

Application note

Ethernet POWERLINK routing using motion drives

AN00247

Rev C (EN)

The MotiFlex e180 and MicroFlex e190 servo drives have inbuilt functionality to operate as an Ethernet POWERLINK router allowing IP packets to be routed from a normal Ethernet network to an Ethernet POWERLINK (EPL) network. This allows EPL nodes to be accessed using an IP based protocol like HTTP or FTP. The drives can also be used as a Modbus/TCP, PROFINET or Ethernet/IP gateway, for interfacing standard Ethernet fieldbus systems to EPL devices such as the NextMove e100



Introduction

This application note explains how to configure a MotiFlex e180 or MicroFlex e190 motion drive to allow it to act as an Ethernet POWERLINK (EPL) router (e.g. to allow a host application or CP600 HMI to connect to a NextMove e100 via Ethernet whilst the NextMove e100 is operating as an EPL network master). The drive can also be used to replace either of the obsolete EPL routers, part numbers OPT036-501 or OPT-EPLR-001.

In its "standard" mode of operation an EPL router receives standard Ethernet frames on the generic Ethernet port and routes these through to the asynchronous portion of the EPL network frames. These standard Ethernet frames can comprise of any mix of standard Ethernet protocols that are supported by e100 and e180/e190 devices (e.g. ABB's ICM protocol used by the Mint ActiveX interface and Modbus/TCP).

The drive-based EPL router also supports an ability to act as either a Modbus/TCP, Ethernet/IP or PROFINET IO gateway instead of just a simple EPL router. It is important to note that using the Modbus/TCP gateway feature is only required when high throughput of Netdata (between the host system and the NextMove e100 device on the EPL network) is needed as Modbus/TCP frames can be routed over EPL to the NextMove anyway. More complex configuration of the EPL network master device (i.e. the NextMove e100) is needed to operate in this manner, but we will discuss this in more detail in the relevant section of this application note.

Pre-requisites

The products being used in the network must have the following firmware version (or later) running on them:

Product	Firmware
MotiFlex e180	5867.4.0 or later
MicroFlex e190	5867.4.0 or later
e100 drives	56xx series
NextMove e100	5639 or later

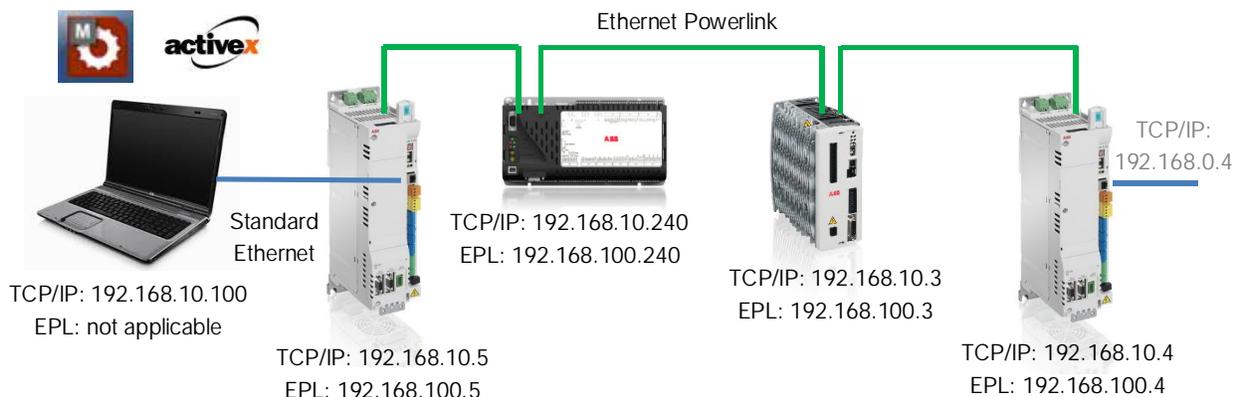
You will need to be running Mint Workbench build 5852 or later to configure a MicroFlex e190
http://www.abbmotion.com/support/SupportMe/productsupport.asp?ID=WB_55

It is assumed that any EPL network has already been configured. For example a NextMove e100 (MN device) has a system configuration file (.dcf) with a list of any e100 and/or e180/e190 EPL drives (or other CN devices) on the network. Refer to application note 'AN00187 - Getting started with e100' for further details on commissioning EPL networks.

As with any EPL network the maximum number of EPL nodes on a chain should not be more than 10.

