

Tonick OEM Decoder Adaptor; ModBus RTU

(Part no. BT2/MB)



Tonick's 2 wire decoder system has the following strengths and advantages.

- TW/2W Decoder design proven in nearly 300,000 stations over 20 years
- 'Rock solid' lightning protection. Warranty includes damage by lightning
- No earth stakes required along the line, just one at the controller
- Most types of cable are acceptable, no special polyethylene or twisted pair cable is necessary
- Indifferent to truly horrendous earth leakage on the field cable
- Decoder communications protocol robust and proven in over 3000+ installations
- Decoder completely waterproof
- The new DIAS (Decoder In A solenoid) fits instead of a solenoid, allowing much improved performance compared to the TW/2W, without the disadvantages.

What the Tonick decoder system does NOT do.

- The TW/2W decoder does not use external DC anywhere, so cable destruction due to electrolytic action is avoided
- The TW/2W decoder applies full AC to the solenoid, so the number of stations on concurrently is limited compared to others that apply DC to the solenoid.
- TW/2W Decoder distances are limited compared to others that use DC on solenoids or latching solenoids. This does not apply to DIAS.

The design of the OEM Decoder Adaptor incorporates the latest Surface Mount Components making the unit smaller and lowering the manufacturing cost.

Additional features are incorporated as follows:

Optional DIN rail mounting Aluminum enclosure

Small board footprint; Eurocard 100 x 160mm.

Large terminals on two wire output

Optional DIN41612 connector with mixed terminals for plug-in capability

Conformally coated to allow operation in 95% humidity (non-condensing)

Operation rated to ambient +70 degC

Runs DIAS (Decoder In A Solenoid) for up to 16 stations active per cable and distances of many Km.

Revisions:

V1.0 Preliminary.

V1.1 Renamed 'Status' as 'Actual' to remove ambiguity

Added bit 7 in Status register 40-001, Station Failures

V2.0 Cased version added.

Conformal coating higher ambient and humidity

Specified for operation up to +70 degC ambient.

Software Version No. unchanged at V1.0 (returned as 10 decimal, 0A hex)

Removed references to plug-in keyboard/display

V3.0 Derived from UI Modbus V2.0.

Tonick TW/2W series of decoders: 1-127 stations

Software version number reported as V1.1 encoded as 11 decimal.

V3.1 Sensor decoder operation added

Software version number reported as V1.2. encoded as 12 decimal

V3.2 Pressure sensor decoder and custom pressure sensor added

V3.4 Modbus reply will be delayed during sensor decoder read. Modbus reply timeout will need lengthening.

Software version number will be reported as V1.5 encoded as 15 decimal

V3.5 Further explanations on Status register 40-001

Bug fix LAST-DESIRED array to be reset .Software now V1.6, encoded as 16 decimal

New software version and decoder type data published in 40-005

V3.6 Faster response to Sensor decoder requests. Combo Decoder provision. DIAS compatibility. Latched decoder fail bit

Software now V2.4

Specification. OEM DECODER ADAPTOR.

Tonick Part No. BT2/MB

Supply Voltage 24 ~32 Vrms AC 50 or 60Hz. Transformer recommended: 26VAC 34VA 1300mA output, either (a) 230VAC 50Hz input OR (b) 115VAC 60Hz input. Customer sourced transformers must be pre-qualified by Tonick as suitable for the Warranty to be valid. DIAS needs 60Hz. 24VAC or 23VAC inverters available for 50Hz regions or if dirty power.

Supply Current Up to 1 .3A

Output Voltage 23 ~ 31 Vrms AC

Output Current (Max continuous) 1 .2A at Ambient +50degC
0.6A at Ambient +70degC
Linearly derate between +50 and +70degC

Note: Full Line output voltage will be continuously applied to the solenoids connected to 'on' decoders. Attention must be given to the specifications of these solenoids. DO NOT EXCEED THE MAXIMUM OUTPUT CURRENT OF THE OEM DECODER ADAPTOR.

Line Signaling Up to 127 Tonick 2 Wire TW/2W (Watermaton-style), or DIAS (Decoder In A Solenoid). Up to 16 active (Subject to total solenoid loads)
Allow 45 seconds after power-up, before switching decoders

Approvals CE (European) marked and compliant
RoHS (European) compliant & lead free

CPU 8 bit RISC. 8MIPs . 64K flash / 4K RAM / 4K EEPROM.

