Operating Manual

FieldServer Configuration Start-up Guide

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1 FieldServer Concepts

1.1 Introduction

The FieldServer functions as a gateway enabling different devices utilizing different protocols to interface with each other. The FieldServer solves communication and protocol conversion problems and improves response times in distributed data acquisition and control systems. The extensive driver library available from MSA Safety provides a wide range of interoperability solutions. For a current list of available drivers visit the MSA Safety website.

The FieldServer also acts as an Ethernet gateway, enabling new and legacy PLCs, RTUs and SCADA devices to link to Ethernet for plant-wide communications.

Depending on the model, the FieldServer is equipped with combinations of Serial, Ethernet and LonWorks® ports as well as various Fieldbus ports. The internal poll-block caching capability ensures that data from Server devices is immediately available to the Client devices when needed. Data can be cached from slower devices or remote units for immediate access by the Client device. See **Section 8 Port Expander Mode – PEX Mode** for details.

NOTE: LonWorks® is a trademark of Echelon Corporation registered in the United States and other countries.

The Hot Standby option for the FS-B3510-05 is available when dual redundancy is required. See ENOTE-Configuring a FS-B35 FieldServer for Hot Standby Mode for details.

The FieldServer is cloud ready and connects with the Grid, MSA Safety’s FieldServer cloud platform.

NOTE: For MSA Grid – FieldServer Manager information, refer to the MSA Grid - FieldServer Manager Start-up Guide online through the MSA website.

NOTE: The latest versions of instruction manuals, driver manuals, configuration manuals and support utilities are available online through the MSA FieldServer webpage.

1.2 Application

Today’s plants are integrated, intelligent facilities requiring multiple mechanical and electrical systems to be controlled from a central processor. Many of these devices are not part of the central automation system, but that system still needs data input from these devices.

Through its powerful protocol conversion capability, the FieldServer allows system designers and managers to connect unique instrumentation and sensor devices onto common protocol systems and into the plant Ethernet backbone. Due to its internal poll-block caching, multiple protocol capability and high port count, the FieldServer improves data and machine update time compared to conventional HMI packages using multiple drivers and port expanders.

The FieldServer is designed to enable devices within a facility to communicate with each other or to a central control station via Serial, Ethernet or other communication busses. Two-way communication is easily available between the various process and control systems.

1.3 Terminology

1.3.1 Nodes

The devices communicating with the FieldServer may be referred to as “Stations”, “Nodes”, “RTU’s”, “DCS’s”, “Workstations”, “SCADA Systems”, “MMI’s”, “Field Devices”, etc. To prevent confusion these devices are always referred to as Nodes in this manual.

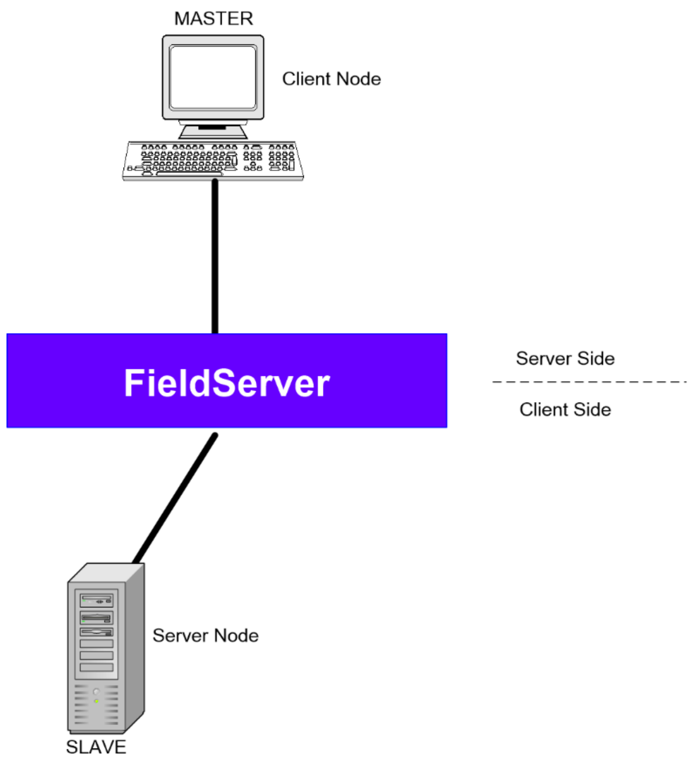
Similarly, “Device Address”, “Station Address”, “Station ID” is always referred to as “Node ID” in this manual.

NOTE: Nodes may have the same Node_ID value, so long as they are connected to different ports.

1.3.2 Clients and Servers

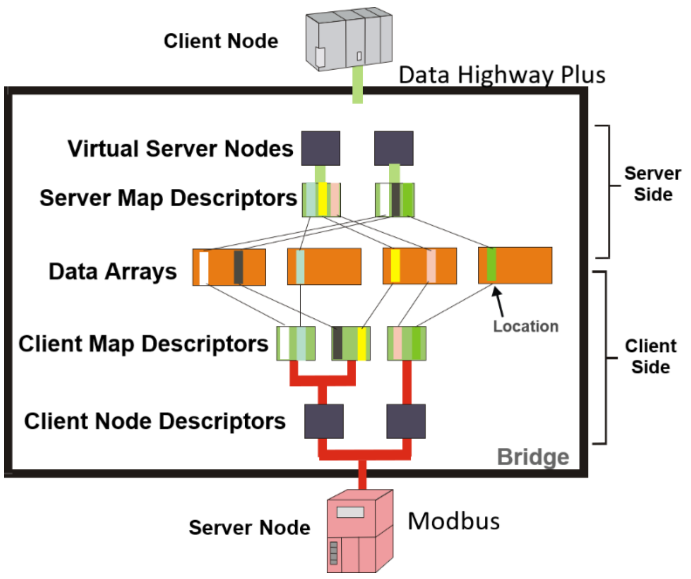
A Client Node can request data from and write data to a Server. In Process Control and Building Automation applications, it is accurate to describe a Client as a device that receives status and alarm data from a Server, then writes setpoints and control points to the Server.

In a FieldServer application, there is a Client/Server relationship on each network coupled to the FieldServer. It is therefore typical that the FieldServer acts as a Client and a Server at the same time.



2 Overall Operation Philosophy

The FieldServer functions as a bridge between two or more different Nodes (see diagram below). The information is gathered by the Client side of the FieldServer from the Server Nodes via a Serial Port, Ethernet port or plug-in card. Nodes may use different protocols and even different communication busses. The Client Node Descriptors contain information about each Node including connection ports and protocol. Each Node is given a Node_Name and a Node_ID. The data from a Server Node is stored on the FieldServer in a Data Array. The exact location as well as the format of the information is determined by the Map Descriptors. The FieldServer can contain any number of Data Arrays, but each Data Array can only store data in one format. The Client Map Descriptors describe where the information is to be stored on the FieldServer, and the Server Map Descriptors describe how this information is able to be accessed by a Client Node. On the Server side of the FieldServer, virtual Nodes are created to convert the information stored in the Data Arrays to the format required by the Client Node. These Nodes can be accessed by any of the available ports on the FieldServer at any time. The FieldServer thus acts as a Client and a Server simultaneously.



For example, consider a Modbus PLC with a set of 10 high alarms in address 00001 to 00010.

A Map Descriptor is allocated to fetch Data Objects from Modbus address 00001 length 10 and save this data to a Data Array named PLC1, offset 20. The high alarm for sensor number 5 on PLC1 is thus stored in Data Array PLC1; offset 24 (the fifth location starting at offset 20).

A DCS using Allen Bradley DH+ protocol can be configured to access the FieldServer and read the Data Array. The FieldServer will appear to the DCS as another DH+ PLC. If the Virtual Node PLC1 is configured to contain the data on sensor 5/PLC1 as a DH+ address B3:57, then the data needed for address B3:57 will be retrieved from Data Array PLC1, offset 24.

3 Getting Started – Basic Configuration

3.1 Configuration File Overview

The default driver configuration file (CONFIG.CSV) for any driver combination ordered is loaded into the FieldServer and can be retrieved using the Graphical User Interface Utility (see the FieldServer FS-GUI Manual for more details). Use this file as a template when editing configuration files to ensure that the edited file takes the correct form. A detailed explanation of the configuration file follows:

3.2 Configuration File Structure

The file begins with some general information.

```
//=============================================================//
//   Delivery.csv
//   SMC Customer           :  XYZ Corp.
//   Ultimate Destination    :  Main Office
//   SMC Sales Order         :  00103400
//   Driver Configuration   :  Modbus RTU
//   Configured By           :  GFM
//   Date                    :  23 Mar 16
//
//   Copyright (c) 2020 MSA Safety
//   1991 Tarob Court, Milpitas, CA 95035
//  (408) 262 6611   Fax: (408) 262 9042
//   smc-support@msasafety.com
```

In the above example:

- Lines beginning with // are comments and do not affect the configuration.

NOTE: Comments should be at the start of a line. If comments are made after a line of parameters, they must not directly follow a comma.

The Common Information Section displays parameters not directly related to any of the connections.

```
//=============================================================
//   Common Information
Bridge
Title
DCC030 CC00103400 V1.00a
//=============================================================
```

```
Data_Arrays
Data_Array_Name  , Data_Format  , Data_Array_Length
DA_AI_01         , UInt16       , 200
DA_AO_01         , UInt16       , 200
DA_DI_01         , Bit          , 200
DA_DO_01         , Bit          , 200
```

In the above example:

- This title (“DCC030….”) will appear at the top of the FS-GUI screen. It may be used to indicate the configuration version loaded, and the relevant customer/project.
- **Data Arrays** – Data Arrays are “protocol neutral” data buffers for storage of data to be passed between protocols. It is necessary to declare the data format of each of the Data Arrays to facilitate correct storage of the relevant data. More information is available in **Section 12.3 Available Data Types for Data Arrays**.

The Client Side Connections Section contains the parameters that describe the nature of the physical connection to the Server Nodes.

```
//================================================================
//   Client Side Connections
//
Connections
Port    , Baud    , Parity    , Data_Bits  , Stop_Bits    , Protocol    , Poll_Delay
P1    , 9600    , None    , 8              , 1        , Modbus_RTU    , 0.100s
```

In the above example:

- **Port** – The port to be connected to, defined in terms of connection speed and properties.
- **Protocol** – The protocol for the network connected to this port.
- **Poll Delay** – Timing parameters on the connection allow for fine tuning of communications.

The Client Side Nodes Section defines the logical connection parameters for the Server Nodes communicating with the FieldServer.

```
//================================================================
//   Client Side Nodes
//
Nodes
Node_Name     , Node_ID     , Protocol    , Port
PLC 1    , 1        , Modbus_RTU    , P1
```

In the above example:

- **Node_Name** – A name allocated to the node for reference by the Map Descriptors.
- **Node_ID** – The Node ID of the Server.
- **Port** – The Server Node is attached to this connection.

The Map Descriptor Section contains parameters that describe the address details required to move data between the FieldServer and an external device and the nature of the data transfer.

```
//==================================================================
//   Client Side Map Descriptors
//
Map_Descriptors
Map_Descriptor_Name , Data_Array_Name , Data_Array_Offset , Function , Node_Name , Address , Length , Scan_Interval
CMD_AI_01           , DA_AI_01        , 0                 , RDBC     , PLC 1     , 30001   , 20     , 1.000s
CMD_AO_01           , DA_AO_01        , 0                 , RDBC     , PLC 1     , 40001   , 20     , 1.000s

Map_Descriptors
Map_Descriptor_Name , Data_Array_Name , Data_Array_Offset , Function , Node_Name , Address , Length , Scan_Interval
CMD_DI_01           , DA_DI_01        , 0                 , RDBC     , PLC 1     , 10001   , 20     , 1.000s
CMD_DO_01           , DA_DO_01        , 0                 , RDBC     , PLC 1     , 00001   , 20     , 1.000s
```

In the above example:

- **Map_Descriptor_Name** – Name assigned to the Map Descriptor. In some protocols the name becomes the variable name.
- **Data_Array_Name** – Data Array to be used for storage of data being passed between protocols.
- **Data_Array_Offset** – Offset in relevant Data Array to start data access/storage.
- **Function** – Determines how data is to be fetched/written. The FieldServer is either reading, being read, or writing data. This can be continuous, or on change.
- **Node_Name** – Node being accessed.
- **Address** – First point address accessed.
- **Length** – Number of points in poll request.
- **Scan_Interval** – Timing parameters assist with pacing of data.

The Server Side Sections are functionally the same as their Client Side equivalents, except that Server parameters are being defined.

```
/=============================================================
//   Server Side Connections
//
Connections
Adapter       , Protocol
N1          , Modbus/TCP
```

In the above example:

- **Adapter** – Adapter definition applies to defining network and FieldServer connections (such as PROFIBUS).
- **Protocol** – The protocol for the network connected to this port.

```
//=============================================================
//   Server Side Nodes
//
Nodes
Node_Name     , Node_ID     , Protocol
MBP_Srv_11    , 11       , Modbus/TCP
```

In the above example:

- **Node_Name** – A Node name for reference by the Map Descriptors.
- **Node_ID** – Since the FieldServer is a Server here, this is the ID of the FieldServer (virtual) Node. The FieldServer can represent multiple Virtual Node_ID's in most protocols.

```
//=================================================================
//   Server Side Map Descriptors
//
Map_Descriptors
Map_Descriptor_Name   , Data_Array_Name   , Data_Array_Offset   , Function   , Node_Name   , Address   , Length
SMD_DI_01   , DA_DI_01    , 0    , Passive    , MBP_Srv_11    , 10001    , 200
SMD_DO_01   , DA_DO_01    , 0    , Passive    , MBP_Srv_11    , 00001    , 200
```

3.3 Editing Configuration Files

The configuration file is in comma-delimited format where entries within a line are separated by commas and the end of a line is indicated by an entry without a comma. This file can be edited using spreadsheet programs or any text editor.

It is recommended that the CONFIG.CSV file be backed up before editing. Once edited, the file can be saved and uploaded in the Graphic User Interface (see FieldServer GUI Manual for details).

Refer to **Section 12.4 Permissible Values for Configuration File Variables** for the parameters that are usually filled out in the configuration file. Only the specified values may be used - other values may affect FieldServer performance or functioning.

Not all parameters are compulsory for every driver (see the related driver manual for details). The **bold** legal value is the value that will be used if the parameter is not specified.

Not all variables need be defined for every configuration. Depending on the protocol and configuration, some variables might not be necessary. More detailed information is located in the relevant Driver Manual, including settings specific to the drivers being used for a particular application.

Most FieldServer parameters are specified in a configuration file and are fixed. A growing number, however, may be changed dynamically using values found in Data Arrays. We call these Dynamic Parameters. Refer to **Section 6.3 Node Parameters** for more information on Dynamic Parameters.

3.4 Testing Configuration Files with DSW32.EXE

DSW32.exe is a program that simulates the FieldServer on the PC and can be used for testing edited configuration files before transferring them back to the FieldServer. This file can be obtained by calling technical support. It is not necessary to use DSW32. The configuration can be loaded into the FieldServer and tested in much the same way.

- Open an MS-DOS prompt and navigate to the directory containing the configuration file.
- Type: "**dsw32.exe -c<configuration file**>", where <configuration file> is the name of the file to be tested. For example, to test the CONFIG.CSV file, type " DSW32 –cconfig.csv".

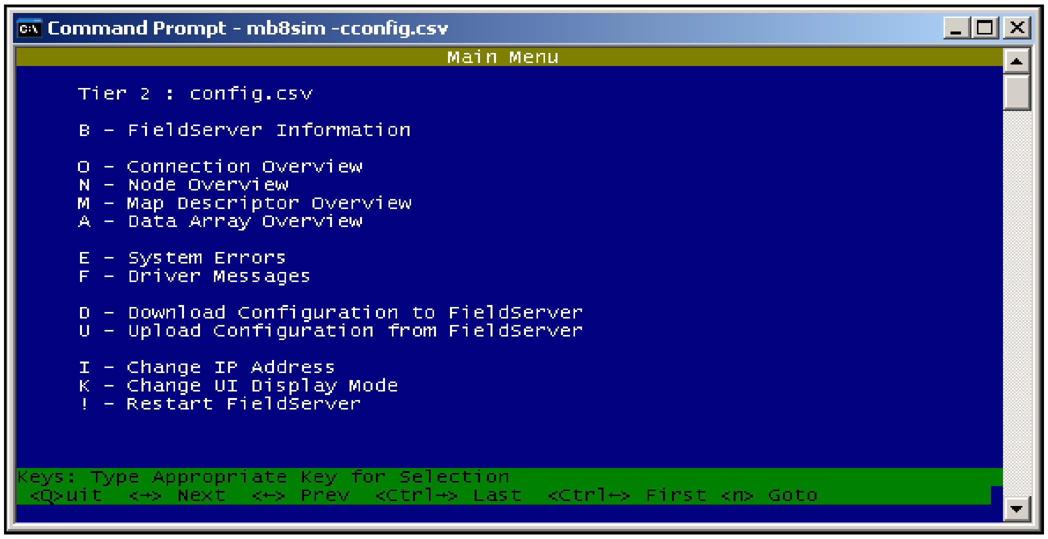
To test specific sections of a configuration file it is possible to ignore certain sections:

To ignore a block, use the "**ignore**" keyword at the start and the "**process**" keyword at the end of the block.

To ignore individual lines use “//”.

The "**end**" keyword will stop processing the file, and anything after this keyword will be ignored.

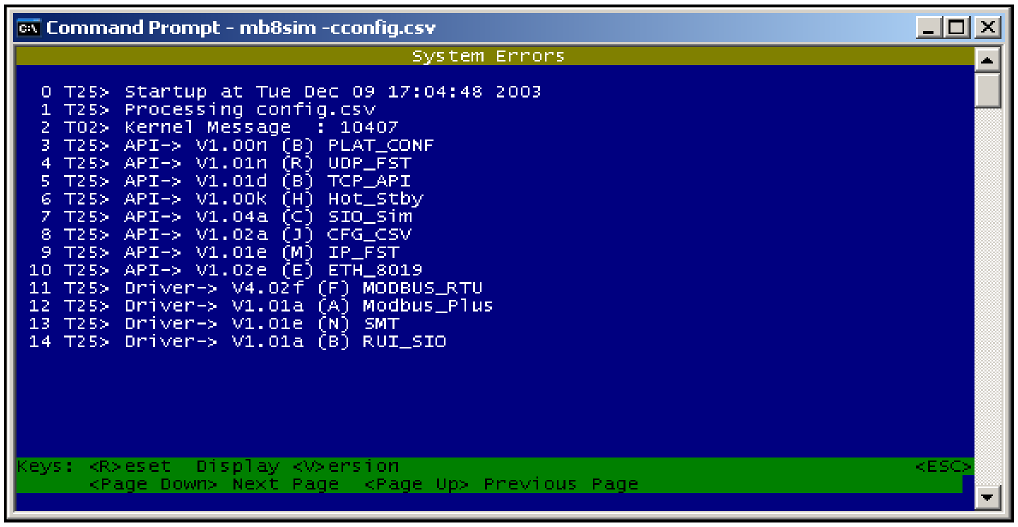
The following is an example of the interface when using DSW32.exe.



```
Command Prompt - mb8sim -cconfig.csv
                              Main Menu

     Tier 2 : config.csv

     B - FieldServer Information

     O - Connection Overview
     N - Node Overview
     M - Map Descriptor Overview
     A - Data Array Overview

     E - System Errors
     F - Driver Messages

     D - Download Configuration to FieldServer
     U - Upload Configuration from FieldServer

     I - Change IP Address
     K - Change UI Display Mode
     ! - Restart FieldServer

Keys: Type Appropriate Key for Selection
 <Q>uit  <-> Next  <-> Prev  <Ctrl-> Last  <Ctrl-> First <n> Goto
```

Check all screens to see if the file is working correctly, paying particular attention to the Error screen. From the main menu, press "E" to enter the error display screen, and examine the errors listed. Take note of System Errors or Configuration Errors. These indicate configuration problems in the configuration file.

