

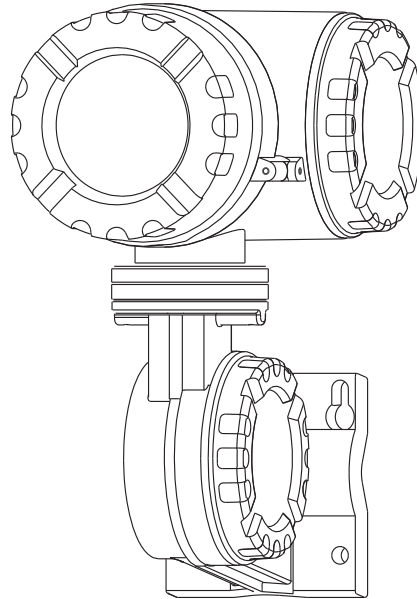
# 4590 Tank Side Monitor

V1 Communication Protocol



## *Service Manual*

Software Version v2.03



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5834 Peachtree Corners East  
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# 1 Introduction

This protocol guide explains the operation of the V1 protocol implemented in the Varec 4590 Tank Side Monitor (TSM).





## 2 Implementation

The implementation of the V1 protocol for the 4590 TSM provides a standard form of digital communication via a 2-wire system.

Check compatibility carefully to ensure that the 4590 TSM is properly configured for the data format expected by the host system or computer. Due to the unique application requirements of the 4590 TSM, exceptions have been made and noted.

**Note!** There is no guarantee that the interpretation made here will be the same as that followed by the V1 master.

The 4590 TSM implementation of the V1 slave protocol supports various old and new V1 protocols. See Chapter 6, V1 Protocol Formats for a full description of each protocol.

- V1 (new V1)
- MDP (old V1)
- BBB (old V1)
- MIC+232 (old V1)

Within the new V1 protocol, both the standard Z0 and Z1 responses are supported.

- Z0 provides: Level, Temperature, Percentage 4 – 20 mA Input, & Status
- Z1 provides: Level & Status

The data values can be accessed at the indicated Mode/Index locations listed in Table 2-1. Note that duplication provides compatibility with older V1 slave devices.

Table 2-1: V1 Data Values

Data Value	Mode	Index	GVH	Transmission Format	Note
Tank Level	0x00 ----- 0x13	0x09 ----- 0x14	008	123456=12345.6 mm	
Observed Density	0x00 ----- 0x13 ----- 0x40	0x06 ----- 0x11 ----- 0x05	005   694	12345 = 1.2345 kg/m <sup>3</sup>	
Middle Density	0x00 ----- 0x13	0x07 ----- 0x12	006	12345 = 1.2345 kg/m <sup>3</sup>	always zero
Tank Vapour Temp	0x01	0x04	13	± 1234 = ±123.4° C	
Tank Water Level	0x00 ----- 0x13	0x03 ----- 0x15	002	123456=12345.6 mm	
Ullage Level	0x00 ----- 0x13	0x02 ----- 0x13	001	123456=12345.6 mm	always zero
Bottom Level	0x00 ----- 0x13	0x05 ----- 0x16	004	123456=12345.6 mm	always zero
N453X Element 1 Temp	0x24	0x01	450		
N453X Element 2 Temp	0x24	0x02	451		
N453X Element 3 Temp	0x24	0x03	452		

Data Value	Mode	Index	GVH	Transmission Format	Note
N453X Element 4 Temp	0x24	0x04	453		
N453X Element 5 Temp	0x24	0x05	454		
N453X Element 6 Temp	0x24	0x06	455		
N453X Element 7 Temp	0x24	0x07	456		
N453X Element 8 Temp	0x24	0x08	457		
N453X Element 9 Temp	0x24	0x09	458	$\pm 1234 = \pm 123.4 \text{ } ^\circ\text{C}$	
N453X Element 10 Temp	0x24	0x10	459		
N453X Element 11 Temp	0x24	0x11			
N453X Element 12 Temp	0x24	0x12			
N453X Element 13 Temp	0x24	0x13			
N453X Element 14 Temp	0x24	0x14			
N453X Element 15 Temp	0x24	0x15			
N453X Element 16 Temp	0x24	0x16			
HART Device 1 PV	0x01	0x02	011	$\pm 1234567 = \pm 12345.67$	units as HART Device 1PV
HART Device 2 PV	0x01	0x03	012	$\pm 1234567 = \pm 12345.67$	units as HART Device 2 PV
Tank W&M Status	0x60	0x01		12345 = 12345	see "V1 Protocol Formats"
P1 Pressure	0x60	0x02		123456 = 123.456 kPa	
P2 Pressure	0x60	0x03		123456 = 123.456 kPa	
P3 Pressure	0x60	0x04		123456 = 123.456 kPa	

