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2Wire Innovations Ltd

Operating Instructions for the DG-3 decoder interface,

For use with the TW/NG-1 family of decoders.

Version 3.3
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Figure 1 DG-3 with Custom Label

The DG-3, Decoder Gateway , offers many new features compared to existing "Blind Translator" and "Irrinet" decoder interfaces.

The DG-3 replaces the DG-2, offering more features and more powerful 2wire excitation. 1 of 4 Modbus slave address can be selected, allowing up to 4 x127 decoders to be operated from one host controller

The control interface is identical to the DG-2, which is now discontinued.

It can also revert back to "Watermation" protocol, to operate legacy decoders instead of the TW/NG-1 series

The LAN interface offers Ethernet access to enable remote Over-The-Air (OTA) firmware upgrade.

The following sections explain how to operate it using ModBus RTU ..RS485 serial interface. (9600.8.none.2)

TURNING VALVES ON AND OFF

For example: Turn on decoder 10
- Set bit #9 in 'desired' holding register 40-008 (decoder 1 is in bit #0), using Write Multiple Registers Fn 16
- Wait about 1 second
- Poll Holding Register 40-001, using Read Multiple Registers Fn 03. Test bit 0. If zero, Busy is finished.
- Test bit #9 in 'Actual' Holding Register 40-016
- Desired & Actual should be the same; if not, a failure.
- Bit 7 in Status register 40-001 will be set if the last station switched fails on or off. HOWEVER, if followed by a successful on or off this bit will be cleared
- Bit 10' Latched Station Failures' will be set if any station switched fails on or off. It will remain set until cleared by writing it to zero using Fn 16

DESIRED AND ACTIAL HOLDING REGISTER DESCRIPTIONS

B address	Read- fn 03. Preset- fn 16 Desired	C address	Read- fn 03. Preset- fn 16 Actual
40-008	outputs 1-16	40-016	Actual 1-16
40-009	outputs 17-32	40-017	Actual 17-32
40-010	outputs 33-48	40-018	Actual 33-48
40-011	outputs 49-64	40-019	Actual 49-64
40-012	outputs 65-80	40-020	Actual 65-80
40-013	outputs 81-96	40-021	Actual 81-96
40-014	outputs 97-112	40-022	Actual 97-112
40-015	outputs 113-127	40-023	Actual 113-127
		D	Read- fn 03. Preset- fn 16
		40-024	Sensor cmd & address
		40-025	Sensor trigger/results
		40-026	2wire path current change: off-on & on-off
		40-027**	Results from an 'on' cmd (1)

** During an 'on' process, as part of the command, the TW/NG-1-AC decoder is interrogated using. talkback command 7.
This returns useful information on the state of the decoder. Top byte: the voltage at the decoder; Bottom byte: 0 =solenoid off, 1=solenoid on, 0x40 = solenoid short circuit, 0x80 = solenoid open circuit

CONTROL REGISTERS DESCRIPTIONS

A	Read- fn 03. Preset- fn 16		40-001	Interface Status
address	description		bit#	description
			0	Busy flag. 1 = busy
40-001	Interface Status		1	Line high current (R/W)
40-002	Current change threshold lower (mA) (R/W)		2	
40-003	Current change threshold upper (mA) (R/W)		3	
40-004	Total 2 wire line current (mA) Read-only		4	
40-005	Top byte: S/w version x 10. Bottom nibble: decoder type, upper nibble: Customer code		5	Line on (1), line off (0) (R/W)
40-006	$AA55 hex. (user changeable)		6	
40-007	Front panel LED values (read-only)		7	Station Failures (mismatch DESIRED & ACTUAL)
			8	AC Supply OK
			9	
			10	Latched Station failures (R/W)
			11	
			12	Good Talkback data received (R/W)
			13	
			14	Can't Implement Signalling (R/W)
			15	

