Weidmüller

Application Note: WI-GTWY-9-ET1 Modbus TCP & OPC Server

App Note WI-GTWY-9-ET1 v1.2

PURPOSE

The purpose of this document is to provide the reader with an application note for setting up an OPCServer, (KEPServer Enterprise) communicating Modbus TCP with an Weidmuller WI-GTWY-9-ET1 gateway.

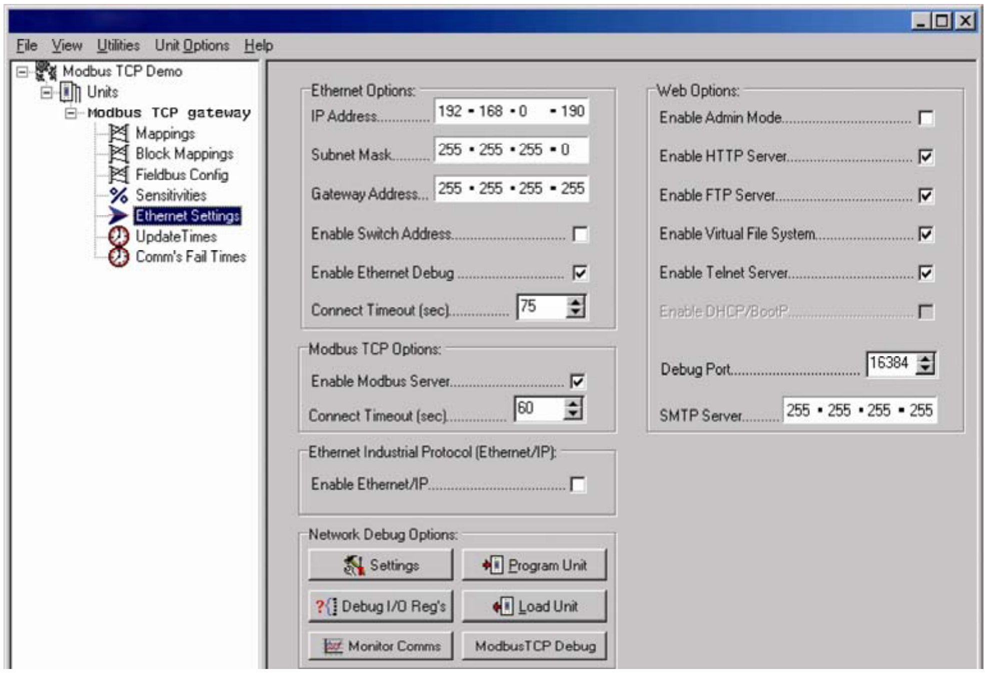
This application should be read in conjunction with user manuals for details on powering and programming WI-GTWY-9-xxx. The reader would also have a firm understanding of the Modbus TCP protocol and programming the KEPWares KEPServer OPC Server.

MATERIALS

Kepware KEPServer OPC Server Software,
WI-GTWY-9-ET1 gateway,
W-Series Configuration utility,
RS232 DB9 serial cable,
RJ45 Ethernet cables and Network Hub (depending on connection crossover cables may be needed)

WI-GTWY-9-ET1 CONFIGURATION

Under Ethernet Settings the modules IP address needs to be set. If going through a network then this address will need to be entered also under Gateway address. Ensure the Enable Ethernet/IP checkbox has been Disabled and Enable Modbus Server has been enabled.



Ethernet Options:
IP Address............ 192 • 168 • 0 • 190
Subnet Mask.......... 255 • 255 • 255 • 0
Gateway Address... 255 • 255 • 255 • 255
Enable Switch Address............................ ☐
Enable Ethernet Debug .... ☑
Connect Timeout (sec)............... 75

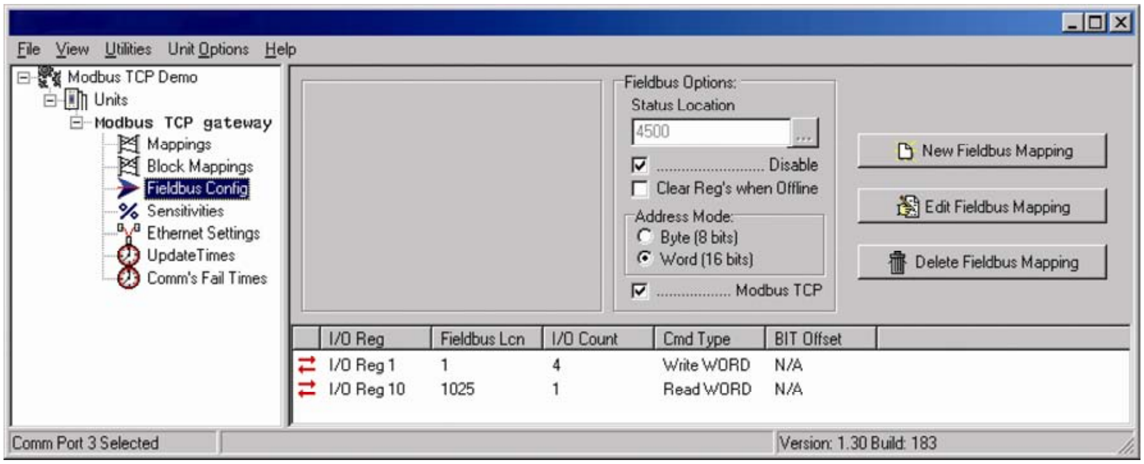
Modbus TCP Options:
Enable Modbus Server............................ ☑
Connect Timeout (sec)............... 60

Ethernet Industrial Protocol (Ethernet/IP):
Enable Ethernet/IP.................................. ☐

Network Debug Options:

Web Options:
Enable Admin Mode................................ ☐
Enable HTTP Server................................ ☑
Enable FTP Server.................................. ☑
Enable Virtual File System......................... ☑
Enable Telnet Server................................ ☑
Enable DHCP/BootP................................ ☐
Debug Port................................ 16384
SMTP Server.......... 255 • 255 • 255 • 255

