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CE

Advanced Wind turbine Controller
AWC 500

System description

Document no.: 4189340735

Revision

Revision	Author	Date	Description
A	SJE	2010-10-02	Initial release
B	LVI	2013-06-14	Updated with IOM5·2 and DIM5·1

Contents

1 General information

1.1   Copyright

2013©by DEIF A/S
This documentation is copyrighted. Any reproduction or third party use of this publication, whether in whole or in part, without the written permission of DEIF A/S, is forbidden.

1.2   Legal information and responsibility

DEIF takes no responsibility for installation or operation of AWC 500 . If there is any doubt about how to install or operate the product, the company responsible for the installation or the operation of the set must be contacted.

> ⚠ **The units are not to be opened by unauthorised personnel. If opened anyway, the warranty will be lost.**

1.3   Disclaimer

DEIF A/S reserves the right to change any of the contents of this documentation without prior notice.

1.4   Electrostatic discharge awareness

Sufficient care must be taken to protect the terminals against static discharges during the installation. Once the unit is installed and connected, these precautions are no longer necessary.

1.5   Safety issues

Installing the unit implies work with dangerous currents and voltages. Therefore, the installation should only be carried out by authorised personnel who understand the risks involved in working with live electrical equipment.

> ⚠ **Be aware of the hazardous live currents and voltages.**
> **Do not touch any ACmeasurement inputs as this could lead to injury or death.**

1.6   Definitions

Throughout this document, a number of notes and warnings will be presented. To ensure that these are noticed, they will be highlighted in order to separate them from the general text.

1.6.1 Notes

The notes provide general information which will be helpful for the reader to bear in mind.

1.6.2 Warnings

The warnings indicate a potentially dangerous situation which could result in death, personal injury or damaged equipment, if certain guidelines are not followed.

2 AWC 500 System description

2.1 Introduction

Figure 2.1: AWC 500

AWC 500 is a powerful controller platform for main control and pitch control systems – engineered specific for wind turbines. The AWC 500 platform includes the latest technologies, with focus on maximum wind turbine availability.

Operating temperature:	**-40...70 °C (with start up from -40°C)**
Relative Humidity (operating):	**97 % condensing @ 55 °**
Storage temperature:	**-40...85 °C**
Altitude:	**<4000 m**
Approvals:	**Designed for marine levels (surpassing Industrial automation levels)**
Design life time:	**No less than 20 years**
Wear Parts Guarantee:	**10 years**

"Design life time" means that the system should be able to survive for 20 years under the conditions that occur in connection with a wind turbine application.

Flexibility
AWC 500 is based on a modular rack concept, which provides compact, flexible and service-friendly solutions - right from simple plug-and-play rack modules to cabling fitted with pluggable connectors.

Reliability
AWC 500 is designed and constructed to meet the strict requirements for maritime use which exceed industrial norms by far. The maritime norms prescribe increased performance on several parameters such as EMC, vibration and shock resistance, temperature spanning, etc.

For instance, the AWC 500 operates from -40. . . 70°C (with start-up from -40 °C) and can be stored from -40°. . . 85 °C. The durability of the construction is verified by HALT testing (Highly Accelerated Life Test) – the controller is designed for a lifetime no less than 20 years.

Unrivalled robustness
The AWC 500 is designed for the harsh environment in a wind turbine. Maximum immunity towards vibrations and shock which can be related to transportation and 20 years of operation in a wind turbine. The electrical design is optimised to withstand electrical bursts from lighting or electrical discharge due to maintenance and handling.

Performance
AWC 500 features new technologies like EtherCAT high speed fieldbus as native I/O communication. This means same update speed for local or distributed I/O. It is fast enough to handle a pure distributed I/O with one main controller and hundreds of distributed Analog and Digital I/O and communication channels placed in multiple racks in Tower, Nacelle and Hub. For turbine system safety considerations we recommend a separate controller in hub.

Resources

- The on-board memory is 128 MB RAM.

- Internal 128 MB Flash is included.

- Removable storage SD card with up to 64 GB flash disc inside.

- Floating point processor supporting both single and double precision.