NOTE: "System Overrun" errors may occur in this screen. They are caused as a result of the simulation and will not cause any problems on the FieldServer.



```
                                System Errors

  0 T25> Startup at Tue Dec 09 17:04:48 2003
  1 T25> Processing config.csv
  2 T02> Kernel Message  : 10407
  3 T25> API-> V1.00n (B) PLAT_CONF
  4 T25> API-> V1.01n (R) UDP_FST
  5 T25> API-> V1.01d (B) TCP_API
  6 T25> API-> V1.00k (H) Hot_Stby
  7 T25> API-> V1.04a (C) SIO_Sim
  8 T25> API-> V1.02a (J) CFG_CSV
  9 T25> API-> V1.01e (M) IP_FST
 10 T25> API-> V1.02e (E) ETH_8019
 11 T25> Driver-> V4.02f (F) MODBUS_RTU
 12 T25> Driver-> V1.01a (A) Modbus_Plus
 13 T25> Driver-> V1.01e (N) SMT
 14 T25> Driver-> V1.01a (B) RUI_SIO

Keys: <R>eset  Display <V>ersion                                           <ESC>
      <Page Down> Next Page  <Page Up> Previous Page
```

In the above example:

- None of these messages are errors. Config and system errors will have a “banner” saying “System Error” or “Configuration Error”.

When the file is free from errors (with the exception of "System Overrun" Errors), download it using the "D" command from the main menu of the Remote User Interface.

3.4.1 Additional Worthwhile DSW32 Checks

- Check the Connections defined to ensure that they are as expected.
- Do the same for Nodes.
- Check the Data Arrays to ensure that all Data Arrays defined are there. If too many Data Arrays exist, this usually signifies that a spelling error exists in the configuration, and that incorrect Data Arrays were specified in the Map Descriptors.

NOTE: The first few lines of the error screen are merely informative and relevant information used for fault finding and do not represent errors. Errors are shown as “System Error” or “Configuration Error” in the error screen.

4 Map Descriptor Functions

Map Descriptor functions determine how data is mapped between Data Arrays and the corresponding driver data points. The choice of function used is critical in ensuring that the right relationship is established with the device being communicated with. The most important decision to make when choosing a function is whether the function needs to be active or passive. Once this is determined, the trigger for initiating communications determines which active or passive function is used.

NOTE: Not all functions are supported by all drivers. Refer to the specific Driver Manual for information on functions supported by individual drivers.

4.1 Active vs. Passive Functions

Active functions control the communications activity for the associated points in the network. Specifying an active function for a point will enable the FieldServer to decide when a point is updated and monitor the health of the communications path for that point (if the associated protocol allows for this). Specifying a passive function will mean that the FieldServer expects the communications for that point to be controlled and monitored by another device on the associated network.

NOTE: By design, it is necessary that all active Map Descriptors communicate to a point that has a passive mapping on the remote device, and that passive Map Descriptors are controlled by an active mapping on the remote device.

There is a loose relationship between Active/Passive and Client/Server. Clients usually use active mappings and Servers usually use passive mappings, but Active Servers and Passive Clients do exist. Points that send an update to a network on change (such as Alarm panels) are a good example of Active Servers.

Another set of terminology used in this area is solicited vs. unsolicited messages. A Client receives a solicited message from a Server when it asks for it (the point is polled). A Client receives an unsolicited message from a Server when the Server sends the point without the Client asking for it. Clients that send solicited messages are Active Clients communicating with Passive Servers. Clients that receive unsolicited messages are Passive Clients communicating with Active Servers.

4.2 Passive Map Descriptor Functions

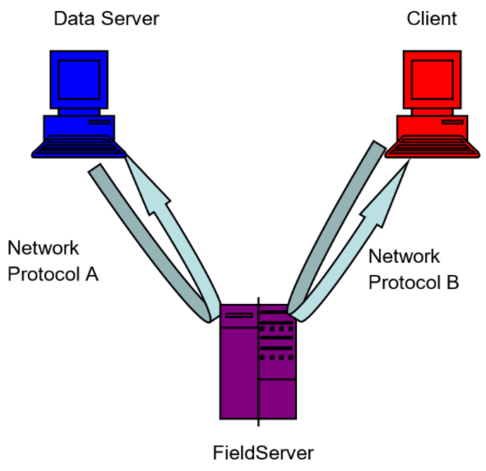
4.2.1 Passive

The Passive function will not initiate any communications but waits to be solicited by a remote device and responds with data accordingly. The Passive function will also accept writes and update the associated Data Array.

4.2.2 Passive Client (Passive_Client)

The Passive_Client function is intended for use where the associated Map Descriptor performs a Client function and is connected to an active Server. The Passive_Client function will consume all unsolicited messages for the related point/s and store them in the associated Data Array.

Passive Server Applications



Typical Properties
Map Descriptor function used for both protocols A and B is "passive".
FieldServer is non-intrusive into both networks and responds to queries and commands only.

Some applications require the data Server to actively write data to and from the FieldServer. To do this it is necessary to change the Client side of the configuration to be passive.

Individual drivers have specific requirements for managing passive communications, but the following steps are typically required to change the Active Client side of a configuration file to make it a Passive Client.

- Remove Adapter/Port to Client side Node
- Change Function from RDBC to Passive
- Remove Scan_Interval
- Change Node ID to remote device's target Device ID

If the Server side remains passive, then every Map Descriptor should have "Passive" as its function. Consequently, the Server device will write data to the FieldServer's Data Arrays, and the Client device will read that data from the same Data Arrays, making the operation of the FieldServer much like that of a normal data Server on an office network.

4.3 Active Map Descriptor Functions

A **Responsible Map Descriptor** is a Map Descriptor that inherently monitors the quality of the data that it is mapping and can be recognized by the “Function” parameter field. The following are all Responsible Map Descriptors.

NOTE: If specific supported drivers aren’t mentioned, the function can be used by any driver.

4.3.1 Read Functions

Read Block Continuous (RDBC)

The RDBC function will read a block of data of length specified by the “length” parameter and transfer that data to the Data Array specified. Reads are performed continuously at an interval specified by the “Scan_Interval” parameter.

The RDBC function also has the ability to perform what is known as “write throughs”. If the driver allows writing to the point related to the Map Descriptor where RDBC is specified, then the RDBC function will write the data in the Data Array back to the point when an update in the associated Data Array is detected. This makes RDBC the ideal function for read/write points.

Read Block (RDB)

The RDB function works the same as the RDBC function except that only one read is executed at startup instead of a continuous number of reads.

Active Read Continuous with Sequencing (ARCS)

This function will perform the same operation as an RDBC (Arc) function but will sequence through the range of addresses starting at "Address" and wrapping at "Address + Length". A length of 1 will be used for every one of the Addresses that gets polled. The following drivers currently support the ARCS function.

- Modbus_RTU
- Lutron_Machine
- BACnet MS/TP, BACnet/IP
- Metasys N2

Active Read Continuous with Offset (ARCO)

This function does a read of length 1 for a range of addresses.

Active Read at Startup (ARS)

This function does an active/single read on startup, or every time the associated node goes online.

Read Block Continuous Expedite (RDBCE)

This function can be used to give higher priority to read data map descriptors that may be held back in a situation where many writes are triggered or where other read map descriptors are taking a very long time to read data. The kernel will alternate between normal and expedited read map descriptors instead of servicing the map descriptors one after the other as they are found in the configuration file.

Active Read Discovery on Startup (ARDS)

This function is used for discovering known Modbus RTU devices. A register(s) will be read and if a known value is received, a profile configuration will be loaded.

Discovery based on Modbus Register:

```
Map_Descriptors
Map_Descriptor_Name , Data_Array_Name , Data_Array_Offset , Function , Node_Name  , Data_Type
CMD_Type01_Disc     , DA_T01_Resp     , 1                 , ARDS     , Type01_Disc , Holding_Register
```

```
, Address , Scan_Interval , Length , Discovery_Node_Range , DA_Linked_Name , DA_Linked_Offset
, 00081   , 0.000s        , 14     , 1 20                 , DA_T01_Node    , 0
```

Discovery based on Slave ID (Modbus FC17):

```
Map_Descriptors
Map_Descriptor_Name , Data_Array_Name , Data_Array_Offset , Function , Node_Name , Data_Type
CMD_SLAVE_ID        , DA_LOAD_ID      , 1                 , ARDS     , Discovery , Slave_Id
```

```
, Config_Table_Name , Scan_Interval , Length
, slave_id_profile  , 0.000s        , 20
```

NOTE: This function is only available for OEM customers who have pre-configured profiles. This function is not compatible with the QuickServer Gateway.

4.3.2 Write Functions

Write Block on Change (WRBX)

The WRBX function will write data from the Data Array to the remote device. The write is triggered by a change in the associated Data Array. If the associated Data Array is updated a write will occur, even if the value/s within the Data Array have not changed. The “Scan_Interval” parameter is not required for this function as writes are event driven and not continuous.

Write Block on Change of Value (WRBCOV)

The WRBCOV function operates much the same as a WRBX but will only write on a value change. The write is triggered by a change in value in the associated Data Array. If the associated Data Array is updated with the same value a write will not occur. The “Scan_Interval” parameter is not required for this function as writes are event driven and not continuous.

Write Block Continuous (WRBC)

This is similar to the WRBX function, except that the writes occur at a regular interval rather than on an event driven basis. The frequency of the writes is determined by the “Scan_Interval” parameter.

Write Block (WRB)

This function is the same as WRBC except that only one write is executed at startup instead of a continuous number of writes.

Active Write at Startup (AWS)

This function does an active/single write on startup, or node coming online.

NOTE: Does not work with any BACnet driver.

Active Write on Trigger (AWT)

This function is used to affect a single data write per trigger. As with the WRBX function, the write only occurs when the Data Array is updated. In this case the updated data is not used to form the write but updating the Data Array triggers a read of a Secondary Data Array which contains the data to be served in the write.

In the example below (from the Lutron Machine Driver) the driver watches the Data Array called ‘Lut_triggers’ (offset 13). If that Data Array element is updated (even if the value remains unchanged) the the write is triggered. The driver extracts the data from the Secondary Data Array called ‘Set_tlck’ (offset 0) and forms a message to write this data to the field device.

Only certain drivers support/require the use of this function. For other drivers, AWT is a synonym for WRBX since there is no secondary Data Array to extract information from.

NOTE: The driver may extract more data from the array than specified by the ‘length’ parameter. The only way to know how much data is to read that specific driver’s manual.

```
Map_Descriptors
Map_Descriptor_Name , Data_Array_Name , Data_Array_Offset , Function , Node_Name   , GRAFIK_command
Set_tck             , Lut_triggers    , 13                , AWT      , LUT_GRF6_0 , Set_tclk
```

```
, DA_Lut_List , DA_Lut_List_Offset , Length
, Set_tclk    , 0                  , 1
```

5 Data Manipulation Features

The features described in this section may or may not be needed depending on the application where the FieldServer is implemented. If the application calls for straight passing of data without modification through the FieldServer, then the features in this section will probably not be useful.

5.1 Moves

The Moves function permits data to be moved from one Data Array to another. The function parameter within moves allows data manipulation to occur while moving the data. Examples of this are Logic operation, Integer to floating point conversion, etc. Scaling, Logic and Math are also possible while moving data.

With the exception of Conditional Moves (**Section 5.2.6 Task Moves**), each Data Array location may only act as the target location of one Responsible Move. This ensures that the data source can be uniquely determined in order to establish source data validity, and so that a write through the target data location is directed to the appropriate location.

Moves will execute whenever the source data changes or the scan interval (if specified) expires. If a task move does not have a scan interval defined, a default scan interval of one second is assumed.

A Move operation must specify the following elements:

Data Elements	
Source_Data_Array	The name of the Data Array from which data is to be copied.
Source_Offset	The offset within the Data Array from which data is to be copied.
Target_Data_Array	The name of the Data Array to which data is to be copied.
Target_Offset	The offset within the Data Array to which data is to be copied. The offset can be either a hardcoded value or can be obtained from another data array. See Moves example in **Section 5.1.1 Simple Moves** for more information.

Optional Elements	
Length	The number of consecutive source Data Array values to be moved to consecutive target locations, starting at the respective offsets.
Task_Name	If a task name is specified, the move operation becomes a continuous task on the FieldServer that is executed at the scan interval specified.
Scan_Interval	The time interval at which the task will be repeated. A task name must be specified if a scan interval is specified.
Function	Defines move functionality (for example byte order manipulation). Functions are summarized in **Section 5.2 Function Moves – Type Casting**.
Conditional_Data_Array	The name of a Data Array to be used for conditional moves. See Separating Responsible Map Descriptors in **Section 5.1.1 Simple Moves** for more information.
Conditional_Offset	The offset into the Conditional_Data_Array where the conditional bits for the move are defined. The value found at this specified location must be non-zero for the move to be executed. If the value is zero, the move is inhibited.

5.1.1 Simple Moves

The simplest move involves the transfer of data without any format or protocol changes. Whenever the Source Data Array is updated (not necessarily changed) the Target Data Array will be updated.

Simple Move Example

```
Data_Arrays
Data_Array_Name , Data_Format , Data_Array_Length
Source_DA       , Float       , 200
Target_DA       , Float       , 200
Offset_DA       , UInt        ,1
```

```
Moves
Function   , Source_Data_Array , Source_Offset , Target_Data_Array , Target_Offset , Length
Move_Only , Source_DA          , 0             , Target_DA         , 40            , 5
```

In the above example:

- **Target_Data_Array** – A move is reversible, meaning data can move from Target_DA to Source_DA if applicable (writeable points).
- **Length** – Five Floating point values are moved from the first offset of Source_DA to offset 40 of Target DA.

Target Offset Example:

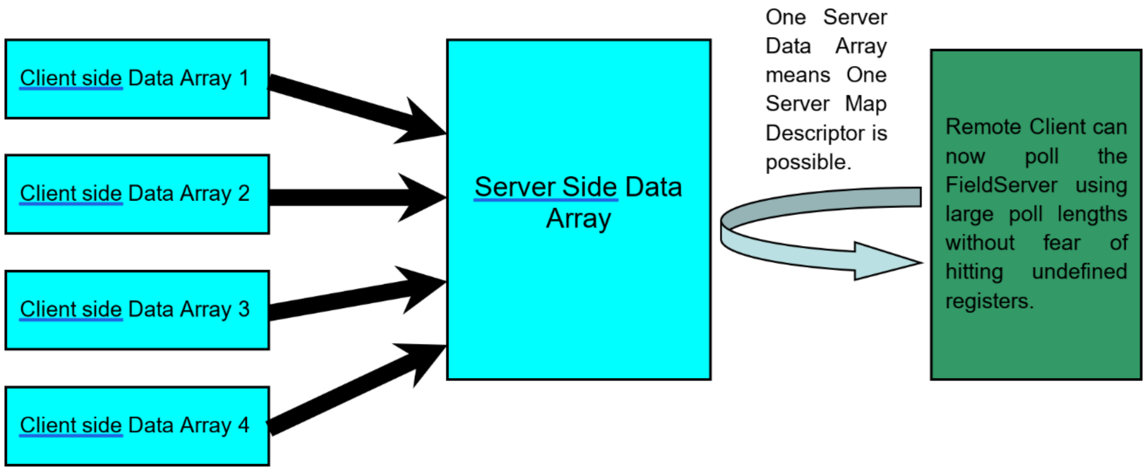
```
Moves
Function   , Source_Data_Array , Source_Offset , Target_Data_Array , Target_Offset  , Length
Move_Only , Source_DA          , 0             , Target_DA         , <Offset_DA.0> , 5
```

In the above example:

- **Target_Offset**– The Target Offset Value will be obtained from the Offset_DA at offset 0.

Grouping Data

The location of data in Data Arrays on the FieldServer is determined by corresponding Map Descriptors. Should a Client poll the FieldServer for data spanning more than one Map Descriptor, the FieldServer will not know which Map Descriptor to use. This can be circumvented by moving data from multiple "Client Side" Source Data Arrays to a single "Server Side" Target Data Array. This Data Array should be larger (of greater length) than the maximum poll length of the Client.


Client side Data Array 1
Client side Data Array 2
Client side Data Array 3
Client side Data Array 4
Server Side Data Array
One Server Data Array means One Server Map Descriptor is possible.
Remote Client can now poll the FieldServer using large poll lengths without fear of hitting undefined registers.

For example, consider a Modbus Client needing registers 40001 through 40050 from the FieldServer. The poll lengths used to obtain this data are unknown.

This could be configured in the FieldServer Server side as follows.

Configuration 1:

Map Descriptor 1 serves up 40001 Length 25.

Map Descriptor 2 serves up 40026 Length 25.

If the two poll blocks fall within these two address spans, the poll will be successful, however, if all 50 registers are polled in a single poll it will fail.

Configuration 2:

Map Descriptor 1 serves up 40001 Length 50.

For this to work, all 50 points must be contiguous in the same Data Array so that one Map Descriptor can be created. If all 50 registers are polled in a single poll it will be successful. If the Client polling algorithm keeps a fixed length of 50, and then decides to poll address 40050, length 50, the poll will fail because addresses 40051 through 40099 are not declared in the FieldServer.

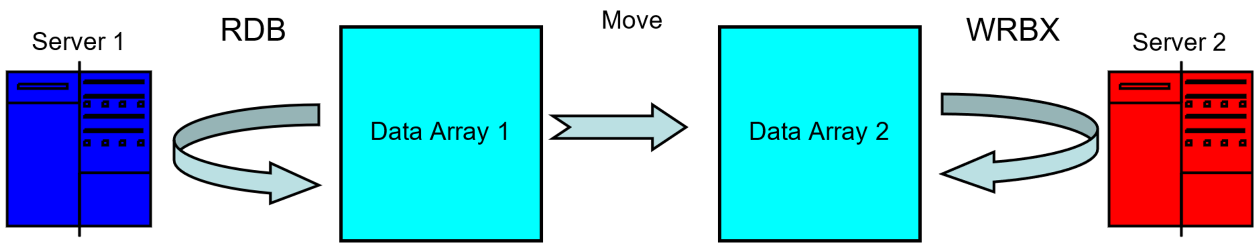
Configuration 3:

Map Descriptor 1 serves up 40001 Length 200.

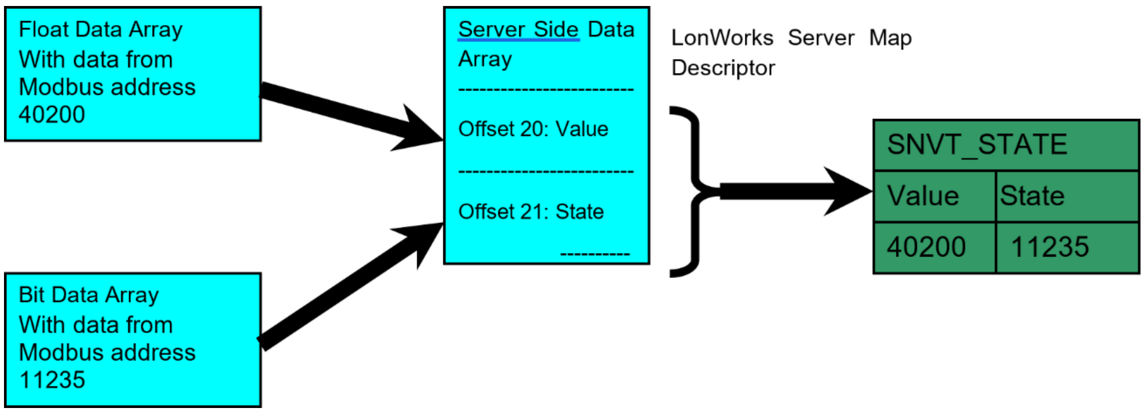
For this to work, points must be contiguous in the Data Array, and the Data Array length must be at least 200. Since Modbus can poll a maximum length of 125, a Client cannot poll the required registers and encounter an address that is not configured. This is therefore the most robust solution, and only costs a few points.

Separating Responsible Map Descriptors

Responsible Map Descriptors are active Map Descriptors that control the Communications (see **Section 4 Map Descriptor Functions**). Two Responsible Map Descriptors cannot share the same Data Array Offset due to monitoring functions present in the kernel (refer to **Section 4.3 Active Map Descriptor Functions** for more information). If two Responsible Map Descriptors require access to the same data, the data can be made accessible to the second Responsible Map Descriptor by moving it to a second Data Array.



Creating a LonWorks SNVT_Switch from 2 Modbus Registers


Float Data Array With data from Modbus address 40200
Bit Data Array With data from Modbus address 11235
Server Side Data Array
Offset 20: Value
Offset 21: State
LonWorks Server Map Descriptor
SNVT_STATE
Value
State
40200
11235

5.2 Function Moves – Type Casting

It is often necessary to manipulate incoming data to create the necessary outgoing data by either joining smaller data types to create a larger data type or splitting larger data types to deliver smaller data types. An example of this is Modbus, where two 16 bit registers are used to transfer a 32 bit floating point value. Upon receipt of these two registers, the FieldServer needs to join the integers to extract the floating point value. The Type Casting moves described below perform these kinds of operations.