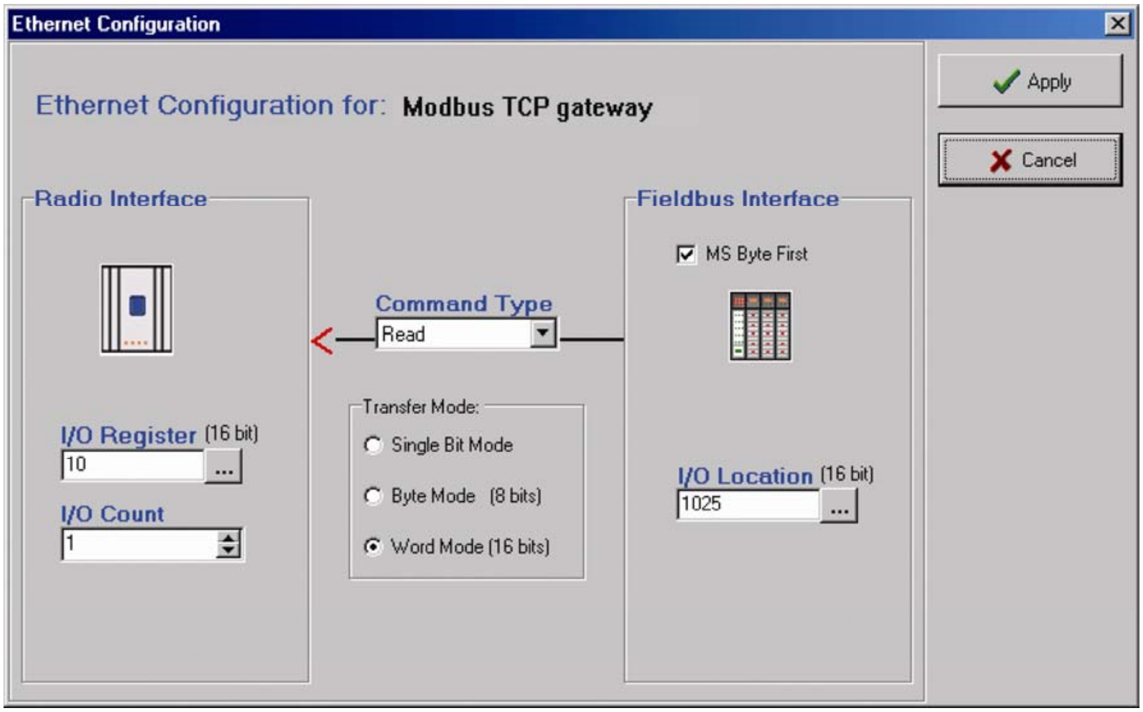
To exchange data between the WI-GTWY-9-ET1 and an OPC Server a series of Fieldbus Configurations that link the I/O registers of the Gateway to the Fieldbus need to be made. In the example below Regs 1,2,3,4 are being written across to Fieldbus location 1,2,3,4. Also Fieldbus location 1025 is being read into Reg 10.



Fieldbus Options:
Status Location 4500
☑ .... Disable
☐ Clear Reg's when Offline
Address Mode:
○ Byte (8 bits)
● Word (16 bits)
☑ .... Modbus TCP

I/O Reg	Fieldbus Lcn	I/O Count	Cmd Type	BIT Offset
I/O Reg 1	1	4	Write WORD	N/A
I/O Reg 10	1025	1	Read WORD	N/A

Comm Port 3 Selected
Version: 1.30 Build: 183



Ethernet Configuration for: Modbus TCP gateway

Radio Interface
I/O Register (16 bit) 10
I/O Count 1

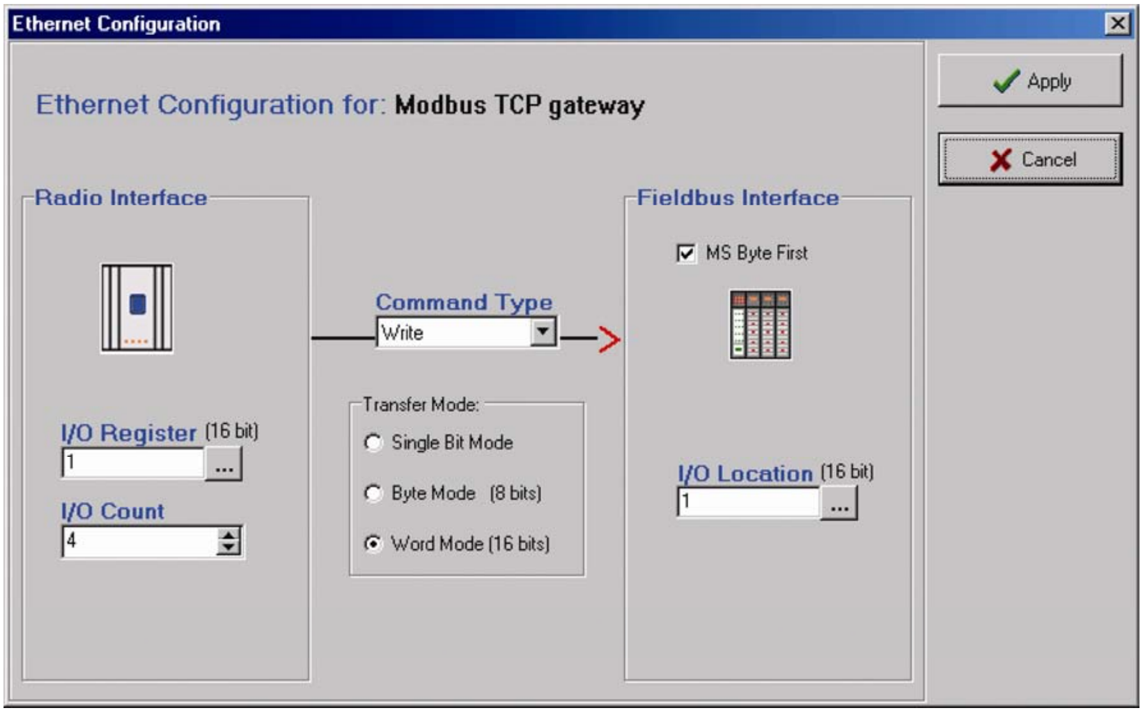
Command Type Read

Transfer Mode:
○ Single Bit Mode
○ Byte Mode (8 bits)
● Word Mode (16 bits)

Fieldbus Interface
☑ MS Byte First
I/O Location (16 bit) 1025

The above example shows a Command Type Read from the Fieldbus Interface to the Gateway. This will come from the OPC Server’s output tags.

The next Command Type Write mapping below is to the Fieldbus Interface in which the OPC Server will read this value and store in its Input tags.


