



FieldServer
FS-8700-56 Caterpillar M5X
Driver Manual
(Supplement to the FieldServer Instruction Manual)

APPLICABILITY & EFFECTIVITY

Effective for all systems manufactured after December 2017.

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Technical Support

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1 CATERPILLAR M5X DRIVER DESCRIPTION

The Caterpillar M5X driver allows the FieldServer to transfer data to and from devices over RS-232 using Caterpillar M5X protocol. The FieldServer can emulate either a Server or Client.

The driver is capable of communications with any device that uses the Caterpillar M5X protocol but has been designed primarily for connection to a Caterpillar CCM which is in turn connected to the Caterpillar engines to be monitored/controlled.

The driver provides a limited set of M5X protocol commands and may address a sub-set of the parameters available in each device. Details are available in [Appendix B.2](#).

The driver provides formal support for 3500 engines and EMCPII devices only. Other devices may be polled using the address of the parameter required as opposed to user friendly parameter names. Establishing the correct Node_ID's for the engines being communicated with can be challenging and requires careful research. See [Appendix B.1](#) for further details.

2 DRIVER SCOPE OF SUPPLY

2.1 Supplied by Sierra Monitor Corporation

| PART # | Description |
|------------|----------------------------------|
| FS-8917-04 | RJ45 to DB25M connection adapter |

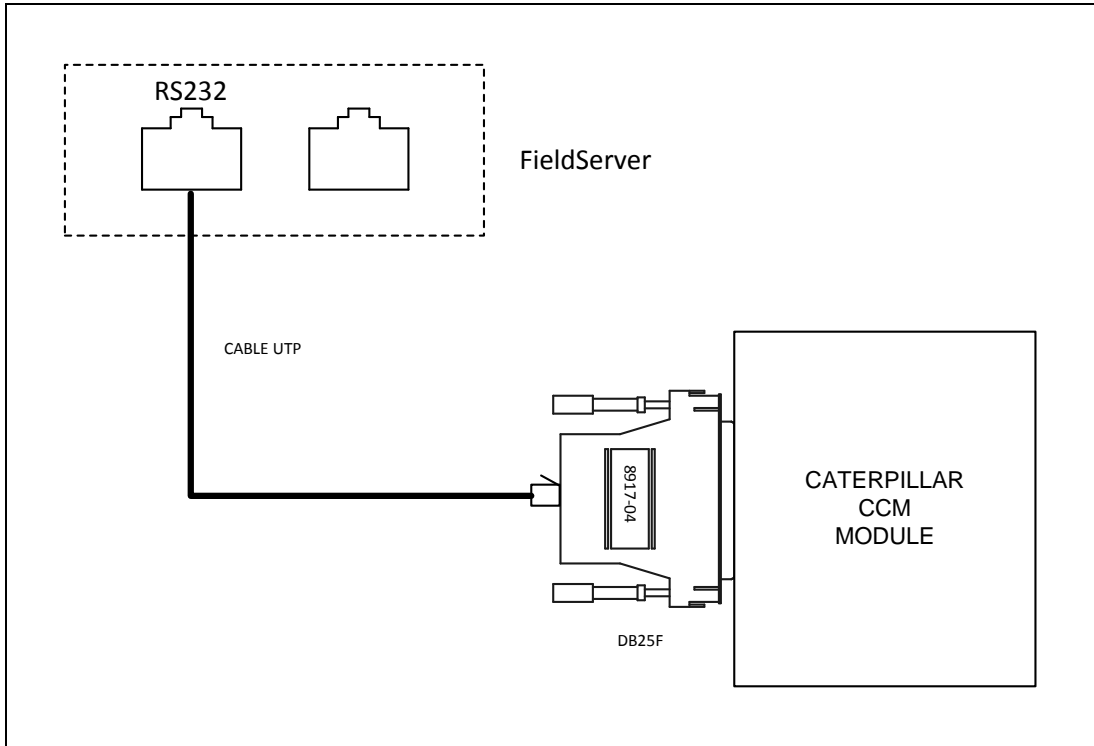
2.2 Provided by Supplier of 3rd Party Equipment

| Part # | Description |
|--------|------------------------|
| | Caterpillar CCM Module |
| | Power Supply |

