1SFC170017M0201 EN, REV. D

Arc Guard System™ – TVOC-2-COM

Modbus configuration manual

Read this first
Warning and safety

Thank you for selecting this ABB TVOC-2 Arc Guard System™. Carefully read and make sure that you understand all instructions before you mount, connect, configure the Arc Guard System.

This manual is intended for configuration of the TVOC-2-COM Modbus interface.

The manual is available on:

http://new.abb.com/low-voltage/products/arc-guard

- Only authorized and appropriately trained personnel are allowed to install and make the electrical connection of the Arc Guard System in accordance with existing laws and regulations.
- Only authorized personnel are allowed to do service and repair on the Arc Guard System.
- Unauthorized repair will effect the warranty.
- This manual is a part of the TVOC-2 Arc Guard System. Always keep this manual available when working with the TVOC-2 Arc Guard System.
- Examine the Arc Guard System and the package when you unpack your new product. If there are damages, please contact the transportation company or the ABB reseller/office immediately.

Safety notes

In this user manual, these symbols are used:

WARNING

General warning symbol indicates the presence of a hazard which could result in personal injury and damage to equipment or property.

WARNING

Warning symbol indicates the presence of hazardous voltage which could result in personal injury.

INFORMATION

Information sign alerts the reader to relevant facts and conditions.

Modifications to data in this manual can be applied without notice.

General safety information

WARNING

Only authorized and appropriately trained personnel are allowed to install and make the electrical connection of the Arc Guard System in accordance with existing laws and regulations.

WARNING

Examine the Arc Guard System and the package when you unpack your new product. If there are damages, please contact the transportation company or the ABB reseller/office immediately.

WARNING

Only authorized and appropriately trained service personnel are allowed to do service and repair on the Arc Guard System. Note: unauthorized repair will effect the warranty.

Personal

Service and repair should be performed by authorized personnel only. Note that unauthorized repair affects safety and warranty.

Arc Guard System™ TVOC-2-COM Modbus

Configuration manual

1 General information

1.1 Introduction

This manual covers the Modbus interface, which offers a direct connection to Modbus RTU for the Arc Guard System™ TVOC-2.

TVOC-2-COM will behave as a slave. This means all communication will be performed by a master device on the same Modbus system. Mostly this will be a PLC. This manual explains how to install the Arc Guard System™ TVOC-2-COM to your Modbus system.

1.2 References

[1] http://www.modbus.org/docs/Modbus_Application_Protocol_V1_1b3.pdf (2012)

[2] http://www.modbus.org/docs/Modbus_over_serial_line_V1_02.pdf (2006)

[3] https://www.modbusdriver.com/modpoll.html

1.3 Quick start-up

❶ Make sure your Modbus master has been installed to the system.

❷ The TVOC-2-COM will be delivered with the following configuration:

- baud rate 19200
- parity even
- stop bits 1
- Modbus ID 248*

*Modbus ID 248 is not a valid id for a Modbus system but is used to indicate that the communication is disabled.

❸ Physically connect the system to the Modbus network.

❹ Test communication between your master and the TVOC-2 system. For example see chapter 5 Troubleshooting.

