USER'S MANUAL

Omniflex

Maxiflex Dual Hart NIM

M1589

SCOPE:

The HART protocol is a comprehensive open communications standard for configuring and communicating with Smart field devices in industrial process applications.

The Maxiflex M1589 Dual Hart NIM (NIM) is a Network Interface Module that acts as a permanent host interface device (primary master) on up to two Hart networks. This NIM is used to acquire data from the HART loops and to make the data available for SCADA, data-logging etc. in the Maxiflex system. Other specialised functions may be performed using the optional custom query block mechanism.

This document describes the installation, set-up and use of the M1589 Hart NIM module in a Maxiflex system.

The reader is assumed to have a working knowledge of the Maxiflex system, and in particular the use of Data Interchange Table Registers (DIT's) for the reading and writing of data in the module.

DATE	REVISION	COMMENTS
April 1999	1	Initial revision
June 1999	2	Custom Query Block functions added.
October 1999	3	Corrections to DIT layout
February 2000	4	Added Table of Contents
October 2003	5	Added query status DITs
November 2003	6	Added HART status bytes to DIT. Allow DIT to be user configurable. Added response data formatting blocks.
January 2004	7	Moved one shot query trigger location
October 2004	8	Added retry count to DIT
May 2005	9	Added Burst Mode functionality. Software Version has progressed to Ver2.00. S.R
August 2005	10	Added Priority Poll Timers. Software version has progressed to V2.02
July 2007	11	Added Loop Inhibit function. Software Version 2.06

Table of Contents

1. Introduction

The M1589 Hart ® NIM module is an intelligent I/O module in the Maxiflex range of products.

The Hart NIM plugs into an I/O slot on a Maxiflex base and independently interrogates field devices on two Hart networks, making the data available to the Maxiflex system.

This data may be accessed by the entire range of Maxiflex CPU's. The method of access may vary from CPU to CPU, and reference should be made to specific documentation for these products for details of the implementation.

2. Specifications

Inputs/Outputs	
Number of HART loops	2
Number of Field devices interrogated	15 max per HART loop
HART Operating Mode	Primary Master
Loop Isolation Voltage	500V dc min.
Maximum Loop Voltage	40Volts
Minimum loop load resistance	230ohms
Maximum loop load resistance	1100ohms
HART Transmitter signal levels	400mV p-p min 600mV p-p max
HART Receiver sensitivity	120mV p-p min 2000mV p-p max
HART Receiver threshold (Must ignore)	80mV
DC load impedance	2microamps max at 60deg C 40Volts
AC load impedance	22 microFarads typical

HART Wiring Recommendations	
Maximum Cable Impedance	R x C must be less than 65us (e.g. 300ohms x 0.2uF = 60us) (R includes load resistance) (C includes field device capacitance)
Cable Type	Overall screen recommended Individually screened pairs over 1500m
Loop Power Supply Maximum Ripple	0.2V p-p (47-125Hz)
Loop Power Supply Maximum Noise	1.2mV (500Hz – 10kHz)
Loop Power Supply Impedance	10ohms

Supported HART Commands as standard	
Universal Commands	
Command 0	Identify Manufacturer, Device Type and Revision Levels.
Command 3	Read Current and four (predefined) dynamic variables.
Other Commands	
User Configurable	Up to 64 Custom Query Blocks may be configured in the NIM. Each query block can address any HART device with any command support supported by that device. The response is stored in its raw data format in the Data Interchange Table for interpretation by the user.

3. The HART Protocol

3.1 Background to the HART Protocol

HART is an acronym for "Highway Addressable Remote Transducer".

The HART® protocol was originally developed by Rosemount Inc. but all rights in the protocol have now passed to the HART Communication Foundation, and the HART protocol is now freely available for general use.

There is an abundance of information on the HART protocol available from a number of sources. The following Internet web-site is a recommended starting point for further reading:

- The HART Communication Foundation at http://www.hartcomm.org

3.2 Application of the HART Protocol

The HART protocol specifies a means for superimposing a digital messaging system on top of a conventional 4-20mA instrumentation loop to allow the remote interrogation and configuration of field devices. The operation of the HART system via the two wire 4-20mA loop does not affect the accuracy of the dc current in the loop.

3.3 Technical Features of the HART Protocol

The HART protocol superimposes a Bell 202 Standard frequency-shift-keying signal at 1200 baud as an ac signal at a low level on the current loop.

HART is a master/slave protocol. The field devices act as slaves in the protocol and only reply to requests addressed to them. Up to 15 slave devices may be connected on to a single pair of wires. In this multi-drop configuration, the field devices disable their 4-20mA signals and communication is exclusively via the HART protocol. When only a single slave device is present, then both the 4-20mA and HART communication may operate simultaneously.

The protocol allows for two masters to be present on a single HART loop. These are typically a permanently connected control system (known as the primary master) and a hand-held configuration device known as a HART Communicator (acting as a secondary master).

The command messages defined in the HART protocol are broken into three groups:

1. The "Universal" commands are implemented in all field devices.
2. The "Common-Practice" commands provide functions common to many field devices, but may not be installed in the device.
3. The "Device-Specific" commands provide functions that are unique to a particular manufacturer's device.

The HART “Device Description Language” (DDL) is a formal language that allows a manufacturer to completely specify the communication interface to its HART equipped field device. This includes a definition of accessible variables, commands and operating procedures. It also includes a menu structure that a host device can use for a human operator. Device Descriptions make it easy to upgrade master devices to support new devices as they become available.

3.4 The M1589 Dual HART NIM in a HART loop.

The M1589 Dual HART NIM is equipped with two independent HART primary master interfaces. This allows this product to communicate independently with two separate HART loops at the same time.

The NIM implements a subset of the universal commands and does not require DDL files to configure the device. The list of commands implemented is defined later in this document.

The NIM is designed to be self-configuring for ease of use. Once powered up, the NIM searches for HART devices on each of its two HART interfaces and builds an inventory of devices found. Various data elements are continuously and automatically read from the device and stored in the Data Interchange Table (DIT) in the device for access by the rest of the Maxiflex system. The NIM in this mode uses HART commands 0 and 3 to extract the most commonly used data from the field devices with no configuration necessary.

The NIM is also provided with a custom query block mechanism. Up to 64 custom query blocks may be configured to perform specialised data manipulation on the connected field devices using any of the command types supported by the field device.

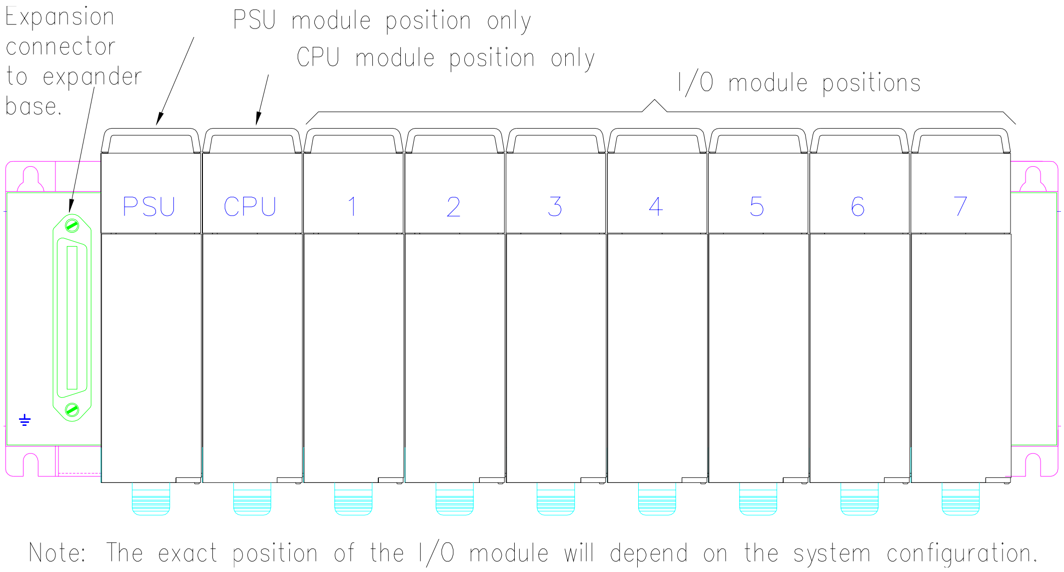
4. Installation

4.1 Installing the NIM on to a Maxiflex Base.

The M1589 NIM must be inserted into one of the I/O positions of a Maxiflex Base.