Configuring as a standard EPL router / switch

Most applications will use this method as it is the easiest to configure and allows a good throughput of data. Operation as an EPL router allows Modbus TCP messages (e.g. from a CP600 series HMI) and ICM frames (e.g. from a PC application using the Mint ActiveX control or Mint Workbench) to be routed through the router directly to the EPL devices. Most applications will find the speed of communications is more than what is necessary for the application. The diagram below shows the example network this application note will use to illustrate the setup / configuration...



In our example network we have a NextMove e100 with 3 drives, a MicroFlex e100 and 2 x MotiFlex e180 (one operating as an EPL router) on an EPL network (one or both of these could equally have been MicroFlex e190 drives, but for this application note we will assume MotiFlex e180 drives have been used throughout). The TCP/IP addresses listed under the devices are the addresses as seen via the EPL router (entered in the NAT table).



The rotary switches on the drive should be set to the required EPL node number. Any unique value from 1 to 239 (01 to EF hex) can be used.

If you have not previously set an IP address for the host/generic Ethernet port on your drive then it will be set to the default value of 192.168.0.1. The PC that you are using to configure this device will therefore need to have a network adaptor with an IP address on the same subnet, i.e. 192.168.0.xxx. Once this is true you can configure the Mint HTTP server to use discovery on the PC's network adaptor and use Mint Workbench to scan for, and connect to, your device.

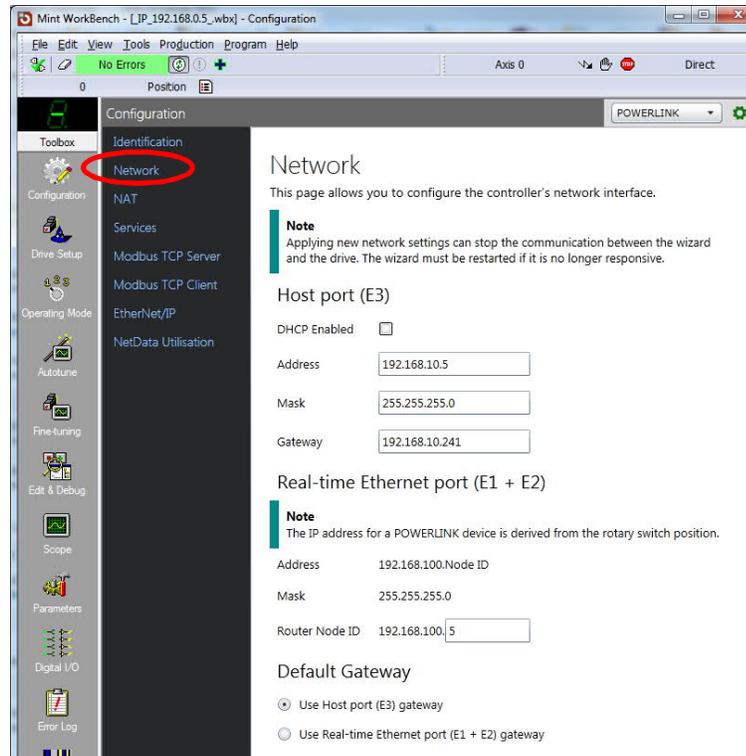
To start the configuration process click the Configuration icon



If you have already done any configuration, such as setting an IP address, then you will have an option to 'Upload configuration from controller', select this. If you have not yet done any configuration at all select 'Start new configuration'.

In these configuration screens you can setup many things. For example, on the first screen 'Identification' you can give the device a name (e.g. "axis5-router").

Click on 'Network' on the left hand side.



← Set the standard Ethernet side IP address of the device. It is recommended **not** to use subnet 192.168.0.x where possible. Further details below...

← Set the gateway to the same subnet as the Ethernet side IP address

← The EPL side IP address depends on the rotary switch positions

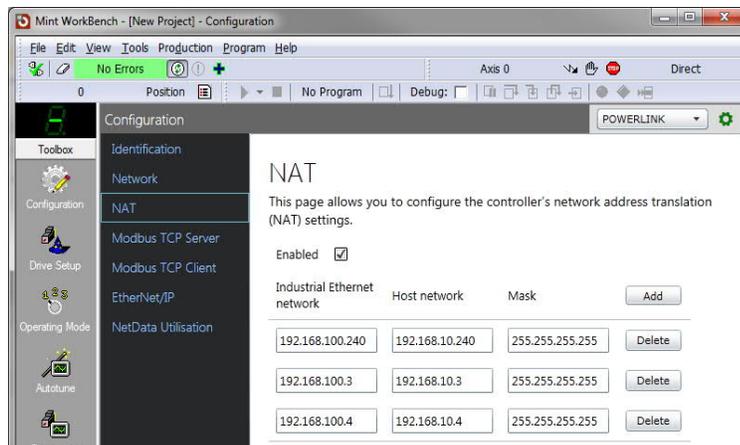
← The MotiFlex e180 EPL router Node ID should be set to the EPL address of the drive, in our case 192.168.100.5