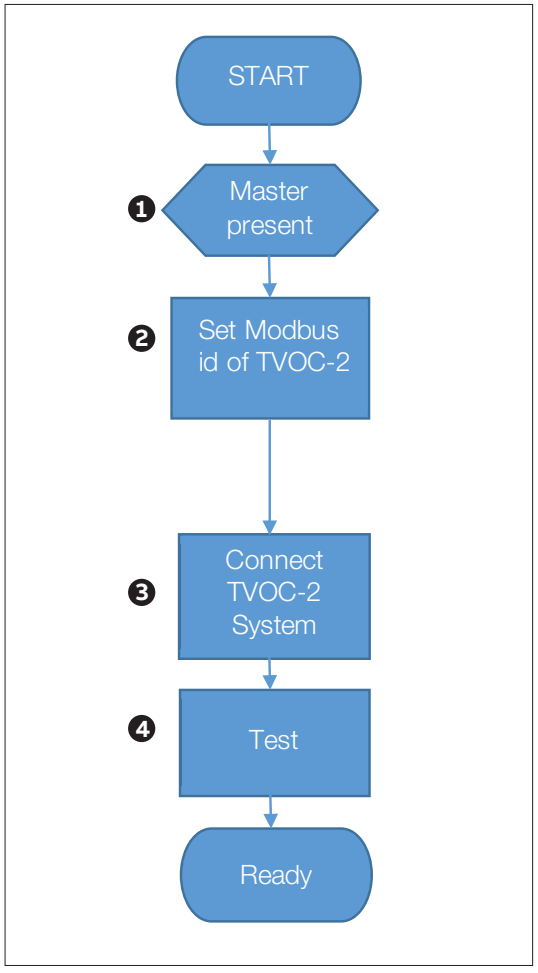

Figure 1
Quick start-up

2 Modbus installation

2.1 General

Modbus RTU is a 2-wire, RS485-based field bus communication system for parameter value exchange.

INFORMATION

The implementation of the Modbus interface is based on standards [1] and [2].

2.2 Modbus connector

The supplied Modbus connector has the following pin configuration:

Table 1 Modbus Connector

Terminal	EIA/TIA-485 name	ITr/IDv	Description
+(B)	B/B'	D1	Transceiver terminal 1 Terminator 1 input*
-(A)	A/A'	D0	Transceiver terminal 0 Terminator 2 input*
DGND	C/C'	Common	Signal common

* If the device is connected as first or last device in a multi-drop system, a 120Ω terminator resistor should be installed between terminator inputs (A) and (B).

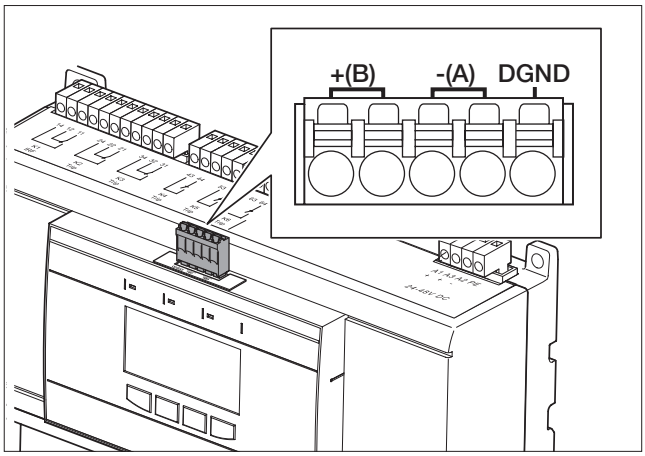

Figure 2
Modbus connector

2.3 Modbus cables

Recommended cable: Belden 3105A (AWG22).

2.4 Termination

For best quality of data transfer, Modbus should be terminated correctly.

The following figure shows Modbus installation according to [3].

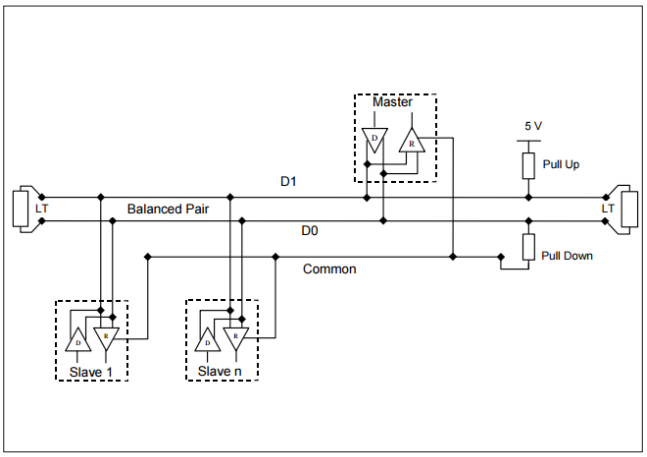

Figure 3
General 2-Wire Topology

2.4.1 Termination resistors

A 120Ω resistor is added in parallel with TVOC-2 System connection if it is installed as first or last device on the network. For this purpose there are double terminals for +(B) and -(A) connections.

2.4.2 Pull-up / pull-down resistors

When the Modbus network is not being actively driven by a device, the bus line is in an undefined state. Bias resistors should then be used to obtain a defined voltage potential on the data lines. The bias resistors act for data line B (D1) as pull-up resistors against 5V and for data line A (D0) as pull-down resistors against GND. This is illustrated in Figure 20 in [2].

