EUROMAP 66-2	Protocol for Communication with Peripheral Equipment **Device Profile for Heating / Cooling Devices**

Version 1.1, July 2002
(21 pages)

This recommendation was prepared by the Technical Commission of EUROMAP.

History

Date	Changes
June 2002	Document revised. Improvement of some typing errors. Consistent representation of hex values. Important changes: 3.2 Controller Function Block Requirements The object 7400h CO_Effective_Current_value_Xeff is read only. Optional object 6413h added. 3.3 Alarm Function Block Requirements Additionally, Alarm Types 4h/5h and 14h/15h “Difference (input – alternate input)” are required for monitoring of effective values following continuously changing setpoints (e.g. ramps). The number of required alarms is 16. DSP-404 V1.0 is contradictory in respect of the Data Type of objects 6508h and 6509h, which is why they are defined as unsigned 8. 3.4.2 Control_Word Behavior on exceptional situations specified. 3.4.8 Control_Errors The Suction Mode Error bit is set only if suction mode is requested. 3.4.11 Difference_Main_Return_Line_Temperature The value represents the absolute difference value between main and return line temperature. 3.4.12 External_Sensor_Value If no sensor is connected, the value is 9999 (999.9 ºC). 3.4.14 Heating_Ramp_Rate_Value A value of 0 means “no ramp”.

Contents

1 Introduction

1.1 Purpose

This document describes the profile for EUROMAP 66 heating/cooling devices.

1.2 Scope

The EUROMAP 66 specification is divided into a general description and the device profile descriptions. The present document describes the EUROMAP 66 heating/cooling device profile, which is based on the ”CANopen Device Profile for Measuring Devices and Closed-Loop Controllers” (CiA DSP-404).

This document is intended for engineers who are concerned with the implementation of this interface. A basic knowledge of CANopen is prerequisite to understand the document.

1.3 Definitions, acronyms and abbreviations

EUROMAP European Committee of Manufacturers of Plastics and Rubber Machinery (http://www.euromap.org/).

CiA CAN in Automation. Organization responsible for the definition of different CAN protocols, a.o. CAN Application Layer (CAL) and CANopen (http://www.can-cia.de/).

CAL CAN Application Layer. Communication mechanisms standardized by CiA for CAN-based systems (DS 201..207).

CANopen Communication profiles (DS 301) and device profiles (CiA DS 40x) based on CAL, standardized by CiA.

1.4 References

Short name	Title	Version	Autor
EUROMAP 66	EUROMAP 66 General Description	1.1	EUROMAP
CiA DS-102	CAN Physical Layer for Industrial Applications	2.0	CiA
CiA DS-301	CANopen Application Layer and Communication Profile	4.0	CiA
CiA DSP-404	Device Profile for Measuring Devices and closed loop controllers	1.0	CiA

1.5 Document Overview

This document is divided into an overview and a detailed description.

The overview describes how EUROMAP 66 uses and extends existing CANopen device profiles.

The detailed description part deals with the demands on CANopen and EUROMAP 66 device blocks.

2 Overview

2.1 CANopen device profiles

Device profiles exist for different types of devices. A type of device ”EUROMAP 66”, however, does not exist. A definition of a corresponding profile, furthermore, would take up very much time. A profile meeting the requirements rather closely is the CiA DSP 404 (”CANopen Device Profile for Measuring Devices and Closed-Loop Controllers”).

Therefore, the EUROMAP 66 heating/cooling device profile is based on DSP 404. EUROMAP 66, however, defines additional extensions specific to temperature control units in the peripheral device area.

2.2 CiA DSP 404

The CANopen profile CiA DSP 404 can be used when it is a matter of capturing process values by means of different sensors or implementing controllers. For this purpose the profile defines different function blocks. Each block can comprise up to 199 channels.

Function block	Application
Digital input function block	Digital inputs. 8 digital inputs can be mapped per channel.
Analog input function block	This block can be used to form a CANopen interface for a sensor. It contains a.o. information on the type of sensor as well as scaling information.
Digital output function block	Digital outputs. 8 digital outputs can be mapped per channel.
Analog output function block	Analog outputs.
Controller function bock	The controller block describes PID algorithms for all types of controllers.
Alarm function block	Monitoring of sensors and limit values.
Device function block	Alarms can be generated with the aid of this block. For example in the case of sensor errors, if values exceed certain thresholds or if the difference between two values exceeds a preset value.

