ZYGGOT ARC SPL

LOW COST ULTRAVIOLET ARC FLASH PROTECTION SYSTEM

ARC SPL

HYPER FAST ULTRAVIOLET ARC FLASH PROTECTION SYSTEM

W/ ETHERNET

Primeiro Sistema de Termografia Online Mundialmente (2004).
Lider Mundial em Monitoramento Continuo de Temperaturas.
Primeiro Sistema de Proteção de Arco por UV Mundialmente *.
Mais de 1 milhão de Sensores Instalados Mundialmente.
* Carta Patente Nº PI 0903809-4

MANUAL ZYGGOT ARC SPL V1.2 ENGLISH October 2025

varixx

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The manual is also available in Portuguese on the website varixx.com and also on the website varixx.com.br.

ZYGGOT ARC SPL

LOW COST ARC FLASH PROTECTION SYSTEM

Ultraviolet Arc Tubular Sensors with 90° viewing angle

DESCRIPTION

Varixx was the world's pioneer in introducing a Continuous, Online, Networked Temperature Monitoring System in 2004 and is a market leader in this area.

Later, it introduced the world's first ultraviolet arc detection system with the ZYGGOT ARC family, with a dedicated relay, supporting the connection of up to 50 arc sensors. It recently introduced the first continuous temperature monitoring system integrated with an ultraviolet arc protection system with multiple triggering Gateways providing high selectivity, with the use of one Gateway per circuit breaker to be tripped in the event of an arc, called THM+ARC. The system described in this manual, called ZYGGOT ARC SPL, was derived from this system.

The low-cost ZYGGOT ARC SPL system was designed to provide protection against ARC FLASH, with high selectivity, with the world's best technology for detecting and protecting against electric arcs, using ultraviolet light (Patent PI 0903809-4), which enables a reduction of up to 150 times in incident energy, compared to systems that detect visible light and current.

Sensors with 90° opening angles allow monitoring of an entire cubicle with a single sensor, since their high sensitivity allows detection of the beginning of an electric arc even at points outside their viewing angle or hidden by equipment, thanks to the reflection of UV radiation on the internal walls of the panel.
The Ultraviolet detection mode does not require confirmation of current increase and inhibits the formation of an arc at its beginning due to its extremely fast action (<250 µs), detecting the arc in its initial phase and not in the fourth phase of the arc, unlike existing systems that detect light and current, which only reduce the effect of the arc, already formed, thus reducing the incident energy by around 80 to 150 times compared to the competition. It is a system that has already been widely approved, with hundreds of real cases of detection and actuation, with minimal or no damage to the protected systems, with a return time of minutes to a few hours.
In addition, since it does not require current monitoring, it is very easy to implement and costs much less than light and current detection systems.
The system presented in this manual is in addition to the independent THM and Arc Flash systems, which continue in the product portfolio, with Modbus and Ethernet communication and several additional programming and protection features. The ZYGGOT ARC SPL system provides efficient protection against electric arcs in equipment that does not allow for high implementation costs. Its particularity is that it does not include a dedicated relay, which is expensive, but it still offers the possibility of interconnecting via Modbus to the user's SDSD system, with each triggering Gateway being able to monitor up to 50 arc sensors.

APPLICATION

Low-cost Arc Flash Protection.

BENEFITS

* Arc detection in phase 1 (pre-arc).
* Reduction of incident energy between 80 and 150 times compared to the competition.
* Indicates any faulty sensor.
* Fault history.
* Modbus communication

System Features

* Applicable to low and medium voltage.
* Up to 50 UV arc sensors in RS485 network with mini USB connections.
* Smart Sensors powered by the network itself.
* 90° measurement angle for Arc.
* Fault history with “Time Stamp”.
* Arc Flash Protection with Gateway independent triggers and up to 50 Arc sensors for Ultraviolet detection per Gateway.
* External fault monitoring.
* Sensor status monitoring.
* 2 programmable digital outputs per Gateway
* Each sensor has a flashing LED and can be controlled by Modbus to facilitate its location and address on the network and integrity verification.
* Open Modbus address map.

KEY POINTS

Main Advantages

- WORLD'S MOST ADVANCED ARC PROTECTION
- HIGH SELECTIVITY FOR ARC (MULTI GATEWAY)
- ARC ACTUATION IN LESS THAN 250uS
- REDUCES INCIDENT ENERGY BY UP TO 150X
- DISPENSES CURRENT MEASUREMENT FOR ARC
- CAN DETECT UV AT NON-VISIBLE POINTS
- DOES NOT USE BATTERIES
- PROVEN RELIABILITY
- HISTORY OF EVENTS
- WORLD LEADING SYSTEM

The ZYGGOT ARC SPL system, with stainless steel tubular sensors, was developed for low and medium voltage panels. The sensors detect UV radiation in the first phase of the arc, without physical contact, and allow local and online protection for up to 50 sensors per Gateway. The sensors are connected to a high-speed CAN network using mini USB cables in sizes from 0.3 to 8.0 meters (supplied), which allows for quick, error-free installation without tools. The Gateway provides local protection and also through a supervisory system. A possible failure in one of the sensors does not interrupt the operation of the other sensors. The Gateways are connected to each other via a Modbus network and this network is also accessible by the user's DCS system if they wish to interconnect with the plant protection system.

KEY POINTS

- **Arc flash protection by UV, the most advanced in the world (Patent No. PI 0903809-4).**
- **Reduces incident energy by up to 150x compared to systems by light and current detection.**
- **Dispenses with current measurement for arc flash confirmation.**
- **Multi Gateways allow high selectivity for arc tripping, using a low-cost triggering Gateway per cubicle or per associated circuit breaker.**
- **Event history.**
- **Modbus RTU communication.**
- **Each Gateway can receive up to 50 arc sensors.**
- **Continuous measurement of supply voltages from each arc sensor (allowing monitoring of network integrity).**

APPLICATIONS

- **Internamente a painéis para proteção contra arco voltaico.**
- **Supervisão de subestações.**

MAIN FEATURES

- **Reads the sensor's power supply voltage.**
- **Up to 50 arc sensors per Gateway.**
- **Monitors Arc Flash by UV detection.**
- **Dispenses with current measurement for arc confirmation.**
- **Actuation in less than 250uS, in the pre-arc phase, reduces the incident energy by up to 150x in relation to systems by light and current detection.**
- **Multi Gateways allow high selectivity for arc, allowing each circuit breaker to be tripped independently of the others, using a low-cost gateway per cubicle.**
- **Event history.**
- **2 configurable digital inputs per Gateway.**
- **2 configurable digital outputs per Gateway.**
- **Dedicated high-speed static contact trip output for tripping the circuit breaker associated with the Gateway + dry contact output for tripping other systems.**
- **Modbus RTU.**

TECHNOLOGY AND TECHNICAL DETAILS

ZYGGOT

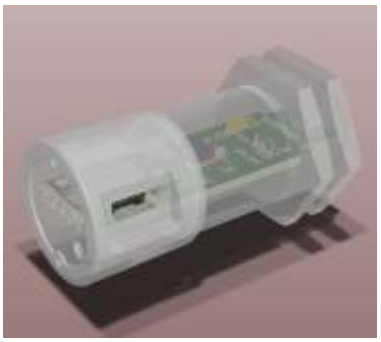
TOPOLOGY DESCRIPTION.

Each sensor has an LED that flashes under Modbus command to facilitate diagnosis and check the addressing and integrity of the system. Each relay can monitor up to 50 ARC SPL sensors. Each Gateway monitors the supply voltage level reaching each sensor, allowing the detection of potential problems in the network, such as cabling exceeding the permitted length. The low-cost SPL ultraviolet arc sensors are connected through 1 independent, low-cost Gateway, allowing selectivity never before available worldwide for the tripping of specific circuit breakers in each cubicle. The Gateway has the function of tripping the associated circuit breaker in the event of an arc flash, memorizing the arc flash sequence, sensor status, such as supply and communication voltages. Two digital inputs and two digital inputs are also available on each Gateway, allowing tripping or alarm due to external fault or arc chaining, tripping multiple circuit breakers in the event of an arc flash downstream. The data transmission method between sensors and Gateway uses high-speed CAN physical layer communication, with all sensors connected in parallel using shielded cables with mini-USB connectors that allow quick installation and operation without the need for any tools.
Each Gateway of the Zyggot SPL system can be connected to a Modbus communication network with a supervisory system or remote monitoring.

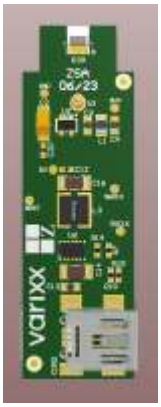
Construction detail of the Gateway

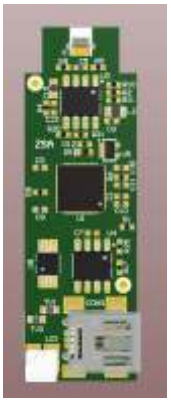
Gateway ZYGGOT ZAG1R/L.

- **Saídas Digitais**:02 Programmable.
- **Parameter programming**: By «Superger» software (free) or Modbus.
- **Value reading**: Supply voltage of each ARCO sensor.
- **Communication**: RS485 serial MODBUS RTU protocol for “Point to Point” connection, for use in network (Droop Out). CAN port for sensor network.
- **Protections and indications**: Modbus communication failure, Arc sensors not responding, Arc Flash trip, Alarm due to Gateway not programmed correctly, Alarm or trip due to ARC Chain, Alarm and Trip due to external fault, Status of digital inputs and digital outputs.
- **Digital Input 1**: Programmable in «None», «Reset».
- **Digital Input 2**: Programmable in «None», «Reset», «Inhibit / Disable Out Trip», «Chain».
- **Real Time Clock**: Included, Synchronized by Modbus.
- **Fault History**: with Date and Time.
- Event Memorization: 50 latest events, memorized indefinitely, with the most recent ones erasing the oldest ones.
- **Programmable Digital Output 1**: «Trip», «Armed», «Alarm», «Remote 1".
- **Programmable Digital Output 2**: «Trip», «Armed», «Alarm», «Remote 2".
- **Parameter programming**: By PC software (Free), or by Modbus.