The following devices usually have built-in bias resistors:

- Modbus masters
- Gateways
- Repeaters

3 Changing Modbus ID and communication parameters

3.1 Changing Modbus ID and communication parameters

On delivery the default parameters are:

- Modbus ID 248
- Baud rate 19200
- Parity even
- Data bits 8
- Stop bits 1

The parameters should be changed to fit the existing network.

3.2 Configuration via HMI

Use the HMI to navigate to menu 3.4 Modbus

Select appropriate submenu to change configuration.

Note: The Modbus ID must be changed to enable communication. The default ID of 248 only indicates that the Modbus communication is disabled. It is not a valid ID in a Modbus network. Valid ID range is 1-247.

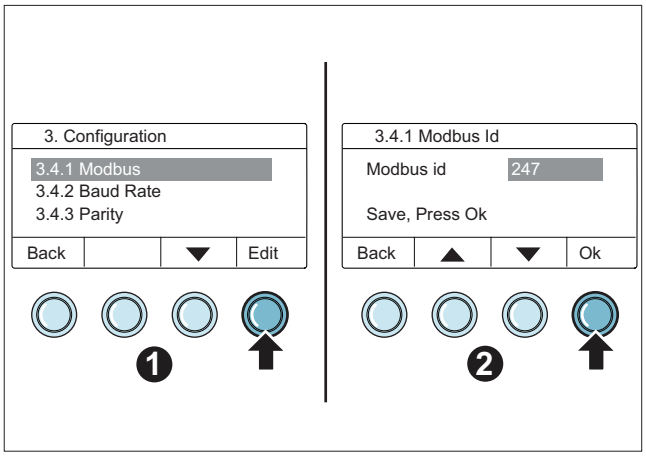

Figure 4
Menu 3.4 Modbus

4 Functional description

4.1 Functional description

The information found here is the basic information needed for the installation of a Modbus system.

4.2 Implementation class

The physical and data link layer are implemented conforming to the “basic slave” implementation class as described in document [2] “MODBUS over Serial Line specification and implementation guide V1.02”.

The following options have been implemented:

Table 2 Modbus Parameters

General settings		
Parameter	**Options**	**Remarks**
Addressing	address configurable 1-248 (default 248)	When set to 248, the communication is disabled.
Baud rate	9600 19200 (default) 38400 57600	
Parity	none even (default) odd	The use of no parity requires 2 stop bits.
Data bits	8	Not configurable.
Stop bits	1 (default) 1.5 2	The use of no parity requires 2 stop bits.
Electrical interface	RS485 2W cabling	

4.3 Supported Modbus functions

This section describes the supported Modbus function codes.

4.3.1 Read Registers (03, 04)

Both function 03, Read Holding Registers and function 04, Read Input Registers, can be used. The addresses are the same.

Table 3 Read Exceptions

Possible exception responses		
Code	**Name**	**Meaning**
02	ILLEGAL_DATA_ADDRESS	Address refers to a register that is not available or not readable.

4.3.2 Write Registers (06, 16)

Functions 06, Write Single Register and function 16, Write Multiple Registers, are supported.

Table 4 Write Exceptions

Possible exception responses		
Code	**Name**	**Meaning**
02	ILLEGAL_DATA_ADDRESS	Address refers to a register that is not available or not readable.
03	ILLEGAL_DATA_VALUE	The value written is not permitted for this register.

4.3.3 Available registers

Modbus registers are numbered from 1 to 65536. In a Modbus PDU (Protocol Data Unit) these registers are addressed from 0 to 65535. In the following table the PDU adress is used, add 1 to the PDU adress to get the register number.

The following table lists the available parameters. More details about the data format can be found in 4.4 Register data format below.

