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**1-800-iQ-ROBOT****Quick Reference Document**

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**FANUC America Corporation Quick Reference Document**

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# **FANUC America Corporation SYSTEM R-30*i*A and R-30*i*B EtherNet/IP Setup and Operations Manual**

MAROC77EN01101E Rev H

Version 7.70 through 8.30

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SCANNER CONFIGURATION

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## 4.1 OVERVIEW

The robot supports up to 32 scanner connections. Each connection can be configured to exchange I/O with a remote device capable of acting as an adapter on an EtherNet/IP network. The EtherNet/IP Scanner option must be loaded to support this functionality. The EtherNet/IP Scanner option includes the adapter functionality as well. An example of an EtherNet/IP adapter device that the robot would connect to might be an I/O block.

The robot must be configured to initiate EtherNet/IP connections. Up to 32 scanner connections are supported. Perform the following steps to configure the scanner connection on the robot :

- Configure the adapter device if required. Refer to [Section 4.2.2](#) .
- Configure the robot scan list on the teach pendant. Refer to [Section 4.2.3](#) or configure the robot scan list from RSNetWorx for EtherNet/IP (Refer to [Appendix A](#) ).
- Map the physical EtherNet/IP I/O to logical I/O points (digital, group, analog, or UOP) on the robot. Refer to [Section 6.2](#) .

**Note** All scanlist configurations must either be done entirely from the *i*Pendant, or be done entirely from a third-party configuration tool such as RSNetWorx for EtherNet/IP.

## 4.2 SETTING UP YOUR ROBOT

### 4.2.1 Overview

For each connection, the following data must be provided on the robot teach pendant (see documentation for the adapter device being configured for more information) :

- Name/IP address
- Vendor ID
- Device Type
- Product Code
- Input Size (16-bit words or 8-bit bytes)
- Output Size (16-bit words or 8-bit bytes)
- RPI (ms)
- Input assembly instance
- Output assembly instance
- Configuration instance

**Note** The robot currently cannot be configured for devices with a non-zero configuration size from the teach pendant (monochrome or *i* Pendant). Refer to [Appendix A](#) for information on third party configuration tools.

### 4.2.2 Configure the Adapter Device

See the documentation for the adapter device being configured. Configuring the adapter is typically a matter of connecting the device to the network and setting the IP address. The device should successfully respond to a PING request before proceeding. Refer to [Chapter 9 DIAGNOSTICS AND TROUBLESHOOTING](#) for details on using PING.

**Note** The number of scanner connections equals 64 minus the number of adapter connections.

### 4.2.3 Configure the Robot Scan List

Use [Procedure 4-1](#) to configure the robot scan list from the teach pendant.

[Table 4-1](#) describes the items displayed on the EtherNet/IP Status screen. [Table 4-2](#) describes the items displayed on the EtherNet/IP scanner configuration screen. [Table 4-3](#) lists RPI minimum values.

**Table 4-1. EtherNet/IP Status Screen Item Descriptions**

ITEM	DESCRIPTION
<b>Description</b> Default: ConnectionX where X is the slot number of the Adapter.	This item is the description of the adapter or scanner. This can be set as desired to coordinate with your equipment.
<b>TYP</b> Default: ADP	This item indicates whether the connection is configured as an Adapter, or as a Scanner.
<b>Enable</b> Default: TRUE (for Adapter 1, FALSE for Adapters 2-64)	This item indicates whether the adapter or scanner is enabled (TRUE) or disabled (FALSE).
<b>Status</b>	<p>The <b>Status</b> field can have the following values :</p> <ul style="list-style-type: none"> <li>• OFFLINE– the connection is disabled.</li> <li>• ONLINE – the connection is enabled but is not active (for example, waiting for a connection).</li> <li>• RUNNING - the connection is enabled and active (I/O is being exchanged).</li> <li>• &lt;RUNNING&gt; - the connection is enabled and active (I/O is being exchanged), and auto-reconnect is enabled. See <a href="#">Table 4-4</a> for more information on the auto-reconnect setting.</li> <li>• PENDING – changes have taken place in configuration. You must turn off the robot, then turn it on again.</li> </ul>

ITEM	DESCRIPTION
Slot	This item is the value used when mapping EtherNet/IP I/O to digital, group, or UOP I/O signals.