Ethernet Configuration

Ethernet Configuration for: **Modbus TCP gateway**

Radio Interface

I/O Register (16 bit): 1

I/O Count: 4

Command Type: Write

Transfer Mode:
○ Single Bit Mode
○ Byte Mode (8 bits)
● Word Mode (16 bits)

Fieldbus Interface

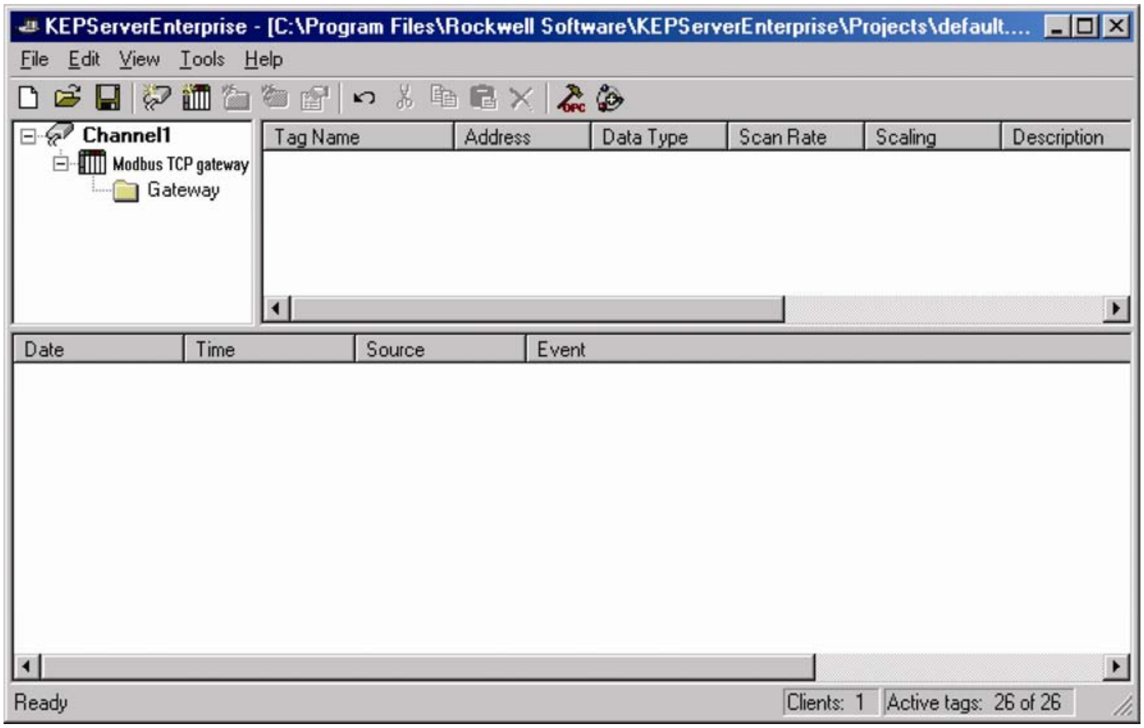
☑ MS Byte First

I/O Location (16 bit): 1

Once mappings are complete configuration will need to be downloaded to module via RS232 cable as per manual.

OPC SERVER CONFIGURATION

The OPC Server software now needs to be setup.


KEPServerEnterprise - [C:\Program Files\Rockwell Software\KEPServerEnterprise\Projects\default....

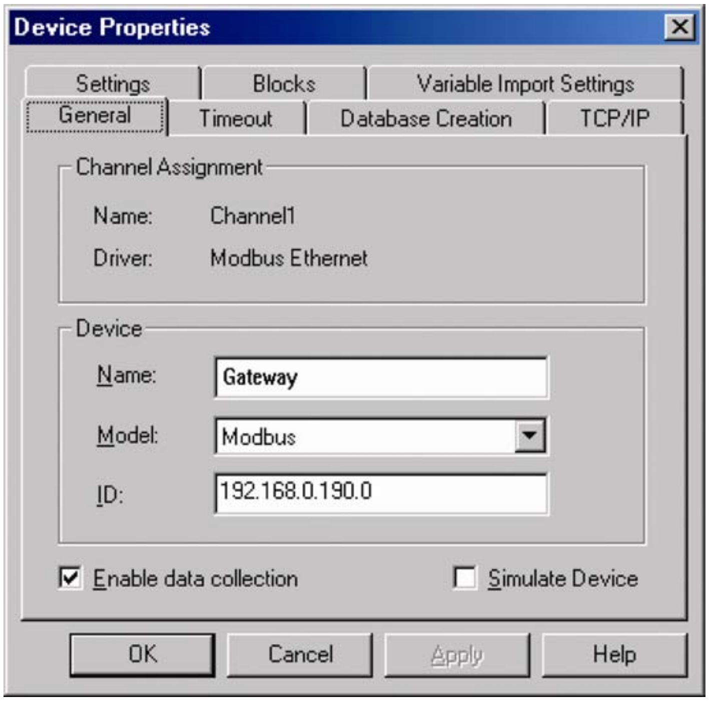
Channel1
Modbus TCP gateway
Gateway

Tag Name	Address	Data Type	Scan Rate	Scaling	Description

Date	Time	Source	Event

Ready | Clients: 1 | Active tags: 26 of 26

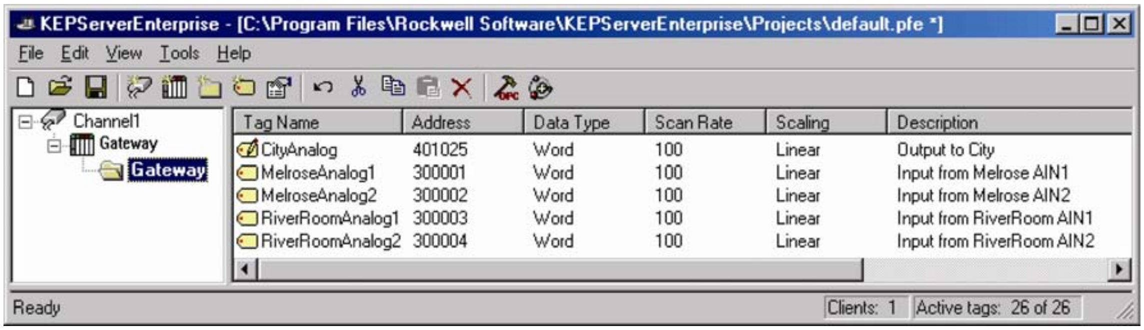
Create a new Channel and add the following
Name – Any name you want
Model – Select Modbus
IP address – Must be the same as the one configured in the WI-GTWY-9-ET1
Timeout times -Default. Connect timeout = 3, Request Timeout = 1000, Fail after = 3.
TCP/IP port - 502.



