COMMUNICATION AND LOGGING TECHNOLOGY

Air Quality can be referred to as the condition or state of air that we breathe and monitoring the Air Quality around us is of utmost importance.

Air quality monitoring however means nothing if we cannot transmit or save the data.

South African Weather Service

Logging of air quality data

Ambient air quality is defined as the physical and chemical measurement of pollutant concentrations in the atmosphere to which the general population will be exposed.

Specialized equipment is used to measure the ambient air quality around us. Most of these instruments do have the capability to store and save the data onto the instrument itself but in order for us to safeguard the data and more easily interpret the data using diagrams and graphs we need to log the data, transmit the data to a safe location and have software that can display the data.

Communication and the logging of data from the instrument to the logging device can be done in two different ways. The two methods of transmitting data is analog communication or digital communication.

Communication types

As stated there are two methods in which data is transmitted from an instrument to a logger and computer:

- Analog communication
- Digital communication

Figure 9.1: Representation of analog and digital signals.

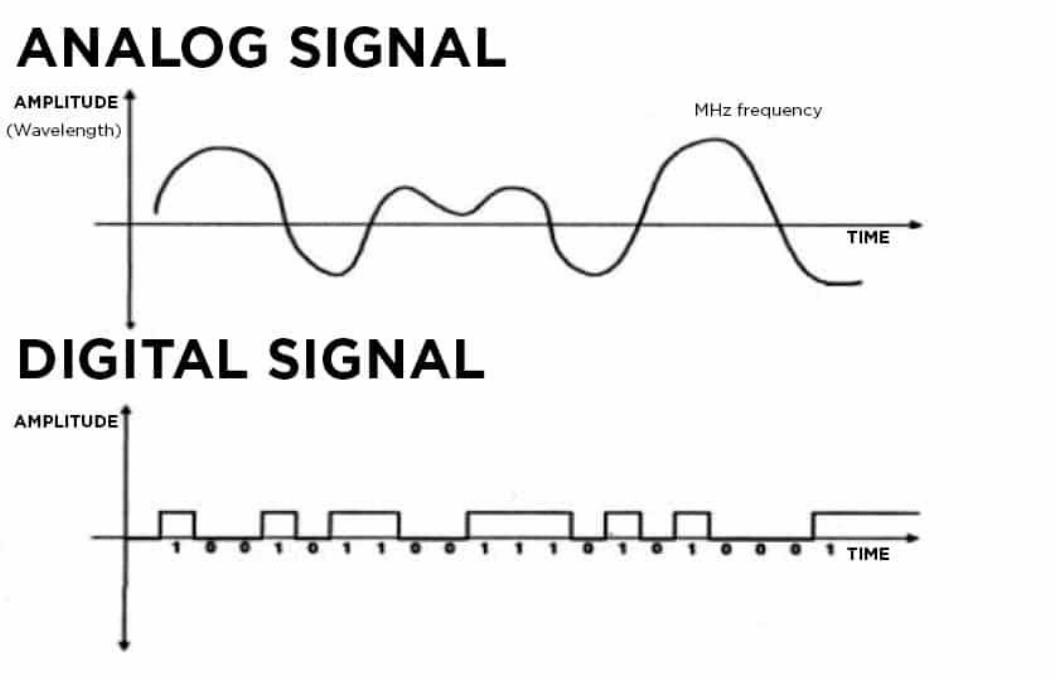


Figure 9.2: Examples of analog and digital signals.

Analog communication

Definition
Analog is an adjective that describes a continuous measurement or transmission of a signal.

Analog Communication is a communication method of sending data information using a continuous signal which varies in amplitude or phase in proportion to that of a variable. The communication that occurs in our day-to-day life is in the form of signals. These signals, such as sound signals, generally, are analog in nature. When the communication needs to be established over a distance, then the analog signals are sent through wire, using different techniques for effective transmission. Typically for instrumentation this would be in the form of a voltage or ampere range.

Eg: Our instrument has a measurement range of 0 – 500ppb. This instrument will express this output as a 0 – 5 VDC output where 0 VDC = 0ppb and 5 VDC = 500ppb and all between will be expressed based on a linear scale.

The signal used in analog communication is generated from an instrument, however we need a logging unit that can receive and interpret that information. Some logging units are designed specifically to only receive and log analog signals for example the Campbell Scientific Logger.

Figure 9.3: Campbell scientific logger using analog communication to receive data signals.

