

# **ANALOG INTERFACE MODULE**

**PD 3240**

**Manual**

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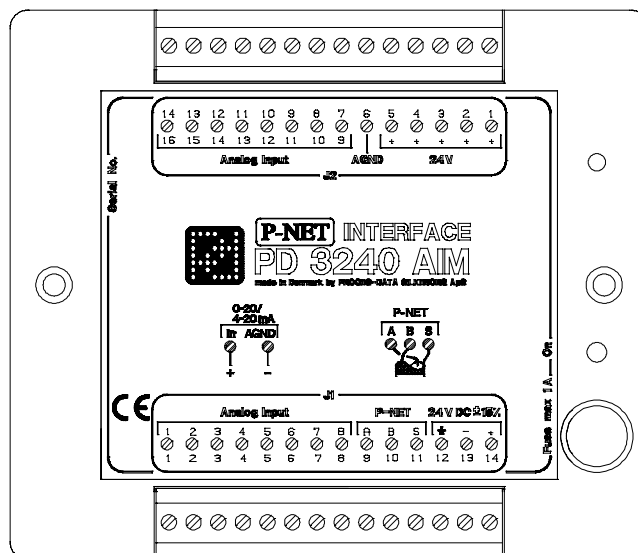
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## 1. General information.

The PD 3240 Analog Interface Module is a member of **Proces-Data**'s module series 3000.

The PD 3240 module is an intelligent module, provided with 16 analog input channels for 0-20 mA or 4-20 mA and an interface to P-NET<sup>®</sup>. It provides a versatile interface between measurement transducers generating analogue current signals, such as temperature transmitters, pressure, density and level sensors, flow meters, etc., and distributed master control computers.



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Configuration of the module for the functions required, and communication between the module and control computers, is carried out via the P-NET.

PD 3240 Analog Interface Module (AIM) provides internal conversion of measurement into any engineering unit representing the analog process being monitored and controlled, for direct interrogation by central control or any master unit connected to the P-NET Fieldbus system.

The compact design and the outstanding environmental specifications for the Analog Interface Module, makes it an ideal process component in industrial as well as other environments.

### 1.1. Features.

- 16 high resolution (15 bit) analog input channels.
- Current input (0-20 or 4-20 mA).
- Filtered input signals
- Suppression of 50 and 60 Hz interference
- High- and Low level limit switch for each channel
- Advanced self testing facility
- Overload protection
- P-NET Fieldbus communication
- Watchdog Timer
- Rail mounting module (DIN / EN)
- EMC approved (89/336/ECC)

## 1.2. System description

The PD 3240 Analog Interface Module utilizes 4 analog to digital converters, using a fully integrating principle. Each measurement is integrated over a 100 ms period, which reduces noise influence and results in a very stable reading of the input signal. The input signals are galvanically separated from the power supply.

The unit offers comprehensive self-testing features, which enables reporting of disconnection, overload and process failure. All inputs are protected against overload. The selectable Watchdog timer creates an internal error message during a communications or power failure.

An incorporate filtered power supply provides a high degree of interference suppression, allowing use of low grade power services. The DC supply may be used for powering external transducers.

The input signals are filtered, and suppressed against 50 and 60 Hz interference. An additional filter may be applied to the input signal. The filter time constant is configurable for each channel.

Each channel may be configured for input simulation. In this mode, no measurement will be calculated, and it is possible for the user to insert any value in this register.

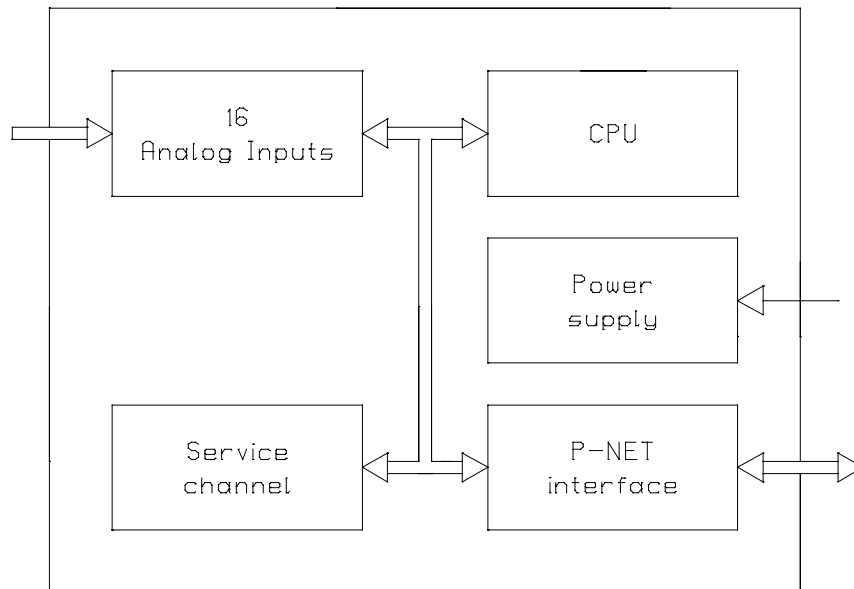
As a distributed module, the unit can be mounted close to the process. Data communications with Controllers are made with a single P-NET cable having a ring length of over 1 km. This reduces plant wiring costs to a minimum.

