EUROMAP 75-3	Protocol for Communication with Peripheral Equipment **Implementation of Different Realtime Ethernet Systems**

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15 pages

This recommendation was prepared by the Technical Commission of EUROMAP.

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History

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1 Introduction

Please note:

When applying EUROMAP 75 please check in your quotation or machine documentation, if there is marked which Ethernet System is used for the device profile.

1.1 Purpose

This document describes the profile for EUROMAP 75 measuring amplifiers.

1.2 Scope

The EUROMAP 75 specification is divided into a general description, the device profile, a definition of the interface between the injection moulding machines and signal converters and the implementation of different realtime Ethernet Systems. The present part of document is the implementation of different realtime Ethernet Systems.

The device profile is based on the “CANopen Device Profile for Measuring Devices and Closed-Loop Controllers (CiA DSP-404)" and is supplemented by the definitions of industrial realtime Ethernet including the specific requirements for these device categories.
The electrical interface comprises the definition of the plug connections, the "physical layer" and the wiring concept on the basis of a realtime Ethernet bus.

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 CANbased 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 75	EUROMAP 75-1 "Protocol for Communication with Peripheral Equipment Device Profile for Measuring Amplifiers" EUROMAP 75-2 "Protocol … - Demands on EUROMAP 75 Devices" EUROMAP 75-3 "Protocol … - Implementation of Different Realtime Ethernet Systems"	1.1 1.1 1.2	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:

• VARAN-BUS implementation
• ETHERCAT implementation
• POWERLINK implementation

2 Mapping the Profile to VARAN-BUS

2.1 VARAN device description

These parameters are already implemented in the VARAN-BUS specification and are therefore not described again here in the IDs.

Mapping General Device Description IDs to VARAN Identification List

Index	Object	Description	Acc	PDO Mapping	Master (machine)	Slave (device)	Mapping to VARAN Identification List
6E08h	VAR	Manufacturer Device Name	ro	no	M	O	Device Name
6E09h	VAR	Manufacturer Hardware Version	ro	no	M	M	Product Version Number
6E01h	VAR	Manufacturer Name	ro	no	M	O	Vendor Name
6E02h	VAR	Device Category	ro	no	M	M	Not direct supported, indirect by the DeviceID
6E03h	VAR	Serial Number	ro	no	M	O	Serial number
6E04h	VAR	Calibration date	ro	no	M	O	Device specific calibration data
6E0Ah	VAR	Manufacturer Software Version	ro	no	O	O	- no mapping
	VAR	Documentation	ro	no	O	O	Device documentation
6E40.1h	VAR	IP Address	rw	no	O	O	Only for TCP/IP communication IPv4
6E40.2h	VAR	Subnet Mask	rw	no	O	O	Only for TCP/IP communication IPv4
6E40.3h	VAR	MAC Address	ro	no	O	O	