NOTES:
- R/W next to an interface status bit means it can be written to from the comms. All other IFSTATUS bits are read-only and will not be affected by the values supplied in the comms (Fn. 16), 16 bit write data. Read-only bits will be refreshed within 200mS to their true values.
- If 'Line High Current', the status bit will be set, even if the 2-wire decoder power has been turned off by the DG-3. This will need to be written to zero to clear it.
- 40-006 may be written to a value different from 0xAA55. If the DG-3 has rebooted, this value will be restored. This can be used by the OEM controller to detect a reboot by the DG-3
- 40-005 publishes the software version x 10 in the top byte. e.g. version 3.2 will be published as 32 decimal, $20 hex. In the bottom byte: Bottom nibble is the code for the type of decoder 6 = TW/NG-1. Top nibble is customer code (0x0..F).
- Latched Station Failure (bit 10) will be set if there is a fail to turn on or fail to turn off in the cluster of stations commanded. It will remain set until written to zero. 'Station Faultless Present' (bit 7) reflects the success of the last station switched. If multiple stations in the 16 command, a failure in one station followed by a success in a subsequent will clear this bit. 'Latched Station Failures' however, will remain set.

Switching Method Using Read/Write Registers

To switch up to 10 decoders at once. TW/NG-1 with eCOIL will consume about 40mA per 'on' decoder; TW/NG-1-AC will consume 50mA when driving a conventional 24VAC solenoid. (eCOIL not needed)

It is useful to only write one bit-change to DESIRED at a time, rather than a cluster. That way the success/failure of an individual station can be easily determined from the status bits. However, this is not mandatory.

- Write DESIRED holding registers 40-008 to 40-015, Bank B, with function 16, with bits set accordingly (up to 10 changes)
- Poll register 40-001, bit 0, Bank A, with function 03 until bit 0 is zero, i.e. Busy finished. Allow about 1 second per decoder operation. Attempts to re-write DESIRED while Busy flag is set, will be blocked and a ModBus exception response 06 returned.
- OR…poll using Fn 11 When status returned is 0000, signalling has finished, otherwise it is Hex FFFF
- Make sure line has not overloaded by checking bits 1 & 3 in register 40-001.
- Look at bit 10 of STATUS 40-001 'Latched Station Failures". If set, an error has occurred. This bit remains set until cleared by writing it to zero with fn 16 on 40-001
- Read ACTUAL holding registers 40-016 to 40-023 with function 03. Compare like bits in Banks B & C. If different, an error has occurred. Bit 7 Stations Failures will be set.
    - Desired 1, Actual 0... fail to turn on
    - Desired 0, Actual 0 and Latched Station Failures set... fail to turn off (but interface has done it using an emergency off). If in a cluster, it will not be possible to see which one failed off.
    - Desired 1, Actual 1...successful on
    - Desired 0, Actual 0 and Latched Station Failures clear...successful off
- Reading ACTUAL registers whilst Busy flag is set, may give erroneous results, but will not generate a ModBus error code.
- If fail to turn off, the ACTUAL bit is automatically set back to 0. This reflects the true sate of the station, i.e. off. However, bit 10 of STATUS 40-001 'Latched Station Failures" will be set. This latter bit will stay set until reset by writing it to zero by the host controller through the comms.
- If fail to turn on, reset its DESIRED (output) bit back to 0 with function 16 to clear the fault indication

The line (2 wire path) will be turned on automatically with the first decoder on and left on, until manually turned off by writing bit 5 of register 40-001 to zero.

The line can be turned on in the absence of any on decoders by writing bit 5 of register 40-001 to one. A write to this location will only modify bits 1, 3, 5, 10 and 15. All other bits in this register will be unaffected by the write data supplied in the comms.

Turning the line on without operating any decoders is very helpful for doing fault-finding on the relevant 2 wire path.

Turning the line off will reset all its bits in Banks B, C, D, E, F to zero.

To maintain compatibility with future developments of DG-3 Decoder Adaptor, the user should NOT read or write to registers that are not currently implemented.