Modbus registers

Parameter name	Access	PDU Address		Remark
		Hex	Dec	
Trip 1 detector, low	R	0x64	100	X1:1 – X2:5
Trip 1 detector, high	R	0x65	101	X2:6 – X3:10
Trip 1 relay	R	0x66	102	K4 (LSb), K5, K6
Trip 1 date	R	0x67	103	Days since January 1, 1970
Trip 1 time HHMM	R	0x68	104	MSB = hours, LSB = minutes
Trip 1 time SS	R	0x69	105	seconds
Trip 2 detector, low	R	0x6B	107	X1:1 – X2:5
Trip 2 detector, high	R	0x6C	108	X2:6 – X3:10
Trip 2 relay	R	0x6D	109	K4 (LSb), K5, K6
Trip 2 date	R	0x6E	110	Days since January 1, 1970
Trip 2 time HHMM	R	0x6F	111	MSB = hours, LSB = minutes
Trip 2 time SS	R	0x70	112	seconds
Trip 3 detector, low	R	0x72	114	X1:1 – X2:5
Trip 3 detector, high	R	0x73	115	X2:6 – X3:10
Trip 3 relay	R	0x74	116	K4 (LSb), K5, K6
Trip 3 date	R	0x75	117	Days since January 1, 1970
Trip 3 time HHMM	R	0x76	118	MSB = hours, LSB = minutes
Trip 3 time SS	R	0x77	119	seconds
Trip 4 detector, low	R	0x79	121	X1:1 – X2:5
Trip 4 detector, high	R	0x7A	122	X2:6 – X3:10
Trip 4 relay	R	0x7B	123	K4 (LSb), K5, K6
Trip 4 date	R	0x7C	124	Days since January 1, 1970
Trip 4 time HHMM	R	0x7D	125	MSB = hours, LSB = minutes
Trip 4 time SS	R	0x7E	126	seconds
Trip 5 detector, low	R	0x80	128	X1:1 – X2:5
Trip 5 detector, high	R	0x81	129	X2:6 – X3:10
Trip 5 relay	R	0x82	130	K4 (LSb), K5, K6
Trip 5 date	R	0x83	131	Days since January 1, 1970
Trip 5 time HHMM	R	0x84	132	MSB = hours, LSB = minutes
Trip 5 time SS	R	0x85	133	seconds
Trip 6 detector, low	R	0x87	135	X1:1 – X2:5
Trip 6 detector, high	R	0x88	136	X2:6 – X3:10
Trip 6 relay	R	0x89	137	K4 (LSb), K5, K6
Trip 6 date	R	0x8A	138	Days since January 1, 1970
Trip 6 time HHMM	R	0x8B	139	MSB = hours, LSB = minutes
Trip 6 time SS	R	0x8C	140	seconds

Modbus registers

Parameter name	Access	PDU Address		Remark
		Hex	Dec	
Trip 7 detector, low	R	0x8E	142	X1:1 – X2:5
Trip 7 detector, high	R	0x8F	143	X2:6 – X3:10
Trip 7 relay	R	0x90	144	K4 (LSb), K5, K6
Trip 7 date	R	0x91	145	Days since January 1, 1970
Trip 7 time HHMM	R	0x92	146	MSB = hours, LSB = minutes
Trip 7 time SS	R	0x93	147	seconds
Number of trips	R	0x95	149	Number of trips in trip log
Diagnostics error date	R	0xC8	200	Days since January 1, 1970
Diagnostics error time HHMM	R	0xC9	201	MSB = hours, LSB = minutes
Diagnostics error time SS	R	0xCA	202	seconds
Diagnostics error DTC, number 2 and 1	R	0xCB	203	
Diagnostics error DTC, number 4 and 3	R	0xCC	204	
Diagnostics error DTC, number 6 and 5	R	0xCD	205	
Diagnostics trip	R	0xCE	206	
Diagnostics trip date	R	0xCF	207	Days since January 1, 1970
Diagnostics trip time HHMM	R	0xD0	208	MSB = hours, LSB = minutes
Diagnostics trip time SS	R	0xD1	209	seconds
Diagnostics trip detector low	R	0xD2	210	X1:1 – X2:5
Diagnostics trip detector high	R	0xD3	211	X2:6 – X3:10
Diagnostics trip relay	R	0xD4	212	
Perform diagnostics	W	0xD5	213	1 = perform diagnostics, 0 = no-operation
Last performed diagnostics date	R	0xDC	220	Days since January 1, 1970
Last performed diagnostics time	R	0xDD	221	MSB = hours, LSB = minutes
Sensor status, X2*	R	0xDE	222	
Sensor status, X3*	R	0xDF	223	
Ambient Light Warning X2*	R	0xE0	224	
Ambient Light Warning X3*	R	0xE1	225	
Error 1 date	R	0x12C	300	Days since January 1, 1970
Error 1 time HHMM	R	0x12D	301	MSB = hours, LSB = minutes
Error 1 time SS	R	0x12E	302	seconds
Error 1 DTC, number 2 and 1	R	0x12F	303	
Error 1 DTC, number 4 and 3	R	0x130	304	
Error 1 DTC, number 6 and 5	R	0x131	305	
Error 2 date	R	0x133	307	Days since January 1, 1970
Error 2 time HHMM	R	0x134	308	MSB = hours, LSB = minutes
Error 2 time SS	R	0x135	309	seconds
Error 2 DTC, number 2 and 1	R	0x136	310	
Error 2 DTC, number 4 and 3	R	0x137	311	
Error 2 DTC, number 6 and 5	R	0x138	312	
Error 3 date	R	0x013A	314	Days since January 1, 1970
Error 3 time HHMM	R	0x013B	315	MSB = hours, LSB = minutes
Error 3 time SS	R	0x013C	316	seconds
Error 3 DTC, number 2 and 1	R	0x013D	317	
Error 3 DTC, number 4 and 3	R	0x013E	318	
Error 3 DTC, number 6 and 5	R	0x013F	319	