Channel Assignment
Name: Channel1
Driver: Modbus Ethernet

Device
Name: Gateway
Model: Modbus
ID: 192.168.0.190.0

☑ Enable data collection ☐ Simulate Device


KEPServerEnterprise - [C:\Program Files\Rockwell Software\KEPServerEnterprise\Projects\default.pfe *]
File
Edit
View
Tools
Help
Channel1
Gateway
Gateway

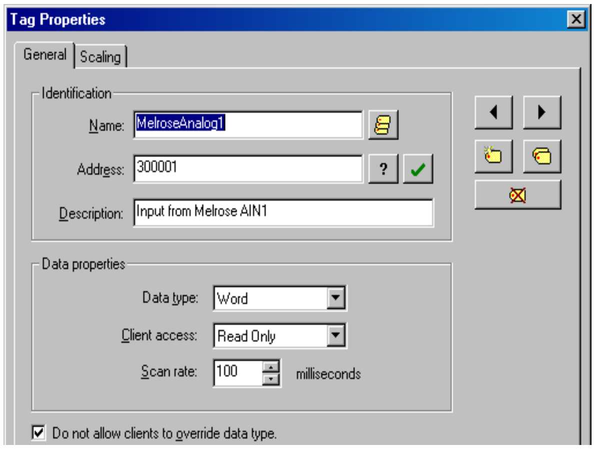
Tag Name	Address	Data Type	Scan Rate	Scaling	Description
CityAnalog	401025	Word	100	Linear	Output to City
MelroseAnalog1	300001	Word	100	Linear	Input from Melrose AIN1
MelroseAnalog2	300002	Word	100	Linear	Input from Melrose AIN2
RiverRoomAnalog1	300003	Word	100	Linear	Input from RiverRoom AIN1
RiverRoomAnalog2	300004	Word	100	Linear	Input from RiverRoom AIN2

Ready Clients: 1 Active tags: 26 of 26

When this is done you can setup appropriate tags for the I/O.
In this example I have setup 4 Modbus Read Word Tags starting at Modbus address 30001 tags and 1 Modbus Write word Tag at address 41025.
The Modbus Command is made up of a Command and a Modbus Address.
Modbus commands are 0X = Write Bit, 1X = Read Bit, 3X = Read Word, 4X = Write Word
So 30001 will Read Word at Modbus location 1 or 41025 will Write Word to Modbus Location 1025.

For Further Information on addressing refer to Weidmuller WI-GTWY-9-xxx Manual for Modbus TCP Addressing Ranges

Each Tag needs to have
Name – Tag name
Modbus address – Standard Modbus command & address i.e 1X, 3X, 4X or 0X
Description - Description of what the I/O is.
Data type – Select Word as all Gateway registers are 16 bit
Client Access – Read only for inputs or Read/Write for Outputs.
Scan Rate – Default 100 mSec.

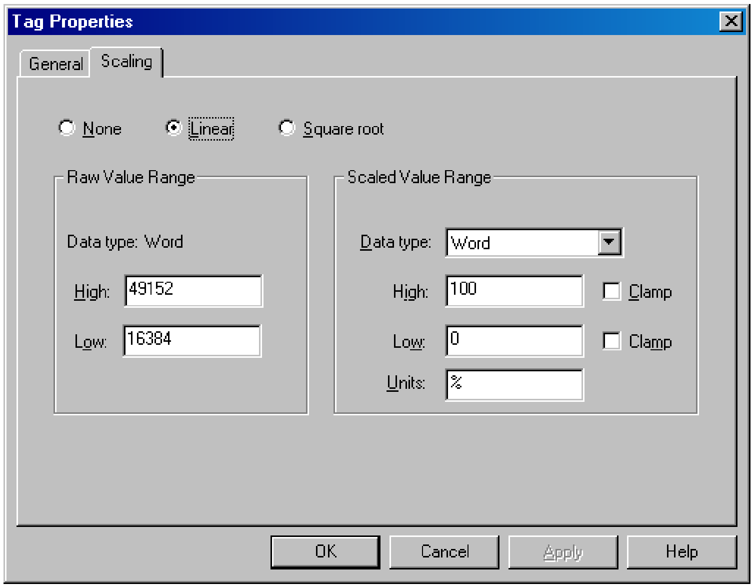

Tag Properties

Identification
Name: MelroseAnalog1
Address: 300001
Description: Input from Melrose AIN1

Data properties
Data type: Word
Client access: Read Only
Scan rate: 100 milliseconds

☑ Do not allow clients to override data type.

You can also setup Scaling on each of the Tags if you wish. WI-GTWY-9-ET1 I/O registers are 16 bit (0 – 65535) and a typical range for an analog value from a field station is
4mA = 16384 decimal
20mA = 49152 decimal
This is shown here as being a linear scale of 0 to 100 % is equal to decimal value 16384 to 49152


Tag Properties

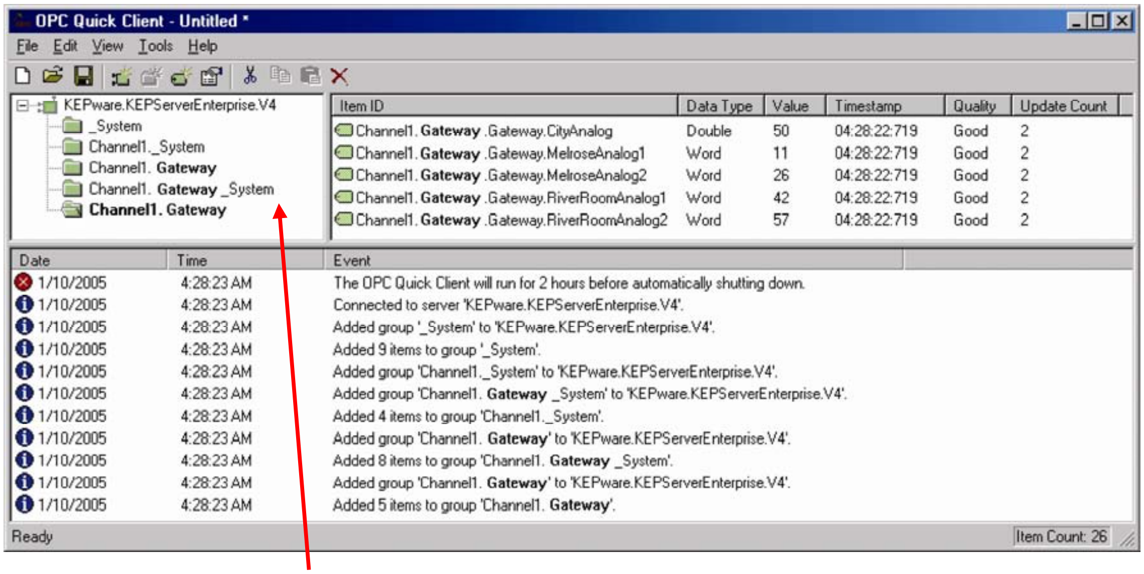
○ None ● Linear ○ Square root

Raw Value Range
Data type: Word
High: 49152
Low: 16384

Scaled Value Range
Data type: Word
High: 100 □ Clamp
Low: 0 □ Clamp
Units: %

For Firmware versions 1.76 and above Scaling of the I/O registers can be applied in the W-series configuration software for all read and write commands.

When all tags have been setup select “Launch OPC Quick Client” from the Tools drop down Menu and this will launch the OPC Client. See below.