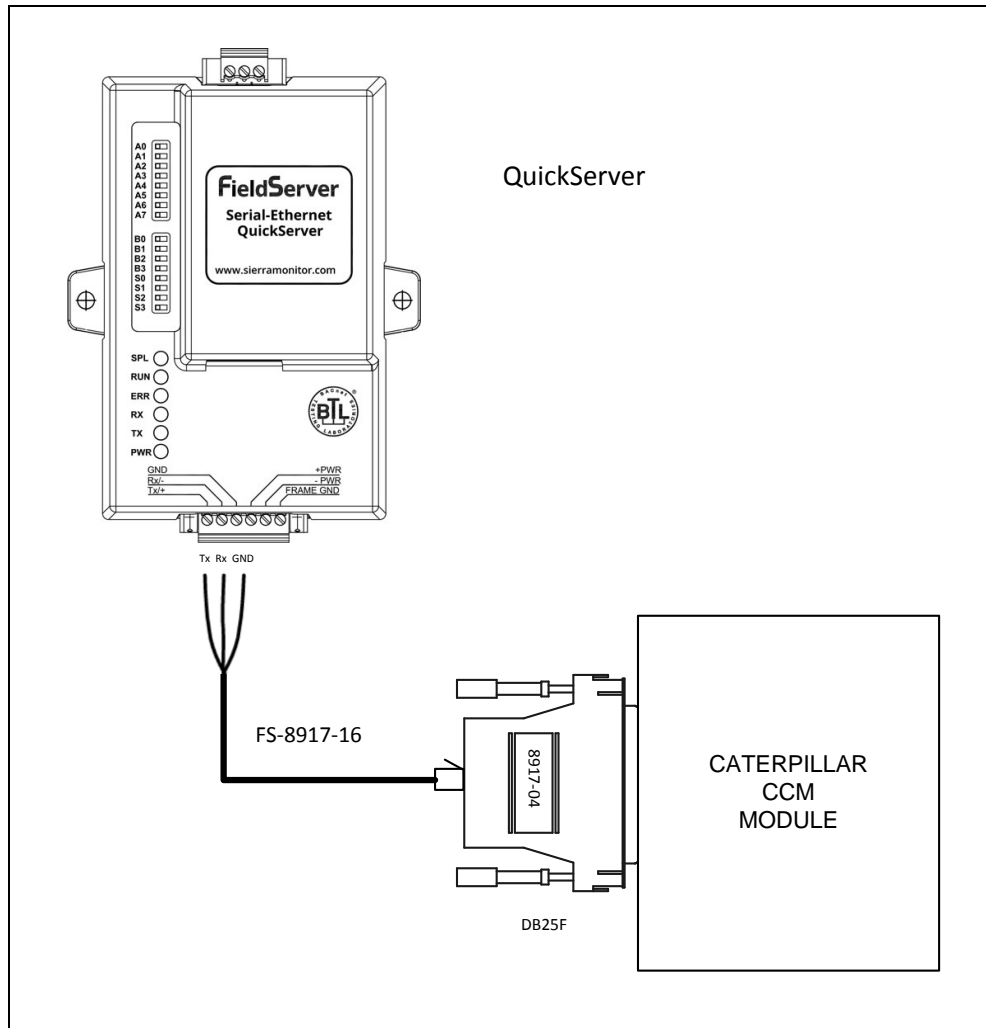
3 HARDWARE CONNECTIONS

The FieldServer is connected to the Caterpillar CCM module as shown below.
 Configure the Caterpillar CCM module according to manufacturer's instructions.

3.1 FS-B35XX



3.2 QuickServer



3.3 Hardware Connection Hints/Tips

- The FieldServer cannot be connected directly to the generator/engine controller but must be connected via the CCM module.
- To establish the caterpillar Node ID, set the Node_ID to 0 in the configuration. Watch the error screen on reboot - the remote device will send a message back with an error stating that it cannot accept a response message from a certain Node ID. That Node ID is the relevant Node ID.

4 DATA ARRAY PARAMETERS

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.

| Section Title | | |
|-------------------|--|---|
| Data_Arrays | | |
| Column Title | Function | Legal Values |
| Data_Array_Name | Provide name for Data Array. | Up to 15 alphanumeric characters |
| Data_Array_Format | Provide data format. Each Data Array can only take on one format. | FLOAT, BIT, UInt16, SInt16, Packed_Bit, Byte, Packed_Byte, Swapped_Byte |
| Data_Array_Length | Number of Data Objects. Must be larger than the data storage area required by the Map Descriptors for the data being placed in this array. | 1-10000 |

Example

```

// Data Arrays
Data_Arrays
Data_Array_Name , Data_Array_Format , Data_Array_Length
DA_AI_01        , UInt16           , 200
DA_AO_01        , UInt16           , 200
DA_DI_01        , Bit              , 200
DA_DO_01        , Bit              , 200
    
```

5 CONFIGURING THE FIELDSEVER AS A CATERPILLAR M5X CLIENT

For detailed information on FieldServer configuration, refer to the FieldServer Configuration Manual. The information that follows describes how to expand upon the factory defaults provided in the configuration files included with the FieldServer (see “.csv” files provided).

This section documents and describes the parameters necessary for configuring the FieldServer to communicate with a Caterpillar M5X Server.

The configuration file tells the FieldServer about its interfaces, and the routing of data required. In order to enable the FieldServer for Caterpillar M5X communications, the driver independent FieldServer buffers need to be declared in the “Data Arrays” section, the destination device addresses need to be declared in the “Client Side Nodes” section, and the data required from the servers needs to be mapped in the “Client Side Map Descriptors” section. Details on how to do this can be found below.

NOTE: In the tables below, * indicates an optional parameter and the bold legal values are default.

5.1 Client Side Connection Parameters

| Section Title | | |
|---------------|--|---|
| Connections | | |
| Column Title | Function | Legal Values |
| Port | Specify which port the device is connected to the FieldServer. | P1-P2 |
| Baud* | Specify baud rate. | 110 – 115200, standard baud rates only, 9600 |
| Parity* | Specify parity. | None |
| Data_Bits* | Specify data bits. | 7, 8 |
| Stop_Bits* | Specify stop bits. | 1 |
| Protocol | Specify protocol used. | CATM5X |
| Poll Delay* | Time between internal polls. | 0-32000s, 1s |
| Application | Specify whether it is necessary to re-login for next transaction if target Node is different from current node. See Appendix A.1 for detail. | Single_Node , Multidrop |

Example

```

// Client Side Connections

Connections
Port          , Baud   , Parity   , Protocol   , Poll_Delay , Application
P1            , 9600  , None    , CatM5X    , 0.100s   , Multidrop
```


5.2 Client Side Node Parameters

| Section Title | | |
|---------------|---|---|
| Nodes | | |
| Column Title | Function | Legal Values |
| Node_Name | Provide name for node. | Up to 32 alphanumeric characters |
| Node_ID | The address of the device (engine) connected to the CCM module to be polled. This is also termed the UNIT number or UNIT ID of the engine being polled. Refer to Appendix B.1 for more information. | 0-255 |
| Protocol | Specify protocol used. | CATM5X |
| Port | Specify which port the device is connected to the FieldServer. | P1-P2 |
| Password* | Specify the node password. The driver logs in to the Cat device before it starts polling. Additional notes provided in Appendix A.2 . | Max 8 Alpha-Numeric characters, no-login, - |

Example

```
// Client Side Nodes

Nodes
Node_Name , Node_ID , Protocol , Port , Password
Engine1 , 33 , CATM5X , P1 , -
Generator , 88 , CATM5X , P1 , -
```

5.3 Client Side Map Descriptor Parameters

5.3.1 FieldServer Specific Map Descriptor Parameters

| Column Title | Function | Legal Values |
|---------------------|---|--|
| Map_Descriptor_Name | Name of this Map Descriptor. | Up to 32 alphanumeric characters |
| Data_Array_Name | Name of Data Array where data is to be stored in the FieldServer. | One of the Data Array names from Section 4 |
| Data_Array_Location | Starting location in Data Array. | 0 to (Data_Array_Length -1) as specified in Section 4) |
| Function | Function of Client Map Descriptor. | Rdbc, Wrbc, Wrbx |

5.3.2 Driver Specific Map Descriptor Parameters

| Column Title | Function | Legal Values |
|--------------|---|---|
| Node_Name | Name of Node to fetch data from. | One of the Node names specified in Section 5.2 |
| Length | Defines how many Data Array storage locations are reserved for the Map Descriptor. Additional information is provided in Appendix A.4 . | 1, 2 |
| CatParam | Each parameter has been allocated a name. Use the parameter name with this keyword to tell the driver which parameter in the engine or generator to be read / written. | Refer to Section 5.3.4 |
| CatPID1* | The parameter may be specified in this alternate format in case parameters are added by Caterpillar for which this driver has no keyword description and for engines unknown to this driver. Use catPID1 & catPID2. Specify the values in the hexadecimal format provided in the caterpillar documentation. | E.g. CatPID1 = 00 CatPID2 = F8 |
| CatPID2* | | |
| CatMethod* | Used to override the data extraction method - allows the driver to parse messages with unknown parameters. The method parameter depends on the number and arrangement of data bytes. A table is provided in Appendix B.3 . | Non-zero positive integers. |

