/admin/admin.html” using the credentials to access Web server. For example, in the case of default credential:

Address: 192.168.1.101/admin/admin.html
Username: web_user0
Password: web_password0

The home page of PLC administration site contains some general information such as the RTS software version:

![Home page](image)

To configure the various parameters follow the instructions in the specific section. **NOTE:** After setting one or more configuration values in the page fields, the data must be written in the PLC via **Send** button of the same page.
2.1. **General information about Ethernet network**

The PLC has an Ethernet port for connecting to a local network (LAN) or directly to a Personal Computer. The Ethernet network must be configured setting the following parameters:

- IP address
- Netmask
- Gateway

The value of IP address is the network address of the device. Normally in a private network this address is 192.168.xxx.xxx where xxx marked fields are different for each device on the network.

Netmask defines the value of a bits mask that separate the IP address part used for routing within the local network (bits to 0) than that used to addressing outside the local network (bits to 1).

Gateway is the specific address of a device connected to the network that performs the functions of "exit door" between the local network (LAN) and the external network (Internet). In a local area network the Gateway usually coincides with a modem-router.

Ultimately in a local network there will be multiple devices (modem-routers, Personal Computers, printers, devices such as the PLC and others) each of which will have its own IP address. When one of these devices must communicate with another it will send a data packet to the IP address of the recipient device. If the destination address is internal to the local network (and this is known by the Netmask), the packet reaches this through the router, but if the address is not internal to the LAN this is sent to the Gateway which will send the packet outside the network.

In particular the CHIP.INI file of the CPU is preconfigured with the following parameters:

```
[IP]
ADDRESS=192.168.1.101
NETMASK=255.255.255.0
GATEWAY=192.168.1.1
DHCP=0
```

The predefined local network is using the fourth field to address the connected devices. In particular, the PLC is at 101 final while the modem router at 1. The Gateway, in this case the modem-router, has the network address 192.168.1.1.

The choice of the network address of a device can be done either manually (by choosing for example the value 101), or automatically using the DHCP (Dynamic Host Configuration Protocol) feature.

In manual configuration must be carefully assigned a unique address to each device connected to a network. When networks are complex, this assignment requires significant attention by the network administrator.

In the automatic configuration, toggled by setting the DHCP parameter of CHIP.INI file, the PLC asks the network Host that is assigned an IP number currently available.

In a typical case of a small local network, where the Host functions are performed by the modem-router, the DHCP server resides within this unit. The CPU with the parameter DHCP=1 performs the function of DHCP clients and waits the IP address assignment from the Host. For example, if the
network is already connected to a PC (which has already been assigned the address 192.168.1.2) and then is connected a PLC, the address 192.168.1.3 can be assigned to this device. The reason why for the default setting of CPU is preferred not to use this service (DHCP=0) is due to the fact that, with the dynamic assignment, the addresses order can be different every time (depending on the active devices on the network). If you do not known the local network address of the PLC is not possible for the modem-router to open specific ports accessible from outside the network using NAT functionality. The NAT (Network Address Translation) service makes the connection from outside the local network, via the Internet, through translations of addresses. The table of translations associates a particular request of a service (Web server, FTP server and remote CoDeSys programming) from outside the network to an internal device of LAN and for this you need to know in advance the IP address. In a next paragraph will be provided all the information needed to use this feature.

2.2. Configuring Ethernet network
The PLC is factory configured with the network values indicated in the previous paragraph. To change these values, the **Network** page of Web interface can be used:
However, in some types of networks, the Web interface could not be immediately accessible because the network configuration parameters could not be compatible with those programmed as default inside PLC. For this it is necessary, initially, set the PLC network values in a manner compatible with the LAN using the CHIPTOOL utility program:

With the start of the CHIPTOOL program is constantly scanned the network for all PLC devices connected (the scanning can be stopped later with Stop button). The window shows some information about the PLC connected and in particular the network parameters currently set on the CHIP.INI configuration file. To change the value of the DHCP parameter (for the service enabling) and others network parameters, position the mouse cursor on the specific line of the device and press the right button to activate the context menu as follows:

Click on the "IP configuration" menu to access the network configuration:
The current values in the configuration file are automatically reported.
To manually configure network parameters, leaving off the "Use DHCP", put the three desired values for "IP Address", "Network mask" and "Gateway".
To activate the self-assigned address instead activate the option "Use DHCP" leaving unchanged the three address fields.
To update the CHIP.INI file with the new settings, click the "Config" button.
With the DHCP=1 option, every time the PLC is powered on, it makes a request to the Host for address assignment, and these values are automatically updated in the CHIP.INI configuration file.
2.3. **Direct Ethernet connection to a PC**

The PLC can be connected directly (point to point) with a single Personal Computer without using a routed network. A direct connection to a PC provides, in a simple way, to accomplish all the programming functions and handling of a single PLC.

In this case a crossover Ethernet cable (usually marked with the "cross" label or a red color) must be used to connected directly the PLC and the PC Ethernet port.