The profile-specific data in the object directory are grouped by function block on the one hand, and by data type on the other:

Index	Data type
6000h ... 6FFFh	Floating point numbers
7000h ... 7FFFh	Integer16
8000h ... 8FFFh	Integer24
9000h ... 9FFFh	Integer32

Type of object	Objects
Digital input function block	Object 6000h..60FFh
Analog input function block	Object X100h..X1FFh
Digital output function block	Object 6200h..62FFh
Analog output function block	Object X300h..X3FFh
Controller function bock	Object X400h..X4FFh
Alarm function block	Object X500h..X5FFh

2.3 Data format and scaling

In CiA DSP-404, the unit can be stated optionally for each value. Moreover, there is the possibility of also transferring non-integer values as 16-bit integers. In this case it is possible to define in a further object how many digits after the comma the number contains (see [DSP-404] Object 6102h).

Example: The value 67.8 is transferred as 678, the number of digits after the decimal point is 1.

2.4 Restrictions on DSP-404 for heating/cooling devices

Heating/Cooling devices use only one channel. If more than one unit is controlled by one processor, they have to be implemented as independent CANopen-nodes.

2.5 Manufacturer- and profile-specific objects

2.5.1 EUROMAP 66 DSP-404 objects

The EUROMAP 66 device interface uses the following blocks from DSP-404:

- Controller function bock
- Alarm function block

The controller block contains the general controller parameters as well as control possibilities.

The alarm block serves to monitor process values for falling-short-of and exceeding.

2.5.2 EUROMAP 66 additional objects

As a matter of principle, the feedback control parameters of temperature control units are mapped in the controller block defined by the device profile. The predefined parameters, however, are not sufficient for these devices. This is why further parameters are defined in the manufacturer-specific part of the object directory. For this purpose the manufacturer-specific area is divided into a specific peripheral device interface area and an area which is freely available to the manufacturer. The freely available area is **not** supported by EUROMAP 66.

The same channel mechanism is defined as with DSP 404: the subindex identifies the channel. If only 1 channel is available, subindex 1 is used.

The division is the same as in the profile-specific area (although only 16 bit parameters are used):

Index	Data type
2000h ... 2FFFh	General parameters, Floating point numbers (not used)
3000h ... 3FFFh	Integer16
4000h ... 4FFFh	Integer24 (not used)
5000h ... 5FFFh	Integer32 (not used)

Remark: In EUROMAP 66, all parameters are currently defined as integer16.

Type of object	Objects	Description
Peripheral device area	Object X000h..X7FFh	EUROMAP 66 area
Manufacturer area	Object X800h..XFFFh	freely available, but not supported by EUROMAP 66

Process values (temperatures, etc.) consist of several parameters:

- effective value
- physical unit field
- decimal digits field

The control word contains some additional commands, such as Suction mode on (a sort of emergency operation in case of leaks in the system) or failure reset.

In the Word status the control is informed of the device activity in each case and of the errors.

This profile defines only a few specific error bits for errors which, in the main, can be eliminated by the user.

If an error at the peripheral device cannot be allocated to the predefined error bits, the "General Error Bit" should be used. The detailed information on the occurred error can then be viewed at the device.

2.6 Nodeguarding

A heating/cooling device has to support a minimum guard time of 500ms.

3 Demands on CANopen EUROMAP 66 heating/cooling devices

3.1 Mandatory blocks

The following blocks have to be implemented:

- DSP-404 Controller Function Block
- DSP-404 Alarm Function Block
- EUROMAP 66 Block

3.2 Controller Function Block Requirements

Controller block details:

- Format for temperature values: Integer16 (Objects 7400h ... 74FFh)
- Unit for temperature values: degrees Celsius
- Decimal_Digits = 1 (1 digit after the decimal point. Example: 543 means 54.3 ºC, i.e. the resolution is 1/10 ºC.)
- In the control block, only objects may be implemented which are released in this definition. This minimum set allows a machine control the manufacturer-independent activation of all EUROMAP 66 devices. No controller parameters (P, I, D) are used, since several sets of them are required for different operating modes. The corresponding values are to be stored in the device itself on commissioning. Apart from this, self-optimization is recommended.