Table 4–2. Scanner Configuration Screen Item Descriptions

ITEM	DESCRIPTION
<b>Description</b>	This item is the comment that shows up on the Status screen.
<b>Name/IP address</b>	This item is the hostname or IP address of the device to which you are connecting. If a hostname is used, it must be in the local host table or available through DNS.
<b>Vendor ID</b>	This item is the vendor ID of the device to which you are connecting. Refer to the adapter (target) device's documentation of EDS files for assigned value. The vendor ID, Device Type, and Product Code can be entered if electronic keying is needed (this information must match the device in order to make a successful connection). If the fields are left at 0 then the keying is ignored.
<b>Device Type</b>	This item is the Device Type of the device to which you are connecting. Refer to the adapter (target) device's documentation or EDS file for assigned value. The vendor ID, Device Type, and Product Code can be entered if electronic keying is needed (this information must match the device in order to make a successful connection). If the fields are left at 0 then the keying is ignored.
<b>Product code</b>	This item is the product code of the device to which you are connecting. Refer to the adapter (target) device's documentation or EDS file for assigned value. The vendor ID, Device Type, and Product Code can be entered if electronic keying is needed (this information must match the device in order to make a successful connection). If the fields are left at 0 then the keying is ignored.
<b>Input size</b> Range: 0 – 252 Default: 0	This item is the number of words or bytes configured for input. The default data type is 16-bit words, but can be configured as 8-bit bytes. To change the data type, modify the I/O Data Type field in the EtherNet/IP Advanced Scanner Configuration Screen (See <a href="#">Table 4–4</a> ). The Input size and Output size need to match the adapter device to which the robot will connect.
<b>Output size</b> Range: 0 – 252 Default: 0	This item is the number of words or bytes configured for output. The default data type is 16-bit words, but can be configured as 8-bit bytes. To change the data type, modify the I/O Data Type field in the EtherNet/IP Advanced Scanner Configuration Screen (See <a href="#">Table 4–4</a> ). The Input size and Output size need to match the adapter device to which the robot will connect.
<b>RPI (ms)</b> Min: 8 ms Max:5000 Default: 32	This item is the requested packet interval. This defines how often I/O updates are done. The minimum value allowed is 8 ms, however this value should be set based on application requirements. Be aware that fast I/O updates cause excessive network traffic. Refer to <a href="#">Table 4–3</a> for a guide to minimum RPI values within the robot. As a rule of thumb, the robot controller can support a maximum of 1500 packets per second (total across both port1 and port2). Both Originator-to-Target and Target-to-Originator packets must be factored into this calculation.

ITEM	DESCRIPTION
<b>Assembly instance (input)</b>	The Input, Output, and Configuration instance values need to be set based on the adapter device to which the robot will connect.
<b>Assembly instance (output)</b>	The Input, Output, and Configuration instance values need to be set based on the adapter device to which the robot will connect.
<b>Configuration instance</b>	The Input, Output, and Configuration instance values need to be set based on the adapter device to which the robot will connect.

### Note

Please note that up to 64 connections can be configured. Maximum 48 connections are supported simultaneously. Below measurements are taken on standard software load with Ethernet/IP option. So if any other network applications are running, RPI may be affected accordingly. I/O sizes were distributed evenly on number of connections given maximum 1024 bytes of IN and 1024 bytes OUT. As noted I/O can't exceed 1024 bytes for each side (IN or OUT) totalling all connections. If more than 16 connections are enabled the arp cache size must be adjusted (\$TCPIPFCFG.\$ARPSIZE). See the *Internet Options Setup and Operations Manual* (MAROUIN9010171E) for more information.

**Table 4–3. Requested Packet Interval (RPI) Minimum Values**

Number of Connections	Minimum RPI for any connection (ms)
1	8
2	8
3	8
4	8
5	8
6	8
7	12
8	12
9	12
10	16
11	16
12	16

Number of Connections	Minimum RPI for any connection (ms)
13	20
14	20
15	20
16	24
17	24
18	24
19	28
20	28
21	28
22	32
23	32
24	32
25	36
26	36
27	36
28	40
29	40
30	40
31	44
32	44
33	44



Number of Connections	Minimum RPI for any connection (ms)
34	48
35	48
36	48
37	52
38	52
39	52
40	56
41	56
42	56
43	60
44	60
45	60
46	64
47	64
48	64