Construction detail of the Sensor





TECHNOLOGY AND MAIN FEATURES OF THE ZYGGOT ARC SPL LOW COST ARC SYSTEM

The low-cost ZYGGOT ARC SPL Arc Flash Protection System was developed as a derivative of the standard Zyggot ARC systems with dedicated relay, plus the THM+ARC system with dedicated relay and integrated with the continuous temperature monitoring system. The low-cost ZYGGOT ARC SPL system provides the most efficient full-time arc flash protection available worldwide for low and medium voltage electrical equipment such as panels, transformers, motors and generators.
The ZYGGOT Arc Flash Protection System in its various versions introduces an important innovation to the market due to the fact that it detects ultraviolet (UV) radiation at the beginning of the arc, i.e., the pilot path, in phase 1 of the arc, before the detection of light from other systems. The light phase is already the final phase of the arc, with expansion of gases and vaporization of copper and other metals. Another important advantage is that selective monitoring of ultraviolet radiation eliminates the need for simultaneous monitoring of the current to confirm the occurrence of the arc, which visible light detection systems require.
If ultraviolet radiation is emitted at certain levels, the system can be safely tripped. Systems that detect visible light could be activated by door openings or light entering through cracks, which requires simultaneous current monitoring to prevent inadvertent tripping.

The ZYGGOT Arc Flash Protection System, unlike light detection systems, can be applied even under direct sunlight, thus opening up the possibility of using it in external systems (outdoor substations, transformers, motors, etc.).

The sensors have a 90° opening angle that allows monitoring large areas and practically an entire cubicle with a single sensor, since it even detects UV reflected on the internal walls of the panel, thus detecting the start of arcs in areas not directly targeted.

The effective monitoring distances are high due to the high sensitivity of the sensors. Each arc sensor (up to 50 per Gateway in the case of the SPL variant) is connected to a high-speed CAN network connected to the triggering Gateway, which is responsible for providing the trip signal in less than 300 uS.
The interconnection of the sensors to the detection and triggering gateway uses a high-speed CAN network with clean and efficient wiring, unlike star systems, with analog or non-analog signals, which require each sensor to be independently connected to concentrator or interface modules. The high speed of detecting the occurrence of an electric arc and sending the trip signal (300 µs) ensures safety, because in the event of an electric arc, the sooner the energy is removed from the system, the less damage will be caused by the incident energy (up to 105 times less than systems with visible light).

Even if using circuit breakers with an opening time of tens of milliseconds, the system is guaranteed to trip even if the network interconnection cable were destroyed by the arc, since before the destruction the signal would have already reached the relay and the circuit breaker (in dozens of real protection cases that have occurred over many years of using Zyggot Arc systems, no Zyggot system was damaged, due to the high speed of operation, inhibiting the arc and not mitigating it). Another important difference is that the transmitted signals are digital, already processed in the microprocessor sensor and transmitted by shielded cables, and are therefore immune to extremely strong electromagnetic fields generated by the arc current, unlike what can occur with visible light detection systems, with photocell, which transmits analog signal to the interface.

BENEFITS

*** Monitors ultraviolet radiation in bands A and B.**
*** Detects phase 1 of the arc, before the visible light phase (i.e. expansion and destruction).**
*** Dispenses with simultaneous current monitoring to determine the occurrence of an arc.**
*** Sends the trip signal in less than 300 µs.**
*** A single Gateway with a state-of-the-art ARM CORTEX microprocessor monitors up to 50 arc sensors.**
*** Reduction of incident energy by up to 150 times.**
*** Low implementation cost.**
*** High reliability.**
*** Allows for high selectivity, if necessary (Multi Gateways).**
*** "Open" system, does not depend on proprietary software, and can be interconnected to the DCS.**

PHASES OF THE ARC

Pre-Arc: Ionization of the air and formation of the path for the occurrence of an electric arc. In this phase, ultraviolet light is released (0 to 1 mS). This is the phase in which the arc sensor operates.
Compression: The energy of the arc is discharged into the air contained in the room, with a consequent increase in pressure (5 to 15 ms).
Expansion: The increase in pressure caused by the previous stage activates the relief mechanism and the air begins to be expelled to the outside, reducing the internal pressure (15 to 40 ms).
Expulsion: The pressure inside the room decreases, but the hot air continues to be expelled at an approximately constant pressure. The temperature potentially increases. The expulsion of air tends to be extinguished when the room's environment reaches the temperature of the arc (40 to 60 ms);
Thermal: The arc completely affects the insulating materials. The temperature reaches thousands of degrees Celsius and the conductive and structural materials begin to melt. This phase continues until the energy dissipates.

MAIN FEATURES OF THE SPL SYSTEM

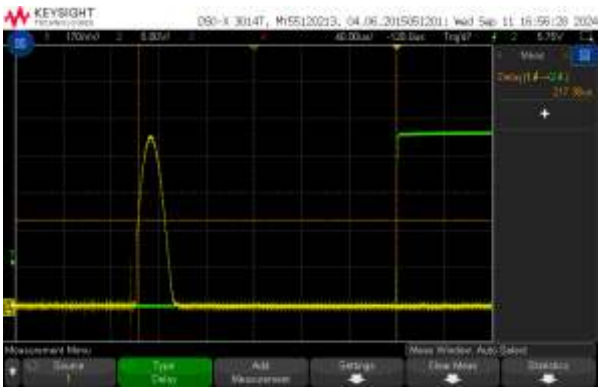
> Intelligent trigger gateway and relay (with ARM CORTEX microprocessors).
> Applicable in low and medium voltage.
> High-speed CAN network for sensors.
> Gateway with Modbus RTU port for connection to PLCs and DCS.
> Intelligent arc sensors powered by the CAN network itself.
> 90° measurement angle.
> Voltage and sensor status monitoring.
> Does not require analog interfaces.
> Gateway, Sensors and Relays can be configured and tested by PC with free software.
> Allows high selectivity for tripping, using a low-cost trigger gateway per cubicle/circuit breaker.
> Has Modbus communication and can be connected directly to the user's DCS system.
> Up to 50 sensors connected to a single SPL Gateway. (Network with plug-in sensors).
> Each sensor has an LED that flashes when commanded by the relay, to detect faults or their identification. > Gateway trigger with 3 digital outputs, one TRIP (solid state and mechanical) and two programmable and two programmable digital inputs.
> Easy testing with ArcSafe manual tester (arc generator)

PRINCIPLE OF OPERATION OF THE ZYGGOT ARC SYSTEM MODEL ARC SPL

PRINCIPLE OF OPERATION

Each sensor in the system has a high-speed, high-performance ARM CORTEX microprocessor. The firmware embedded in the sensor will operate the communication and other tasks, but if an arc is detected, a high-priority interruption will occur and the arc detection data transmission routine, with the sensor number, will be immediately transmitted to the triggering Gateway. The time from the detection of the arc by the sensor until the activation of the Gateway's TRIP output is less than 300 µs, activating a solid-state contact that supports 12 A continuously and up to 200 Amps peak for 5 cycles, plus a dry contact in parallel, allowing rapid actuation plus a guarantee of permanence through the mechanical contact.
The Modbus network connected to the Gateway allows, if desired, to acquire data from the Gateway, without the need for speed since the trip occurs through the Gateway. After detection, the Gateway memorizes the sequence of arc occurrence, or "Arc Chain", if more than one sensor is actuated or there is an arc chain coming from other Gateways. The high-speed CAN network of arc sensors connected to the Gateway provides high detection speed and the fact that the sensors detect the initial phase of the arc ensures that even if the network cable were destroyed by the arc itself, the trip sequence would be terminated, protecting the system from catastrophic destruction (Note: in hundreds of real cases reported by users, this has never happened. The system itself has never been destroyed, unlike light and current detection systems, which frequently suffer from this and there has also never been catastrophic destruction in real cases protected by UV).
The system will be protected even during the LED flash time or any other communication, since the CAN protocol has communication priorities, that is, more than one or even all network elements can generate communication at the same time and the one with the highest priority for all communication of lower priority packets is served immediately. Since the arc detection data packet is the highest priority, the arc detection signal will be read immediately by the intelligent Gateway. If one or more sensors detect arcing, a list of these sensors will be available to the user on the Gateway via Modbus communication. Each Gateway in the system can be configured using free software available on the Varixxx website.

Gateway Trip Output

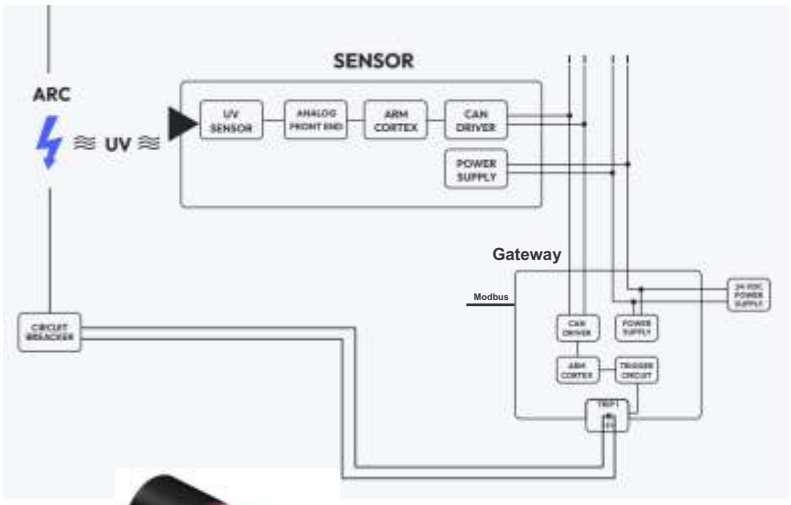


Ocorrência do arco

Saída de trip

READING AND REFLECTION ANGLES

The sensor's opening (detection) angle defines the UV measurement area, i.e. the area where the arc can be detected.
UVA and UVB sensors have an opening angle of 90°, covering practically the entire area of a cubicle, depending on the attachment point. In a single-compartment cubicle, a single sensor installed at a suitable point, such as in one of the corners, may be sufficient.
Two sensors at opposite angles leave the entire volume free of shadows. Ultraviolet radiation is reflected from surfaces like visible light (although it can be attenuated). Zyggot sensors can capture reflected UV radiation, which facilitates detection throughout the volume of interest.