Used controller block objects are:

Index	Object Code	Description	Data Type	Acc	PDO mapping	Master (machine)	Slave (device)
7400h	ARRAY	CO_Effective Current Value Xeff	Integer16	ro	Possible	M	M
7401h	ARRAY	CO_Effective Set Point Weff	Integer16	ro	Possible	M	M
7402h	ARRAY	CO_Set Point W	Integer16	rw	Possible	M	M
7403h	ARRAY	CO_2nd Set Point W2	Integer16	rw	Possible	M	M
6406h	ARRAY	CO_Physical Unit Current Value / Set Point	Unsigned32	rw	No	M	M
6407h	ARRAY	CO_Decimal Digits Current Value / Set Point	Unsigned8	rw	No	M	M
6410h	ARRAY	CO_Effective Controller Output Y	Unsigned16	ro	Possible	M	M
6413h	ARRAY	CO_Lower Controller Output Limit Ymin 1)	Integer16	rw	No	M	O
6414h	ARRAY	CO_Upper Controller Output Limit Ymax 2)	Integer16	rw	No	M	O
6415h	ARRAY	CO_Physical Unit Controller Output	Unsigned32	rw	No	M	M
6416h	ARRAY	CO_Decimal Digits Controller Output	Unsigned8	rw	No	M	M
6423h	ARRAY	CO_Controller mode	Unsigned8	rw	Possible	M	M
6425h	ARRAY	CO_control byte	Unsigned8	rw	Possible	M	M
6427h	ARRAY	CO_status information	Unsigned16	ro	Possible	M	M

1) If the device supports both heating and cooling, object 6413h describes the cooling Limit. The value is given in percent with one decimal digit after the comma. The valid range is typically 0 .. –100%.

2) Object 6414h describes the upper limit for the controller output. The value is given in percent with one decimal digit after the comma. The valid range is typically 0 .. 100%.

REMARK: In DSP-404 V1.0, the Access Type of object 7400h is defined as rw. This is obviously wrong, it shall be ro and CiA (CAN in Automation) is going to change it in a further version of DSP-404. In EUROMAP 66 it is defined as ro (read only).

3.2.1 6425h CO_control_byte

The following bits are mandatory:

- Controller on/off (activate controller)
- Selfoptimisation (start self tuning)
- Set point (set second setpoint active)

3.2.2 6427h CO_status_information:

The following bits are mandatory:

- Controller on/off (remote operation, controller active)
- Selfoptimisation (self tuning is active)
- Manual Mode
- Set point (second setpoint is active)

REMARK: DSP-404 V1.0 is contradictory in respect of the polarity of the On/Off information, which is why this is defined as follows: 0 = Off, 1 = On.

Object 6426h (CO_ControlByteEnable) is not used. The mandatory Controlbyte-bits are activated in standard execution.

Other objects than the ones listed here are not supported by the master. If further objects are implemented, they must be initialized with safe default values!

3.3 Alarm Function Block Requirements

In DSP-404 a universal alarm block is defined with which one object can be compared with a comparison value or another object. Depending on the configuration, alarms are released in case of certain events (falling short of or exceeding, within or outside window, etc).

Temperature control units frequently use their internal monitoring mechanisms which often feature additional parameter-specific start conditions, with the effect that no alarms are triggered on starting or in case of changes of nominal values.

The EUROMAP 66 interface is implemented as an extra to the device control. If the DSP-404 alarm block is now implemented additionally, discrepancies occur between the device-internal alarms and the ones reported to the control.

Thus, if an object is already monitored device-internally, the result of this internal supervision must be imaged (in case of corresponding alarm type).

If the device does not support a certain alarm, it is admissible to use the corresponding universal alarm block function.

As a minimum, the following alarm types must be supported:

- 2h “above or equal"
- 3h “Below"
- 4h “Difference (input – alternate input) above”
- 5h “Difference below”
- 6h “in window (including boarders)"
- 7h “out of window (excluding boarders)"
- 12h “above with starting condition”
- 13h “below with starting condition”
- 14h “Difference above with starting condition”
- 15h “Difference below with starting condition”
- 16h “in window with starting condition”
- 17h “out of window with starting condition”

“… with starting condition” means that immediate (e.g. temperature-) alarm is suppressed until a setpoint is once reached. This is valid after switching on as well as after setpoint changes.