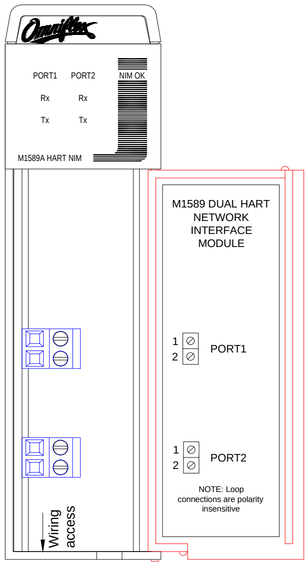
Refer to the Maxiflex bases General Instructions (PN 98-8952-930-XXX) for more detail on base layout, module insertion and module removal.

Figure 1: Layout of the 7I/O Master Base



4.2 Connecting the HART Loops.

Figure 2: Layout of the M1589 DUAL HART NIM



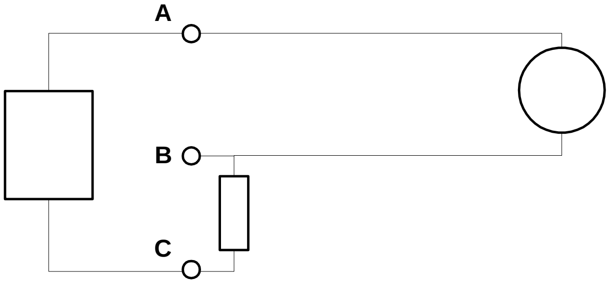
Note: The LED indicators can only be seen when illuminated.

A two-way connector is provided for each HART interface. This interface is completely isolated from the NIM circuitry and therefore will not affect the performance of a 4-20mA loop when connected.

The connection is symmetrical, and may be connected with either polarity without affecting the performance of the system.

It is NOT recommended that this connection be made while the 4-20mA loop is active, as a small current upset may be observed when the NIM circuit's blocking capacitors charge.

4.3 Typical Connection Diagrams



Two Wire Transmitter Connection

Four Wire Transmitter Connection

The HART NIM may be connected across A-B or B-C

5. Operation

5.1 Hart Loop Independence

The NIM operates two completely independent polling procedures, one for each HART loop.

The following description applies to either of these HART loops.

5.2 Philosophy of Operation

In accordance with the Maxiflex inter-networking philosophy, the design of the M1589 Dual HART NIM has been designed for maximum flexibility and ease of use.

The HART NIM is designed as an interrogation device to be used for the purpose of exchanging live plant data with a number of HART devices for data acquisition, monitoring and data-logging applications.

The HART NIM is not designed to replace the field device manufacturer's recommended set-up tools or procedures.

The configuration requirements for the NIM have been kept to a minimum. In most applications, no configuration at all is required, because the NIM automatically identifies the presence of field devices on the HART network, and begins polling for the most popular field device configuration and dynamic data. This data is automatically stored in the NIM's Data Interchange Table (DIT) from where it can be read by the rest of the Maxiflex system in the conventional manner.

Upon power up, the NIM begins an automatic polling sequence on each of the HART loops (using universal HART command 0), and identifies any devices present on the loops. The presence and identification of these field devices is made available in the DIT. Dynamic data is then read on a regular basis (using universal HART command 3) from these devices and is made available in the DIT.

The NIM continues to poll on a regular but infrequent basis for the presence of any additional field devices in the loop (using universal HART command 0), and automatically begins polling these devices (using universal HART command 3) when found.

If a device is removed from the loop, then this is detected and the DIT updated accordingly.

5.3 LED Indication

Name	Colour	Indication
NIM OK	GREEN	Steady ON - module healthy OFF or Flashing – module unhealthy (except on startup)
PORT1 Rx	YELLOW	Flashes when a message is received on Loop 1
PORT1 Tx	RED	Flashes when a message is transmitted on Loop 1
PORT2 Rx	YELLOW	Flashes when a message is received on Loop 2
PORT2 Tx	RED	Flashes when a message is transmitted on Loop 2

Note that the NIM module always polls for new devices. This means that the transmit (Tx) LEDs will flash continuously, even there are no devices connected to that loop.

5.4 Device Identification

There is a possibility of up to 16 devices being present on a single HART loop. These devices are identified by their address in the range 0 to 15. (In normal operation it is not permitted to have all sixteen devices present at one time, but the NIM is designed to cope with this error condition.)

If a field device is configured for poll address 0 then it assumes it is the only HART device in the loop and its analogue current loop functions as a normal 4-20mA transmitter. If the HART loop is to be used in its multi-drop mode, then all HART field devices on that loop must be set to poll addresses in the range 1-15. If a HART device has its poll address set to anything other than 0 then its analogue output current is set to a constant 4mA.

The NIM reserves a space in the DIT for each address from 0 to 15. If a device is found, then the data from this device is stored in the DIT in the space reserved for its address.

Each field device address slot can be in three states:

- State 0: No device present
- State 1: Revision 2,3 or 4 HART device present
- State 2:Revision 5 HART device present

The current state for each device address slot can be viewed in the DIT.

The NIM will periodically poll each slot in the “Device Not Present” state for a device being added. If a device is found then that slot is put into State 1 or 2 depending upon the type of device found.

The Revision level of each field device dictates how the NIM addresses the device. HART Revision 5 devices have the facility to be addressed using a worldwide 5 byte unique identifier instead of the single byte address in the range 0 – 15. If the NIM identifies a device as being Revision 5 or above, then this method of addressing is used for all other messages sent to the device.

When the NIM powers up, the entire DIT is cleared to 0 and all device slots are set to State 0 – No device present. The NIM then searches for any present devices before entering its normal scan cycle.

Part of this scan cycle entails periodically polling all address slots for a device to ensure that no devices are added later. This procedure ensures that within 60 seconds of any change in status, any device connected to the HART loop will have been identified and data will be valid.

If polling of any present device fails 5 times in a row, then the device is returned to State 0 – device not present.

5.5 Burst Mode Operation

5.5.1 Introduction

In Burst Mode operation there can only be a single slave per Loop. Burst Mode operation allows a single Slave to continuously send data to the Primary Master without the Master polling for the data hence improving data throughput.The Master will initiate Burst Mode once the User has selected Burst Mode operation in the Configuration and the Master has detected the presence of the Slave device. If the Slave has not been detected then the Master will revert to polled mode.

5.5.2 Master in Burst Mode and Slave in Polled Mode after Power on Reset

The configuration in the HART NIM is retained after a power on reset. Therefore if the Master was set to Burst and the Slave is in Polled Mode, then there will be no communication between the Master and the Slave until the Master is set to Polled Mode. Then if you recycle power the Master will start communicating with the Slave. At this point if you wish for the Slave to be in Burst Mode then you can configure the Slave by selecting Burst Mode in the configuration register for that Loop once the Master has detected the Slave in Polled Mode.

5.5.3 Master in Polled Mode and Slave in Burst Mode after Power on Reset

If the Master was set to Polled mode and the Slave is in Burst mode then you will need to set the configuration to Burst Mode then recycle power to the Master, this will prevent the master from transmitting to the Slave which is already in Burst Mode. Now if you wish to switch the Slave to Polled Mode you can simply select Polled Mode in the configuration register for that Loop.

5.5.4 Master in Polled Mode and Slave in Polled Mode after Power on Reset

If both the Master and the Slave are in Polled Mode then after a power on reset the Master will try to detect the Slave and once this has happened, then the Master will get the data from the Slave and store it in the **Loop n - Device x**, x is the ID of the Slave when in Polled Mode. Refer to the GROUP **NIM Dynamic Data** and the item **Loop n Devices Present** to determine where to find the Dynamic data for that Slave.

5.5.5 Master in Burst Mode and Slave in Burst Mode after Power on Reset

If both the Master and Slave are in Burst Mode after a power on reset then the Slave's Dynamic data will be stored in in **Loop n - Device 0 Data GROUP in DITView**, **n** is the Loop number to which the slave is connected**.** If you wish to switch the Slave to Polled Mode you can simply select Polled Mode in the configuration for that Loop and write it to the target. The Dynamic Data for the Slave will no longer appear in **Loop n - Device 0 Data** but will rather appear in the GROUP pointed to by the Slave ID. Refer to the GROUP **NIM Dynamic Data** and the item **Loop n Devices Present** to determine where to find the Dynamic data for that Slave.