* Registers only available for firmware versions 03.00.00 and later.

Modbus registers

Parameter name	Access	PDU Address		Remark
		Hex	Dec	
Error 4 date	R	0x141	321	Days since January 1, 1970
Error 4 time HHMM	R	0x142	322	MSB = hours, LSB = minutes
Error 4 time SS	R	0x143	323	seconds
Error 4 DTC, number 2 and 1	R	0x144	324	
Error 4 DTC, number 4 and 3	R	0x145	325	
Error 4 DTC, number 6 and 5	R	0x146	326	
Error 5 date	R	0x148	328	Days since January 1, 1970
Error 5 time HHMM	R	0x149	329	MSB = hours, LSB = minutes
Error 5 time SS	R	0x14A	330	seconds
Error 5 DTC, number 2 and 1	R	0x14B	331	
Error 5 DTC, number 4 and 3	R	0x14C	332	
Error 5 DTC, number 6 and 5	R	0x14D	333	
Error 6 date	R	0x14F	335	Days since January 1, 1970
Error 6 time HHMM	R	0x150	336	MSB = hours, LSB = minutes
Error 6 time SS	R	0x151	337	seconds
Error 6 DTC, number 2 and 1	R	0x152	338	
Error 6 DTC, number 4 and 3	R	0x153	339	
Error 6 DTC, number 6 and 5	R	0x154	340	
Error 7 date**	R	0x0156	342	Days since January 1, 1970
Error 7 time HHMM**	R	0x0157	343	
Error 7 time SS**	R	0x0158	344	
Error 7 DTC, number 2 and 1**	R	0x0159	345	
Error 7 DTC, number 4 and 3**	R	0x015A	346	
Error 7 DTC, number 6 and 5**	R	0x015B	347	
Error 8 date**	R	0x015D	349	Days since January 1, 1970
Error 8 time HHMM**	R	0x015E	350	
Error 8 time SS**	R	0x015F	351	
Error 8 DTC, number 2 and 1**	R	0x0160	352	
Error 8 DTC, number 4 and 3**	R	0x0161	353	
Error 8 DTC, number 6 and 5**	R	0x0162	354	
Error 9 date**	R	0x0164	356	Days since January 1, 1970
Error 9 time HHMM**	R	0x0165	357	
Error 9 time SS**	R	0x0166	358	
Error 9 DTC, number 2 and 1**	R	0x0167	359	
Error 9 DTC, number 4 and 3**	R	0x0168	360	
Error 9 DTC, number 6 and 5**	R	0x0169	361	
Number of errors	R	0x170	368	
Sensor status 1, X2*	R	0x172	370	
Sensor status 1, X3*	R	0x173	371	
Ambient Light Warning 1, X2*	R	0x174	372	
Ambient Light Warning 1, X3*	R	0x175	373	
Sensor status 2, X2*	R	0x176	374	

* Registers only available for firmware versions 03.00.00 and later.
** Registers only available for firmware versions earlier than 03.00.00.