Reliable system software
The AWC 500 features a complete software technology relying on open source Linux made real-time with PRE-EMPT_RT patch, featuring well known toolboxes.
The operating system is operational after ca. 10 sec after power on. Additional it provides fail-safe system upgrade. We provide the platform as a fully open architecture platform – meaning the customers have full access to setting up the system.

Programming
AWC 500 can be delivered with two different software packages:

- AWC 500 C/C++ Development package – for C/C++ programming.

- AWC 500 CODESYS Development package – for IEC61131-3(PLC) programming.

- AWC 500 External C Lib Development package – for integrating C/C++ based libraries in CODESYS.

The hardware configuration is independent of which software package is used.

PLC Link - MATLAB/Simulink interface
The DEIF in-house developed PLC Link software tool can be used to optimize the application coding. PLC Link translates models in MATLAB, Simulink and Stateflow into IEC 61131-3 PLC code.

The generated code is flawless, due to the auto generation, eliminating the risk of human errors. At the same time, it is extremely fast compared to human programming, potentially cutting months off the duration of a customer project.

Visualization
The AWC 500 support different visualization solutions, depending on software packages. For the customized C-

application a graphical user interface is implemented and can be customized for the individual application. The graphical user interface can with a remote client, be installed on a standard Windows CE or Windows XP touch screen display.

SCADA & Wind Park Power management
A full-featured SCADA system (Supervisory Control And Data Acquisition) can be a part of the solution. The SCADA-system will offer full remote control and supervision of the entire wind park and the individual wind turbines.

Related products
Together with AWC 500 it can be relevant to also offer some wind specific components like the static wind sensors (WSS), GPUs and TCMs.

Technical documentation
The technical documentation for AWC 500 consists of the documents:

- System description (this document)
- Datasheet
- Installation instructions
- Getting started
- Operative System Software
- IEC61131-3 programming
- C/C++ programming
- Type certificate

The technical documentation is available from our website `http://www.deifwindpower.com` (CURRENT Versions) and FTP server `ftp://support.deif.com` (CURRENT and DEVELOPMENT versions)

2.2 Configurations

The AWC 500 can be configured from a variety of processor and interface modules which can be used to build up different configuration to match a given application.
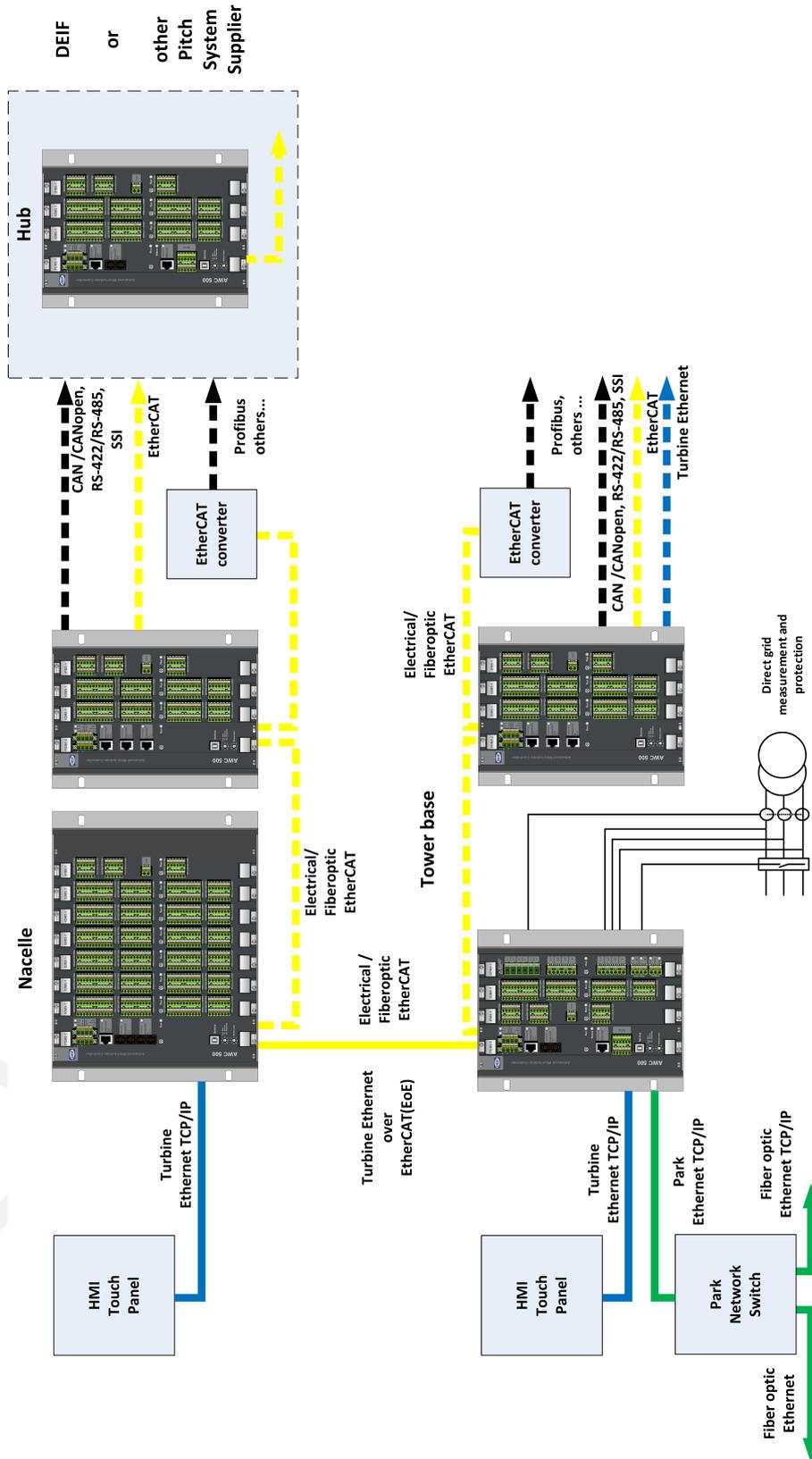
Figure 2.2: Turbine example configuration