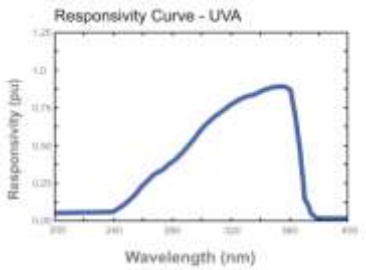
SYSTEM RELATED TO THE SPL MODEL ARCH

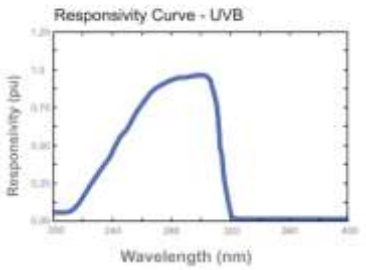
A) 90° arc sensor - ZSA/90/24/UVA/SPL
B) 90° arc sensor - ZSA/90/24/UVB/SPL
C) ZAG1R/SPL gateway
F) Interconnection cable with mini-USB connector - ZCB/4/2U/...
G) 24 VDC power supply VPS12024
H) Tester (test arc generator) ZSA
I) Termination resistor ZFR

ZSA/90/24/UVB/SPL

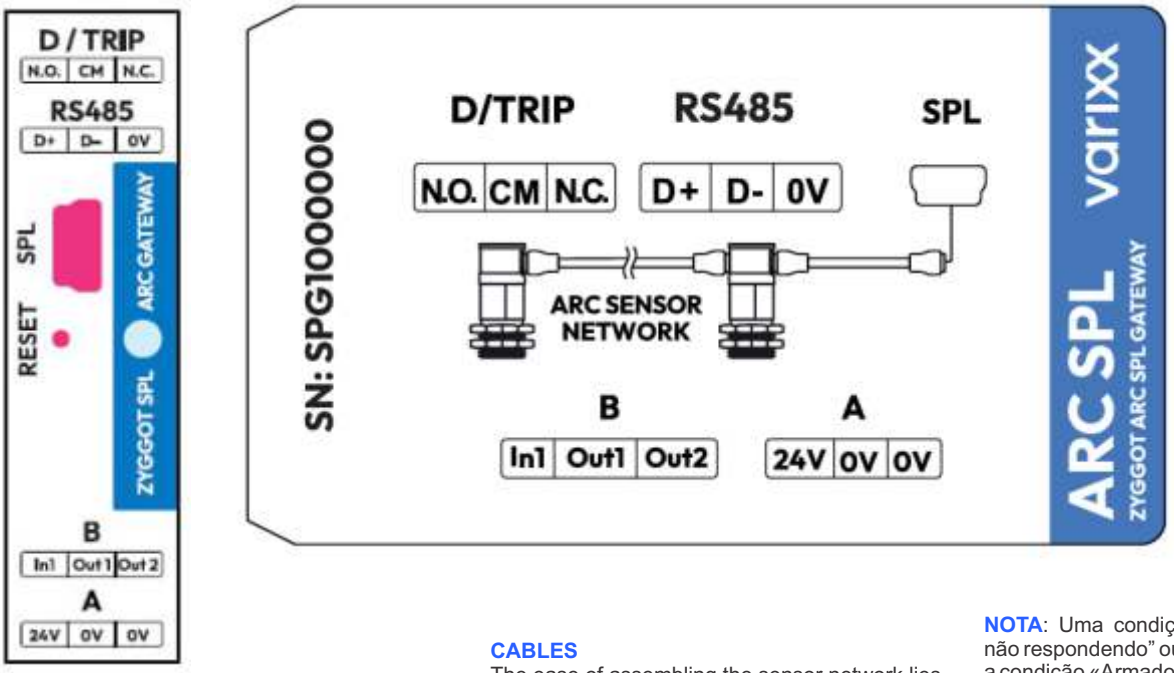
TESTER (ZSA ARC GENERATOR)

ZSA/90/24/UVA/SPL





ZAG1R/L GATEWAY OVERLAY AND SIDE LABEL



ZSA/90/24/UVA/SPL Sensor Features

> Power supply: 24VDC via standard cable.
> Opening angle: 90º.
> LED indicator for location and faults.
> Network addressing configurable via PC.
> Detects UVA radiation and a small portion of visible light (240 to 340 nm).
> Applicable in panels and sheltered environments.
> Does not operate with ambient light or internal light from panels. (It may operate if pointed directly at UV light sources, such as clear sky, sun, flash or intense light).
> Sensitivity to 2 cm electric arc produced by test device at a distance of 1 to 1.5 m or real arc at up to 30 m*
* Depends on arc intensity (with 200A and 1 cm arc path the detection distance is 7 meters)

ZSA/90/24/UVB/SPL Sensor Features

> Power supply: 24VDC via standard cable.
> Opening angle: 90º.
> LED indicator for location and faults.
> Network addressing configurable via PC.
> Detects UVB radiation (220 to 320 nm).
> Applicable in panels, open environments or monitoring equipment outdoors.
> Does not operate even with strong visible light (except if pointed directly at the sun, whose rays contain UVB).
> Sensitivity to a 2 cm electric arc produced by a test device at a distance of 0.2 m to 0.4 m or a real arc of up to 10 m*.
* Depends on the intensity of the arc (with 200A and a 1 cm arc path, the detection distance is 3 meters).

CABLES

The ease of assembling the sensor network lies in the two mini USB connectors present on the sensors and in the shielded mini USB cables supplied in different sizes by Varixx, ready to use.

PROGRAMMING TOOL

A PC program is provided free of charge by Varixx and allows parameterization and testing of the Gateway and sensors

GATEWAY COMMUNICATION PORT

The ZAG1R/L Gateway has 2 communication ports: One RS485 port with Modbus RTU protocol, for communication with supervisory systems or with Zyggot V5FTA relay or for connection to a PC for parameterization and one mini USB port with CAN protocol, for communication with networked sensors.

GATEWAY DIGITAL INPUTS

The Gateway has 2 digital inputs, 1 for Reset and 1 programmable by the relay or by the PC software. The "Reset" contact, if closed momentarily, performs the function of erasing the Gateway's alarms and trips, also erasing the Arc Flash occurrence sequence data.

DIGITAL GATEWAY OUTPUTS

The Gateway has 3 digital outputs, 1 for TRIP and 2 programmable by the relay or by the PC software. The trip output has an ultra-fast acting solid state relay and another N.A. dry contact in parallel. The programmable outputs are normally open dry contact type.

GATEWAY INDICATOR LED

The Gateway has 1 RGB LED, which will be «Green» if the gateway is programmed, configured and without alarms or trips. It will be «Yellow» in case of occurrence of alarms or trips that have not been reset or will be «Red» in case of a Trip that has not been reset.

NOTA: Uma condição de Alarme por "Sensor não respondendo" outro ocorrência não desativa a condição «Armado» e a conseqüente defecção em caso de ocorrência de arco. Por segurança o sistema, mesmo em alarme estará ativo para detecção de Arc Flash.

CONECTOR MINI USB MULTI-FUNÇÃO DO SENSOR

Os conectores mini-USB no sensor servem tanto para parametrização, utilizando um cabo padrão mini USB / USB (fornecido separadamente) e um PC, quanto para comunicação com o Gateway através do cabo da rede (fornecido separadamente). As portas mini USB do sensor estão em paralelo não havendo diferença entre qual porta conectar o cabo. A dupla porta mini-USB facilita a montagem da rede. Para detalhes de como parametrizar o sensor consulte a seção de programação.

CAUTION

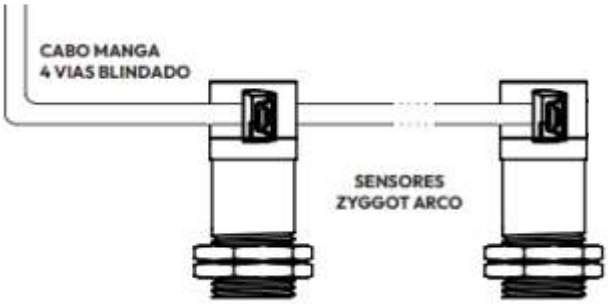
Não conectar o sensor ao computador com a outra extremidade do sensor conectada à rede de sensores. Isto pode danificar o sensor e o computador!
Para parametrização deve-se ligar um sensor por vez ao computador.

SYSTEM DETAILS RELATING TO ZYGGOT ARCO SPL SYSTEM

CABLE LENGTH SELECTION OF EACH SENSOR AND THE NEXT

The sensors are connected to the network using a shielded sleeve-type cable, without the need for any tools. These cables, which already have a mini USB connector on both ends, are supplied by Varixx in various lengths.
Below are the available codes and sizes.

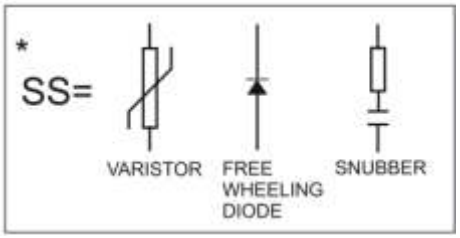
ZCB/4/2U/030	Cabo de conexão dos sensores 0,3 m
ZCB/4/2U/050	Cabo de conexão dos sensores 0,5 m
ZCB/4/2U/100	Cabo de conexão dos sensores 1 m
ZCB/4/2U/200	Cabo de conexão dos sensores 2 m
ZCB/4/2U/400	Cabo de conexão dos sensores 4 m
ZCB/4/2U/600	Cabo de conexão dos sensores 6 m
ZCB/4/2U/800	Cabo de conexão dos sensores 8 m



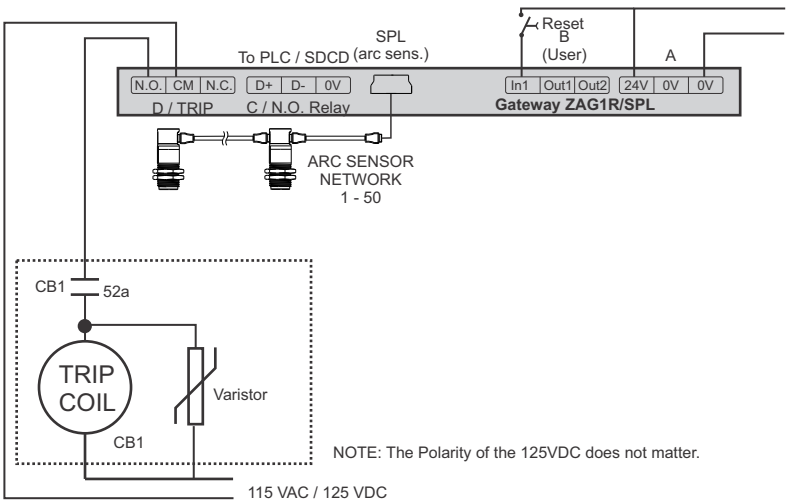
ZYGGOT SPECIFICATIONS	
Arcing Sensors	(No Contact)
Tightening	2 x Nuts
Power Supply Types	By CAN Network
UV Wavelenght	200 to 320 nm
Case Type	Stainless Steel
Sensor Measurement Angle	90°
Radiation Rages	UVA and UVB Insensible to visible and IR
Sensor Transmission Type	High Speed CAN
Temperature Operation	-20 to 89 °C
Temperature Storage	-40 to 125 °C
Maximum Measurement Rage (distance from sensor to target)	30 m depending on the Arc Power
Max. CAN Cable Lenght	500 m
Configuration (Address, Sensitivy)	By Computer with Free Program
Indication	Led at rear face
Max. Sensors per Gtwy SPL	50
CE	Compliant

TRANSIENT SUPPRESSOR IN THE GATEWAY TRIP CONNECTION

It is mandatory to use a type of transient suppressor compatible with the type of load. For trip coils (highly inductive), it is recommended to use a Varistor with appropriate characteristics. Possible variations for this circuit are “Free Wheeling Diode” (for DC power) and “Snubber” circuit composed of Resistor and Capacitor. This minimizes the generation of arcs in the 52a contact of CB1 and noise, increasing the useful life of the system and avoiding interference and improper operation of other equipment. If in doubt between the types of circuit, use the varistor.
Consult the Circuit Breaker Manual.