5.2.1 Functions Available for Type Casting

- Join_Float, Split_Float
- Join_Int16, Split_Int16
- Join_Int32, Split_Int32
- Swapped versions of the above (Big Endian vs Little Endian)
- Bit_Extract, Bit_Pack, Bit_Move

The following legacy functions have been replaced by the functions listed above. They are simply presented in the table below for reverse compatibility.

Old Keyword	New Keyword	Function Performed
	Int32 Join	
2.i16-1.i32	Join_Int32_Swapped	source bytes: [ab][cd] target bytes: [abcd}
2.i16-1.i32-sw	Join _Int32	source bytes: [ab][cd] target bytes: [cdab]
2.i16-1.i32-m10k	Join _M10K	Modulo-10 format
	Int32 Split	
1.i32-2.i16	Split_Int32_Swapped	source bytes: [abcd] target bytes: [ab][cd]
1.i32-2.i16-sw	Split_Int32	source bytes: [abcd] target bytes: [cd][ab]
	Float Join	
2.i16-1.float	Join _Float_Swapped	source bytes: [ab][cd] target bytes: [abcd]
2.i16-1.float-sw	Join _Float	source bytes: [ab][cd] target bytes: [cdab]
	Float Split	
1.float-2.i16	Split_Float_Swapped	source bytes: [abcd] target bytes: [ab][cd]
1.float-2.i16-sw	Split_Float	source bytes: [abcd] target bytes: [cd][ab]
	Integer Join	
2.i8-1.i16	Join_Int16_Swapped	source bytes: [a][b] target bytes: [ab]
2.i8-1.16-s	Join_Int16	source bytes: [a][b] target bytes: [ba]
	Integer Split	
1.i16-2.i8	Split_Int16_Swapped	source bytes: [ab] target bytes: [a][b]
1.i16-2.i8-s	Split_Int16	source bytes: [ab] target bytes: [b][a]

5.2.2 Converting Two Integers to a Float

```
Data_Arrays
Data_Array_Name , Data_Format , Data_Array_Length
Source_DA       , Uint16      , 200
Target_DA       , Float       , 200
```

In the example below, ten 16 Bit Integers are taken from Source_DA and combined in twos to make up 5 floating point values.

```
Moves
Function   , Source_Data_Array , Source_Offset , Target_Data_Array , Target_Offset , Length
Join_Float , Source_DA         , 0             , Target_DA         , 40            , 5
```

In the above example:

- **Length** – Refers to the data type referenced in the Function. For example, if n is the value shown in Length, then:

  Join_Float Creates n Floats.

  Split_Float Disassembles n Floats.

  Join_Int16 Creates n Integers.

  Bit_Extract Extracts n Bits, etc.

5.2.3 Using Moves to Pack and Unpack Bits to/or from a Register

A register provided by a device often consists of a set of binary values packed together for efficient data transfer. These registers are normally 16 bits in size but may also be 8 or 32 bits long. Since a register is read as an analog value by most protocols, these binary values need to be extracted out of the register into a bit data array before they can be read as useful data. The Bit_Extract Move function has been created for this purpose.

The Bit_Pack function can be used to pack bits into a register.

The Bit_Move function allows the user the ability to extract a group of bits in one register and place them singly into another register.

The Bit_Offset keyword can be used to start moving a group of bits from a specified offset within the register. This keyword may also be used in conjunction with the Bit_Extract and Bit_Pack functions to specify the first register offset to Extract or Pack.

The Length keyword will always specify the number of bits to be moved in the move operation when using these three functions. If the length keyword is not used, then only one bit will be moved.

The Data_Array_Type being used in source and target Data_Arrays can produce varying results and care should be taken to use the correct type. For example, when using the Bit_Extract function, it makes sense to use Byte, UInt16, or Uint32 source Data_Array_Types to extract 8, 16 or 32 bits per register respectively. It also makes sense to use the Bit Data Type for target Data_Array_Type. However, the FieldServer will allow other types to be used and follow a routine choice of conversion that may not be considered predictable to all users. For example, if the Float Data_Type is used as a source type in Bit_Extract, 32 bits per register will be extracted according to the rounded Integer number being represented in the Float Register. If the Float Data_Type was used as a target type in Bit_Extract, then each float register would store one binary value and would only ever represent 1 or 0.

Parameter	Function
Bit_Extract	The function extracts bits out of the source Data_Array Registers at the Data Array offset specified. The bits are placed into the destination array in sequence. Only one bit is allocated per offset. If the source array is of Bit Data Array type, a straight move is performed.
Bit_Pack	The function extracts the binary version of each source offset and packs the bits into the Data Array offset specified. The number of bits packed depends on the target Data type (for example, Bytes will get 8 bits, Floats will get 32, etc.). The length will specify the number of bits to pack. If the destination Array is a Bit data type, a straight move is performed.
Bit_Move	The function extracts a subset of bits out of a source Register offset and transfers these to a destination Register offset in packed form. Length specifies the number of bits to be extracted.

Keywords	Function	Legal Values
Bit_Offset*	The parameter specifies the bit offset within a word to start at when performing a bit move. For Bit_Extract operations, the source bit offset in the word pointed to by the Source_Offset parameter is implied. For Bit_ Pack operations, the bit offset within the word pointed to by Target_Offset is implied.	0 (default)
Length*	The length parameter specifies the number of bits to be extracted/packed.	1 (default)

5.2.4 Examples

Simple Bit Extraction

The following example extracts 3 16-bit registers worth of data from the 6th register of the source array into the equivalent target of 48 bits:

```
Data_Arrays
Data_Array_Name , Data_Format , Data_Array_Length
Source_DA       , Uint16      , 200
Target_DA       , Bit         , 200
```

```
Moves
Function    , Source_Data_Array , Source_Offset , Target_Data_Array , Target_Offset , Length
Bit_Extract , Source_DA         , 5             , Target_DA         , 0             , 48
```

Simple Bit Packing

In this example, 12 bits are packed into the 3rd and 4th register of the target byte array, starting at the eleventh bit in the source array. Note that the second target register will only be half populated, leaving the last 4 bits empty.

```
Data_Arrays
Data_Array_Name , Data_Format , Data_Array_Length
Source_DA       , Bit         , 200
Target_DA       , Byte        , 200
```

```
Moves
Function , Source_Data_Array , Source_Offset , Target_Data_Array , Target_Offset , Length
Bit_Pack , Source_DA         , 10            , Target_DA         , 2             , 12
```

Extracting Bit Groups

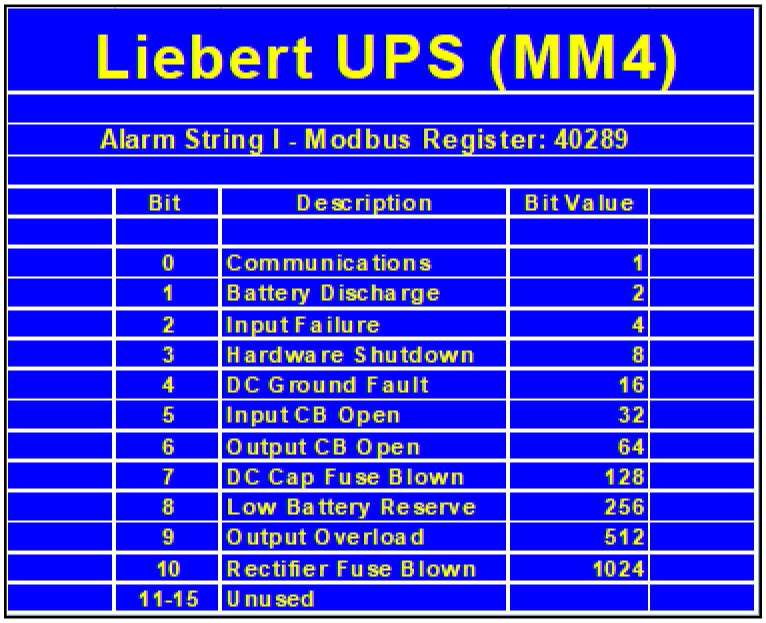
The following example extracts 3 bits from the second byte of a 32-bit register and places them into a byte register on their own. The Bit_Offset keyword is used here to achieve this:

```
Data_Arrays
Data_Array_Name , Data_Format , Data_Array_Length
Source_DA       , Uint32      , 200
Target_DA       , Byte        , 200
```

```
Moves
Function , Source_Data_Array , Source_Offset , Bit_Offset , Target_Data_Array , Target_Offset , Length
Bit_Move , Source_DA         , 0             , 8          , Target_DA         , 0             , 3
```

5.2.5 Bit Extraction Application Example

Assume a Liebert device has been set up as follows:



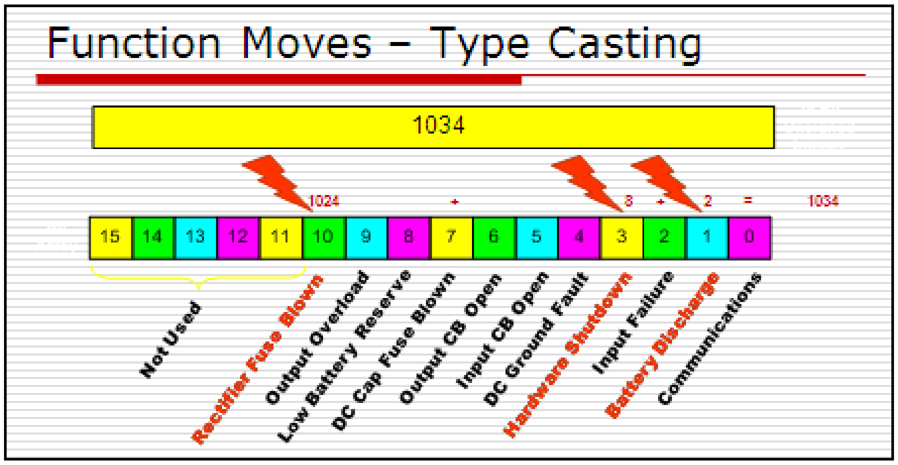
Liebert UPS (MM4)

Alarm String I - Modbus Register: 40289

Bit	Description	Bit Value
0	Communications	1
1	Battery Discharge	2
2	Input Failure	4
3	Hardware Shutdown	8
4	DC Ground Fault	16
5	Input CB Open	32
6	Output CB Open	64
7	DC Cap Fuse Blown	128
8	Low Battery Reserve	256
9	Output Overload	512
10	Rectifier Fuse Blown	1024
11-15	Unused	

Bits 0 - 10 are each used to specify a unique event, and each has a corresponding integer value determined by the binary contribution it makes to the integer value. For example, bit 10 has an integer value of 1024 as its weighting in the integer value is 2 to the power 10.

A single packed bit integer with a value of 1034 signifies a blown rectifier fuse, a hardware shutdown, and a battery discharge (sum of the values for the corresponding events). The value “1034” has no meaning as such, but when the integer is “unpacked” the individual data bits communicate the required information. This is depicted in the following diagram.



Example Configuration

```
//    Example of Bit Extraction

Data Arrays
Data_Array_Name , Data_Format , Data_Array_Length
Source_DA           , Uint16           , 200
Target_DA           , Bit                  , 200
```

```
Map Descriptors
Map_Descriptor_Name , Data_Array_Name , Data_Array_Offset , Node_Name , Function , Address , Length
CMD_PI_Alarm01_01   , Source_DA           , 0                          , UPS_01       , RDBC     , 40289    , 1
```

```
Moves
Function     , Source_Data_Array , Source _Offset , Target_Data_Array , Target_Offset , Length
Bit_Extract , Source_DA               , 0                      , Target_DA              , 0                      , 10
```

In the above example:

- **Target_Data_Array** – Target_DA offsets 0 to 9 now contain the first 10 bits of Register 40289. These can now be served as bits to the protocol of choice.

5.2.6 Task Moves

If a Task_Name is defined the move will become a repetitive task and the data will be updated on a regular basis. The time between updates can be set using the Scan_Interval parameter. If the Scan_Interval parameter is set the Task_Name parameter must be set. If a Task_Name is declared, but no Scan_Interval is defined, a default scan interval of 1s is assumed.

Node Status

The following data array can be configured to capture the status of a Node (refer also to **Section 6.1.1 Node Status Function**).

```
Data_Arrays
Data_Array_Name , Data_Format , Data_Array_Length , Data_Array_Function
DA_Comm_OK      , Bit                  , 256                          , Node_Status
Target_DA           , Bit                  , 200                          , -
```

Node status bits are only evaluated by the FieldServer when the data is accessed. Since the data is only accessed on update, the data will be neither accessed nor updated and a move would never occur. This can be circumvented by giving the move a Task_Name and specifying a Scan_Interval.

```
Moves
Function      , Source_Data_Array , Source_Offset , Target_Data_Array , Target_Offset , Task_Name   , Scan_Interval
Move_Only , DA_Comm_OK       , 0                     , Target_DA             , 40                    , PLC1_Status , 1
```

5.2.7 Match-Pattern

The match pattern move is used at run time to move a customized single value based on combinations of values in a Data Array as compared with preloaded customized criteria.

- The user builds a table of patterns (strings of tokens separated by "-") each linked to a particular location in a target Data Array.
- A "PATTERN DID NOT MATCH" string may also be defined and linked to a Data Array location.
- A pattern is built based on the values in the Data Array at run time by the move function.
- The pattern built at run time is compared with the preloaded table of patterns. The tokens in each pattern must match exactly. If the preloaded pattern contains a wildcard (*), that token would not be compared.
- If the pattern matches a pattern in the table, its value will be stored in the target Data Array at the specified location.
- If the pattern does not match any of the preloaded patterns in the table a check is done for a "PATTERN DID NOT MATCH" string in table. If found, the corresponding value will be stored in the target Data Array.
- If a "PATTERN DID NOT MATCH" string is not defined, a default value of –1 will be stored and an SDO will be generated prompting the user to add a "PATTERN DID NOT MATCH" record to the table.

In the example below, a combination of 4 values in a "Tokens" Data Array shows the status. The FieldServer can perform "match-pattern" arithmetic and store the status as a single number 0 thru 8.

```
Data_Arrays
Data_Array_Name , Data_Format , Data_Array_Length
Tokens          , Byte        , 4
Status          , Int         , 1
```

Consider the following combinations of 4 values, here * is a wildcard. The token starting with the wildcard will not be compared.

Data Array Values	Status Description	Status Value for Device
37 46 46 20	Good	0
36 * * 20	Channel disabled	1
* 45 * 20	Fault indicated2	2
* 43 * 20	Fault, aeration indicated	3
* * 45 20	Spacing indicator	4
* * 43 20	Zeromatc channel fault	5
* * 42 20	Empty Pipe	6
* * 37 20	hi/lo flowrate	7
00 00 00 00	comm. Error	8
	None of the above	111

Table of Patterns Configuration Example - Offset Table

Column Title	Function	Legal Values
Offset_Table_ Name	Provide name for Offset Table.	Up to 16 alphanumeric characters
Table_Index_ Value	A unique value that will be stored if the pattern matches.	1-255
Table_String	The pattern: "–" is the delimiter which separates tokens in a pattern and should not be considered as part of pattern. "*" means ignore this token	1-10000
Length*	The number of Data Array items to be used to build the pattern to compare with the Table string.	Number of tokens in table string should be the same as length under Moves, **1**
Table_User_ Value	Table user value defined by the applicable driver protocol. 0 = normal 1 = alarm 2 = fault	0-65,535

```
Offset_Table
Offset_Table_Name , Table_String             , Table_Index_Value , Table_User_Value , Length
SPR4052           , 37-46-46-20              , 0                 , 10               , 4
SPR4052           , 36-*-*-20                , 1                 , 20               , 4
SPR4052           , *-45-*-20                , 2                 , 30               , 4
SPR4052           , *-43-*-20                , 3                 , 40               , 4
SPR4052           , *-*-45-20                , 4                 , 50               , 4
SPR4052           , *-*-43-20                , 5                 , 60               , 4
SPR4052           , *-*-42-20                , 6                 , 70               , 4
SPR4052           , *-*-37-20                , 7                 , 80               , 4
SPR4052           , 00-00-00-00              , 8                 , 90               , 4
SPR4052           , PATTERN DID NOT MATCH    , 111               , 100              , 1
```

Moves Definition

```
Moves
Source_Data_Array , Source_Offset , Target_Data_Array , Target_Offset , Length , Function      , Offset_Table_Name
Tokens            , 0             , Status            , 0             , 4      , Match-pattern , SPR4052
```

The "Status" Data Array will contain only the numbers 0 thru 8 or 111 depending upon the combinations existing in the "Tokens" Data Array.

Table String Composition

Source Data Array Values	Source Data Array Format	Build Pattern	Description
55 15 0 255	Byte	37-0F-00-FF	Two Hex Characters.
555 15 0 -2550	INT, UINT16, UINT32	555-15-0--2550	Just as decimal values. **NOTE: 2550 is a negative value; there are two dashes before it "--"; one is considered a delimiter.**
55.12 15.123 0 255	FLOAT	55.12- 15.12- 0.00-255.00	Requires period and two decimal places.
1 1 0 1	Bit	1-1-0-1	Binary pattern.

NOTE: "*" can be inserted in place of any token if the value for that token is unimportant.

5.2.8 Conditional Moves

A move can be defined so that it is executed conditionally based on the status of a bit in a predefined Data Array location (conditional Data Array).

A useful feature of the conditional move is that data is able to be moved to the same target offset as defined by another conditional move. The user is thus able to move data from different sources into the same target based on the status of a bit in a Data Array.

The conditional bit can be placed in any Data Array and can also be in the source or destination Data Array. It simply needs to be declared in the Move instruction parameters.

A conditional move needs to be scheduled by the kernel for processing and therefore requires a task name and scan interval. The Parameters for a Conditional move are as follows:

Conditional Move Parameters	Description
Source_Data_Array	The name of the Data Array from which data is to be copied.
Source_Offset	The offset within the Data Array from which data is to be copied.
Target_ Data_Array	The name of the Data Array to which data is to be copied.
Target_Offset	The offset within the Data Array to which data is to be copied. The offset can be either a hardcoded value or can be obtained from another data array. See moves example in **Section 5.1.1 Simple Moves** for more information.
Length	The number of consecutive source Data Array values to be moved to consecutive target locations, starting at the respective offsets.
Conditional_Data_Array	The name of a Data Array to be used for conditional moves. See **Section 5.1.1 Simple Moves** "Separating Responsible Map Descriptors" for more information.
Conditional_Offset	The offset into the Conditional_Data_Array where the conditional bits for the move are defined. The value found at this specified location must be non-zero for the move to be executed. If the value is zero, the move is inhibited.
Task_Name	If a task name is specified, the move operation becomes a continuous task on the FieldServer that is executed at the scan interval specified.
Scan_Interval	The time interval at which the task will be repeated. A task name must be specified if a scan interval is specified.

Conditional Moves Example 1

In this example, the user needs to move the data from one of two source locations based on the status of bit 1 or 2 of the conditional Data Array. If bit 1 is high, then the data from Source_1 will be moved. If bit 2 is high, the Data from Source_2 will be moved. The kernel checks the condition of the bits every second for a change in status.

```
Moves
Source_Data_Array , Source_Offset , Target_Data_Array , Target_Offset , Length , Conditional_Data_Array
Source_1          , 0             , Target            , 00            , 1      , Status
Source_2          , 0             , Target            , 01            , 1      , Status
```

```
, Conditional_Offset , Task_Name , Scan_Interval
, 1                  , a         , 1
, 2                  , b         , 1
```

Conditional Moves Example 2

In this example, the data from DA_GV_01 will be moved to Gas_Snapshot only when DA_GP_PW_01 or DA_GL_PA_01 is updated on offset 192. In this example all of the Data Arrays are bits, but analog data types will work as well.

```
Moves
Source_Data_Array , Source_Offset , Target_Data_Array , Target_Offset , Length , Conditional_Data_Array
DA_GV_01          , 192           , Gas_Snapshot      , 00            , 1      , DA_GL_PW_01
DA_GV_01          , 192           , Gas_Snapshot      , 01            , 1      , DA_GL_PA_01
```

```
, Conditional_Offset , Task_Name , Scan_Interval
, 192                , a         , 1
, 192                , b         , 1
```

The Conditional Move that executed last becomes the Responsible Move by which data validity is determined, and through which write operations are routed. If none of the Conditional Moves targeting a specific location have executed, the Conditional Move defined last acts as the Responsible Move.