A typical application would be a wind turbine with a Main controller with I/O in Tower base and distributed I/O in the Nacelle and Hub.
The Pitch Motion Controller can be a separate system interfacing typically via RS-485/CAN/Profibus with the Main Controller.
Please note for Profibus interface an EtherCAT to Profibus converter is inserted in DEIFs configurations.
Another typical application would be as a Tower Base / Nacelle configuration - a wind turbine with a Nacelle main controller, I/O and distributed I/O in Tower Base.
Wind park network and turbine network can be separated and the Ethernet is routed via the EtherCAT network to nacelle.

2.2.1   Modules

The table shows the different modules and their I/O and interface configurations.
The detailed specification can be seen in the AWC 500 datasheet.
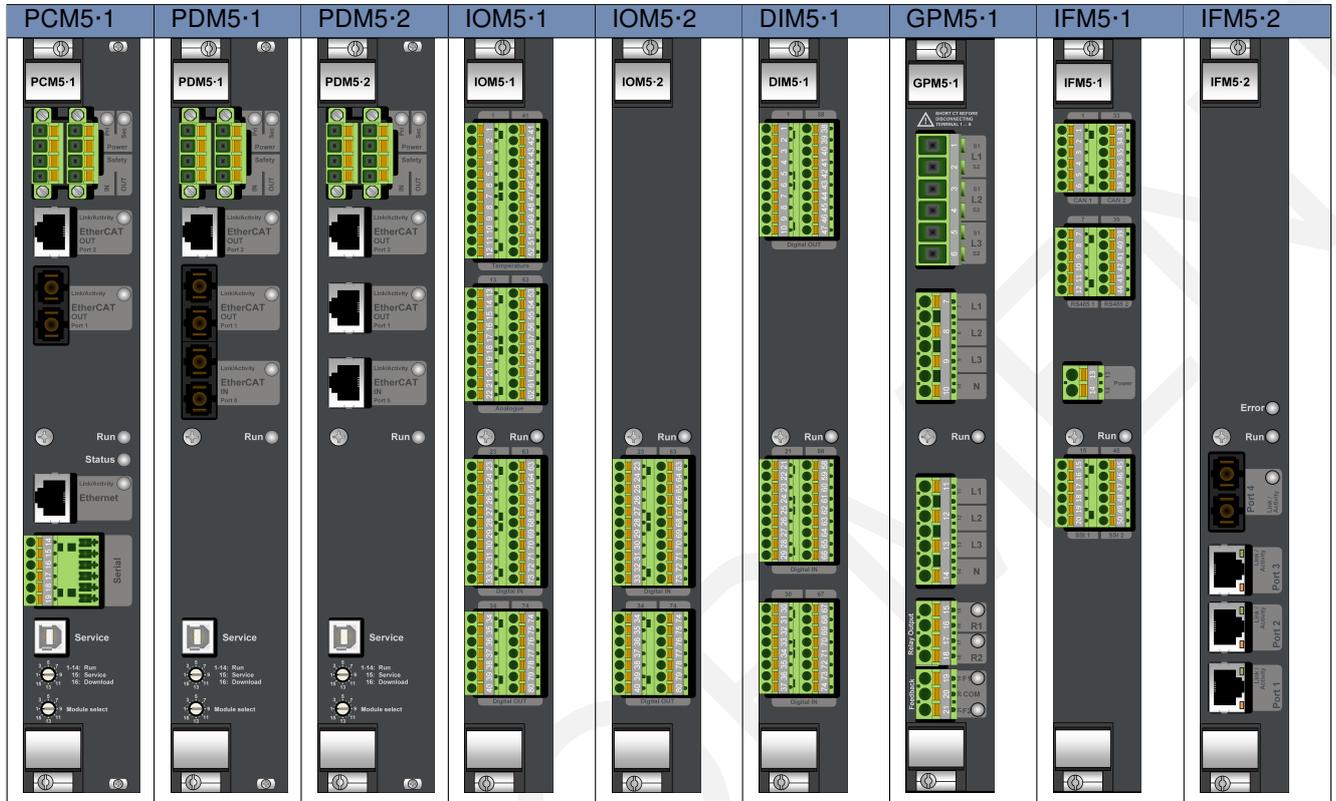
PCM5·1		Power and Control Module	Rack system power supply and main system controller. The main processor the wind turbine application
PDM5·1 PDM5·2		Power and Distributed communication Module	Remote I/O interface module (optical or electric Ether-CAT)