The conventional methods of communication used analog signals for long distance communications, which suffer from many losses such as distortion, interference, and other losses including security breach. In order to overcome these problems, the signals are digitized using different techniques. The digitized signals allow the communication to be more clear and accurate without losses.

Most instruments today are capable of communicating using digital communication however there are some instruments for example Meteorological equipment which can only supply an analog signal and does not communicate using digital signals. To log these signals digitally further equipment is used to receive the analog signal and digitize this signal for digital communication. These units are referred to as analog to digital converter units and are used to log the analog signals within air quality monitoring stations.

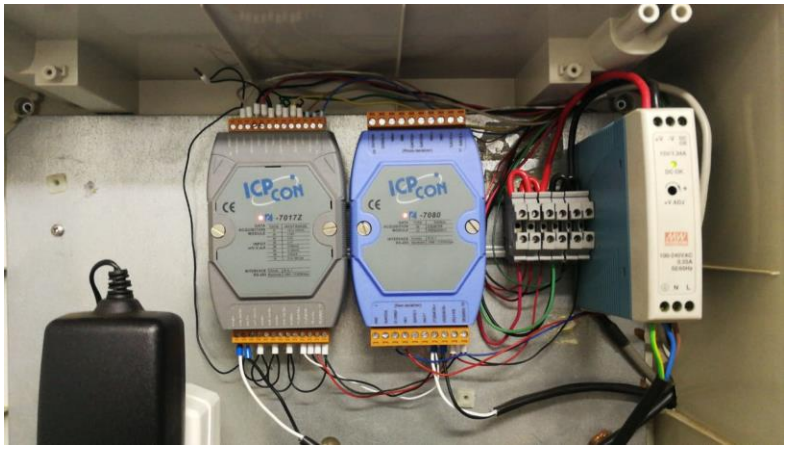


Figure 9.4: Example of ICP CON units used to convert analog to digital signals.

Digital communication

Definition
Digital information is stored using a series of ones and zeros. Computers are digital machines because they can only read information as on or off -- 1 or 0. This method of computation, also known as the binary system, may seem rather simplistic, but can be used to represent incredible amounts of data.

Digital Communication is the physical transfer of data (a digital bit stream) over a point-to-point transmission medium. This information is received and transmitted from the logging instrumentation through the use of communication protocols and commands. The logging units sends a command to the gas analyser requesting information, if the correct command is received the instrument will respond by sending the requested data.

Data is transmitted from the instruments with the use of serial communication cables or Ethernet cables. This allows the transfer of digital communication over a RS232 protocol when using serial communication. Care must be taken to ensure the correct RS232 cables are used, always refer to the instrument manual for the correct cable that must be used (either null modem or normal RS232).

Figure 9.5: Example of serial communication cables used for RS232 communication.

Logging systems

There are several manufactures of logging equipment, however they all function with the same principles. The only difference between them will be their software interface and the communication methods used.

Figure 9.6: Examples of types of logging systems used in industry.

Logging system setup

To enable the logging system and the instrument being used to communicate with each other both the instrument and the logging system needs to be setup correctly with the sample communication protocols. For the purpose of this document we will make use of the Envitech logging system to display the setup variables that needs to be set.

The first step in setting up the logging system is to check the communication parameters and the protocol used on the instrument. The below setup is the usual parameter settings that are used but always refer to the instrument manual to ensure the correct parameters are being used and then duplicated on the logger.

Baud rate: 9600
Databits: 8
Parity: None
Stop bits: 1
Flow control: None

Once the settings on the instrument has been verified the second step is to install a communication cable between the instrument and the logging system, ensure that the correct type of cable is used and make note of the comm-port being used on the logging system. The amount of available comm-ports on the different type of logging systems do differ but the available ports are normally numbered starting from comm-port 1 and the corresponding comm-port is labelled on the logging system's hardware.

Now that the instrument is setup correctly and the correct communication cable has been installed between the instrument and the logging system, the setup on the logging system can be done.

The third step in setting up the logging of data is to setup the comm-port settings on the logging system. First verify which comm-port is being used on the logging system's hardware and select the corresponding comm-port on the port setup. When the correct comm-port has been selected (COM 1 in the example below) the parameters for the comm-port can be adjusted to be a replica of the settings used on the instrument. In this case we will setup the comm-port with the exact same settings as on our instrument.

Baud rate: 9600
Databits: 8
Parity: None
Stop bits: 1
Flow control: None

Our instrument and logging system is now setup to communicate with each other. As mentioned previously the logging system will send a data request to the instrument and if the instrument understands this request it will reply with the data as requested from the logging system.