Remember that 'Busy flag' must be polled (and seen to be zero) before examining the corresponding ACTUAL bit.

The DG-3/ Decoder Adaptor automatically turns the line on if decoders are desired on and left on until manually turned off by writing bit 5 of register 40-001 to zero. Set/reset of Bit 5 in Holding Register 40-001 will force the line on and off, but only until the reception of the next message that alters the DESIRED bits (even if nothing is changed).

Decoders are switched one at a time in roughly 3 second intervals. Decoders will be switched on in the order biggest address…smallest address. e.g. Decoders 1, 3, 5, 126, will be turned on: - 126, then 5, then 3 then 1.

NOTE: If simultaneously turning stations on and off in the same 16 command. The OFF stations will be turned off first before the on stations are turned on second.

Successful operation of a decoder station is determined initially by the measured change in line current as a result of the attempt at switching. The values for determining a correct change in current can be inspected in registers 40-002 and 40-003, accessed through function 03. The unit expects a minimum change of 75mA for TW/NG-1 family decoders. A maximum change of 910mA is used to detect shorted solenoids. These values are adequate for most applications. If a new value is required, the register may be set using Fn 16 with the value in mA

Turn-on involves a sequence of commands, as laid out in the following chapter.

Turn-on strategy

Turning a decoder on requires a procedure involving a trial on, then confirmation using a talkback cmd 7 and a retry if unsuccessful. This takes approximately 3 seconds per decoder

This done with a little Finite State Machine FSM.

state	name	If-good	If-bad	Action
1	1st try on	4	2	Try to turn on
2	Confirm bad	5	3	Failed on, check with talkback
3	2nd try on	5	6	Retry to turn on
4	Confirm good	7	5	Good on, double check with talkback
5	Re-confirm good	7	6	Reconfirm with talkback
6	Flag Fail & Exit	EXIT		Exit FSM with a fail
7	Flag pass & Exit	EXIT		Exit FSM with a pass

Notes:

- As a turn-on involves a talkback with command 7, it will interfere with a concurrent sequence of command 6s when interrogating the 35 parameters stored in that **same** decoder
- During an 'on' process, after the 'on' command has been sent and the change in 2wire line current has been measured, that decoder is further interrogated using. talkback command 7. This returns useful information on the state of the decoder. Published in Modbus holding register 40-027.
- 40-027 Top byte: the voltage at the decoder; To the nearest volt AC on the decoder's input. (13-37V)
- 40-027 Bottom byte: 0 =solenoid off, 1=solenoid on, 0x40 = solenoid short circuit, 0x80 = solenoid open circuit
- Turn-off does not involve a talkback and nothing is published in 40-027
- Turn-off takes approximately 1 second per decoder

Line Current Monitoring

The DG-3 Decoder Adaptor continuously monitors line current (2 wire path), and will turn off the line, if a current above the maximum of 1.6A is measured for more than about 3 seconds. The capability of DG-3 Decoder Adaptor to supply current is determined by its transformer or the inverter, if used. The transformer recommended is 36VAC, 40-50VA.

The 2-wire path for decoders is monitored every 100mS, so its results in mA may be read in register 40-004. Resolution is +/-5mA, and any reading less than 10mA will be read as zero.

Situations that set the Line high Current (bit 1) will drop the line for safety but leave the flags set. The user must reset these flags using Fn. 16, or reboot.

Note. Short Circuits on the line that are many ohms (cable length) away from DG-3 Decoder Adaptor may not trigger this short action, and in the event of extreme field cable lengths, may not even trigger an overload; both Overload and Short circuit events can be polled for via the status register, and also set the 'Line Faults' red LED.

After an overload, the current will read 0mA, but the flags in register 40-001 will reflect what has happened. This can be read with Fn. 03, read multiple 16-bit registers with number of registers =1.