Firmware Re-writable application in general flash space.
Uses Kanda Keyfob programmer.

Communications RS485 half duplex (+-80V fault, 15kV discharge)
9600 Baud, N,8,2 (Other formats on request)
A, B line biasing resistors and 130 Ohm line terminating resistor

Isolation 1KV between decoder line/ transformer AC input and RS485 circuitry

Slave address programmable 1...7 using the plug-in DIL switches. Factory Set: Slave address 1

Connections

The OEM DECODER ADAPTOR should be wired as follows.

AC and **AC** terminals should be wired to the transformer supply
L1 is the Field Cable 'Live' terminal (referred to as the 'line')
L2 is the Field Cable 'Neutral' terminal

EST1 The Earth Stake terminal (EST) MUST be connected to a properly bedded earth stake or plate via a 4mm² (#11 AWG) or larger earth wire. This earth system is not to be regarded as an electrical safety earth. Connection of the EST to a building and/or an electrical earth is NOT permitted. If it was, a lightning strike on the field cable would be conducted into the building and/or its electrical installation.

RS485 Terminals

A (D0), B (D1) are half duplex RS485 signals. **B** is more +ve than **A** during line idle conditions
COM is the ground of the RS485 circuitry, and must be connected to the RS485 0V of host controller.
The RS485 is optically isolated from the OEM Decoder Adaptor decoder circuits by at least 1KV to help protect against lightning surges propagating into the host controller.

Environmental General

Storage 0 to 70 Degrees Centigrade
5% to 95 % humidity (non -condensing)

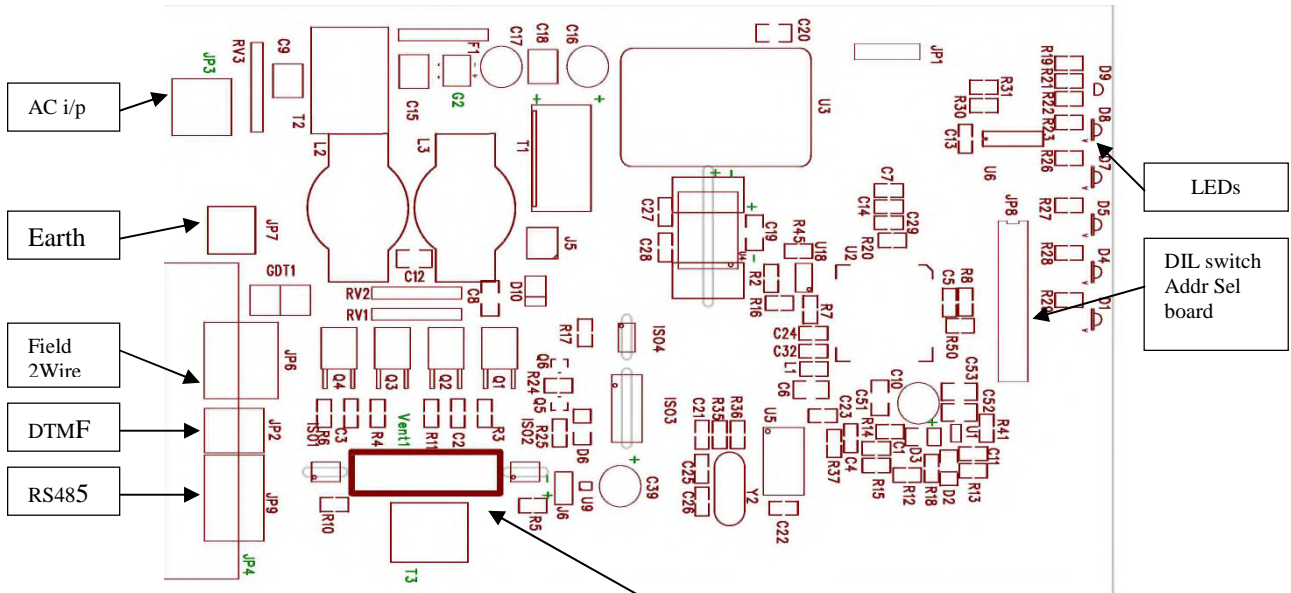
Operation +5 to +70 degrees centigrade. Derated from 1.2A output at +50degC to 0.6A output at +70degC
5 to 95 % humidity (non -condensing). Conformally coated with Acrylic, except fan and terminals

OEM Decoder Adaptor Housing:

The OEM Decoder Adaptor is assembled on a standard sized Eurocard 100mm x 160mm. Conformally coated with Acrylic. Connection via top screwed, side entry Euro terminal blocks.