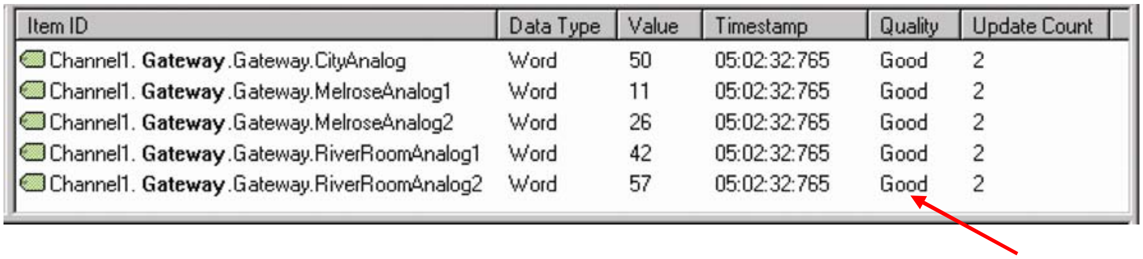


KEPware.KEPServerEnterprise.V4
- _System
- Channel1._System
- Channel1. **Gateway**
- Channel1. **Gateway** _System
- **Channel1. Gateway**

Item ID	Data Type	Value	Timestamp	Quality	Update Count
Channel1. **Gateway** .Gateway.CityAnalog	Double	50	04:28:22:719	Good	2
Channel1. **Gateway** .Gateway.MelroseAnalog1	Word	11	04:28:22:719	Good	2
Channel1. **Gateway** .Gateway.MelroseAnalog2	Word	26	04:28:22:719	Good	2
Channel1. **Gateway** .Gateway.RiverRoomAnalog1	Word	42	04:28:22:719	Good	2
Channel1. **Gateway** .Gateway.RiverRoomAnalog2	Word	57	04:28:22:719	Good	2

Date	Time	Event
1/10/2005	4:28:23 AM	The OPC Quick Client will run for 2 hours before automatically shutting down.
1/10/2005	4:28:23 AM	Connected to server 'KEPware.KEPServerEnterprise.V4'.
1/10/2005	4:28:23 AM	Added group '_System' to 'KEPware.KEPServerEnterprise.V4'.
1/10/2005	4:28:23 AM	Added 9 items to group '_System'.
1/10/2005	4:28:23 AM	Added group 'Channel1._System' to 'KEPware.KEPServerEnterprise.V4'.
1/10/2005	4:28:23 AM	Added group 'Channel1. **Gateway** _System' to 'KEPware.KEPServerEnterprise.V4'.
1/10/2005	4:28:23 AM	Added 4 items to group 'Channel1._System'.
1/10/2005	4:28:23 AM	Added group 'Channel1. **Gateway**' to 'KEPware.KEPServerEnterprise.V4'.
1/10/2005	4:28:23 AM	Added 8 items to group 'Channel1. **Gateway** _System'.
1/10/2005	4:28:23 AM	Added group 'Channel1. **Gateway**' to 'KEPware.KEPServerEnterprise.V4'.
1/10/2005	4:28:23 AM	Added 5 items to group 'Channel1. **Gateway**'.

We can see it generate a number of default groups showing system status etc but the main one we are interested in is the **Channel1.WI-GTWY-9-ET1.Gateway** group which shows all of the Tags we configured in the previous step.

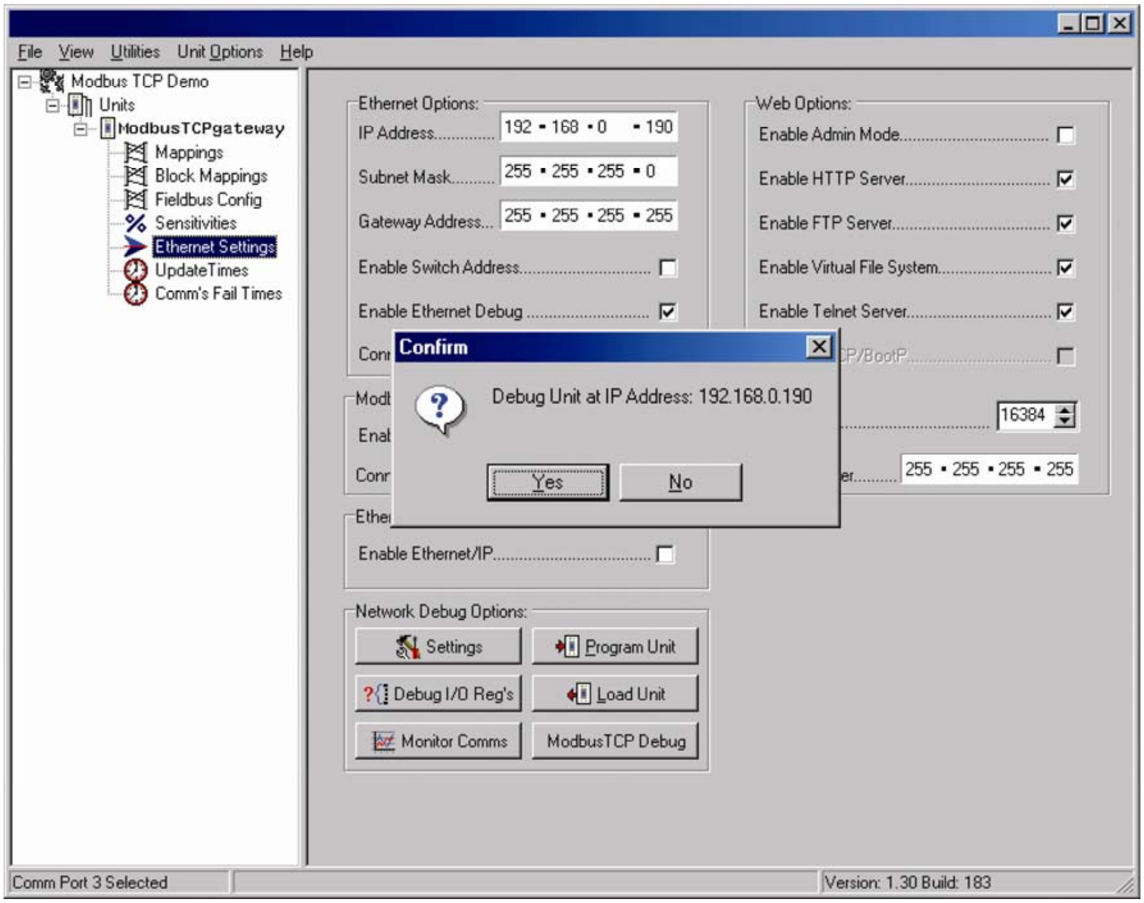


Item ID	Data Type	Value	Timestamp	Quality	Update Count
Channel1. **Gateway** .Gateway.CityAnalog	Word	50	05:02:32:765	Good	2
Channel1. **Gateway** .Gateway.MelroseAnalog1	Word	11	05:02:32:765	Good	2
Channel1. **Gateway** .Gateway.MelroseAnalog2	Word	26	05:02:32:765	Good	2
Channel1. **Gateway** .Gateway.RiverRoomAnalog1	Word	42	05:02:32:765	Good	2
Channel1. **Gateway** .Gateway.RiverRoomAnalog2	Word	57	05:02:32:765	Good	2

If the OPC Server is reading values from the Gateway you will see under “Quality” – Good. It will show “Bad” if there is a communications problem.
Also you will have a value which is the scaled value from the Gateway registers.