**Procedure 4-1 Configuring the Robot Scan List****Steps**

1. Press MENU.
2. Select I/O.
3. Press F1, [TYPE], and select EtherNet/IP. You will see a screen similar to the following.

```

I/O EtherNet/IP          JOINT  10 %
EtherNet/IP List (Rack 89)      1/64
Description  TYP  Enable  Status  Slot
Connection1  ADP  TRUE    ONLINE  1
Connection2  ADP  FALSE   OFFLINE 2
Connection3  ADP  FALSE   OFFLINE 3
Connection4  SCN  FALSE   OFFLINE 4
Connection5  SCN  FALSE   OFFLINE 5
Connection6  SCN  FALSE   OFFLINE 6
Connection7  SCN  FALSE   OFFLINE 7
Connection8  SCN  FALSE   OFFLINE 8

```

4. Move the cursor to the connection you want to set. If the connection is configured as an adaptor, move the cursor to the TYP column, and press F4. This configures the connection as a scanner.

**Note** If the scanner connection is enabled, the first line of the scanner configuration screen will display “Scanner config (Read-only)” and the items on the screen cannot be modified. To make changes to the read-only scanner configuration screen, you must disable the scanner connection on the EtherNet/IP status screen.

#### 5. To change scanner status:

- a. Move the cursor to highlight the field in the Enable column for the scanner you want to modify.
- b. To disable the scanner and change the status to OFFLINE, press F5, [FALSE].

To enable the scanner and change the status to RUNNING, press F4, [TRUE].

**Note** The status will not change until the connection has been established and I/O is being exchanged.

6. Press F4, CONFIG. You will see a screen similar to the following.

```

I/O EtherNet/IP          JOINT  10 %
Scanner configuration :      1/10
Description :      Connection1
Name/IP address : 192.168.0.12
Vendor Id :      0
Device Type :      0
Product code :      0
Input size (words): 1
Output size (words): 1
RPI (ms) :      32
Assembly instance(input) : 1
Assembly instance(output) : 2
Configuration instance : 4

```

7. Move the cursor to select each item and set the appropriate value.

**Note** If you make changes to I/O size, you must turn off then turn on the controller in order for the changes to take effect. Other changes in the configuration do not require you to turn off then on the controller to take effect.

8. Press the PREV key to return to the EtherNet/IP Status screen. You can enable the connection. If the status is PENDING then you must turn off then turn on the controller in order for the changes to take effect.

**Note** Any enabled scanner connections which are not RUNNING or PENDING will be retried each time the robot is RESET.


**Note** To map EtherNet/IP I/P to digital, group, analog, or UOP I/O, refer to [Section 6.2](#).

#### 4.2.4 Advanced EtherNet/IP Scanner Configuration

An advanced EtherNet/IP configuration screen is provided to allow you to access advanced scanner configuration options. [Table 4-4](#) describes the items displayed on the Advanced Scanner Configuration Screen. The advance screen can be accessed and configured by using [Procedure 4-2](#).

**Table 4-4. EtherNet/IP Advanced Scanner Configuration Screen Item Descriptions**

ITEM	DESCRIPTION
I/O Data Type Default: 16-bit words	This item indicates allows changing the data type to 16-bit words or 8-bit bytes.
Timeout Multiplier Default: DEFAULT	This item indicates allows changing the timeout multiplier. When set to DEFAULT, the controller will intelligently choose an appropriate multiplier based on the RPI value.
Reconnect Default: FALSE	If this item is set to TRUE, the scanner will attempt to re-establish the connection when the connection is enabled and in an OFFLINE state.

ITEM	DESCRIPTION
	<div data-bbox="841 281 927 363">  </div> <p data-bbox="959 281 1049 306"><b>Warning</b></p> <p data-bbox="959 342 1414 722">The reconnect parameter was intended for tool-changing applications, and enabling reconnect can have side effects like all EtherNet/IP alarms relating to connection establishment and connection time-outs for the corresponding connection will not be posted. As a result, the user cannot notice when I/O is not updating correctly, which may cause injury or property damage. Therefore, the user must carry out risk assessments when setting reconnect to TRUE.</p> <p data-bbox="959 758 1414 884">For tool changing applications, the user must use the corresponding MACROS and follow the programming guidelines as described in Appendix B.</p>
Major Revision Default: 0	This item indicates the major revision number of the device being scanned. Is sometimes required by third-party configuration devices.
Minor Revision Default: 0	The minor revision number of the device being scanned. Is sometimes required by third-party configuration devices.
Alarm Severity	This item indicates the severity of alarm that will be posted by the scanner connection. The valid choices are STOP, WARN, and PAUSE.
Quick Connect Default: FALSE	<p data-bbox="824 1272 1406 1398">If this item is set to TRUE, the scanner will attempt to establish the connection in quick connect mode if connection is started using KAREL macro. See Appendix A for details.</p> <p data-bbox="824 1434 1406 1623"><b>Note</b> The quick connect parameter was designed for tool changing applications. Enabling connect using KAREL macro forces scanner to wait for gratuitous ARP from adapter device before initiating the connection. As such, it is recommended that non-tool changing applications do not enable this parameter in a production environment.</p>
Originator To Target RPI(ms) Default: 32	This item indicates the Requested Packet Interval for the scanner to produce at in milliseconds. This field allows for the scanner to have different RPIs for producing and consuming data.

