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# ***Connecting ConveyLinux-Ai/Ai2 modules to Siemens S7 PLCs***

## ***Appendix A***

### ***Motor and Module Diagnostics***

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The LeftMDRDiagnostic / RightMDRDiagnostic fields contain the following named bits:

**MDRStatus1 and MDRStatus2** – Motor status. These two bits can be used to evaluate if the motor is rotating. If MDRStatus1 == MDRStatus2, then the motor is stopped. If they differ from each other, the motor is running. The four different combinations are given below:

Status1	Status2	Description
0	0	Motor not running. Brake method is normal or servo
0	1	Motor running in CCW direction
1	0	Motor running in CW direction
1	1	Motor not running. Brake method is free

**MDRinDMode** indication– Motor is in digital I/O mode. Motor port is switch in digital I/O mode (see Appendix B for details).

**OverVoltage** – Over voltage error. Power supply voltage is over 30V. The error will be automatically removed when supply voltage falls below 29V. Motors are stopped. Overvoltage protection is active. The module has cut the connection between the motors and the power supply. No voltage is returned to the power supply.

**LowVoltage** – Low voltage error. Power supply voltage is under 18V. The error will be automatically removed when supply voltage rises above 21V. Motors are stopped. The module microcontroller is still fully operational. However, some if the Logic power is not connected some sensors may give unreliable signals.

**Overheat** – Overheated error. The ConveyLinx-Ai module is both measuring and calculating the motor temperature. The reason is due to the fact that the temperature sensor is inside the motor, but not right inside the motor coils. This means that there is a lag for the temperature sensor to register the real temperature. If the calculated temperature is over the limit of 105 Celsius motor is stopped for cooling. Error will be automatically removed, after the calculated temperature goes down to 95 degrees Celsius. In the temperature range between 91C and 104C, the motor is in a power restricted mode. The current to the motor is limited to 1A to 1.5A in an attempt to cool off the motor.

**MaxTorque** – Maximum torque output indication. Indicates that motor current consumption is being limited. The ConveyLinx-Ai card is protecting the motor and limits the current consumption of the motor. Limits are between 2.8A and 8A depending of the motor type and mode of operation. Once this indication is raised, the programmer has no guarantee that the motor is running with the set speed.

**ShortCircuit** – Short circuit error. Hardware protection against high current picks. It is an indication for a possible problem on the motor cable or the motor connector.

**MDRNotConnected** – A general indication or error. This may be normal in the cases, where only one of the motors is used for a given card. Or it may be an actual error like for example a faulty motor.

**Overload** – Overload error. The module has detected that the motor has been running in the Stalled condition for more than 20 seconds and has shut off the motor to protect it. In the Stalled situation, the temperature can rise very fast inside the motor. The error will be auto-cleared after 2 minutes.

**Stalled** – Stalled warning. The motor is running with less than 10% of its set speed. This warning is very important, but not critical. The main concern here is the swift rise in the core motor temperature. After 20 seconds in Stalled, the Overload error will be activated and the motor stopped.

**MDRBadHall** – Motor Hall effect sensor error. The module has received an invalid Hall effect sensor combination. This is possible to be seen during normal operation in certain high load usage scenarios, but the incidence is very low at about one per million on off cycles. More frequent observations of this error is a cause for motor inspection.

**MDRNotUsed**– Motor currently is not used. If the module is in “PLC I/O controlled” mode, both motors are in use, so this bit will be always “OFF”.

## **1.2. Motor and module temperature fields.**

While, these fields are not considered real diagnostics, they can provide valuable information about the motor operation. If the temperature is consistently higher on a certain position, an inspection of this position may diagnose a problem that would otherwise decrease the longevity of the system.

- **LeftCalcTemp**(BYTE) provides the calculated temperature of the left motor in degrees Celsius.
- **RightCalcTemp**(BYTE) provides the calculated temperature of the right motor in degrees Celsius.
- **ModuleTemp**(BYTE) and **ModuleTemp1**(BYTE) provide the same information – the temperature inside the microcontroller.



[illegible]

Fig. 3

Most of the errors and indications provided by the Diagnostic structure are the same as the ones for the PLCIO mode. For them, please refer to the previous chapter. The additional fields that are included are:

**LeftMDR\_NotUsed** – Indication that the Left motor is currently not used. If the bit is “OFF” the motor is used. If the bit is “ON”, this is an indication that, the ConveyLinx-Ai module is configured as Single Zone and this motor is not used and it can't be controlled.

**LeftMDR\_AnyErr** – Any error on the left motor. This bit acts like a shortcut to catch any of the serious motor errors:

**ConnectionsNotOK** – Module-to-Module communication has been broken. If the bit is “ON”, some of the module connections are not OK. It can be connection to upstream, downstream or slave module. When the bit is “OFF”, all established connections are OK.

**UpstreamJamErr** – A JAM error is active on the upstream zone. Please refer to the User's guide for more information on JAM errors.