2.2 Address Mapping of the VARAN Client

<table>
<tr><th>Byte No.</th><th>Content description</th></tr>
<tr><td>0</td><td>start address of RPDO</td></tr>
<tr><td>2</td><td>Length of RPDO</td></tr>
<tr><td>4</td><td>start address of TPDO</td></tr>
<tr><td>6</td><td>Length of TPDO</td></tr>
<tr><td>8</td><td>start address of RSDO</td></tr>
<tr><td>10</td><td>Length of RSDO</td></tr>
<tr><td>12</td><td>start address of TSDO</td></tr>
<tr><td>14</td><td>Length of TSDO</td></tr>
<tr><td>..</td><td></td></tr>
<tr><td>RPDO
Manager => Client</td><td>
<table>
<tr><td>Header</td><td>Message Info</td><td>unsigned 8 :6
unsigned 8 :2</td><td>Message counter (0-63)
Reserved</td></tr>
<tr><td></td><td>Mapping</td><td>unsigned 8</td><td>0</td></tr>
<tr><td>DataArea</td><td colspan="3">Data structure according to the used mapping, see Default PDO Mapping in EUROMP 75-1.</td></tr>
</table>
</td></tr>
<tr><td>..</td><td></td></tr>
<tr><td>TPDO
Client => Manager</td><td>
<table>
<tr><td>Header</td><td>Message Info</td><td>unsigned 8 :6
unsigned 8 :1
unsigned 8 :1</td><td>Message counter (0-63)
Device Status
Error Flag</td></tr>
<tr><td></td><td>Mapping</td><td>unsigned 8</td><td>0</td></tr>
<tr><td>DataArea</td><td colspan="3">Data structure according to the used mapping, see Default PDO Mapping in EUROMP 75-1.</td></tr>
</table>
</td></tr>
<tr><td>..</td><td></td></tr>
<tr><td>RSDO
Manager => Client</td><td>
<table>
<tr><td>Header</td><td>Counter</td><td>unsigned 8 :6
unsigned 8 :2</td><td>Message counter (0-63)
Reserved</td></tr>
<tr><td></td><td>Length of Data</td><td>unsigned 8</td><td>Length of DataArea</td></tr>
<tr><td>Command</td><td>Opcode</td><td>unsigned 8 :3
unsigned 8 :5</td><td>1=readReq, 2=writeReq
Reserved</td></tr>
<tr><td></td><td>Channel Number</td><td>unsigned 8</td><td>1-128</td></tr>
<tr><td></td><td>ID</td><td>unsigned 16</td><td>Parameter number</td></tr>
<tr><td></td><td>Dummy</td><td>unsigned 16</td><td>Reserved</td></tr>
<tr><td>DataArea</td><td colspan="3">Data (write request)</td></tr>
</table>
</td></tr>
<tr><td>..</td><td></td></tr>
<tr><td>TSDO
Client => Manager</td><td>
<table>
<tr><td>Header</td><td>Counter</td><td>unsigned 8 :6
unsigned 8 :2</td><td>Message counter (0-63)
Reserved</td></tr>
<tr><td></td><td>Length of Data</td><td>unsigned 8</td><td>Length of DataArea</td></tr>
<tr><td>Command</td><td>Opcode</td><td>unsigned 8 :3
unsigned 8 :1
unsigned 8 :1
unsigned 8 :3</td><td>1=readRes,2=writeRes
Reserved
Error
Reserved</td></tr>
<tr><td></td><td>Channel Number</td><td>unsigned 8</td><td>1-128</td></tr>
<tr><td></td><td>ID</td><td>unsigned 16</td><td>Parameter number</td></tr>
<tr><td></td><td>Dummy</td><td>unsigned 16</td><td>Reserved</td></tr>
<tr><td>DataArea</td><td colspan="3">Data (read response) / ErrorCode if Error is set (Opcode bit 4)</td></tr>
</table>
</td></tr>
<tr><td>..</td><td></td></tr>
</table>

2.3 Process data RPDO, TPDO

2.3.1 Alternating Buffer

The PDO channels are to be realised with alternating buffers. These are switched over from the manager and client side. When one is currently reading and the other writing, no switch-over is carried out, otherwise this could lead to inconsistent data.

An alternating buffer is integrated in the TPDO in order to maintain data consistency. This alternating buffer is automatically operated by the writing access to the message counter. The basic principle here is that the Client must always write the data first and the message counter must be incremented **lastly**.

An alternating buffer is also integrated in the RPDO for reasons of data consistency. This alternating buffer is automatically operated by the reading access to the message counter. The basic principle here is that the Client must always read the message counter first and then the data.

2.3.2 PDO Mapping

PDO mapping is selected by the manager in RPDO and also applies to TPDO. If the Client supports RPDO mapping, it will be able to process the RPDO block and use the mapping structure for TPDO also. If an unknown mapping structure is selected in RPDO the Client will not be able to process the RPDO block and will use the default mapping (=0) for the TPDO.

The “Number of channels”, i.e. the number of PDO channels to be transmitted, is defined by the controller in RPDO. The Client also uses this number of channels for the TPDO block.
The Client can however only read and write the maximum number of its own available channels. If the number of channels defined by the controller is larger, the additional channels are ignored in RPDO and only the recognised number is acknowledged in TPDO.

RPDO Header

Unsigned8	Bit 0..5 : Message counter 0-63 Bit 6,7 : Reserved
Unsigned8	Number of RPDO Mapping, default = 0

Process data structure (RPDO)

Header	Unsigned8	0-63	Bit 0..5 : Message counter (0-63)
	Unsigned8	0	RPDO Mapping: 0 = Default Mapping Nr.0
DataArea			Data structure according to the used mapping, see Default PDO Mapping in EUROMP 75-1.

TPDO Header

Unsigned8	Bit 0..5 : Message counter 0-63 Bit 6 : Device Status 1 = Operational Bit 7 : Device error flag 1 = general device error according to error register, index 1001h Bit 0 in CiA DS-301.
Unsigned8	Number of TPDO Mapping, default = 0

Process data structure (TPDO)

Header	Unsigned8	0-63	Bit 0..5 : Message counter: (0-63) Bit 6 : Device Status: 1=Operational Bit 7 : Device error flag: 1=general device error
	Unsigned8	0	TPDO Mapping: 0 = Default Mapping Nr.0
DataArea			Data structure according to the used mapping, see Default PDO Mapping in EUROMP 75-1.