A 4 way DIL switch may be temporarily plugged in, which allows the slave address to be set, 1...7.

The PCB is housed in an open fronted Aluminum enclosure, DIN rail mountable. (See below)



- JP3 AC input from external transformer
- JP7 Lightning protective earth stake/plate
- JP6 Field connection to decoder 2 wire path
- JP2 Remote control audio using DTMF tones from cellphone or radio
- JP9 RS485 communications for commands and status
- JP4 Alternative DIN41612 I/O connector (size M/2), replacing JP2, 3, 6, 7, 9
- JP8 Connector for temporary plug-in address selection DIL switches
- LED D9 Blue=signalling decoder, Green=decoder power on, Red=station fail (Tri-colour)
- LED D8 AC input present (not fused) (Orange)
- LED D7 Comms message error (Red)
- LED D5 Sending comms reply (Yellow)
- LED D4 Receiving comms command (Yellow)
- LED D1 DC power & Micro OK (Green)

The Eurocard is housed in a open-fronted, DIN rail mountable aluminum enclosure.



Dimensions:

187mm long, 75.4mm high

35mm deep when mounted on 'top hat' DIN rail

Left hand cheek milled to allow wire connections into the terminals.

LEDs visible from the top.

Snap on/off 'top hat' DIN rail mounting.

HARDWARE

The communication hardware specification for TONICK OEM DECODER ADAPTOR MODBUS RTU is 9600Baud RS485 1 Start, 8 Data, No parity, 2 Stop bits. The port is isolated to 1000V from the 2 wire paths and is +-80V fault tolerant on A and B. It will also withstand up to 15kV discharge from both direct and human body models. The isolation is intended to resolve lightning strike issues on the 2 wire paths, so protecting the host controller

OEM Decoder Adaptor supports a maximum of 127 Tonick 2 wire decoders or DIAS (Decoder In A Solenoid) on its 2 wire path line,.

The OEM Decoder Adaptor hardware will drop the relevant line if a current greater than approx 1.6A is detected for more that 3 seconds. This event sets error bits in the 16 bit signaling status register 40-001 accessed with function code 03H. An algorithm in the firmware attempts to make a decision about whether a line current fault can be attributed to a particular decoder. If it can, an error will be recorded for that decoder. Note: The short-circuit detection may not be triggered if there is significant line resistance between the controller and the short-circuit.

The Earth Stake terminal (EST) MUST be connected to a properly bedded earth stake or plate via a 4mm² (#11 AWG) or larger earth wire. This earth system is not to be regarded as an electrical safety earth. Connection of the EST to a building and/or an electrical earth is NOT permitted. If it was, a lightning strike on the field cable would be conducted into the building and/or its electrical installation. Conversely, a lightning surge on the power line will be transmitted to the decoder field cable and cause possible decoder damage.

Wiring

The OEM Decoder Adaptor should be wired as follows.

AC and **AC** terminals should be wired to its transformer supply.

L1 is the Field Cable 'Live' terminal (referred to as the 'line' or 2 wire path)

L2 is the Field Cable 'Neutral' terminal

EST1 (Earth Stake Terminal) must be connected to the earth stake (see above for recommendations)

RS485 Terminals

A (D0), B (D1) are half duplex RS485 signals. **B** is more +ve than **A** during line idle conditions

COM is the ground of the RS485 circuitry, and must be connected to the RS485 0V of host controller.

The RS485 is optically isolated from the OEM Decoder Adaptor decoder circuits by at least 1KV to help protect against lightning surges propagating into the host controller.

Address Select DIL switches; Plugged into JP8 whilst powering up. Sets slave address.

DIL Position;	Off = 0,	On = 1
1 slave addr 0	0	1
2 slave addr 2	0	1
3 slave addr 4	0	1
4	Yellow slider not used	

For example: powering up the interface with no DIL switches fitted will result in no changes from previous settings.

With all DIL switches on, slave address 7

A small plug-in PCB is provided with the DIL switches on it. This is fitted temporarily to set the address, then removed.

Combination Master Valve Decoder, Pressure Sender and Flow Sender

The COMBO decoder combines a Master Valve solenoid on/off control settable to address 126 or 127 (default, out of the box), a pressure sensor input and two alternative flow inputs; one for Woltmann-type contact closures flow meters and the other for pulse-type open-collector flow meters.