PD 3240 is approved in compliance with the **EMC-directive no 89/336/ECC**. Test limits are determined by the generic standards **EN 50081-1** for emission and **PrEN 50082-2** for immunity.

PD 3240 is approved in compliance with the **IEC 68-2-6 Test Fc** standard for vibration .

### 1.3. Channels/registers.

The PD 3240 module contains:



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1 Service channel	(channel 0)
16 Analog inputs	(channel 1-\$10)

A set of 16 variables, numbered from 0 - \$F, is associated with each channel. For addressing a variable within a particular channel, a logical address called a SoftWire Number (SWNo), is used. The SWNo is calculated as:  $(\text{channel number} * \$10 + \text{variable number within the channel})$ .

Example: Variable 4 on channel 3 needs to be addressed.  
The SWNo will therefore be \$34.

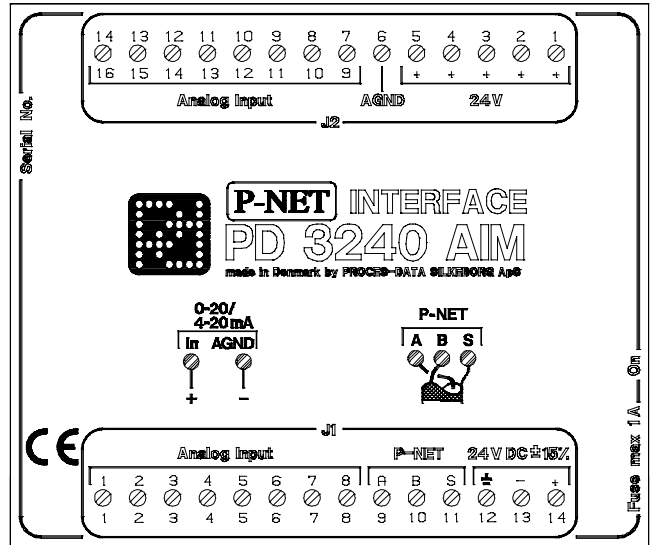
Throughout the manual the variables are depicted as tables. The variable names are standard identifiers, as defined in Process-Pascal.

The channel names are depicted on the corresponding channel tables as standard identifiers, defined in Process-Pascal.

### 1.4. Connections.

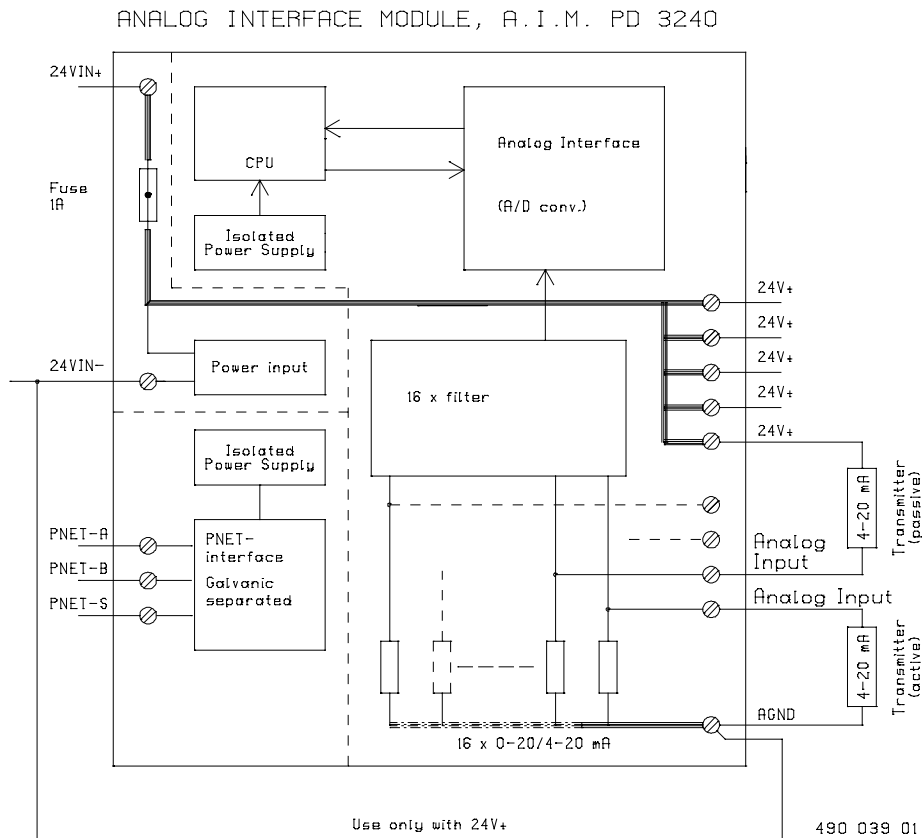
The PD 3240 is physically designed as a black box, having two 14 pin connectors for screw terminals. The connectors are removable and equipped with a key pin, to avoid reversed connections. The module has a built in fuse, which is used to protect the module, and externally connected wiring and equipment. When connecting external equipment, the additional fuse protected +24 V screw terminals should be used (see hardware diagram).