IOM5·1		Input and Output Module	40 channel multi-function I/O module with: Analogue inputs, temperature inputs, digital inputs, frequency counter inputs, analogue outputs and digital outputs
IOM5·2		Input and Output Module	26 channel digital I/O module with : 16 digital inputs and 10 digital outputs
DIM5·1		Input and Output Module	46 channel digital I/O with: 30 digital inputs and 16 digital outputs
GPM5·1		Grid and Protection Module	Direct 690 VAC 3-phase grid and generator voltage, current and power measurement (Class 0.5)
IFM5·1		Interface and Fieldbus Module	RS-422/485, SSI and CAN interfaces
IFM5·2		Interface and Fieldbus Module	Four-port Ethernet twisted-pair and fiber switch module. As for example for display and park network

2.2.2   Racks

The AWC 500 modules can be built in 4 different size of rack system, to fulfil different demands for I/O and field bus configurations.

| Rack5·2 (24TE) | Rack5·3 (30TE) | Rack5·5 (42TE) | Rack5·8 (60TE) |
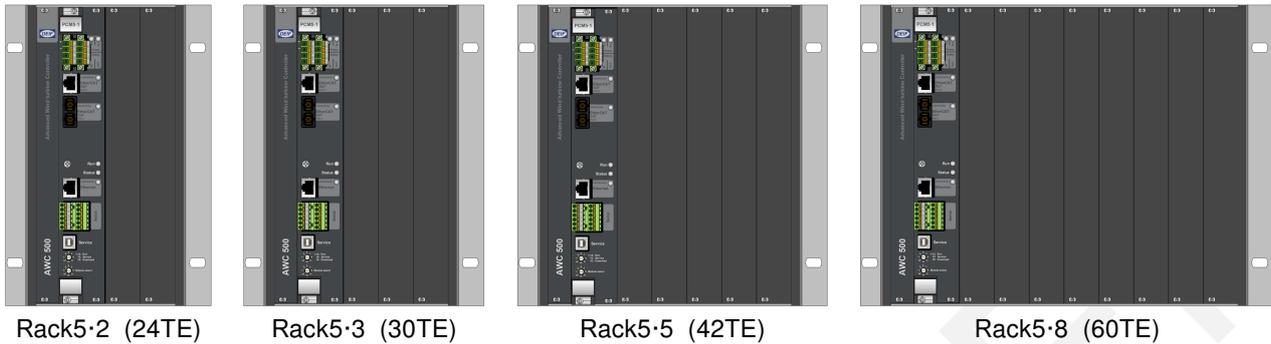
Other rack sizes are possible, however for racks larger than Rack5·8 we cannot guarantee all combinations of modules, because a limitation in power supply of the PCM/PDM.