5.3.3 Timing Parameters

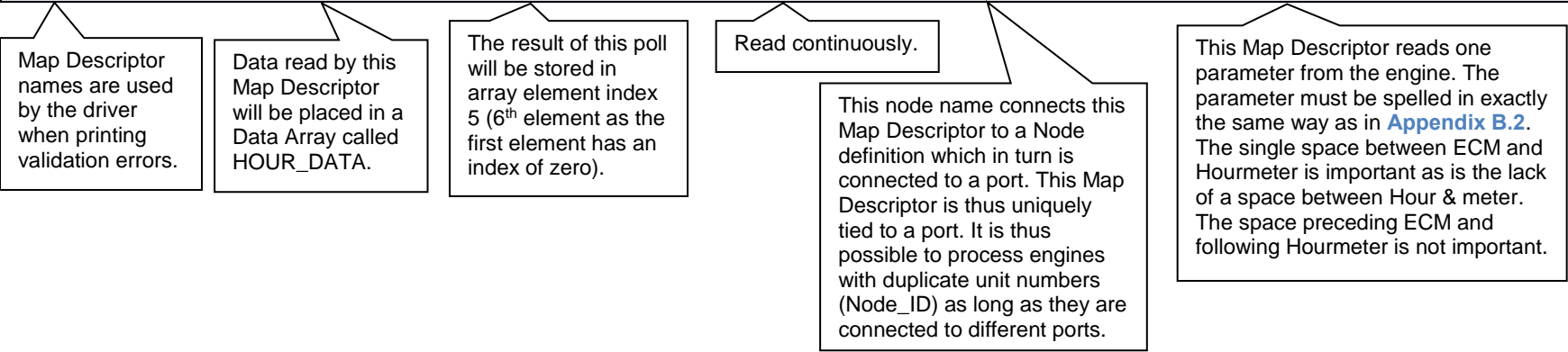
| Column Title | Function | Legal Values |
|---------------|------------------------------|--------------|
| Scan_Interval | Rate at which data is polled | >0.1s |

5.3.4 Map Descriptor Example 1

In this example the driver reads the hour meter from a node called Engine 5.

```
// Client Side Map Descriptors

Map Descriptors
Map_Descriptor_Name , Data_Array_Name , Data_Array_Offset , Function , Node_Name , Scan_Interval , CatParam , Length
ENGINE5_HOURS , HOUR_DATA , 5 , Rdbc , Engine5 , 5 , ECM Hourmeter , 1
```



5.3.5 Map Descriptor Example 2

In this example, the driver reads the hour meter from a node called engine 5 but the parameter being read has been specified by the Caterpillar PID rather than the keyword values provided by the driver. A consequence of specifying a parameter that must be read by its ID rather than by its name is that the driver may not know how to extract data from the response.

This can be overcome by specifying the CatMethod.

- In this example the CatMethod has been set to 2.
- The reason that 2 was specified is that on inspection of the CAT manual which describes the parameter, we found that the response data takes the form 'AA'. From [Appendix B.3](#) the method extraction parameter is 2 and the length setting is 1.

If a parameter is specified by its ID and not its name, but the driver recognizes the parameter it will be able to deduce the extraction method automatically. In this example, the driver would find that '00 5E' corresponds to the ECM Hourmeter and thus it would know the extraction method. The list of parameters known to the driver is presented as [Appendix B.2](#).

```
// Client Side Map Descriptors
Map Descriptors
Map_Descriptor_Name , Data_Array_Name , Data_Array_Offset , Function , Node_Name , Scan_Interval , CatMethod , CatPid1 , CatPid2 , Length
ENGINE5_HOURS , HOUR_DATA , 5 , Rdbc , Engine5 , 5 , 2 , 00 , 5e , 1
```

The CatMethod tells the Driver which method to use to extract data from the response.

The parameter with PID = 00 5e is being read from the engine.

6 CONFIGURING THE FIELDSEVER AS A CATERPILLAR M5X SERVER

For detailed information on FieldServer configuration, refer to the instruction manual for the FieldServer. The information that follows describes how to expand upon the factory defaults provided in the configuration files included with the FieldServer (see “.csv” files provided).

This section documents and describes the parameters necessary for configuring the FieldServer to communicate with a Caterpillar M5X Client.

The configuration file tells the FieldServer about its interfaces, and the routing of data required. In order to enable the FieldServer for Caterpillar M5X communications, the driver independent FieldServer buffers need to be declared in the “Data Arrays” section, the FieldServer virtual node(s) needs to be declared in the “Server Side Nodes” section, and the data to be provided to the clients needs to be mapped in the “Server Side Map Descriptors” section. Details on how to do this can be found below.

NOTE: In the tables below, * indicates an optional parameter and the bold legal values are default.

6.1 Server Side Connection Descriptors

| Section Title | | |
|---------------|--|---------------------------|
| Connections | | |
| Column Title | Function | Legal Values |
| Port | Specify which port the device is connected to the FieldServer. | P1-P2 |
| Baud* | Specify baud rate. | 110 – 115200, 9600 |
| Parity* | Specify parity. | None |
| Data_Bits* | Specify data bits. | 7, 8 |
| Stop_Bits* | Specify stop bits. | 1 |
| Protocol | Specify protocol used. | CATM5X |

Example

```
// Server Side Connections
Connections
Port      , Baud  , Parity  , Protocol
P1       , 9600  , None   , CATM5X
```

6.2 Server Side Node Descriptors

| Section Title | | |
|---------------|---|----------------------------------|
| Nodes | | |
| Column Title | Function | Legal Values |
| Node_Name | Provide name for node. | Up to 32 alphanumeric characters |
| Node_ID | The address of the device (engine) connected to the CCM module to be polled. This is also termed the UNIT number or UNIT ID of the engine being polled. Refer to Appendix B.1 for more information. | 0-255 |
| Protocol | Specify protocol used. | CATM5X |
| Port | Specify which port the device is connected to the FieldServer. | P1-P2 |

Example

```
// Server Side Nodes
Nodes
Node_Name , Node_ID , Protocol
Engine1  , 33      , CATM5X
```

6.3 Server Side Map Descriptors

6.3.1 FieldServer Specific Map Descriptor Parameters

| Column Title | Function | Legal Values |
|---------------------|---|--|
| Map_Descriptor_Name | Name of this Map Descriptor. | Up to 32 alphanumeric characters |
| Data_Array_Name | Name of Data Array where data is to be stored in the FieldServer. | One of the Data Array names from Section 4 |
| Data_Array_Location | Starting location in Data Array. | 0 to (Data_Array_Length -1) as specified in Section 4) |
| Function | Function of Server Map Descriptor. | Passive |