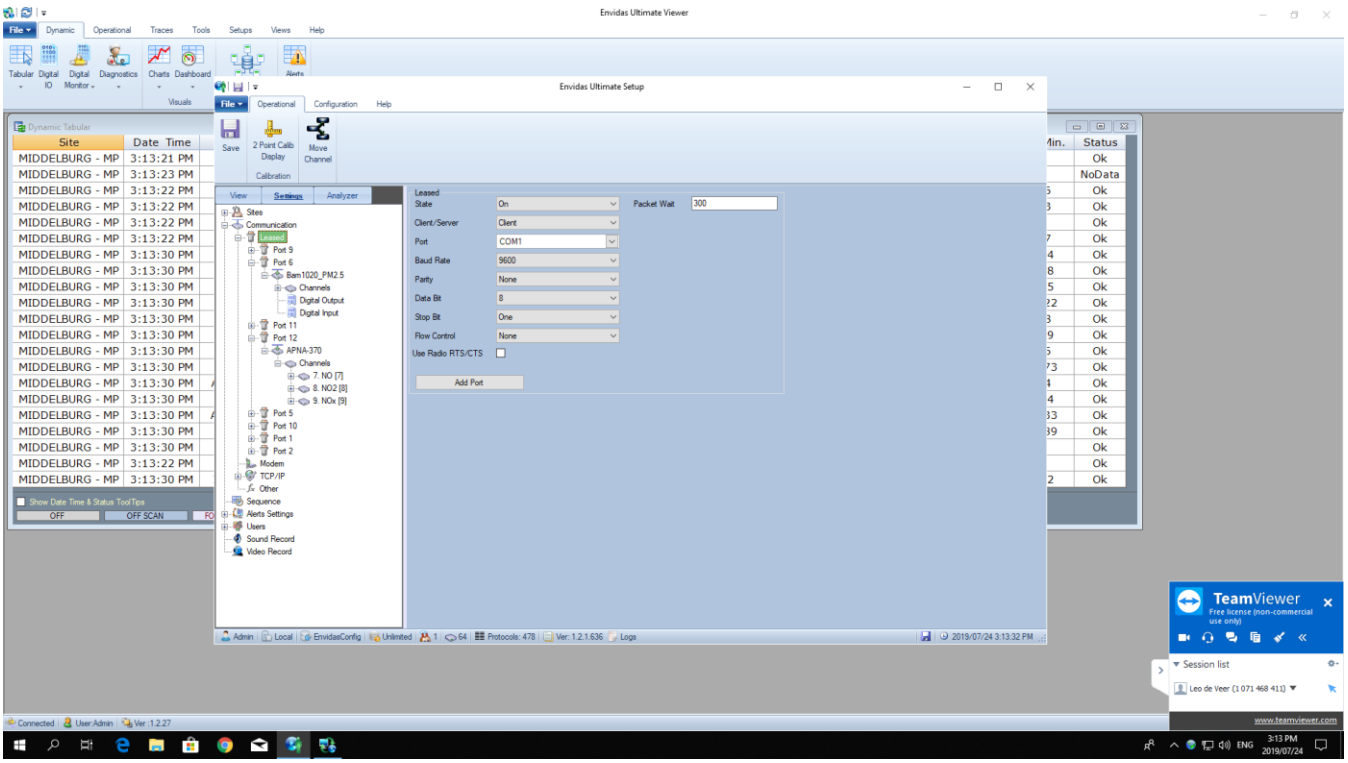


Figure 9.7: Example of Envitech comm-port setup.

Now that the communication setup is complete, we can select the correct type of instrument being used. Instruments make use of different communication protocols so the correct instrument must be selected to ensure the instrument understands the requests being sent from the logging system.