← Set the Default Gateway to 'Use Host port (E3) gateway'

NOTE - As mentioned above, it is recommended that the subnet 192.168.0.x is not used for the standard Ethernet side of the drive-based EPL router. Using this subnet can cause problems with other e180/e190 drives on the EPL network unless every drive on the network has its standard Ethernet side IP address modified to be on a different subnet to that used by the router (a time consuming process). If the subnet of the standard Ethernet side of the drive is the same as the subnet of any of the other drives (by default 192.168.0.x) problems will occur when messages are sent to a drive. The drive will try to respond to the subnet the message came from but will end up sending this message out of its own standard Ethernet port instead of directing the response back to the drive via EPL because the subnets clash. This would result in the device the message came from (e.g. a Modbus/TCP master, Mint Workbench or a Host program) never receiving a response.

By ensuring the standard Ethernet side of the drive-based EPL router is not on the same subnet as the other drives' standard Ethernet port this problem is avoided. In the example above we have used address 192.168.10.5 - changing the subnet so we don't have subnet clashes and the final octet to 5 to match the EPL node ID of the MotiFlex e180 EPL router (this makes it easy to remember).

Next click on 'NAT' on the left hand side.



- ← Click the Add button to add an entry
- ← Our entry for the NextMove e100 on EPL
- ← Our entry for Axis 3 on EPL
- ← Our entry for Axis 4 on EPL

The number of entries here will depend on what devices you need to access from the standard Ethernet side. For example, if you are using a MotiFlex e180 EPL router to allow a CP600 to communicate via Modbus/TCP to a NextMove e100 you would only need an entry for the NextMove e100, the drive entries would be optional.

Once you have added your NAT table entries you can hit the Apply button at the bottom of the screen. Workbench will lose communications with the drive-based EPL router if you have changed the standard Ethernet side IP address from subnet 192.168.0.x to 192.168.10.x (for example) as recommended. You will now need to modify the IP address of your PC's network adaptor so that it is on the same subnet as the EPL router again, 192.168.10.y (for example). Once the PC is on the same subnet Workbench will reconnect.

Once this is done the drive-based EPL Router configuration is complete and we now need to configure the network manager / MN (in our case, a NextMove e100). Use Mint Workbench to connect to the NextMove e100. At this point your EPL router is not yet operational so you will need to make a connection using something other than Ethernet, USB being the simplest method.

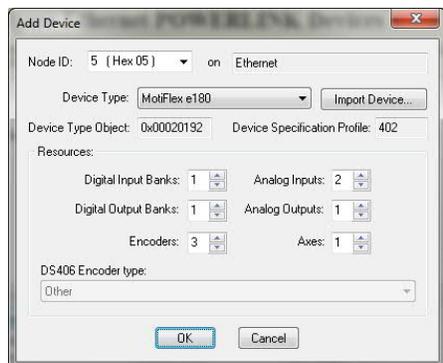
Once connected to the NextMove e100 click on the System Configuration icon



This will start the System Configuration Wizard and you will be prompted to 'Upload configuration from controller', 'Open existing configuration file' or 'Start new configuration'. In most case you will want to 'Start new configuration' but if you can 'Upload configuration from controller' you may want to select this option to modify the existing file. Make an appropriate selection then click the Next button.