EXAMPLE OF TYPICAL APPLICATION WITH 115 VAC / 125 VDC TRIP COIL

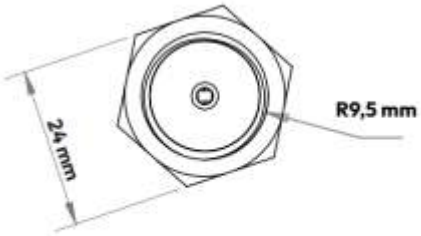


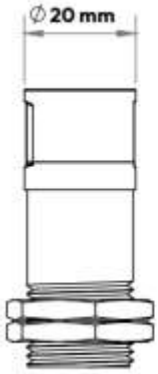
IDENTIFICATION OF ARC SENSORS

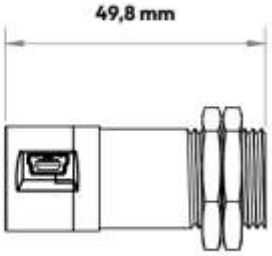
When the sensors are powered on, each sensor will flash its rear LED indefinitely until the first communication with the relay occurs. This allows for a quick check of communication with the relay and sensor integrity. If in doubt, disconnect the sensor and then reconnect it. The LED should flash for a very short time and then remain on continuously.

If it continues to flash, it is because it is not communicating. Check the cables, programming the sensor address and programming the number of sensors in the relay. Obviously, if the sensor is not communicating, the relay will also indicate the lack of communication.

YELLOW LED



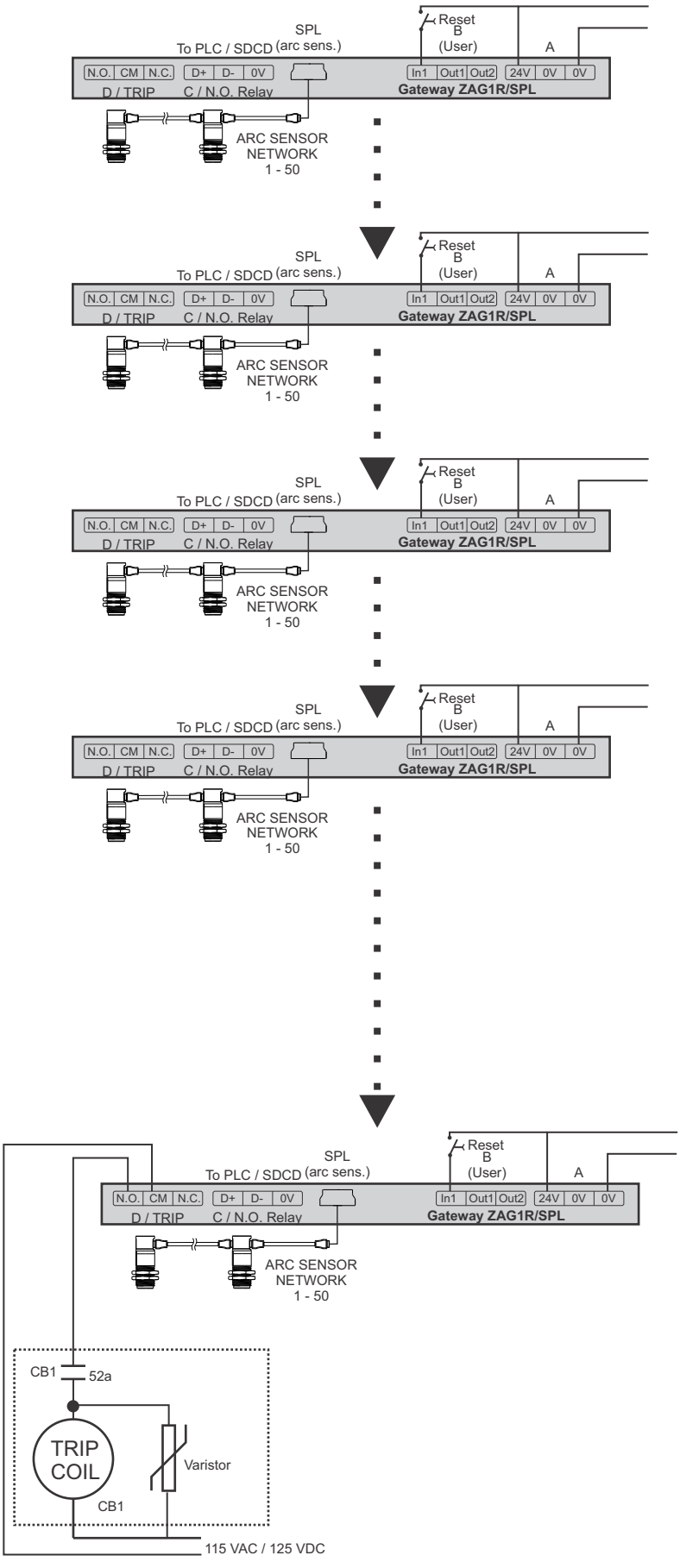




PROGRAMMING THE SENSORS

1 - Download and install the free software “Zyggot Arc Configurator” from the Varixx website (http://www.varixx.com.br).
2 - Open the configuration program.
3 - Connect the sensor to the computer’s USB port using a mini USB / USB cable (connect one sensor at a time). When the sensor is connected, its back light will turn on. The program automatically detects the sensor. If this does not happen, you can choose manual connection, choose the serial port corresponding to the USB to which the sensor cable is connected and press the Connect key to attempt a connection. When connecting (in both manual and automatic mode), a green light will turn on in the program indicating that the connection was successful.
4 - Program the sensor address (from 1 to 50 in the case of the SPL version) in the corresponding window and press «Send» to save the information to the sensor. Disconnect the sensor by simply removing it from the cable.
5 - It is advisable to label the sensor with its programmed address to make it easier to assemble in the field. If you wish to configure another sensor, return to step 3. Then check that there are no duplicate addresses between the sensors.
6 - Once all the sensors have been programmed with the addresses, fix the sensors in the defined positions using the two nuts on the front of the sensor. As a suggested assembly, we recommend using our metal “adjustable fixing bracket” (REF. ZSF2), with adjustable angle, which allows the use of just one Boelhoff rivet or similar in the chosen location, to fix the sensor and direct it.

TYPICAL APPLICATION EXAMPLE USING ONE OR MORE SPL GATEWAYS



NOTE: The Polarity of the 125VDC does not matter.

In cases where high selectivity is required, such as in cases of distribution branches with one circuit breaker per branch, the side topology can be used with multiple triggering Gateways, each one triggering its own associated circuit breaker, each one with up to 50 arc sensors, i.e. configuring a low-cost, high-efficiency system (Multi Gateways).
Each Gateway sends the «TRIP» signal to its circuit breaker in less than 300 µs.

Note that it is possible to use only one Gateway with its sensors, which can be from 1 to 50. Typically, one Gateway per cubicle, associated with its circuit breaker, and 1 or two Zyggot UV Arc sensors would be enough to have each cubicle fully protected against Arc-voltaic.

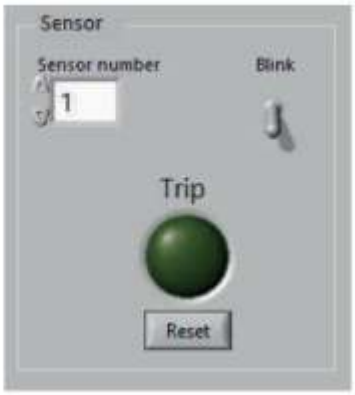
PROGRAMMING SENSORS WITH ZYGGOT SUPERGER SOFTWARE

PROGRAMMING - ZYGGOT ARCO SENSORS

Zyggot Superger is a configuration software that addresses and tests sensors, as well as parameterizes and configures Zyggot relays for versions other than SPL. The software is available for free download from the Varixx website (http://www.varixx.com.br). The figure below shows the home screen of the Zyggot Superger software.

NEVER connect two sensors to the PC simultaneously

The software automatically recognizes the device and the port to which it is connected to the computer. If the port is not recognized, you can manually select the port using the Manual Connection box. When choosing to connect manually, you must select the serial port to which the device is connected and press the Connect button. When a sensor is connected to the computer, the program screen automatically changes to the image below. When connecting a sensor, the program automatically reads the address settings.



To set a new address for the sensor, you must change the sensor number in the Sensor tab. When you do this, the sensor number will flash red, indicating that the change has not yet been sent to the sensor. To save the change, press the Send button.
The Sensor tab also provides the sensor's Trip indicator. If you want to test the sensor, use the ArcSafe tester to generate an arc in front of the sensor. When an arc is detected, the Trip indicator will change to red, and the LED on the back of the sensor will flash for a few moments. To restore the sensor status, press the Reset button. Use the Blink key to make the LED on the back of the sensor flash indefinitely. Press again to stop.
When you want to disconnect the sensor, simply remove it from the mini USB port.

USING THE ARCSAFE ZSA TESTER

OPERATION TEST USING ARCSAFE TESTER (ZSA)

The ArcSafe tester generates very low current arcs, which represents a low risk of injury. However, the risk is not zero, and can cause serious muscle damage and even death, especially if the operator is in special conditions such as high places or confined spaces, which can lead to falls or collisions with objects or live parts and involuntary movements in the event of an impact. Use the ZSA with extreme care and attention.
Always turn off the slide switch when it is not in operation. Only turn on the switch just before each test and turn it off immediately afterwards. Each time the switch is turned on, the front light will flash and the LED to indicate that it is on will light up.
The figure on the side shows the ArcSafe Varixx tester (supplied separately) for testing system operation. The ArcSafe is rechargeable in a 110 or 220 VAC outlet.
The equipment generates an extra high voltage (3,800,000 Volts) generating small low-energy electric arcs between its electrodes, which are detected by the sensor up to an average distance of 1 meter (UVA sensor) within its viewing angle.
You can hold down the trigger button to generate a sequence of arcs (the arc detection by the sensor and relay will always be on the first arc) or quickly press the button to generate a single arc.