Housed in a water-tight encapsulated enclosure, 70x50x35mm, the combination decoder may use any or all the inputs and outputs. A green/red/orange LED makes troubleshooting easier.

The combo pressure and flow sender register addresses now occupy 9-14 in the sender address range. See next section.

More details in the combo Decoder Brochure.

In software V2.4 There is no longer a pump decoder at 127 automatically turning on with the 2 wire path on. 127 is now a normal valve decoder

Sensor Decoders

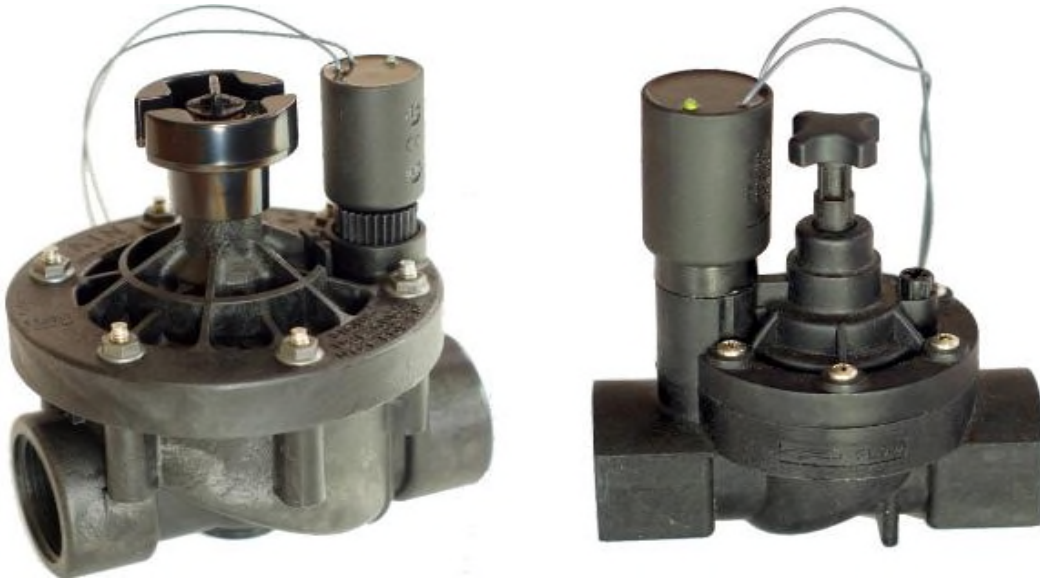
There can be up to 8 sensor decoders in addition to the 127 valve decoders. These are separately addressed as 1-8, but do not interfere with decoders 1-8

There are currently 6 types.

1. Volumetric soil Moisture Content (VMC), returning 0-55% in 1% increments
2. Contact closure counting. Measuring up to 5 closures/second from volt-free contacts. Counting into 7 bits in a byte 0x00-0x7F, wrapping around. The top bit is the contact position. 1=closed, 0=open.
3. Combo Decoder flow measurement frequency of pulses 0-200Hz
4. 8 digital inputs. Measuring 12-30V AC or DC on each input with respect to a common. A voltage present returns a 1 in the byte. Inputs are isolated up to 1KV from the 2wire path.
5. Gauge pressure, 0-10BAR using an IP68 custom sensor, G1/4 male thread
6. Gauge pressure, -1BAR to +6BAR using an IP68 custom sensor, G1/4 male thread

More details on these sensors are in the brochure 'Tonick Watering Sensor Decoders'

DIAS (Decoder In A Solenoid)



2Wire Decoder built-into a valve solenoid

- Combines a 2Wire Decoder and Solenoid into one product.
- Reduces number of field wire connections by 50%
- Multi-colored LED provides feedback — reduces troubleshooting time.
- Screws into most valves. (Thread adapters for Hunter, Rain Bird and TORO).
- 3-Way solenoid with back water port for big agricultural valves.
- Compatible with all Underhill & Tonick 2Wire Controllers and Converters.
- Superior distance and number of concurrent active stations.
- No grounding necessary along the 2Wire path.
- Built-in powerful protection from Lightning surges.
- Can re-use old wiring. Earth leakage on 2Wire well tolerated.
- 'Out of the box', works as a normal 24VAC solenoid with ultra low current.
- Works with the Tonick Sensor decoder range; soil moisture, flow and pressure.