6.3.2 Driver Specific Map Descriptor Parameters

| Column Title | Function | Legal Values |
|--------------|---|---|
| Node_Name | Name of Node to fetch data from. | One of the Node names specified in Section 6.2 |
| CatParam | Each parameter has been allocated a name. Use the parameter name with this keyword to tell the driver which parameter in the engine or generator to be read / written. | Refer to Section 6.3.4 |
| CatPID1* | The parameter may be specified in this alternate format in case parameters are added by Caterpillar for which this driver has no keyword description and for engines unknown to this driver. Use catPID1 & catPID2. Specify the values in the hexadecimal format provided in the caterpillar documentation. | E.g. CatPID1 = 00 CatPID2 = F8 |
| CatPID2* | | |
| CatMethod* | Used to override the data extraction method - allows the driver to parse messages with unknown parameters. The method parameter depends on the number and arrangement of data bytes. A table is provided in Appendix B.3 . | Non-zero positive integers. |

6.3.3 Timing Parameters

| Column Title | Function | Legal Values |
|--------------------|---|--------------|
| Scada_Hold_Timeout | Specifies time Server side waits before responding to Client that Node is offline on FieldServer Client side. | >1.0s |

6.3.4 Map Descriptor Example

In this example, the FieldServer acts a Passive Server capable of responding to queries for its ECM hourmeter.

```
// Server Side Map Descriptors

Map Descriptors
Map_Descriptor_Name , Data_Array_Name , Data_Array_Offset , Function , Node_Name , CatParam
E1_Hour , DA_AI3 , 0 , Passive , ENG1 , ECM Hourmeter
```

The Data Array named DA_AI3 will be used to provide data to any poll's processed using this Map Descriptor.

The first element of the array's value will be served as the ECM Hourmeter.

The Map Descriptor is passive. It responds to poll's (read or write) received for this node.

The driver is not capable of processing requests for other Caterpillar parameters until they too have been given a Server Side Map Descriptor.

APPENDIX A USEFUL FEATURES

Appendix A.1 Data Retrieval from Multiple Hosts

Caterpillar protocol only allows the retrieval of data from one host per port at a time. If a module (like CCM) connected to the FieldServer is in turn connected to multiple devices, the FieldServer may need to log in and out of these devices sequentially in order to collect data from each device. To facilitate this, the Driver uses the “application” keyword on connection (**Section 5.1**) to determine whether FieldServer should re-login for the next transaction. If the application type is “Multidrop” then FieldServer will re-login whenever the next transaction is for a different Node, otherwise, whether specified or not, the application type is considered as “Single_Node” and FieldServer will not re-login.

Appendix A.2 Passwords

Appendix A.2.1 Cat Device has Blank Password

To configure a Node to poll a Cat device with a blank password define the client node as follows:

```
// Client Side Nodes
Nodes
Node_Name , Node_ID , Protocol , Port , Password
Engine1 , 33 , CATM5X , P1 , -
```

The parameter can also be specified as “no-login”.

Appendix A.2.2 Example – Cat Device has Password

Every variable (PID) in the Cat device has an associated security level (0, 1, 2 or 3). A user with a particular security level may access variables of the same or lower level. The Caterpillar vendor documentation provides details of the security level of each variable. Most variables can be read by a user of any level.

The password protection of the CCM device is initially enabled. Changing the password protection and passwords can be done with the PC software for the CCM. This software is provided by Caterpillar.

We note that in many places in the Caterpillar vendor documentation we have seen references to a password of “11112222” and suspect that this password may be commonly used.

```
Client Side Nodes
Nodes
Node_Name , Node_ID , Protocol , Port , Password
Engine1 , 33 , CATM5X , P1 , 11112222
```

Appendix A.2.3 Example – Password Causes Configuration File Errors

A node definition which will produce configuration file errors is provided. The problem can easily be rectified by using a client node definition similar to example 1 or 2.

```
// Client Side Nodes
Nodes
Node_Name , Node_ID , Protocol , Port , Password
Engine1 , 33 , CATM5X , P1 ,
```

If the FieldServer is configured to emulate a Caterpillar device (driver acts as server), then any password can be specified as the driver does not perform password verification when a remote device logs in prior to polling.

Appendix A.3 Scaling

When the driver is configured as a Client and reads data from a Caterpillar device the response contains values for each parameter that is read. These 'raw' values are scaled by the driver to represent engineering values before storing. This scaling activity is not configurable. The scaling is only applied for variables known to the driver. Some variables may be read by specifying the PID1/2 parameters but if the variable is unknown to the driver (not listed in [Appendix B.2](#)) – no scaling is applied to these variables.

Example

“Generator Bus Value” returns a value of 0-65503 representing 0-6535.3 Hz. The driver stores the scaled engineering value in Hertz as a floating point number.

The driver ignores the Map Descriptor keywords “Data_Array_Low_Scale, Data_Array_High_Scale, Device_Low_Scale, Device_High_Scale” as it has already performed the scaling.

Appendix A.3.1 Using the driver as a Server

No scaling is applied. The diver transmits the values it finds in the Data Arrays.

Appendix A.4 Map Descriptor Lengths

When a Client Side Map Descriptor is defined it is necessary to specify the 'Length' ([Section 5.3.2](#)). For this driver, length is the number of Data Array locations reserved for storage of the data read by the Map Descriptor. In most cases a single value of data is returned for each read of the Caterpillar device. For some read's, however, the data returned consists of several values which are separated by the driver and stored in multiple consecutive locations in the specified Data Array. [Appendix B.3](#) lists the format of the data returned by the Caterpillar device and the required length.