5.3 Mathematical Functions

Mathematical functions implement subset of math functions of Data Array values. Some single-operator functions can be incorporated into Moves, but Multi-operator/operand functions must be defined in the Math block. The length of the move defines the number of input operands.

The following table shows the Mathematics functions and their text representation:

Operator (csv text)	Mathematics Operator	Notes
ADD	+	All operands are combined and a single output is produced for n (=length) of input values.
SUB	-	
MULT	*	
DIV	/	
GTE	>=	Each move works as follows: value_of_(DA_SDA1 offset0) MathOperator value_of_(DA_SDA1 offset1) Result is stored in DA_TDA offset. Example (using GTE): value1 = DA_SDA1[0] ; value2 = DA_SDA1[1] If value1 is GTE value2, 1 will be stored at DA_TDA[10] otherwise 0 will be stored. **NOTE: The length parameter is always 1 as only one operation can be performed per move.**
LTE	<=	
GT	>	
LT	<	
EQ	=	
NE	!=	
SQ	Square	n outputs are produced for n (=length) values stored in sequence starting at the Target Offset.
SQRT	Square root	
PER	%	For 2 values (A and B), the result of A PER B will be (A/B)*100; which will be stored in the target Data Array.

5.3.1 Math Function as a Moves Function

```
Moves
Function , Source_Data_Array , Source_Offset , Target_Data_Array , Target_Offset , Length
ADD      , DA_SDA1           , 0             , DA_TDA            , 0             , 10
SUB      , DA_SDA1           , 0             , DA_TDA            , 10            , 10
MULT     , DA_SDA1           , 0             , DA_TDA            , 20            , 4
DIV      , DA_SDA1           , 10            , DA_TDA            , 30            , 3
SQ       , DA_SDA1           , 0             , DA_TDA            , 100           , 4
SQRT     , DA_SDA1           , 10            , DA_TDA            , 140           , 2
GTE      , DA_SDA1           , 0             , DA_TDA            , 10            , 1
LTE      , DA_SDA1           , 0             , DA_TDA            , 11            , 1
GT       , DA_SDA1           , 0             , DA_TDA            , 12            , 1
LT       , DA_SDA1           , 0             , DA_TDA            , 13            , 1
PER      , DA_SDA1           , 0             , DA_TDA            , 14            , 1
EQ       , DA_SDA1           , 0             , DA_TDA            , 15            , 1
NE       , DA_SDA1           , 0             , DA_TDA            , 16            , 1
```

5.3.2 Standalone Math

The Math definition allows up to four source data locations, up to four Math operations, and one output data location. Operands are kept on a “stack” and are operated on in the sequence in which they have been defined. Math functions consume 1 or 2 stack variables as inputs (2 for ADD, SUB, MULT, DIV, GTE, LTE, GT, LT, NE, EQ and 1 for SQRT, SQ) and leave the output on the stack, ready to be used by the next defined Math operation. The output of each operation becomes an input to the next operation, along with the next defined operand.

NOTE: Output of GTE, LTE, GT, LT, EQ, NE, AND, OR, and NOT is binary either 1 or 0.

AND, OR, and NOT work the same way as Logic.

The following fields are specific to the Math & Logic definition:

Fields Specific to the Logic Definition	
DAI1...DAI4	Input Data Arrays 1 through 4
DOI1...DOI4	Input Data Array offsets 1 through 4
DAO	Output Data Array
DOO	Output Data Array offset
FN1...FN4	Logic functions 1 through 4 (permitted values: ADD, SUB, MULT, DIV, GTE, LTE, GT, LT, EQ, NE, SQRT, SQ, AND, OR, NOT, - (no setting))

5.3.3 Math Usage Example

```
Math
Task_Name , Scan_Interval , DAI1  , DOI1 , DAI2  , DOI2 , DAI3  , DOI3 , DAI4  , DOI4 , FN1  , FN2  , FN3    , FN4    , DAO  , DOO
Task_105     , 1                    , DA_1 , 0       , DA_2 , 1       , DA_3 , 2       , DA_4 , 3       , ADD , SUB , MULT , SQRT , DA_5 , 21
```

This definition will result in the following operation:

DA_5[21] = Sqrt(((DA_1[0] + DA_2[1]) - DA_3[2]) * DA_4[3])

```
Math
Task_Name , Scan_Interval , DAI1  , DOI1 , DAI2  , DOI2 , DAI3  , DOI3 , DAI4  , DOI4 , FN1 , FN2
Task_105,    , 1                    , DA_1 , 0       , DA_2 , 1       , DA_3 , 2       , DA_4 , 3       , Div  , Sub
```

```
, FN3 , FN4 , DAO  , DOO
, Mult , Sq    , DA_5 , 21
```

This definition will result in the following operation:

DA_5[21] = (((DA_1[0] / DA_2[1]) - DA_3[2]) * DA_4[3] $)^2$

```
Math
Task_Name , Scan_Interval , DAI1  , DOI1 , DAI2  , DOI2 , FN1 , DAO  , DOO
Task_105     , 1                     , DA_1 , 0       , DA_2 , 0       , Per  , DA_5 , 0
```

This definition will result in the following operation:

DA_5[0] = DA_1[0] Per(%) DA_2[0]

Or

DA_5[0] = (DA_1[0] /DA_2[0]) * 100

For example, if DA_1[0] = 10 and DA_2[0] = 20 then this means Da_1[0] is 50 % of Da_2[0] so DA_5[0] will contain 50.

5.3.4 Optional Parameters

Parameter	Description	Legal Values
Length*	Specifies the number of consecutive source Data Array values from all defined source Data Arrays (for example, DAI1 through DAI4) to be operated on and to store a result at consecutive target locations, starting at the respective offsets.	Any positive integer
Task_ Name*	If a task name is specified, the move operation becomes a repetitive task on the FieldServer and the data will be updated on a regular basis.	Any string
Scan_ Interval*	Specifies the time interval at which the task will be repeated. A task name must be specified if a scan interval is specified.	>0.1s, **2s**
Truncate Result*	This function causes all intermediate and final results to be stored after truncating. Refer to the Truncate Result Example shown below.	Yes, **-**

Truncate Result Example

```
Math
DAI1  , DAI2  , DAI3  , FN1 , FN2  , DAO  , DOI1 , DOI2 , DOI3 , DOO , Length , Truncate_Results
DA_X  , DA_17 , DA_17 , DIV , MULT , DA_Z , 0    , 0    , 0    , 0   , 1      , Yes
```

If DA_17[0] = 17 and DA_X[0]=100=x

DA_Z[0]=(x/17)*17 will be = 85 NOT 100

5.4 Logic

Logic functions implement Boolean functions (True/False statements) of bit Data Array values. Single-operator logic can be incorporated into Moves, but Multi-operator/operand logic must be defined in the Logic block.

5.4.1 Logic as a Moves Function

The length of the Move defines the number of input operands. For binary operators [AND, OR] all operands are combined, and a single output is produced. For the unary operator [NOT] an output is produced for every input and is stored in sequence starting at the output location.

5.4.2 Standalone Logic

The logic definition allows up to four source data locations, up to four logic operations, and one output data location. Operands are kept on a "stack" and are operated on in the sequence in which they have been defined. Logic functions consume 1 or 2 stack variables as inputs (2 for AND, OR, and 1 for NOT) and leave the output on the stack, ready to be used by the next defined logic operation. The output of each operation becomes an input to the next operation, along with the next defined operand.

Fields Specific to the Logic Definition	
DAI1...DAI4	Input Data Arrays 1 through 4
DOI1...DOI4	Input Data Array offsets 1 through 4
DAO	Output Data Array
DOO	Output Data Array offset
FN1...FN4	Logic functions 1 through 4 (permitted values: And, Or, Not, - [no setting])

Logic Usage Example

```
Logic
Task_Name , Scan_Interval , DAI1  , DOI1 , DAI2  , DOI2 , DAI3  , DOI3 , DAI4
Task_105    , 1                  , DA_1 , 0       , DA_2 , 1       , DA_3 , 2       , DA_4
```

```
, DOI4 , FN1  , FN2 , FN3  , FN4  , DAO  , DOO
, 3       , AND , OR   , AND , NOT , DA_5 , 21
```

This definition will result in the following operation:

DA_5[21] = ~ (((DA_1[0] & DA_2[1]) | DA_3[2]) & DA_4[3])

5.5 Scaling

When writing a configuration file for the FieldServer, it may be required for the FieldServer to scale data before passing it on to the receiving devices. This can be accomplished in three different places in the FieldServer configuration:

- In the Client Side Map Descriptor section by adding scaling parameters.
- In the Server Side Map Descriptor section by adding scaling parameters.
- In the Moves section by adding scaling parameters.

In all cases, four keywords are added to the section that needs to be populated with the necessary scaling parameters. The FieldServer makes use of the four scaling parameters to calculate a slope and offset for scaling all incoming values. It is possible therefore, to do any linear value conversion that may be required.

5.5.1 Map Descriptor Scaling

For the first two cases where keywords are added to the map descriptors, the four keywords to be used along with their valid ranges are as follows:

Column Title	Function	Legal Values
Data_Array_Low_Scale	Scaling zero in Data Array.	Any signed 32-bit floating point value; **0**
Data_Array_High_Scale	Scaling max in Data Array.	Any signed 32-bit floating point value; **100**
Node_Low_Scale	Scaling zero in Connected Node.	Any signed 32-bit floating point value; **0**
Node_High_Scale	Scaling max in Connected Node.	Any signed 32-bit floating point value; **100**

NOTE: Bold numbers in the Legal Values column are default.

Converting Celsius to Fahrenheit

The following portion of a Map Descriptor example shows the settings required for a Client Map Descriptor to take a Fahrenheit temperature reading and store it into the Data Array as a Celsius value.

NOTE: These parameters do NOT define the data range, thus a temperature of 500^{o} F will still be properly converted.

```
Data_Array_Low_Scale , Data_Array_High_Scale , Node_Low_Scale , Node_High_Scale
0                    , 100                   , 32             , 212
```

5.5.2 Scaling Using Moves

It is also possible to scale values while moving data between Data Arrays. Doing the scaling this way often provides more visibility as it is then possible to view both scaled and unscaled data in the Data Arrays. The keywords for scaling in the moves section are different from the Map Descriptor keywords in order to avoid confusion, but function in much the same way. The keywords are:

Column Title	Function	Legal Values
Source_Low_Scale	Scaling zero in Source Data Array.	Any signed 32-bit floating point value; **0**
Source_High_Scale	Scaling max in Source Data Array.	Any signed 32-bit floating point value; **100**
Target_Low_Scale	Scaling zero in Destination Data Array.	Any signed 32-bit floating point value; **0**
Target_High_Scale	Scaling max in Destination Data Array.	Any signed 32-bit floating point value; **100**

NOTE: Bold numbers in the Legal Values column are default.

Multiplying Values by 10

The following move example shows 5 values being moved from one Data Array to another (DA_Unscaled=>DA_Scaled). During the move, the values are multiplied by 10, because the scaling parameters state that "A value from 0 to 10 in the Source is being represented as a value from 0 to 100 in the Target". Again, these do not represent limits, and so a value of 500 would also be scaled properly and end up as 5000 in the Target Data Array Offset.

```
Moves
Function , Source_Data_Array , Source_Offset , Target_Data_Array , Target_Offset , Length
Scale    , DA_Unscaled       , 00            , DA_Scaled         , 00            , 5
```

```
, Source_Low_Scale , Source_High_Scale , Target_Low_Scale , Target_High_Scale
, 00               , 10                , 00               , 100
```

5.6 Preloading Data Arrays with Initial Values

5.6.1 Introduction

Preloads provide a technique which allows parts of one or more Data Arrays to be initialized to specified values. The Preloads are defined in a configuration file and loaded once when the configuration file is loaded as the FieldServer starts.

5.6.2 Parameters Used to Define Preloads

Column Title	Function	Legal Values
Data_Array_Name	Name of the Data Array to be preloaded. The Data Array must exist or be defined in the configuration file and its definition must precede the preload that references it. If not, System Error Message 10117 will be printed.	Up to 15 alphanumeric characters.
Data_Array_Offset, Preload_Data_ Index, Location, Data_Array_ Location, Data_Array_Index or Buffer_Offset	The location in the Data Array to be preloaded.	0 to the length of the Data Array referenced minus 1. If the Data Array length is 200, the maximum value of this parameter is 199.
Length	Not used. A length of 1 is always applied.	
Preload_Data_Value or Preload_Value	Specify the value to be used to initialize the Data Array Location. If the Data Array specified is a Data Array of Complex Data Objects (CDO) then the kernel stores the value to the objects 'Present_ Value' field. The value is assumed to be a floating point value and the format specified by the parameter below is ignored. Strings: This has been tested with strings up to 320 characters long. Leading and trailing spaces and tabs are ignored; commas cannot be used and support for other special characters is unknown. Format must be specified as 'STRING'. The case of the characters is preserved.	Any number – may be specified with a fractional part, such as: 0, 1, 1.01, -1, 123.456 A String (see information in Function section)
Preload_Data_ Format*, Data_Array_Format* or Data_Format*	This parameter tells the kernel how to interpret and apply the value specified using the "Preload_Data_Value" parameter. **Not to be confused with the format of the Data Array.**	Float, Bit, Byte, Uint16, **Uint32**, Sint16, Sint32, String (must be specified as String if Preload_Value is String.), -
Preload_Obj_Name*	If this parameter is specified, then the kernel takes the value specified by the parameter and uses it to assign a 'Name' to the Data Array object if the Data Array is an array of Complex Data Objects (CDO).	A maximum of 39 characters. Leading/trailing spaces and tabs are ignored. Commas not supported; support for other special characters unknown. **-**

5.6.3 Limitations and Operational Considerations

- Each Data Array location to be preloaded requires its own preload line in the configuration file.
- The value specified must be compatible with the format of the Data Array – for example, Integer arrays cannot be preloaded with numbers that contain fractions.
- Preloads cause Data Array updates. The FieldServer kernel does not differentiate between an update on a Data Array performed as a preload or as the result of a store after processing a protocol message. If the Data Array point is associated with a Map Descriptor using the Write-on-update (WRBX) function or an RDBX function set to "Write through", the preload will trigger the write. Refer to **Section 4.3.2 Write Functions** "Write Block on Change (WRBX)" for more information.
- The 'Preload_Data_Format' must not be confused with the format of the Data Array being preloaded. The 'Preload_Data_Format' tells the kernel how to interpret the number specified by the 'Preload_Data_Value' parameter. For example, if 'Preload_Data_Format' is set to Byte then the preload value is cast to a byte* before being stored in the Data Array.

5.6.4 Examples of Loading Values

Load a Value

```
Preloads
Data_Array_Name , Preload_Data_Value , Preload_Data_Format , Preload_Data_Index
DA_SDA1         , 11                 , -                   , 0
```

In the above example:

- **Data_Array_Name** – The Data Array named 'DA_SDA1' must have been previously defined in the configuration file or else there will be a configuration error.
- **Preload_Data_Format** – Format specified with a dash, therefore the value 11 will be type cast to an unsigned 32-bit integer. Omitting the value altogether would have the same effect.

NOTE: If the format of the Target Data Array is "Bit", then the value 11 will not be stored as Bit arrays can only store 1 and 0.

Effect of Target Data Array Format

```
Data_Arrays
Data_Array_Name , Data_Format , Data_Array_Length
DA_1            , FLOA        , 20
DA_2            , BYTE        , 20
```

```
Preloads
Data_Array_Name , Preload_Data_Value , Preload_Data_Format , Preload_Data_Index
DA_1            , 257                , FLOAT               , 0
DA_2            , 257                , FLOAT               , 0
```

In the above example:

- **Data_Array_Name** – Only numbers in the range 0-255 inclusive can be stored in a BYTE array. The kernel removes any number that exceeds the byte. Therefore, the value stored will be 1.
- **Preload_Data_Value** – The value 257 will be stored.
- **Preload_Data_Format** – The value 257 is cast to a floating point number.

Negative Numbers

Only SINT16, SINT32 and FLOAT formatted Data Arrays can store negative numbers. The Preload_Data_Format must also be specified with one of those formats. Preload_Data_Format must be cast so that the sign is preserved and then stored in a Data Array whose format can support negative numbers.

```
Data_Arrays
Data_Array_Name , Data_Format , Data_Array_Length
DA_1            , FLOAT       , 20
```

```
Preloads
Data_Array_Name , Preload_Data_Value , Preload_Data_Format , Preload_Data_Index
DA_1            , -1                 , FLOAT               , 0
```

Floating Point Numbers

Only FLOAT formatted Data Arrays can store floating point numbers. The Preload_Data_Format must also be specified with ‘FLOAT’. In this example the value 123.456 is stored to the 11th element (index 10) of the Data Array called ‘DA_1’.

```
Data_Arrays
Data_Array_Name , Data_Format , Data_Array_Length
DA_1            , FLOAT       , 20
```

```
Preloads
Data_Array_Name , Preload_Data_Value , Preload_Data_Format , Preload_Data_Index
DA_1            , 123.456            , FLOAT               , 10
```

Strings (1)

Strings can be stored in Data Arrays of any format. If the Data Array format is UINT32 or SINT32 then the kernel will store two characters from the string in each Data Array element.

```
Data_Arrays
Data_Array_Name , Data_Format, , Data_Array_Length
DA_1            , FLOAT        , 20
```

```
Preloads
Data_Array_Name , Preload_Data_Value , Preload_Data_Format , Preload_Data_Index
DA_1            , Revision 123aA     , STRING              , 1
```

The string ‘Revision 123aA’ is stored starting in the 2nd element (index 1) of the Data Array named DA_1.

Strings (2)

```
Data_Arrays
Data_Array_Name , Data_Format , Data_Array_Length
DA_1            , Uint32      , 20
```

```
Preloads
Data_Array_Name , Preload_Data_Value , Preload_Data_Format , Preload_Data_Index
DA_1            , ABCD               , String              , 0
```

The value found in the 1st element of the Data Array will be 0x4241 (Ascii value of A) and the value found in the 2nd element will be 0x4443 (Ascii value of B). A UINT32 Data Array can store 2 characters per element.

Casting

In the following example, both Data Arrays are formatted as FLOAT and so can store the value 257.

```
Data_Arrays
Data_Array_Name  , Data_Format  , Data_Array_Length
DA_1             , FLOAT        , 20
DA_2             , FLOAT        , 20
```

```
Preloads
Data_Array_Name  , Preload_Data_Value  , Preload_Data_Format  , Preload_Data_Index
DA_1             , 257                 , FLOAT                , 0
DA_2             , 257                 , BYTE                 , 0
```

The value 257 will be cast to a byte before it is stored. Only numbers in the range 0-255 inclusive can be stored in a BYTE. The kernel chops off the part of the number that exceeds the byte and then stores this truncated value in the FLOAT array. Thus, the value 257 will be stored in the 1st element of DA_1 and the value 1 in the 1st element of DA_2.

Load an Object Name

In the example below a Complex Data Object for Analog Outputs is created with 20 objects. The preload sets the name of the 1st object (index 0) to the string ‘ABCDEFGHIJKLMNOPQRSTUV’ as well as setting the value of the Present Value field in the object to zero.

```
Data_Arrays
Data_Array_Name  , Data_Format  , Data_Array_Length
DA_1             , AO           , 20
```

```
Preloads
Data_Array_Name  , Preload_Data_Value          , Preload_Data_Format  , Preload_Data_Index
DA_1             , ABCDEFGHIJKLMNOPQRSTUV      , String               , 0
```

Loading Data_Array Values from the FieldServer’s Non-Volatile Memory

If the value in the Data Array changes, the FieldServer can be configured to save this changed value to its Non-Volatile Memory up to 3 times a minute using the DA_Function_After_Store Parameter. On startup the value will be loaded from the Non-Volatile Memory into the Data Array. This value will only be stored 3 times a minute, so if more writes than that are done, the values will be stored in the Data Array, but not to the Non-Volatile Memory. Storing this value has performance impacts, so care must be taken to store this value only if needed.

There is a limit to the number of values that can be stored from a single data array:

UINT32: 9

FLOAT: 9

UINT16: 19

BYTE: 39

```
Data_Arrays
Data_Array_Name , Data_Format , Data_Array_Length  , DA_Function_After_Store
DA_NV_UINT32    , UINT32      , 1                  , Non_Volatile
```

6 Node Management

6.1 Data Array Functions

6.1.1 Node Status Function

The Node Status Function is a Data Array function which provides the communication status between the FieldServer and the actively mapped Nodes. The online status of a Node is indicated in the Node Status Data Array. If the communication status is good, then the Node Status is set to 1. The communication status goes bad if it does not receive a response to a poll. The offset number in the Data Array is equivalent to the station address of the Node. Refer also to **Section 9 Timing Parameters**, **Section 12.2 Default Settings for Parameters** and **Section 12.4.5 Nodes**.