- In-Rush Current – 300mA-350mA
- Holding Current - 30mA (2-way solenoid), - 60mA (3-way solenoid), both relatively independent of applied AC voltage.
- Idle Current (typical) — 4.5mA
- Maximum Active Valves per 2Wire path:
 - 2-way 16 (spread relatively equally along the path)
 - 3-way 10 (spread relatively equally along the path)
- Maximum operating distance 2-way: (Low water pressure: ~3Bar)
- 2.5mm² conductors 11,000m 35,750 feet (1 valve active)
- AWG14 conductors 10,000m 32,500 feet (1 valve active)
- 4mm² conductors 22,000m 71,500 feet (1 valve active)

For more details, please see the DIAS data sheet.

SOFTWARE

HOLDING REGISTER DESCRIPTIONS

B Read- fn 03H. Preset- fn 16H **C** Read- fn 03H. Preset- fn 16H

address	Desired	address	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 03H. Preset- fn 16H
		40-024	Sensor address
		40-025	Sensor trigger/results

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 16H
 Wait about 1 second
 Poll Holding Register 40-001, using Read Multiple Registers Fn 03H. 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 any mismatch between DESIRED and ACTUAL arrays

A

Read- fn 03H. Preset- fn 16H

		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	Resettable line fuse tripped (R/W)
40-004	Total 2 wire line current (mA) Read-only	4	
40-005	Top byte: S/w version x 10. bottom: decoder type	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 present
		8	
		9	
		10	Latched Station Fail (R/W)
		11	
		12	
		13	
		14	Can't Implement Signalling
		15	

- 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. 16H), 16 bit write data. Read-only bits will be refreshed within 1 second to their true values.
- If Line high current or resettable fuse tripped, the status bits will be set even if the 2 wire decoder power is off. These will need to be written to zero to clear them.
- 40-006 may be written to a value different from \$AA55. If the BT2 has rebooted, this value will be restored. This can be used by the OEM controller to detect a reboot by the BT2. If not \$AA55 and RS485 communications have ceased, the BT2 will reboot in 16 seconds
- 40-005 publishes the software version x 10 in the top byte. e.g. version 2.4 will be published as 24 decimal, \$18 hex. The bottom byte is the code for the type of decoder. 0 = Underhill TK-DEC-1, 1 = Tonick TW/2W, 2 = AquativePlus(AC) motorized valve, 3 = DIAS (Decoder In A Solenoid)
- 40-005 will be refreshed at boot.
- Bit 7 in Status register 40-001 will be set if any mismatch between DESIRED and ACTUAL arrays. *A Fail-Turn-Off will not set this bit.*
- (NEW) Bit 10 in status register 40-001 will be set if there has been a failure on or off. This can be used to detect a previous fail-turn-off. Only reset by the host controller.

Switching Method Using Read/Write Registers

To switch up to 4 TW/2W or TK-DEC-1 decoders at once. (But be careful of Ohms Law and not turn on too many at once; 2 at a time per line is more usual) . Up to 10 DIAS (Decoder In A Solenoid) may be switched at once.

(NEW) The BT2 will switch off the decoders no longer needed before switching on the new ones.

- Write DESIRED holding registers 40-008 to 40-015, Bank B, with function 16H, with bits set accordingly.
- Poll register 40-001, bit 0, Bank A, with function 03H until bit 0 is zero, i.e. Busy finished. Allow about 0.5 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 11H. 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.
- Read ACTUAL holding registers 40-016 to 40-023 with function 03H. Compare like bits in Banks B & C. If different, an error has occurred
 - Desired 1, Actual 0... fail to turn on
 - Desired 1, Actual 1...successful on
 - Desired 0, Actual 0...successful off, (but may have been an EMERGENCY OFF. See Latched station Faults bit 10 of 40-001)
- 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, reset its ACTUAL bit back to 0 with function 16H to clear the fault indication.
- If fail to turn on, reset its DESIRED (output) bit back to 0 with function 16H to clear the fault indication. (NEW) This will not result in an EMERGENCY OFF if it previously failed to turn on

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 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 faultfinding on the relevant 2 wire path.

Turning the line off will reset all its bits in Banks B & C to zero.

To maintain compatibility with future developments of OEM 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 OEM Decoder Adaptor automatically turns the relevant 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 0.5 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. (NEW) Any decoders no longer needed will be turned off first, before new ones on.

Successful operation of a decoder station is determined 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 03H. As shipped, the unit expects a minimum change of 67mA and a maximum change of 920mA. These values are adequate for most applications. If a new value is required, the register may be set using Fn 16H in mA.