Example: Read Warning Status

Look up Warning Status in Appendix B.2. The Data extraction method is 8.

| | | | | |
|-------|----|----|---|----------------|
| 3500B | fc | 07 | 8 | Warning Status |
|-------|----|----|---|----------------|

From Appendix B.3, data extraction method 8 requires a length of 4.

| | | | |
|---|------|-----|---|
| 8 | ABCD | Yes | 4 |
|---|------|-----|---|

APPENDIX B REFERENCE

Appendix B.1 Node ID's

The following are the node ID's defined by the CATM5X protocol. The value is specified in decimal. Thus Engine 21H should be specified with a node ID of 33. The value of zero has a special meaning.

| Hex Value | Decimal Value | Description |
|--|---------------|---|
| This is the engine unit type | | |
| 61 | 97 | CCM |
| 3500B Marine Engine Unit Number | | |
| 21 | 33 | Electronic Engine Controller (Port) |
| 22 | 34 | Electronic Engine Controller (Starboard) |
| 24 | 36 | Electronic Engine Controller (Single or Center) |
| 3500B Gen Set | | |
| 21 | 33 | Electronic Engine Controller - Unit 1 |
| 22 | 34 | Electronic Engine Controller - Unit 2 |
| 23 | 35 | Electronic Engine Controller - Unit 3 |
| 24 | 36 | Electronic Engine Controller - Unit 4 |
| 25 | 37 | Electronic Engine Controller - Unit 5 |
| 26 | 38 | Electronic Engine Controller - Unit 6 |
| 27 | 39 | Electronic Engine Controller - Unit 7 |
| 28 | 40 | Electronic Engine Controller - Unit 8 |
| EMCP II Gen Set | | |
| 58 | 88 | GSC - Unit 1 |
| 59 | 89 | GSC - Unit 2 |
| 5A | 90 | GSC - Unit 3 |
| 5B | 91 | GSC - Unit 4 |
| 5C | 92 | GSC - Unit 5 |
| 5D | 93 | GSC - Unit 6 |
| 5E | 94 | GSC - Unit 7 |
| 5F | 95 | GSC - Unit 8 |
| 0 | 0 | Auto Discover Node number Under normal operation the driver compares the polled Node_ID to the Node_ID contained in the response. If only 1 Cat engine is connected to the port, the Node_ID can be specified as zero and the driver will ignore the Node number in the responses. |

Appendix B.2 Engine Parameter Keywords & PID's

The following table provides a list of all the keywords that may be used in the catParam field of the CSV file. The keywords are not case specific BUT no tabs may be used between the keywords and they must be spelled exactly as in the table.

| Engine Type | PID1 | PID2 | Extraction Method (see Appendix B.3) | Keyword / Parameter |
|-------------|------|------|--|----------------------|
| 3500B | 00 | 08 | 1 | Engine Configuration |
| 3500B | 00 | 0d | 1 | Remote Fault Reset |
| 3500B | 00 | 15 | 1 | Throttle Position |
| 3500B | 00 | 40 | 2 | Engine RPM |
| 3500B | 00 | 44 | 2 | Engine Coolant Temp |

| Engine Type | PID1 | PID2 | Extraction Method (see Appendix B.3) | Keyword / Parameter |
|-------------|------|------|--|---|
| 3500B | 00 | 46 | 2 | Desired Engine Speed |
| 3500B | 00 | 4d | 2 | Transmission Oil Temp |
| 3500B | 00 | 4e | 2 | Transmission Oil Press |
| 3500B | 00 | 53 | 2 | Atmospheric Press |
| 3500B | 00 | 54 | 2 | Filtered Engine Oil Press Gauge |
| 3500B | 00 | 55 | 2 | Boost Press Gauge |
| 3500B | 00 | 58 | 2 | Air Filter Restriction |
| 3500B | 00 | 5a | 2 | Filtered Engine Oil Press Absolute |
| 3500B | 00 | 5b | 2 | Boost Press Absolute |
| 3500B | 00 | 5c | 2 | Left Turbo Inlet Press Absolute |
| 3500B | 00 | 5e | 2 | ECM Hourmeter |
| 3500B | 00 | 5f | 2 | Right Turbo Inlet Press Absolute |
| 3500B | 00 | 82 | 3 | ECM Fault Log Codes |
| 3500B | 00 | 83 | 3 | ECM Fault Log Request Additional |
| 3500B | 00 | 84 | 4 | ECM Fault Log Request Additional Response |
| 3500B | 00 | c8 | 5 | Total Fuel |
| 3500B | f0 | 13 | 1 | System Battery Voltage |
| 3500B | f0 | 14 | 1 | Cooldown Duration |
| 3500B | f0 | 16 | 1 | Cold Mode Status |
| 3500B | f0 | 1b | 1 | Engine Prelube Duration |
| 3500B | f0 | 2a | 1 | Remote Start Status |
| 3500B | f0 | 2c | 1 | Engine Coolant Level Status |
| 3500B | f0 | 8f | 1 | Engine Control Switch Position |
| 3500B | f0 | 9c | 1 | Shutdown Notify Relay Status |
| 3500B | f0 | a6 | 1 | Overspeed Verify Switch Position |
| 3500B | f0 | a8 | 1 | Remote Emergency Stop Switch Position |
| 3500B | f0 | a9 | 1 | Start-up Mode Status |
| 3500B | f0 | aa | 1 | Air Shutoff Status |
| 3500B | f0 | ac | 1 | Max Number of Crank Cycles |
| 3500B | f0 | b1 | 1 | Remote Emergency Stop |
| 3500B | f0 | b2 | 1 | Cooldown Override Control |
| 3500B | f0 | b5 | 1 | Engine Prelube Status |
| 3500B | f0 | b6 | 1 | Engine Fuel Level Status |
| 3500B | f0 | c1 | 1 | Acceleration Delay Time |
| 3500B | f0 | c2 | 1 | Remote Throttle Override |
| 3500B | f0 | f2 | 1 | ECM in Control |
| 3500B | f0 | fd | 1 | Low Idle Switch |
| 3500B | f1 | 18 | 1 | Percent Engine Load |
| 3500B | f1 | 4f | 1 | Backup ECM Status |
| 3500B | f1 | 89 | 1 | Engine Power Derate Percentage |
| 3500B | f2 | 13 | 1 | Remote Start Initiate |
| 3500B | f2 | 4d | 1 | Emergency Override Switch Status |
| 3500B | f2 | 4f | 1 | General Alarm Output Status |
| 3500B | f4 | 0e | 2 | Engine Oil Press Differential |
| 3500B | f4 | 10 | 2 | Effective Rack |
| 3500B | f4 | 11 | 2 | Effective Rack Limit |
| 3500B | f4 | 12 | 2 | Effective Smoke Rack Limit |