For example, if there are seven devices connected to the FieldServer, with node addresses 1 through 7. Offsets 1 through 7 of the Node Status Data Array will represent the statuses of these devices. Therefore, if all of the devices are online, a value of 1 will be found in offsets 1 through 7. If a device goes offline, device 5 for example, then offset 5 in the Node Status data array will change from a value of 1 to a value of zero.

Data Array offset zero is not available with this function, please use the Alias Node ID feature to reassign a node ID of zero to another value.

Typical Data Array Parameters are:

Column Title	Function	Legal Values
Data_Array_Name	Provide name for Data Array	Up to 15 alphanumeric characters
Data_Format	Provides Data format	Bit
Data_Array_Length	Number of Data Objects	1 to **256**
Data_Array_Function	Special function for Data Array	Node_Status

```
Data Arrays
Data_Array_Name , Data_Format , Data_Array_Length , Data_Array_Function
DA_Comm_OK      , Bit         , 256               , Node_Status
```

6.1.2 Alias_Node_ID

If you have two Nodes with the same Node_ID or your Node_ID's are longer than 255, the Node Status Function as described above will not work correctly. In such cases, each Node can be assigned an Alias_Node_ID which can be used to provide Node Status.

Typical Data Array Parameters are:

Column Title	Function	Legal Values
Data_Array_Name	Provide name for Data Array	Up to 15 alphanumeric characters
Data_Format	Provides data format	BIT
Data_Array_Length	Number of Data Objects	Minimum of 256 bits
Data_Array_Function*	Special function for the Data Array	Alias_Node_Status, **None**

Example

A Data Array has been defined to report the status of the Nodes in the configuration using the Alias_Node_ID. Each Node that has been allocated an Alias_Node_ID will have the corresponding bit in the Data Array set/unset based on the Node's status.

```
Data Arrays
Data_Array_Name , Data_Format , Data_Array_Length , Data_Array_Function
Comm_Bits       , Bit         , 900               , Alias_Node_Status
```

```
Nodes
Node_Name , Node_ID , Alias_Node_ID , Protocol    , Port , Retry_Interval , Recovery_Interval
N1        , 1       , 3             , Modbus_RTU  , P1   , 0.1s           , 0.1s
N3        , 1       , 300           , Modbus_RTU  , P2   , 0.1s           , 0.1s
```

Alias_Node_Status differs from Node_Status as follows:

- If a Node does not have an Alias_Node_ID defined, then that Node's status will not be reflected in the Data Array.
- The Alias_Node_ID's can be any positive whole number including zero up to the limit of the maximum Data Array size.

6.1.3 Node_Online_Bits

This Data Array function allows the user to specify Nodes and Subnets for which communication status is required. Typical Data Array Parameters are:

Column Title	Function	Legal Values
Data_Array_Name	Provide name for Data Array.	Up to 15 alphanumeric characters
Data_Format	Provides Data format.	Bit
Data_Array_ Length	If specified, this allows the user to configure the number subsequent nodes after the Node_ID.	1 to **256**
Data_Array_ Function	Special function for Data Array.	Node_ Online_ Bits, **None**
Node_ID*	If configured, the Node address of the specified Node will be at offset 0. The length parameter will be used to determine the number of Node addresses starting from the Node_ID. If not declared or specified as -, Node_ID 0 will be at offset 0.	1 to 256, **-**
Subnet_ID*	This allows the subnet of the Node to be declared. If subnets are not used, this parameter can be excluded. If specified as -, the subnet is ignored, and all Nodes will be found.	**0** to 256, -

```
Data_Arrays
Data_Array_Name , Data_Format , Data_Array_Length , Data_Array_Function , Node_ID , Subnet_ID
Node_on_Net     , Bit         , 30                , Node_Online_Bits    , 1       , -
Node_on_Net1    , Bit         , 30                , Node_Online_Bits    , 1       , 1
Node_on_Net2    , Bit         , 30                , Node_Online_Bits    , 10      , 2
Node_on_Net3    , Bit         , 30                , Node_Online_Bits    , 10      , 3
Node_on_Net4    , Bit         , 30                , Node_Online_Bits    , 10      , 4
Node_on_Net5    , Bit         , 30                , Node_Online_Bits    , 10      , 5
```

6.2 Connection Parameters

6.2.1 Node_Retire_Delay

When a FieldServer is started up, it polls all Nodes. Nodes that respond within the specified timeout period (seconds) will be marked online. Nodes failing to respond within the timeout period will be repeatedly polled for the length of time specified in the Node_Retire_Delay parameter (seconds). Once this period has expired, there will be one further poll and if the Node does not respond within the specified timeout period, it will be retired. The FieldServer must be restarted for retired or new Nodes to be identified. This is an optional parameter. If not set, the FieldServer will continue retrying indefinitely. This would be useful in a situation where there are plans for expansion and some Nodes have not yet been installed and so would never respond.

```
Connections
Port         , Timeout  , Node_Retire_Delay
P1           , 0.2      , 10
P2           , 0.2      , 10
P3           , 0.2      , 10
Nodes
Node_Name    , Node_ID , Protocol          , Port , Retry_Interval , Recovery_Interval
Dev1         , 1       , Modbus_RTU        , P1   , 0              , 0
Dev2         , 2       , Modbus_RTU        , P2   , 0              , 0
Dev3         , 3       , Modbus_RTU        , P3   , 0              , 0
```

6.2.2 Backup_Port

The FieldServer will initially poll using the port defined under the Port parameter. If no communication occurs, it will use the port defined under the Backup_Port parameter. The FieldServer will continue to switch between the ports until communications are established. This is an optional parameter. If not set, the FieldServer will only use the port defined under the Port parameter.

```
Connections
Port         , Timeout , Backup_Port
P1           , 0.2     , P2
```

6.3 Node Parameters

6.3.1 Node Offline Action

This function allows the user to clear the values from a Data Array if the associated active connection to a Passive Node is lost. By default, the last values obtained from the Passive Node will remain in the Data Arrays if the connection is lost. This functionality has been implemented for the following protocols – BACnet/IP, BACnet MS/TP, Modbus RTU, Modbus TCP/IP, LonWorks, and Metasys N2. A configuration example follows:

```
Nodes
Node_Name , Node_ID , Protocol    , Port , Address_Type , Node_Offline_Action
PLC_12    , 12      , Modbus_RTU  , P1   , ADU          , Clear_data_Array
PLC_13    , 13      , Modbus_RTU  , P1   , PDU          , No_Action
```

6.3.2 Node Inactivity Timeout

This parameter can be used with Passive Client drivers to let the FieldServer mark the node offline, should no messages be received in the set time period. Normal node recovery will take place and the node will go online once messages are received again. Sometimes it might be required to keep the node always online. An example of this could be if the FieldServer is connected to a printer port of a device (such as some Fire Panel drivers) that only generates messages at an event rate of once per every couple of weeks or months. In such cases the parameter can be omitted or set to zero.

```
Nodes
Node_Name , Node_ID , Protocol , Port , Node_Inactivity_Timeout
PLC_12    , 12      , FCI_E3   , P1   , 0
PLC_13    , 13      , FCI_E3   , P1   , 15
```

In the above example:

- **Node_Inactivity_Timeout** – In PLC_12, the timeout function is disabled. The Node will stay online. In PLC_13, the Node will be marked offline if no messages are received for 15 seconds.

7 Setup Dynamic Parameters

Most FieldServer parameters are specified in a configuration file and are fixed. A growing number, however, may be changed dynamically using values found in Data Arrays. We call these Dynamic Parameters.

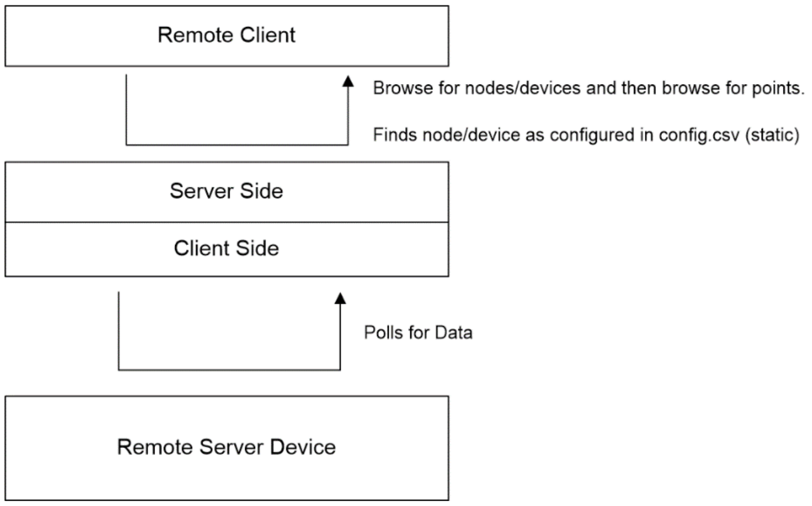
The following parameters can be dynamically configured.

Parameter	Section Title	Notes
Node_ID	Nodes	This parameter typically describes the Server device address of a communications session.
System_ Node_ID	FieldServer	Many drivers use this parameter and the 'meaning' of the parameter is dependent on its context. For example: BACnet - Used as the MAC address DNP 3.0 - Used as the local station ID
BACnet_ MAC_ Address	FieldServer	Similar to changing the System_Node_ID but specifically designed for use on ProtoCessors because it also writes the new ID down to the PIC where BACnet is implemented.
Baud	Connections	The baud rate on a connection can be changed dynamically from the value in a data array.
Function	Dynamic_ Parameters	This parameter is used to load a profile config.

7.1 Dynamic Allocation of Node_ID or Station Number

Almost all FieldServer configurations consist of a Server and Client side. The Client side of the FieldServer reads data from the Server device. The Server side of the FieldServer then serves this data to remote Client Nodes using a different protocol. The configuration of the Server Side of the FieldServer is done in a configuration file and as such is fixed. This is illustrated in the sections that follow.

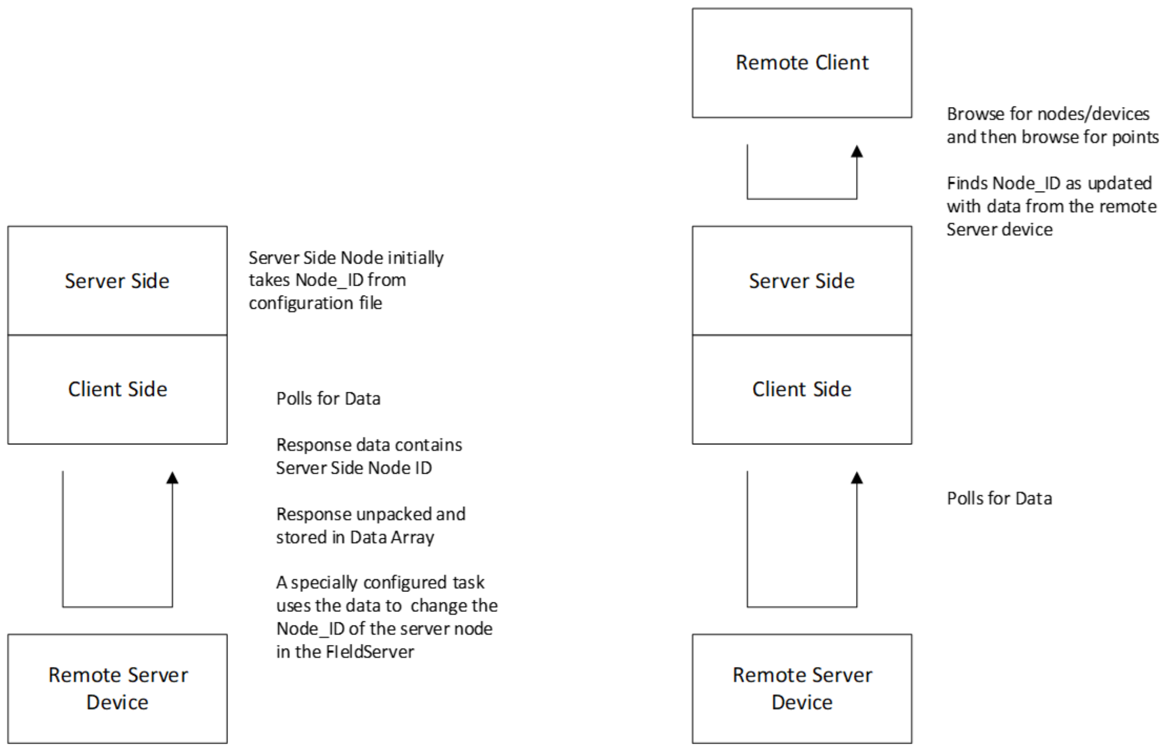
7.1.1 Static Server Side Node_ID


Remote Client
Browse for nodes/devices and then browse for points.
Finds node/device as configured in config.csv (static)
Server Side
Client Side
Polls for Data
Remote Server Device

7.2 Dynamic Server Side Node_ID

It is possible to control the Node_ID of the Server Node by including a special task in the Configuration file that watches the value of a single element of a Data Array. When the value is updated then this task takes the value and replaces the Node_ ID of a designated Node so that its new Node_ID is the value found in the Data Array. This is illustrated in the following diagram.

This new Node_ID can be saved to the Non-Volatile Memory so that it isn't lost on a power cycle. When the device starts up again, the stored value will be used.


Server Side
Client Side
Remote Server Device
Server Side Node initially takes Node_ID from configuration file
Polls for Data
Response data contains Server Side Node ID
Response unpacked and stored in Data Array
A specially configured task uses the data to change the Node_ID of the server node in the FIeldServer
Remote Client
Browse for nodes/devices and then browse for points
Finds Node_ID as updated with data from the remote Server device
Server Side
Client Side
Polls for Data
Remote Server Device

7.3 Map Descriptor Parameters Specific to Dynamic Parameters

Column Title	Function	Legal Values
Function	Function of Client Map Descriptor.	Change_Node_ID Change_System_Node_ID Change_System_MAC_Addr
Descriptor_ Name	Name of the Object that will be affected by the Dynamic Parameter function.	One of the Node names specified as described in **Section 12.4.5 Nodes**, or the Bridge Title of the FieldServer specified as described in **Section 12.4.1 Common Information - FieldServer**; Refer to the example sections for more information
Data_ Array_ Name	Name of Data Array from which the parameter value is taken.	One of the Data_ Array_ Names specified as described under **Section 12.4.2 Data Arrays**
Data_ Array_ Offset*	Offset into the Data Array from which the parameter value is taken.	**0** to (Data_Array_Length -1) as defined in **Section 12.4.2 Data Arrays**
Low_Limit* High_Limit*	These parameters can be used to define a range of offsets that are affected by this command.	Positive integer, 0, **-**
Save*	The save value enables or disables making the change permanent. If yes, the value will be stored and used next time on start-up as the Node_ID. If no, the change will only remain until the next power cycle, at which time the value in the configuration file will be used.	Yes, **No**

7.4 Dynamic Parameters

Column Title	Function	Legal Values
Function	Function to load profile.	Load_csv, Load_csv_with_parameter, Load_profile
Parameter	Parameter to load profile.	DA_Offset
Data_Array_ Name	Name of Data Array from which the parameter value is taken.	One of the Data_Array_Names specified as described under **Section 12.4.2 Data Arrays**
Data_Array_ Offset*	Offset into the Data Array from which the parameter value is taken.	**0** to (Data_Array_Length -1) as defined in **Section 12.4.2 Data Arrays**
Length*	If specified, this allows the user to configure the number subsequent nodes after the Node_ID.	**1** to 255
Config_Table_ Name	Used to select between different profiles.	Table name created from Config table section (**Section 7.5 Config Table**)
Restart_ Method	Determines the restart behavior on a profile load.	Never, On_change
Profile_Group	Used to select between different profiles.	Table name created from profiles section (**Section 7.6 Profiles**)

7.5 Config Table

Column Title	Function	Legal Values
Config_Table_Name	Name of config table.	Up to 32 alpha numeric characters
Table_String	Name of csv file to load.	Filename ending with ".csv"
Table_Index_Value	Expected value that will be used to load profile.	Any integer value

7.6 Profiles

Column Title	Function	Legal Values
Profile_Name	Name of profile table.	Up to 32 alpha numeric characters
Profile_Filename	Name of csv file to load.	Filename ending with ".csv"
Profile_Parameters	Name of parameters used to load into profile.	Up to 32 alpha numeric characters
Profile_Group	Name of group used to load a profile.	Up to 32 alpha numeric characters
Profile_Selector	Expected value(s) that will be used to load profile.	Any integer value

7.7 Dynamic Allocation Examples

7.7.1 Node ID

The parameter value is taken from the specified Data Array and Data Array Offset and is used to modify the parameter specified under Function of the object (example: Node) specified under Descriptor_Name, subject to the limits set by Low_ Limit and High_Limit.

In this example, when the value of Node_Array offset 160 is updated (presumably by a driver) then the FieldServer will check the value is in the range 0 to 255 inclusive. If it is, it will look for the Node called 'PLC_1'. If found, the Node_ID will be changed to the new value.

```
Dynamic_Parameters
Function          , Descriptor_Name , Data_Array_Name , Data_Array_Offset , Low_Limit , High_Limit , Save
Change_Node_ID    , PLC_1           , Node_Array      , 160               , 0         , 255        , Yes
```

7.7.2 System Node ID

The FieldServer watches DA_NODE_ID_NEW offset 0. When the data is updated, the FieldServer looks for a Node named 'NODE_1'. If a valid one is found, then the NODE_ID of that Node will be changed and the FieldServer will print a message reporting the change.

```
Dynamic_Parameters
Function              , Descriptor_Name , Data_Array_Name , Data_Array_Offset , Low_Limit , High_Limit , Save
Change_System_Node_ID , NODE_1          , DA_NODE_ID_NEW  , 0                 , 0         , 255        , Yes
```

The Low_Limit and High_Limit parameters may be omitted in which case the Node_ID is not validated against them.

The save value enables or disables making the change permanent. If yes, the value will be stored and used next time on start-up as the Node_ID. If no, the change will only remain until the next power cycle, at which time the value in the configuration file will be used.

7.7.3 BACnet MAC Address

Configuration and operation is the same as changing the System_Node_ID except that this command not only changes the value of the System_Node_ID parameter it also causes the firmware to write to the underlying PIC on the FieldServer to have it start using the new ID.

```
Dynamic_Parameters
Function               , Descriptor_Name , Data_Array_Name  , Data_Array_Offset , Low_Limit , High_Limit , Save
Change_System_MAC_Addr , Bridge1         , DA_NODE_ID_NEW   , 0                 , 0         , 255        , Yes
```

In the example above, the FieldServer watches offset zero of the Data Array called DA_NODE_ID_NEW. If it changes and the new number is valid (in range) then the ‘Bridge’ section of the configuration file is scanned until a bridge whose ‘Title’ matches the descriptor name’ is found. Once found, the value of the System_Node_ID is updated, and the driver writes the new ID down to the PIC on which the BACnet driver has been implemented.

The Low_Limit and High_Limit parameters may be omitted in which case the Node_ID is not validated against them.

The save value enables or disables making the change permanent. If Yes, the value will be stored and used next time on start-up as the System_MAC_Addr. If No, the change will only remain until the next power cycle, at which time the value in the configuration file will be used.

7.7.4 Connection Baud Rate

The Baud Rate on a connection can be dynamically changed from a Data Array Value by one of the following methods.

Method 1: Using pre-mapped Data Array values to Baud Rates

By defining the Data Array format as Baud, a responsible Map Descriptor can be used to dynamically change the Baud Rate on the associated connection. In the Example the below the Baud Rate on the R1 connection will be set to 9600 at startup and will be changed to one of the following Baud Rates (if supported) whenever the Map Descriptor stores a value in the Data Array.