Line Current Monitoring

The OEM Decoder Adaptor continuously monitors line current (2 wire path), and will turn off the relevant line, if a current above the maximum of 1.6A is measured for more than 3 seconds. The capability of OEM Decoder Adaptor to supply current is determined by its transformer or inverter if fitted. The transformer recommended is 26VAC, 34VA.

The 2 wire path for decoders is monitored every 100mS. 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 Fuse Tripped (bit3) and or Line high Current (bit 1) will drop the line for safety, but leave the flags set. The user must reset these flags using Fn. 16H, or reboot.

Note. Short Circuits on the line that are many ohms (cable length) away from OEM Decoder Adaptor may not trigger this instant 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 or fuse trip, the current will read 0mA, but the flags in register 40-001 will reflect what has happened. This can be read with Fn. 03H, 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. 16H, 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 there is a mismatch in any of the 127 stations. HOWEVER a fail-turn-off will NOT leave a mismatch, as the BT2 will never leave an unwanted decoder on. Instead read bit 10 of STATUS register 40-001 to see if a latched station fail is present. This must be reset to zero by the host controller with Fn. 16H, write 16 bit registers.

Sensor Decoders

There can be up to 8 sensor decoders and 2 Master Valve Combo decoders in addition to the 127 valve decoders. These are separately addressed as 1-14, but do not interfere with decoders 1-14

There are currently 6 types.

1. Volumetric soil Moisture Content (VMC), returning 0-55% in 1% increments
2. Contact closure counting. Measuring up to 5 closures/second from volt-free contacts. Counting into 7 bits in a byte 0x00-0x7F, wrapping around. The top bit is the contact position. 1=closed, 0=open.
3. Combo Decoder flow measurement frequency of pulses 0-200Hz
4. 8 digital inputs. Measuring 12-30V AC or DC on each input with respect to a common. A voltage present returns a 1 in the byte. Inputs are isolated up to 1KV from the 2wire path.
5. Gauge pressure, 0-10BAR using an IP68 custom sensor, G1/4 male thread
6. Gauge pressure, -1BAR to +6BAR using an IP68 custom sensor, G1/4 male thread

More details on these sensors are in the brochure 'Tonick Watering Sensor Decoders'

More details on the Combo Decoder in its brochure

Accessing the Sensors

The interface to the sensor decoders is by two 16 bit holding registers

40-024 Sensor address

40-025 Sensor Trigger/results

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

- Load Sensor address with a number between 1 and 14
- And load the trigger/results register with -1, 0xFFFF
- Wait 200mS
- Using command 03- read multiple holding registers: Poll 40-001 bit 0 (Busy) until busy =0. Up to 2 +/- 0.1 seconds total until busy goes back to zero.
- The Modbus reply to any poll will be delayed by up to 2 +/- 0.1 seconds whilst the sensor decoder is actually being read. At the end of this time (or earlier if the read is finished) the Modbus reply will come back from the poll. ENSURE THE CONTROLLER MODBUS 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 sensor decoder, the bottom 8 bits of 40-025 will be the sensor value returned and the top 8 bits will be set to 0x01 i.e. 0x01ss, where ss is 8 bits of sensor data.

If no response from the sensor decoder, all 16 bits will be 0x0000

The Modbus reply to any poll will be delayed by up to 2 +/- 0.1 seconds whilst the sensor decoder is actually being read. At the end of this time (or earlier if the read is finished) the Modbus reply will come back from the poll. ENSURE THE CONTROLLER MODBUS TIMEOUT DELAY IS SET TO A SUITABLY LONG FIGURE

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.

LEDS:

The LEDs register 40-007 holds the following data which is mimicked on the front panel LEDES. 1 = LED on, 0 = LED off. It can be read using Fn. 03H, but not written using Fn. 16H

- Bit 0: DC Power OK Green, D1
- Bit 1: Modbus Frame being received Yellow, D4
- Bit 2: Modbus Frame being sent Yellow, D5
- Bit 3: ModBus comms error Red, D7
- Bit 4: Line AC present Orange, D8
- Bit 5: decoder signaling Blue)
- Bit 6: Line energized Green) Tri-colour LED, D9
- Bit 7: Last decoder Faulty Red)

Bit 5 (blue) is only on during the transmission of a decoder on/off command.