Connection identities are printed on the top of the module.



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Hardware diagram, principle.





## 1.5. Memory types.

The PD 3240 stores data in different types of memory depending on the value of a control variable following a reset or a power failure, and the state of write protection.

Some variables are stored in both non volatile memory and in volatile memory. The state of the module's WriteEnable register determines whether the contents are changed in both types of memory or only in the volatile type.

The following memory types are listed in the channel definition tables.

### Read Only

#### PROM ReadOnly

The PROM is always write protected and can never be changed.

#### RAM ReadOnly

The variable is stored in RAM and is only accessible for Reading.

### Read Protected Write

#### EEPROM RPW (Read, Protected Write)

The EEPROM is always write protected directly following a reset. By setting WriteEnable to TRUE, the contents of the EEPROM can be changed. The contents of the EEPROM will remain unchanged during and after a power failure.

### Read Write

#### RAM ReadWrite

The variable can be changed instantly. After reset or a power failure, it's value is set to zero.

### Read Write, Protected BackUp Write

#### RAM InitEEPROM

The variable is stored in both RAM and EEPROM. After a reset, the variable is copied from EEPROM into RAM. When the variable is changed via P-NET, the value is changed in RAM. If WriteEnable is TRUE, the value is changed in both RAM and EEPROM when the variable is changed via P-NET.

## 2. Service channel.

PD 3240 contains a service channel containing variables and functions common to the entire module.

Variables on Service channel (channel 0).

Channel identifier: **Service**

SWNo	Identifier	Memory type	Read out	Type
0	NumberOfSWNo	PROM Read Only		Integer
1	DeviceID	PROM Read Only	- - - - -	Record
2				
3	Reset	RAM Read Write	Hex	Byte
4	PnetSerialNo	Special function	- - - - -	Record
5				
6				
7	FreeRunTimer	RAM Read Only	Decimal	LongInteger
8	WDTimer	RAM Read Write	Decimal	Real
9	ModuleConfig	EEPROM RPW	- - - - -	Record
A	WDPreSet	EEPROM RPW	Decimal	Real
B				
C				
D	WriteEnable	RAM Read Write	Binary	Boolean
E	ChType	PROM Read Only	- - - - -	Record
F	CommonError	RAM Read Write	- - - - -	Record

### SWNo 0: NumberOfSWNo

This variable holds the highest SWNo in the module

### SWNo 1: DeviceID

The purpose of this record is to be able to identify the device. The record includes a registered manufacturer number, the type number of the module and a string, identifying the manufacturer.

The record is of the following type:

*Record*

*DeviceNumber: Word; (\* Offset = 0 \*)*

*ProgramVersion: Word; (\* Offset = 2 \*)*

*ManufacturerNo: Word; (\* Offset = 4 \*)*

*Manufacturer: String[20]; (\* Offset = 6 \*)*

*end*

An example of the field values in the DeviceID record is shown below:

```
DeviceNumber = 3240
ProgramVersion= 100          (the first version)
ManufacturerNo = 1
Manufacturer = Proces-Data DK
```

### **SWNo 3: Reset**

By writing \$FF to SWNo 3, the module performs a reset, and ExternalReset in CommonError SWNo \$F is set TRUE.

### **SWNo 4: PnetSerialNo**

This Variable is a record of the following type:

```
Record
    PnetNo: Byte; (* Node address *) (* Offset = 0 *)
    SerialNO: String[20];           (* Offset = 2 *)
end
```

The serial number is used for service purposes and as a 'key' to setting the module's P-NET Node address.

A special function is included for identifying a module connected to a network containing many other modules, having the same or unknown node addresses, and to enable a change of the node address via the P-NET.

Setting a new node address via the P-NET is performed by writing the required node address together with the serial number of the module in question, into the PnetSerialNo at node address \$7E (calling all modules). All modules on the P-NET will receive the message, but only the module with the transmitted serial number will store the P-NET node address.