Heating/cooling devices can use there own sophisticated algorithms for alarm suppression. EUROMAP 66 does not specify how this feature has to be implemented.

The maximum number of required alarms is 16.

REMARK: DSP-404 V1.0 is contradictory in respect of the Data Type of objects 6508h and 6509h, which is why they are defined as unsigned 8.

IMPORTANT: Objects can be monitored simultaneously according to different criteria, i.e. for exceeding of a maximum and falling short of a minimum value. For this, however, different alarms must be activated!

The parameterization of the alarm block is effected by the control. If an object cannot be monitored as desired, corresponding parameterization commands must be acknowledged by SDO-Abort. The same applies if a parameter is put which is not considered (e.g. a hysteresis which is firmly predefined by the device).

The following order is to be used as basis for the parameterization:

1. AL n Link Input is put by means of SDO. If the corresponding object cannot be monitored, the SDO must be acknowledged with "abort".
2. AL n Level is put (and if appropriate passed on to the device control device-internally) or
   AL n Link Alternate Input is put (if two objects are to be compared).
3. AL n Hysteresis may be put if required.
4. AL n Type is put. If the alarm type is not supported by the object to be monitored, the SDO is to be acknowledged with "abort" and the appropriate AL n Type is to be put on a supported type.

5. AL n Action is put (typically on 0).

Afterwards, Alarm Level and Alarm Hysteresis may be changed at any time.

If an alarm has to be completely reconfigured, it is advisable to first disable the alarm by setting the Alarm Type to 0, to avoid wrong alarms.

3.4 EUROMAP 66 Block Requirements

The following objects must be implemented in the manufacturer-specific area of the object directory.

Important: Device and CANopen interface must build a unit. Objects that are not implemented in the device must not be implemented in the CANopen interface!

Index	Object	Description	Acc	PDO-Mapping	Master (machine)	Slave (device)	
2000h	VAR	EUROMAP66_Device_Profile	ro	no	M	M	EUROMAP Device Profile
2001h	Array	Control_Word	rw	possible	M	M	Control Word
2002h	Array	Status_Information	ro	possible	M	M	Status Information
2003h	Array	Controller_Mode	wo	no	M	M	Chosen Controller op. mode
2004h	Array	Controller_Mode_Display	ro	no	M	M	Current Controller op. mode
2005h	Array	Controller_Switch_Off_Mode	wo	no	M	O	Chosen Switch Off Mode
2006h	Array	Controller_Switch_Off_Mode_Display	ro	no	M	O	Current Switch Off Mode
2007h	Array	Switch_Off_Status	ro	possible	M	M	
2008h	Array	Error_Status	ro	possible	M	M	
2009h	Array	Control_Errors	ro	possible	M	M	
3010h	Array	Main_Line_Temperature_Value	ro	possible	M	M	Flow temperature
2011h	Array	Main_Line_Physical_Unit_Field	ro	no	M	M	See DSP-404 Object 6101h
2012h	Array	Main_Line_Decimal_Digits_Field	ro	no	M	M	See DSP-404 Object 6102h
3020h	Array	Return_Line_Temperature_Value	ro	possible	M	O	Return temperature
2021h	Array	Return_Line_Physical_Unit_Field	ro	no	M	O	
2022h	Array	Return_Line_Decimal_Digits_Field	ro	no	M	O	
3030h	Array	Difference_Main_Return_Line_Temperature	ro	possible	M	O	Difference between flow and return temperature
2031h	Array	Difference_Main_Return_-Line_Physical_Unit_Field	ro	no	M	O	
2032h	Array	Difference_Main_Return_-Line_Decimal_Digits_Field	ro	no	M	O	
3040h	Array	External_Sensor_Value	ro	possible	M	O	Mould temperature
2041h	Array	External_Sensor _Physical_Unit_Field	ro	no	M	O	
2042h	Array	External_Sensor _Decimal_Digits_Field	ro	no	M	O	
3050h	Array	Flow_Value	ro	possible	M	O	Throughflow
2051h	Array	Flow_Value_Physical_Unit_Field	ro	no	M	O	
2052h	Array	Flow_Value_Decimal_Digits_Field	ro	no	M	O	
3060h	Array	Heating_Ramp_Rate_Value	rw	no	M	O	Heating ramp
2061h	Array	Heating_Ramp_Rate_Physical_Unit_Field	ro	no	M	O	
2062h	Array	Heating_Ramp_Rate_Decimal_Digits_Field	ro	no	M	O	
3070h	Array	Cooling_Ramp_Rate_Value	rw	no	M	O	Cooling ramp
2071h	Array	Cooling_Ramp_Rate_Physical_Unit_Field	ro	no	M	O	
2072h	Array	Cooling_Ramp_Rate_Decimal_Digits_Field	ro	no	M	O	
3080h	Array	Intake_Pressure_Value	ro	no	M	O	Intake pressure
2081h	Array	Intake_Pressure_Physical_Unit_Field	ro	no	M	O	
2082h	Array	Intake_Pressure_Decimal_Digits_Field	ro	no	M	O	
2600h	Var	Manufacturer_Name	ro	no	M	M	Manufacturer name
2601h	Var	Device_Category	ro	no	M	M	Device category
2602h	Var	Serial_Number	ro	no	M	O	Serial number