The DHCP=1 option is possible only if in the PC is running a "DHCP server" program that can automatically assign an IP address to the PLC. The most common situation is however to assign manually two different IP addresses, one for the PLC and one for the PC.

To set a specific IP address for the PC the properties of the TCP/IP Internet protocol must be accessed:

![Software installation and configuration](image1)

![Software installation and configuration](image2)
2.4. **FTP connection and PLC files management**

An important tool offered by the CHIPTOOL program is the FTP client. FTP (File Transfer Protocol) allows the access to the folders and files on the FLASH disk of the PLC.

On the CPU is active, by default, the FTP server service that allows the connection to any FTP client program like that, very simple, provided by CHIPTOOL.

Remember that any FTP client program can be used such as the sophisticated “FileZilla” freely downloadable from the Internet.

The FTP connection is made either in the local network or remotely by running the FTP client on a PC connected to the Internet. For the outside access must be opened a FTP port using the NAT service of the modem-router as will be described in the specific paragraph.

Activate the context menu after placing the mouse cursor on the specific line of the founded device:

![FTP connection menu](image)

Click on the FTP menu to access the FTP connection:

![FTP connection dialog](image)
The IP address of the PLC is automatically proposed while the User and Password fields should be properly set equal to the values currently stored on the CHIP.INI file.
In the CPU pre-installation the default values are:

**Username:** ftp\_user0  
**Password:** ftp\_password0

The CHIP.INI file provides for the possibility of having two separate users (0 and 1) each with its own User and Password values.
An extract of the file section on CHIP.INI for the FTP connection parameters is as follows:

```
[FTP]
...
USER0=ftp\_user0
PASSWORD0=ftp\_password0
...
USER1=ftp\_user1
PASSWORD1=ftp\_password1
```

In the absence of definition lines regarding USER and PASSWORD by default are defined two special users:

**Username:** anonymous  
**Password:** “not defined”  
**Username:** ftp  
**Password:** ftp

The connection option "Use passive mode" must be enabled in the case of remote connection via the Internet.
Confirming the connection with the "Connect" button to access the files window:
On the left side is available the folders/files tree of the Personal Computer while, on the right side, the files of the PLC.

This tool allows the execution of some commands such as view, edit, copy, move and delete files and folders and perform the PLC FLASH disk operations. In this way the CHIP.INI and AUTOEXEC.BAT files can be customized and can be managed all the files of the IEC program in the "A:\PLC_PRG" folder.
2.5. **Web server connection**

CoDeSys programming environment allows you to create, in a simple and intuitive mode, graphic pages for visualization and management of the IEC program variables.

With this feature, called "Visualizations", pages created can be viewed within the CoDeSys environment (usually for testing and development) and by a "Web browser" locally or remotely over the Internet.

The PLC includes a Web server that can make accessible the pages, created with the CoDeSys IEC program, through a "Web browser" (such as Internet Explorer) by typing the specific network address of the PLC.

To use the Web visualization on the PC must be installed the Java engine program that can be downloaded, free of charge, at the following link:

www.java.com/download/index.jsp

To access Web pages created by CoDeSys, in the case of PLC configured with default parameters, use the following values:

- **Address:** 192.168.1.101
- **Username:** web_user0
- **Password:** web_password0

After loading the Java application on the PC, the home page, created in the IEC program, will be viewed. Each page corresponds to an XML file (generated by CoDeSys and transferred to the PLC) that will be downloaded and subsequently interpreted by the local Java program, leaving to the network communication only the exchange of the values displayed on the page.

2.6. **Configuration by CoDeSys**

The configuration of the main parameters of the FTP connection, the Web server and other parts of the PLC can be performed, as an alternative to Web administration interface or editing of CHIP.INI file by the FTP connection, through the CoDeSys programming environment.

Through the CoDeSys "PLC_Browser" function a communication with the PLC can be established using a command window. There are some commands to perform PLC configuration such as the setting of the Ethernet network, the FTP connection, the Web server and the Real Time Clock.

The configuration of the Ethernet network connection can also be done with the "PCL Configuration" function, clicking on "CPU (* Local resources *) [SLOT]" and then "Modul Parameters". After selecting the line for the device, new network addresses for the PLC can be selected.
3. Remote access via Internet

3.1. Configuring the modem-router on the LAN

In a private LAN the Gateway is a network device that allows access to and from the outside (the public Internet network). This device is usually an ADSL modem that often integrates the router function. This operates as the central for the routing of the communication packets of the other devices connected in the local network. The Ethernet port only provides a physical connection between two devices. Therefore, to form a complete network, routers are needed with a number of sockets to be connected to various devices. There are other devices such as switches that allow the creation of even more complex structures operating in a similar way of routers. The switches allow multiple devices to interconnect with each other on the same network and routers also interconnect different networks among them.

In the following example will be made reference to a LAN realized by a simple ADSL modem-router with 4 ports. At this router two Personal Computers and one PLC are connected. The PLC is configured with 192.168.1.101 static address (DHCP client disabled) while the modem-router has the address 192.168.1.1 and the DHCP server enabled:

The two Personal Computers, with the DHCP client enabled (option "Obtain an IP address automatically" in the properties of the TCP/IP Internet protocol), make request to the router of its own unique network address. The modem-router then assigns the network address 192.168.1.74, 192.168.1.2 to the PC’s.