5.6 Priority Polling Operation

5.6.1 Introduction

This feature allows the User to prioritise the rate at which the transmitters are polled by the Master. This is done using Configurable Transmitter Polling Rates. These configurable timers will allow the User to adjust the rate of polling of each device on each loop as per the User's requirements to allow the User to customise the data throughput. The User can switch between Manual and Automatic mode of Operation. Manual mode uses the Configurable Timers to decide whether to poll the transmitter or not also how often to poll the transmitter. In automatic mode all transmitters are polled at the same rate and the Poll Timer Configuration is ignored.

5.6.2 Automatic Polling

When automatic polling is selected for the loop, all transmitters are polled at the same rate. After every 7 cycles of polling, the Master will search for a device which is not Online. If the device is found then it will be switched to Online. When Automatic polling is selected the Programmable Poll Timers for each loop are ignored.

5.6.3 Manual Polling

When Manual polling is selected for the loop, all transmitters connected to the loops are polled according to the Poll Timer setting rate. If the Poll Timer is set to "**Do Not Poll"** then that slave device will be ignored by the polling engine. The User can select from a range of polling rates which range from As fast as Possible to 5 seconds per device. The polling engine will only search for Offline devices that have their poll timers configured.

5.6.4 Inhibit Polling

In specialized applications where the two HART NIM modules are used in a redundant switch over configuration, two HART NIMs are connected to the same loop. One module is the active module whilst the other is in standby, ready to be made active if the active module becomes faulty. In order to operate this way, it is necessary to inhibit the transmitter of the standby NIM module so as not to cause conflict on the current loop. A special Dynamic DIT register (DIT 91) is used for this purpose, where a single bit is used to control the transmitter of each port. These bits are to be controlled by Maxiflex CPU program only and are always cleared on startup i.e. transmitter always enabled. Refer to the DIT layout for more details.

6. Configuration

6.1 Basic Configuration

No configuration is necessary for the HART NIM to operate in its basic polling state. Once connected and powered up, the NIM automatically begins polling all addresses on the HART loop identifying any HART field devices present on the loop.

The NIM then reads the specified data from the device and stores it in the DIT to be accessed by the Maxiflex CPU in the system.

It can take up to 60 seconds after power up for the data to become valid in the DIT. The validity of data may be checked by monitoring DIT Registers 100 and 101. These registers identify the presence of valid data for field devices by setting the corresponding bits in the DIT. If the bit is clear, then the data in the DIT for that device is not valid.

The layout of the DIT as shown in section 7 is the default layout when the HART NIM is shipped. It is possible to optimise this layout for each application. This technique is described in the next section.

6.2 Customising the DIT Layout

The default setting when the HART NIM is shipped is for the static and dynamic data for each device to be stored in the range 200 to 973 for Loop 1 and 1200 to 1973 for Loop 2. The default settings for each device are defined in the table in section 7. It is possible to customize this layout. The reason that this may be useful is to compact the data for easier retrieval particularly if fewer than the maximum number of devices is to be used. By this means it is possible to order the data returned by the basic polling routine, as well as that returned by custom queries (see next section) as required.

To customise the DIT layout, change the default settings in DIT registers 3900 to 3963. Note that care must be taken to ensure that reserved registers are not overwritten and that device data does not overlap. A useful feature is that it is possible to ignore a device’s data by entering a DIT address of 0 for both its static and dynamic settings.

It is also possible to customise the storage area for custom query (refer to next section) status and command response codes. Two registers per query in use should be reserved for this purpose.

6.3 Configuring Custom Query Blocks

6.3.1 Introduction

The user can configure up to 64 Custom Query Blocks in the NIM. Each query block can contain any valid HART command and can address any device on either of the HART loops.

Each Query Block can be configured as a “one-shot” query that is triggered by the user, or can be configured as a cyclic query where the Query is triggered on a regular basis by the NIM.

The status of each Query is presented in the Query Status DIT registers. These registers indicate the success or failure of each query last time it was sent.

6.3.2 Polling Sequence

As described above, the NIM automatically identifies all field devices present on each HART loop and polls each present device in turn using HART command 3. After the Command 3 sequences to all present devices have been completed, all Custom Query Blocks ready to execute are then triggered in turn. The NIM then returns to execute the command 3 queries to all present devices, and the cycle repeats. This is known as a complete polling sequence.

6.3.3 Controlling the Execution of a Custom Query Block

Each Custom Query Block has a Control Register used to control the Query Block. If this register is set to 0 then the query block is disabled.

If a value “n” between 1 and 255 is stored into this register then the Query block acts as cyclic query, and the Query is triggered every “n” number of polling sequences.

To use the query as a one shot (sent once on command), set the control register to zero and use the one shot query trigger bits to initiate it.

6.3.4 Setting the device to be addressed by a Custom Query Block

The least significant byte of this register holds the polling address of the field device to be polled using this query block. For devices on HART loop 2, the polling address is derived by adding 16 to the actual address.

i.e. Polling addresses 0 to 15 refer to HART Loop 1, and polling addresses 16-31 refer to HART Loop 2.

If the device is a HART revision 5 device, then the NIM will use the device’s corresponding unique identifier to address it in this Query Block provided the device is currently online.

6.3.5 Setting the command type in a Custom Query Block

For each Query Block, the HART command to be used is specified in the third register of the query block along with two other items.

The Command is a single byte number in the range 0 to 153 as specified by the HART protocol. The command to be used in this query block must be stored in the least significant byte of this DIT register.

6.3.6 Setting the Data to be transmitted in a query

Some HART commands require that data be included in the message transmitted to the field device. Store the number of bytes to be transmitted in the most significant byte of the third DIT register in the query block. This is a count of the number of actual data bytes to be transmitted and excludes any header information and checksum in the transmitted message. The HART protocol specified that this count is limited to 25 bytes of data.

If there is no data associated with the command then this byte count must be set to 0.

Store the actual data bytes to be transmitted in any free area of the NIM’s DIT, packed 2 bytes per register, starting in the least significant byte position of the first register. Store the DIT start address of the data in the fourth register in the Query Block.

If this data is to be changed dynamically by the user, then it should be stored in the dynamic DIT area (from address 100 to 2999). If the data can be pre-configured, and you wish this data to be retained on power down, then store it in the unreserved static configuration area of the DIT (from address 3220 to 3999).

Care should be taken in the allocation of DIT space for this data to avoid overwriting other data inadvertently.

6.3.7 Setting the destination of the received data from a Query Block.

Some HART commands return data as part of the reply. This data will be written to the DIT in an area specified in the query block.

Store the DIT address where you wish the start of the returned data to be written in the fifth register in the Query Block.

By default, the data will be written packed two bytes to a register, however it is possible to format the way in which the data is stored as explained in the next two sections.

6.3.8 Setting an offset to the start of response data.

Many HART response messages have a mixture of single byte and multi-byte data. As a result, it is sometimes convenient to start storing the returned data in the most significant byte of the first DIT register. This will allow multi-byte data later in the message to be conveniently contained in a one or two DIT registers instead of split across DIT Register boundaries. This can be achieved by setting the Receive Data Offset Bit which is the most significant bit of the third Query Block register (sharing space with the byte count and command type). Set this bit to start the returned data storage in the most significant byte of the first register. The least significant byte will then be set to zero. Clear this bit to start the data storage in the least significant byte of the first DIT register.

6.3.9 Specifying a format for response data.

Where further formatting of the response data is required, use can be made of the response formatting blocks. These blocks facilitate the specification of the exact order and position that every byte in the response is stored in the DIT. Each block consists of 25 registers to cater for the maximum of 25 bytes in a HART response. Each register in a block can be configured to specify the byte number (data) from the response that should be stored in either the least or most significant byte of the corresponding DIT register. Up to 16 such format blocks may be configured, and any number of queries may reference a single format block. Note that a query that uses a format block, will ignore the receive data offset setting as described in the previous section.

6.4 Burst Mode Configuration

To configure a Loop for Burst Mode or Polled Mode operation select the GROUP labelled **Busrt Mode Configuration** and select the item you wish to configure depending on the Loop you wish to setup for Burst Mode by right clicking on that item then select the configuration of your choice for that Loop either Burst Mode if you want to configure the Slave for Burst Mode operation or Polled Mode if you wish to exit Burst Mode operation. Refer to Section 7 **DIT Layout** for the DIT address of these configuration items.