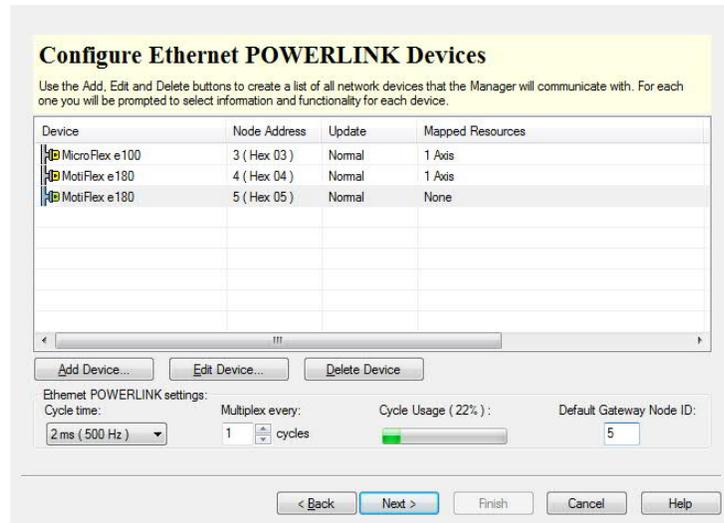
You will now see the Configure Ethernet POWERLINK Devices screen. On this screen you need to add all EPL CN devices connected to the NextMove e100 (the MN device). See application note 'AN00187 - Getting started with e100' for a detailed description on how to set up an EPL network.

Click the Add Device button to add the MotiFlex e180 or MicroFlex e190. Select the appropriate Node ID and Device type for the drive from the drop downs.



← Here we are adding a MotiFlex e180 as Node ID 5 (rotary switches set to 05 hex)

The screenshot below illustrates our setup so far:



- ← MicroFlex e100, node 3
- ← MotiFlex e180, node 4
- ← MotiFlex e180, acting as an EPL Router, node 5

← Default Gateway Node ID set to the node ID of the EPL router

It is important that you set the Default Gateway Node ID correctly or the EPL routing functionality will not work.

The drive-based EPL router is now ready for use in its standard/typical mode of operation – there is no need to read on unless you are sure you require high speed operation and are using a Modbus TCP client for communication or you want to use the drive as a Gateway between Ethernet/IP or PROFINET and EPL.

Configuring as a gateway

NextMove e100 supports Modbus/TCP natively so frames from a Modbus client (e.g. PLC) can be routed via the drive-based EPL router, over the EPL network and directly to the NextMove e100. This may take several EPL cycles to complete each Modbus transaction, but for most applications this is adequate.

If you are using a PC application communicating with the EPL devices via Modbus/TCP with a very high throughput (update rate) requirement, or if you have an Ethernet/IP device (e.g. Allen Bradley PLC) or PROFINET device (e.g. Siemens PLC) that needs to exchange data with a NextMove e100, you may wish to use the drive-based EPL router drive as a gateway.

Benefits of using this method are:

- Faster Modbus responses – The Modbus messages are direct to the router so do not have to be routed through onto the EPL network to the EPL device. Each message will only be slightly quicker (in the order of milliseconds) but when you add up multiple calls during a machine cycle you can save seconds each machine cycle
- Deterministic response times – The Modbus/Netdata registers on the router will be updated according to the PDO mappings in the EPL manager node or MN (e.g. NextMove e100). This means the update rate of the data will be known
- NextMove e100 does not support Ethernet/IP or PROFINET natively so using a gateway is the only way to exchange application data between EPL and non-EPL devices in the system

Complications of using this method are:

- Requirement to set up PDO mappings for Netdata exchange – any data that needs to be read from the router via Modbus / Ethernet IP / PROFINET will need an associated PDO mapping from the EPL MN to the router to update the data. Any data that needs to be written to the EPL devices via Modbus / Ethernet IP/ PROFINET will need an associated PDO mapping from the router to the EPL MN.
These additional PDO mappings increase the EPL network loading and may mean the EPL cycle time needs to be increased.

Using the device in this way still allows the standard EPL router functionality (e.g. NAT table configuration) to operate as described earlier.

The process for setting up a MotiFlex e180 or MicroFlex e190 as a gateway is very similar to the previous EPL router method.