Data Array Value	Baud Rate	Data Array Value	Baud Rate
0	Default	8	19200
1	110	9	20833
2	300	10	28800
3	600	11	38400
4	1200	12	57600
5	2400	13	76800
6	4800	14	115200
7	9600		

Specify the Data Format as Baud. This forces the use of the Values/Baud Rate table above.

```
Data_Arrays
Data_Array_Name , Data_Format , Data_Array_Length
DA_BAUD         , BAUD        , 1
```

The Connection, Node and Map Descriptor examples below apply to both methods.

```
Connections
Port          , Baud  , Parity , Data_Bits , Stop_Bits , Protocol
R1            , 9600  , None   , 8         , 1         , Modbus_RTU
```

```
Node_Name , Node_ID    , Protocol    , Port
MB_RTU    , 11         , Modbus_RTU  , R1
```

```
Map_Descriptors
Map_Descriptor_Name , Scan_Interval , Data_Array_Name , Data_Array_Offset , Function , Node_Name , Address , Length
CMD_AO1             , 1.0s          , DA_BAUD         , 0                 , RDBC     , MB_RTU    , 40001   , 1
```

Method 2: Using actual Baud Rate Values

Specify the Data Format as a conventional value data type (for example - Byte, Uint16, Uint32)

```
Data_Arrays
Data_Array_Name , Data_Format , Data_Array_Length
DA_BAUD         , UINT32      , 1
```

Only for this method, specify a dynamic parameter of Function Baud_Rate to allow the use of actual Baud Rate values in the Data Array to change the Baud Rate Dynamically stored in the Data Array will cause the Baud Rate to be changed.

```
Dynamic_Parameters
Function    , Descriptor_Name  , Data_Array_Name , Data_Array_offset
Baud_Rate , R1                 , DA_BAUD         , 0
```

7.7.5 Error Messages

Message	Description
DynParam:#1 Err. Validation impossible. Lo=%f Hi=%f Desc=%s"	The low validation value is greater than the high value.
DynParam:#2 Err. DescName=%s too long.	This message is printed when evaluating a Dynamic parameters task where the function = ‘Change_Node_ID’. The maximum length of the descriptor is 32 characters.
DynParam:#3 Err. Node_ID Set from DA. Node=%s not found	While trying to change the Node_ID, the FieldServer could not find a Node whose name matches the task’s ‘Descriptor_Name’ parameter.
DynParam:#4 Err. Node_ID Validation failed. Lo=%ld Hi=%ld Rqd=%d Node=%s	The Node_ID was not changed because the dynamic value extracted from a DA did not satisfy the validation. Check that the devices have been correctly configured. Possibly mapping of DA and offset need adjustment.
DynParam:#5 FYI. Node=%s Id=%d changed to %d (%s:%d=DA:off)	This message is printed each time the Node_ID is successfully updated dynamically. You may ignore this message if it confirms your expectations.
DynParam:#6 Err. DescName=%s too long.	This message is printed when evaluating a Dynamic parameters task where the function = ‘Change_System_Node_ID’ or ‘Change_System_MAC_Add’. The maximum length of the descriptor is 32 characters.
DynParam:#7 Err. System_ Node_Id Validtn failed. Lo=%ld Hi=%ld Rqd=%d Node=%s	The value extracted from the DA to be used as a dynamic parameter is out of range (based on the low and high values specified). Review the validation range in the configuration file and also review your mapping. Perhaps the DA:offset does not contain the new ID.
DynParam:#8 FYI. Bridge=%s(%d) Id=%d changed to %d (%s:%d=DA:off)	This is confirmation of a change of a symnica parameter where the function is ‘Change_ System_Node_ID’ or ‘Change_System_MAC_Add’. You may ignore this message if it confirms your expectations.
DynParam:#9 FYI. Cant write MAC_ADDR to PIC with this firmware	This message will be printed immediately after #8. If the platform is not a ProtoCessor, it can be ignored.

NOTE: If you edit the configuration, download the modified configuration and reset the FieldServer for the changes to take effect.

8 Port Expander Mode – PEX Mode

Under certain conditions the FieldServer can be configured in a Port Expander Mode where statically configured Map Descriptors are not required to retrieve data from a Server Node.

8.1 How Port Expansion Works

When the FieldServer receives a poll from the Client Node, it scans its internal tables looking for a Map Descriptor that matches the poll. If such a Map Descriptor is found, the FieldServer responds with data from the appropriate Data Array. If no Map Descriptor is found, the FieldServer scans the list of configured Nodes and *creates* a Map Descriptor (cache) to fetch the data from that Node and returns this data to the Client. The FieldServer will continue to retrieve data from the Node for future polls from the Client Node. If the Client Node does not access the data for longer than the time configured under Cache_Time_To_Live, (refer to **Section 12.4 Permissible Values for Configuration File Variables**) then the FieldServer will stop reading the data and remove the Map Descriptor (cache).

8.2 Advantages of Port Expander Mode

Configuration is simpler - the FieldServer automatically creates and deletes Map Descriptors as required. If mapping changes are made to a Client, the FieldServer usually does not need to be reconfigured.

8.3 Limitations of Port Expander Mode

Port Expander Mode does not work with all combinations of drivers.

If the FieldServer is used as a Pure Port Expander (Single Protocol) there is no restriction at all (such as Modbus RTU Port Expander).

The following families of drivers support Port Expansion within the family:

- Modbus RTU

8.4 Port Expander Write Options

Three possible scenarios exist for Writes in Port Expansion Mode:

- A Temporary Read Map Descriptor already exists for the point being written.
- A Temporary Write Map Descriptor already exists for the point being written.
- No Temporary Map Descriptor exists for the point being written.

In the first two cases data is simply written through the FieldServer to the Server using the existing Temporary Data Arrays. In the third case, temporary Map Descriptors are created.

The Node parameter Write_Ack_Option needs to be configured. By default, the FieldServer will wait for a write to complete before sending an acknowledgement of a write. However, it is possible to configure the FieldServer to send acknowledgement of the write when the write is received and not wait for upstream device to acknowledge it. Refer to **Section 12.4 Permissible Values for Configuration File Variables**.

8.5 Handling of Successive Writes to the Same Point

When multiple successive port expansion writes to the same point occur, there is a potential build-up of pending write transactions in the FieldServer, since the Server side may receive write transactions at a faster speed than they are completed on the Client side (depending on the speeds of the respective protocols).

There are two fundamental ways of dealing with the potential accumulation of successive writes to the same point:

- **Overwrite – any pending write values that have not yet been sent to the Server are overwritten with the latest write value. This is the default option and it ensures that the last value that was received from the Client is written to the Server. Intervening writes may be lost.**
- **Blocking – if it is important to preserve the sequence of write values to the same point (such as a switching sequence of on/off transitions), then the Server can be configured to handle writes in a blocking mode. Here successive writes to the same point are queued to a configurable maximum length. Writes are accepted from the Client until the queue is full, at which point further writes will be rejected. This option must be configured on the Server using the below connection parameters and values.**

Column Title	Function	Legal Values
Write_ Queue_ Mode	Mode for dealing with potential accumulation of successive writes to the same point can be configured.	**Overwrite**, Blocking
Write_ Queue_Size	The length of the queue can be configured **if blocking mode is set**. Blocking will occur when there is no more space on the Write_Queue. If size=0 every successive write is blocked. A message will be displayed when blocking occurs, except if the Queue_Size=0.	Non-negative integer, **0**

```
Connections
Port , Baud , Parity , Data_Bits , Stop_Bits , Protocol     , Poll_Delay , Write_Queue_Mode , Write_Queue_Size , Timeout
P1   , 9600 , None   , 8         , 1         , Modbus_RTU , 0.100s     , Blocking         , 5                , 8s
```

8.6 Port Expansion Configuration

The example configuration file for this mode is available from technical support if needed. Although Map Descriptor configuration is not required, Connections and Nodes do need to be configured.

```
Connection
Port        , Protocol , Server_Hold_Timeout
P1          , mb_rtu   , 12
P2          , mb_rtu   , -
```

```
Nodes
Node_Name , Node_ID , Protocol , Port , Timeout , Write_Ack_Option
Dev1      , 1       , mb_rtu   , P2   , 12      , Ack_Complete
```

9 Timing Parameters

Under normal operation, the FieldServer will send a poll request to a Server device and that device will reply with a response. The amount of time between successive poll requests is called the **Scan_Interval.** The time between receiving a response from a Server device and the next poll request is called the **Poll_Delay**.

If the FieldServer sends a poll request, and the Server device does not send a response, it is considered a timeout. The time the FieldServer waits before declaring a timeout can be adjusted by the **Timeout** parameter. If a timeout occurs, then the FieldServer will retry the poll request (number of times retried is specified by the **retries** parameter). The interval between **Retries** is specified by the **Retry_Interval**. The FieldServer will send poll requests at the end of each **Retry_ Interval.** Once the specified numbers of **Retries** have been sent, the FieldServer will mark the Node offline. Once a Node has been marked offline, it will wait for a period specified by **Recovery_Interval** before sending another poll request.

Once the communications have been re-established, the FieldServer will wait for a period called **Probation_Delay**, before marking the Node as online.

NOTE: The Ic_Timeout parameter monitors the time between characters in a response. If the time exceeds the Ic_Timeout, the response is discarded and is considered a Timeout.

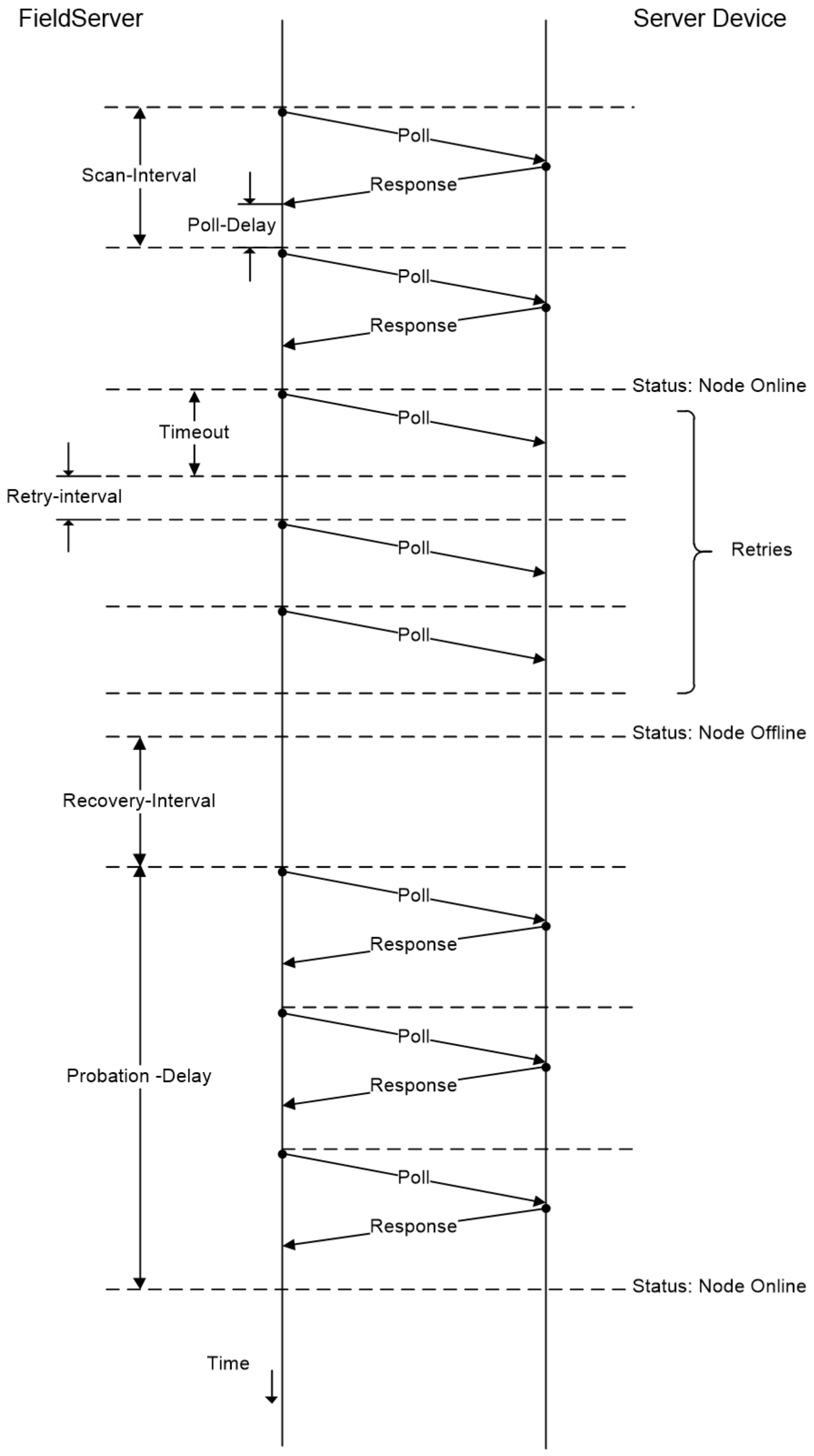
NOTE: All parameters in bold above are configurable. See table below for where they are configured, and what the defaults will be if they are not configured. Refer also to Section 12.2 Default Settings for Parameters.

Parameter	Default Value	Where Used
Scan_Interval	2 seconds	Map Descriptor, Node, Connection
Poll_Delay	0.05 seconds	Connection
Timeout	2 seconds	Map Descriptor, Node, Connection
Retry_Interval	10 seconds	Node
Retries	3 times	Node
Recovery_Interval	30 seconds	Node
Probation_Delay	1 minute	Node
Ic_Timeout	0.5 seconds	Map Descriptor, Node, Connection
Node_Inactivity_Timeout	0 seconds	Node (**Section 6.3.2 Node Inactivity Timeout**)

NOTE: In the case of parameters that may be declared at the Connection, Node or Map Descriptor level, when the parameter is declared at more than one level, the Map Descriptor declaration takes highest priority, followed by the Node declaration and then the Connection declaration.

NOTE: A non-response from the remote Server device causes a Timeout. The driver does nothing until a response is received or the timeout period has expired. If a connection has two Nodes and one Node is producing Timeouts this will have the effect of slowing down communication for the other Node in the sense that the driver does nothing while the timeout timer is counting up to its setpoint. Once there is a timeout on one Node, the driver will not retry any Map Descriptors on that Node until the Retry_Interval has expired. During the Retry_Interval the other Node will get 100% of the service.

FieldServer Timing Diagram



9.1 Enable on RS-232 Port

```
Connections
Port , Baud , Parity , Data_Bits , Stop_Bits , Protocol , Poll_Delay
P1   , 9600 , None   , 8         , 1         , mb_rtu   , 0.1
```

10 Useful Features

10.1 Using Comments

Configuration file comments are either lines or line segments that start with “//”. These allow notation within the code for reference or organization. See Examples below.

```
Nodes       // Main building Node
Node_Name    , Node_ID    , Protocol
Test_A       , 1       , Modbus_RTU
```

```
Nodes    // Main building Node
Node_Name    , Node_ID    , Protocol
Test_A       , 1       , Modbus_RTU
```

NOTE: It is recommended to keep a good margin of space between the code and the comment when you follow code with a comment on the same line. This prevents confusion.

However, never place comments in the middle of a segment of code. This will prevent the code from running properly.

```
Nodes       // Main building Node
Node_Name    , Node_ID    , Protocol
Test_A       , 1       , Modbus_RTU
```

10.2 Using Conditional Process Statements

The Client or Server sides of a configuration can be disabled using the following keywords:

Keyword	Function
Ignore	All lines will be ignored after this statement until a process statement is encountered.
Process	Causes lines after this statement to be processed again.
End	Configuration stops here, ignoring all further lines.

10.3 Disabling the Client Side of a Configuration

```
//    Set up the Modbus Server side
//
Data_Arrays
Data_Array_Name    , Data_Format    , Data_Array_Length
DA_DO_01    , Bit     , 1

Connections
Port    , Baud    , Parity    , Data_Bits    , Stop_Bits    , Protocol
P1    , 9600    , None    , 8    , 1    , Modbus_RTU

Nodes
Node_Name    , Node_ID    , Protocol
RTU_Srv_11    , 11        , Modbus_RTU

Map_Descriptors
Map_Descriptor_Name    , Data_Array_Name    , Data_Array_Offset    , Function    , Node_Name    , Address    , Length
SMD_DO1    , DA_DO_01    , 0    , Passive    , RTU_Srv_11    , 00001    , 1

ignore

//=================================================================
//Set up the Modbus Client side
//
Connections
Port
P2
Nodes
Node_Name    , Node_ID    , Protocol    , Port
DEV11        , 11        , Modbus_RTU    , P2

Map_Descriptors
Map_Descriptor_Name    , Data_Array_Name    , Data_Array_Offset    , Function    , Node_Name    , Address    , Length
SMB_BO1    , DA_DO_01    , 0    , RDBC    , DEV11    , 1    , 1

Process
```

10.3.1 Disabling a Node

```
Nodes
Node_Name , Node_ID , Protocol     , Port
DEV11     , 11      , Modbus_RTU , P2
ignore
DEV12     , 12      , Modbus_RTU , P2
process
```

10.4 Disabling Statistics Display

For large configurations with many Map Descriptors there is a possibility that the FieldServer will run out of memory before the entire configuration file is loaded. In order to conserve memory, it is possible to disable the collection of per Map Descriptor statistics. This is done by adding the MD_Option parameter to the Map Descriptor section and setting the value to No_Stats for each Map Descriptor. If a specific Map Descriptor is to be monitored, then this setting can be omitted for that Map Descriptor.

Setting the No_Stats option on a Map Descriptor will disable the display of statistics for that Map Descriptor in FS-GUI and will cause zero values to be reflected for all statistics relating to that Map Descriptor in FieldServer Diagnostics Logs.

NOTE: Statistics on the Node and Connection are not affected.

This example will disable statistics on SMD_11_AI_01 but not on SMD_11_MI_02.

```
Map_Descriptors
Map_Descriptor_Name , Data_Array_Name , Data_Array_Offset , Function , Node_Name      , Object_Type
SMD_11_AI_01        , DA_AI_01        , 0                 , Passive  , Virtual_Dev_11 , AI
SMD_11_MI_02        , DA_AI_01        , 1                 , Passive  , Virtual_Dev_11 , MI
```

```
, Object_Instance , MD_Option
, 01              , No_Stats
, 02              , -
```

10.5 DHCP Client Options

The FieldServer DHCP (Dynamic Host Configuration Protocol) Client can be enabled to obtain an IP Address lease from a networked DHCP server. Currently, the DHCP hostname option can be enabled to report the FieldServer’s network hostname to a DHCP Server. This is done by creating a text file named hostname.ini containing a single line of text (such as Boiler_Bridge_A). This file must be sent to the FieldServer and restarted to take effect. This hostname will be visible in the DHCP Server’s list of IP leases and could be optionally, manually added to a DNS server (a Static lease IP Address should be reserved in the DHCP Server), in order to address the FieldServer by its hostname. For more information on enabling the FieldServer DHCP Client, refer to the FieldServer FS-GUI Manual.

11 Troubleshooting

11.1 Moves Performance

Suppose we need to read 1000 points from a PLC and transfer it to another data array, there are several ways to do it using moves. The table below shows the impact on the time it takes to complete the moves using different configuration methods:

Map Descriptor	Length	Moves	Length	Operations	Memory Locations Transfer	Performance Degrade Due to Moves
1	1000	1	1000	1	1000	None
1000	1	1000	1	1000	1000	None
1	1000	1000	1	1000	1000	Some what
1000	1	1	1000	1000	1000000	Too Much

11.2 Restart Cause Table

Value	Reason
0	No Registry Entry
1	Reset caused by RUI (Remote User Interface)
2	Request to load new config
3	General application specific
4	Power Cycle
5	N/A
6	Scheduled reset
7	Unknown
8	CGI reset
9	RPC reset
10	Reinitialize BACnet Device
11	Restart file found
12	Thread Failure
13	Forth
14	Logging Error
15	CGI reboot

11.3 Server Hold Timeout Errors

When an incoming read request references multiple data points, the FieldServer will wait for all points to be valid before responding. Previously, the FieldServer waited for the 1st point to be valid. This can have the effect of triggering Server Hold Timeout errors if the data does not all become valid in time for a response. The solution is to configure a longer server hold timeout.

12 Reference

12.1 Working with the Driver Manuals

12.1.1 Introduction

The purpose of the Driver Manual is to provide driver specific configuration information. When drivers are installed in the FieldServer the specific combination is assigned a Driver Configuration Code (DCC). The DCC covers the combination of drivers listed on the cover. In addition to the specific configuration instructions for each driver, these manuals provide drawings and default configuration files for the combination of drivers.

The Driver Manual contains a section for both the Client and Server side software drivers. Each section of this supplement is split into two parts. The first describes the hardware and software included with the FieldServer, as well as providing additional information relating to getting the FieldServer set-up and connected. The next part discusses the configuration file in detail and provides all the information needed to configure the driver related parameters.