6.5 Automatic/Manual Polling Configuration

6.5.1 Automatic Polling

To configure a loop for Automatic Polling, using Omniset and the latest M1589 configuration template select the GROUP labelled Configuration->Advanced Settings->Poll Priority Timers and then double click on the ITEM labelled Polling Method Loop1 to set Loop1 or Polling Method Loop2 to set Loop2 to Automatic Polling. Once you have changed the configuration for the desired Loop to Automatic Polling you can then write that GROUP to the Target, by clicking on the Write Current Group to Target TAB.

6.5.2 Manual Polling

To configure a loop for Manual Polling, using Omniset and the latest M1589 configuration template select the GROUP labelled Configuration->Advanced Settings->Poll Priority Timers and then double click on the ITEM labelled Polling Method Loop1 to set Loop1 or Polling Method Loop2 to set Loop2 to Manual Polling. You will also need to setup the Devicex Timer Config ITEMS for that Loop, to do this simply double click on the Device ITEM of choice and select the Poll Rate from the drop downlist. Once you have changed the configuration for the desired Loop to Manual Polling Operation you can then write that GROUP to the Target, by clicking on the Write Current Group to Target TAB.

7. DIT Layout

The HART NIM has the following DIT layout:

Note that certain areas of the DIT can be relocated. Therefore the DIT numbers shown in this table are only the default addresses.

DIT No.	DESCRIPTION	COMMENT
Live Data Storage Area		
0-99	**COMMON MODULE DATA AREA**	
0	Product Code = 0x159	Uniquely identifies the HART NIM
1	DIT Revision Number	Specifies register layout supported by the NIM
2	Kernel Version	Current Firmware Version
3	Supported Services	
4	User Tag	Allows a unique identifier to be configured for each NIM. Once setup, the Omniflex configuration packages will warn the user if the tag name in the configuration file does not match that in the target.
5	User Tag	
6	User Tag	
7	User Tag	
8-21	Reserved	
22	System Register	
23	Alive Counter	
24-99	Reserved	
91	**LOOP INHIBIT**	
91	Inhibit Loop transmitters.	The transmitter of each loop can be disabled to allow the loop to act as a standby loop for redundant/fail-over applications. Bit 0: Loop 1: 1 to inhibit, 0 to enable Bit 1: Loop 2: 1 to inhibit, 0 to enable Bits 2 to 15 not used. All bits are cleared on startup.
92-95	**ONE SHOT QUERY TRIGGER BITS**	
92	One Shot Query Trigger Bits for Queries 1 to 16.	This register facilitates the triggering of HART queries on a one shot basis from an application program or SCADA/DCS etc. By setting a bit to 1, the associated query will be triggered on the next query cycle. Once the query has been executed, the bit is automatically reset to 0.

93	One Shot Query Trigger Bits for Queries 17 to 32.	As for DIT 92
94	One Shot Query Trigger Bits for Queries 33 to 48.	As for DIT 92
95	One Shot Query Trigger Bits for Queries 49 to 64.	As for DIT 92
96-99	Reserved	
100-107	**HART NIM DYNAMIC DATA**	
100	Loop 1 Devices Present	This is a 16 bit pattern where each bit represents the presence or absence of a HART field device in the HART loop and of valid data in the DIT. Bit 0 (LSB) is address 0 and Bit 15 (MSB) is address 15. A ‘1’ indicates that valid data is available in the DIT for that device i.e. the device is online.
101	Loop 2 Devices Present	See DIT 100
102	Loop 1 Good Message Counter	Increments on the receipt of every good message on Loop 1. This counter wraps around back to zero when 65535 is reached. The user can clear this counter at any stage.
103	Loop 1 Error Message Counter	Increments on the failure of any poll request either through time-out or bad checksum. It is not incremented for no response to a message during the device search phase. The counter stops when it reaches 32767. The user can clear this counter at any stage.
104	Loop 1 Last Good Message Timer	This register counts the seconds that have elapsed since a valid response was received. This timer is reset to zero when a valid response is received from any device on the loop.
105	Loop 2 Good Message Counter	As for Loop 1 (DIT 102)
106	Loop 2 Error Message Counter	As for Loop 1 (DIT 103)
107	Loop 2 Last Good Message Timer	As for Loop 1 (DIT 104)
108 – 109	Reserved	
110-113	**CUSTOM QUERY STATUS**	
110	Query Status for Queries 1 to 16	Bit status of queries 1 to 16. Bit 0 represents Query 1 and Bit 15 represents Query 16. The status indicates the success or failure of the query when it was last transmitted. A status bit cleared to zero indicates a successful query or an unused query. A status bit set to one indicates a failed query. A query may fail for a variety of reasons such as device offline, checksum error, query not supported by the device etc.

111	Query Status for Queries 17 to 32	As for DIT 110. Bit status of queries 17 to 32. Bit 0 represents Query 17 and Bit 15 represents Query 32.
112	Query Status for Queries 33 to 48	As for DIT 110. Bit status of queries 33 to 48. Bit 0 represents Query 33 and Bit 15 represents Query 48.
113	Query Status for Queries 49 to 64	As for DIT 110. Bit status of queries 49 to 64. Bit 0 represents Query 49 and Bit 15 represents Query 64.
114 – 129	Reserved	
130-193	**Communication / Device Status and Command Response**	These registers present the 2 status bytes returned by every device response.
130	Loop 1 Device 0 Communication / Device Status.	The most significant bit if set indicates a communication error in the message received by the device. When this bit is set, the bits in the most significant byte of this register indicate what type of error it was. If the most significant bit is clear then the bits in the least significant byte indicate the device status. Possible status readings are: 0 = No Errors / Status Normal 01H = primary variable out of limits 02H = non-primary variable out of limits 04H = analogue output saturated 08H = analogue output current fixed 10H = more status available 20H = cold start 40H = configuration changed 80H = field device malfunction 8200H = rx buffer overflow 8800H = checksum error 9000H = framing error A000H = overrun error C000H = parity error
131	Loop 1 Device 0 Command Response	This register indicates either errors or warnings and can have single or multiple meanings. Refer to the HART protocol document for further details.
132	Loop 1 Device 1 Communication / Device Status.	Refer to Loop 1 Device 0 (DIT 130).
133	Loop 1 Device 1 Command Response	Refer to Loop 1 Device 0 (DIT 131).
134	Loop 1 Device 2 Communication / Device Status.	Refer to Loop 1 Device 0 (DIT 130).
135	Loop 1 Device 2 Command Response	Refer to Loop 1 Device 0 (DIT 131).

136	Loop 1 Device 3 Communication / Device Status.	Refer to Loop 1 Device 0 (DIT 130).
137	Loop 1 Device 3 Command Response	Refer to Loop 1 Device 0 (DIT 131).
138	Loop 1 Device 4 Communication / Device Status.	Refer to Loop 1 Device 0 (DIT 130).
139	Loop 1 Device 4 Command Response	Refer to Loop 1 Device 0 (DIT 131).
140	Loop 1 Device 5 Communication / Device Status.	Refer to Loop 1 Device 0 (DIT 130).
141	Loop 1 Device 5 Command Response	Refer to Loop 1 Device 0 (DIT 131).
142	Loop 1 Device 6 Communication / Device Status.	Refer to Loop 1 Device 0 (DIT 130).
143	Loop 1 Device 6 Command Response	Refer to Loop 1 Device 0 (DIT 131).
144	Loop 1 Device 7 Communication / Device Status.	Refer to Loop 1 Device 0 (DIT 130).
145	Loop 1 Device 7 Command Response	Refer to Loop 1 Device 0 (DIT 131).
146	Loop 1 Device 8 Communication / Device Status.	Refer to Loop 1 Device 0 (DIT 130).
147	Loop 1 Device 8 Command Response	Refer to Loop 1 Device 0 (DIT 131).
148	Loop 1 Device 9 Communication / Device Status.	Refer to Loop 1 Device 0 (DIT 130).
149	Loop 1 Device 9 Command Response	Refer to Loop 1 Device 0 (DIT 131).
150	Loop 1 Device 10 Communication / Device Status.	Refer to Loop 1 Device 0 (DIT 130).
151	Loop 1 Device 10 Command Response	Refer to Loop 1 Device 0 (DIT 131).
152	Loop 1 Device 11 Communication / Device Status.	Refer to Loop 1 Device 0 (DIT 130).
153	Loop 1 Device 11 Command Response	Refer to Loop 1 Device 0 (DIT 131).
154	Loop 1 Device 12 Communication / Device Status.	Refer to Loop 1 Device 0 (DIT 130).
155	Loop 1 Device 12 Command Response	Refer to Loop 1 Device 0 (DIT 131).
156	Loop 1 Device 13 Communication / Device Status.	Refer to Loop 1 Device 0 (DIT 130).
157	Loop 1 Device 13 Command Response	Refer to Loop 1 Device 0 (DIT 131).
158	Loop 1 Device 14 Communication / Device Status.	Refer to Loop 1 Device 0 (DIT 130).
159	Loop 1 Device 14 Command Response	Refer to Loop 1 Device 0 (DIT 131).
160	Loop 1 Device 15 Communication / Device Status.	Refer to Loop 1 Device 0 (DIT 130).