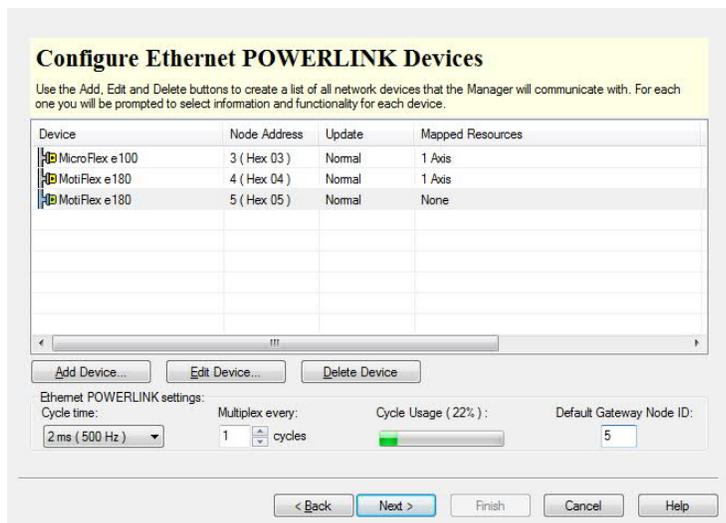
First follow the EPL router setup process described previously in the section 'Configuring as a standard EPL router / switch'. Once this is done the drive-based EPL router configuration is complete and we now need to further configure the network manager / MN (in our case, a NextMove e100). If you are not still connected to the NextMove e100 use Mint Workbench to connect. At this point your EPL router is probably not yet operational so you will need to make a connection using something other than Ethernet, USB being the simplest method.

Once connected to the NextMove e100 click on the System Configuration icon



This will start the System Configuration Wizard and you will be prompted to 'Upload configuration from controller', 'Open existing configuration file' or 'Start new configuration'. In most case you will want to 'Start new configuration' but if you can 'Upload configuration from controller' you may want to select this option to modify the existing file. Make an appropriate selection then click the Next button.

You will now see the Configure Ethernet POWERLINK Devices screen. If you have followed the method to setup an EPL router as described previously then the screenshot below will illustrate our setup so far:



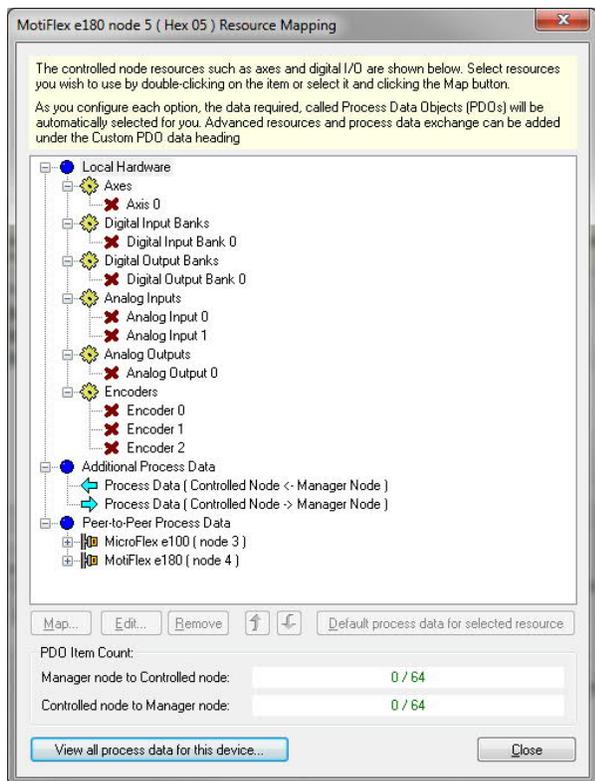
← MicroFlex e100, node 3
 ← MotiFlex e180, node 4
 ← MotiFlex e180, acting as an EPL router and gateway, node 5

← Default Gateway Node ID set to the node ID of the EPL router

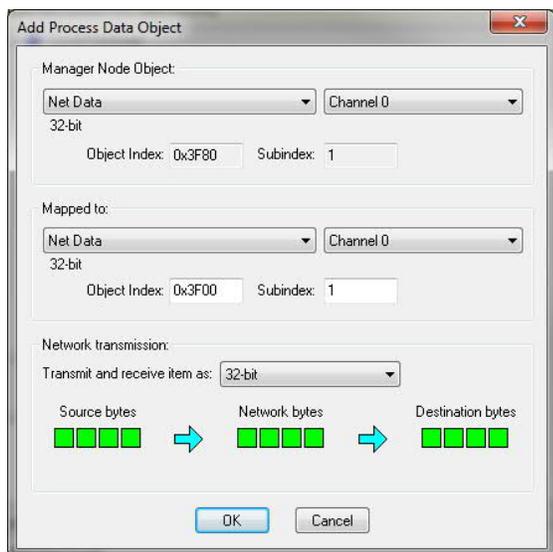
Highlight the drive being used as the Gateway (node 5 in our example) and hit the Edit Device button.