12.1.2 Driver Manuals as Part of the Documentation Set

In order to install and configure the FieldServer, proceed through the instructions in the Start-up Guide. Refer to the Driver Manual for connection information. If the default file is all that is needed then nothing further is required, it is already loaded onto the FieldServer. If it is necessary to modify the Configuration Files to suit specific needs, refer to **Section 1 FieldServer Concepts** of this manual for a general overview of the configuration file, and then refer to the specific driver supplements for configuration information on the drivers.

12.2 Default Settings for Parameters

Parameter	Default Setting
Default response timeouts	2000 ms = 2 sec
Inter character timeout	500 ms
SCADA hold	2000 ms = 2 sec
Data cache age limit for acceptable data	20000 ms = 20 sec
Cache	80
Retry Interval	10000 ms = 10 sec
Recovery Interval	30000 ms = 30 sec
Probation Delay	60000 ms = 1 min
Scan Interval	1 second
Poll Delay	50 ms
Retries	3
Activity Timer	120000 ms = 2 hour
Parity	None
Baud	9600
Data Bits	8
Stop Bits	1
Handshake Timeout	2000 ms = 2 sec

12.3 Available Data Types for Data Arrays

To facilitate the choice of data type, each of the data types available are described below.

Data Format	Description
Float	Format used to store Floating Point Analog values (Example: temperature, volts). Each point in the array represents one 32 bit Floating Point value.
Bit	Format for storing Binary Data. Each point in the array represents one bit.
Byte	Format for storing Bytes of data. Each point in the Array represents one Byte.
SInt16 – Signed 16 bit Integer	Range: -32768 to 32767, discrete. Each point in the array represents one integer.
Uint16 – Unsigned 16 bit Integer	Range: 0 to 65 535, discrete. Each point in the array represents one integer.
SInt32 – Signed 32 bit Integer	Range: -2147483648 to 2147483647, discrete. Each point in the array represents one integer.
Uint32 – Unsigned 32 bit Integer	Range: 0 to 4294967295, discrete. Each point in the array represents one integer.
Baud	Format used to dynamically change the Baud rate on a connection (refer to **Section 7 Setup Dynamic Parameters**).

In transferring data points from one protocol to another via the Data Arrays in the FieldServer, the integrity of the data format is retained. For example, if a point representing a bit data type is transferred into a Data Array of type Float, the value will be a 32 bit floating point value that will only take on the values of 0 and 1. If this is transferred to an integer point in another protocol, the value will still only ever take on the values of 0 and 1 despite the type conversions. This can be overcome using Moves – refer to **Section 5.2 Function Moves – Type Casting**.

12.4 Permissible Values for Configuration File Variables

Default and acceptable values for the different variables defined in the configuration file. Optional Values ate indicated with an asterisk. Default values are indicated in bold. Timing parameters are listed in seconds (0.003 would represent three milliseconds).

While this list contains acceptable variables for the FieldServer, some are not suitable for all configurations, depending on the drivers used. Refer to specific driver manuals for complete information regarding acceptable variable values for any driver.

NOTE: For the following sections, titles in parenthesis indicate aliases.

12.4.1 Common Information - FieldServer

Column Title	Function	Legal Values
Title	Allows user to specify the title of the FieldServer.	Title Text
Cache_Age; (Cache_Age_ Timeout)*	When poll block caching is used, data previously polled and stored in an internal data buffer is returned to the Server, providing the data is not too old. This parameter specifies the length of time cached data is valid.	Time in seconds, **300s**
Cache_Size*	Specify size of Cache.	0-1000; **80**
Cache_ Time_ To_ Live*	Used for Port Expansion. A cache is created for data from a Node for which no Map Descriptor is configured. If this data is not accessed for longer that the time specified by this parameter, the cache will be cleared.	Time in seconds, **300s**
Tier*	FieldServers have the ability to run as “multiple” FieldServers on one platform. To differentiate between the different running applications, each of the applications is referred to as a Tier with a specific name.	**2**
FieldServer_Name*	A name by which a FieldServer is identified - need not be unique.	**Blank**
Cache_Age_Limit*	Maximum age of data in a cache Map Descriptor for immediate response to poll.	**5 minutes**
System_Node_ID (System_ station_ address or System_ station) *	Use is driver dependent. Generally used to identify the FieldServer as a Node when it is configured as a Server.	**1**
Network_number*	Displayed where a protocol requires the FieldServer to be assigned a network number (such as BACnet).	**5**
Hot_Standby_ Mode*	Where specified, this parameter defines the behavior of the standby FieldServer in Hot Standby mode. In Mode 1 the FieldServer is completely passive; in Mode 2 the standby FieldServer polls the connected devices through alternate communication paths.	**Blank**
Port_Expander_ Mode*	Indicates whether the port expander mode function is enabled or not.	**Blank**
Cache_Map_ Descriptor_ Scan_Interval*	If the value 65535 is displayed, then this is an error and it indicates that there is no setting.	**2 seconds**
Hot_Standby_ Designation*	Primary or Secondary. On boot the primary tries to become the active and the secondary tries to become the standby FieldServer. This behavior may be different if the so called secondary FieldServer gets re-booted first.	**Primary**
Hot_Standby_Pair_ Name*	A name by which a pair of FieldServers configured as a Hot Standby pair is known. When one of a pair boots, it broadcasts a message with its pair name in order to try and locate the other FieldServer that forms the hot standby pair.	**Blank**
Pex_Mode*	Specify if Pex_Mode should be enabled or disabled. Refer to **Section 8 Port Expander Mode – PEX Mode** .	**Blank or Enabled,** Disabled

12.4.2 Data Arrays

Column Title	Function	Legal Values
Data_Array_Name (DA_Name)	Provides name for Data Array.	Up to 15 Alpha Numeric Characters.
Data_Format	Provides Data Format.	INT16, INT32, or BYTE; Specifies size of source value when scaling FLOAT; specifies floating point format for preloaded data in buffer.
Data_Array_Length (Buffer_Length)	Number of Data Objects.	0-10000
Data_Array_ Function*	Special function for the Data Array.	Refer to table in **Section 12.4.3 Data Array Function**, **None**
DA_Function_ After_Store*	If this parameter is specified, when a value different to the current value is written to the Data Array it will be stored in the FieldServer's Non-Volatile Memory. On start-up this value is loaded from the Non-Volatile Memory into the Data Array. This value is only stored 3 times a minute, so if more writes than that are done, the values will be stored in the Data Array, but not to the Non-Volatile Memory. Storing this value has performance impacts, so care must be taken to store this value only if needed. Refer to **Section 5.6.4 Examples of Loading Values**. – Loading Data_Array Values from the FieldServer's Non-Volatile Memory.	Non-Volatile, **Default value blank**
Max_Value	Specify maximum value of data array. Specifies the maximum value that can be stored in the data array.	Any integer; use – if no hard limit is desired
Min_Value	Specify minimum value of data array. Specifies the minimum value that can be stored in the data array.	Any integer; use – if no hard limit is desired

12.4.3 Data Array Function

The Data_Array_Function Keyword is used in the configuration file to get system specific error conditions and statistics. The available keywords are listed below:

Keyword	Description
Node_Online_Bits Node_Error_Bits	Bit 0 is unused. Every bit corresponds to the Node with that number up to 255. Example: Bit 3 corresponds to Node 3, etc. Refer to **Section 6.1.3 Node_Online_Bits**.
Cable_Status_Bits	See specification in the Hot Standby ENOTE – link in **Section 1.1 Introduction**.
Hot_Standby_ Status_Bits	See specification in the Hot Standby ENOTE – link in **Section 1.1 Introduction**.
Node_Detail_Stat (Dev_Detail_Stat)	A Data Array is created to reflect Node details. Handle can be set. Values are reflected in the following order: 0 = Device handle, 1 = Node port; 2 = connection; 3 = old station; 4 = station.
Chan_Detail_Stat	Connection information 0 = First value handle; 1 = port; 2 = old port; 5 = error count Values in Data Array will reflect these values.
Node_Overview_ Stat	Gives overview of all devices configured on the FieldServer. Cycles through all the devices on the FieldServer in the order that they are configured. **NOTE: The Data Array needs to be long enough to store all device information.** 0 = Handle; 1 = station; 2 = port; 3 = adapter; 4 = status; 6 = old station; 10 = Historical message count; 11 = minutes; 12 = hour; 13 = day; 14 = month; 15 = Historical error count; 16 = minutes; 17= hour; 18 = day; 19 = month. The next device starts at position 20 and the same structure is repeated. Reporting will stop after all the devices have been reported or when the Data Array is full.
Chan_ Overview_ Stat	Same except 0 = handle; 1 = port; 2 = adapter; 3 = status; 8 = old port; 9 = old adapter. Thereafter follow Historical message and Error blocks in the same format as above.
Dev_Error_Rates	Reports the number of errors per hour for each Node. Location in the Data Array is the station of the device. For example, if the device station is configured to be 10, position 10 in the Data Array will show the number of errors per hour. Errors for the past 60 minutes are stored.
Dev_Msg_Rates	Same as above, except counting messages not errors.
Dev_Error_ Percentage	Percentage of messages generating errors over the past hour.
Node_Status	Provides the communication status between the FieldServer and the actively mapped Nodes. Refer to **Section 6.1.1 Node Status Function**.
Alias_Node_Status	Where 2 nodes have the same Node_ID or Node_ID's are longer than 255, each Node can be assigned an Alias_Node_ID which can be used to provide Node Status. Refer to **Section 6.1.2 Alias_Node_ID**.
Get_System_Time	This parameter can access the system clock via Data Array. The suggested Data Array format is UINT32, with a minimum length of 9. The Data Array calculates system time in the following format: Offset =Description: 0=Seconds since 1 Jan 1970 00:00:00, 1=Milliseconds past the second, 2=Year (20XX), 3=Month (1-12), 4=Day, 5=Hour, 6=Minute, 7=Second, 8=Milliseconds **NOTE: After a boot up, the FieldServer system time is not set on startup, and the initial timestamps will start at 0. An external time sync to initialize its clock is needed.** This can be done via either of the following options: • The FS -GUI can be used to set the system time if it connects to a FieldServer with an uninitialized system time. To synchronize time in FS-GUI, click the System Time Synch button at the bottom. • Connecting the bridge to the MSA Grid will allow the time to be updated even after boot up. • If the bridge is set up for BACnet, the BACnet Client can perform a time sync.
System_LED_ Status	Provides the states of the system's hardware LEDs with a 1 indicating an LED is on and a 0 indicating an LED is off. The target data array for this function should be of type "BIT" and needs to have a minimum length of 5. The system LEDs correspond to the following bit offsets: Bit 0 = Run LED. Toggles every second while the FieldServer is running. Bit 1 = HSB Active LED. Bit 2 = Node Offline LED. Bit 3 = Configuration Error LED. Bit 4 = System Error LED.

12.4.4 Connections/Adapters

Column Title	Function	Legal Values
Port	Specifies the serial port that connects the device to the FieldServer. **NOTE: Not all ports shown in the legal values are necessarily supported by the hardware. Consult the appropriate Instruction manual for details of the ports available on specific hardware.**	P1-P2, R1-R2
Adapter	Used for Ethernet and hardware connections.	N1-N2, WLAN
Protocol	The name of the protocol used by this connection.	
Baud*	Specifies Baud Rate.	300, **9600**, 38400
Parity*	Specifies serial data byte parity.	Even, Odd, **None**
Data_Bits*	Sets number of data bits for serial port.	7, **8**
Stop_Bits*	Sets the stop bits for communications.	**1**, 2
Ic_Timeout*	Specifies inter-character timeout period within a message once it starts.	Timeout in seconds, **15 ms**
Turnaround_ Delay * (Turnaround_ Time)	This is the time the Server takes to initiate a response after receiving a poll.	Serial Drivers: **5 ms** Ethernet Drivers: **0 ms**
Client/Server_ Mode*	Where two FieldServers are connected in Hot Standby mode each with a PEX and a SCADA Tier, if the SCADA Tier of one FieldServer polls the SCADA Tier of the other FieldServer, that tier will start acting as a Server. Setting this parameter to Client_Only will prevent this happening.	Client_Only
Node_Retire_ Delay*	This parameter allows the user to configure a time after which a Node is no longer polled until the FieldServer is restarted. See **Section 6.1.3 Node_Online_Bits**.	Time (s), **0**
Write_Queue_ Mode*	Mode for dealing with potential accumulation of successive writes to the same point can be configured.	**Overwrite,** Blocking
Write_ Queue_ Size*	The length of the queue can be configured if blocking mode is set. Blocking will occur when there is no more space on the Write_Queue. If size=0 every successive write is blocked. A message will be displayed when blocking occurs, except if the Queue_ Size=0.	Non-negative integer, **0**
Bias_Mode*	Only relevant to ProtoNode. If this parameter is set to Yes or Enabled, it loads the RS-485 line by placing additional resistance on it This has the benefit of making the signals cleaner in a noisy environment but may reduce the maximum number of devices possible in a multidrop configuration.	Enabled, Yes, **Disabled**, No
Poll_Delay*	The minimum amount of time that must pass between one Client Map Descriptor completing its task and the next Client Map Descriptor being serviced. Refer to Driver Manuals.	**.05 seconds**
Low_Pri_Poll_ Delay*	The poll delay used for lower priority Map Descriptors.	Protocol dependent
Server_Hold_ Timeout*	When an upstream device polls the FieldServer, and the data is unavailable or too old, the driver generates a poll to the downstream device for fresh data, (port expansion). The Server_Hold_Timeout defines the time available for this transaction to complete before an error is returned.	**2 seconds**
IP_Address*	An IP Address for the connection if applicable.	
Remote_IP_ Address*	A remote IP Address for the connection if applicable.	
Timeout*	The timeout defined for the connection.	**2 seconds**
Recovery_ Interval*	The time after a node goes off-line before the driver tries to poll the device again.	**30 seconds**
Probation_ Delay*	The length of time communication needs to be re-established for before an offline Client node is marked on-line again.	**1 minute**
Multidrop_ Mode*	Indicates whether Multidrop mode is enabled or not. Multidrop mode allows a server to ignore requests to nodes that are not configured.	Enabled for RS-485, disabled for RS-232

IP_port*	Determined by specific driver or protocol used. See Driver Manual.	
Remote_IP_ Port*		
Max_Master*		
Max_Info_ Frames*		
Connection_ Type*		
Application*		
TLS_Port	Refer to **Section 8 Port Expander Mode – PEX Mode** .	
Validate_ Client_Cert		
Cert_ Authority_File		
Check_ Remote_Host		
Server_Cert_ File		

Adapter Section

Column Title	Function	Legal Values
Adapter	Adaptor name.	DH+, Modbus+, PROFIBUS, etc.
MAC_Address (Net_number)	Specify Network MAC address.	

12.4.5 Nodes

Column Title	Function	Legal Values
Node_ Name (Device_ Name)	The node name specified in the CSV file.	Up to 32 Alpha Numeric Characters
Node_ID*	The station number or address of the node. The actual meaning is dependent on the driver and protocol – refer to the Driver Manual.	1-255
Protocol	The protocol being used to update the data for that node. Refer to the Driver Manual.	Modbus/TCP etc.
IP_Address*	IP Address of the Server Device.	Valid IP Address, -
Host_Name*	Specifies the host name of the remote device. If a Host name is used instead of an IP Address, the FieldServer will try to resolve it to an IP_Address before starting to poll the remote device. If using an IP_Address and a Host_Name, the FieldServer will try to resolve the host name to get the latest IP_Address to use, otherwise the configured IP_Address will be used. The FieldServer will try to re-resolve the host name before starting node recovery to get the latest IP_ Address. If a host name cannot be resolved, the last known IP_Address will remain in use	Any valid host name (see Function), -
Retries*	Specifies how many sequential errors must occur before marking a data buffer and poll block bad and marking a device offline. The FieldServer will poll the device and if it receives no response will retry polling the device the number of times specified by the retries parameter. The FieldServer will attempt to recover the connection once the recovery interval has elapsed.	Count default **3**
Retry_Interval*	The amount of time in seconds that the driver should wait before retrying a poll after a timeout has occurred.	Interval in Seconds
Node_Offline_Action*	If this parameter is defined, when a Client Node goes offline, all Data Array values of Map Descriptors defined on this Node will be set to zero.	Clear_Data_Array, **No_Action**, **-**
Remote_IP_Address*	The remote IP Address used by this node.	Required for protocols that use it
Node_Type*	Specified in the configuration file as the PLC_Type. - Consult the driver manual for additional information.	Required for protocols that use it
Port*	Port number for a serial connection.	
Srv_Offline_Method*	A Server Node could send contradictory information if its data comes from multiple Client Nodes, some of which are offline and others online, causing it to respond differently depending on what data is polled. This confuses some systems. This setting allows the user to select whether the Server Node should appear online or offline if there is a mix of Client Node Statuses. **Ignore_Clients** - causes the Server to behave explicitly – not to depend on the status of the Client Node, but on the data validity only. Meaning non-expired data will be served whether or not the responsible Client Nodes are online. **Any_Offline** - suppress a data response if ANY of the responsible Client Nodes for the data range concerned are offline **All_Offline** - only suppress a data response if ALL of the responsible Client Nodes for the data range concerned are offline. **Always_Respond** - overrides the data validity as well. Forcing the Server Node to regard data as valid even if the Client Node is offline or the data has expired.	Ignore_Clients Any_Offline All_Offline Always_Respond
Write_Ack_Option*	**Ack_ Complete** - the Server waits for the Client Side write transaction to complete before acknowledging the Write request. This makes for good reliability but has a cost in terms of throughput. **Ack_Immediate** (default) - fast, but less reliable. The Server immediately acknowledges a Write request before queuing the Client Side Write. The acknowledgement is thus not affected by the success or failure of the Client Side Write. Only recommended if the same points are updated regularly. (In PEX mode Ack_Immediate is the same as Ack_Complete). **Ack_Verified** - most reliable, and slowest. The Server waits for a Client Side Write and Readback to be completed, and only updates the data value if a data comparison between the Client Side Write and Read values passes. If the transaction fails for any reason or if the data comparison fails, the Server responds with a negative acknowledgement.	Ack_Complete, **Ack_Immediate**, Ack_Verified
Enable_Write_Retries*	Default write behavior is to attempt a write operation (WRB or WRBX) only once. If the write times out then the write operation is aborted. If set to yes, this parameter enables failed write requests to be retried. The number and timing of the write retries are decided via Retries and Retry_Interval parameters. **Warning:** Ensure that repeated writes are safe for your application since a Write may be retried because of a transmission error in the Write acknowledgement, in which case the remote device will see two similar write requests.	Yes**, No**
Readback_Option*	This Client Side parameter enables the user to configure the timing of a read after a write. The Readback operation will apply to all drivers that support Active Reads and Write-Through operations. **Readback_Asynchronously** - When a write occurs, the read will occur when scheduled. **Readback_On_Write** - When a write occurs, set the timer to 0, so Responsible Map Descriptor gets	**Readback_On_ Write**, Readback_ Asynchronously, Readback_

	queued in the next cycle. **Readback_Immediately_On_Write** - Prioritize both write and read to happen in a higher priority queue than normal reads. The Readback operation will apply to all drivers that support Active Reads and Write-Through operation.	Immediately_On_ Write
MAC_Address*	Required for protocols that use it, not needed for other. Specified by remote Mac Address of the device.	Required for protocols that use it
Node_Offline_ response*	The type of response the Server side of the driver sends when it finds the Server node to be offline.	**No_Response**, Old_ Data, Zero_Data, FFFF_Data (not valid for all protocols)
Timeout*	The timeout specified for the node.	**2 seconds**
Recovery_Interval*	The time in seconds after a node goes off-line before the driver tries to poll the device again.	**30 seconds**
Probation_Delay*	The length of time communication needs to be re-established for before an offline Client node is marked on-line again.	**1 minute**
Server_Name*	An alternate to specifying the IP Address. Used when the user wants two nodes to talk to each other. When specified, the FieldServer sends out a broadcast with the server name and uses the reply to fill in the IP Address for the node. Until the reply has been received all polling for the node is disabled. The server name given should correspond to the pair_name specified in the remote FieldServer's bridge settings.	Only applies to the SMT protocol
Alias_Node_ID*	Used to distinguish between different nodes connected to the FieldServer when a PLC does not support the allocation of different None_ID's. Each node is given a different alias. Upstream devices poll the Alias_Node_ID and the FieldServer routes the poll to the correct PLC, polled using the Node_ ID.	Any integer, **-**
Ports_on_PLC*	For hot standby operation. This field is used to control which port on a PLC to poll.	See specification in the Hot Standby ENOTE – link in **Section 1.1 Introduction**.