ITEM	DESCRIPTION
Transport Type Default: UNICAST	This item allows the scanner to request that the adapter send data using a point-to-point/unicast connection, or to multicast data. If multicasting is not required, we strongly recommend setting this value to UNICAST. However, a small number of adapter devices only support the MULTICAST setting.
Target To Originator RPI(ms) Default: 32	This item indicates the Requested Packet Interval for the scanner to consume at in milliseconds. This field allows for the scanner to have different RPIs for producing and consuming data.
Connection Type Default: (blank)	This item allows the user to set up a scanner connection of type Exclusive-Owner, Input-Only, or Listen-Only. When a connection type is selected, the O=>T Format and T=>O Format fields will automatically be modified to correspond with the selected Connection Type. This field will be blank after each power-cycle, as this field is only an aid in selecting the proper O=>T and T=>O formats. Exclusive-Owner is the most common connection type.
O=>T Format Default: Run/Idle Header	The format of the producer's data packet. By default this is set to Run/Idle Header, consistent with an Exclusive-Owner Connection Type.
T=>O Format Default: Modeless	The format of the consumer's data packet. By default this is set to Modeless, consistent with an Exclusive-Owner Connection Type.
Configuration String Status Size(bytes)	Some EtherNet/IP adapters accept or require a non-zero length configuration string. This configuration data can only be configured on the robot using a third party configuration tool such as RSNetWorx for EtherNet/IP (Refer to Appendix A in the manual). This status item displays how much configuration data is currently configured for the connection. If no third party configuration tool is used, this item will always be 0.

#### **Procedure 4-2 Configuring Advanced Scanner Options**

1. Press MENU.
2. Select I/O.
3. Press F1, [TYPE], and select EtherNet/IP.
4. Move the cursor to a Scanner connection.
5. Press F4, [CONFIG].
6. Press F2, [ADV]. You will see a screen similar to the following:

```

I/O EtherNet/IP          JOINT 100 %
Advanced configuration :   1/12
General
  I/O Data Type :         16-BIT WORDS
  Timeout Multiplier : 4
  Reconnect :             FALSE
  Major Revision :        0
  Minor Revision :        0
  Alarm Severity :        STOP
  Quick Connect :         FALSE
Originator To Target
  RPI :                   32
Target To Originator
  Transport Type :        UNICAST
  RPI :                   32
Connection Type
  Type :                  Exclusive-Owner
  O=>T Format :            Run/Idle Header
  T=>O Format :            Modeless
Configuration String Status
  Size(bytes) :           0

```

7. Move the cursor to select each item and set the appropriate value.
8. Press the PREV key to return to the EtherNet/IP Scanner configuration screen.
9. Press the PREV key to return to the EtherNet/IP Status screen. You can enable the connection. If the status is PENDING then you must turn off then turn on the controller in order for the changes to take effect.

#### 4.2.4.1 Quick Connect Feature

To make using EtherNet/IP feasible for changes in robot end-of-arm tooling, especially when frequent changes are involved, a methodology for EtherNet/IP “Quick Connect” must be established. This means that the robot scanner should establish an EtherNet/IP implicit connection and begin exchanging I/O with a new end-of-arm adapter device “within 150 ms after receiving gratuitous ARP from the adapter device”. As per spec EIP Vol 2 V1.11 adapter device shall power-up within 300 ms. Altogether power-up and first IO data exchange shall not exceed 500ms.