| Engine Type | PID1 | PID2 | Extraction Method (see Appendix B.3) | Keyword / Parameter |
|-------------|------|------|--|--|
| 3500B | f4 | 15 | 2 | Peak Air Filter Restriction |
| 3500B | f4 | 17 | 10 | Engine Status |
| 3500B | f4 | 19 | 2 | Unfiltered Engine Oil Press Absolute |
| 3500B | f4 | 1c | 2 | Engine Fuel Press Differential |
| 3500B | f4 | 1f | 2 | Unfiltered Engine Fuel Press Absolute |
| 3500B | f4 | 20 | 2 | Engine Aftercooler Temp |
| 3500B | f4 | 40 | 2 | Right Exhaust Temp |
| 3500B | f4 | 41 | 2 | Left Exhaust Temp |
| 3500B | f4 | 5b | 2 | Acceleration Ramp Rate |
| 3500B | f4 | 6d | 2 | Cooldown Time Remaining |
| 3500B | f5 | 08 | 2 | Crankcase Air Pressure Absolute |
| 3500B | f5 | 09 | 2 | Crankcase Air Pressure Gauge |
| 3500B | f5 | 0a | 2 | Cooldown Engine Speed |
| 3500B | f5 | 0b | 2 | Cycle Crank Time Setpoint |
| 3500B | f5 | 0d | 2 | Crank Terminate Speed Setpoint |
| 3500B | f5 | 0e | 2 | Filtered Engine Fuel Press Absolute |
| 3500B | f5 | 0f | 2 | Filtered Engine Fuel Press Gauge |
| 3500B | f5 | 10 | 2 | Low Idle Speed |
| 3500B | f5 | 11 | 2 | Intake Manifold Air Temp |
| 3500B | f5 | 15 | 2 | Percent Droop |
| 3500B | f5 | 1f | 2 | Right Air Filter Restriction |
| 3500B | f5 | 20 | 2 | Left Air Filter Restriction |
| 3500B | f5 | 25 | 2 | Fuel Consumption Rate |
| 3500B | f5 | 3e | 2 | Engine Oil Temp |
| 3500B | f8 | 14 | 6 | Application Software Part Number |
| 3500B | f8 | 1a | 7 | Vehicle System ID |
| 3500B | fc | 07 | 8 | Warning Status |
| 3500B | fc | 08 | 8 | Shutdown Status |
| 3500B | fc | 09 | 8 | Engine Derate Status |
| EMCP2 | 00 | 0d | 1 | EMCP2 Remote Fault Reset |
| EMCP2 | 00 | 40 | 2 | EMCP2 Generator Set Engine RPM |
| EMCP2 | 00 | 42 | 2 | EMCP2 Generator Set Ring Gear Teeth Setpoint |
| EMCP2 | 00 | 44 | 2 | EMCP2 Engine Coolant Temperature |
| EMCP2 | 00 | 54 | 2 | EMCP2 Engine Oil Pressure kPa |
| EMCP2 | 00 | 5e | 2 | EMCP2 Generator Set Hourmeter |
| EMCP2 | 00 | 80 | 11 | EMCP2 Device ID Code |
| EMCP2 | 00 | 82 | 12 | EMCP2 GSC Fault Log Codes Status and Number of Occurrences |
| EMCP2 | 00 | 83 | 3 | EMCP2 GSC Fault Log Request for Additional Data |
| EMCP2 | 00 | 84 | 13 | EMCP2 GSC Fault Log Response for Additional Information |
| EMCP2 | f0 | 13 | 1 | EMCP2 System Battery Voltage |
| EMCP2 | f0 | 14 | 1 | EMCP2 GSC Cooldown Timer Setpoint |
| EMCP2 | f0 | 2a | 1 | EMCP2 Remote Start Status |
| EMCP2 | f0 | 8f | 1 | EMCP2 Engine Control Switch Position |
| EMCP2 | f0 | b0 | 1 | EMCP2 Generator Phase Select |

| Engine Type | PID1 | PID2 | Extraction Method (see Appendix B.3) | Keyword / Parameter |
|-------------|------|------|--|---|
| EMCP2 | f0 | b1 | 1 | EMCP2 Remote Emergency Stop |
| EMCP2 | f0 | b2 | 1 | EMCP2 Cooldown Override Control |
| EMCP2 | f0 | b3 | 1 | EMCP2 Generator AC Voltage Full Scale and External Potential Transformer Setpoint |
| EMCP2 | f0 | b4 | 1 | EMCP2 Generator AC Current Full Scale Setpoint |
| EMCP2 | f1 | d3 | 1 | EMCP2 Generator Phase A Power Factor Lead/Lag Status |
| EMCP2 | f1 | d4 | 1 | EMCP2 Generator Phase B Power Factor Lead/Lag Status |
| EMCP2 | f1 | d5 | 1 | EMCP2 Generator Phase C Power Factor Lead/Lag Status |
| EMCP2 | f1 | d6 | 1 | EMCP2 Generator Average Power Factor Lead/Lag Status |
| EMCP2 | f2 | 13 | 1 | EMCP2 Remote Start Initiate |
| EMCP2 | f2 | cb | 1 | EMCP2 EPG Circuit Breaker Status |
| EMCP2 | f2 | cc | 1 | EMCP2 Remote Generator Synchronizer Control |
| EMCP2 | f2 | d6 | 1 | EMCP2 Remote Synchronization Control Readiness |
| EMCP2 | f2 | d7 | 1 | EMCP2 Generator Synchronizer Control Status |
| EMCP2 | f4 | 40 | 2 | EMCP2 Right Exhaust Temperature |
| EMCP2 | f4 | 41 | 2 | EMCP2 Left Exhaust Temperature |
| EMCP2 | f4 | 42 | 2 | EMCP2 Generator RMS Voltage Phase A-B |
| EMCP2 | f4 | 43 | 2 | EMCP2 Generator RMS Voltage Phase B-C |
| EMCP2 | f4 | 44 | 2 | EMCP2 Generator RMS Voltage Phase C-A |
| EMCP2 | f4 | 45 | 2 | EMCP2 Generator RMS Voltage Phase A to Neutral |
| EMCP2 | f4 | 46 | 2 | EMCP2 Generator RMS Voltage Phase B to Neutral |
| EMCP2 | f4 | 47 | 2 | EMCP2 Generator RMS Voltage Phase C to Neutral |
| EMCP2 | f4 | 48 | 2 | EMCP2 Generator Phase A RMS Current |
| EMCP2 | f4 | 49 | 2 | EMCP2 Generator Phase B RMS Current |
| EMCP2 | f4 | 4a | 2 | EMCP2 Generator Phase C RMS Current |
| EMCP2 | f4 | 4b | 2 | EMCP2 Generator Frequency |
| EMCP2 | f4 | 4c | 2 | EMCP2 GSC Relay Status |
| EMCP2 | f4 | 4d | 2 | EMCP2 GSC Relay Control |
| EMCP2 | f4 | 60 | 2 | EMCP2 GSC Alarm Status |
| EMCP2 | f4 | 61 | 2 | EMCP2 GSC Shutdown Status |
| EMCP2 | f4 | 62 | 2 | EMCP2 GSC Spare Fault Alarm Status |
| EMCP2 | f4 | 63 | 2 | EMCP2 GSC Spare Fault Shutdown Status |
| EMCP2 | f4 | 64 | 2 | EMCP2 Generator Line-Line Voltage |
| EMCP2 | f4 | 65 | 2 | EMCP2 Generator Line Current |
| EMCP2 | f4 | 66 | 2 | EMCP2 Engine Overspeed Setpoint |
| EMCP2 | f4 | 67 | 2 | EMCP2 Engine Oil Step Speed Setpoint |
| EMCP2 | f4 | 68 | 2 | EMCP2 Low Engine Oil Pressure at Rated Speed Setpoint |