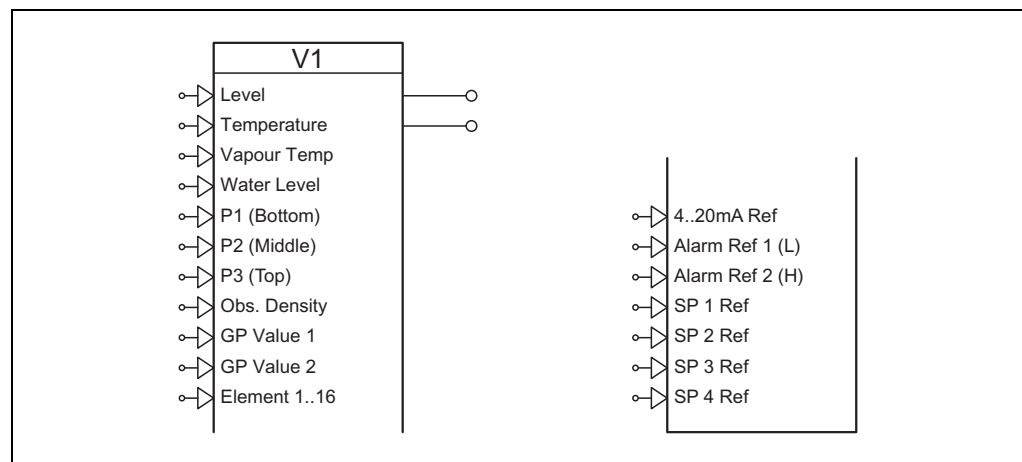


Figure 2-1: Function Block "V1 Output"

### 3 Installation Recommendations

#### 3.1 Cable Specifications for the V1 Protocol

Table 3-1 summarizes the cable specifications used for the V1 Protocol.

Table 3-1: Cable Specifications for the V1 Protocol

Cable Method	Type of Cable	Resistance in one Direction & Line Capacitance	Maximum Available Transmission Distance
2-wire signal cable connection independent from power cable line	0.9 mm telephone cable, PE insulation (60 V rating)	30 Ω 0.05 μF/km	4 km
	1.2 mm telephone cable, PE insulation (60 V rating)	1.65 Ω 0.05μF/km	6 km

The maximum transmission distance allowed is dependant upon the actual cable conditions and specifications used.

#### 3.2 Example Topologies

##### 3.2.1 Cascaded Topology

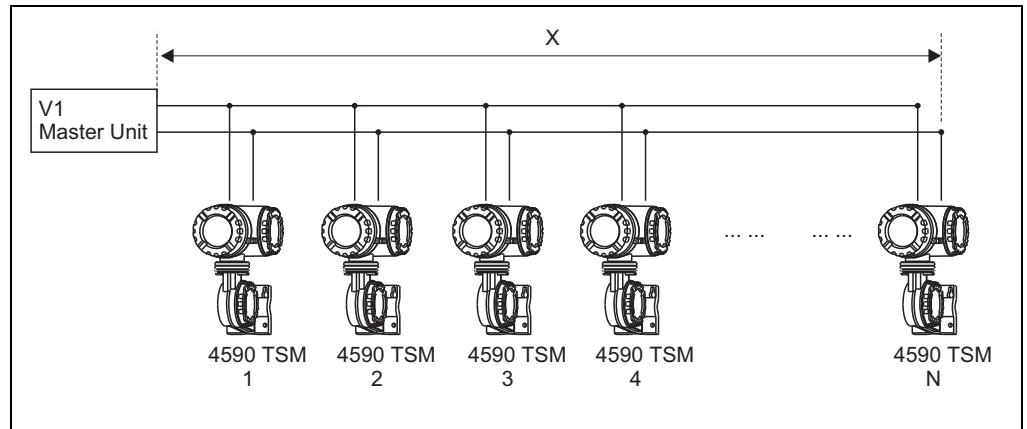


Figure 3-1: Cascaded Topology

The furthest master-to-slave cable distance "X" should be less than or equal to the maximum transmission distance.