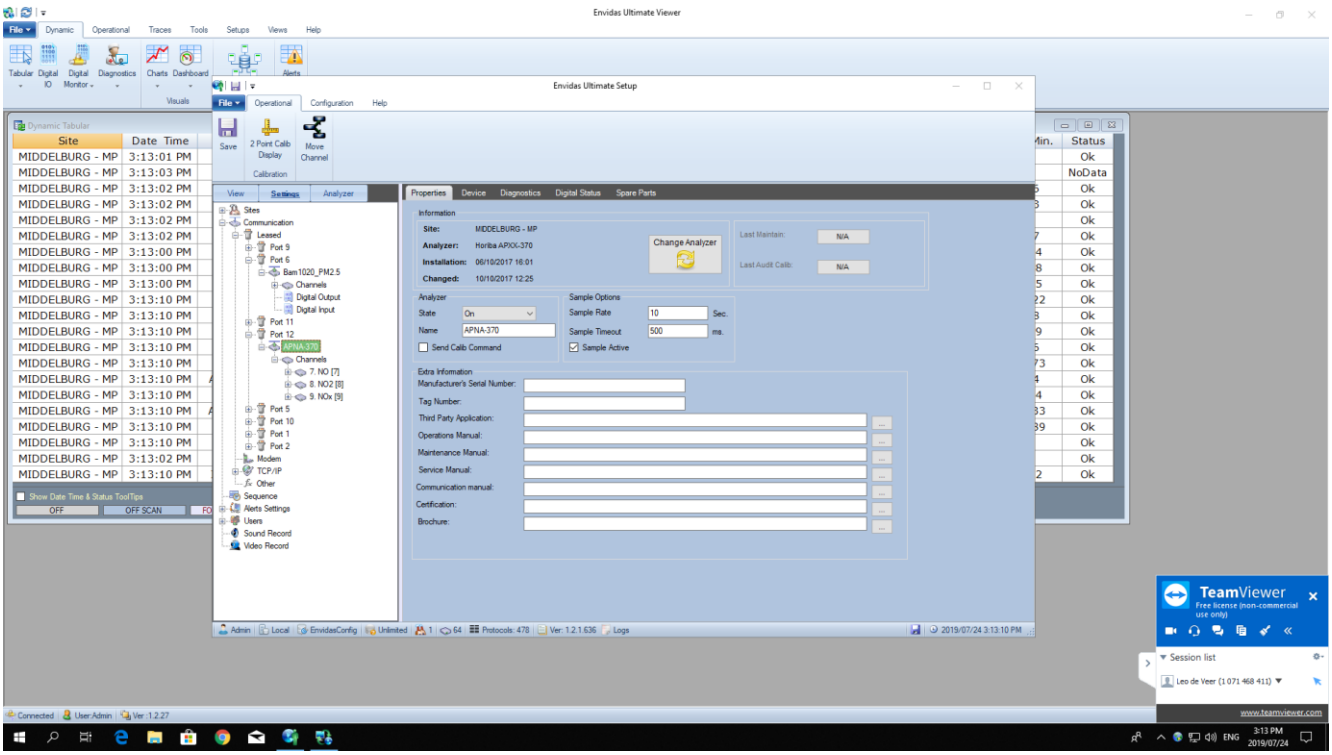


Figure 9.7: Example of Envitech instrument type setup.

The final step is to setup the data parameters that we wish to use when logging the data from the instrument. These parameters include items like the decimal format and details from the specific instrument like the serial number etc.