An attempt to write data to node address \$7E will give no reply. Consequently the calling master must disable the generation of a transmission error when addressing this node.

In the module, the SerialNo = "XXXXXXXXPD", is set by **Proces-Data**, and cannot be changed. The seven X's indicate the serialnumber, and PD is the initials of Proces-Data.

### **SWNo 7: FreeRunTimer**

FreeRunTimer is a timer, to which internal events are synchronized. The timer is of type LongInteger in 1 /256 Second.

**P-NET Watchdog function**

PD 3240 Analog Interface module is equipped with a P-NET Watchdog. The P-NET Watchdog uses SWNo 8 and SWNo A.

**SWNo 8: WDTimer [s]**

WDTimer is automatically preset with the value from WDPreset (SWNo A), either each time the module is called via P-NET, or following a power-up or module reset. If the WDTimer reaches zero before it is preset again, the PnetWDRunOut flag will be set. The timer contains a value in sec.

**SWNo 9: ModuleConfig**

The variable is a record of the following type:

```

Record
  Enablebit   : Bit8;           (* Offset = 0 *)
  Functions   : BYTE;          (* Offset = 1 *)
  Ref_A       : BYTE;          (* Offset = 2 *)
  Ref_B       : BYTE;          (* Offset = 3 *)
end

```

The EnableBit field is not utilised in the module.

The Watchdog facility may be switched on and off by means of the field variable Functions as shown below.

```

ModuleConfig.Functions = 0      Watchdog
ModuleConfig.Functions = $10    No Watchdog

```

The Ref\_A and Ref\_B fields are not utilised in the module.

**SWNo A: WDPreset [s]**

The maximum allowable time between two calls for the module, before the Watchdog is activated, is defined in seconds, in this register.

**SWNo D: WriteEnable**

Write protected variables can only be changed when WriteEnable is TRUE. After reset, WriteEnable is set to FALSE.

After modifying the contents of module EEPROM, WriteEnable should be set FALSE. An EEPROM sum check is calculated each time WriteEnable is changed from "TRUE" to

"FALSE". This sum check calculation period is approximately 0.25 second. Consequently, the module should not be reset during this period, otherwise an EEPROM error can occur (see SWNo F: CommonError).

NB: Writing to EEPROM is limited to 10,000 cycles for each byte, including the sum check bytes.

### SWNo E: ChType

Each channel in an interface module is described in an individual ChType variable. This is a Record, consisting of a unique number for the channel type and a TRUE boolean value for each of the registers which are represented within a channel. The register number in a channel, corresponds to the index number in the boolean array. In addition to these fields, various other fields can be found in the record, which depends on the channel type.

The record for the service channel has the following structure:

```

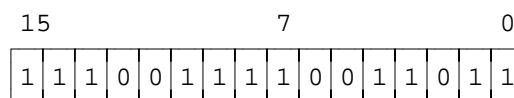
Record
  ChannelType: WORD;           (* Offset = 0 *)
  Exist: Bit16;               (* Offset = 2 *)
  Functions: Bit16;           (* Offset = 4 *)
end

```

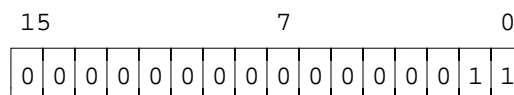
For the service channel, ChType has the following value:

**ChannelType = 1**

**Exist =**



**Functions =**



No Watchdog  
Watchdog



**SWNo F: CommonError**

The CommonError variable holds error information on all Channels.  
 This variable is a record of the following type:

*Record*

*ChError: Record*

*His: Array[0..7] of Boolean; (\* Offset = 0 \*)*

*Act: Array[0..7] of Boolean; (\* Offset = 2 \*)*

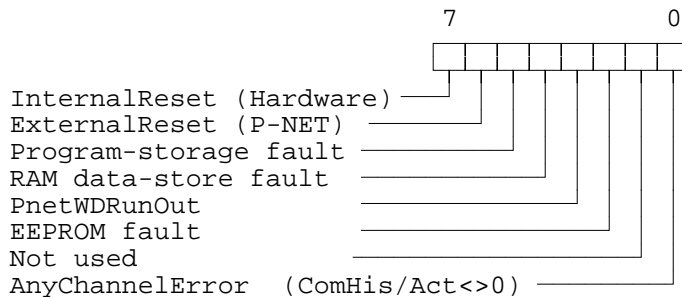
*End;*

*ComHis24: Array [0..\$17] of Boolean; (\* Offset = 4 \*)*

*ComAct24: Array [0..\$17] of Boolean; (\* Offset = 8 \*)*

*End*

The 8 bits in ChError.His and ChError.Act have the following meaning:



- Bit 7 InternalReset is set TRUE if a reset is caused by a power failure, or if the power has been disconnected.
- Bit 6 ExternalReset is set TRUE if a reset is caused by writing \$FF to SWNo 3, Reset, via P-NET.
- Bit 5 Program-storage fault is set TRUE if the self test finds an error in the program memory (PROM).
- Bit 4 RAM data-store fault is set TRUE if the self test finds an error in the data memory (RAM).
- Bit 3 PnetWDRunOut is set TRUE if the WDTimer reaches zero and the Watchdog function is switched ON.
- Bit 2 EEPROM fault is set to TRUE if the self test finds an error in the data memory (EEPROM). The error may be corrected by setting and resetting WriteEnable.
- Bit 0 AnyChannelError = 1 means that an error or an unknnowledged error exists, in one or more channels.