You can view the current values in the registers by using online diagnostics over an Ethernet Connection to tags show the correct values or debug any problems

Select Ethernet Settings in Configuration Program, Select Debug I/O Regs and confirm that you want to debug the I/O registers at IP address.



Ethernet Options:
IP Address............ 192 • 168 • 0 • 190
Subnet Mask.......... 255 • 255 • 255 • 0
Gateway Address... 255 • 255 • 255 • 255
Enable Switch Address............................ ☐
Enable Ethernet Debug .... ☑
Conr

Modl
Enal
Conr

Ether
Enable Ethernet/IP.................................. ☐

Web Options:
Enable Admin Mode................................ ☐
Enable HTTP Server............................... ☑
Enable FTP Server.................................. ☑
Enable Virtual File System........................ ☑
Enable Telnet Server............................... ☑
P/BootP.............................. ☐
.... 16384
er.......... 255 • 255 • 255 • 255

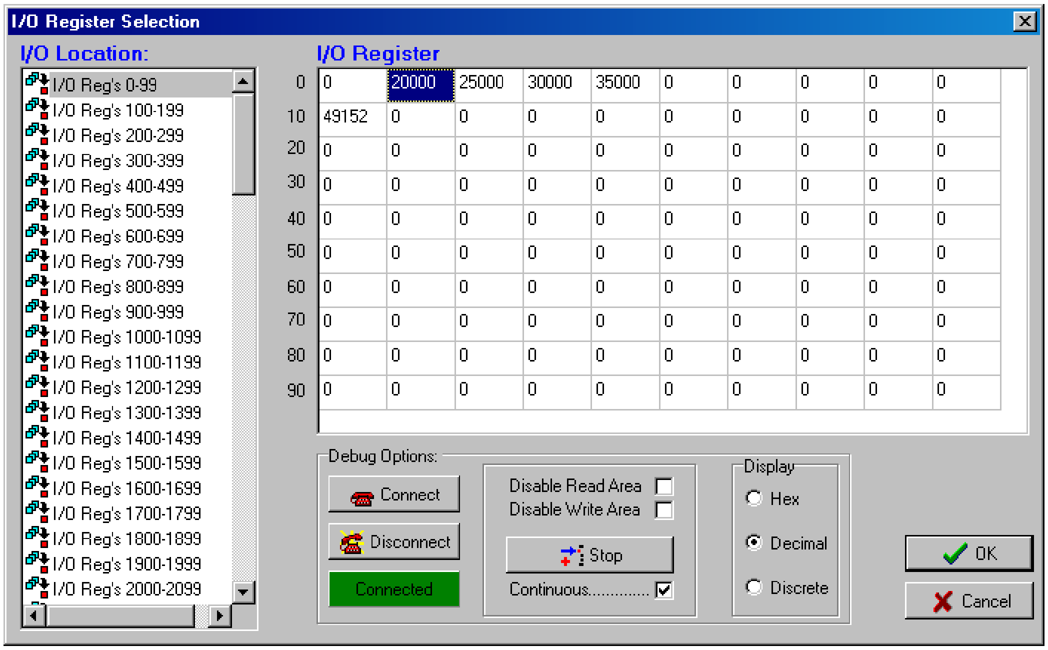
Confirm

Debug Unit at IP Address: 192.168.0.190

Comm Port 3 Selected

Version: 1.30 Build: 183

Press “Connect” button and you should get a Green Connected indication. Then tick “Continuous and press “Read” button.
The W-series configuration will now be continuously scanning the I/O Database in the WI-GTWY-9-ET1.



I/O Register Selection

I/O Location:

- I/O Reg's 0-99
- I/O Reg's 100-199
- I/O Reg's 200-299
- I/O Reg's 300-399
- I/O Reg's 400-499
- I/O Reg's 500-599
- I/O Reg's 600-699
- I/O Reg's 700-799
- I/O Reg's 800-899
- I/O Reg's 900-999
- I/O Reg's 1000-1099
- I/O Reg's 1100-1199
- I/O Reg's 1200-1299
- I/O Reg's 1300-1399
- I/O Reg's 1400-1499
- I/O Reg's 1500-1599
- I/O Reg's 1600-1699
- I/O Reg's 1700-1799
- I/O Reg's 1800-1899
- I/O Reg's 1900-1999
- I/O Reg's 2000-2099

I/O Register

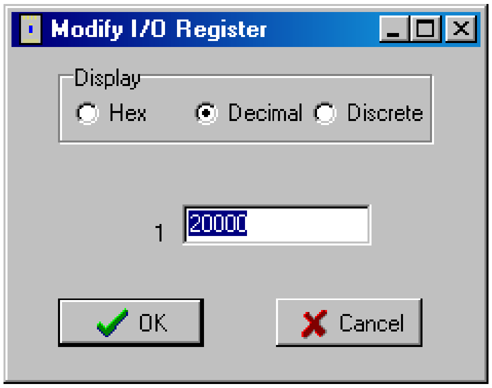
0	0	20000	25000	30000	35000	0	0	0	0	0
10	49152	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0
80	0	0	0	0	0	0	0	0	0	0
90	0	0	0	0	0	0	0	0	0	0

Debug Options:
Connect
Disconnect
Connected
Disable Read Area □
Disable Write Area □
Stop
Continuous.............. ☑

Display
○ Hex
● Decimal
○ Discrete

OK
Cancel

Back in the WI-GTWY-9-ET1Configuration section we configured Registers 1,2,3,4 to be written across to the Fieldbus location 1,2,3,4 (Modbus Tag Commands 30001,30002, 30003, 30004) and also Fieldbus location 1025 (Modbus Tag Command 41025) is being read into Reg 10.
We can edit the registers in the I/O Register Selection Window by double clicking on the register which will open a modufy box like this



