# TONICK WATERING SENDER DECODER— SDI-12 INTERFACE

The Tonick Watering Sender decoder allows SDI-12 sensors to be interfaced into the 2wire path.

SDI-12 is an industry standard protocol used by many environmental sensors. This include:

- Multi-level soil moisture and temperature
- Leaf wetness
- Weather stations
- Pyranometer
- Rainfall measurement
- ETo

The SDI-12 sender decoder may be used on the same 2wire path, alongside valve decoders, flow, pressure, 4-20mA and contact closure.

It is compatible with Tonick BT2 and Irrinet decoder interfaces. Additionally, the Tonick RM-2 Internet-based controller.
(The BT2 is an OEM product and can be customised to suit the customer's controller. The range includes a full function Eurocard, down to a pre-programmed microprocessor that can be built into the customer's own controller PCB.)

**Connections:**

| | |
|---|---|
| **RED** | 2wire path live (19-32VAC) (Typical idle current 9mA) |
| **BLACK** | 2wire path neutral |
| **BROWN** | SDI-Sensor Power (8-9V DC) |
| **BLUE** | SDI Sensor signal (SDI-12 digital signal. See SDI-12 V1.3 Specification) |
| **GREEN** | SDI Sensor 0V |


Up to 15 SDI-12 Senders may be used on the same 2wire path. Their addresses do not clash with the valve on/off decoder addresses.

Each sender can interface to one SDI-12 Sensor. Up to 7 parameters may be extracted from one SDI-12 sensor and can be read by the decoder interface.

The Sender decoder has a red/green led.

On power up the led will indicate green, with a short orange flash at the end of the boot. 2 seconds after this, the sender will issue an SDI-12 Command ?! to find the SDI-12 address of the sensor. This will be stored in the sender (as ‘a’) and used in subsequent SDI-12 commands.

**Commanding the Sender:**

The SDI12 sender decoder 2wire address( 1-15) is further enhanced with an upper 4 bits in its 8 bit address field

In the BT2 (Modbus) and Irrinet interfaces, the sender addressing register can now use the upper 4 bits of the 8 bit address field to carry extra commands:

- Bits 0-3 carry the conventional sender address 1-15, (but extra data are in the top 4 bits…)
- The top bit of the 8-bit address field is the read/write bit
- Bits 4,5,6 determine what object is to be manipulated

**Sender Addressing:**

The incoming 8 bit sender decoder address from the decoder interface contains the following:
7 6___5___4 3___2___1___0
R/W cmd n sender addr

The sender will respond if its 2wire address matches bits 0...3 (1-15)
Bit 7 determines what the sender will do with bits 4...6

If bit 7=0 (R)
The nth 8 bit parameter will be returned from SDI12-DATA (parameter 0-7)

If bit 7=1 (W)
n will be appended to the command to the sensor aCn!
a is sensor address.
C is 'concurrent measure' command
n is what type of measurement to make (0-7), held in bits 4...6
! terminates the command to the sensor

**Reply Data Format:**

Reply parameter data storage array is available in the sender for the returned sensor data.
SDI12-DATA
Maximum number of sensor readings can only be stored in array 1-7
Param 0 is SDI sensor configuration data. see below

Signed 8 bits per parameter.

e.g. 27.4568 degC from the sensor will be reported in an 8-bit reply as 27.
27.6789 degC will be reported as 28 (rounded)
-5 degC will be reported as 0xFB

For example:
1 001 0010 is received by the sender in 8 bits from the host controller, through the BT2/Irrinet decoder interface

sender address is 2

Bit 8 is a write, so This sender will send aC1! in ASCII to the sensor and wait for its reply.

When the aCn! Is sent, the LED will flash red

The sensor's reply will be atttmm<CR><LF> (in ASCII)
a is the sensor's address
ttt will be the time in seconds before the reading is ready
mm is the number of readings which will be available from the sensor

SDI12 sender parameter 0 will then be packed with:
Bottom 4 bits: delay in seconds (0-15) till sensor readings are ready =ttt
Top 4 bits will be the number of sensor readings which will be available =mm
and the sender will reply to the host controller with the contents of
SDI12 parameter 0. *

ttt seconds (0-15) after the aCn!, the sender will issue a succession of aDn! counting parameters that are returned, until the full number mm have been read. This may mean a succession of aD0!, aD1!, aD2! until mm readings have been accounted for. Each reading will be converted to a signed 8 bit value and placed in the relevant SDI12-DATA array in ascending order starting from SDA12-DATA 1. During the reading operation the LED will flash red each time an aDn! Is sent

It is up to the host controller to wait AT LEAST ttt + 3 seconds, before asking to read the sensor's data from the SDI12-DATA array (3-18 seconds). The 3 extra seconds are to allow the sender to issue aD1!, aD2! etc. and get the ASCII data from the sensor.

During the waiting period between asking for a measure and getting the data, the value ttt will count down to zero. Successive reads of SDI12-DATA will read the number of seconds left before the values in the array SDI12-DATA 1-7 are available. Allow 3 more for the serial comms to/from the sensor have completed.

The host controller can then send a command comprising…
the incoming 4 bit sender decoder address and n:
7 6___5___4 3___2___1___0
**R** cmd n sender addr

And the sender will reply on the 2wire path with the contents of the nth parameter (0-7).

During the reply, the sender's LED will flash orange

**LIMITATIONS:**
Number of readings mm can only be stored in array 1-7.
Maximum wait time before readings ttt are available can only be 0-15 seconds.
Only one SDI-12 sensor may be attached to the sender's brown/blue/green wires.
The SDI-12 sensor's address (a) must be between 0-7
It is anticipated that there will only be a short distance between the sender and the sensor.
*Most SDI-12 sensors, likely to be used in irrigation, will conform to these.*
BT2 and Irrinet need the software version that extends the delay between asking for a measure command and receiving the reply from the sender containing the number of sensor readings available mm and the time to wait in seconds ttt.
If earlier versions of the interface are used, there may not be a reply from the measure command within the timeout period. However, a second read of SDI-DATA 0 will return the desired information.