2.2.3   Example configurations

Some examples of different configurations are shown here.

Rack5·3 – 30TE	1 x PCM5·1 , 2 x IOM5·1 , 1 x GPM5·1
	Input and output configuration
	Main Controller Rack
	1x Ethernet 10/100 Mbit/s
	1x Fibre optic EtherCAT Out port
	1x Electrical Twisted pair EtherCAT Out port
	12x PT100 temperature inputs
	8x Analog inputs -20 mA. . . 20 mA or as -10 V. . . 10 V
	8x Analog outputs -20 mA. . . 20 mA
	32x Digital inputs (up to 8 digital frequency inputs)
	20x Digital outputs
	2x Direct three phase voltage inputs 690 V 40. . . 70 Hz
	1x3-phase Current measurement 1 A/5 A

Rack5·8 – 60TE	1 x PDM5·1 , 4 x IOM5·1 , 1 x IFM5·1
	Input and output configuration
	Distributed I/O rack
	1x Fibre optic EtherCAT In port
	1x Fibre optic EtherCAT Out port
	1x Electrical Twisted pair EtherCAT Out port
	24x PT100 temperature inputs
	16x Analog inputs -20 mA. . . 20 mA or as -10 V. . . 10 V
	16x Analog outputs -20 mA. . . 20 mA
	64x Digital inputs (up to 16 digital frequency input)
	40x Digital outputs
	2x SSI ports
	2x CAN/CANopen ports
	2x RS-422/485 ports

With the IFM5·2 card Ethernet ports in the system is expanded, so it will be possible to have a separated turbine display and park network.

2.3   The AWC 500 development software

2.3.1   AWC 500 CODESYS

The CODESYS®Control(CODESYS V3) runtime system from the company 3S-Smart Software Solutions GmbH has been installed on the AWC 500 , to implement a IEC61131-3 compliant PLC feature.
The main advantage is the integration of many features in one tool:

- Editor – with UNICODE support.