12.4.6 Map Descriptors

Column Title	Function	Legal Values
Map_ Descriptor_ Name	Used to identify a Map Descriptor by name.	Up to 32 Alpha Numeric Characters
Data_Array_ Name (DA_ Name)	The name of the Data Array where information will be stored to and retrieved from by the Map Descriptor.	One of the Data Array names as defined in **12.4.2 Data Arrays**
Data_Array_ Offset	The offset into the Data Array where data should be stored on reads or retrieved from on writes.	0 to (Data_Array_Length -1) as defined in **12.4.2 Data Arrays**
Function	Function of Client Map Descriptor.	Refer to **Section 4.3 Active Map Descriptor Functions**
Node_Name	Name of Node to fetch Data from.	One of the Node names specified in "Client Node Descriptor" Section
Data_Type (Type)*	Data Type in PLC.	See applicable driver manual for validity and applicability
File_Type*	File Type in PLC.	
Block_Number (DB) (File_Number)*	Block Number in PLC.	
Data_Array_ Low_Scale* (Buffer_Low_ Scale)	Scaling zero in Data Array.	Any signed 32-bit floating point value; **0**
Data_Array_ High_Scale* (Buffer_High_ Scale)	Scaling max in Data Array.	Any signed 32-bit floating point value; **100**
Node_Low_ Scale*	Scaling zero in Connected Node.	Any signed 32-bit floating point value; **0**
Node_High_ Scale*	Scaling max in Connected Node.	Any signed 32-bit floating point value; **100**
MD_Option*	Setting the No_Stats option on a Map Descriptor will disable the display of statistics for that Map Descriptor in FS-GUI and will cause zero values to be reflected for all statistics relating to that Map Descriptor in FieldServer ToolBox logs. Refer to **10.4 Disabling Statistics Display** .	No_Stats, **-**
Node_ID*	The Node ID used by this Map Descriptor when the driver builds read or write messages.	
Address*	Allows a Map Descriptor to address remote device data at a specific start memory location.	Protocol dependent
Length*	Allows a Map Descriptor address a number of remote device data locations from the start address.	1, **Protocol dependent**
Scan_Interval*	When using continuous Map Descriptor functions such as RDBC, this is the time a Map Descriptor will wait before polling for data again.	**.5sec**
Units*	Used to specify engineering units to interpret data if used. Will display a dash if not used.	Protocol Dependent
Network*	Used by some drivers as a network number.	Check manual for values
Sector*	Used by some drivers as a sector number for rack addressing.	Check manual for values
Panel*	Used by some drivers as a panel number for rack addressing.	
Card*	Used by some drivers as a card number for rack addressing.	

12.5 Valid Characters for Common Fields in Configuration Files

ASCII Code	Char	Comment		ASCII Code	Char	Comment
32	[space]			82	R	
33	!			83	S	
35	#			84	T	
36				85	U	
38 & 39	‘			86	V	
40	(			87	W	
41	)			88	X	
42	*			89	Y	
43	+			90	Z	
45	-			91	[	
46	.			92	\	
47	/			93	]	
48	0			94	^	
49	1			95	_ [underscore],	
50	2			96	`	
51	3			97	a	
52	4			98	b	
53	5			99	c	
54	6			100	d	
55	7			101	e	
56	8			102	f	
57	9			103	g	
58	:			104	h	
59	;			105	i	
60	<			106	j	
61	=			107	k	
62	>			108	l	
63	?			109	m	
64	@			110	n	
65	A			111	o	
66	B			112	p	
67	C			113	q	
68	D			114	r	
69	E			115	s	
70	F			116	t	
71	G			117	u	
72	H			118	v	
73	I			119	w	
74	J			120	x	
75	K			121	y	
76	L			122	z	
77	M			123	{	
78	N			124	|	
79	O			125	}	
80	P			126	~	
81	Q					

12.6 Kernel Error Messages and Descriptions

Error	Description	Action
10003	A write to a Data Array exceeds the available space.	Check Map Descriptor Offset, length.
10004	A write to a Byte/FloatData Array exceeds the available space.	
10005	A range of data exceeds the length of a BYTE Data Array.	Check Map Descriptor Offset, length, count.
10009	Protocol not detected.	Check Node_Name in csv file.
10010	No connection defined for an existing Physical Node Descriptor.	Confirm that Active Map Descriptors are not added to a Server Node. Define the Client Node Descriptor connection in the CSV file.
10011	Unable to create a Client Node Descriptor, since no valid channel adapter or port has been specified.	Specify a valid channel adapter or port.
10014	Attempting to read a range past the end of BYTE Data Array.	Check Map Descriptor Offset, length, count.
10016	Could not find or create Node.	Check Node_Name, Node_ID and protocol in CSV file.
10019	Spelling Error	Check CSV file spelling.
10023	Protocol or Node_Name for Map_Descriptor not detected.	Check CSV file.
10025	Modbus/TCP - Client goes offline before receiving a response to a poll.	Increase the timeout on the Modbus/TCP Client.
10026	There is no connection to one side of a virtual wire.	Ensure that a Client and a Server is configured for each virtual wire.
10027	Connection mode of Hot_Standby_Data only supported in Hot Standby Mode1.	See specification in the Hot Standby ENOTE – link in **Section 1.1 Introduction**.
10028	Could not find nor create a Node.	Refer to Error 10010 "No Connection defined for an existing Physical node Descriptor".
10031	The data_points limit on the FieldServer has been reached.	Contact technical support.
10032	A Server Node has been assigned to a Client Map Descriptor OR a Client Node does not have a connection/Server_Name.	Check CSV file.
10033	Invalid length specified for Cable_Status_Bits.	See specification in the Hot Standby ENOTE – link in **Section 1.1 Introduction**.
10034	An attempt to generate a write cache block failed because the Node did not have a connection.	Establish communication.
10034	A protocol was specified in the configuration file, but the required driver is not loaded in the firmware (CB8MENU).	Correct the protocol in the configuration file. Obtain the correct DCC.
10038	The FieldServer did not respond due to a Data Array Age time exceeding the Cache Age time limit.	Increase Cache Age setting in the configuration file.
10039	There was a message overrun on Modbus TCP slave driver. The Client is polling too often for the FieldServer to respond and there is more than one message in the in-buffer. There should be overrun statistics on the Server Connection in question.	Increase the timeout on the Client device.
10040	Same as 10039, except the overrun is more than two messages.	
10041	Invalid move function specified in configuration file, or move not defined.	Fix the configuration error.
10042	High and Low Scaling values are equal.	Specify different scaling values
10045	Move overruns Data Array. This usually means that the offset PLUS the length of the Move command is larger than the length of the Data Array.	Check Data_Array Length, Check Move settings
10046	Move Offset lies outside the Data Array. This usually means that the offset of the Move command is larger than the length of the Data Array.	
10047	Could not find Source Data Array for Move.	Make sure that the specified Data Array exists before specifying move.
10048	Could not find Target Data Array for Move.	
10049	Could not find Client Data Array for Move.	
10050	Could not find Server Data Array for Move.	
10051	Could not find Feedback Data Array for Move.	
10052	Could not find Mode Data Array for Move.	
10053	Data Array already has a responsible move	
10054	Setpoint Moves are only allowed to be 1 item in length.	
10055	A move was defined, and a write occurred to the target Data Array, but cannot transfer to the Source Data Array because no	

Error	Description	Action
	Responsible Active Map Descriptor is defined.	
10056	A move was defined, and a write occurred to the target Data Array, but cannot transfer to the Source Data Array because the Node associated with the Responsible Active Map Descriptor is offline.	
10058	8051bp03 or CB8MENU found SMCTCP.INI and FS_TCP.INI files, so it will delete FS_TCP.INI and use SMCTCP.INI in future.	
10070	Illegal Node_ID.	
10071	Map Descriptor length of 0 is not allowed.	
10072	Map Descriptor length too large.	
10073	Illegal Data Type for J-Bus.	Legal values = AI AR DI DR.
10074	An attempt to generate a write cache block failed because the Node did not have a connection.	
10075	Illegal Map Descriptor address.	
10076	This Data Array section already has a responsible Map Descriptor.	
10077	Unable to add parameters from this line.	Ensure Map Descriptor headings are in the .CSV file.
10079	Map Descriptor length greater than Data Array length.	
10082	Failed attempt to do a Modbus read from Node_ID 0.	Only writes can be broadcast.
10083	Illegal Modbus Map Descriptor length.	
10084	Illegal Modbus Map Descriptor address.	
10085	Check backup station number settings.	
10085	PLC_Port_Count set to 1, but Hot Standby not configured for Mode2.	Set FieldServer parameter hs_mode to mode2.
10087	Protocol specified in config file, but no such driver is loaded.	
10089	Illegal Modbus Node ID.	Must be in range 1 to 255.
10102	An attempt to generate a write cache block failed because the Node did not have a connection.	Typically, a Node has a Server_Name specified, and a write to this Node occurred before the Server_ Name mechanism discovered a valid connection.
10103	The maximum number of concurrent cache blocks has been exceeded. A write cache_block poll did not occur.	
10104	Connection mode of Hot_Standby_Data is only supported in Hot Standby Mode1.	
10105	PLC_Port_Count = 1 only supported in hot_standby mode2.	Set FieldServer parameter hs_mode to mode2.
10106	An invalid hot_standby_mode has been specified as part of the FieldServer parameters.	check hsb_p(s).ini files
10107	Could not create cache block - possibly because the maximum number of data_points has been exceeded.	Contact technical support.
10108	A BACNet alarm event was generated but the required Alarm Limits has not been set.	
10110	Hot_ Standby "partner_ discover" found a PRIMARY SECONDARY mismatch.	
10111	Hot_ Standby "partner_ discover" found an API Version mismatch.	
10112	Hot_ Standby "partner_ discover" found a DCC version mismatch.	
10113	Hot_Standby "partner_discover" found a config file mismatch	
10114	A Node_ID > 255 was used in the Hot_Standby commbit configuration.	
10117	The Gateway Address for adapter N1 has not been specified. The FieldServer is only accessible on the local TCP/IP subnet.	
10118	The NETMASK for adapter N1 or N2 has not been specified. This FieldServer will not be accessible on the TCP/IP network through one or both of these adapters.	
10119	The IP_ ADDRESS for adapter N1 or N2 has not been specified. This FieldServer will not be accessible on the TCP/IP network through one or both of these adapters.	
10125	In the BACnet driver, the OPTION_LIST specified caused the packet buffer to be exceeded. As a result the packet buffer was	

Error	Description	Action
	truncated.	
10126	The BACnet driver received a request for a read_property_ multiple with multiple objects.	This is not reported in the current release of the BACnet driver.
10127	An UDP socket buffer overflowed and UDP data was lost.	
10128	The keyword MY_IP has been used in the FS_TCP.INI file.	Only use KW_N1 and KW_N2
10129	The keyword N1_IP has been used in the SMCTCP.INI file.	Use the FS_TCP.INI file.
10130	UDP broadcast panics has been disabled until a hardwired send is added.	
10133	The ARP resolve queue has been overrun. This is typically the result of a mis-configuration on the FieldServer.	Check all IP_Addresses, in particular the gateway address.
10134	A cache block was not created.	The Client side plc_channel has not yet been discovered, or an attempt to write to an Analog_Input Data_Type.
10136	A temporary write block has been removed because an identical one existed. Write data might have been lost.	
10209	Warning: the Server is responding with data from an explicit Map Descriptor that is not reading continuously.	
10210	Info: INET Server received a write to input command that is not supported.	
10214	Warning: A Server side driver tried to read from a Data_Object that has a WRBX as a responsible Map Descriptor. The data being read from the Server side might not be the same as on the Client side.	
10216	A Server node is associated with more than one Client Node.	
10302	An IP Fragmented packet was received while IP Defragmentation was disabled.	Display "RX IP fragments" stat in the Ethernet api stat screen. If this occurs frequently enable IP defragmentation.
10401	The I/Net Server ignored a write to an input.	
10402	The Baud Rate on a Connections Port has not been defined.	A default value will be used.
10403	The MS/TP driver must run at a cycle time shorter that 10ms or proper operation cannot be guaranteed.	
10404	The Write Queue is full and data has been overwritten. This could be caused by using moves to do multiple write-thru's on a RDBC Map Descriptor.	Solve by increasing the Write_Queue_Size or slowing write-thru's.
11001	Lutron driver: Data Array length for Area names too small.	Increase Data_Array_Length in .CSV file.
11002	Lutron driver: Data Array length for Scene names too small.	
11003	Lutron driver: Data Array length for Zone names too small.	
11004	Envirotronics SystemsPlus driver: Name entered in the SysPlus_Cmd mapdesc field is invalid or not entered.	This field must be filled in with a valid SysPlus_Cmd.
11005	Envirotronics SystemsPlus driver: Name entered in the SysPlus_Data_Type mapdesc field is invalid or not entered.	This field must be filled in with a valid SysPlus_Data_Type.
11006	Envirotronics SystemsPlus driver: Name entered in the Store_ Data_Array_Name mapdesc field is invalid or missing.	This field must be filled in with a valid Data Array name.
11007	Envirotronics SystemsPlus driver: The name entered in the Par_Data_Array_Name mapdesc field is invalid or not entered.	
11008	Envirotronics SystemsPlus driver: The name entered in the SysPlus_Alarm_Name mapdesc field is invalid or not entered.	
11009	Envirotronics SystemsPlus driver: The requested number of events or auxs is more than set up in the parameter Data Array.	Reduce number of events or auxs or increase parameter Data Array length.
11010	Siemens Cerberus driver: Counts Data Array has less than 14 data elements per panel and event counts could not be stored.	Increase the number of data elements in the counts Data Array to 14 elements per panel.
11011	Siemens Cerberus driver: Client driver could not find a suitable Map Descriptor to store the incoming event. The error message reported the event's panel, module and device numbers.	Use the event's panel, module and device numbers to define a Map Descriptor with Node_Name = panel. Example: For message: DRIVER-> CER : No mapdesc for panel 2, module 15, device 4, Create a mapdesc that will map to an address of15*256 + 4 = 3844, since there are always 256 devices per module for Cerberus. The mapdesc field block_ number represents the Cerberus module number. A Cerberus mapdesc maps to addresses from module*256 + 0 to module*256 + (length-1). For example, the following addresses are defined for a mapdesc of module 15 and length 4: (15*256 +0); (15*256 +1) ; (15*256 +2); (15*256 +3). Our example event will cause this error message since the greatest address is (15*256 +3) = 3843 and we need an address of 3844. A mapdesc with module 15 and length 5 will store the event ok, since (15*256 + (5-1)) =

Error	Description	Action
		(15*256 +4) = 3844.
11012	Envirotronics SystemsPlus driver: The SystemsPlus panel replied with "Not Monitored" when the driver tried to edit read scan alarm or tried to read alarm status. The driver message screen records the specific alarm's name.	Refer to the SystemsPlus user manual to set up the alarm for monitoring in the panel. This message can only be solved in the panel and is not a driver problem.
11013	A BACnet Ethernet packet was received on a network adapter that is not configured in the CSV file. Message will be ignored.	If BACnet comms fail, check the configuration and network connection.
11014	An 802.3 (Hot Standby) packet was received on an incorrectly configured network adapter. Packet will be discarded.	
11015	GE SRTP - SD016 message indicates NAK error.	

12.7 Networking Glossary of Terms

Term	Description
10Base2	10Base2 is the implementation of the IEEE 802.3 Ethernet standard on thin coaxial cable. Thin Ethernet or thinnet, as it is commonly called, runs at 10Mbps. Stations are daisy chained and the maximum segment length is 200 meters.
10Base5	10Base5 is the implementation of the IEEE 802.3 Ethernet standard on thick coaxial cable. Thick or standard Ethernet, as it is commonly called, runs at 10Mbps. It uses bus topology and the maximum segment length is 500 meters.
10BaseT	10BaseT is the implementation of the IEEE 802.3 Ethernet standard on unshielded twisted-pair wiring. It uses star topology, with stations directly connected to a multi-port hub. It runs at 10Mbps and has a maximum segment length of 100 meters.
802.3	This IEEE standard governs the Carrier Sense Multiple Access/Collision Detection (CSMA/CD) networks, which are more commonly called Ethernet. 802.3 networks operate at varying speeds and over different cable types. See 10Base2, 10Base5 and 10BaseT.
Bandwidth	Bandwidth is the amount of data that can be transmitted over a channel, measured in bits per second. For example, Ethernet has a 10Mbps bandwidth and FDDI has a 100 Mbps bandwidth. Actual throughput may be different than the theoretical bandwidth.
FieldServer	A FieldServer connects two networks of the same access method, for example, Ethernet to Ethernet or Token Ring to Token Ring. A FieldServer works at the OSI's Media Access Layer and is transparent to upper-layer devices and protocols. FieldServers operate by filtering packets according to their destination addresses. Most FieldServers automatically learn where these addresses are located, and thus are called learning FieldServers.
Ethernet	Ethernet is a 10Mbps CSMA/CD network that runs over thick coax, thin coax, twisted-pair, and fiber-optic cable. A thick coax Ethernet uses a bus topology. A thin coax Ethernet uses a daisy chain topology. A fiber Ethernet is point-to-point. DIX or Blue Book Ethernet is the name of the Digital Equipment Corp., Intel and Xerox specification; 8802/3 is the ISO's specification.
Gateway	In OSI terminology, a gateway is a hardware and software device that connects two dissimilar systems such as a LAN and a mainframe. It operates at the fourth through seventh layers of the OSI model. In Internet terms, a gateway is another name for a router.
GUI (FS-GUI)	Graphical User Interface.
Hub	A concentrator is a hub repeater or concentrator that brings together the connections from multiple network Nodes. Hubs have moved past their origins as wire concentrator centers, and often house FieldServers, routers, and network-management devices.
Internet	The Internet is a collection of over 2, 000 packet-switched networks located all over the world, all linked using the TCP/IP protocol. It links many university, government and research sites.
Internet Protocol (IP)	IP is part of the TCP/IP suite. It is a session layer protocol that governs packet forwarding.
Interoperability	Interoperability is the ability of one manufacturer's computer equipment to operate alongside, communicate with, and exchange information with another vendor's dissimilar computer equipment.
Leased line	A leased line is a transmission line reserved by a communications carrier for the private use of a customer. Examples of leased line services are 56 Kbps or T-1 lines.
Local Area Network (LAN)	A LAN is a group of computers, each equipped with the appropriate network adapter card and software and connected by a cable, that share applications, data and peripherals. All connections are made by cable or wireless media, but a LAN does not use telephone services. It typically spans a single building or campus.
LUI	Local User Interface.
Network	A network is a system of computers, hardware and software that is connected over which data, files, and messages can be transmitted. Networks may be local or wide area.
Open Systems	In open systems, no single manufacturer controls specifications for the architecture. The specifications are in the public domain, and developers can legally write to them. Open systems are crucial for interoperability.
Packet	A packet is a collection of bits comprising data and control information, which is sent from one Node to another.
Packet Switching	In packet switching, data is segmented into packets and sent across a circuit shared by subscribers. As the packet travels the network, switches read the address and route the packet to its destination. X.25 and frame relay are types of packet-switching services.
PFE	Protocol Front End.
Protocol	A protocol is a standardized set of conversation rules that specify the format, timing, sequencing and/or error checking.
Router	A router is a network layer device that connects networks using the same Network-Layer protocol, for example TCP/IP or IPX. A router uses a standardized protocol, such as RIP, to move packets efficiently to their destination over an internetwork. A router provides greater control over paths and greater security than a FieldServer; however, it is more difficult to set up and maintain.
Server	A Server is a computer that provides shared resources to network users. A Server typically has greater CPU power, number of CPUs, memory, cache, disk storage, and power supplies than a computer that is used as a single-user workstation.
SUI	System User Interface.
TCP/IP, Transmission Control Protocol/ Internet Protocol	TCP/IP is the protocol suite developed by the Advanced Research Projects Agency (ARPA), and is almost exclusively used on the Internet. It is also widely used in corporate internetworks, because of its superior design for WANs. TCP governs how packets are sequenced for transmission. IP provides a connectionless datagram service. "TCP/IP" is often used to generically refer to the entire suite of related protocols.
Wide Area Network (WAN)	A WAN consists of multiple LANs that are tied together via telephone services and/or fiber optic cabling. WANs may span a city, state, a country or even the world.
Wireless LAN	A wireless LAN does not use cable, but rather radio or infrared to transmit packets through the air. Radio frequency (RF) and infrared are the most common types of wireless transmission.