3.4.1 EUROMAP 66_Device_Profile

This object defines the EUROMAP device profile.

Index	Sub-Index	Name	Type	Attr	Default val.	Range
2000h	0	EUROMAP66_Device_Profile	VAR	ro	01 00 01 42h	

For more Information see [general description EUROMAP 66].

MSB			LSB
Profile Version	Profile Index	EUROMAP66-Profile Code	EUROMAP 66 Code

EUROMAP66-Code: 66 (42h)

The EUROMAP66-Profile Code for heating/cooling devices is 1.

Profile version and index correspond to the version of the device profile document for heating/cooling devices. For example:

Document Version 1.0: Profile Version 01h and Profile Index 00h

Document Version 3.4: Profile Version 03h and Profile Index 40h

etc.

3.4.2 Control_Word

This object is used to control some special behavior of the heating/cooling equipment.

Index	Sub-Index	Name	Type	Attr	Default val.	Range
2001h		Control_Word	Array			
	00	Number_of_entries	Unsigned8	ro	1	1..199
	01	Control_Word _1	Unsigned8	rw	0	
	..	”				
	199	Mode_Control _199	Unsigned8	rw	0	

Control Word:
Bit 0 : Suction mode on (emergency operation in case of leaks in the system)
Bit 1 .. 6 : Reserved
Bit 7 : Failure Reset

Behavior on suction mode request (see also 3.4.8 Control_Errors):

Situation	Behavior
Suction mode not supported or Suction mode conflict (e.g. setpoint to high for suction mode)	Suction Mode Error bit in the Control Error Object is set.
Suction mode delayed (e.g. evacuation active, effective value to high)	No immediate reaction. Suction Mode will be activated as soon as possible. Suction Mode On bit in the Status Information Object is set as soon as suction mode is active.
Suction mode activated	Suction mode on bit in the Status Information Object is set.

3.4.3 Status_Information

This object provides status information.

Although it is nearly a copy of object 2001h, it may hold a different value. If, for example, the user wants to activate the suction mode, the corresponding bit is set in object 2001h. If the device for any reason can not activate this mode, bit 0 in the status information will not change to 1.

Index	Sub-Index	Name	Type	Attr	Default val.	Range
2002h		Status_Information	Array			
	00	Number_of_entries	Unsigned8	ro	1	1..199
	01	Status_Information _1	Unsigned8	ro	0	
	..	”				
	199	Status_Information _199	Unsigned8	ro	0	

Status Information:
Bit 0 : Suction mode is on (emergency operation in case of leaks in the system)
Bit 1..7 : reserved

3.4.4 Controller_Mode and Controller_Mode_Display

With the Controller_Mode object the user can select an operation mode.

Index	Sub-Index	Name	Type	Attr	Default val.	Range
2003h		Controller_Mode	Array			
	00	Number_of_entries	Unsigned8	ro	1	1..199
	01	Controller_Mode _1	Unsigned8	wo		
	..	”				
	199	Controller_Mode _199	Unsigned8	wo		

The write only object Controller_Mode is used to switch the operation-mode. The actual controller mode will be represented in object 2004h.