**LeftSensLowGain** – Left photo eye low gain error. The monitoring for this error can be activated via the Pin2 functions. Some sensors can output this error to the Pin 2 of the M8 connector, when the strength of the signal is not high enough.

**RightMDR\_NotUsed** – Indication that the Right motor is currently not used. If the bit is “OFF” the motor is used. If the bit is “ON”, this is an indication that, the ConveyLinx-Ai module is configured as Single Zone and this motor is not used and it can’t be controlled.

**RightMDR\_AnyErr** – Any error on the right motor. This bit acts like a shortcut to catch any of the serious motor errors:

**DownstreamJamErr** – A JAM error is active on the downstream zone. Please refer to the User’s guide for more information on JAM errors.

**RightSensLowGain** – Right photo eye low gain error. The monitoring for this error can be activated via the Pin2 functions. Some sensors can output this error to the Pin 2 of the M8 connector, when the strength of the signal is not high enough.

### 3. Production and preventive maintenance data of the motors

For both PLCIO and ZPA mode, the PLC can get the production and maintenance data of the motors that are attached to both sides of the ConveyLinX-Ai module. These data structures are not available in the cyclic process data, but can be read asynchronously by the PLC with the ReadRecord function.

The production and preventive maintenance data of a Senergy-Ai MDR is available with all 4.x Firmware revisions of ConveyLinX-Ai from EasyRoll. However, this data can be read out by a Siemens PLC, only when the ConveyLinX-Ai has **firmware version 4.9 or later**. The ConveyLinX-Ai provides 40 bytes of production and preventive maintenance (PPM) data arranged in 20 16-bit fields for each motor. All of them can be read individually or as a whole. The "Read Record" function is located in the "Extended Instructions" tab :

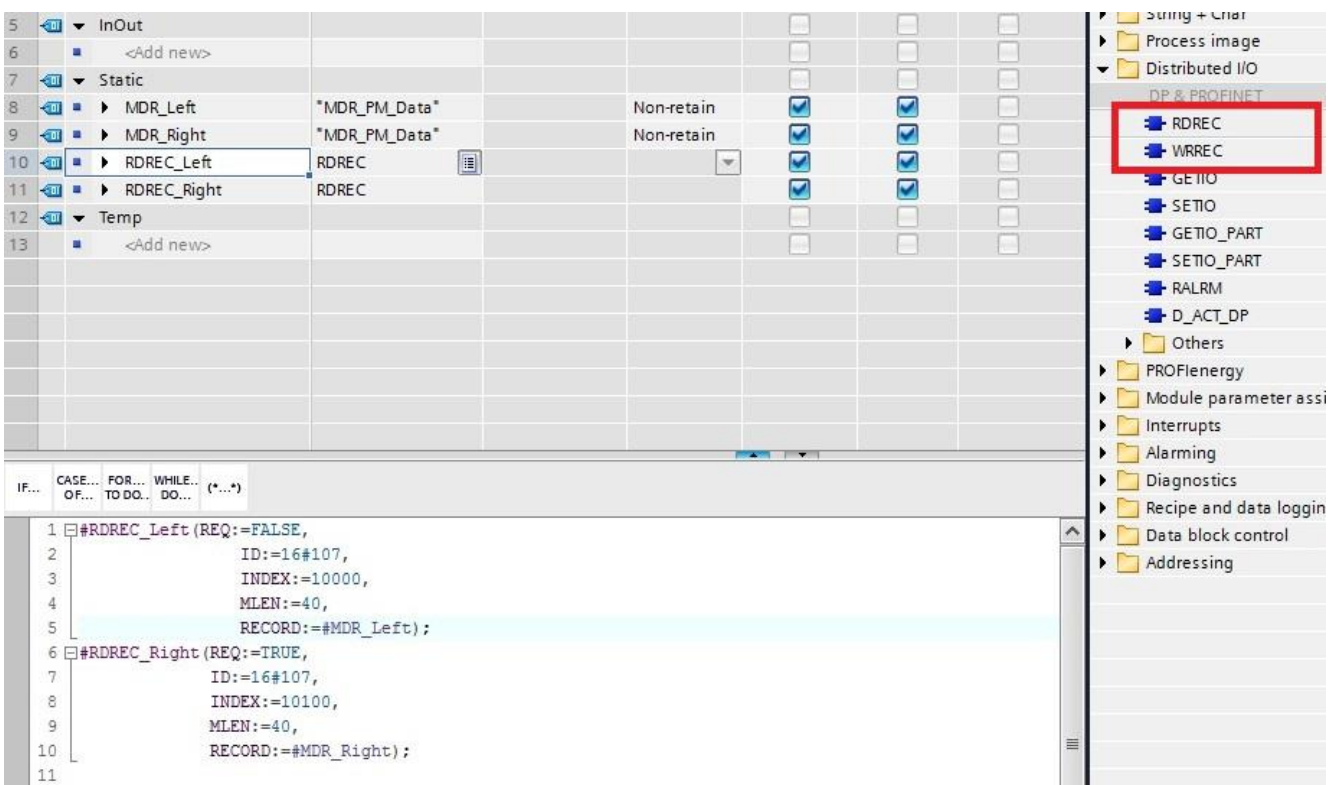


Fig. 4 – The instruction tree is visible, and two ReadRecord function blocks are added, which store the data into two MDR\_PM\_Data type tags