**Note** Please note that Quick Connect feature is disabled by factory default setting.

##### Enable Quick Connect Feature in FANUC's Scanner

Quick Connect feature can be turned on by setting 'Quick Connect' parameter to TRUE. Quick Connect feature is only effective when it is started using KAREL macros. See [Appendix B](#) for more details.

**Note** Please note that FANUC's adapter does not support quick connect feature.

**Enable Quick Connect Feature in Adapter (not FANUC's)**

Follow : Menu >> I/O >> EthernetI/P >> NEXT >>F2 (EXP\_MSG) >> Input Mode >> F4 (Q-Conn). You will see a screen similar to [Figure 4-1](#) .

**Figure 4-1. Enabling Quick Connect using Explicit Messaging**

I/O EtherNet/IP			
2/3			
Explicit Message Query			
Input Mode:	Q-Conn		
IP Addr:			
Class:	245		
Instance:	1		
Attribute:	12		
Service:	Get Att		
Value Size:	Byte(1)		
Value:	0		
[ TYPE ]	EXEC	?	HELP

Fill-in IP address of target device and cursor down to Service. You will see a screen similar to [Figure 4-2](#) . Now you can choose the service you want to perform. To check current status of quick connect feature on target device leave default i.e. 'Get Att' or press F2 to select. Now cursor up or down to see 'EXEC' on F3 and press F3 to execute selected service.

Figure 4-2. Fill-in IP Address and Select Service

I/O EtherNet/IP

3/3

Explicit Message Query

Input Mode:

Q-Conn

IP Addr:

172.22.200.167

Class:

245

Instance:

1

Attribute:

12

Service:

Get Att

Value Size:

Byte(1)

Value:

0

[ TYPE ]

Get Att

QC\_ON

QC\_OFF


 HELP



Figure 4–3. Select Quick Connect Service

I/O EtherNet/IP	
2/3	
Explicit Message Query	
Input Mode:	Q-Conn
IP Addr:	172.22.200.167
Class:	245
Instance:	1
Attribute:	12
Service:	QC_ON
Value Size:	Byte(1)
Value:	1
[ TYPE ]	EXEC ? HELP

To turn on quick connect feature press F3 (QC\_ON) or press F4 (QC\_OFF) to turn off quick connect feature on target device. Now cursor up or down (Figure 4–3 ) to see 'EXEC' on F3 and press F3 to execute selected service.

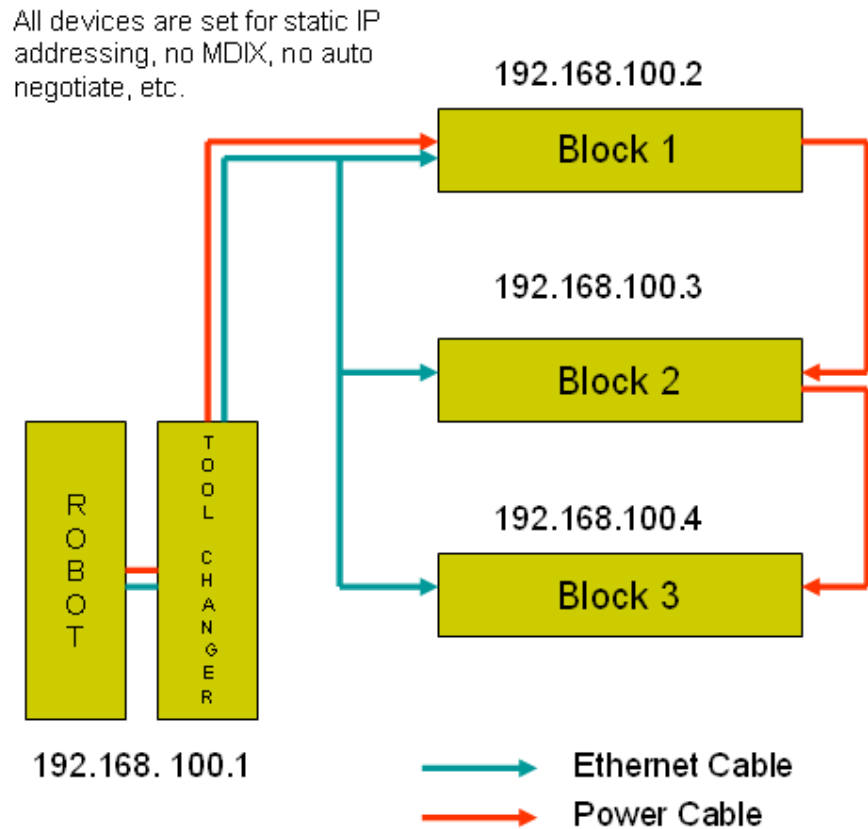
### Quick Connection Time

The scanner connection is estimated as follows after device powers up and sends gratuitous ARP indicating that it is ready to communicate. This time may vary due to network load along with switch and adapter device behavior. Figure 4–4 shows general quick connect setup.