The PLC, with DHCP automatic assignment disabled, is configured at 192.168.1.101 as programmed in the CHIP.INI configuration file.
At this point the Gateway (ADSL modem), the two Personal Computers and the PLC form a private network. Through each of the two PCs, the CPU disk can be accessed with FTP connection, the PLC can be programmed and the pages of CoDeSys visualization viewed by a Web browser. The PLC can also directly access outside the network, for example by sending E-mail or synchronizing the clock with a NTP server.

### 3.2. Setting the NAT service

The next step is to allow access, from outside the local network, to the PLC and to the services that it offers. For this some ports in the modem-router must be opened using NAT service, usually available on all devices of this type.

The connection through the external network (Internet) to a device connected in a private local area network (LAN) is done by the remote software (Web browser, FTP client and CoDeSys) with the sending of a port address as well as the IP address of the device (address assigned to the modem from the Internet Service Provider).

Each type of service is usually associated to a predetermined port address. For example, the port values normally used for services of interest are:

<table>
<thead>
<tr>
<th>Service</th>
<th>Port Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>FTP</td>
<td>21</td>
</tr>
<tr>
<td>HTTP (Web browser)</td>
<td>80</td>
</tr>
<tr>
<td>Telnet</td>
<td>23</td>
</tr>
<tr>
<td>CoDeSys</td>
<td>1200</td>
</tr>
</tbody>
</table>

In this example the NAT service is accessible via the "Port Mapping" menu. It should be added the 4 rows in the table of virtual servers. Normally there is a predefined list of virtual servers such as FTP, HTTP and Telnet. It may be possible to manually define all four services with the "Custom Virtual Server":

The purpose of this table is to redirect an external request of a particular service directly to the IP address of the LAN device that offers this service. For example, when CoDeSys wants to remotely access the PLC, it sends packets with the TCP/IP internet address associated with the ADSL modem and the port address 1200. The modem-router, looking at this table, will send packets to address 192.168.1.101 of the PLC. At this point, the PLC responds to the sender, transmitting own data packets. As the answer destination is outside the local network, the Gateway (or modem) sends this data to the external network and so the replay is returned to the remote PC on which CoDeSys operates.

Similarly are accessed from the outside, on a different port addresses, other services such as Web server and the FTP connection.

3.3. Registering a name server for the PLC

Every network device has its own IP address. This is true both for the local private networks (where normally is used the addresses group 192.168.xxx.xxx) and for the public network (Internet). The popularity of Internet has, however, quickly led to a shortage of addresses, despite the 32 bits used for the TCP/IP version 4. For this was introduced a 128bits addressing with protocol version 6 with which the PLCs of IEC-line are already compatible. However, because the large use of the 32 bits protocol, is used a solution to solve the problem of addresses shortage. Instead of assigning to every Internet connected computer a fixed IP address, the Internet Service Provider assigns a different IP (dynamic address) that is free at the moment in order to more efficiently allocate network addresses.

When an ADSL modem-router is turned on, the provider assigns a temporary IP address within the WAN (Wide Area Network), which represents a great network that connects local networks in large geographical areas. Viewing the WAN settings in the modem, the IP address that is currently assigned to the modem can be checked.
The presence of a dynamic IP makes it very difficult to access from outside the services locally performed by a network device because this address may vary and consequently the remote computer will not have the address information.

For this reason, could be necessary the use of a Dynamic DNS (Domain Name System) capable of continuously match the value of dynamic IP address to a well-defined naming convention. The DNS servers are very important for Internet because it can translate a name of a website into the corresponding IP address as it happens in a telephone directory for a name and the related telephone number. It is much easier to type the name of a site rather than its IP address.

The service provided by "dyndns.com" and other similar sites, as "no-ip.com", is also very useful in the case of dynamic IP addresses. Normally these sites offer the service with an inexpensive subscription but are also possible free accounts as in the case of "no-ip.com".

Now will be recorded, by way of example, the third level domain "myplc.no-ip.org" to be associated with the IP of the modem-router which is connected to the PLC:
Using the "Sign Up Now" button a simple registration form of the service is visualized:

In the Hostname field, type the name chosen for the PLC (in the example "myplc"). Confirming the subscription, the following page is viewed:
To complete the registration, must be accessed the E-mail account, specified in the previous form, clicking on the link received in the confirmation E-mail.
At this point, the registration of the name associated with the PLC is ended.
To maintain updated, on the DNS server, the correspondence between the dynamic IP address and the Internet "myplc.no-ip.org" address, the modem-router must be configured with the information about this service:

In particular, under the "Dynamic DNS" menu you have to add a row to the table providing the full name of the Host ("myplc.no-ip.org"), the Username and Password chosen when registering to the service and selecting the DNS server provider ("no-ip.com").
The modem-router, so configured, will operate as a dynamic DNS client, and the dynamic IP will be constantly updated on the DNS server.