Before further 'on' commands will be actioned, these flags must be set to zero with Fn. 16, write 16-bit registers.

Failed Stations
These will be indicated by a mismatch between corresponding bits in DESIRED and ACTUAL. Bit 7 of IFSTATUS 40-001 will be set if these is a mismatch in <u>any</u> of the 127 stations. Writing DESIRED to equal ACTUAL will clear this bit, but not the Latched Station Failures, bit 10.

TW/NG DECODERS

There are currently 5 types.

1. **TW/NG-1. Decoder.** No external sensor. Valve on/off
2. **TW/NG-1-CC. Contact closure counting**. Valve on/off plus: Measuring up to 4 closures/second from volt-free contacts. Counting into 15 bits in a cell 0x0000-0x7FFF, wrapping around. The top bit is the contact position. 1=closed, 0=open. Used for totalising-type water meters and rain gauges. Also used for verifying valve water flow (see later)
3. **TW/NG-1-420. 4-20mA sensor Interface. .**Valve on/off plus: Supplies 24VDC up to 25mA for an external 4-20mA sensor. 12 bit resolution. Accuracy 0.2%.
4. **TW/NG-1-2.5 .** Valve on/off plus: Sensor interface 0-2.5V full scale voltage. Supplies +5VDC to the sensor. 12 bit resolution. Accuracy 0.2%. Used for moisture sensors
5. **TW/NG-1-HZ**. Valve on/off plus interface to insertion flowmeter which outputs pulses. 1-250HZ as a function of fluid velocity. Supplies 24VDC to the sensor, 11 mA draw when sensor pulses low.
6. **TW/NG-1-AC Decoder** Operates the valve's existing 24VAC solenoid directly. After solenoid pull-in, the current to the solenoid is reduced to hold in the plunger. Whilst holding in, the decoder/solenoid pair consumes just 57mA from the 2wire path.

Data to the decoder interface
DG-3 allows it to collect sensor measurements by the decoder and to record the NFC-loaded data.
(Data is returned in 16 bits, big endian).

NOTE: Customer number, Modulation type and Protocol type are already known,
as a mismatch would mean no communications with the decoder!!

In the PSK command protocol there are 8 commands available
 3 binary bits:
%000 (0) valve off
%001 (1) Valve on
%010 (2) Reserved
%011 (3) Reserved for factory calibration of 4-20mA and 0 – 2.5V sensor decoders
%100 (4) Ask reply type 1. Pulse count, 15 bits. MS bit = contact state; OR 4-20mA reading, scaled 0-4095,OR frequency 1-250 (from -HZ decoder)
%101 (5) Ask reply type 2. Turn on 4-20mA loop excitation. 24VDC
%110 (6) Ask reply type 3. read next stored data, pointed to by RTNPTR
%111 (7) Ask reply type 4. read AC i/p volts, solenoid state. Reset RTNPTR

Sender interrogation
Triggered by writing to registers 40-024 and 40-025

40-024 SENSADDR must be set between 1-127 in the bottom byte for the sensor address
  and the command %100-%111 (4-7) in the top byte   e.g 0x0714 talkback 7 from decoder 20
 Talkback 'address' 1-127 in this DG-3

40-025 SENSDATA The demanding variable, is used to trigger an interrogation.
 -1(0xFFFF) in SENSDATA and non-zero in SENSADDR, means Sender action is required.
 It is then filled with the reply, or all 0's if no reply is returned. CAN'T bit (14) is set/reset in status and the ASKBIT (12) is set if a good reply or is reset if no reply.