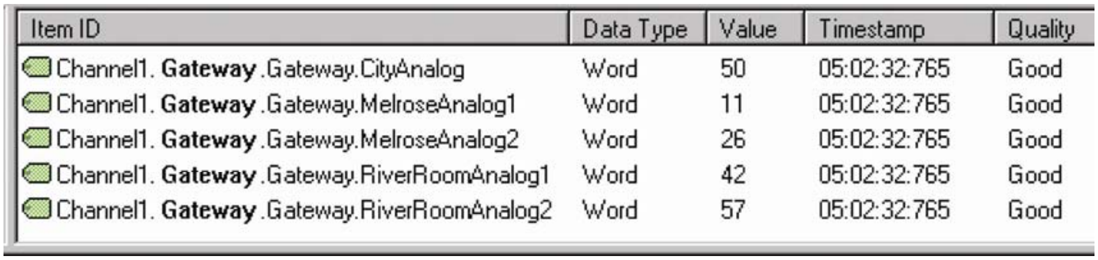
Modify I/O Register

Display
○ Hex ● Decimal ○ Discrete

1 20000

OK
Cancel

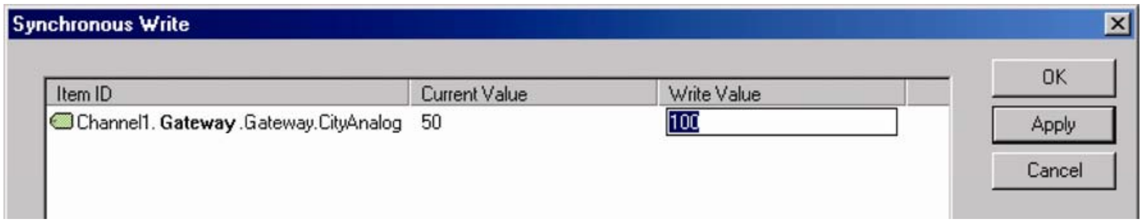
From here we can enter a value into the register in the available formats i.e Hex, Decimal or Discrete. Then press “OK” and you should notice the Tag Value change on the OPC Server screen



Item ID	Data Type	Value	Timestamp	Quality
Channel1. **Gateway** .Gateway.CityAnalog	Word	50	05:02:32:765	Good
Channel1. **Gateway** .Gateway.MelroseAnalog1	Word	11	05:02:32:765	Good
Channel1. **Gateway** .Gateway.MelroseAnalog2	Word	26	05:02:32:765	Good
Channel1. **Gateway** .Gateway.RiverRoomAnalog1	Word	42	05:02:32:765	Good
Channel1. **Gateway** .Gateway.RiverRoomAnalog2	Word	57	05:02:32:765	Good

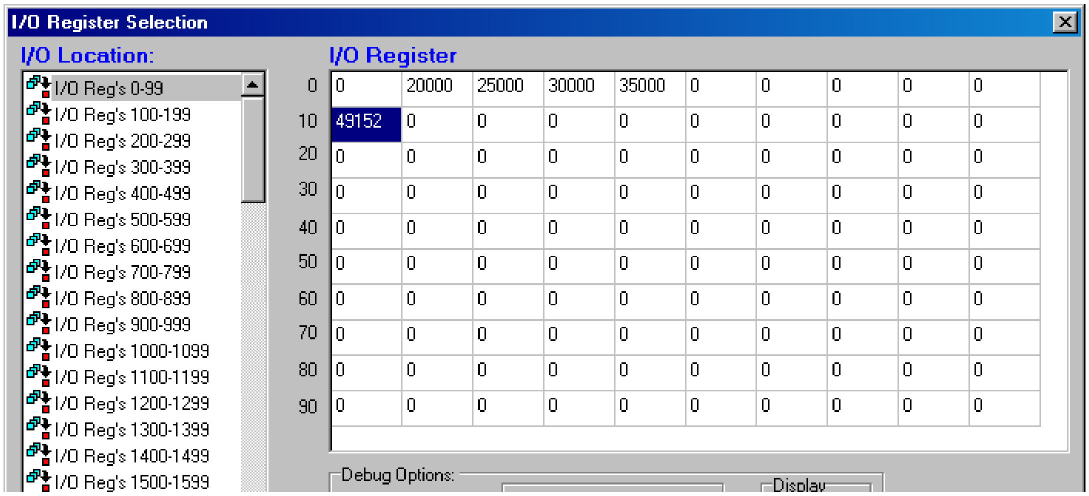
You will see each of the Tags in the OPC Server Corresponds to the values entered into the Debug I/O screen
Melrose Analog 1 has a scaled value of 11 for 20000
Melrose Analog 2 has a scaled value of 26 for 25000
River Room Analog 1 has a scaled value of 42 for 30000
River Room Analog 2 has a scaled value of 57 for 35000.

We can now check that we can write a value into the OPC Server and read a value in the Debug I/O reg screen.
Right click the Output Tag in this case it is Channel1.WI-GTWY-9-ET1.Gatway.CityAnalog and enter a scaled value you wish to change.



Item ID	Current Value	Write Value
Channel1. **Gateway** .Gateway.CityAnalog	50	100

You should now be able to go back to the Debug I/O register screen and see that the register has changed. In this case the scaled value was set for 100 % which would change the register value to 49152 (20mA)



I/O Reg's 0-99
I/O Reg's 100-199
I/O Reg's 200-299
I/O Reg's 300-399
I/O Reg's 400-499
I/O Reg's 500-599
I/O Reg's 600-699
I/O Reg's 700-799
I/O Reg's 800-899
I/O Reg's 900-999
I/O Reg's 1000-1099
I/O Reg's 1100-1199
I/O Reg's 1200-1299
I/O Reg's 1300-1399
I/O Reg's 1400-1499
I/O Reg's 1500-1599

0	0	20000	25000	30000	35000	0	0	0	0	0
10	49152	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0
80	0	0	0	0	0	0	0	0	0	0
90	0	0	0	0	0	0	0	0	0	0

CSV File Import and Export

The server supports the import and export of tag data in a CSV (comma separated variable) file. The CSV functions are only available when a Device or Tag Group is selected. Using CSV import and export, tags can be created quickly in the application of your choice.