Slave Address Selection:

As shipped the OEM Decoder Adaptor is set to slave address 1 and 9600 Baud. The yellow slider baud rate selector is not used. Baudrate factory set at 9600.

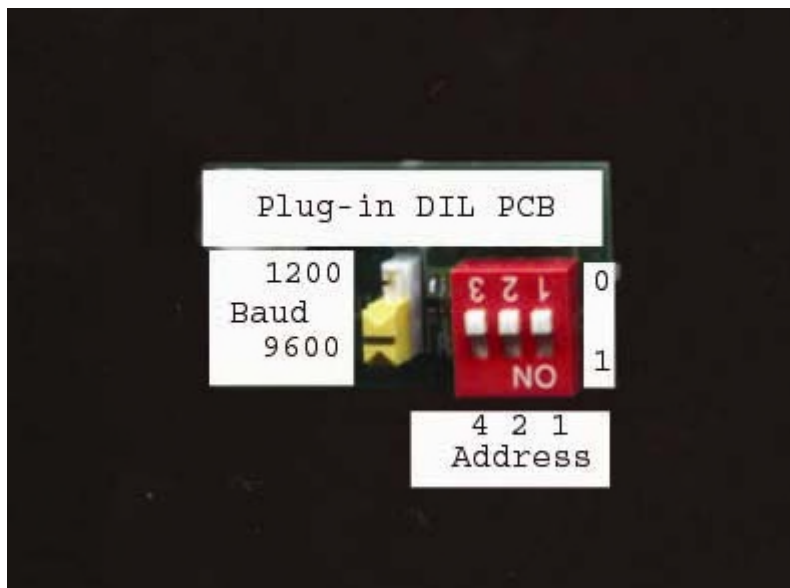
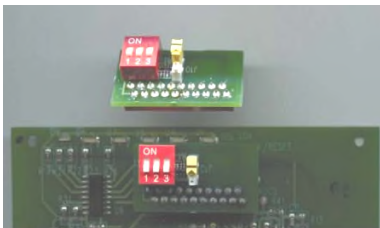
To change address, plug in the address selector DIL switches into JP8 and turn on the interface power. The address on the DIL switches 0...7 will be mimicked on LEDs D5 (=1), D4 (=2), and D1(=4), with the baud rate of 9600 on D8 together with a Red LED on D9.

On power-up with no DIL switches fitted, a Green LED on D9 will show for 3 seconds during boot, and the following LEDs will mimic the settings before continuing.

- D5 Address bit 1
- D4 Address bit 2
- D1 Address bit 4
- Led on = 1, led off = 0

- D8 Led on = 9600 Baud

A small plug-in PCB is provided with the DIL switches on it.



Address Select DIL switches: Plugged into JP8 whilst powering up. Sets slave address and baud rate
DIL Position; Off = 0, On = 1

1 slave addr	0	0	1
2 slave addr	2	0	1
3 slave addr	4	0	1
Yellow slider	not used		

For example: powering up the interface with no DIL switches fitted will result in no changes from previous settings.

With all DIL switches on, and the board plugged in, the settings will become: 9600 Baud, slave address 7

- Jumper link pair J5, on the main board, alters the polarity of decoder signaling waveform on the line. Consult factory if these need to be altered.

The OEM DECODER ADAPTOR MODBUS: Communications Protocol

The Tonick OEM Decoder Adaptor ModBus is a variant on the Tonick Watering Translator with neither LCD display nor keypad. It is engineered as a single Eurocard 100x160mm PCB for incorporation in an OEM's controller and is powered from a single external **24V-32V** AC RMS transformer of 35VA rating. For DIAS, a 24VAC 60Hz or 32VAC 60 Hz inverter must be used. Tonick 2-wire decoders TW/2W or DIAS may be operated. (Factory set). The communications command set has been extended to compensate for the inability to alter parameters from a keypad or observe data on an LCD. Up to 6 decoders out of 127 may be active when powering conventional 24VAC solenoids (subject to Ohm's Law and 1.2A total line current at +50degC). Up to 10 DIAS-C 3-Way or 16 DIAS-C 2Way Decoder In a Solenoid may be operated, see DIAS data sheet for limitations on numbers that can be operated depending in 2wire path length.

This protocol defines what the Tonick OEM Decoder Adaptor must do and hence the Comms messages that must pass between the controller and it. The OEM controller is referred to as the 'master' or 'Host' and the Adaptor(s) as the 'slave(s)'. The Tonick OEM Decoder Adaptor can have a slave address between 1...7, as commanded by a plug-in DIL switch assembly, temporarily inserted.