First let's configure some PDO mappings from the NextMove e100 (MN) to the Gateway (CN) – this corresponds to data that the host system (e.g. Modbus TCP client) would want to read from the EPL system.

Double click on Process Data (Controlled Node ← Manager Node).



← The Process Data section will allow you to add PDO mappings between the drive/Gateway (CN) and NextMove e100 (MN). These PDO mappings will be used to pass the data the Gateway receives to Netdata locations on the NextMove e100. It will also pass data from the NextMove e100 into Netdata registers on the Gateway which are internally mapped to Modbus / Ethernet IP / PROFINET registers, ready to be read by the host system on the standard Ethernet port using the relevant protocol.

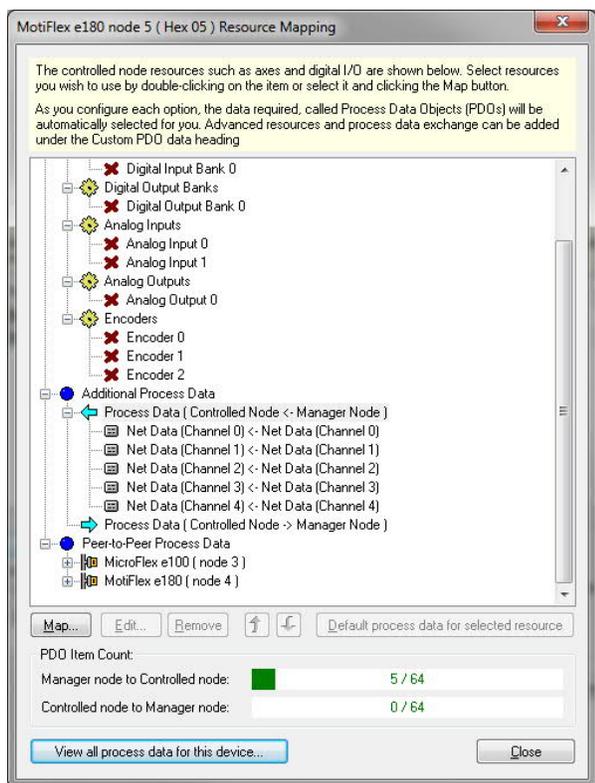


← The MN object to be PDO mapped is selected here. Select Netdata from the dropdown box. The next dropdown box allows the Netdata channel to be selected

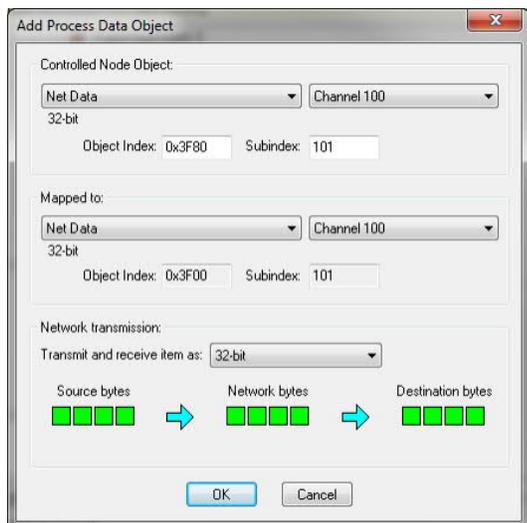
← The object on the CN (i.e. the drive/Gateway) that the above object will be mapped to is set here. Select Netdata from the dropdown box. The next dropdown box allows the Netdata channel to be selected

Clicking OK on this dialog will PDO map the data in Netdata channel 0 on the NextMove e100 to Netdata channel 0 on the drive/Gateway.

Repeating the process of double clicking on Process Data (Controlled Node ← Manager Node) will bring up a new window like the one above but with the sub-indexes both automatically incremented by 1. This allows additional PDO mappings to be done easily. For this example we will map 5 locations, Netdata channels 0-4. The finished result is shown below...



← Next double click on Process Data (Controlled Node → Manager Node).