Modbus registers

Parameter name	Access	PDU Address		Remark
		Hex	Dec	
Sensor status 2, X3*	R	0x177	375	
Ambient Light Warning 2, X2*	R	0x178	376	
Ambient Light Warning 2, X3*	R	0x179	377	
Sensor status 3, X2*	R	0x17A	378	
Sensor status 3, X3*	R	0x17B	379	
Ambient Light Warning 3, X2*	R	0x17C	380	
Ambient Light Warning 3, X3*	R	0x17D	381	
Sensor status 4, X2*	R	0x17E	382	
Sensor status 4, X3*	R	0x17F	383	
Ambient Light Warning 4, X2*	R	0x180	384	
Ambient Light Warning 4, X3*	R	0x181	385	
Sensor status 5, X2*	R	0x182	386	
Sensor status 5, X3*	R	0x183	387	
Ambient Light Warning 5, X2*	R	0x184	388	
Ambient Light Warning 5, X3*	R	0x185	389	
Sensor status 6, X2*	R	0x186	390	
Sensor status 6, X3*	R	0x187	391	
Ambient Light Warning 6, X2*	R	0x188	392	
Ambient Light Warning 6, X3*	R	0x189	393	
Custom name, letter 1 and 2	RW	0x190	400	
Custom name, letter 3 and 4	RW	0x191	401	
Custom name, letter 5 and 6	RW	0x192	402	
Custom name, letter 7 and 8	RW	0x193	403	
Custom name, letter 9 and 10	RW	0x194	404	
Custom name, letter 11 and 12	RW	0x195	405	
Custom name, letter 13 and 14	RW	0x196	406	
Custom name, letter 15 and 16	RW	0x197	407	
Installed modules	R	0x1F4	500	
Dip Switches	R	0x258	600	
Arc Monitor SW version XXYY	R	0x320	800	
Arc Monitor SW version ZZ	R	0x321	801	
Arc Monitor HW version	R	0x322	802	
Arc Monitor CPLD version XXYY	R	0x323	803	
Arc Monitor CPLD version ZZ	R	0x324	804	
Arc Monitor ID, char 1 & 2	R	0x326	806	
Arc Monitor ID, char 3 & 4	R	0x327	807	
Arc Monitor ID, char 5 & 6	R	0x328	808	
Arc Monitor ID, char 7 & 8	R	0x329	809	
Arc Monitor ID, char 9 & 10	R	0x32A	810	
Arc Monitor ID, byte 0	R	0x32B	811	

* Registers only available for firmware versions 03.00.00 and later.

Modbus registers

Parameter name	Access	PDU Address		Remark
		Hex	Dec	
Arc Monitor ID, byte 1	R	0x32C	812	
Arc Monitor ID, byte 2	R	0x32D	813	
Arc Monitor ID, byte 3	R	0x32E	814	
Arc Monitor ID, byte 4	R	0x32F	815	
HMI SW version XXYY	R	0x334	820	
HMI SW version ZZ	R	0x335	821	
HMI HW version	R	0x336	822	
HMI ID, byte 0	R	0x33D	829	
HMI ID, byte 1	R	0x33E	830	
HMI ID, byte 2	R	0x33F	831	
HMI ID, byte 3	R	0x340	832	
HMI ID, byte 4	R	0x341	833	
Other HMI SW version XXYY	R	0x348	840	
Other HMI SW version ZZ	R	0x349	841	
Other HMI HW version	R	0x34A	842	
Other HMI ID, byte 0	R	0x351	849	
Other HMI ID, byte 1	R	0x352	850	
Other HMI ID, byte 2	R	0x353	851	
Other HMI ID, byte 3	R	0x354	852	
Other HMI ID, byte 4	R	0x355	853	
X2 SW version XXYY*	R	0x35A	858	
X2 SW version ZZ*	R	0x35B	859	
X2 HW version	R	0x35C	860	
X2 CPLD version XXYY	R	0x35D	861	
X2 CPLD version ZZ	R	0x35E	862	
X2 ID, byte 0	R	0x364	868	
X2 ID, byte 1	R	0x365	869	
X2 ID, byte 2	R	0x366	870	
X2 ID, byte 3	R	0x367	871	
X2 ID, byte 4	R	0x368	872	
X3 SW version XXYY*	R	0x36E	878	
X3 SW version ZZ*	R	0x36F	879	
X3 HW version	R	0x370	880	
X3 CPLD version XXYY	R	0x371	881	
X3 CPLD version ZZ	R	0x372	882	
X3 ID, byte 0	R	0x378	888	
X3 ID, byte 1	R	0x379	889	
X3 ID, byte 2	R	0x37A	890	
X3 ID, byte 3	R	0x37B	891	
X3 ID, byte 4	R	0x37C	892	
Reset trip	W	0x3E8	1000	1 = reset, 0 = no-operation