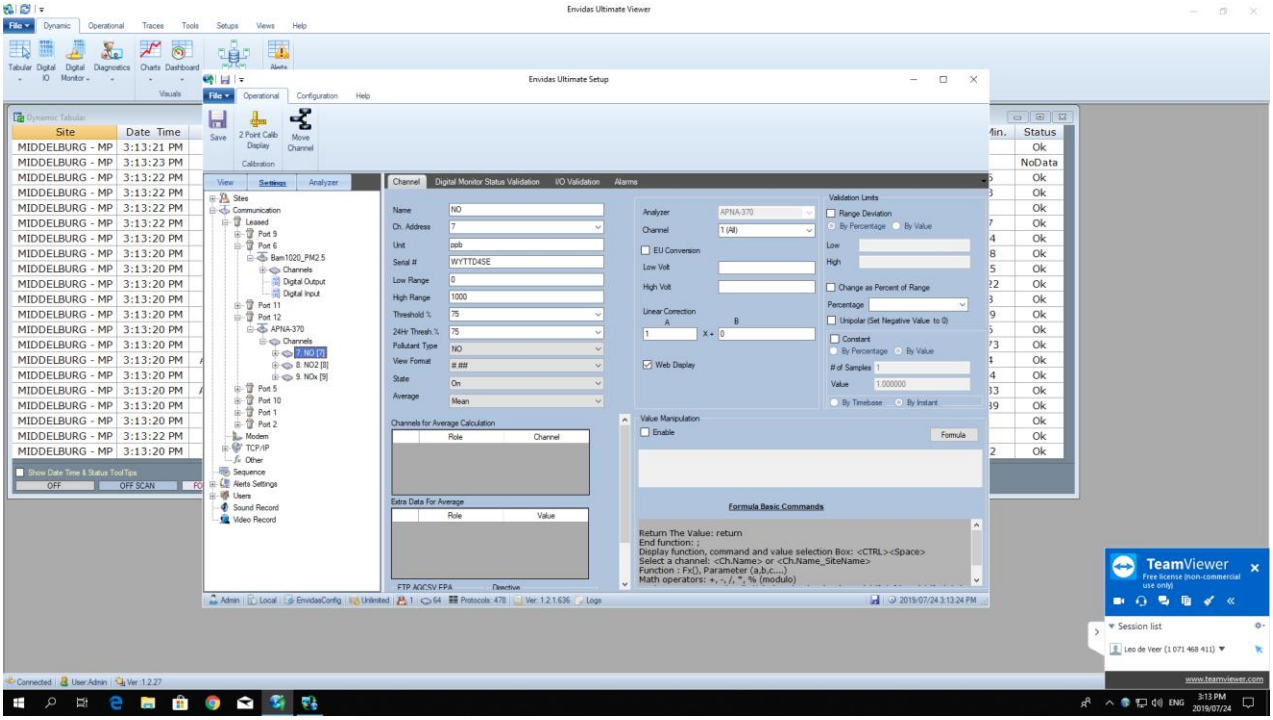
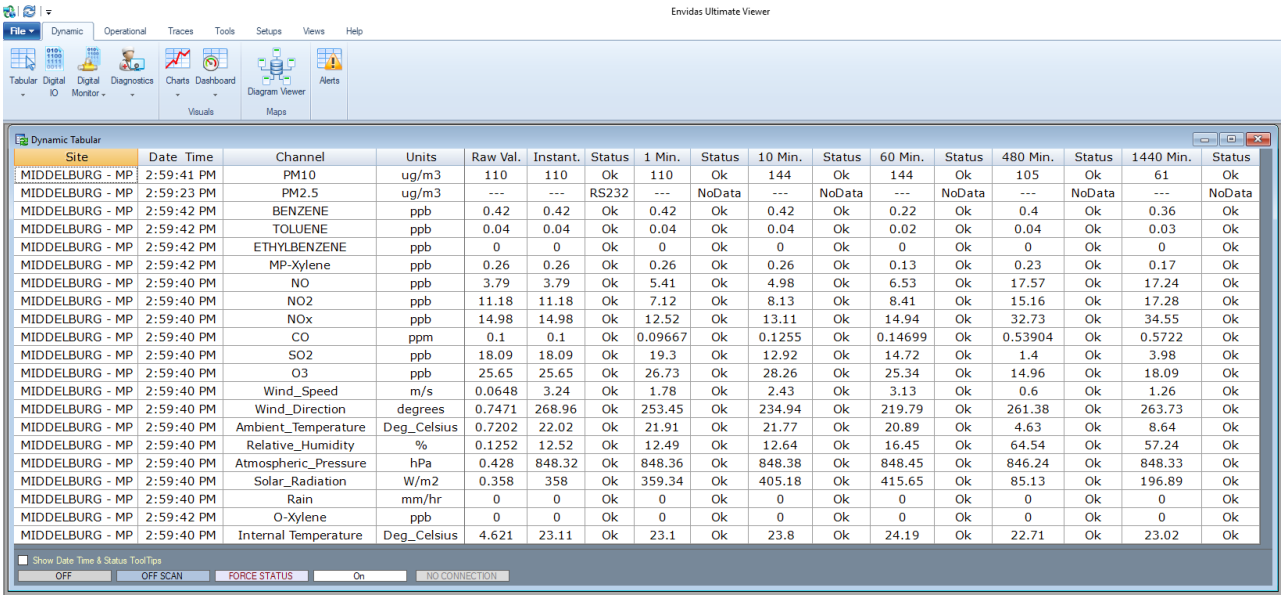


Figure 9.8: Example of Envitech data parameter and instrument details setup.

If the communication setup and instrument setup was done correctly the logging system will start requesting data from the instrument and saving the data onto the logging system. Data will be displayed in a tabular format as shown in figure 9.9.