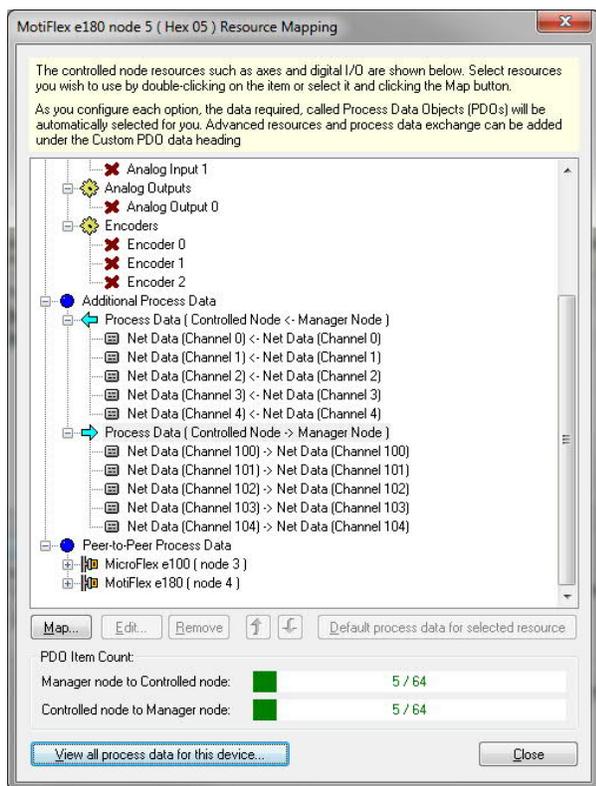


← This time the CN (drive/Gateway) object to be PDO mapped is selected here. Select Netdata from the dropdown box. The next dropdown box allows the Netdata channel to be selected

← The object on the MN that the above object will be mapped to is set here. Select Netdata from the dropdown box if it isn't selected automatically. The next dropdown box allows the Netdata channel to be selected.

Clicking OK on this dialog will PDO map the data in Netdata channel 100 on the drive/Gateway to Netdata channel 100 on the NextMove e100.

Repeating the process of double clicking on Process Data (Controlled Node → Manager Node) will bring up a new window like the one above but with the sub-indexes both automatically incremented by 1. This allows additional PDO mappings to be done easily. For this example we will map 5 locations, Netdata channels 100-104. The finished result for all PDO mappings is shown below...



Click the Close button to finish configuring the resource mappings for this device. Click Next until the Finish button becomes available. Ensure the download and reset tick boxes are checked and then click on Finish.

The mappings are now configured as shown in the table below.

NextMove e100 – EPL Manager node (192.168.100.240 EPL / 192.168.10.240 Ethernet)	Mapping direction	Drive-based EPL router – EPL Controlled node (192.168.100.5 EPL / 192.168.10.5 Ethernet)
Netdata channel 0	→	Netdata channel 0
Netdata channel 1	→	Netdata channel 1
Netdata channel 2	→	Netdata channel 2
Netdata channel 3	→	Netdata channel 3
Netdata channel 4	→	Netdata channel 4
Netdata channel 100	←	Netdata channel 100
Netdata channel 101	←	Netdata channel 101
Netdata channel 102	←	Netdata channel 102
Netdata channel 103	←	Netdata channel 103
Netdata channel 104	←	Netdata channel 104

If the host system (Modbus/TCP client, PROFINET IO client or Ethernet/IP client) wants to write Netdata to the NextMove e100 it would perform either;

- a Modbus 'write holding registers' function call to the Gateway drive (192.168.10.5, Port 502).
- a write to client outputs (i.e. drive inputs) via Ethernet/IP or PROFINET

If the host system (Modbus/TCP client, PROFINET IO client or Ethernet/IP client) wants to read Netdata from the NextMove e100 it would perform either;

- a Modbus 'read holding registers' function call to the Gateway drive (192.168.10.5, Port 502).
- a read of client inputs (i.e. drive outputs) via Ethernet/IP or PROFINET

On the standard Ethernet side the Netdata is automatically internally mapped to either...

- Modbus registers. Modbus register offsets 0 and 1 are mapped to Netdata channel 0, Modbus register offsets 2 and 3 are mapped to Netdata channel 1 etc...

Or

- 32 bit I/O words that the client can access

...depending on which network protocol is used.

For further information on Modbus operation see application note 'AN00198 - Integrated Modbus support'. For further information on Ethernet/IP operation see application note AN00222. For further information about PROFINET operation see application note AN00251.

The MotiFlex e180 or MicroFlex e190 drive is now ready for use as a Gateway. Remember that NAT settings can still be used even in Gateway mode so standard (non-Modbus/TCP) Ethernet frames (e.g. Mint ICM calls via the ActiveX control) will still be routed through to EPL and onto the relevant EPL device.

Contact Us

For more information please contact your local ABB representative or one of the following:

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