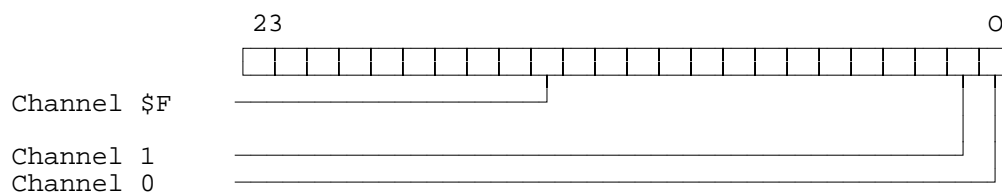
The following function of ChError.His and ChError.Act is analogous in all Channels:

- 1 When an error occurs the corresponding bits in ChError.Act and ChError.His is set.
- 2 When the error disappears the corresponding bit is reset in ChError.Act.
- 3 After reading ChError.His, ChError.Act is copied to ChError.His.
- 4 Transmission responses from a module will include the Actual Data Error bit (DataError) set TRUE if ChError.Act  $\neq$  0.
- 5 The Historical Data Error bit (GeneralError) will be set TRUE in all responses from the module if ChError.His  $\neq$  0.

ComHis and ComAct are unique fields in the service channel, and hold an error status relating to all channels, where the bit number corresponds to the channel number. Each Channel has an error register, ChError. If ChError.His in a particular channel is  $\neq$  0, the corresponding bit is set in ComHis. If ChError.Act in a particular channel is  $\neq$  0, the corresponding bit is set in ComAct in the service channel. If the error disappears (ChError. Act = 0), the corresponding bit in ComAct is automatically cleared.

If the channels become error free, individual bits in ComHis will be cleared when reading ChError in each of the channels.

ComHis:=0 performs a special function, equivalent to reading all ChErrors.His in all channels.



### 3. Analog input channel (channel 1-\$10).

16 analog input signals may be connected to the PD 3240, which can be a current signal (0-20 or 4-20 mA). Signal type etc. is selected individually for each channel, by means of a channel configuration (ChConfig). The input signals are filtered, and suppressed against 50 and 60 Hz interference.

Variables on analog input channel x.

Channel identifier: **Analog\_In\_x**

SWNo	Identifier	Memory type	Read out	Type	SI Unit
x0	AnalogIn	RAM Read Write	Decimal	Real	*
x1					
x2					
x3					
x4					
x5					
x6					
x7	HighLevel	RAM Init EEPROM	Decimal	Real	*
x8	LowLevel	RAM Init EEPROM	Decimal	Real	*
x9	ChConfig	EEPROM RPW	- - - - -	Record	
xA					
xB	FullScale	EEPROM RPW	Decimal	Real	*
xC	ZeroPoint	EEPROM RPW	Decimal	Real	*
xD	Maintenance	EEPROM RPW	- - - - -	Record	
xE	ChType	PROM Read Only	- - - - -	Record	
xF	ChError	RAM Read Only	Binary	Record	

\* SI unit depends on the connected process component.

#### SWNo x0: AnalogIn

This variable holds the measurement result of the current input, (selected in ChConfig.Functions) as a scaled value in SI units, according to the contents of FullScale and ZeroPoint. If the value should attempt to exceed 110% of FullScale, the contents of this register will be held at 110% of FullScale and the module will generate an error code (see ChError). A similar situation occurs if the output signal attempts to drop below -5%.

#### SWNo x7: HighLevel

HighLevel is a "limitswitch" with the following function:

```

IF AnalogIn > HighLevel and ChConfig.Enablebit[4] THEN
    HighAlarm:=true
ELSE
    HighAlarm:=false.
    
```



**SWNo x8: LowLevel**

LowLevel is a "limitswitch" with the following function:

```

IF AnalogIn < LowLevel and ChConfig.Enablebit[3] Then
  LowAlarm:=true
ELSE
  LowAlarm:=false.