### 3.2.2 Tree Topology

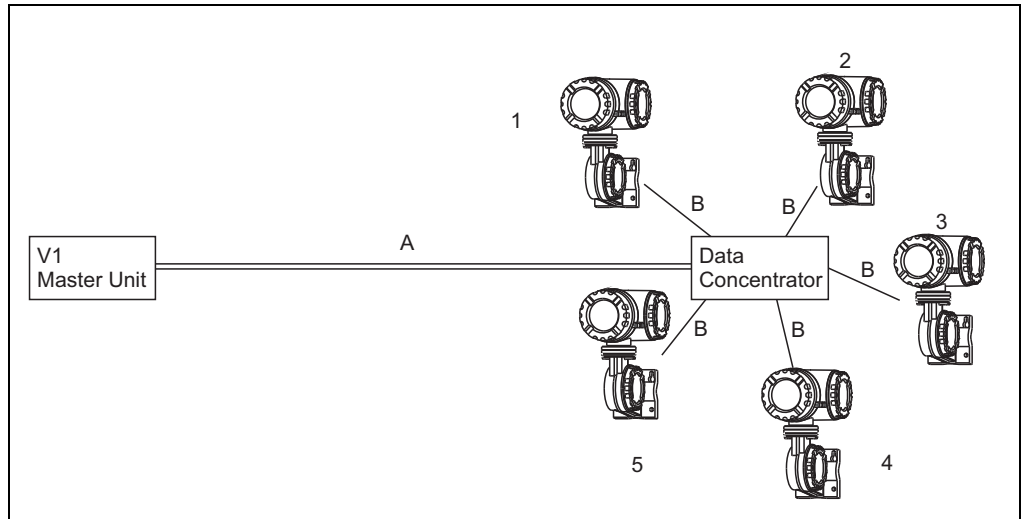


Figure 3-2: Tree Topology

A+B should be less than or equal to the maximum transmission distance. In this topology, "A" is the main distance, whereas "B" is considerably shorter.

### 3.2.3 Star Topology

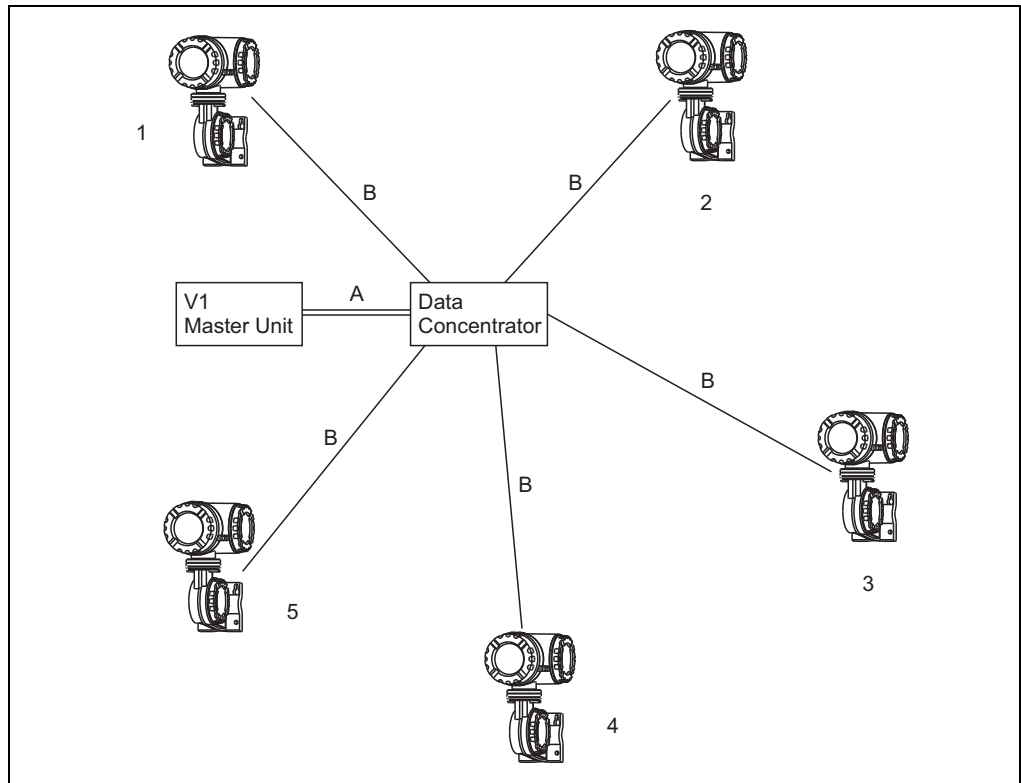


Figure 3-3: Star Topology

A+B should be less than or equal to the maximum transmission distance. In this topology, "B" is the main distance, whereas "A" is considerably shorter.