The electrical spec is RS485 half duplex, multi-drop with line turnaround controlled by each talker on an as-needed basis. Code is asynchronous, 1 start, 8 data, no parity, 2 stop, at 9600baud. Protocol is binary, ModBus RTU. The normal line state is for the master to keep its end in transmit (or the line biased in the mark state) and the slaves in receive. Slaves will never initiate a message on their own. All slaves remain silent in receive until talked to by master. Errored messages received by slaves are met with silence, not NAK.

Message checksum is ModBus CRC16.

The OEM Decoder Adaptor has biasing resistors in its RS485 A, B lines and a 130 Ohm line terminating resistor, so that with nothing driving the line, signal 'B' is 300mV more positive than signal 'A', keeping the line in the (mark) idle state. This prevents all receivers from picking up a continuous stream of 0's (the break condition). The Tonick OEM Decoder Adaptor uses an RS485 transceiver with reduced slew-rate. The electrical capacity of the RS485 bus is 32 receivers.

This document draws on information contained in the following Modicon Documents: -

- *MODBUS over Serial Line – Specification and Implementation Guide V1.02 Dec 20 2006*
- *Modicon Modbus Protocol Reference Guide **PI-MBUS-300 Rev.J***

TONICK OEM DECODER ADAPTOR resolves a query complete by 4 character periods, or 750uS (whichever is the greater for the baud rate) of line idle. TONICK OEM DECODER ADAPTOR does NOT respond to any message that times-out. A break of 4 characters / 750uS initiates the interpretation of the query received. The host controller therefore needs to be sure that commands are sent as single bursts of characters with no significant inter-character breaks or delays.

The TONICK OEM DECODER ADAPTOR MODBUS protocol is implemented using RTU transmission mode (Binary). Message framing is achieved by line idle durations as described above. Please refer to the Modicon documents mentioned above if a fuller understanding of ModBus and its implementation on serial lines is required.

The TONICK OEM DECODER ADAPTOR MODBUS implementation embraces the MODBUS function numbers such that decoder stations are accessed as bits in holding registers 40-008 to 40-015 called DESIRED and corresponding STATUS (Actual) in the same bits in holding registers 40-016 to 40-023, whilst data values (such as line sensitivity) are accessed in holding registers 40-001 to 40-007.

In general, slave specific Comms counts and errors counts are recorded, but TONICK OEM DECODER ADAPTOR does not record successful message counts for the bus as a whole. Available counts are available on Fn 11H; these counts are reset to zero at power-up.

ModBus standard decrees that register number 1 is transmitted within a ModBus messages as address 0000. The addresses discussed below are the addresses that would appear in the master program. The numbers that are transmitted within messages will be one less.

Each decoder address/station is controlled by a DESIRED bit in a holding register and a STATUS bit in another holding register. An error flag can be generated by software in the host controller, if after a signaling has finished, the DESIRED and STATUS differ.

Function Summary

(n/u means not used)

Modbus Commands implemented on TONICK OEM DECODER ADAPTOR are:-

01 Read Coil Status - not implemented.
02 Read i/p Status - not implemented
03 Read multiple (holding) Registers.
04 n/u
05 Force Single Coil - not implemented
06 n/u
07 n/u
08 Diagnostics (loopback)
09 n/u
10 n/u
11 Fetch Comms Event Counter – Returns busy status and a count of successful comms implementations
12 n/u
13 n/u
14 n/u
15 Force multiple coils – not implemented
16 Preset multiple (holding) registers.
17 Report Slave ID – Returns the H/W code for this device and software Version. No.
18 n/u
19 n/u
20 n/u
21 n/u

Functions outside of the range quoted above are not allowed.

Note:

Fun 17. Returns TONICK OEM DECODER ADAPTOR information – slave ID, on/off, Serial Number, H/W Version, S/W Version.

Information is returned as: -

<ADD> <FUN> <COUNT> <Slave ID> <On/off> <Ser# Hi> <Ser# Lo> <H/W Ver> <S/W Ver> <CRC Hi> <CRC Lo>

Where <slave ID> = 01, <On/off> = HEX FF = (always) on;

Fun. 11. Returns a status of \$FFFF (hex) if the Signaling in Process bit is set.

Please refer to *Modicon Modbus Protocol Reference Guide PI-MB US-300 Rev.J* for details of these commands.

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