The last talkback data received ASKBIT (12) in 40-001 IFSTATUS must be reset **BEFORE** the next talkback trigger command is written ($FFFF, 0xFFFF) to sensor trigger 40-025

Good reply: IFSTATUS bit 12 =1, IFSTATUS bit 14=0.
 No reply: IFSTATUS bit 12 =0, IFSTATUS bit 14=1

Total time for a good reply: approx. 1 second at 60Hz line frequency

To trigger a sensor read, using command 16-write multiple holding registers

- First, reset In IFSTATUS 40-001, bit 12 (good reply) to zero.
- Then, Load Sensor address with bottom byte address 1-127. Top byte with command (%100-%111, 4-7)
- And load the trigger/results register with -1, 0xFFFF
- Wait 1 second
- Using command 03- read multiple holding registers: Poll 40-001 bit 0 (Busy) until busy =0. Up to 1 second total until busy goes back to zero.
- The Modbus reply to any poll will be delayed by up to 1 second whilst the sensor decoder is being read. At the end of this time, the Modbus reply will come back from the poll. ENSURE THE CONTROLLER MODUS TIMEOUT DELAY IS SET TO A SUITABLY LONG FIGURE
- Using command 03- read multiple holding registers: Read 40-025 for the result.
- As an alternative to polling 40-001, 40-024 and 40-025 may be read using 03- read multiple holding registers. When the data is ready, the register 40-025 will no longer contain -1 0xFFFF.

If a there is a response from the decoder, the 16 bits of 40-025 will be the value returned. In IFSTATUS, 40-001, bit 12 (good reply) =1, bit 14 (Can't signal) =0
If no response from the sensor decoder, all 16 bits will be 0x0000. In IFSTATUS, 40-001, bit 12 (good reply) =0, bit 14 (Can't signal) =1
Any attempt to change DESIRED (switch a decoder on/off) will be delayed until the response (or response timeout) is back from the sensor decoder.

To get a 4-20mA reading: using command 16-write multiple holding registers

- First, reset In IFSTATUS 40-001, bit 12 (good reply) to zero.
- Then, Load Sensor address with bottom byte address 1-127. Top byte with command (%101, 5)
- And load the trigger/results register with -1, 0xFFFF. This will turn on the loop excitation 24VDC
- Wait 1 second
- Using command 03- read multiple holding registers: Poll 40-001 bit 0 (Busy) until busy =0. Up to 1 second total until busy goes back to zero.
- The Modbus reply to any poll will be delayed by up to 1 second whilst the sensor decoder reply is being generated. At the end of this time, the Modbus reply will come back from the poll. ENSURE THE CONTROLLER MODUS TIMEOUT DELAY IS SET TO A SUITABLY LONG FIGURE.
- Using command 03- read multiple holding registers: Read 40-025 for the ACK which will be 1
- Then delay the reading until the sensor has settled. (Some soil moisture sensors take 5 seconds.)
- Again, reset In IFSTATUS 40-001, bit 12 (good reply) to zero.
- Then, Load Sensor address with bottom byte address 1-127. Top byte with command (%100, 4)
- And load the trigger/results register with -1, 0xFFFF. This will trigger the 4-20mA read:
- Wait 1 second
- Using command 03- read multiple holding registers: Poll 40-001 bit 0 (Busy) until busy =0. Up to 1 second total until busy goes back to zero.
- Using command 03- read multiple holding registers: Read 40-025 for the sensor reading. 4mA = 565, 20mA = 4030

- After the mA has been returned, the loop excitation will be removed.

Ask reply type 4: (cmd= %111=7)
 16 bits returned, big endian
 Top byte: Input AC voltage between 13V and 32V, whole number. Voltage below 13V will return 0V
 Bottom byte: solenoid state. LS bit: 1 = retracted, 0 = released
  Other bits in the byte (TW/NG-1-AC only): 0x40 solenoid open circuit. 0x80 solenoid short circuit

Sending this command, also resets the decoder's returned data pointer RTNPTR =0

Ask reply type 2: (cmd= %101=5):
  Only in 4-20mA version of decoder; turns on the loop excitation, 24VDC
  Returns 1 in the reply to signal an ack

+24V excitation is always output in the -HZ version sensor decoder. This will load the 2wire path by +11mA every time the insertion flowmeter output pulses low.