## 4 Configuration

The V1 slave ports on the 4590 TSM must be configured to establish communication. The local display or ToF tool allows the user to set the 4590 TSM V1 slave port to match the V1 master settings.

### 4.1 Address

The 4590 TSM addresses provide unique identification for the host. The 4590 TSM address is configured through the local display or ToF tool. This address may range from 0 to 99 in the V1 protocol variant, and from 0x00 to 0xFF for the other variants (MDP, BBB, and MIC+232).

### 4.2 Configuration Settings

For successful communication on a V1 bus, a number of configuration settings must be made to match the configuration of the bus.

#### 4.2.1 Summary of Basic Configuration Parameters

Table 4-1 summarizes the configuration information required by the 4590 TSM.

*Table 4-1: Summary of the Configuration Information required by the 4590 TSM*

Configuration Parameter	Valid Entries	Default
Protocol Type	<ul style="list-style-type: none"> <li>• V1</li> <li>• MDP</li> <li>• BBB</li> <li>• MIC+232</li> </ul>	V1
ID Decimal <sup>1)</sup>	0 – 99	1
ID Hexadecimal <sup>1)</sup>	0x00 – 0xFF	0x01
Line Impedance	0 – 15	15
Level Mapping	<ul style="list-style-type: none"> <li>• +ve only</li> <li>• +ve &amp; -ve</li> </ul>	+ve only
Service Relay	<ul style="list-style-type: none"> <li>• Off</li> <li>• On</li> </ul>	Off

1) The ID parameter is set either in decimal or hexadecimal form according to the Protocol Type specified. ID decimal is used when the V1 variant is set as a type. For the other variants (MDP, BBB, MIC+232), ID hexadecimal is used.

## 4.2.2 Description of Basic Configuration Parameters

Table 4-2 summarizes the basic configuration values of the V1 slave group for the 4590 TSM. The numbers in parentheses indicate the menu position.

Table 4-2: Basic Configuration Values of the V1 Slave Group for the 4590 TSM

Field	Description	Default
Protocol <sup>(9211)</sup>	This value selects the V1 slave protocol in which the 4590 TSM will communicate.	
ID Decimal, ID Hexadecimal <sup>(9212)</sup>	This is a unique number for the device on the V1 bus. It is only when a request with this number is received that the 4590 TSM will generate a response. This ID can be in decimal or hexadecimal form depending on the type of protocol variant used (V1 uses decimal; MDP, BBB, and MIC+232 use hexadecimal).	
Line Impedance <sup>(9213)</sup>	The "Line R" value enables variation in the load that the 4590 TSM uses for replying on the V1 bus. It is needed to adjust for installation parameters with older control room equipment. For new equipment and the new V1 protocol, the default value (15) is suitable.	15
Level Mapping <sup>(9214)</sup>	Sets the level mapping mode for the new V1 communication protocol. When set to "+ve only", the returned level value is from 0.0mm to 99999.9mm. However, if set to "+ve & -ve", values from -49999.9mm to 50000.0mm can be returned (using the mapping rule described in Chapter 6, V1 Protocol Formats)	
Service Relay <sup>(9215)</sup>	When the service relay is closed, the V1 interface circuit is disconnected from the V1 terminals and a fixed load resistor is connected instead. This mode can be used to assist in diagnosing loop problems.	
SP1 <sup>(9221)</sup> , SP2 <sup>(9222)</sup> , SP3 <sup>(9223)</sup> , & SP4 <sup>(9224)</sup> References	This parameter indicates which discrete value is transmitted as the V1 External status.	<ul style="list-style-type: none"> <li>• SP1 = IS DI1</li> <li>• SP2 = IS DI2</li> <li>• SP3 = unknown</li> <li>• SP4 = unknown</li> </ul>
Analogue (4–20 mA) Reference <sup>(9225)</sup>	This parameter indicates which discrete value is transmitted as the Analogue value.	The default value is connected to the IS AI.
Alarm 1 Reference H <sup>(9226)</sup>	This parameter indicates which discrete value is transmitted as the V1 Alarm 1 (low) status.	The default is connected to the level alarm H or HH value.
Alarm 2 Reference L <sup>(9227)</sup>	This parameter indicates which discrete value is transmitted as the V1 Alarm 2 (high) status.	The default value is connected to the level alarm L or LL value.