#### 3.1. The Read Request function block has several important Inputs, that need to be filled out:

- **REQ** - When TRUE, the read record request will be send out to the ConveyLinX-Ai. Keeping this as TRUE all the time will result in constant sending of the request every 10 milliseconds. This will burden the ConveyLinX-Ai2 module with unnecessary communication requests.
- **ID** - This is the ID of the module to which the Read Record is sent. Siemens PLC series 300 / 400/ 1200(older) would expect the logical IO address of the ConveyLinX-Ai module. PLC series 1500/ 1200(newer) would expect the Hardware ID of the ConveyLinX-Ai module.



- **Index** - This is the index of the record. The MDR data registers(16 bit words) are located at Indexes 10000 - 10019 (0x2710 - 0x2723) for the Left MDR, and at Indexes 10100 - 10119 for the Right MDR.
- **MLEN** - This is the length of the data you want the function to read in bytes. When individual data indexes are read this should be set to 2. If the entire data struct is to be read, then this parameter should be set at 40.
- **RECORD** - This is the tag, where the function will put the data it receives from the ConveyLinX-Ai . Industrial Software provides pre-prepared tags of type "MDR PM Data", which can be used to store the received data from the ConveyLinX-Ai . All fields are named and have added comments to them to simplify use.

### 3.2. “MDR PM Data” fields descriptions

The data structure of the 20 MDR data registers and their possible values are:

- **ProductionID** - Index 1000/10100. Length : 16 bits
- **Roller type+CustomerID** - Index 10001/10101. Length : 16 bits.  
High byte is Roller type in ASCII code : 'A' - standard / 'T' - tapered / 'W' - Wash-down rated(IP66) / 'Z' - Freezer rated(-30C)(not applicable for PGD)  
Low byte is Customer ID
- **Diameter code+Motor type** - Index 10002/10102. Length : 16 bits  
High byte is Diameter code : Tube diameter in millimeters(not applicable for PGD)  
Low byte is Motor type : 0 = PR / 1 = PGD
- **Interlock+Speed code** - Index 10003/10103. Length : 16 bits  
High byte is InterLock in ASCII code : 'A' - straight / 'B' - V-Pulley / 'G' - grooved / 'H' -micro-V pulley  
Low byte is SpeedCode for PR motor type and GearRatio for a PGD motor type
- **Manufacture year+Manufacture month** - Index 10004/10104. Length : 16 bits  
High byte is the year : 16 = 2016 , 20=2020 and so on.  
Low byte is the month.
- **Tube+Custom option(Shaft)** - Index 10005/10105. Length : 16 bits  
High byte is Tube type(ASCII) : 'Z'-zinc / 'A' - Steel / 'J' - Stainless tube/  
'B' - 3mm black rubber / 'W' - 3mm Urethane / 'Q' - 2mm PVC sleeve (not applicable for PGD)  
Low byte is Custom Option
- **Roller length in millimeters(not applicable for PGD)** - Index 10006/10106. Length : 16 bits
- **Assembly country + Manufacture day** - Index 10007/10107. Length : 16 bits  
High byte is the country in which the motor has been assembled. 0 = EU/ 1 = Japan/ 2 = USA  
Low byte is the day, in which the motor has been manufactured.
- **Operating Time Low Word in minutes** - Index 10008/10108. Length : 16 bits
- **Operating Time High Word in minutes** - Index 10009/10109. Length : 16 bits
- **Time in Current Limit Low Word in minutes** - Index 10010/10110. Length : 16 bits
- **Time in Current Limit High Word in minutes** - Index 10011/10111. Length : 16 bits
- **Timer Overheated (90+ degrees Celsius) Low Word in minutes** - Index 10012/10112. Length : 16 bits
- **Timer Overheated (90+ degrees Celsius) High Word in minutes** - Index 10013/10113. Length : 16 bits
- **On Off Cycles Low Word** - Index 10014/10114. Length : 16 bits

- **On Off Cycles High** Word - Index 10015/10115. Length : 16 bits
- **OvervoltageCounter** Low Word - Index 10016/10116. Length : 16 bits
- **OvervoltageCounter** High Word - Index 10017/10117. Length : 16 bits
- **UndervoltageCounter** Low Word - Index 10018/10118. Length : 16 bits
- **UndervoltageCounter** High Word - Index 10019/10119. Length : 16 bits