HOW TO RUN SYSTEM TEST WITH ARCSAFE GENERATOR

- Assemble the system completely and make sure that the relay is indicating Armed, that is, monitoring the occurrence of an arc. In this condition, there will be no indication of previous trips.
Note that the condition of sensors not responding only activates the Alarm output, not preventing the Armed condition, since even with some sensors in the network not responding, others may be operational and active. It is highly recommended to use the Alarm output for indication on the DCS system or panel door.
- For each sensor to be tested, position the ZSA arc generator in front of the sensor, within the 90° viewing angle, that is, up to 45° from the straight line extending from the center of the sensor.
Remember to comply with the maximum detection distance of the tester for UVA (1.5 m) and UVB (0.2 m) sensors.
Note: in the case of a real arc, the detection distances are greater due to the large amount of energy released in UV radiation. Real arcs can be detected at a distance of up to 30 m*.
- Preferably generate a single arc by quickly pressing the ArcSafe trigger button.
- The arc will be detected and the Trip output will be activated, with the Trip LED on the relay and the corresponding sensor indicating the arc. (The rear LED on the sensor will also flash for a few moments).
- After checking that it is operating correctly, reset the relay by pressing and holding the front RESET/ENTER button or the RESET/INHIBIT contact for a few moments.
- Repeat the test operation for each sensor in the system.
* Maximum detection limit for sensors. The actual detection distance of an arc depends on the intensity at which the arc occurs.

CAMERA FLASH TEST

Common camera flashes are also a spark gap in an inert gas bulb, and so most flashes emit ultraviolet light in addition to visible light. More modern LED flashes also have a percentage of ultraviolet light.
UVA sensors can detect some of these flashes, while UVB sensors have a lower detection spectrum and are therefore more immune to photographic flashes.
Note: Not all photographic flashes emit UV radiation.

ZYGGOT ARC SPL SYSTEM COMPOSITION

COD: ZSA/90/24/UVA/SPL

UVA AR SENSOR

COD: ZSA/90/24/UVB/SPL

UVB ARC SENSOR

Technical information

FEATURES: ARC UVA SENSOR

Measuring angle:	90°
Power Supply:	24 VCC by the NET
Detection range:	UVA (240 to 380 nm)
Test sensitivity:	1 to 1,5 m (w/tester ZSA)
Real Arc Sensitivity:	up to 30 m
LED status indicator:	Included
Settings:	By PC software
Diameter:	19mm
Length:	53mm
Communication:	Rede CAN 512 MBs
Material:	Stainless Steel and Polycarbonate

Technical information

FEATURES: ARC UVB SENSOR

Measuring angle:	90°
Power Supply:	24 VCC by the NET
Detection range:	UVB (220 to 320 nm)
Test sensitivity:	1 to 1,5 m (w/tester ZSA)
Real Arc Sensitivity:	up to 30 m
LED status indicator:	Included
Settings:	By PC software
Diameter:	19mm
Length:	53mm
Communication:	Rede CAN 512 MBs
Material:	Stainless Steel and Polycarbonate

COD: ZAG1R/L

GATEWAY FOR SPL ARCH SYSTEM

ACCESSORIES

Accessory

COD: VPS6024 ou VPS12024

POWER SUPPLY

Accessory

COD: ZSF2

Support for fixing and sight for tubular

Accessory

COD: VZX/B1/U ou VZX/B1/U/P

SUITCASE WITH LASER SIGHT

Accessory

COD: ZFR

COD: ZTA

COD: ZCB4/2U/xxx

Y-split Derivator, USB cables and terminating resistor

Accessory

COD: VLP2

Laser sight attachable to tubular sensor for startup

Accessory

COD: RJ45/C2
(Comes with each V5CON module and each Eblock)

RJ45 CABLE

Accessory

COD: ZSA

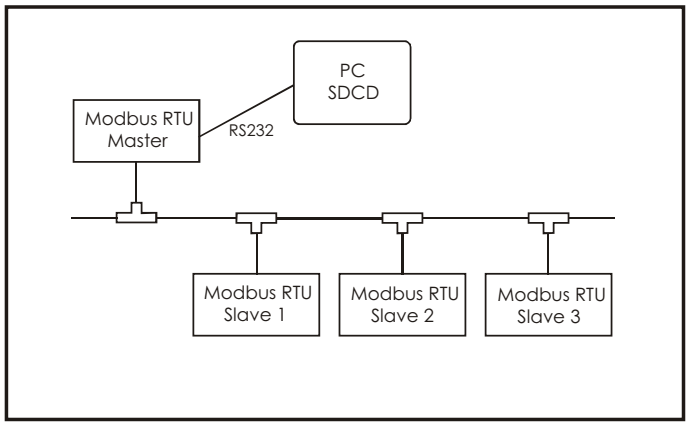
ARCSAFE Arc Tester

MODBUS

A complete explanation of the Modbus RTU or ASCII protocol is not within the scope of this manual. It is assumed that the user who will apply it using this protocol must have sufficient knowledge for this.

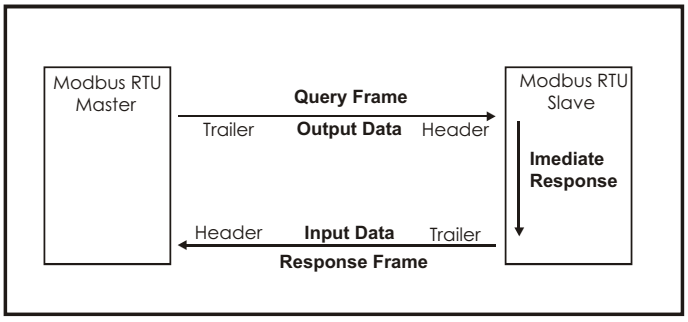
Also, in this manual we will only provide the basic addresses of the memory map to perform usual operations of reading faults and others, without however allowing programming of parameters via Modbus, for safety reasons. Any programming of parameters should be performed on the equipment itself since it is normally done only once, during Startup.

Below there will be a brief introduction to the Modbus communication network before presenting the memory map.



Devices communicate using a master-slave technique, in which only one device (the master) can initiate transactions (called 'queries'). The other devices (the slaves) respond by providing the requested data to the master or performing the action requested in the query. Typical master devices include host processors and programming panels. Typical slaves include programmable controllers, motor controllers, load monitors, etc., see Fig. 1.

The master can address individual slaves. Slaves return a message (called a 'response') to queries that are addressed to them individually.
The Modbus protocol establishes the format for the master's query by placing in it the device address, a function code defining the requested action, any data to be sent, and an error checking field. The slave's response message is also constructed using the Modbus protocol. It contains fields confirming the action performed, any data to be returned, and an error checking field. If an error occurs while receiving the message, or if the slave is unable to perform the requested action, the slave will construct an error message and send it as a response, see Fig.2



Address field
The address field of a message frame contains eight bits. The individual slave devices are assigned addresses in the range of 1 - 247. A master addresses a slave by placing the slave address in the address field of the message.
When the slave sends its response, it places its own address in this address field of the response to let the master know which slave is responding.

Function field
The function code field of a message frame contains eight bits. Valid codes are in the range of 1 - 6, 15, 16 and 23. When a message is sent from a master to a slave device, the function code field tells the slave what kind of action to perform.
Examples are:
• to read the ON/OFF states of a group of inputs;
• to read the data contents of a group of parameters;
• to read the diagnostic status of the slave;
•to write to designated coils or registers within the slave.

When the slave responds to the master, it uses the function code field to indicate either a normal (error-free) response or that some kind of error occurred (called an exception response). For a normal response, the slave simply echoes the original function code. For an exception response, the slave returns a code that is equivalent to the original function code with its most significant bit set to a logic 1.
In addition to its modification of the function code for an exception response, the slave places an unique code into the data field of the response message. This tells the master what kind of error occurred, or the reason for the exception.
The master device's application program has the responsibility of handling exception responses. Typical processes are to post subsequent retries of the message, to try diagnostic messages to the slave and to notify operators. Additional information about function codes and exceptions comes later.

Data field
The data field is constructed using sets of two hexadecimal digits (8 bits), in the range of 00 to FF hexadecimal.
The data field of messages sent from a master to slave devices contains additional information which the slave must use to take the action defined by the function code. This can include items like discrete and register addresses, the quantity of items to be
handled and the count of actual data bytes in the field.
For example, if the master requests a slave to read a group of holding registers (function code 03), the data field specifies the starting register and how many registers are to be read. If the master writes to a group of registers in the slave (function code 10 hexadecimal), the data field specifies the starting register, how many registers to write, the count of data bytes to follow in the data field, and the data to be written into the registers.
If no error occurs, the data field of a response from a slave to a master contains the data requested. If an error occurs, the field contains an exception code that the master application can use to determine the next action to be taken.

CRC Error checking field
The error checking field contains a 16 bit value implemented as 2 bytes. The error check value is the result of a Cyclical Redundancy Check (CRC) calculation performed on the message contents.
The CRC field is appended to the message as the last field in the message. When this is done, the low-order byte of the field is appended first, followed by the high-order byte. The CRC high-order byte is the last byte to be sent in the message. Additional information about CRC calculation are found in this manual.

MODBUS - GENERIC EXAMPLES

Functions
Standard MODBUS function codes.

Function name	Function code
Read Coil (Bit) Status	1 (01h)
Read Input Status	2 (02h)
Read Holding Registers	3 (03h)
Read Input Registers	4 (04h)
Force Single Coil (Bit)	5 (05h)
Force Single Register	6 (06h)
Force Multiple Coils (Bits)	15 (0Fh)
Force Multiple Registers	16 (10h)
Force/Read Multiple Holding Registers	23 (17h)

Reading Input Status

Reading the status of digital information - read only.
EXAMPLE: Request digital input 2. Assuming it is not active.
Status: Modbus no = 2.

Request message.

Field name	Hex value
Slave address	01
Function	02
Start address HI	00
Start address LO	02
Number of Inputs HI	00
Number of Inputs LO	01
CRC LO	18
CRC HI	0A

Response message.

Field name	Hex value
Slave address	01
Function	02
Byte count	01
Input no.2 (02h)status	00
CRC LO	A1
CRC HI	88

Reading Holding Registers

Read the value of the analog variable information.
Example,
Asking for some Voltage, Frequency and Current. Their values are 400.0V, 60Hz and 15.5A.
400.0V, 0.1V unit - 4000 (0FA0h)
60Hz 1Hz unit - 60 (003Ch)
15.5A, 0.1A unit - 155 (009Bh)

Request message.