Ask reply type 1: (cmd= %100=4):
In contact closure decoder; returns Pulse count, 15 bits. MS bit = contact state
  1 = contact closed, 0 = contact opened. Pulse count wraps around $7FFF -- $0000
In 4-20mA decoder; returns a 12bit reading.
  4mA = 565, 20mA = 4030
Loop excitation is turned off after the reading has been taken.

+24V excitation is always output in the -HZ version sensor decoder. This will load the 2wire path by +11mA every time the insertion flowmeter output pulses low.

Ask Reply type 3: (cmd= %110=6)
 returns the data, big endian, pointed to by RTNPTR
 and post increments RTNPTR: -

       NOTES:
       Whether a decoder is fitted and it's NFC stored data, can be automatically gathered by the DG-3. (see
       INTERROGATED) However, this following section can be used by the host through Modbus to gather the
       decoder's embedded data one by one, if the automatic gathering has not been used.
       Ensure Ask Reply Type 4 (command 7) has been used to reset the decoders RTNPTR to 0 ready for a
       subsequent command 6s ATTENTION do not operate the valve on/off on a decoder whilst it is being
       interrogated with command 6s. The 'on' action will reset the Return Pointer back to 0.

RTNPTR =0
 top 16 bits of latitude (lat & long stored as 32-bit signed integers. Always 6 digits after the decimal point [-]nn.nnnnnn)

RTNPTR =1
 bottom 16 bits of latitude

RTNPTR =2
 top 16 bits of longitude. Always 6 digits after the decimal point [-]nnn.nnnnnn)

RTNPTR =3
 bottom 16 bits of longitude

RTNPTR =4
 first 2 characters of text line 1

RTNPTR =5
 next 2 characters of text line 1

...

RTNPTR =15
 last 2 characters of text line 1

RTNPTR =16
 first 2 characters of text line 2

RTNPTR =17
 next 2 characters of text line 2

...

RTNPTR =27
 last 2 characters of text line 2

RTNPTR =28
 App serial no (0-9999 in 16 bits)

RTNPTR =29
 top 16 bits of time when last configured (using NFC)

RTNPTR =30
 bottom 16 bits of time (32 bits: seconds since midnight)

RTNPTR =31
 top 16 bits of date when last configured (using NFC)

RTNPTR =32
 bottom 16 bits of date (days since JAN 1 1900)

RTNPTR =33
 PIN (0-9999 in 16 bits)

RTNPTR = 34
s/w version x10 in top byte
h/w version x10 in bottom byte

Hardware and Software Variants

TW/NG-1   basic decoder   V1.0 -V2.9
TW/NG-1-CC   with contact closure sensing V3.0-V4.9
TW/NG-1-420   with 4-20mA sensor measurement V5.0-V6.9
TW/NG-1-2.5   with 0-2.5v sensor measurement V5.0-V6.9 (note, a green wire on decoder denotes a 0- 2.5V version)
TW/NG-1-AC. Direct 24vAC solenoid drive V7.0-V8.9
TW/NG-1-HZ with frequency measurement V9.0-V10.9

Hardware reported as version x 10. E.g. V1.5 is 15

software:
Reported as version x10 e.g. Version 1.6 is 16
these are reported in talkback with RTNPTR=34

AUTOMATIC DATA COLLECTION:

Detection of duplicated decoder numbers:

DELTAI in 40-026 **D** holds the number of mA increase due to the ACK pulse from a successful decoder switch.   This is typically +250 to +290 mA. If a decoder number is duplicated, both will respond to the same 'on' command and both will produce an ACK at the same time, so DELTAI will be approximately double. This is a reliable marker of double numbering.

Setting 40-003 "Current change threshold upper (mA)" to less than double the ACK value will generate a fail but leave the DELTAI value to be inspected by the host controller.