- Integrated HMI design, with multilanguage support in visualisation

- Integrated Compiler and debugger

- Integrated PLC and I/O configuration

- Chinese support in menu and in the online help

PLC programs written in CoDeSys V2 can be imported in CODESYS V3.
Conversion tools are build-in CODESYS V3 to guide the user through this. Opening a CoDeSys V2 project (.pro or .lib files) initates the conversion process automatically. The below figures show a CoDeSys V2 project2.3 that has been ported to CODESYS V3 2.4.
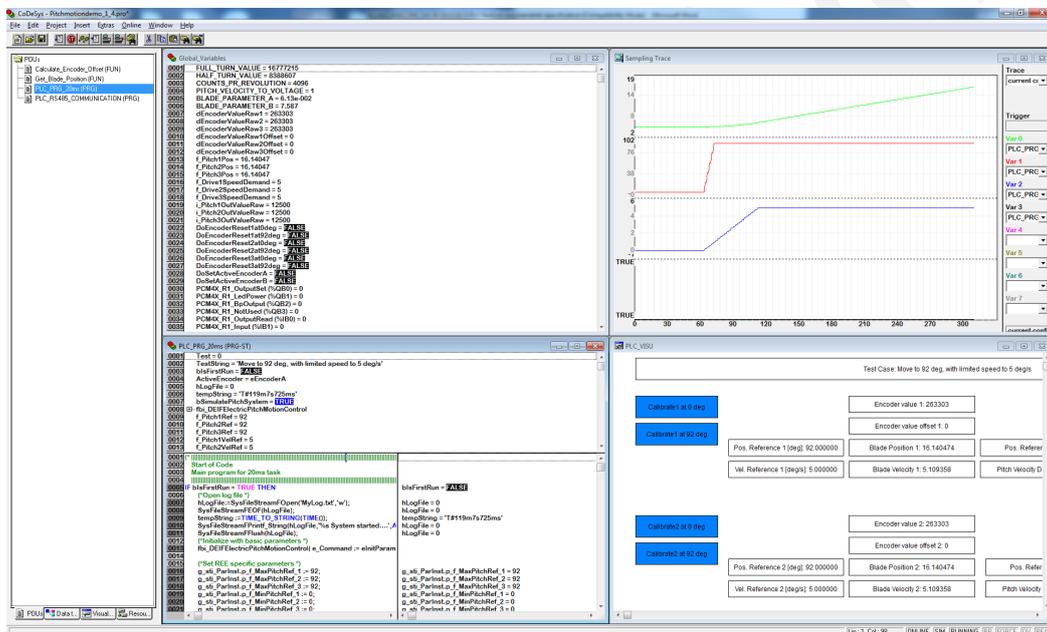
Figure 2.3: The CoDeSys V2 Editor
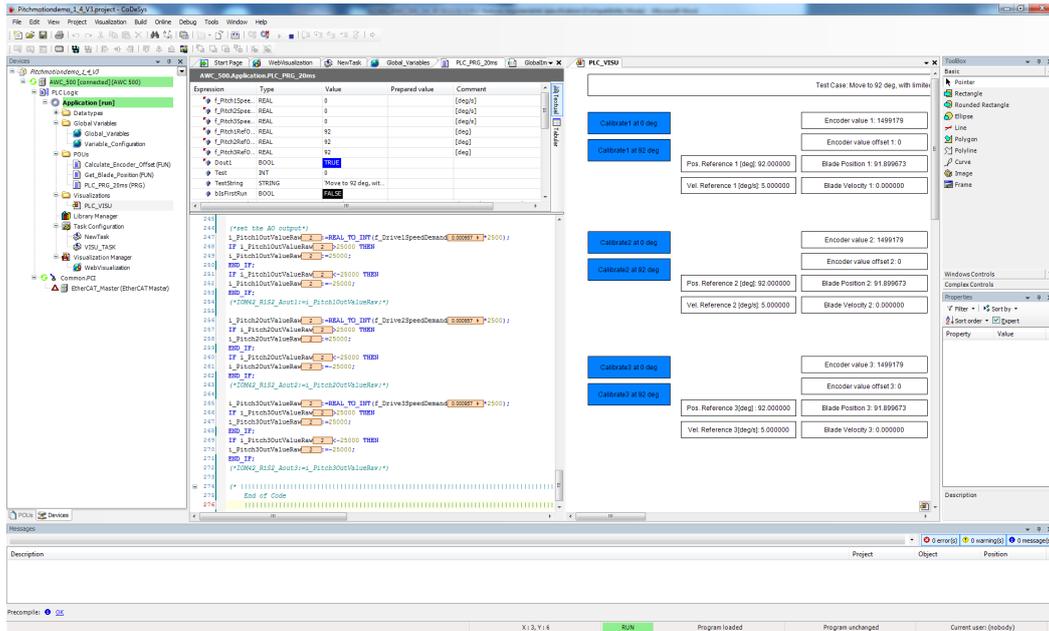
Figure 2.4: The CODESYS V3 Editor – DEIF AWC 500
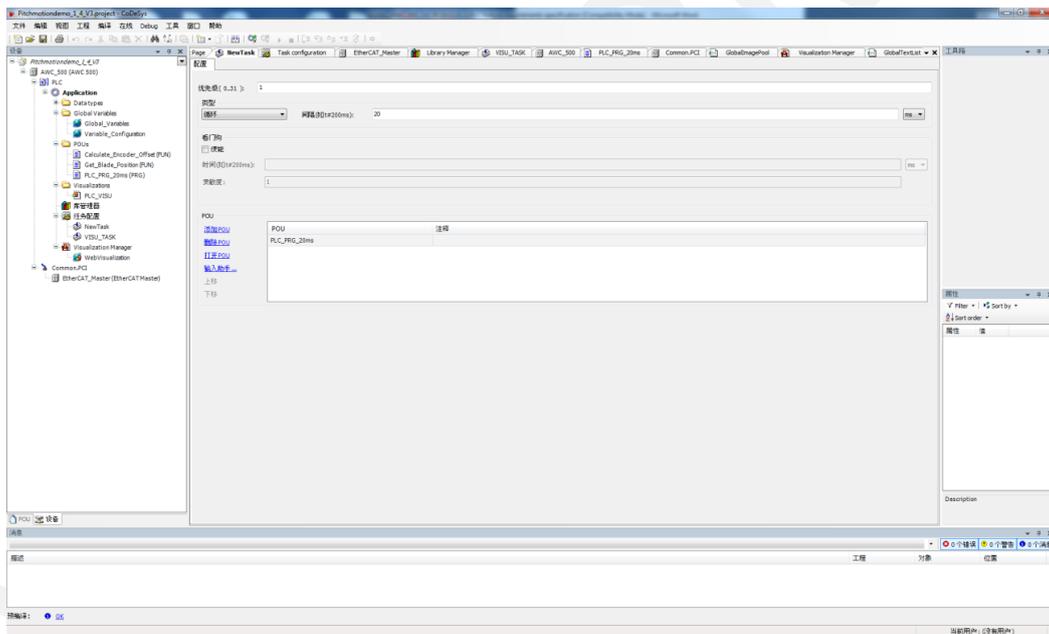
Figure 2.5: The CODESYS V3 editor in Chinese.
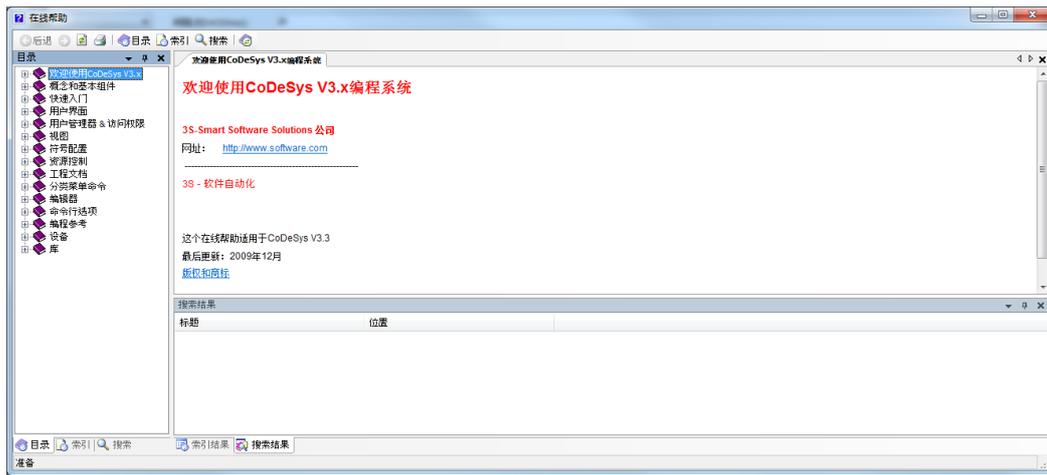
Figure 2.6: Example of the Chinese help files in CODESYS.