```

**SWNo x9: ChConfig**

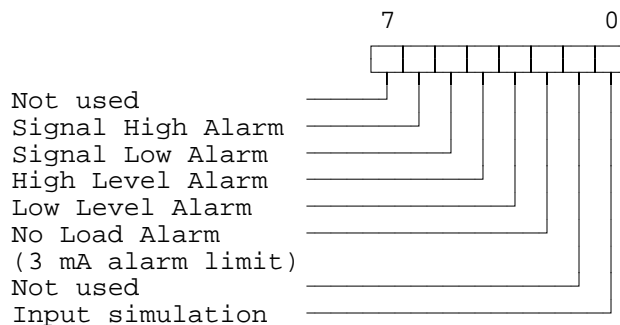
The channel configuration for an analog input channel is stored in a record variable of the following type:

```

Record
  Enablebit   : Bit8;           (* Offset = 0 *)
  Functions   : BYTE;          (* Offset = 1 *)
  Ref_A       : BYTE;          (* Offset = 2 *)
  Ref_B       : BYTE;          (* Offset = 3 *)
end

```

where each field has the following interpretation:

**Enablebit :****Functions :**

The Functions field holds a 2 digit hexadecimal value, where the most significant digit is used to specify the input signal type, and the least significant digit is used to select a time constant for the input filter. The filter time constant defines that for a stepped change at the input terminals, the measured value (AnalogIn), will have only changed by 63 % of it's target value, at the end of the specified time period.

Input signal specification:

Functions = \$0x	=> Channel disabled
Functions = \$2x	=> Current 0-20 mA
Functions = \$3x	=> Current 4-20 mA

Filter constant specification:

Functions = \$x0	=> No filter
Functions = \$xA	=> Time constant = 1 sec.
Functions = \$xB	=> Time constant = 2 sec.
Functions = \$xC	=> Time constant = 5 sec.
Functions = \$xD	=> Time constant = 10 sec.

**Ref\_A :** Not used

**Ref\_B :** Not used

**Note:** If a channel is not in use, "00" should be written in ChConfig.Functions, ("channel disable"), otherwise errors can occur.

No filter should be selected, if the AnalogIn value is to be used for regulation.

When the input is a (4-20 mA) current, an extra function can be used (3 mA low-limit alarm). If this function is selected, the module will generate an error as soon as the current through the input falls below 3 mA. The function is enabled by setting ChConfig.Enablebit[2] to TRUE (see register xF).

When the channel is configured for input simulation mode (ChConfig.Enablebit[0] = TRUE), no measurement value will be calculated, and it is possible for the user to insert any value in AnalogIn.

#### **SWNo xB: FullScale**

The resultant measured value expected in AnalogIn when the input signal is at it's maximum, i.e. 20 mA, should be placed in the FullScale variable. The value is inserted in SI units corresponding to the result value in AnalogIn.

#### **SWNo xC: ZeroPoint**

The resultant measured value expected in AnalogIn when the input signal is at it's minimum, i.e. 0 mA / 4 mA, should be placed in the ZeroPoint variable. The value is inserted in SI units corresponding to the result value in AnalogIn.

#### **SWNo xD: Maintenance**

The Maintenance variable is used for service management and maintenance purposes, and holds the last date of service and indicates the type of service.

Date, month, year, type.

Maintenance is a Record of the following type:

```

Record
    Date       : BYTE;
    Month      : BYTE;
    Year       : BYTE;
    Category   : BYTE;
End
    
```

**SWNo xE: ChType**

For the analog input channels, ChType is of the following type:

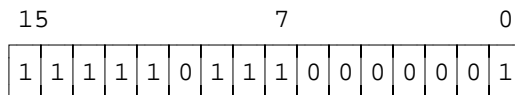
```

Record
    ChannelType: WORD;           (* Offset = 0 *)
    Exist: Bit16;                (* Offset = 2 *)
    Functions: Bit16;           (* Offset = 4 *)
    FilterConstant: Bit16;      (* Offset = 6 *)
end
    
```

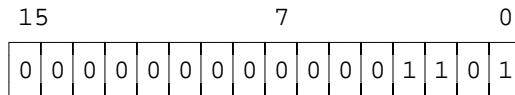
ChType has the following value:

**ChannelType = 4**

**Exist =**

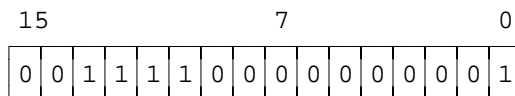


**Functions =**



Current 4 - 20 mA └──┬──┘  
 Current 0 - 20 mA └──┬──┘  
 Channel can be disabled └──┬──┘

**FilterConstant =**



Time constant= 10s └──┬──┘  
 Time constant= 5 s └──┬──┘  
 Time constant= 2 s └──┬──┘  
 Time constant= 1 s └──┬──┘  
 No filter └──┬──┘