Field name	Hex value
Slave address	01
Function	0
Start address HI	00
Start address LO	00
Number of Registers HI	00
Number of Registers LO	03
CRC LO	05
CRC HI	CB

Response message

Field name	Hex value
Slave address	01
Function	03
Byte count	06
Reg no. 0, (0h) data HI	0F
Reg no. 0, (0h) data LO	A0
Reg no. 1, (1h) data HI	00
Reg no. 1, (1h) data LO	3C
Reg no. 2, (2h) data HI	00
Reg no. 2, (2h) data LO	9B
CRC LO	20
CRC HI	34

Reading Coil Status

Read the status of mutable digital parameters.
Example
Requesting the state of coil input (Bit) 29. Assume it is on 30 input: Modbus no = 29 (1Dh)
On = Yes = 1 Coil = 0001
1 byte of data: Byte count=01

Request message.

Field name	Hex value
Slave address	01
Function	01
Start address HI	00
Start address LO	1D
Number of Coils HI	00
Number of Coils LO	01
CRC LO	6D
CRC HI	CC

Response message.

Field name	Hex value
Slave address	01
Function	01
Byte count	01
Coil no.29 (1Dh) status	01
CRC LO	90
CRC HI	48

MODBUS - GENERIC EXAMPLES

Reading Input Registers

Read the contents of the read-only analog information.
Example
Request the Modbus value 30011 - No. 10. Assume it is 452.0. It is long representation. 2 registers are used (30011 high word and 30012 low word)
452.0, unit 0.1 - 4520 (000011A8h).

Request message.

Field name	Hex value
Slave address	01
Function	04
Start address HI	00
Start address LO	0A
Number of Registers HI	00
Number of Registers LO	02
CRC LO	51
CRC HI	C9

Response message.

Field name	Hex value
Slave address	01
Function	04
Byte count	04
Reg no. 10 (0Ah) data HI	00
Reg no. 10 (0Ah) data LO	00
Reg no. 11 (0Bh) data HI	11
Reg no. 11 (0Bh) data LO	A8
CRC LO	F6
CRC HI	6A

Forcing Single Coil (Bit)

Set the status of a changeable digital parameter.
Example
Set a command to ON. This will cause some type of action.
Modbus no = 1 - LO address 1 (01h)
Execute = 1 - 0 Data HI = 255 (0FFh), Data LO = 00 (00h)

Request message..

Field name	Hex value
Slave address	01
Function	05
Start address HI	00
Start address LO	01
Data HI	FF
Data LO	00
CRC LO	DD
CRC HI	FA

Response message.

Field name	Hex value
Slave address	01
Function	05
Start address HI	00
Start address LO	01
Data HI	FF
Data LO	00
CRC LO	DD
CRC HI	FA

MODBUS - GENERIC EXAMPLES

Force Multiple Coil

Set the status of several changeable digital parameters.

Example

Set one flag to ON and another to ON. This will cause some actions or change parameters. Coil n. = 0-1 Reset -> 1 // Run = 1 ->- 00000011 (03h)

Request message.

Field name	Hex value
Slave address	01
Function	0F
Start address HI	00
Start address LO	00
Number of Coils HI	00
Number of Coils LO	02
Byte count	01
Coil no. 0-1 status (0000 0011B)	03
CRC LO	9E
CRC HI	96

Response message.

Field name	Hex value
Slave address	01
Function	0F
Start address HI	00
Start address LO	00
Number of Coils HI	00
Number of Coils LO	02
CRC LO	D4
CRC HI	0A

Forcing Multiple Registers

Set the contents of several changeable analog parameters.

Example

Set register 40018 (Modbus No. 17) to 25.0 (250 / 10)
and 40019 (Modbus No. 18) to 55.
25.0, unit 0.1 -> -250 (00FAh) // 55, unit 1% -> 55 (0037h)

Request message.

Field name	Hex value
Slave address	01
Function	10
Start address HI	00
Start address LO	11
Number of Registers HI	00
Number of Registers LO	02
Byte count	04
Data HI reg 17 (11h)	00
Data LO reg 17 (11h)	FA
Data HI reg 18 (12h)	00
Data LO reg 18 (12h)	37
CRC LO	52
CRC HI	88

Response message.

Field name	Hex value
Slave address	01
Function	10
Start address HI	00
Start address LO	11
Number of Registers HI	00
Number of Registers LO	02
CRC LO	11
CRC HI	CD

Force/Read Multiple Register

Set and read the contents of multiple modifiable analog parameters in the same message.

Example

Set one parameter to 2 (40022 = Modbus No. 21) and another to 1 (40023 = Modus No. 22) and read the other two. They are 1450 and 17000.
1450, unit 1 -> 1450 (05AAh)
17000, unit 1-> 17000 (4268h)

Request message.

Field name	Hex value
Slave address	01
Function	17
Start read address HI	00
Start read address LO	03
Number of read Regs HI	00
Number of read Regs LO	02
Start write address HI	00
Start write address LO	15
Number of write Regs HI	00
Number of write Regs LO	02
Byte count	04
Data HI Reg 21 (15h)	00
Data LO Reg 21 (15h)	02
Data HI Reg 22 (16h)	00
Data LO Reg 22 (16h)	01
CRC LO	62
CRC HI	77

Response message.

Field name	Hex value
Slave address	01
Function	17
Byte count	04
Reg no. 3, (3h) data HI	05
Reg no. 3, (3h) data LO	AA
Reg no. 4, (4h) data HI	42
Reg no. 4, (4h) data LO	68
CRC LO	E8
CRC HI	85

Exception response message..

Field name	Hex value
Slave address	01
Function	84
Exception code	02
CRC LO	C2
CRC HI	C1

Exception codes.

Exc. code	Name	Description
01	Illegal function	This unit doesn't support the function code.
02	Illegal data address	The data address is not within its boundaries.
03	Illegal data value	The data value is not within it's boundaries.
06	Busy	The unit is unable to perform the request at this time. Retry later.

MODBUS - GENERIC DETAILS

Using Modbus Slave Communications

Overview:
The ZYGGOT V5F allow the serial port to act as a Modbus/RTU slave. The Modbus function supports both ASCII and RTU modes (RTU configured by factory, ASCII under request) of operation across a range of baud rates and protocol frames. Also supported is port activity status, an in-activity timer and support for call-on-exception operation.

Basic Operation:
Before the Modbus function accepts messages, the Modbus must be activated pressing F5 (keyboard) for more than 3 seconds (Toogle).
Inactivity Timer:
The Modbus function contains a timer that is reset on the reception of a valid message addressed to this function. Should communications cease between the master and this function, that timer expires which sets an Inactivity timeout bit in the status word. Once communications is reestablished, both the timer and the Inactivity timeout bit in the status word are reset. Setting the timeout value to zero (at menu 13) disables this feature.

Report-on-exception:
Report-on-exception is a method of immediately informing the master that the slave has important information pending. This method is typically used in applications where modems are used as the communication channel, and the slaves are polled for data between long intervals. Once the connection is established, the master and slave require some cooperative functionality on determining the address of the slave calling. Since this functionality is not a standardized or a part of the Modbus protocol, the Modbus function contains two alternate methods such that the one most appropriate for the master is selected.
The first method involves the slave responding to the non-standard Modbus request Get Slave Address, which is broadcasted by the master after the connection is established. Since this is just a response to a Modbus request, this method does not require that Exception Messaging be enabled. This is method used by ZYGGOT. Use of this method with a third party master can require that master to be modified to support this command. The Modbus request and response frames are presented below:

Request:

ADDR	FUNC
0	65 (41H)

Response:

ADDR		FUNC	DATA
(SLAVE ADDR)	65(41H)	(SLAVE ADDR)	

The second method involves the slave sending an unsolicited response (Exception Message) to the master once the connection is established (available only by request). The specific byte pattern used for the Exception Message depends on that supported by the master. When sent, the appropriate header and checksums are inserted automatically by the Modbus function. The Byte Count acts as the trigger that starts the transmission of the response. When the Byte Count transitions from zero to a specific number, that number of bytes are sent. Once transmitted, the Modbus function responds to master requests as expected.

Master Mapping:
To access a memory point or memory flag over Modbus, the master must be configured as to the point's type and offset. This is usually accomplished with one of two methods. The first method uses the traditional addressing scheme where the high digit represents the point's type and the lower digits represent the point's offset (starting with point 1). Since only four types can be represented in this manner, the Modbus function packs several data tables into a single point type array.

The Traditional RTU Reference column below specifies the starting address of each table. The second method requires the master to be configured with the specific Modbus command and offset. The supported Modbus commands and the associated offset are also illustrated below.

Comm Port Buffering

The ZYGGOT firmware maintains a Transmit Buffer and a Receive Buffer. When a Send or Receive task is performed, data is transferred between the appropriate buffer and the program's registers.
For a Comm Port Transmit element, the TX Count word contains the number of characters moved from the program registers to the transmit buffer. This number can be less than the requested number if the comm port buffer is full.
For a Comm Port Receive element, the RX Count word contains the number of characters moved from the receive buffer in the program area. This number can be less than the requested number if the comm port buffer contains fewer characters than requested.

Serial Port
The serial port physically present on the ZYGGOT unit is referred to as COMM1.

Handshaking
Handshaking is a method whereby the destination end of a transmission can control how much and when data is sent to it.

NOTE: For purposes of this discussion, source end is defined as the unit which is transmitting data. Destination end is defined as the unit which actually receives the data.
Handshaking is configured on ZYGGOT V5FTA menu. There are five (5) possible types of handshaking:
NONE -- There is no handshaking. The source unit sends as many data bytes as it can as fast as possible for a given the baud rate. No consideration is given to the capabilities of the target endpoint.

consideration is given to the capabilities of the destination end.
XON/XOFF -- (Also called software handshaking) The destination end keeps track of how many characters it has received and the size of its internal buffers. If the buffer gets full or the unit is otherwise unable to receive further characters, it must transmit the XOFF (transmit off) character. The source end must then stop transmitting data until a subsequent XON character is sent by the destination end.
Because there is some heavy software overhead involved, the timing of transmissions is variable. The destination must first determine that it is full and then transmit the XOFF signal. The source end must read the XOFF signal and react to it. In the mean time, several additional data bytes can be sent. It is up to the destination end to ensure that it sends the XOFF signal soon enough that the buffer is not overrun.
The XON and XOFF characters are predefined by the ASCII character set. XON is 11 hex or 17 decimal. XOFF is 13 hex or 19 decimal. The XON/XOFF handshaking is most often used where only ASCII values are being sent. XON/XOFF can not be easily used where binary data is involved, because the XON/XOFF codes are also valid binary codes.
Note that XON/XOFF handshaking usually implies a full duplex (both ends may transmit simultaneously) communications channel as the destination end needs to transmit the XOFF characters at any time (including in the middle of a transmission from the source end).
The advantage to XON/XOFF handshaking is that it can be implemented using an easy and cheap three-wire (TX/RX/Common) cable.
HARDWARE -- Also called RTS/CTS handshaking. Hardware handshaking requires extra signals be sent between the two units, thus this is more expensive to implement due to the increased numbers of wires in the interconnecting cables.