2.4 Example PDO Mapping

Process data structure (RPDO) with one "Default Mapping" no. 0 via “Number of channels”, with 61E0 = 8.

Header	Unsigned8	0-63	Bit 0..5 : Message counter (0-63)
	Unsigned8	0	RPDO Mapping: 0 = Default Mapping Nr.0
Number of channels	Unsigned8	8	Number of measuring channels (default = 61E0, may be limited by the application)
Alarm block optional	Unsigned8	0	Bit 0: 6610 Alarm General Reset Bit 1: 6630 Alarm Snapshot Trigger
Measuring channel 1	Unsigned16		6160/1 Control Word.1
	Unsigned8		61E3/1 Span number.1
	Unsigned8		6110/1 Sensor Type.1
Measuring channel 2	Unsigned16		6160/2 Control Word.2
	Unsigned8		61E3/2 Span number.2
	Unsigned8		6110/2 Sensor Type.2
Measuring channel 3	Unsigned16		6160/3 Control Word.3
	Unsigned8		61E3/3 Span number.3
	Unsigned8		6110/3 Sensor Type.3
Measuring channel 4	Unsigned16		6160/4 Control Word.4
	Unsigned8		61E3/4 Span number.4
	Unsigned8		6110/4 Sensor Type.4
Measuring channel 5	Unsigned16		6160/5 Control Word.5
	Unsigned8		61E3/5 Span number.5
	Unsigned8		6110/5 Sensor Type.5
Measuring channel 6	Unsigned16		6160/6 Control Word.6
	Unsigned8		61E3/6 Span number.6
	Unsigned8		6110/6 Sensor Type.6
Measuring channel 7	Unsigned16		6160/7 Control Word.7
	Unsigned8		61E3/7 Span number.7
	Unsigned8		6110/7 Sensor Type.7
Measuring channel 8	Unsigned16		6160/8 Control Word.8
	Unsigned8		61E3/8 Span number.8
	Unsigned8		6110/8 Sensor Type.8

Process data structure (TPDO) with one "Default Mapping" no. 0 via “Number of channels”, with 61E0 = 8.

Header	Unsigned8	0-63	Bit 0..5 : Message counter: (0-63) Bit 6 : Device Status: 1=Operational Bit 7 : Device error flag: 1=general device error
	Unsigned8	0	TPDO Mapping: 0 = Default Mapping Nr.0
Number of channels	Unsigned8	8	Number of measuring channels (default = 61E0, may be limited by the application)
Alarm block optional	Unsigned8	0	Bit 0: 6602 Alarm General OR State Bit 1: 6622 Alarm General AND State
Measuring channel 1	Unsigned16		6150/1 Status Word.1
	Integer32		9130/1 Input Process Value.1
Measuring channel 2	Unsigned16		6150/2 Status Word.2
	Integer32		9130/2 Input Process Value.2
Measuring channel 3	Unsigned16		6150/3 Status Word.3
	Integer32		9130/3 Input Process Value.3
Measuring channel 4	Unsigned16		6150/4 Status Word.4
	Integer32		9130/4 Input Process Value.4
Measuring channel 5	Unsigned16		6150/5 Status Word.5
	Integer32		9130/5 Input Process Value.5
Measuring channel 6	Unsigned16		6150/6 Status Word.6
	Integer32		9130/6 Input Process Value.6
Measuring channel 7	Unsigned16		6150/7 Status Word.7
	Integer32		9130/7 Input Process Value.7
Measuring channel 8	Unsigned16		6150/8 Status Word.8
	Integer32		9130/8 Input Process Value.8

2.4.1 Service Data RSDO, TSDO

Any transmission of service data is initiated by the manager via the RSDO channel. The manager always waits for the reply from the client in TSDO before requesting the next transmission of data. There is no SDO queue at the Client end. If a currently running command is overwritten by the manager, the Client cancels the command and processes the new command.

The Client monitors the message counter in RSDO. When this changes, this means a new command has been received from the manager. The Client carries out the new command and, **after** filling in the data box of the TSDO, copies the message counter of the RSDO into the message counter of the TSDO. In this way the reply always has the same message counter value as the respective command.

Note: Because the manager only sends the RSDO once and then reads the TSDO only as far as the command acknowledgement from the Client, overlapping of the data in the Dual Port Ram is not possible.
For reasons of data consistency, the Client must first read the message counter in RSDO and then the data and **LASTLY** the message counter again. The data may only be interpreted as valid when both counter values are identical.