**SWNo xF: CHError**

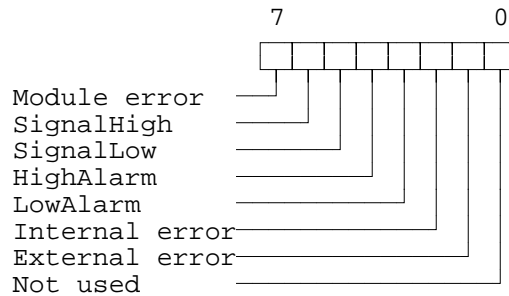
*ChError: Record*

*His: Array[0..7] of Boolean; (\* Offset = 0 \*)*

*Act: Array[0..7] of Boolean; (\* Offset = 2 \*)*

*End;*

The 8 bits in ChError.His and ChError.Act have the following meaning. When an error occurs, the corresponding bit is set in both ChError.His and ChError.Act, and when the error disappears, the bit is cleared in ChError.Act.



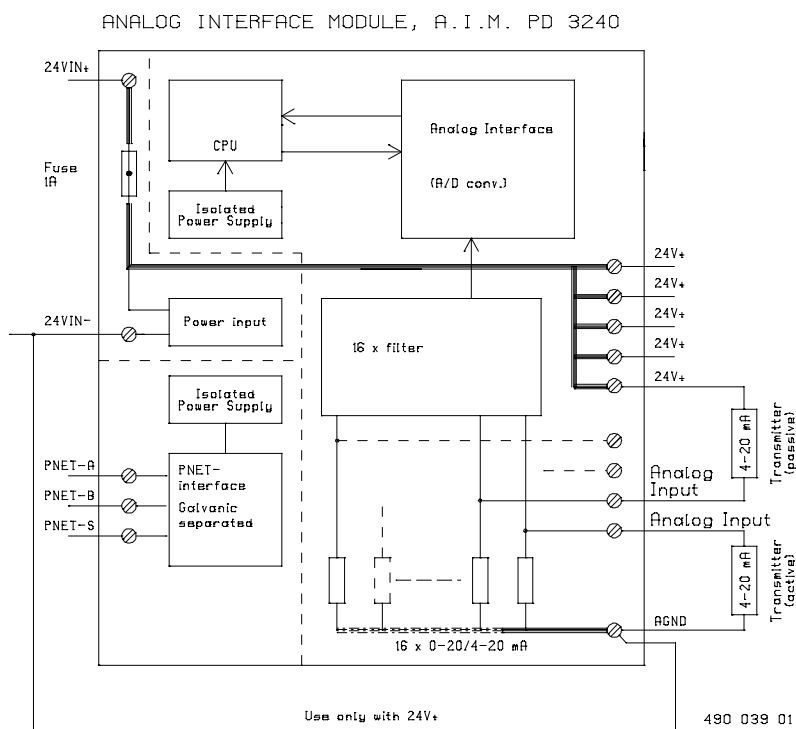
- Bit 7      Module error. If this bit is set, the rest of the bit are insignificant, because a module error can lead to random error codes on individual channels (also see "Service channel").
- Bit 6      SignalHigh is set if the input signal exceeds the maximum value (20mA) with more than 10% and ChConfig.Enablebit[6] = TRUE.
- Bit 5      SignalLow is set if the input signal falls below the minimum value (0mA) with more than 5% of the maximum value (20mA) and ChConfig.Enablebit[5] = TRUE.
- Bit 4      HighAlarm is set if AnalogIn > HighLevel and ChConfig.Enablebit[4] = TRUE.
- Bit 3      LowAlarm is set if AnalogIn < LowLevel and ChConfig.Enablebit[3] = TRUE.
- Bit 2      An internal error is indicated. If the module continues to indicate internal error after a reset, the module is likely to require repair.
- Bit 1      External error is set if the channel is configured for current input (4 - 20 mA) and the current input signal falls below 3 mA and ChConfig.Enablebit[2] = TRUE.
- Bit 0      Not used.

### 3.1. Connection to analog input channels.

The PD 3240 module has terminals used for connection of the analog input signals. The connection for each signal is determined from the analog input transmitter type, and each signal processing is determined from the channel configuration.

Analog current signals of 0-20 mA or 4-20 mA characteristic can be connected to the PD 3240 module. The analog current transmitter may be passive or active.

The two types of transmitters are connected to the terminals as shown below:



#### 4. Construction, Mechanical.

The PD 3240 module is housed in a black plastic case. The case measures W x H x D = 130.0 x 112.0 x 50.9 mm (tolerance to DIN 16901 ).

The module is designed for plugging directly on to a mounting rail (EN 50 022 / DIN 46277). The module incorporates two snap connectors, which provide the terminals for field connection, power and communications.