Site	Date Time	Channel	Units	Raw Val.	Instant.	Status	1 Min.	Status	10 Min.	Status	60 Min.	Status	480 Min.	Status	1440 Min.	Status
MIDDELBURG - MP	2:59:41 PM	PM10	ug/m3	110	110	Ok	110	Ok	144	Ok	144	Ok	105	Ok	61	Ok
MIDDELBURG - MP	2:59:23 PM	PM2.5	ug/m3	---	---	RS232	---	NoData	---	NoData	---	NoData	---	NoData	---	NoData
MIDDELBURG - MP	2:59:42 PM	BENZENE	ppb	0.42	0.42	Ok	0.42	Ok	0.42	Ok	0.22	Ok	0.4	Ok	0.36	Ok
MIDDELBURG - MP	2:59:42 PM	TOLUENE	ppb	0.04	0.04	Ok	0.04	Ok	0.04	Ok	0.02	Ok	0.04	Ok	0.03	Ok
MIDDELBURG - MP	2:59:42 PM	ETHYLBENZENE	ppb	0	0	Ok	0	Ok	0	Ok	0	Ok	0	Ok	0	Ok
MIDDELBURG - MP	2:59:42 PM	MP-Xylene	ppb	0.26	0.26	Ok	0.26	Ok	0.26	Ok	0.13	Ok	0.23	Ok	0.17	Ok
MIDDELBURG - MP	2:59:40 PM	NO	ppb	3.79	3.79	Ok	5.41	Ok	4.98	Ok	6.53	Ok	17.57	Ok	17.24	Ok
MIDDELBURG - MP	2:59:40 PM	NO2	ppb	11.18	11.18	Ok	7.12	Ok	8.13	Ok	8.41	Ok	15.16	Ok	17.28	Ok
MIDDELBURG - MP	2:59:40 PM	NOx	ppb	14.98	14.98	Ok	12.52	Ok	13.11	Ok	14.94	Ok	32.73	Ok	34.55	Ok
MIDDELBURG - MP	2:59:40 PM	CO	ppm	0.1	0.1	Ok	0.09667	Ok	0.1255	Ok	0.14699	Ok	0.53904	Ok	0.5722	Ok
MIDDELBURG - MP	2:59:40 PM	SO2	ppb	18.09	18.09	Ok	19.3	Ok	12.92	Ok	14.72	Ok	1.4	Ok	3.98	Ok
MIDDELBURG - MP	2:59:40 PM	O3	ppb	25.65	25.65	Ok	26.73	Ok	28.26	Ok	25.34	Ok	14.96	Ok	18.09	Ok
MIDDELBURG - MP	2:59:40 PM	Wind_Speed	m/s	0.0648	3.24	Ok	1.78	Ok	2.43	Ok	3.13	Ok	0.6	Ok	1.26	Ok
MIDDELBURG - MP	2:59:40 PM	Wind_Direction	degrees	0.7471	268.96	Ok	253.45	Ok	234.94	Ok	219.79	Ok	261.38	Ok	263.73	Ok
MIDDELBURG - MP	2:59:40 PM	Ambient_Temperature	Deg_Celsius	0.7202	22.02	Ok	21.91	Ok	21.77	Ok	20.89	Ok	4.63	Ok	8.64	Ok
MIDDELBURG - MP	2:59:40 PM	Relative_Humidity	%	0.1252	12.52	Ok	12.49	Ok	12.64	Ok	16.45	Ok	64.54	Ok	57.24	Ok
MIDDELBURG - MP	2:59:40 PM	Atmospheric_Pressure	hPa	0.428	848.32	Ok	848.36	Ok	848.38	Ok	848.45	Ok	846.24	Ok	848.33	Ok
MIDDELBURG - MP	2:59:40 PM	Solar_Radiation	W/m2	0.358	358	Ok	359.34	Ok	405.18	Ok	415.65	Ok	85.13	Ok	196.89	Ok
MIDDELBURG - MP	2:59:40 PM	Rain	mm/hr	0	0	Ok	0	Ok	0	Ok	0	Ok	0	Ok	0	Ok
MIDDELBURG - MP	2:59:42 PM	O-Xylene	ppb	0	0	Ok	0	Ok	0	Ok	0	Ok	0	Ok	0	Ok
MIDDELBURG - MP	2:59:40 PM	Internal Temperature	Deg_Celsius	4.621	23.11	Ok	23.1	Ok	23.8	Ok	24.19	Ok	22.71	Ok	23.02	Ok

Figure 9.9: Example of Envitech data view Manager software.

References

https://techterms.com/definition/analog
https://techterms.com/definition/digital
https://www.tutorialspoint.com/digital_communication/digital_communication_analog_to_digital.htm