## 5 Measured Values

The V1 response contains a number of measurement values—level, temperature, percentage, density, pressure, and more. Tables 5-1 and 5-2 list the limits they are subject to.

### 5.1 Old V1 Protocol

*Table 5-1: Old V1 Protocol Limits*

Measured Value	Minimum <sup>1)</sup>	Maximum <sup>1)</sup>	Granularity	Units	TANK Parameter <sup>2)</sup>
Level	0	99999	1	mm	Corr. Level
Temp	-50.0	+359.5	0.1	°C	Temp.

1) The control room equipment indicates a value error when the value reaches these limits (either minimum or maximum).

2) This column indicates the source of the value returned by the V1 communication.

5.2 New V1 Protocol

Table 5-2: New V1 Protocol Limits

Measured Value	Minimum	Maximum	When Invalid or Offline	Granularity	Units	TANK Parameter <sup>1)</sup>
Level <sup>2)</sup>	0.0 ----- 49999.9	99999.9 ----- 50000.0	99999.9 ----- 50000.0	0.1	mm	Level
Temperature ----- Vapor Temp. ----- Element Temps.	-999.9	999.9	999.9 ----- 999.9 ----- 999.9	0.1	°C	Temp. ----- Gas Temp. ----- NMT??? Element Temps <sup>3)</sup>
Percentage 4 – 20 mA	0.0	100.0	100.0	0.1	%	*4)
Pressures P1, P2, & P3	000.000	999.999	999.999	0.001	kPa	P1,2,or 3 Pressure
Density	0.0000	9.9999	9.9999	0.0001	kg/m <sup>3</sup>	Obs. Density
BSW <sup>2)</sup>	0.0 ----- -49999-9	99999.9 ----- 50000.0	99999.9 ----- 50000.0	0.1	mm	Water Level
Hart 1 PV ----- Hart 2 PV	-99999.99	+99999.99	99999.99 ----- 99999.99	0.01	*5)	HART1 PV ----- HART2 PV

- 1) This column indicates the source of the value returned by the V1 communication.
- 2) Depending on the "Level Mapping" configuration setting. For a detailed description of the message formats, see Chapter 6, V1 Protocol Formats.
- 3) Element temperatures can only be provided if an 453x ATC multi-element temperature device is connected to the 4590 TSM. In this case, the first value returned is the 453x ATC Element#1 temperature value, the second is the 453x ATC Element#2, and so on.
- 4) This percentage is shown in the function of which discrete value is selected as the source on the V1 configuration menu.
- 5) The unit of these values are determined by the 5) Hart devices PV unit. No conversion is applied.

5.3 Measured Values Error Handling

The following error-handling rules are applied to all values returned in the V1 message:  
Refer to Tables 5-1 and 5-2 for related minimum and maximum values.

- 1. If a value (level, temperature, or any other) is below the minimum value, the minimum value is returned.
- 2. If a value (level, temperature, or any other) is above the maximum value, the maximum value is returned.
- 3. If the level is invalid or offline, the level returned is either 99999.9 mm or 50000.0 mm depending on the level mapping configuration setting.
- 4. If the temperature is invalid or offline, the temperature returned is +999.9°C.



**Note!** If an 7200/7500 series Radar Tank Gauge (RTG) is connected to the 4590 TSM and is used for level values, an “in safety distance” or “echo lost” error condition will cause a maximum level value to be returned on the V1 bus and not a “data invalid” message. The RTG and 4590 TSM must be properly configured for alarm handling. Refer to the 4590 TSM documentation for details.



## 6 V1 Protocol Formats

### 6.1 Physical Layer

The V1 communication takes place on a 2-wire voltage mode bus. Bits are represented by the pulse width on requests from the control room and voltage level for the response. The V1 protocol encodes a clock pulse from the control room for both requests and replies, removing the need for a baud rate setting in the slave devices.

### 6.2 Old V1 Protocol

The old V1 protocol relies on fixed-length request and reply data packets which have a fixed data format. This allows basic tank values to be transferred to the control room from the slave.

Table 6-1 summarizes the parameters used for the old V1 protocol.