2.4.2 Commands

```
unsigned char Opcode    : 2;   // 1 = readReq / readRes
                               // 2 = writeReq / writeRes
                        : 2;   // reserved
                        : 1;   0x00 = NoError
                               0x01 = Error occured, (ErrorCode unsigned 16; follows in DataArea)
                        : 3;   // reserved
```

If the Client recognises an error in the interpretation or execution or a command it notifies the manager of this in the answer in ErrorCode.

The parameter is given a unique address consisting of the Channel Number and ID (in RSDO and TSDO).

2.4.3 Data structure for the RSDO service channel

Header	Unsigned8	Message counter (Bit 0-5 = 0-63)
	Unsigned8	Length of DataArea
Command	Unsigned8	Opcode (ReadReq, WriteReq)
	Unsigned8	Channel Number
	Unsigned16	ID
	Unsigned16	Dummy
DataArea		Data

2.4.4 Data structure for the TSDO service channel

Header	Unsigned8	Message counter (Bit 0-5 = 0-63) Same as in request
	Unsigned8	Length of DataArea
Command	Unsigned8	Opcode (ReadRsp, WriteRsp), Error (0x00 = no Error, 0x01 = Error)
	Unsigned8	Channel Number
	Unsigned16	ID
	Unsigned16	Dummy
DataArea		Data / Error Code if error is set

2.4.5 Example of SDO data transmission (Read Channel Type)

Read Request: Read Channel_Type

Header	Unsigned8	Message counter (Bit 0-5 = 0-63)
	Unsigned8	Length of DataArea = 0
Command	Unsigned8	Opcode (ReadReq)
	Unsigned8	Channel Number n (1-128)
	Unsigned16	ID = 61E1(Channel Type)
	Unsigned16	Dummy
DataArea		

Read Response: Read Channel_Type

Header	Unsigned8	Message counter (Bit 0-5 = 0-63) Same as in read request
	Unsigned8	Length of DataArea = 4
Command	Unsigned8	Opcode (ReadRsp), Error (0x00 = no Error)
	Unsigned8	Channel Number n (1-128)
	Unsigned16	ID = 61E1(Channel Type)
	Unsigned16	Dummy
DataArea	Unsigned32	Contents from 61E1

2.4.6 Example of SDO data transmission (Read Span List)

Read Request: Read Span_List

Header	Unsigned8	Message counter (Bit 0-5 = 0-63)
	Unsigned8	Length of DataArea = 0
Command	Unsigned8	Opcode (ReadReq)
	Unsigned8	Channel Number n (1-128)
	Unsigned16	ID=61E4
	Unsigned16	Dummy
DataArea		

Read Response: Read Span_List

Header	Unsigned8	Message counter (Bit 0-5 = 0-63) Same as in read request
	Unsigned8	Length of Data = 22
Command	Unsigned8	Opcode (ReadRsp), Error (0x00 = no Error)
	Unsigned8	Channel Number n (1-128)
	Unsigned16	ID = 61E4 (Span List)
	Unsigned16	Dummy
DataArea	Unsigned8	Number of entries; = 1 groups of sensor types with identical meas. ranges
	Unsigned32	Sensor Type List; = 0x00100200 group 1 of sensor types
	Unsigned8	Number of meas. ranges 1; =2
	Integer32	Span 1 start; = 0
	Integer32	Span 1 End; = 5.000
	Integer32	Span 2 start; = 0
	Integer32	Span 2 End; = 20.000

2.4.7 Example of SDO data transmission (Write Sensor Type)

Write Request: Write Sensor_Type

Header	Unsigned8	Message counter (Bit 0-5 = 0-63)
	Unsigned8	Length of Data = 1
Command	Unsigned8	Opcode (WriteReq)
	Unsigned8	Channel Number n (1-128)
	Unsigned16	ID = 6110 (Sensor Type)
	Unsigned16	Dummy
DataArea	Unsigned8	Sensor Type z.B.: 1 für Thermocouple Type J

Write Response: Write Sensor_Type

Header	Unsigned8	Message counter (Bit 0-5 = 0-63) Same as in request
	Unsigned8	Length of Data = 0
Command	Unsigned8	Opcode (WriteRsp), Error (0x00 = no Error)
	Unsigned8	Channel Number n (1-128)
	Unsigned16	ID = 6110 (Sensor Type)
	Unsigned16	Dummy
DataArea		

Write Response: Write Sensor_Type with error message

Header	Unsigned8	Message counter (Bit 0-5 = 0-63) Same as in request
	Unsigned8	Length of Data = 2
Command	Unsigned8	Opcode (WriteRsp), Error (0x01 = Error)
	Unsigned8	Channel Number n (1-128)
	Unsigned16	ID = 6110 (Sensor Type)
	Unsigned16	Dummy
DataArea	Unsigned16	Error Code z.B.: 1 = "invalid Channel Number"