| Engine Type | PID1 | PID2 | Extraction Method (see Appendix B.3) | Keyword / Parameter |
|-------------|------|------|--|--|
| EMCP2 | f4 | 69 | 2 | EMCP2 Low Engine Oil Pressure at Idle Speed Setpoint |
| EMCP2 | f4 | 6a | 2 | EMCP2 High Engine Coolant Temperature Setpoint |
| EMCP2 | f4 | 6b | 2 | EMCP2 Low Engine Coolant Temperature Setpoint |
| EMCP2 | f4 | 6c | 2 | EMCP2 GSC Configuration |
| EMCP2 | f4 | 6d | 2 | EMCP2 Remaining Cooldown Time |
| EMCP2 | f4 | c3 | 2 | EMCP2 Generator Average RMS Voltage |
| EMCP2 | f4 | c4 | 2 | EMCP2 Generator Total RMS Current |
| EMCP2 | f4 | c7 | 2 | EMCP2 Generator Power |
| EMCP2 | f4 | c8 | 2 | EMCP2 Generator Phase A Power Factor |
| EMCP2 | f4 | c9 | 2 | EMCP2 Generator Phase B Power Factor |
| EMCP2 | f4 | ca | 2 | EMCP2 Generator Phase C Power Factor |
| EMCP2 | f4 | cb | 2 | EMCP2 Generator Average Power Factor |
| EMCP2 | f4 | cf | 2 | EMCP2 Generator Bus Frequency |
| EMCP2 | f4 | d0 | 2 | EMCP2 Generator Bus RMS Voltage |
| EMCP2 | f4 | d1 | 2 | EMCP2 Generator Set Control Output Status |
| EMCP2 | f4 | d2 | 2 | EMCP2 Generator Set Shutdown Status Extension #1 |
| EMCP2 | f5 | 0b | 2 | EMCP2 Cycle Crank Time Setpoint |
| EMCP2 | f5 | 0c | 2 | EMCP2 GSC Total Crank Time Setpoint |
| EMCP2 | f5 | 0d | 2 | EMCP2 GSC Crank Terminate Speed Setpoint |
| EMCP2 | f5 | 3e | 2 | EMCP2 Engine Oil Temperature |
| EMCP2 | f5 | 57 | 2 | EMCP2 Bus to Generator Phase Difference |
| EMCP2 | f8 | 14 | 9 | EMCP2 Application Software Part Number |
| EMCP2 | fc | 0d | 8 | EMCP2 Spare Outputs |
| EMCP2 | fc | 0f | 5 | EMCP2 Generator Total Real Power |
| EMCP2 | fc | 10 | 8 | EMCP2 Relay Driver Module Relay State |
| EMCP2 | fc | 11 | 5 | EMCP2 Generator Phase A Real Power |
| EMCP2 | fc | 12 | 5 | EMCP2 Generator Phase B Real Power |
| EMCP2 | fc | 13 | 5 | EMCP2 Generator Phase C Real Power |
| EMCP2 | fc | 14 | 5 | EMCP2 Generator Phase A Reactive Power |
| EMCP2 | fc | 15 | 5 | EMCP2 Generator Phase B Reactive Power |
| EMCP2 | fc | 16 | 5 | EMCP2 Generator Phase C Reactive Power |
| EMCP2 | fc | 17 | 5 | EMCP2 Generator Total Reactive Power |
| EMCP2 | fc | 18 | 5 | EMCP2 Generator Phase A Apparent Power |
| EMCP2 | fc | 19 | 5 | EMCP2 Generator Phase B Apparent Power |
| EMCP2 | fc | 1a | 5 | EMCP2 Generator Phase C Apparent Power |
| EMCP2 | fc | 1b | 5 | EMCP2 Generator Total Apparent Power |
| EMCP2 | fc | 1c | 5 | EMCP2 Generator Total kW hours |
| EMCP2 | fc | 1d | 5 | EMCP2 Generator Total kVAR hours |
| EMCP2 | fc | 1e | 8 | EMCP2 Generator Shutdown Status |
| EMCP2 | fc | 1f | 8 | EMCP2 Generator Alarm Status |

Appendix B.3 Data Extraction Methods

These methods correspond to data formats described in the CATM5X protocol document. Each parameter (PID) is assigned a data format by Caterpillar. The format defines the number of data bytes and their internal arrangement.

| # | Format | Implemented | Length |
|----|------------|-------------|--------|
| 1 | A | Yes | 1 |
| 2 | AA | Yes | 1 |
| 3 | AAB | Yes | 2 |
| 4 | CDDEE | No | 3 |
| 5 | AAAA | Yes | 1 |
| 6 | 10 x A | Yes | 10 |
| 7 | 17 x A | No | 17 |
| 8 | ABCD | Yes | 4 |
| 9 | 8 x A | Yes | 10 |
| 10 | AB | Yes | 2 |
| 11 | AABBCC | Yes | 3 |
| 12 | AAB[C] | Yes | 3 |
| 13 | AAB[CDDEE] | Yes | 5 |
| 14 | AABB | No | 2 |

Appendix B.4 Driver Error Messages

| Message | Explanation |
|--|---|
| CatM5X:#1 Error. Node=<%s> not connected to a port. | This protocol requires that Nodes are connected to ports as the driver checks the relationship between the port, the Node_ID and port a message was received on. ¹ |
| CatM5X:#2 Error. Node=<%s> Station Rqd/Actual=(0-255)/%d. | Valid Node_ID are 0–255. Not all of the values correspond to legal Unit ID’s defined by Caterpillar, however. The Node_ID must be specified as a decimal number. Thus engine \$21 should be specified as 33. ¹ |
| CatM5X:#3 Error. Invalid PID. Map Descriptor=<%s> requires a catParam. | The PID provided is not recognized by the driver. The keyword may have been misspelled or mis-spaced. If using the catPID1/2 parameters then specify a method also. ¹ OR A PID1/2 was specified that is not available in the list of supported PID’s. This problem can be avoided by specifying a catMethod. See Appendix B.3 . ¹ |

¹ Download the CSV file, make the necessary adjustments, upload the file and reset the FieldServer.