* Registers only available for firmware versions 03.00.00 and later.

Modbus registers

Parameter name	Access	PDU Address		Remark
		Hex	Dec	
System date	RW	0x44C	1100	
System time HHMM	RW	0x44D	1101	
Modbus failure register	R	0x4B0	1200	
System state	R	0x514	1300	
Active DTC, number 1	R	0x515	1301	
Active DTC, number 2	R	0x516	1302	
Active DTC, number 3	R	0x517	1303	
Active DTC, number 4	R	0x518	1304	
Active DTC, number 5	R	0x519	1305	
Active DTC, number 6	R	0x51A	1306	

4.4 Register data format

This section describes details about the data format for selected registers.

4.4.1 Trip information

The trip registers contain information about the last 7 trips that has occurred. If less than 7 trips has occurred, which can be checked by reading register Number of trips, the register values will be 0xFFFF.

4.4.1.1 Trip x detector, low

This register contains a bit field that contains which detectors triggered the trip.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	-	X2:5	X2:4	X2:3	X2:2	X2:1	X1:10	X1:9	X1:8	X1:7	X1:6	X1:5	X1:4	X1:3	X1:2	X1:1

4.4.1.2 Trip x detector, high

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	-	X3:10	X3:9	X3:8	X3:7	X3:6	X3:5	X3:4	X3:3	X3:2	X3:1	X2:10	X2:9	X2:8	X2:7	X2:6

4.4.1.3 Trip x relay (IGBT)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	-	-	-	-	-	-	-	-	-	-	-	-	-	K6	K5	K4

4.4.1.4 Trip x date

The date the trip occurred. The date is expressed as number of days since January 1, 1970.

Example: the value 0x42B6 (17078) corresponds to October 4, 2016.

4.4.1.5 Trip x time HHMM

The hours and minutes of time the trip occurred. The time is expressed in 24h format as a 16 bit value where the most significant byte contains the hours and the least significant the minutes.

Example: The value 0x0922 (2338) corresponds to 09:34, (0x09 = 9 and 0x22 = 34).

4.4.1.6 Trip x time SS

The seconds of the time the trip occurred.

4.4.1.7 Number of trips

The number of trips that has occurred.

4.4.2 Diagnostics information (200 - 225)

The following registers contain the same information as menu 2. Diagnostics on the HMI.

Diagnostics error registers contain information about the current active error. If there is no active error they contain 0x0000. The format of the registers are as described in 4.4.3 Error information below.

Diagnostics trip registers contain information about the current active trip. If there is no active trip they contain 0x0000. The format of the registers are as described in 4.4.1 Trip information above.

Sensor status and Ambient light warning registers contain information about the current active error, if there is no active error on the sensors they contain 0x0000. Register System state can be read to see if there is an active error/trip.

4.4.2.1 Perform diagnostics

Write value 1 to this register to perform diagnostic test.

4.4.2.2 Last performed diagnostics date

Date of last performed diagnostics. Format as described in 4.4.1.4 Trip x date above.

4.4.2.3 Last performed diagnostics time HHMM

Time of last performed diagnostics. Format as described in 4.4.1.5 Trip x time HHMM above.

4.4.3 Error information

The error registers contain information about the last 6 errors that has occurred. If less than 6 errors has occurred, which can be checked by reading register Number of errors, the register values will be 0xFFFF.

4.4.3.1 Error x date

The date the error occurred. The date is expressed as number of days since January 1, 1970.

Example: The value 0x0922 (2338) corresponds to 09:34, (0x09 = 9 and 0x22 = 34).

4.4.3.2 Error x time HHMM

The hours and minutes of time the trip occurred. The time is expressed in 24h format as a 16 bit value where the most significant byte contains the hours and the least significant the minutes.