161	Loop 1 Device 15 Command Response	Refer to Loop 1 Device 0 (DIT 131).
162	Loop 2 Device 0 Communication / Device Status.	Refer to Loop 1 Device 0 (DIT 130).
163	Loop 2 Device 0 Command Response	Refer to Loop 1 Device 0 (DIT 131).
164	Loop 2 Device 1 Communication / Device Status.	Refer to Loop 1 Device 0 (DIT 130).
165	Loop 2 Device 1 Command Response	Refer to Loop 1 Device 0 (DIT 131).
166	Loop 2 Device 2 Communication / Device Status.	Refer to Loop 1 Device 0 (DIT 130).
167	Loop 2 Device 2 Command Response	Refer to Loop 1 Device 0 (DIT 131).
168	Loop 2 Device 3 Communication / Device Status.	Refer to Loop 1 Device 0 (DIT 130).
169	Loop 2 Device 3 Command Response	Refer to Loop 1 Device 0 (DIT 131).
170	Loop 2 Device 4 Communication / Device Status.	Refer to Loop 1 Device 0 (DIT 130).
171	Loop 2 Device 4 Command Response	Refer to Loop 1 Device 0 (DIT 131).
172	Loop 2 Device 5 Communication / Device Status.	Refer to Loop 1 Device 0 (DIT 130).
173	Loop 2 Device 5 Command Response	Refer to Loop 1 Device 0 (DIT 131).
174	Loop 2 Device 6 Communication / Device Status.	Refer to Loop 1 Device 0 (DIT 130).
175	Loop 2 Device 6 Command Response	Refer to Loop 1 Device 0 (DIT 131).
176	Loop 2 Device 7 Communication / Device Status.	Refer to Loop 1 Device 0 (DIT 130).
177	Loop 2 Device 7 Command Response	Refer to Loop 1 Device 0 (DIT 131).
178	Loop 2 Device 8 Communication / Device Status.	Refer to Loop 1 Device 0 (DIT 130).
179	Loop 2 Device 8 Command Response	Refer to Loop 1 Device 0 (DIT 131).
180	Loop 2 Device 9 Communication / Device Status.	Refer to Loop 1 Device 0 (DIT 130).
181	Loop 2 Device 9 Command Response	Refer to Loop 1 Device 0 (DIT 131).
182	Loop 2 Device 10 Communication / Device Status.	Refer to Loop 1 Device 0 (DIT 130).
183	Loop 2 Device 10 Command Response	Refer to Loop 1 Device 0 (DIT 131).
184	Loop 2 Device 11 Communication / Device Status.	Refer to Loop 1 Device 0 (DIT 130).
185	Loop 2 Device 11 Command Response	Refer to Loop 1 Device 0 (DIT 131).

186	Loop 2 Device 12 Communication / Device Status.	Refer to Loop 1 Device 0 (DIT 130).
187	Loop 2 Device 12 Command Response	Refer to Loop 1 Device 0 (DIT 131).
188	Loop 2 Device 13 Communication / Device Status.	Refer to Loop 1 Device 0 (DIT 130).
189	Loop 2 Device 13 Command Response	Refer to Loop 1 Device 0 (DIT 131).
190	Loop 2 Device 14 Communication / Device Status.	Refer to Loop 1 Device 0 (DIT 130).
191	Loop 2 Device 14 Command Response	Refer to Loop 1 Device 0 (DIT 131).
192	Loop 2 Device 15 Communication / Device Status.	Refer to Loop 1 Device 0 (DIT 130).
193	Loop 2 Device 15 Command Response	Refer to Loop 1 Device 0 (DIT 131).
194 – 199	Reserved	
200 – 973	**LOOP 1 - DEVICE DATA**	These registers hold the static and dynamic data for the HART field devices on Loop 1. When operating the HART loops with only a single device per loop, the standard data for these devices will be grouped together here for easy access.
200-209	LOOP 1 DEVICE 0 STATIC DATA	
200	Transmitter Type Code	Used for HART revision 2,3 or 4 devices. Is set to “254” for HART revision 5 or above devices.
201	Manufacturer’s Identification Code in High Byte; Manufacturer’s Device Type Code in Low Byte	These are HART revision 5 device parameters. If an earlier revision device at this address position, then this register will be 0.
202	Number of Preambles Required	This parameter is used by the HART NIM in constructing the request messages to the field device.
203	Universal Command Revision in High Byte; Device Specific Command Revision in Low Byte.	
204	Software Revision in High Byte; Hardware Revision in Low Byte.	
205	Device Function Flags in High Byte; First Byte of Final Assembly Number/ID Number in Low Byte.	Final Assembly Number in HART Revision 2,3, or 4; Device ID Number in HART Revision 5.

206	Second Byte of Final Assembly Number/ID Number in Hi Byte; Third Byte of Final Assembly Number/ID Number in Low Byte.	See 205
207	Common Practice Command Revision in High Byte; Common Tables Revision in Low Byte.	Proposed for future HART Revision. not in HART Rev 5.3
208	Data Link Revision in High Byte; Device Family Code in Low Byte.	Proposed for future HART Revision. not in 5.3
209	Reserved	
210 - 223	LOOP 1 DEVICE 0 DYNAMIC DATA	This Dynamic Data Area will be used to store LOOP 1 Slave's data when the Slave is in Burst Mode.
210-211	Current (mA)	These two DIT registers hold the field device output current as milliamps in IEEE 754 floating point format. The msb is in the high byte of the first register and the lsb is in the low byte of the second.
212	Primary Variable Units Code	Stored as a single byte
213-214	Primary Variable Value	These two DIT registers hold the field device variable in IEEE 754 floating point format. The msb is in the high byte of the first register and the lsb is in the low byte of the second.
215	Second Variable Units Code	
216-217	Second Variable Value	See comment for Primary Variable
218	Third Variable Units Code	
219-220	Third Variable Value	See comment for Primary Variable
221	Fourth Variable Units Code	
222-223	Fourth Variable Value	See comment for Primary Variable
224-249	Unused	
250-273	LOOP 1 - DEVICE 1 DATA	Identical layout to Device 0 but with DIT addresses starting as shown.
300-323	LOOP 1 - DEVICE 2 DATA	Identical layout to Device 0 but with DIT addresses starting as shown.
350-373	LOOP 1 - DEVICE 3 DATA	Identical layout to Device 0 but with DIT addresses starting as shown.
400-423	LOOP 1 - DEVICE 4 DATA	Identical layout to Device 0 but with DIT addresses starting as shown.
450-473	LOOP 1 - DEVICE 5 DATA	Identical layout to Device 0 but with DIT addresses starting as shown.
500-523	LOOP 1 - DEVICE 6 DATA	Identical layout to Device 0 but with DIT addresses starting as shown.
550-573	LOOP 1 - DEVICE 7 DATA	Identical layout to Device 0 but with DIT addresses starting as shown.