Connection Time =  $60 + 10 \times (\text{no of devices} - 3)$  milliseconds

Table 4–5. Connection Time

No of Devices	Connection Time
3	$60 + 10 \times (3-3) = 60$ ms
7	$60 + 10 \times (7-3) = 100$ ms

**Figure 4–4. Quick Connection Setup**

## 4.2.5 Analog I/O

### 4.2.5.1 Overview

I/O for EtherNet/IP Scanner connections can be mapped to analog. Analog and digital I/O can be intermixed—for example a device may produce sixteen points of Digital Inputs and two words of Analog Inputs on the same connection to the robot controller.

[Table 4–6](#) describes the items displayed on the Scanner Analog Configuration Screen. The analog screen can be accessed and configured by using [Procedure 4-3](#).

Table 4–6. Scanner Analog Configuration Screen Setup Items

ITEM	DESCRIPTION
RANGE Default: 1 – maximum allocated I/O	The Range of I/O points to be mapped to an analog channel, or a digital start point.
TYPE Default: Digital	The type of I/O being mapped: Analog or Digital.
START PT/CHNL Default: 1	The analog channel or the digital start point.

**Procedure 4-3 Configuring Scanner Analog I/O**

1. Press MENU.
2. Select I/O.
3. Press F1, [TYPE], and select EtherNet/IP.
4. Move the cursor to a Scanner connection.
5. Press F4, [CONFIG].
6. Type the correct input and output sizes.
7. Press F4, [ANALOG]. You will see a screen similar to the following.

```

I/O EtherNet/IP                JOINT 100 %
Map Inputs:                    1/1
#      RANGE      TYPE      START PT/CHNL
1 [    1- 128]    Digital      1

```

8. Move the cursor to the RANGE column and select the range of the first collection of Inputs. If you do not want to intermix Analog and Digital Inputs, do not modify this column.
9. Select the type of Inputs, Analog or Digital, in the TYPE column.
10. Select the channel for Analog Input, or the point for Digital Input in the START PT/CHNL column.
11. Repeat as necessary as additional rows are automatically created.
12. Press F2 [IN/OUT]. You will see a screen similar to the following.

```

I/O EtherNet/IP                JOINT 100 %
Map Outputs:                   1/1
#      RANGE      TYPE      START PT/CHNL
1 [    1- 128]    Digital      1

```

13. Repeat [Step 8](#) through [Step 11](#) as necessary for Outputs.
14. Press the PREV key to return to the EtherNet/IP Scanner configuration screen.

15. Press the PREV key to return to the EtherNet/IP Status screen. You can enable the connection. If the status is PENDING then you must turn off then turn on the controller in order for the changes to take effect.

**Note** The 16-bits of each analog I/O channel can be byte-swapped (toggled from big-endian to little-endian) on a per connection basis by toggling the system variable \$EIP\_SC[].\$ANALOGFMT. When the system variable is set to 0, the data will be produced and consumed in big-endian format. When set to 1, little-endian format will be used.

#### 4.2.5.2 Examples

Suppose a device produces sixteen consecutive points of digital input followed by two words of analog input. A properly configured EtherNet/IP Analog In screen would look like the following:

I/O EtherNet/IP		JOINT 100 %	
Map Inputs:		1/2	
#	RANGE	TYPE	START PT/CHNL
1	[ 1- 16]	Digital	1
2	[ 17- 48]	Analog	1

Suppose a device produces sixteen consecutive points of digital input followed by two words of analog input followed by eight more consecutive points of digital input. A properly configured EtherNet/IP Analog In screen would look like the following. Note that the 49th connection input point will be mapped as the 17th digital input point.

I/O EtherNet/IP		JOINT 100 %	
Map Inputs:		1/3	
#	RANGE	TYPE	START PT/CHNL
1	[ 1- 16]	Digital	1
2	[ 17- 48]	Analog	1
3	[ 49- 56]	Digital	17