| Message | Explanation |
|--|--|
| CATM5X:#4 Error. Polls from Masters only | CATM5X messages contain a field indicating whether the poll is from a Client or Server. If the driver receives a message from a Server when it isn't expecting one then this message is printed. This could occur if a response was received after the driver acting as a Client timed out waiting for the response. In these circumstances, the incoming message is sent to the Server side of the driver which then prints this message because the Server side expects a poll not a response. This message is printed once and then suppressed. It can be monitored by watching the driver specific stats (Appendix B.5). If this event occurs repeatedly then capture a serial log and contact Tech Support. Run the log for long enough to capture one of these events. You can determine this by watching the stats and ensuring the stat which monitors this event increases by at least one count during the course of the log. If the event occurs infrequently and the data from the engine is still updating, the message may be ignored. |
| CATM5X:#5 Error. Expected/Rcvd Function (34 or 24)/%c%c | These messages are associated with driver events that cause the FieldServer to panic. You cannot correct the problem and should call Sierra Monitor. |
| CATM5X:#6 Error. Driver cannot process IID=%x(h) | |
| CATM5X:#7 Error. Storing. Method for PID %x %x is unknown. | |
| CATM5X:#8 Error. Incoming data from unit=%x(hex) is being abandoned. | This message is produced when data is being written to the FieldServer but the FieldServer cannot find a Map Descriptor to process the message with. For example, an ECM Hourmeter is being written to the FieldServer but a Map Descriptor with catParam = "ECM Hourmeter" cannot be found. The error message will identify the unit the message originated from and the PID1/2 of the incoming data. ² |
| CATM5X:#9 Error. Responses from CCM's only | These messages are associated with driver events that cause the FieldServer to panic. Take a log and contact Sierra Monitor. |
| CATM5X:#10 Error. Expected/Rcvd Function 35/%c%c | |
| CATM5X:#11 Error. Expected/Rcvd Unit 61/%c%c | |
| CATM5X:#12 Error. Expected/Rcvd PID F012/%c%c%c%c | |
| CATM5X:#13 Error. Responses from CCM's only | |
| CATM5X:#14 Error. Expected/Rcvd Function (25 or 35)/%c%c | |
| CATM5X:#15 Error. Driver cannot process IID=%x(h) | |
| CATM5X:#16 Error. Cannot Login. Incorrect Password. | Determine the correct password for the Caterpillar device. ² |

² Download the CSV file, make the necessary adjustments, upload the file and reset the FieldServer.

| Message | Explanation |
|---|---|
| CATM5X:#17. FYI. Logged in. Level= %d | The driver is reporting the access level at which it has logged into the remote device. This is an information message which may be ignored. |
| CatM5X:#18 Error. Method Not Supported. Map Descriptor=<%s> | The data extraction method specified in the csv file is not supported. Appendix B.3 lists supported methods. ² |
| CATM5X:19 Error. Data Method for PID %x %x is unknown. | This error should have been prevented by the driver. If an invalid method has been specified in the CSV file then error 18 should be produced. If this error is produced without error 18 in the log file then call Sierra Monitor for support. |
| CATM5X:#20.%d Err.Retriving. Array <%s> too short. Index=%d | The Data Array offset specified is too large as its points beyond the end of the Data Array. When sending a response (as a Server) the driver is trying to extract data beyond the end of the array. This could arise as some methods use more than one array location to get data to build the response. For example, if the method requires 4 consecutive array locations and the offset specified is that last location in the array then this will produce an error. ² |
| CATM5X:#21.%d Err. Storing. Array <%s> too short. Index=%d | |
| CATM5X:#22 FYI. Node is responding with Node_ID=%d | This message is printed when a node is polled as Node_ID zero but responds with another Node_ID. This is part of the auto discovery system. The message can be ignored, but it is recommended that the configuration file is changed to specify the Node_ID of the station that is responding. Once specifically configured there is no possibility of confusion if a second engine controller is introduced on the same communications port. |

Appendix B.5 Driver Stats

In addition to the standard FieldServer communication statistics described in the FieldServer Configuration Manual, the driver can expose certain key stats by writing data to a Data Array. A special Map Descriptor named “catm5x-stats” is required.

The following lines may be added to the configuration file to activate these stats.

```
// Expose Driver Operating Stats.

Data_Arrays
Data_Array_Name           , Data_Format   , Data_Array_Length
catm5x-stats              , UINT32      , 200
```

In the table below, Stat # refers to the **relative** offset into the "catm5x-stats" Data Array where the data will be stored. To determine the actual offset, add a Base Offset to the Stat #. The Base Offset is calculated by multiplying the port handle number by 100.

| Stat # | Stats | Description |
|--------|--------------------------------|--|
| 1 | CAT_STAT_NO_START | The driver received a message which contained an invalid byte in the 1st byte of the message. All catm5x messages begin with a fixed header of 2 bytes. If this occurs repeatedly then it may indicate that the connections setting such as baud or parity are incorrect. This stat increments by 1 each time this occurs. |
| 2 | CAT_STAT_NO_START2 | The driver received a message which contained an invalid byte in the 2nd byte of the message. All catm5x messages begin with a fixed header of 2 bytes. If this occurs repeatedly then it may indicate that the connections setting such as baud or parity are incorrect. This stat increments by 1 each time this occurs. |
| 3 | CAT_STAT_COMPL_CR_BAD | The driver received a message that was not correctly formatted. More than 132 bytes had been received but a 'CR' had still not been found. The message will be rejected. |
| 4 | CAT_LOGIN_RESPONSE | This stat increments by 1 each time a valid login response is received. |
| 5 | CAT_LOGIN_RESPONSE_BAD | This stat increments by 1 each time a invalid login response is received. |
| 6 | CAT_STAT_COMPL_CHKSUM | This stat increments by 1 each time a message with an invalid checksum is received. The message will be rejected. |
| 7 | CAT_STAT_STORE_NO_MAP | This stat increments by 1 each time a message with a data payload is processed but the driver cannot find a Map Descriptor to use to determine where to store the data. This stat is associated with Error message CATM5X:#8 which is only printed once and then suppressed. |
| 8 | CAT_STAT_BAD_PASSWORD | Increments by 1 each time a login attempt was rejected by the CCM because the password was invalid. |
| 9 | CAT_STAT_NOT_FROM_MASTER | Increments by 1 each time the Server side of the driver receives a message that didn't come from a Client. The driver stores the two bytes which indicate the message origin in stat 10 and stat 11. These two stat locations are overwritten each time this event occurs. Read the notes associated with error message CATM5X:#4. |
| 10 | CAT_STAT_NOT_FROM_MASTER_BYTE0 | |
| 11 | CAT_STAT_NOT_FROM_MASTER_BYTE1 | |