Table 6-1: Old V1 Protocol

Parameter	Data Source / Value
Level	Tank Corrected Level <sup>1)</sup>
Temp	Tank Temperature
S1	SP1—when the referred discrete value is active, the bit would be ON <sup>2)</sup>
S2	SP2—when the referred discrete value is active, the bit would be ON <sup>2)</sup>
S3	SP3—when the referred discrete value is active, the bit would be ON <sup>2)</sup>
S4	SP4—when the referred discrete value is active, the bit would be ON <sup>2)</sup>
AL High	V1 Alarm 1 H status (active = bit ON, inactive = bit OFF)
AL Low	V1 Alarm 2 L status (active = bit ON, inactive = bit OFF)
UNDER	Fixed Value "0"
OVER	Fixed Value "0"
/UP	Fixed Value "1"
STOP	Fixed Value "0"
AD	Fixed Value "0"
/DOWN	Fixed Value "1"
/DCT	Fixed Value "1"
BAL	Fixed Value "1"
C3, C2, C1	Fixed Value "0"

1) When the gauge type is 453x ATC and the V1 protocol is "BBB" or "MIC+232", a Servo Error is indicated by setting the level 10,000 digit to 15 (0xF) and setting the level 1,000 digit to 13 (0xD), 14 (0xE), or 15 (0xF) depending on the errors Encoder Error, Over Tension, and Under Tension respectively.

2) The ON status is a logical state. If the input is configured as normally closed, ON indicates the open state.

## 6.3 New V1 Protocol

The new V1 protocol encodes ASCII requests and responses onto the bus allowing the addressing of a large number of possible data values depending on the slave device capabilities.

The protocol also includes two special commands, Z0 and Z1. These commands are replied to by the slave with a response encoding all of the main tank parameters into the one data block. These commands allow faster polling times for the main tank values.

### 6.3.1 Z0 & Z1 Responses

Table 6-2 summarizes the parameters used for the two special commands, Z0 and Z1.

Table 6-2: Z0 & Z1 Responses

Parameter	Included in Response	Data Source / Value
Level	Z0, Z1	Tank Corrected Level
Temp	Z0	Tank Temperature
Sensor Status	Z0, Z1	Fixed value "05"—Level & Balanced
Sensor Error	Z0, Z1	Fixed value "00"—None
External Status	Z0, Z1	<ul style="list-style-type: none"> <li>bit 0 = DIO #1 (only when DIO is Input)</li> <li>bit 1 = DIO #2 (only when DIO is Input)</li> </ul> Input is ON when bit is set <sup>1)</sup>
% 4 -20 mA	Z0	IS Analogue Input Percentage Value (from Analogue 4 - 20 mA reference)
Alarm	Z0, Z1	<ul style="list-style-type: none"> <li>bit 0 = V1 Level Alarm #1 Status</li> <li>bit 1 = V1 Level Alarm #2 Status</li> </ul>
Balance	Z0, Z1	Fixed Value "1"—Balanced
Answer Back	Z0	Fixed value "0"

1) The ON status is a logical state. If the input is configured as normally closed, ON indicates the open state.

### 6.3.2 Level Mapping

The level value in the reply from the 4590 TSM is always a number in the range from 000000 to 999999 in 1/10 mm.

- In "+ve only" mode, this value directly relates to the level:
  - +00000.0 mm = 000000
  - +99999.9 mm = 999999
- In "+ & -" mode, the value range is used to encode both positive and negative values using the following method:
  - +00000.0 mm to 50000.0 mm = 000000 to 500000
  - 00000.1 mm to -49999.9 mm = 500001 to 999999

### 6.3.3 Configuration with the 8130 RTU

While communicating with the 8130 RTU , pay special attention to some of the 8130 RTU parameters.

1. In the V1 SCAN menu:
  - Number of response pulses—the maximum number of response pulses to be provided by the master should be set to 3000 according to the V1 specification.
2. In the 4590 TSM point menu:
  - Module = RTU card module slot used (1 to 4)
  - Channel for Communication = use either 1 or 2 depending on the channel used
  - TSM Address = use the V1 protocol address
  - BaudRate = use a value between 0 and 99 which will determine the pulse width of the request signal—suggested 99 (max).



## NOTES

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Varec, Inc.  
5834 Peachtree Corners East, Norcross (Atlanta), GA 30092 USA  
Tel: +1 (770) 447-9202 Fax: +1 (770) 662-8939

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