Controller Mode and Controller Mode Display:
0 : Undefined
1 : Main_Line_Mode (flow)
2 : Return_Line_Mode (return)
3 : External_Sensor_Mode (EUROMAP: ”Mould Temperature”)
4 .. 255 : Reserved for future use

The device must not accept a mode that is not supported. If the device does not support mode 3, but the user tries to set it by SDO, the device mast respond with SDO abort!

The Controller_Mode_Display object reflects the actual controller mode of the device, or the mode that it will run when switched on.

Index	Sub-Index	Name	Typ	Attr	Default Wert	Bereich
2004h		Controller_Mode_Display	Array			
	00	Number_of_entries	Unsigned8	ro	1	1..199
	01	Controller_Mode_Display_1	Unsigned8	ro		
	..	”				
	199	Controller_Mode_Display_199	Unsigned8	ro		

The Controller_Mode_Display object shows the current Controller_Mode. The meaning of the returned value corresponds to that of the Controller_Mode (index 2003h)

Values: See Object 2003h.

3.4.5 Controller_Switch_Off_Mode and Controller_Switch_Off_Mode_Display

Object Controller_Switch_Off_Mode switches between different switch off modes.

Index	Sub-Index	Name	Type	Attr	Default val.	Range
2005h		Controller_Switch_Off_Mode	Array			
	00	Number_of_entries	Unsigned8	ro	1	1..199
	01	Controller_Switch_Off_Mode _1	Unsigned8	wo		
	..	”				
	199	Controller_Switch_Off_Mode _199	Unsigned8	wo		

The write only object Controller_Switch_Off_Mode defines how the controller is switched off. This Object is only interpreted when CO_ControllerOn/Off changes from On to Off. An active switch off operation will not be affected by a new value.

The actual switch off mode will be represented in object 2006h.

Active Switch Off Actions are reflected in the Status Information (Object 2002h), The Controller On/Off Bit in the CO_StatusInformation will change to Off only when all Switch Off Operations are completed.

Controller Switch Off Mode and Controller Switch Off Mode Display:
0 : Undefined
1 : Switch off immediate
2 : First cool down, then switch off
3 : First evacuate, then switch off
4 : First cool down, then evacuate, then switch off
5 .. 255 : Reserved for future use

Object Controller_Switch_Off_Mode_Display reflects the actual controller switch off mode of the device, or the mode that it will use when switched off.

Index	Sub-Index	Name	Type	Attr	Default val.	Range
2006h		Controller_Switch_Off_Mode_Display	Array			
	00	Number_of_entries	Unsigned8	ro	1	1..199
	01	Controller_Switch_Off_Mode_Display_1	Unsigned8	ro		
	..	”				
	199	Controller_Switch_Off_Mode_Display_199	Unsigned8	ro		

The Controller_Switch_Off_Mode_Display object shows the current Controller_Switch_Off_Mode. The meaning of the returned value corresponds to that of the Controller_Switch_Off_Mode _Mode (index 2005h)
Values: See Object 2005h.

3.4.6 Switch_Off_Status

This object reflects the active actions while switching off.

Index	Sub-Index	Name	Type	Attr	Default val.	Range
2007h		Switch_Off_Status	Array			
	00	Number_of_entries	Unsigned8	ro	1	1..199
	01	Switch_Off_Status_1	Unsigned8	ro	0	
	..	”				
	199	Switch_Off_Status_199	Unsigned8	ro	0	

Status Information:
Bit 0 : Evacuating
Bit 1 : Cooling Down
Bit 3 .. 7 : Reserved

3.4.7 Error_Status

This object contains Error Information. This profile defines only a few specific error bits for errors which, in the main, can be managed and eliminated by the operator.

If an error at the peripheral device cannot be allocated to the predefined error bits, the "General Error Bit" should be used. The detailed information on the occurred error can then be viewed at the device.