MODBUS - GENERIC DETAILS

HARDWARE -- Also called **RTS/CTS handshaking**. Hardware handshaking requires extra signals to be sent between the two units, so it is more expensive to implement due to the increased number of wires in the interconnect cables.
In operation, the destination end determines that it is idle and asserts its **CTS (Clear To Send)** signal. In response, the source end sends data as long as the CTS signal remains active.
Many devices have the RTS/CTS signals hardwired directly into the hardware. Thus, an inactive CTS signal from the destination end can instantly shut down the source end. These hardware operations can be very fast because no software control is required in this case. Furthermore, this form of handshaking can be used regardless of the nature of the data being transmitted, ASCII or binary encoded.
Full Duplex Multi-Drop -- In a full-duplex multi-drop situation, all available units are connected in parallel. For the receiver circuitry, this is not a problem as long as the load on the network is not excessive. All units have their receivers enabled at all times.
Every message sent by the system is somehow identified by a receiving address. All units will receive all messages. All units check the delivery address against their own address and only the unit with the matching address responds.
When a unit determines that it has something to transmit, it turns on its transmitter, sends the necessary data packet, and then turns off its transmitter.
Full Duplex Multi-drop is typically found in multi-master or peer-to-peer systems where all units have a roughly equal chance of needing to transmit a message. Often, units need to verify that the message sent was sent correctly so that the receiver is on at all times.
The advantage of this system is that many units can be connected to a simple three-wire cable (RX/RX/Common). The disadvantage of this system is the increased complexity of the firmware and software.
Half Duplex Multi-Drop -- Half-Duplex Multi-Drop operation is identical to Full-Duplex, except that the transmitting unit's receiver is disabled when the unit is transmitting.
All units keep their transmitters disabled and receivers enabled at all times, except when they need to transmit. Typically, protocols dictate that only the unit corresponding to the drop address can transmit. This unit turns on its transmitter, turns off its receiver, sends the required data packet, then disables its transmitter and enables its receiver.
Half Duplex Multi-Drop is typically found in Master/Slave systems where one unit is designated the Master and all other units are Slaves. The Master transmits a message to a Slave, then disables its transmitter. All slaves hear the message, but only the slave with the matching "drop address" will turn on its transmitter and respond.

Using RS-485 with ZYGGOT

ZYGGOT does not provide RS-485-compatible signals. You must purchase and install a third-party RS-232 to RS-485 converter or a Varixx converter.
In this mode, the transmitter is controlled by the ZYGGOT CTS signal, available on the DB-9 connector, Pin 8. When the ZYGGOT activates this signal, the converter enables its transmit section.

DATA TYPES

In ZYGGOT V5FTA, data can be stored or used in several different formats. The format used depends on how the information is to be interpreted. Typical interpretations are binary bit patterns, unsigned numbers, signed numbers, floating point values, and strings.

Tipo Nome Descrição

BOOL: **Boolean** -A single BIT. Can contain only the values '0' or '1'.
BYTE: **Byte** - A string of 8 consecutive bits. Byte values are used where the data value is not as important as the bit patterns (shifts and rotations).
WORD: **Word** - A string of 16 consecutive bits. Word values are used where the data value is not as important as the bit patterns (shifts and rotations).
DWORD: **Double Word** - A string of 32 consecutive bits. DWORD values are used where the data value is not as important as the bit patterns (shifts and rotations).
INT: **Integer** - A 16-bit signed value. Integers are used where the data value is expected to be in the range -32,768 to +32,767
SINT: **Short Integer** - An 8-bit signed value. Short integers are used where the data value is expected to be in the range -128 to +127. DINT: Double Integer A 32-bit signed value. Double integers are used where the data value is expected to be in the range -2,147,483,648 to +2,147,483,647.
UINT: **Unsigned Integer** - A 16-bit unsigned value. Unsigned integers are used where the data value is expected to be in the range -0 (zero) to 65,535.
USINT: **Unsigned Short Integer** - An 8-bit unsigned value. Unsigned short integers are used where the data value is expected to be in the range 0 (zero) to 255.
UDINT: **Unsigned Double Integer** - A 32-bit unsigned value. Unsigned double integers are used where the data value is expected to be in the range 0 (zero) to 4,294,967,296.
REAL Floating Point: A 32-bit value. Values are stored and operated on in IEEE single-precision (six-digit) format. Values range from -3.40282E+38 to +3.40282E+38.
STRING: A variable-length sequence of characters. Each character is represented by one byte.
Bits in word registers can be used as boolean values. In this case, Bit Offset Addressing is used to specify the Register Type, Offset, and Bit Offset for the required bit.
Using boolean registers to represent real numbers is generally inefficient.

STORAGE ORDER

32-bit values (DWORD, DINT, UDINT) occupy 32 consecutive bits of data or two (2) consecutive 16-bit registers. For example, if a DINT is defined in Register %R43, the 32-bit value is contained in both %R43 and %R44.
For 32-bit values, the data is stored low-order first. For example, if a DINT is defined in Register %R43 and contains the value "65540", (0000000000000001 0000000000000100) then Register %R43 will contain "4" and %R44 will contain "1".
Byte values (such as STRINGS) are stored high-order first. For example, to store the string "31" in Register %R43, store the HEX value 3133 (decimal 12595).

MODBUS - GENERIC DETAILS

Real Numbers

A number which contains an explicit decimal point is known as a REAL or Floating Point number. The numbers are termed "real" because they reflect the real value of a measurement (to the accuracy of the system) in whole units and fractional parts of units without artificial truncation to some less-precise format such as integers.
The location of the decimal point (thus determining the number of whole units and fractional parts) is contained with the number itself. Since for any given real number the decimal point can be in a different position, real number are often called floating point. In ZYGGOT, the terms real and floating point are used interchangeably.

FORMAT

Real numbers are usually input and displayed as a six digit field:

3.12159 654321

If the number is too large or too small to be represented using only six digits, the number is displayed as a six-digit field plus an exponent:
1.03647e+12 9.73157e-22

For display purposes, the format consists of a six-digit value with floating decimal point, and an optional exponent. If the number to be displayed can be displayed in six digits or less, there is no exponent:

+3.14159 -654321 12 .001357 -.000032

The sign, '+' or '-', is optional. If the sign is not included, then '+' is assumed.
Numbers with more decimal places are displayed using Scientific Notation. This displays a six-digit number with decimal point and an exponent. The exponent part is indicated by the letter 'E' or 'e', the sign of the exponent ('+' or '-') and a two-digit number that is the exponent. For example:

.0000000004567 = 4.567e-10 3143286945 = 3.14329e+09

Note that in the second example some precision is lost, because there are only six significant digits possible.

Internally, floating point numbers are stored in single-precision 32-bit IEEE format. This format uses a 23-bit mantissa (the value portion), an 8-bit exponent, and a single sign bit.

It is important to note that 32 bits are required for storage. In the ZYGGOT V5F this requires two (2) consecutive 16-bit word registers, presumably %R.

RANGE
Given the single precision 32-bit IEEE format, acceptable values range from +/-3.40282E+38 (a very small fractional number) to +/-3.40282E+38 (a very large integer number).

SIGNIFICANT DIGITS

The real number format supports six (6) significant digits. When more than six (6) significant digits are displayed, only the first six can be counted on for accuracy.

3.14159265 = 3.14159 2535.00000045 = 2535

ENTERING FLOATING POINT VALUES

All floating numbers must adhere to the above format.
If an exponent is included, the mantissa (value) portion must also contain a decimal point. Note that if the entered format is other than x.yyy, the decimal point is moved and the exponent adjusted accordingly:

123.456e+3 = 123456 [The actual value can be displayed with six digits and no exponent]

143.643E-12 = 1.43643E-10 [Decimal point is moved and exponent adjusted]

A decimal point must be included to reduce any ambiguities. For example, 123e10 should be entered as 123.0e10, or better still 1.23e12.

Neither the mantissa nor the exponent may contain spaces.
"123 45e-12" and "4.3256e -23" will not be interpreted correctly because of the embedded spaces.

Both the mantissa and the exponent may contain a sign, + or -; i.e.:
"-1.3245e+12" or "4.243e-8". if the sign is missing then the associated part is assumed to be positive, "1.2345e10".

ERRORS

OVERFLOW is the most common error. This occurs when the result of a real number operation is greater than +3.40282E+38 or less than -3.40282E-38. For example, the equation
1.2345E-20 * 2.3456E-20
certainly causes this problem.

INFINITY

In case of an overflow result, power flow through the offending element is OFF, and the resulting value is set to Positive Infinity (if the value is greater than +3.40282E+38) or Negative Infinity (if the value is less than -3.40282E+38).

NOT A NUMBER (NAN)

If an infinity result is passed through to other calculations, the result can be undefined. This is know as Not a Number (NAN).
In the case of a NAN result, power flow through the offending element is OFF.
If a NAN result is passed through to another element, it feeds through to successive elements.

MODBUS - GENERIC DETAILS

Register Types

Controllers offer a wide variety of Register Types. In most cases, the controller treats register types as if they were memory locations.
The following is a list of register types implemented normally available but not all are available for the user.

%AI Analog Input
16-bit input registers used to gather analog input data such as voltages, temperatures, and speed settings coming from an attached device.
%AQ Analog Output
16-bit output registers used to send analog information such a voltages, levels or speed settings to an attached device.
%I Digital Input
Single-bit input registers. Typically, an external switch is connected to the registers.
%K Key Bit
Single-bit flags used to give the programmer direct access to any front panel keys appearing on a unit. Only the OCS series has keypads.
%Q Digital Output
Single-bit output registers. Typically, these bits are connected to an actuator, indicator light or alarm annunciator.
%R General Purpose Register
Retentive 16-bit registers.
%S System Bit
Single-bit bit coils predefined for system use.
%SR System Register
16-bit registers predefined for system use.
%T Temporary Bit
Non-retentive single-bit registers.

Bit-Mapped Addressing of 32-bit Registers

Bit-mapped addressing of 32-bit registers is not allowed. Bit offset values range from 1 to 16.
In order to access all 32 bits in a double register it is necessary to address the upper word of the register separately. Storage is such that the lower word is stored in the first (base) register, and the upper word is stored in the next consecutive register.
For example. if the 32-bit binary 0000000000000001 0000000000000100 value (65540 decimal) is loaded into register %R43, %R43 contains 0000000000000100 and %R44 contains 0000000000000001. Therefore, to check Bit 17 of the DWORD stored at %R43, one must check Bit 1 of %R44, addressed as %R44.1.