A tally of discovered decoders: E

DISCOVERED, 40-029 to 40-036, holds a tally of decoders discovered during successful on/off or from a background check, using talkback command 7 to see if there is any reply. (same format as in ACTUAL, 1 bit per decoder)

This polling goes on in the background, but only now and again, so as not to clog valve on/off or sender interrogation using 40-024/40-025

Discovery of fitted decoders is initiated when the 2wire line is first powered up. When all 127 decoder stations have been interrogated this will be suspended. The operation takes approximately 7 minutes to complete all 127 possible decoder, however normal valve on/off and sender interrogation using Modbus commands can commence immediately.
This interrogation will only happen if INTERROGATED 40-037 is set to zero 0x0000. It defaults to this after a DG-3 boot.

It is important to only run through all decoders only once, as a talkback command 7 will reset the addressed decoder's RTNPTR to zero. This means the first returned parameter from a talkback 6 will be parameter 0. Thereafter further 6 commands will return the next, until all 35 parameters (0-34) have been recovered.

Optional Background interrogation of fitted decoders: F

INTERROGATED (Modbus 40-037), is a command and status register to control and monitor the automatic collection of parameters from each fitted decoder in the background.

INTERROGATED holds the decoder number in the lower byte (1-127 in the DG-3) The top byte holds command and status results:
40-037

Status	cmd	addr	Note
ssss	cccc	0aaaaaaa	(1-127)

Status
0000   nothing to report
0001 (0x1) command in progress
1000   (0x8) command completed successfully
1100   (0xC) command unsuccessful

cmd
0000 (0x0) do nothing or stop (set to 0 by INIT at boot)
0001 (0x1) initiate a collection from decoder xx and store it into EEPROM
0010 (0x2) delete data in EEPROM for decoder xx

0011 (0x3) publish from EEPROM earlier collected data from xx into ModBus registers
0100 (0x4) start collecting from fitted decoders 0aaaaaaa up to top channel (127)
0101 (0x5) cyclically check the sensor inputs on all 'on' valves type TW/NG-1-CC (0aaaaaaa) don't care

Background retrieval of decoder stored parameters.

When commanded with 4 the DG-3 inches through the fitted decoders, asking for all 35 parameters from each, then storing them into an EEPROM page. (20.5 hours to collect for all 127, if every decoder fitted). This is normally done at commissioning time. If all 127 decoders have been fitted, this will take about 21 hours.

Information can be collected from an individual decoder using command 1 instead

When collection is completed, if subsequently asked through Modbus to publish the INFORMATION inside a decoder (by writing command 3 and the wanted decoder address into INTERROGATED; 40-037), the DG-3 retrieves all 35 parameters stored in EEPROM and places them into the INFORMATION holding register array 40-038 to 40-072, ready for Modbus reading by the host.

Sensing Water Flow Through a Valve:

A new type of valve is being produced with a sensing system to detect the position of the diaphragm in the control chamber.

One method used, is to fit a permanent magnet on the top of the diaphragm and a magnetic sensor on the top of the bonnet.

When the valve is fully open and passing water, the diaphragm is fully flexed, bringing the magnet closer to the sensor to activate it. If the diaphragm does not flex when the solenoid's plunger is retracted (e.g. a leak in the diaphragm, plunger jammed, or no water), the sensor will not activate. It will only activate if the valve is fully opened and passing water normally. Thus, by reading the sensor, the correct operation of the valve may be ascertained, *without the necessity for a flow meter.*

The TW/NG-1-CC has an extra pair of wires (black) that can attach to a magnetic reed switch, when used as the sensor. The state of the sensor can be read through the 2wire path using talkback command 4. Additionally, the DG-3 can cyclically interrogate all currently 'on' decoders automatically by loading INTERROGATED, Modbus 40-037, with command 5, (with decoder address 'don't'-care')