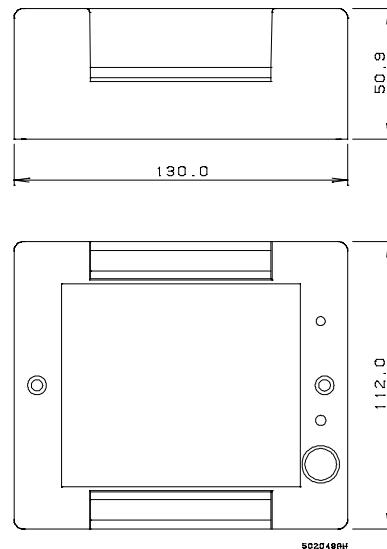
The module may be DIN rail mounted for a panel mounted configuration, or contained in a sealed box designed for the plant environment. It may be removed for service, without interfering with operational activities on the rest of the network.

**Materials**

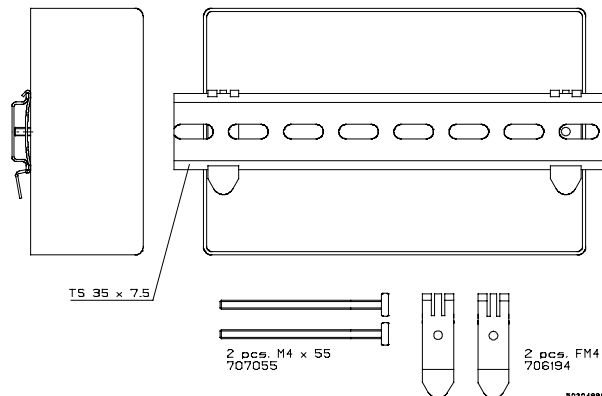
- Case : Black NORYL GFN ( injection moulded )
- Front foil : Polycarbonate.
- Back plate : Black anodized aluminium.

**Weight** : 400 gram.

**Scale drawing (in mm):**



**Rail mounting:**



## 5. Specifications.

All electrical characteristics are valid at an ambient temperature  $-25\text{ }^{\circ}\text{C}$  -  $70\text{ }^{\circ}\text{C}$ , unless otherwise stated.

All specifications are respected in the approved EMI conditions. EMC test specifications for PD 3240 are available in a separate document, PD no. **506 026**.

### 5.1. Power supply.

Power supply DC:	nom.	24.0 V
	min.	20.0 V
	max.	28.0 V
Ripple :	max.	5 %
Power consumption :	max.	1.3 W
Current at power up :	max.	250 mA
Fuse 1 A (time lag).		

### 5.2. Analog input.

Current input (0-20mA, 4-20mA):

Measurement error:

@ $0^{\circ}\text{C}$ to $+50^{\circ}\text{C}$ :	max.	$\pm 0.1\%$ of actual current $\pm 2\text{ }\mu\text{A}$
@ $-25^{\circ}\text{C}$ to $+70^{\circ}\text{C}$ :	max.	$\pm 0.3\%$ of actual current $\pm 2\text{ }\mu\text{A}$

Resolution :  $1\text{ }\mu\text{A}$

Repeatability :  $\pm 2\text{ }\mu\text{A}$

Voltagedrop across input at 20 mA : max. 1.4 V

Current input measurement update time (channel 1 - 4 enabled): 0.6 s

Current input measurement update time (channel 1 - 8 enabled): 0.9 s

Current input measurement update time (channel 1 - 12 enabled): 1.2 s

Current input measurement update time (channel 1 - 16 enabled): 1.5 s

### 5.3. Ambient Temperature.

Operating temperature :  $-25\text{ }^{\circ}\text{C}$  -  $70\text{ }^{\circ}\text{C}$

Storage temperature :  $-40\text{ }^{\circ}\text{C}$  -  $85\text{ }^{\circ}\text{C}$

**5.4. Humidity.**

Relative humidity : max. 95 %

**5.5. Approvals.**

Compliance with EMC-directive no.: 89/336/ECC

Generic standards for emission:

Residential, commercial and light industry EN 50081-1  
Industry PrEN 50081-2

Generic standards for immunity:

Residential, commercial and light industry EN 50082-1  
Industry PrEN 50082-2

Vibration (sinusoidal): IEC 68-2-6 Test Fc



## 6. Survey of variables in the PD 3240 module.

<b>SWNo</b>	<b>Service 0</b>	<b>Analog_In_x 1 - \$10</b>
x0	NumberOfSWNo	AnalogIn
x1	DeviceID	
x2		
x3	Reset	
x4	PnetSerialNo	
x5		
x6		
x7	FreeRunTimer	HighLevel
x8	WDTimer	LowLevel
x9	ModuleConfig	ChConfig
xA	WDPreset	
xB		FullScale
xC		ZeroPoint
xD	WriteEnable	Maintenance
xE	ChType	ChType
xF	CommonError	ChError

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