2.3.2 AWC 500 C/C++

AWC 500 can be ordered as a bare C/C++ programmable controller. The AWC 500 C/C++ Development Package is build around open tools GNU gcc compiler, gdb debugger, AWC 500 SDK and Eclipse environment. Mulitple templates for eg. Task set-up, I/O configuration or communication is included to speed up the creation of the project.
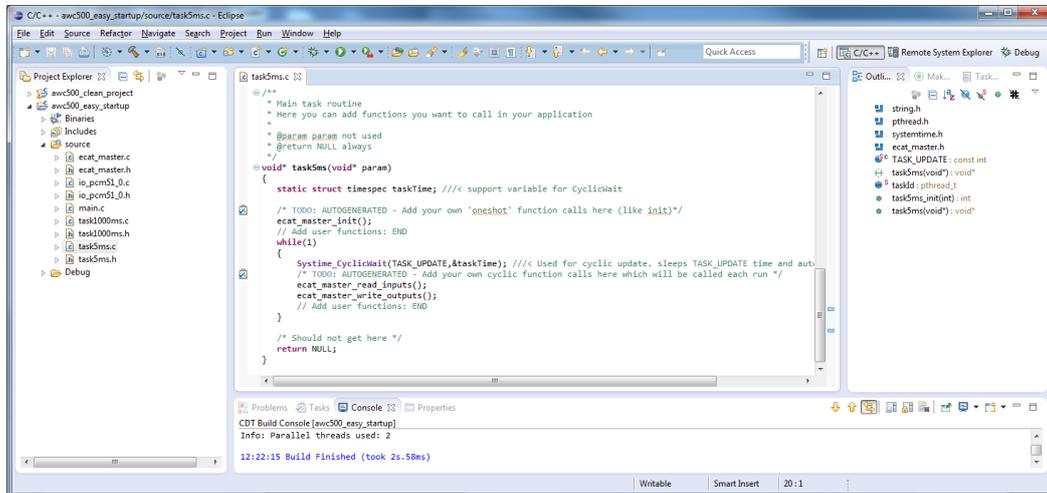

Figure 2.7: AWC 500 C/C++ development environment – Eclipse

3 Support

If you are experiencing an issue with our product or software, please contact us and mention the following details:

- How do you see there is a problem?

- What are the related products and versions?

- The sequence of your actions leading to the problem? What was your last action, before the problem arose?

- What versions of firmware, software packages, operative system are you using?

- What operating system are you using (Windows XP, Windows Vista, Windows 7, etc.)?

- If the problem relates to the AWC 500 rack send a copy of /app/log/syslog file

- As precise state of the actions taken or commands given to the AWC 500 since last power cycle/reboot– Connect to the PCM5·1 via SSH and run this command: `deif_feedback`

Please try to mention as many relevant details as possible.

Before contacting us for technical support, please make sure that you are using the latest version of the software, since your problem may have been fixed in a later update.

You can find information about the latest releases at `http://www.deifwindpower.com`

3.1   Request support from local DEIF office

If you have questions regarding the DEIF AWC 500 product, you can get support via email or telephone to your local DEIF office.

3.2   International AWC 500 support

International AWC 500 support can be requested via email: **awc500support@deif.com** or phone **+45 3010 3199** (CET 8–16).

4 Service

4.1 Limited hardware warranty and liability

The product is designed to operate in extreme conditions up to 70°C. A constant operating temperature above 40°C will reduce the life time of the product from expected minimum lifetime of 20 years.
The product continuously monitors the operating temperature and stores this information in a log file. DEIF uses this information for service purpose and to validate, if issues with the product are covered by the warranty.

The warranty period is defined in the contact, and additional DEIFs Terms and Conditions of Sale and Delivery apply.

The warranty does not cover:

Software

The software packages are supplied in good faith and is believed to be of the highest quality. Due to the nature of the software development process, it is possible that there are hidden defects in the software which may affect its use, or the operation of any software or device developed with this Software package.
Missing features or defects, here under also included third party software is thus not covered by the warranty.
The Client accept all responsibility for determining whether this package is suitable for the application, and for ensuring the correct operation of the application software and hardware. DEIF will not be liable for any consequential damages under any circumstances.

Product wear parts like:

Internal flash disc

SD card (available as spare part)

Battery used for the real time clock (available as spare part)

Products, which has been damaged due to mistreatment, unintended use or accidents such as:

use of incorrect power supply voltage or unprotected(fused) power supply,

failure to follow the installation instructions that are provided by DEIF

improper or insufficient ventilation,

improper or unauthorized repair,

malfunction due to lightning strikes or

transport accident or other unforeseen events beyond the control of DEIF.

4.2 Product service

Contact any DEIF or local DEIF office to get product service under warranty.

DEIF A/S reserves the right to change any of the above.