600-623	LOOP 1 - DEVICE 8 DATA	Identical layout to Device 0 but with DIT addresses starting as shown.
650-673	LOOP 1 - DEVICE 9 DATA	Identical layout to Device 0 but with DIT addresses starting as shown.
700-723	LOOP 1 - DEVICE 10 DATA	Identical layout to Device 0 but with DIT addresses starting as shown.
750-773	LOOP 1 - DEVICE 11 DATA	Identical layout to Device 0 but with DIT addresses starting as shown.
800-823	LOOP 1 - DEVICE 12 DATA	Identical layout to Device 0 but with DIT addresses starting as shown.
850-873	LOOP 1 - DEVICE 13 DATA	Identical layout to Device 0 but with DIT addresses starting as shown.
900-923	LOOP 1 - DEVICE 14 DATA	Identical layout to Device 0 but with DIT addresses starting as shown.
950-973	LOOP 1 - DEVICE 15 DATA	Identical layout to Device 0 but with DIT addresses starting as shown.
1000-1127	**Device Status / Command Response for Each Query**	These registers present the 2 status bytes returned by every query response.
1000	Query 1 Communication / Device Status.	Refer to description for Loop 1 Device 0 (DIT 130).
1001	Query 1 Command Response	Refer to description for Loop 1 Device 0 (DIT 131).
1002	Query 2 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1003	Query 2 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1004	Query 3 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1005	Query 3 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1006	Query 4 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1007	Query 4 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1008	Query 5 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1009	Query 5 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1010	Query 6 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1011	Query 6 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1012	Query 7 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1013	Query 7 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1014	Query 8 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1015	Query 8 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1016	Query 9 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1017	Query 9 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1018	Query 10 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1019	Query 10 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1020	Query 11 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).

1021	Query 11 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1022	Query 12 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1023	Query 12 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1024	Query 13 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1025	Query 13 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1026	Query 14 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1027	Query 14 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1028	Query 15 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1029	Query 15 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1030	Query 16 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1031	Query 16 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1032	Query 17 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1033	Query 17 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1034	Query 18 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1035	Query 18 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1036	Query 19 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1037	Query 19 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1038	Query 20 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1039	Query 20 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1040	Query 21 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1041	Query 21 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1042	Query 22 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1043	Query 22 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1044	Query 23 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1045	Query 23 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1046	Query 24 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1047	Query 24 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1048	Query 25 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1049	Query 25 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1050	Query 26 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1051	Query 26 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1052	Query 27 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1053	Query 27 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1054	Query 28 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1055	Query 28 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1056	Query 29 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1057	Query 29 Command Response	Refer to Loop 1 Device 0 (DIT 131).

1058	Query 30 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1059	Query 30 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1060	Query 31 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1061	Query 31 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1062	Query 32 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1063	Query 32 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1064	Query 33 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1065	Query 33 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1066	Query 34 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1067	Query 34 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1068	Query 35 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1069	Query 35 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1070	Query 36 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1071	Query 36 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1072	Query 37 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1073	Query 37 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1074	Query 38 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1075	Query 38 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1076	Query 39 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1077	Query 39 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1078	Query 40 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1079	Query 40 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1080	Query 41 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1081	Query 41 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1082	Query 42 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1083	Query 42 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1084	Query 43 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1085	Query 43 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1086	Query 44 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1087	Query 44 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1088	Query 45 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1089	Query 45 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1090	Query 46 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1091	Query 46 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1092	Query 47 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1093	Query 47 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1094	Query 48 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).

1095	Query 48 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1096	Query 49 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1097	Query 49 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1098	Query 50 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1099	Query 50 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1100	Query 51 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1101	Query 51 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1102	Query 52 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1103	Query 52 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1104	Query 53 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1105	Query 53 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1106	Query 54 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1107	Query 54 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1108	Query 55 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1109	Query 55 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1110	Query 56 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1111	Query 56 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1112	Query 57 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1113	Query 57 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1114	Query 58 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1115	Query 58 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1116	Query 59 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1117	Query 59 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1118	Query 60 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1119	Query 60 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1120	Query 61 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1121	Query 61 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1122	Query 62 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1123	Query 62 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1124	Query 63 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1125	Query 63 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1126	Query 64 Comms / Dev. Status.	Refer to Loop 1 Device 0 (DIT 130).
1127	Query 64 Command Response	Refer to Loop 1 Device 0 (DIT 131).
1200-1973	**HART LOOP 2 DATA**	

1200- 1223	LOOP 2 - DEVICE 0 DATA	Identical layout to Loop 1 Device 0 but with addresses starting as shown. This Dynamic Data Area will be used to store LOOP 2 Slave's data when the Slave is in Burst Mode.
1250- 1273	LOOP 2 - DEVICE 1 DATA	Identical layout to Loop 1 Device 0 but with addresses starting as shown.
1300-1323	LOOP 2 - DEVICE 2 DATA	Identical layout to Loop 1 Device 0 but with addresses starting as shown.
1350- 1373	LOOP 2 - DEVICE 3 DATA	Identical layout to Loop 1 Device 0 but with addresses starting as shown.
1400-1423	LOOP 2 - DEVICE 4 DATA	Identical layout to Loop 1 Device 0 but with addresses starting as shown.
1450- 1473	LOOP 2 - DEVICE 5 DATA	Identical layout to Loop 1 Device 0 but with addresses starting as shown.
1500-1523	LOOP 2 - DEVICE 6 DATA	Identical layout to Loop 1 Device 0 but with addresses starting as shown.
1550- 1573	LOOP 2 - DEVICE 7 DATA	Identical layout to Loop 1 Device 0 but with addresses starting as shown.
1600-1623	LOOP 2 - DEVICE 8 DATA	Identical layout to Loop 1 Device 0 but with addresses starting as shown.
1650- 1673	LOOP 2 - DEVICE 9 DATA	Identical layout to Loop 1 Device 0 but with addresses starting as shown.
1700-1723	LOOP 2 - DEVICE 10 DATA	Identical layout to Loop 1 Device 0 but with addresses starting as shown.
1750- 1773	LOOP 2 - DEVICE 11 DATA	Identical layout to Loop 1 Device 0 but with addresses starting as shown.
1800-1823	LOOP 2 - DEVICE 12 DATA	Identical layout to Loop 1 Device 0 but with addresses starting as shown.
1850- 1873	LOOP 2 - DEVICE 13 DATA	Identical layout to Loop 1 Device 0 but with addresses starting as shown.
1900-1923	LOOP 2 - DEVICE 14 DATA	Identical layout to Loop 1 Device 0 but with addresses starting as shown.
1950- 1973	LOOP 2 - DEVICE 15 DATA	Identical layout to Loop 1 Device 0 but with addresses starting as shown.
1974- 2999	Available for use by custom queries	Note that the areas between the above blocks are also available for general use. In addition, if there are any devices that are unused in a system, their respective blocks can be made use of.
3000-3999	**NON-VOLATILE CONFIGURATION DATA AREA**	
3000-3319	64 Custom Query Blocks of 5 registers each.	These registers are used to set up custom polling sequences for either of the HART loops.
3000-3004	Custom Query Block No. 1	

3000	Query Block Control Register	This register controls this query block. If this register is set to zero, then the query block is disabled. If this register is set to any number “n” between 1 and 255, then this query block is executed every “n” query cycles.
3001	Format Block / HART Device Address	This least significant byte of this register holds the address of the field device to be polled using this query block. For loop 2, device addresses are derived by adding 16 to the actual address. i.e. Addresses 0 to 15 refer to Loop1, and addresses 16-31 refer to Loop 2. The most significant byte of this register specifies the number of format block to be used to arrange the response data. If it is set to zero, no formatting is required. Format blocks between 1 and 16 may be specified. Refer to DIT registers 3400-3799 for details on the use of format blocks.
3002	Count/Command Register	This register defines the command to be executed by the query block. The HART command is placed in the least significant byte of this register. The most significant byte holds the count of the number data bytes to be transmitted with the command. The HART protocol limits this count to 27 bytes. These data bytes will be found starting at the DIT register defined below. The most significant bit of this register when set indicates that the returned data, which is returned as bytes, is stored with a byte offset of 1. Because some of the HART messages have a mixture of single byte and multi-byte data, it is sometimes convenient to start storing the returned data in the most significant byte of the first DIT register (least significant byte will be 0). Note that the offset setting is ignored if a formatting block is specified (see register 3001).
3003	Transmitted Data Address	This register holds the address of the first byte of data to be transmitted with the query block command. The count specified in the register above defines the number of bytes that will be transmitted with the command. The data must be stored 2 bytes per DIT with the first byte in the least significant byte position. If the data is static then it can be stored in the configuration area of the DIT (above address 3000). If the data is dynamic, and will be changed in real time, it must be stored in the dynamic area of the DIT (Between 100 and 2999)