Open Position   Closed Position
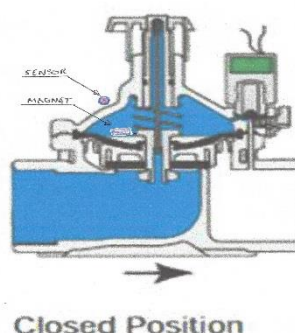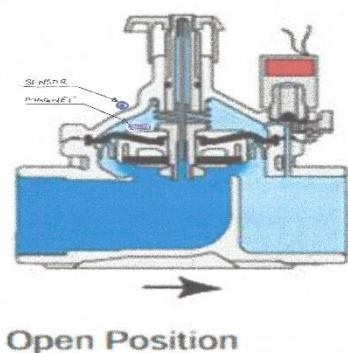
During action with INTERROGATED command 5, the address of each 'on' decoder being interrogated will be displayed in the bottom byte of INTERROGATED, whilst its status will be set to 0001 (0x1) "in progress"

A bank of ModBus registers, 40-073 to 40-080 will hold a 1 for each valve detected as flowing.

CONFIRMATION OF WATER FLOWING IN AN OPEN VALVE

A bank of ModBus registers, 40-073 to 40-080 will hold a 1 for each flowing valve

G   Read- fn 03.   Read- fn 03.

Address	Valves Flowing	Address	Valves Flowing
40-073	Flowing 1-16	40-077	Flowing 65-80
40-074	Flowing 17-32	40-078	Flowing 81-96
40-075	Flowing 33-48	40-079	Flowing 97-112
40-076	Flowing 49-64	40-080	Flowing 113-127

As it takes time between a solenoid plunger retracting and the valve then to fully open. the FLOWING table will not immediately show a 1.
When a valve is commanded off, the valve's table value will be set back to a zero by the DG-3.

Modbus Additional Registers

E	Read- fn 03.	F	Read- fn 03. Preset- fn 16
address	Fitted/Discovered	address	**Decoder Parameters**
40-029	Fitted 1-16	40-037	Census Cmd & Status (R/W)
40-030	Fitted 17-32	40-038	P0 Top 16 bit Lat
40-031	Fitted 33-48	40-039	P1 Bot 16 bit Lat
40-032	Fitted 49-64	40-040	P2 Top 16 bit Long
40-033	Fitted 65-80	40-041	P3 Bot 16 bit Long
40-034	Fitted 81-96	40-042	P4 text L1, 1 & 2
40-035	Fitted 97-112	40-043	P5 text L1, 3 & 4
40-036	Fitted 113-127	40-044	P6 text L1, 5 & 6
		40-045	P7 text L1, 7 & 8
		40-046	P8 text L1, 9 & 10
		40-047	P9 text L1, 11 & 12
		40-048	P10 text L1, 13 & 14
		40-049	P11 text L1, 15 & 16
		40-050	P12 text L1, 17 & 18
		40-051	P13 text L1, 19 & 20
		40-052	P14 text L1, 21 & 22

F	Read- fn 03.	F	Read- fn 03.
address	Decoder Parameters	address	**Decoder Parameters**
40-053	P15 text L1, 23 & 24	40-069	P31 top 16 bit date
40-054	P16 text L2, 1 & 2	40-070	P32 bot 16 bit date
40-055	P17 text L2, 3 & 4	40-071	P33 PIN
40-056	P18 text L2, 5 & 6	40-072	P34 top byte s/w version, f/w; bottom f/w version
40-057	P19 text L2, 7 & 8		
40-058	P20 text L2, 9 & 10		
40-059	P21 text L2, 11 & 12		
40-060	P22 text L2, 13 & 14		
40-061	P23 text L2, 15 & 16		
40-062	P24 text L2, 17 & 18		
40-063	P25 text L2, 19 & 20		
40-064	P26 text L2, 21 & 22		
40-065	P27 text L2, 23 & 24		
40-066	P28 App serial no.		
40-067	P29 top 16bit time		
40-068	P30 bot 16 bit time		

Descriptions of the formats can be found on page 8