Numbering Base

In ZYGGOT all offsets begin with 1 (one). 0 (zero) is not valid for register offset nor bit offset addressing.
Register offsets are thus in the range of 1 to X, where X is the maximum number of register in this model. For example, if the selected type has 2048 %R registers, they are addressed as %R01 through %R2048.

Bit Offsets are in the range of 1 to 16.

Groups of Boolean registers can be accessed as a 16-bit register. In this case, though, the Bit offset must lie on a 16-bit boundary, 1, 17, 33, etc.

ARC GATEWAY MODBUS SPEC

GENERAL SPECIFICATIONS

Input Register (Modbus function 04) (read-only)																		
									0 a 100 sensores									
OFFSET	WORD = 16 BIT																	
	32768	16384	8192	4096	2048	1024	512	256	128									
	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1		
1	Version (value 100 = 1.00)																	
2	Serial Number 32bits - LSB																	
3	Serial Number 32bits - MSB																	
4	Manufacture Day																	
5	Manufacture Month																	
6	Manufacture Year																	
7	Manufacture Lot																	
8	Manufacture User 1																	
9	Manufacture User 2																	
10	Manufacture User 3																	
11	Manufacture User 4																	
12	Sensor Number (Last Sensor Of Network)																	
13	Trip List Size																	
100	OUT_TRIP	OUT_2	OUT_1	IN_2	IN_1	Any Sensor Not Respomnding	Any Sensor Configured	Any Sensor Trip	CHAIN 0= None , 1= Chain)	Trip Sequence Size (0=none)								
101	OUT TRIP	OUT_2	OUT_1	IN_2	IN_1	Sensor 1 Not Responding	Sensor 1 Configured	Sensor 1 Trip		Sensor 1 Trip Sequence (0=No 1=First N=Position)								
102	TRIP	OUT_2	OUT_1	IN_2	IN_1	Sensor 2 Not Responding	Sensor 2 Configured	Sensor 2 Trip		Sensor 2 Trip Sequence (0=No 1=First N=Position)								
	"	"	"	"	"	"	"	"		"								
150	TRIP	OUT_2	OUT_1	IN_2	IN_1	Sensor 50 Not Responding	Sensor 50 Configured	Sensor 50 Trip		Sensor 50 Trip Sequence (0=No 1=First N=Position)								
201	Trip List 1 (0=None N=Sensor)																	
202	Trip List 2 (0=None N=Sensor)																	
	"																	
249	Trip List 49 (0=None N=Sensor)																	
250	Trip List 50 (0=None N=Sensor)																	
301	Sensor 1 Version (100=1.00)																	
302	Sensor 2 Version (100=1.00)																	
	"																	
349	Sensor 49 Version (100=1.00)																	
350	Sensor 50 Version (100=1.00)																	
401	Sensor 1 Level																	
402	Sensor 2 Level																	
	"																	
450	Sensor 50 Level																	
1010	0																	
1011	Event 1 - Sequence ID																	
1012	Event 1 - Sensor Number																	
1013	Event 1 - Timestamp Day																	
1014	Event 1 - Timestamp Month																	
1015	Event 1 - Timestamp Year																	
1016	Event 1 - Timestamp Hour																	
1017	Event 1 - Timestamp Minute																	
1018	Event 1 - Timestamp Seconds																	
1019	Event 1 - Repeat Count																	
	"																	
1500	0																	
1501	Event 50 - Sequence ID																	
1502	Event 50 - Sensor Number																	
1503	Event 50 - Timestamp Day																	

FACTORY DEFAULT SETTING

The Gateway leaves the factory ready for use with the following settings. Simply configure the PLC in a compatible way to operate. If using only one Gateway, use the factory default address 200 to make things easier. If using multiple Gateways, program the address of each one in sequence, for example 201, 202, 203, etc.

GATEWAY GAZ1R/SPL	
ADDRES:	200
BAUDRATE:	19200
PARITY:	NONE
DATA BITS:	8
STOP BITS:	1
HANDSHAKE:	MD HALF
PROTOCOL:	MODBUS RTU
PORT MODE:	RS485

Holding Register (Modbus function 03) (read-write)

OFFSET	WORD = 16 BIT																Defaut Hex
	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
	Trip Mode	OUT_2 Mode B2	OUT_2 Mode B1	OUT_1 Mode B2	OUT_1 Mode B1	IN_2 Mode B2	IN_2 Mode B1	IN_1 Mode	Sensor Network Syze (0...100) (Last Sensor Of Network)								
1	0 → Keep On 1 → Pulse 3 Sec	B2=0 B1=0 → Trip B2=0 B1=1 → Armed (No Trip) B2=1 B1=0 → Alarm B2=1 B1=1 → Remote 2		B2=0 B1=0 → Trip B2=0 B1=1 → Armed (No Trip) B2=1 B1=0 → Alarm B2=1 B1=1 → Remote 1		B2=0 B1=0 → None B2=0 B1=1 → Reset B2=1 B1=0 → Inhibits/Disable Trip B2=1 B1=1 → Chain		0 → None 1 → Reset	BIT 1 - 8 = 0 a 100 sensores								0x0000
2	x	x	x	x	x	x	x	Blink Active 0=no / 1=Blink	Sensor to Blink (0=All) BIT 1 - 8 = 0 a 100 sensores								0x0000
3	Unlock Bits 12 to 15 0=no / 1= Unlock	Force OutTrip SCR 0=no / 1= force	Force Out Trip Relay 0=no / 1= force	Force OUT_2 0=no / 1= force	Force OUT_1 0=no / 1= force	Remote_2 0= Off / 1 = On	Remote_1 0= Off / 1 = On	x	x	x	x	x	x	x	x	Reset Trip 0=no / 1=Reset	
4	Unlock 0 → Read-only 1 → Enable Bits 1 to 14	Terminator RS485 0 → No Resistor 1 → 120R Resistor	Baudrate Mode B3 B3=0 B2=0 B1=0 → 1200 B3=0 B2=0 B1=1 → 2400 B3=0 B2=1 B1=0 → 4800 B3=0 B2=1 B1=1 → 9600 B3=1 B2=0 B1=0 → 19200 B3=1 B2=0 B1=1 → 38400 B3=1 B2=1 B1=0 → 57600 B3=1 B2=1 B1=1 → 115200	Baudrate Mode B2	Baudrate Mode B1	Parity Mode B2 B2=0 B1=0 → None B2=0 B1=1 → Even B2=1 B1=0 → Odd	Parity Mode B1	Stop Bit Mode 0 → 1 stop bits 1 → 2 stop bits	RS485 Gateway Modbus Address - SLAVE ID (Initial = 200)								0x20C8
5	Sensor Network Size (0...100) (Last Sensor Of Network)																
6	IN_1 Mode (0=None, 1=Reset)																
7	IN_2 Mode (0=None, 1=Reset, 2=Inhibits/Disable OUT_TRIP, 3=Chain)																
8	OUT_1 Mode (0=None, 1=Armed (No Trip and Configured), 2=Alarm, 3=REMOTE_1)																
9	OUT_2 Mode (0=None, 1=Armed (No Trip and Configured), 2=Alarm, 3=REMOTE_2)																
10	OUT_TRIP (0= Keep On, 1= Pulse 3 Sec)																
11	Sensor to Blink (0=All)																
12	Blink Command (0=Blink_Off, 1=Blink_On, 2=None)																
13	Clock Control (0=Keep, 1=Rear, 2=Write)																
14	Clock Day (1...31)																
15	Clock Month (1..12)																
16	Clock Year (1..3000)																
17	Clock Hour (0..24)																
18	Clock Minute (0...60)																
19	Clock Second (0...60)																
20	Clear All Saved Event																
21	Start Loader Password																

ABOUT VARIXX

For over 40 years, Varixx has pursued its vocation for developing high-tech products and focuses its efforts on serving the industrial market with quality and speed. Our know-how in power electronics has allowed us to offer the market a wide range of products that have become known for their long service life and reliability. We were the creators of the global online thermography market, with the Zyggot line, which is becoming a global reference in the market for temperature monitoring and diagnostics and arc flash detection in electrical systems in general.

Our product portfolio also includes LED luminaires from our ONNO division, developed and manufactured 100% in Brazil with cutting-edge technology. Varixx values the introduction of innovative concepts worldwide.

AREAS OF ACTIVITY

- MANUFACTURERS OF GENERATOR MACHINES AND SYNCHRONOUS MOTORS
  Static Exciters, Control Box Controllers, Low and Medium Voltage Soft Starters, Semiconductors
- PRODUCTION OF ALUMINUM AND HYDROGEN / OXYGEN
  High Current Rectifiers, Solid State Contactors, Smart Relay for CCM, Online Thermography System and Arc Flash Detection and Onno LED Luminaires.
- BASE INDUSTRY, MINING AND STEEL INDUSTRY
  Smart Relays for CCMs, Low and Medium Voltage Soft Starters, Solid State Contactors, AC/DC Converters for electromagnets, High Current Rectifiers, Online Thermography System, Arc Flash Detection and Protection and Onno LED Luminaires.
- OIL COMPANIES
  Smart Relays for CCMs, Static Excitation, Low and Medium Voltage Soft Starters, Solid State Contactors, Online Thermography System, Arc Flash Detection and Protection and Onno LED Luminaires.
- ELECTRIC PANEL ASSEMBLERS
  Smart Relays for CCMs, Online Thermography, Arc Flash Detection and Protection System, Semiconductors, Power Supplies and Onno LED Luminaires.

Why ZYGGOT Thermography And Arc Flash Protection?

- SINGLE CABLE / EASY TO INSTALL
- PREDICTIVE / DIFFERENTIAL PROTECTION
- EFFECTIVE PROTECTION AGAINST ARC DESTRUCTION
- WORLDWIDE UNIQUE BY UV DETECTION / NO CURRENT READING REQUIRED
- DOES NOT NEED CONVENTIONAL THERMOGRAPHY / ALSO MEASURES AIR TEMP.
- WITHOUT CONTACT / WITH NETWORK COMMUNICATION

LEARN MORE!

ZYGGOT ARC FLASH SYSTEM

- **Low Cost // Up to 100 sensors per relay.**
- **Innovative in the market // Faster (<300 uS versus up to 500 mS)**
- **Ultraviolet arc detection**
- **Does not operate with ambient light (False Alarm)**
- **No need current reading**

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