3004	Received Data Address	This register holds the address of the first DIT where the received data from the reply to the query block will be stored. The data in the reply will be stored 2 bytes per DIT with the first byte in the least significant byte position. Because this data will change based upon the reply received, this data must be stored in the dynamic portion of the DIT (between 100 and 2999)
3005-3009	Custom Query Block No. 2	See Custom Query Block No. 1 for the layout of this block
3010-3014	Custom Query Block No. 3	See Custom Query Block No. 1 for the layout of this block
3015-3019	Custom Query Block No. 4	See Custom Query Block No. 1 for the layout of this block
3020-3024	Custom Query Block No. 5	See Custom Query Block No. 1 for the layout of this block
3025-3029	Custom Query Block No. 6	See Custom Query Block No. 1 for the layout of this block
3030-3034	Custom Query Block No. 7	See Custom Query Block No. 1 for the layout of this block
3035-3039	Custom Query Block No. 8	See Custom Query Block No. 1 for the layout of this block
3040-3044	Custom Query Block No. 9	See Custom Query Block No. 1 for the layout of this block
3045-3049	Custom Query Block No. 10	See Custom Query Block No. 1 for the layout of this block
3050-3054	Custom Query Block No. 11	See Custom Query Block No. 1 for the layout of this block
3055-3059	Custom Query Block No. 12	See Custom Query Block No. 1 for the layout of this block
3060-3064	Custom Query Block No. 13	See Custom Query Block No. 1 for the layout of this block
3065-3069	Custom Query Block No. 14	See Custom Query Block No. 1 for the layout of this block
3070-3074	Custom Query Block No. 15	See Custom Query Block No. 1 for the layout of this block
3075-3079	Custom Query Block No. 16	See Custom Query Block No. 1 for the layout of this block
3080-3084	Custom Query Block No. 17	See Custom Query Block No. 1 for the layout of this block
3085-3089	Custom Query Block No. 18	See Custom Query Block No. 1 for the layout of this block
3090-3094	Custom Query Block No. 19	See Custom Query Block No. 1 for the layout of this block
3095-3099	Custom Query Block No. 20	See Custom Query Block No. 1 for the layout of this block

3100-3104	Custom Query Block No. 21	See Custom Query Block No. 1 for the layout of this block
3105-3109	Custom Query Block No. 22	See Custom Query Block No. 1 for the layout of this block
3110-3114	Custom Query Block No. 23	See Custom Query Block No. 1 for the layout of this block
3115-3119	Custom Query Block No. 24	See Custom Query Block No. 1 for the layout of this block
3120-3124	Custom Query Block No. 25	See Custom Query Block No. 1 for the layout of this block
3125-3129	Custom Query Block No. 26	See Custom Query Block No. 1 for the layout of this block
3130-3134	Custom Query Block No. 27	See Custom Query Block No. 1 for the layout of this block
3135-3139	Custom Query Block No. 28	See Custom Query Block No. 1 for the layout of this block
3140-3144	Custom Query Block No. 29	See Custom Query Block No. 1 for the layout of this block
3145-3149	Custom Query Block No. 30	See Custom Query Block No. 1 for the layout of this block
3150-3154	Custom Query Block No. 31	See Custom Query Block No. 1 for the layout of this block
3155-3159	Custom Query Block No. 32	See Custom Query Block No. 1 for the layout of this block
3160-3164	Custom Query Block No. 33	See Custom Query Block No. 1 for the layout of this block
3165-3169	Custom Query Block No. 34	See Custom Query Block No. 1 for the layout of this block
3170-3174	Custom Query Block No. 35	See Custom Query Block No. 1 for the layout of this block
3175-3179	Custom Query Block No. 36	See Custom Query Block No. 1 for the layout of this block
3180-3184	Custom Query Block No. 37	See Custom Query Block No. 1 for the layout of this block
3185-3189	Custom Query Block No. 38	See Custom Query Block No. 1 for the layout of this block
3190-3194	Custom Query Block No. 39	See Custom Query Block No. 1 for the layout of this block
3195-3199	Custom Query Block No. 40	See Custom Query Block No. 1 for the layout of this block
3200-3204	Custom Query Block No. 41	See Custom Query Block No. 1 for the layout of this block
3205-3209	Custom Query Block No. 42	See Custom Query Block No. 1 for the layout of this block
3210-3214	Custom Query Block No. 43	See Custom Query Block No. 1 for the layout of this block

3215-3219	Custom Query Block No. 44	See Custom Query Block No. 1 for the layout of this block
3220-3224	Custom Query Block No. 45	See Custom Query Block No. 1 for the layout of this block
3225-3229	Custom Query Block No. 46	See Custom Query Block No. 1 for the layout of this block
3230-3234	Custom Query Block No. 47	See Custom Query Block No. 1 for the layout of this block
3235-3239	Custom Query Block No. 48	See Custom Query Block No. 1 for the layout of this block
3240-3244	Custom Query Block No. 49	See Custom Query Block No. 1 for the layout of this block
3245-3249	Custom Query Block No. 50	See Custom Query Block No. 1 for the layout of this block
3250-3254	Custom Query Block No. 51	See Custom Query Block No. 1 for the layout of this block
3255-3259	Custom Query Block No. 52	See Custom Query Block No. 1 for the layout of this block
3260-3264	Custom Query Block No. 53	See Custom Query Block No. 1 for the layout of this block
3265-3269	Custom Query Block No. 54	See Custom Query Block No. 1 for the layout of this block
3270-3274	Custom Query Block No. 55	See Custom Query Block No. 1 for the layout of this block
3275-3279	Custom Query Block No. 56	See Custom Query Block No. 1 for the layout of this block
3280-3284	Custom Query Block No. 57	See Custom Query Block No. 1 for the layout of this block
3285-3289	Custom Query Block No. 58	See Custom Query Block No. 1 for the layout of this block
3290-3294	Custom Query Block No. 59	See Custom Query Block No. 1 for the layout of this block
3295-3299	Custom Query Block No. 60	See Custom Query Block No. 1 for the layout of this block
3300-3304	Custom Query Block No. 61	See Custom Query Block No. 1 for the layout of this block
3305-3309	Custom Query Block No. 62	See Custom Query Block No. 1 for the layout of this block
3310-3314	Custom Query Block No. 63	See Custom Query Block No. 1 for the layout of this block
3315-3319	Custom Query Block No. 64	See Custom Query Block No. 1 for the layout of this block
3320-3399	Unused. Can be used for storage of non-volatile user data.	

3400-3799	**Query Format Blocks 1 to 16**	
3400-3424	Query Format Block No. 1	Enter the format in which the response data is required in byte order and position. For example if byte 4 is required in the MSB of register 1 (of received data address range) and byte 3 is required in the LSB of register 1, enter 0403 for register 1. Byte or register gaps may be left, by configuring zero in these positions. **Note that byte 1 refers to the first data byte in the HART response message after the status bytes, whereas the HART manual refers to data bytes from 0 upwards.** Once a format block has been configured, the block number may be specified for as many queries as necessary. Note that the formatting affects response data ONLY, not transmitted data.
3425-3449	Query Format Block No. 2	See Query Format Block No. 1
3450-3474	Query Format Block No. 3	See Query Format Block No. 1
3475-3499	Query Format Block No. 4	See Query Format Block No. 1
3500-3524	Query Format Block No. 5	See Query Format Block No. 1
3525-3549	Query Format Block No. 6	See Query Format Block No. 1
3550-3574	Query Format Block No. 7	See Query Format Block No. 1
3575-3599	Query Format Block No. 8	See Query Format Block No. 1
3600-3624	Query Format Block No. 9	See Query Format Block No. 1
3625-3649	Query Format Block No. 10	See Query Format Block No. 1
3650-3674	Query Format Block No. 11	See Query Format Block No. 1
3675-3699	Query Format Block No. 12	See Query Format Block No. 1
3700-3724	Query Format Block No. 13	See Query Format Block No. 1
3725-3749	Query Format Block No. 14	See Query Format Block No. 1
3750-3774	Query Format Block No. 15	See Query Format Block No. 1
3775-3799	Query Format Block No. 16	See Query Format Block No. 1
3800-3899	Unused. Can be used for storage of non-volatile user data.	
3900-3963	**Configure DIT Layout**	
3900	DIT Address for Loop 1 Device 0 Static Data	Reserve 9 registers for this purpose. Default value = 200.
3901	DIT Address for Loop 1 Device 0 Dynamic Data	Reserve up to 14 registers for this purpose depending on device. Default value = 210
3902	DIT Address for Loop 1 Device 1 Static Data	See Loop 1 Device 0. Default value = 250.
3903	DIT Address for Loop 1 Device 1 Dynamic Data	See Loop 1 Device 0. Default value = 260