Index	Sub-Index	Name	Type	Attr	Default val.	Range
2008h		Error_Status	Array			
	00	Number_of_entries	Unsigned8	ro	1	1..199
	01	Error_Status_1	Unsigned8	ro	0	
	..	”				
	199	Error_Status_199	Unsigned8	ro	0	

Status Information:
Bit 0 : low level of fluid (leakage)
Bit 1 : above safety temperature limit
Bit 2 : external sensor failure
Bit 3..6 : Reserved
Bit 7 : General Failure

Error status description

- Bit 0 low level of fluid: The alarm is active as long as the fluid is under the limit or with automatically refilling the function is failed.
- Bit 1 above safety temperature limit: The alarm is active, if the temperature rises over the safety limit of the device.
- Bit 2 external sensor failure: The alarm is active as long as the external sensor does not run.
- Bit 7 General Failure: The general failure bit should only be used, if no other failure bits or alarm function bits are possible. A fully description of the general failure has to be done on the control panel of the device. The following possible failures are general:
    - process alarm (process not possible)
    - machine alarm (device not ready)
    - controller failure (controller does not run)
    - heater failure (temperature sensor error, heater/cooler does not run)
    - pump failure (pump does not run)
    - mains failure

3.4.8 Control_Errors

This object contains errors caused by the control word (object 2001H).

Index	Sub-Index	Name	Type	Attr	Default val.	Range
2009h		Control_Errors	Array			
	00	Number_of_entries	Unsigned8	ro	1	1..199
	01	Control_Errors_1	Unsigned8	ro	0	
	..	”				
	199	Control_Errors_199	Unsigned8	ro	0	

Status Information:
Bit 0 : Suction mode error (e.g. not implemented or not possible because of to high setpoint).
This bit is only set if suction mode is requested (see also 3.4.2 Control_Word)!
Bit 1..7 : reserved

3.4.9 Main_Line_Temperature

The value holds the main line temperature value.

Index	Sub-Index	Name	Type	Attr	Default val.	Range
3010h		Main_Line_Temperature_Value	Array			
	00	Number_of_entries	Unsigned8	ro	1	1..199
	01	Main_Line_Temperature_Value_1	Integer16	ro	0	
	..	”				
	199	Main_Line_Temperature_Value_199	Integer16	ro	0	

Index	Sub-Index	Name	Type	Attr	Default val.	Range
2011h		Main_Line_Physical_Unit_Field	Array			
	00	Number_of_entries	Unsigned8	ro		
	01	Main_Line_Physical_Unit_Field_1	Unsigned32	ro	002D0000h	
	..	”				
	199	Main_Line_Physical_Unit_Field_199	Unsigned32	ro	002D0000h	

002D0000h = deg. Celsius (see DSP-404:Object 6101h as well as CiA DRP-303-2)

Index	Sub-Index	Name	Type	Attr	Default val.	Range
2012h		Main_Line_Decimal_Digits_Field	Array			
	00	Number_of_entries	Unsigned8	ro	1	1..199
	01	Main_Line_Decimal_Digits_Field_1	Unsigned8	ro	1	0..254
	..					
	199	Main_Line_Decimal_Digits_Field_199	Unsigned8	ro	1	0..254

See also DSP-404 Object 6102h

3.4.10 Return_Line_Temperature

The value holds the return line temperature value.

Index	Sub-Index	Name	Type	Attr	Default val.	Range
3020h		Return_Line_Temperature_Value	Array			
	00	Number_of_entries	Unsigned8	ro	1	1..199
	01	Return_Line_Temperature_Value_1	Integer16	ro	0	
	..	”				
	199	Return_Line_Temperature_Value_199	Integer16	ro	0	

2021h/2022h: See 2011h/2012h.

3.4.11 Difference_Main_Return_Line_Temperature

The value holds the absolute difference value between main and return line temperature.

Index	Sub-Index	Name	Type	Attr	Default val.	Range
3030h		Difference_Main_Return_Line_Temperature	Array			
	00	Number_of_entries	Unsigned8	ro	1	1..199
	01	Difference_Main_Return_Line_Temperature _1	Integer16	ro	0	
	..	”				
	199	Difference_Main_Return_Line_-Temperature_199	Integer16	ro	0	

2031h/2032h: See 2011h/2012h.

3.4.12 External_Sensor_Value

This object holds the external sensor temperature value.

Index	Sub-Index	Name	Type	Attr	Default val.	Range
3040h		External_Sensor _Value	Array			
	00	Number_of_entries	Unsigned8	ro	1	1..199
	01	External_Sensor _Value _1	Integer16	ro	0	
	..	”				
	199	External_Sensor _Value _199	Integer16	ro	0	

If no sensor is connected, the value is 9999 (999.9 ºC).