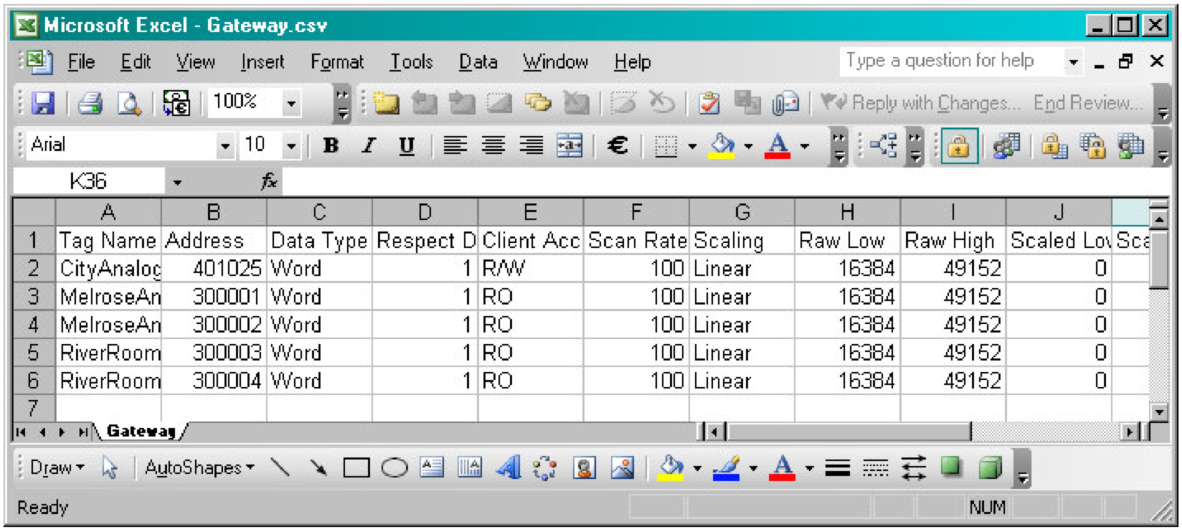
Important Note: The easiest way to create an import CSV file is to create a template using File|Export CSV. Define the channels and devices that the project will contain. Next define a tag for each device. Export each device or tag group as a CSV file. Use this template in a spreadsheet application that supports CSV files and modify the file. The resulting CSV file can then be saved to disk and imported back into the server under the same device or tag group or under a new device or tag group.

Exporting a Server Tag List:
This generates a .CSV (comma separated variable) text file that contains a heading record followed by a record for each tag defined under the selected device or tag group. The heading record contains the following fields.

Tag Name - Name of the tag as it will be referenced in an OPC client.
Address - The device location referenced by the tag.
Data Type - The data type used for the tag as shown in the server Tag Data Type drop down list box.
Respect Data Type - This forces the tag to follow its defined data type not the OPC client request.(1, 0)
Client Access - Read/ Write access (RO, RW, WO)
Scan Rate - The rate in milliseconds that the tag address will be scanned when used with most non-OPC clients.
Scaling - Scaling mode (Linear, Square Root)
Raw Low - Low raw value
Raw High - High raw value
Scaled Low - Scaled low value
Scaled High - Scaled high value
Scaled Data Type - The data type used for the tag after scaling is applied.
Clamp Low - Force the resulting scaled value to stay within the limit of Scaled Low.(1, 0)
Clamp High - Force the resulting scaled value to stay within the limit of Scaled High.(1, 0)
Eng. Units - Units string.
Description - Tag description

Each tag record contains the data for each field in a tag record.

Microsoft's Excel makes an excellent tool for editing large groups of tags outside of the server. Once a template CSV file has been exported is can be loaded directly into Excel for editing. A CSV file load in Excel would appear as follows:

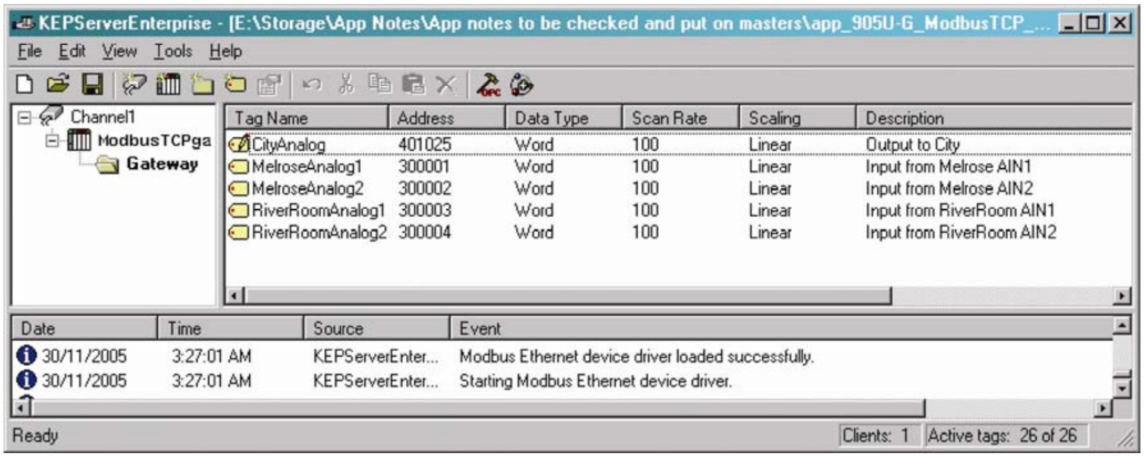


Microsoft Excel - Gateway.csv

	A	B	C	D	E	F	G	H	I	J	
1	Tag Name	Address	Data Type	Respect D	Client Acc	Scan Rate	Scaling	Raw Low	Raw High	Scaled Lov	Sca
2	CityAnalog	401025	Word	1	R/W	100	Linear	16384	49152	0	
3	MelroseAn	300001	Word	1	RO	100	Linear	16384	49152	0	
4	MelroseAn	300002	Word	1	RO	100	Linear	16384	49152	0	
5	RiverRoom	300003	Word	1	RO	100	Linear	16384	49152	0	
6	RiverRoom	300004	Word	1	RO	100	Linear	16384	49152	0	
7											

Importing a CSV tag list into the Server

Once you have finished editing your tag list it can be imported back into the server using the import CSV function File|Import CSV. This option is available only when you have either a device or tag group selected.



KEPServerEnterprise - [E:\Storage\App Notes\App notes to be checked and put on masters\app_905U-G_ModbusTCP_...

Channel1
ModbusTCPga
Gateway

Tag Name	Address	Data Type	Scan Rate	Scaling	Description
CityAnalog	401025	Word	100	Linear	Output to City
MelroseAnalog1	300001	Word	100	Linear	Input from Melrose AIN1
MelroseAnalog2	300002	Word	100	Linear	Input from Melrose AIN2
RiverRoomAnalog1	300003	Word	100	Linear	Input from RiverRoom AIN1
RiverRoomAnalog2	300004	Word	100	Linear	Input from RiverRoom AIN2

Date	Time	Source	Event
30/11/2005	3:27:01 AM	KEPServerEnter...	Modbus Ethernet device driver loaded successfully.
30/11/2005	3:27:01 AM	KEPServerEnter...	Starting Modbus Ethernet device driver.

Ready Clients: 1 Active tags: 26 of 26

Note: This application note is using the Analog Inputs for testing the communications. When transferring Integer values such as for level, pressure and temp from field 105/905U-1,2,3,4 etc the values will always in the range of 16384 to 49152 for 4-20mA and 8192 to 49152 for 0-20mA.

A digital input is either On or Off and depending on the format you read it as in the Debug I/O screen i.e Hex, Decimal or Discrete you will see FFFF, 65535, 1 for ON & 0000, 0, 0 for OFF respectively.