3904	DIT Address for Loop 1 Device 2 Static Data	See Loop 1 Device 0. Default value = 300.
3905	DIT Address for Loop 1 Device 2 Dynamic Data	See Loop 1 Device 0. Default value = 310
3906	DIT Address for Loop 1 Device 3 Static Data	See Loop 1 Device 0. Default value = 350.
3907	DIT Address for Loop 1 Device 3 Dynamic Data	See Loop 1 Device 0. Default value = 360
3908	DIT Address for Loop 1 Device 4 Static Data	See Loop 1 Device 0. Default value = 400.
3909	DIT Address for Loop 1 Device 4 Dynamic Data	See Loop 1 Device 0. Default value = 410
3910	DIT Address for Loop 1 Device 5 Static Data	See Loop 1 Device 0. Default value = 450.
3911	DIT Address for Loop 1 Device 5 Dynamic Data	See Loop 1 Device 0. Default value = 460
3912	DIT Address for Loop 1 Device 6 Static Data	See Loop 1 Device 0. Default value = 500.
3913	DIT Address for Loop 1 Device 6 Dynamic Data	See Loop 1 Device 0. Default value = 510
3914	DIT Address for Loop 1 Device 7 Static Data	See Loop 1 Device 0. Default value = 550.
3915	DIT Address for Loop 1 Device 7 Dynamic Data	See Loop 1 Device 0. Default value = 560
3916	DIT Address for Loop 1 Device 8 Static Data	See Loop 1 Device 0. Default value = 600.
3917	DIT Address for Loop 1 Device 8 Dynamic Data	See Loop 1 Device 0. Default value = 610
3918	DIT Address for Loop 1 Device 9 Static Data	See Loop 1 Device 0. Default value = 650.
3919	DIT Address for Loop 1 Device 9 Dynamic Data	See Loop 1 Device 0. Default value = 660
3920	DIT Address for Loop 1 Device 10 Static Data	See Loop 1 Device 0. Default value = 700.
3921	DIT Address for Loop 1 Device 10 Dynamic Data	See Loop 1 Device 0. Default value = 710
3922	DIT Address for Loop 1 Device 11 Static Data	See Loop 1 Device 0. Default value = 750.
3923	DIT Address for Loop 1 Device 11 Dynamic Data	See Loop 1 Device 0. Default value = 760
3924	DIT Address for Loop 1 Device 12 Static Data	See Loop 1 Device 0. Default value = 800.
3925	DIT Address for Loop 1 Device 12 Dynamic Data	See Loop 1 Device 0. Default value = 810
3926	DIT Address for Loop 1 Device 13 Static Data	See Loop 1 Device 0. Default value = 850.

3927	DIT Address for Loop 1 Device 13 Dynamic Data	See Loop 1 Device 0. Default value = 860
3928	DIT Address for Loop 1 Device 14 Static Data	See Loop 1 Device 0. Default value = 900.
3929	DIT Address for Loop 1 Device 14 Dynamic Data	See Loop 1 Device 0. Default value = 910
3930	DIT Address for Loop 1 Device 15 Static Data	See Loop 1 Device 0. Default value = 950.
3931	DIT Address for Loop 1 Device 15 Dynamic Data	See Loop 1 Device 0. Default value = 960
3932	DIT Address for Loop 2 Device 0 Static Data	See Loop 1 Device 0. Default value = 1200.
3933	DIT Address for Loop 2 Device 0 Dynamic Data	See Loop 1 Device 0. Default value = 1210
3934	DIT Address for Loop 2 Device 1 Static Data	See Loop 1 Device 0. Default value = 1250.
3935	DIT Address for Loop 2 Device 1 Dynamic Data	See Loop 1 Device 0. Default value = 1260
3936	DIT Address for Loop 2 Device 2 Static Data	See Loop 1 Device 0. Default value = 1300.
3937	DIT Address for Loop 2 Device 2 Dynamic Data	See Loop 1 Device 0. Default value = 1310
3938	DIT Address for Loop 2 Device 3 Static Data	See Loop 1 Device 0. Default value = 1350.
3939	DIT Address for Loop 2 Device 3 Dynamic Data	See Loop 1 Device 0. Default value = 1360
3940	DIT Address for Loop 2 Device 4 Static Data	See Loop 1 Device 0. Default value = 1400.
3941	DIT Address for Loop 2 Device 4 Dynamic Data	See Loop 1 Device 0. Default value = 1410
3942	DIT Address for Loop 2 Device 5 Static Data	See Loop 1 Device 0. Default value = 1450.
3943	DIT Address for Loop 2 Device 5 Dynamic Data	See Loop 1 Device 0. Default value = 1460
3944	DIT Address for Loop 2 Device 6 Static Data	See Loop 1 Device 0. Default value = 1500.
3945	DIT Address for Loop 2 Device 6 Dynamic Data	See Loop 1 Device 0. Default value = 1510
3946	DIT Address for Loop 2 Device 7 Static Data	See Loop 1 Device 0. Default value = 1550.
3947	DIT Address for Loop 2 Device 7 Dynamic Data	See Loop 1 Device 0. Default value = 1560
3948	DIT Address for Loop 2 Device 8 Static Data	See Loop 1 Device 0. Default value = 1600.
3949	DIT Address for Loop 2 Device 8 Dynamic Data	See Loop 1 Device 0. Default value = 1610

3950	DIT Address for Loop 2 Device 9 Static Data	See Loop 1 Device 0. Default value = 1650.
3951	DIT Address for Loop 2 Device 9 Dynamic Data	See Loop 1 Device 0. Default value = 1660
3952	DIT Address for Loop 2 Device 10 Static Data	See Loop 1 Device 0. Default value = 1700.
3953	DIT Address for Loop 2 Device 10 Dynamic Data	See Loop 1 Device 0. Default value = 1710
3954	DIT Address for Loop 2 Device 11 Static Data	See Loop 1 Device 0. Default value = 1750.
3955	DIT Address for Loop 2 Device 11 Dynamic Data	See Loop 1 Device 0. Default value = 1760
3956	DIT Address for Loop 2 Device 12 Static Data	See Loop 1 Device 0. Default value = 1800.
3957	DIT Address for Loop 2 Device 12 Dynamic Data	See Loop 1 Device 0. Default value = 1810
3958	DIT Address for Loop 2 Device 13 Static Data	See Loop 1 Device 0. Default value = 1850.
3959	DIT Address for Loop 2 Device 13 Dynamic Data	See Loop 1 Device 0. Default value = 1860
3960	DIT Address for Loop 2 Device 14 Static Data	See Loop 1 Device 0. Default value = 1900.
3961	DIT Address for Loop 2 Device 14 Dynamic Data	See Loop 1 Device 0. Default value = 1910
3962	DIT Address for Loop 2 Device 15 Static Data	See Loop 1 Device 0. Default value = 1950.
3963	DIT Address for Loop 2 Device 15 Dynamic Data	See Loop 1 Device 0. Default value = 1960
3964	DIT Start Address for Query Response Codes	A block of up to 128 DIT registers starting at this address must be reserved to store the communication / device status and command response to each query in use. If the register is set to zero, this facility is disabled. Default value = 1000.
3965	Message Retry Count	This setting is applied to all devices for normal cyclic poll messages. After 'n+1' consecutive communication failures to the same device, where n is the retry count setting, the device will be marked as off-line. Valid values are from 1 to 20. Default value = 5
3970-3971	**Burst Mode Configuration**	

3970	Loop 1 Burst Mode Configuration	**Burst Mode/Polled Mode** **Burst Mode**: Select this item if you wish to configure the Slave for Burst Mode Operation. **Polled Mode**: Select this item if you wish to exit Burst Mode operation and enter Polled Mode operation.
3971	Loop 2 Burst Mode Configuration	**Burst Mode/Polled Mode** **Burst Mode**: Select this item if you wish to configure the Slave for Burst Mode Operation. **Polled Mode**: Select this item if you wish to exit Burst Mode operation and enter Polled Mode operation.
3966-3999	Unused. Can be used for storage of non-volatile user data.	