2.4.8 List of Error Codes

Value	Error description
0	reserved
1	Object ID not supported
2	Channel number out of range
3	Object not writeable
4	Error in Length of Data
5	Command error e.g. invalid Opcode

3 Mapping the profile to ETHERCAT

3.1.1 References

IEC 61158 series, Industrial communication networks – Fieldbus specifications, Type 12

3.1.2 General

EtherCAT is defined in IEC 61158 as Type 12.
The Mapping of the profile EUROMAP 75 to EtherCAT can easily be done by using the CoE (CAN application protocol over EtherCAT) services.

3.2 EtherCAT Device Description

The following parameters are part of the EtherCAT specification (IEC 61158-6-12).

Index	Object	Description	Type
1000h	VAR	Device Type	Unsigned32
1001h	VAR	Error Register	Unsigned8
1008h	VAR	Manufacturer Device Name	VisibleString
1009h	VAR	Manufacturer Hardware Version	VisibleString
100Ah	VAR	Manufacturer Software Version	VisibleString
1018h	RECORD	Identity Object	Identity (0x23)
	Subindex 0	Number of entries	Unsigned8
	Subindex 1	Vendor ID	Unsigned32
	Subindex 2	Product Code	Unsigned32
	Subindex 3	Revision Number	Unsigned32
	Subindex 4	Serial Number	Unsigned32
1600h	RECORD	1st receive PDO Mapping	PDO Mapping
1601h	RECORD	2nd receive PDO Mapping	PDO Mapping
…	…	…	…
17FFh	RECORD	512th receive PDO Mapping	PDO Mapping
1A00h	RECORD	1st transmit PDO Mapping	PDO Mapping
1A01h	RECORD	2nd transmit PDO Mapping	PDO Mapping
…	…	…	…
1BFFh	RECORD	512th transmit PDO Mapping	PDO Mapping

3.3 Process Data

The standard PDO mapping services and protocol specifications as defined in IEC 61158 series Type 12 shall be used.

The default mapping as defined in EUROMAP 75 Part 1, clause 5, shall be used.

3.4 Service Data Objects

The standard SDO service and protocol specifications via CoE as defined in IEC 61158 series Type 12 shall be used to access the objects.

4 Mapping the profile to POWERLINK

4.1 References

IEC 61158 series, Industrial communication networks – Fieldbus specifications, Type 13
EPSG DS 301 V1.1.0, Ethernet POWERLINK communication profile specification, Version 1.1.0
EPSG Generic Profile Transformation, Version 1.0.0

4.2 General

POWERLINK is defined in IEC 61158 as Type 13.
The Mapping of the profile EUROMAP 75 to POWERLINK can easily be done by using the EPSG Generic Profile Transformation.

4.3 POWERLINK Device Description

The following parameters are part of the POWERLINK specification (IEC 61158-6-13).

Index	Object	Description	Type
1000h	VAR	Device Type	Unsigned32
1001h	VAR	Error Register	Unsigned8
1008h	VAR	Manufacturer Device Name	VisibleString
1009h	VAR	Manufacturer Hardware Version	VisibleString
100Ah	VAR	Manufacturer Software Version	VisibleString
1018h	RECORD	Identity Object	Identity (0x23)
	Subindex 0	Number of entries	Unsigned8
	Subindex 1	Vendor ID	Unsigned32
	Subindex 2	Product Code	Unsigned32
	Subindex 3	Revision Number	Unsigned32
	Subindex 4	Serial Number	Unsigned32
1600h	RECORD	1st receive PDO Mapping	PDO Mapping
1601h	RECORD	2nd receive PDO Mapping	PDO Mapping
…	…	…	…
16FFh	RECORD	256th receive PDO Mapping	PDO Mapping
1A00h	RECORD	1st transmit PDO Mapping	PDO Mapping
1A01h	RECORD	2nd transmit PDO Mapping	PDO Mapping
…	…	…	…
1AFFh	RECORD	256th transmit PDO Mapping	PDO Mapping

4.4 Process Data

The standard PDO mapping services and protocol specifications as defined in IEC 61158 series Type 13 shall be used.

The default mapping as defined in EUROMAP 75 Part 1, clause 5, shall be used.

4.5 Service Data Objects

The standard SDO service and protocol specifications as defined in IEC 61158 series Type 13 shall be used to access the objects.

EUROMAP

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European Committee of Machinery Manufacturers for the Plastics and Rubber Industries

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