2041h/2042h: See 2011h/2012h.

3.4.13 Flow_Value

This object holds the flow value.

Index	Sub-Index	Name	Type	Attr	Default val.	Range
3050h		Flow_Value	Array			
	00	Number_of_entries	Unsigned8	ro	1	1..199
	01	Flow_Value _1	Integer16	ro	0	
	..	”				
	199	Flow_Value _199	Integer16	ro	0	

Index	Sub-Index	Name	Type	Attr	Default val.	Range
2051h		Flow_Value _Physical_Unit_Field	Array			
	00	Number_of_entries	Unsigned8	ro		
	01	Flow_Value _Physical_Unit_Field_1	Unsigned32	ro	00444700h	
	..	”				
	199	Flow_Value _Physical_Unit_Field_199	Unsigned32	ro	00444700h	

00444700h = Litres / minute (see DSP-404:Object 6101h as well as CiA DRP-303-2)

2052h: See 2012h.

3.4.14 Heating_Ramp_Rate_Value

With this object the user can set the heating ramp rate.

Index	Sub-Index	Name	Type	Attr	Default val.	Range
3060h		Heating_Ramp_Rate_Value	Array			
	00	Heating_Number_of_entries	Unsigned8	ro	1	1..199
	01	Heating_Ramp_Rate_Value _1	Integer16	rw	0	
	..	”				
	199	Heating_Ramp_Rate_Value _199	Integer16	rw	0	

A value of 0 means “no ramp”.

Index	Sub-Index	Name	Type	Attr	Default val.	Range
2061h		Heating_Ramp_Rate_Physical_Unit_Field	Array			
	00	Heating_Number_of_entries	Unsigned8	ro		
	01	Heating_Ramp_Physical_Unit_Field _1	Unsigned32	ro	002D4700h	
	..	”				
	199	Heating_Ramp_Physical_Unit_Field _199	Unsigned32	ro	002D4700h	

002D4700h = degrees Celsius / minute (see DSP-404:Object 6101H as well as CiA DRP-303-2)

2062h: See 2012h.

3070h: See 3060h.

2071h: See 2061h.

2072h: See 2012h.

3.4.15 Intake_Pressure_Value

This object holds the intake pressure value.

Index	Sub-Index	Name	Typ	Attr	Default val	Range
3080h		Intake_Pressure_Value	Array			
	00	Intake_Pressure_Number_of_entries	Unsigned8	ro	1	1..199
	01	Intake_Pressure_Value _1	Integer16	rw	0	
	..	”				
	199	Intake_Pressure_Value _199	Integer16	rw	0	

Index	Sub-Index	Name	Typ	Attr	Default val	Range
2081h		Intake_Pressure_Physical_Unit_Field	Array			
	00	Intake_Pressure_Number_of_entries	Unsigned8	ro		
	01	Intake_Pressure_Physical_Unit_Field _1	Unsigned32	ro	004E0000h	
	..	”				
	199	Intake_Pressure_Physical_Unit_Field _199	Unsigned32	ro	004E0000h	

004E0000h = bar (see DSP-404:Object 6101H as well as CiA DRP-303-2)

2082: See 2012.

3.4.16 Manufacturer_Name

Object 2600h contains the manufacturer name as ASCII-String. Example: “VDMA Organization”. (Do not use more than 20 characters!).

Index	Sub-Index	Name	Typ	Attr	Default val	Range
2600h	0	Manufacturer_Name	Vis-String	ro		

3.4.17 Device_Category

Object 2601h contains the device category as ASCII-String. Example: “H/C device” for heating/cooling device. (Do not use more than 20 characters!).

Index	Sub-Index	Name	Typ	Attr	Default val	Range
2601h	0	Device_Category	Vis-String	ro		

3.4.18 Serial_Number

This optional object contains the serial number of the device as ASCII-String. (Do not use more than 20 characters!).

Index	Sub-Index	Name	Typ	Attr	Default val	Range
2602h	0	Serial_Number	Vis-String	ro		

Remark: Strings with more than 4 characters are transmitted with segmented SDO transfer, see [DS-301].

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