Example: the value 0x0922 (2338) corresponds to 09:34.

4.4.3.3 Error x time SS

The seconds of the time the trip occurred.

4.4.3.4 Diagnostics error DTC

A diagnostic trouble code (DTC) consist of 6 numbers. When displayed on the HMI it has the following format: n6-n5-n4-n3-n2-n1, where n<n> denotes number n.

Two numbers are stored in each register, the first number (y) in the most significant byte and the second (z) in the least significant.

DTC, number 2 and 1 (203, 303, 310, 317, 324, 331, 338)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	DTC 2							DTC 1								

DTC, number 4 and 3 (204, 304, 311, 318, 325, 332, 339)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	DTC 4							DTC 3								

DTC, number 6 and 5 (205, 304, 311, 318, 325, 332, 339)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	DTC 6							DTC 5								

Example: With DTC 64-0-0-2-0-0, DTC 3 has value 2 and DTC 6 has value 64.

4.4.3.5 Number of errors

The number of errors that has occurred.

4.4.3.6 Sensor status x, X2 (222, 370, 374, 378, 382, 386, 390)

This register contains a bit field showing status of the detectors during the corresponding error.
Bit value: 1 = OK, 0 = Error

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	-	-	-	-	-	-	X2:10	X2:9	X2:8	X2:7	X2:6	X2:5	X2:4	X2:3	X2:2	X2:1

4.4.3.7 Sensor status x, X3 (223, 371, 375, 379, 383, 387, 391)

This register contains a bit field showing status of the detectors during the corresponding error
Bit value: 1 = OK, 0 = Error

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	-	-	-	-	-	-	X3:10	X3:9	X3:8	X3:7	X3:6	X3:5	X3:4	X3:3	X3:2	X3:1

4.4.3.8 Ambient light warning x, X2 (224, 372, 376, 380, 384, 388, 392)

This register contains a bit field showing warning status of ambient light warnings during the corresponding error
Bit value: 1 = OK, 0 = Warning

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	-	-	-	-	-	-	X2:10	X2:9	X2:8	X2:7	X2:6	X2:5	X2:4	X2:3	X2:2	X2:1

4.4.3.9 Ambient light warning x, X3 (225, 373, 377, 381, 385, 389, 393)

This register contains a bit field showing warning status of ambient light warnings during the corresponding error
Bit value: 1 = OK, 0 = Warning

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	-	-	-	-	-	-	X3:10	X3:9	X3:8	X3:7	X3:6	X3:5	X3:4	X3:3	X3:2	X3:1

4.4.4 Custom name registers

The custom name registers contains the letters in the custom name that can be programmed to the HMI.

Allowed characters are the alphanumeric characters plus “-“, “_” and “ “ (space). This means ASCII character 32, 45, 48-57, 65-90, 95, 97-122. If not all 16 characters are needed, the trailing characters should be set to value 32 (space) to keep the layout of the name center aligned.

In each register, two characters are stored. One in the most significant byte and one in the least significant.

Example: To set the custom name to “Example” the registers should be set as follows

Custom name, letter 1 and 2	0x4578 (Ex)
Custom name, letter 3 and 4	0x616D (am)
Custom name, letter 5 and 6	0x706C (pl)
Custom name, letter 7 and 8	0x6520 (e)
Custom name, letter 9 and 10	0x2020 ( )
Custom name, letter 11 and 12	0x2020 ( )
Custom name, letter 13 and 14	0x2020 ( )
Custom name, letter 15 and 16	0x2020 ( )

Using modpoll (see 5.2 Example of reading with modpoll below) the command is:

```
modpoll -m rtu -a 247 -0 -r 400 COM1 0x4578 0x616D 0x706C 0x6520 0x2020 0x2020 0x2020 0x2020
```

4.4.4.1 Custom name, letter x and y

Letter x is stored in the most significant byte, letter y in the least significant byte.

4.4.5 Installed modules

This register contains a bit field that reflects which modules are installed and detected on the Arc Guard System™ TVOC-2.

A high bit signals an installed module.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	-	-	-	-	-	-	-	-	-	-	CSU22	CSU21	X3	X2	External HMI	Internal HMI

Example: the value 0x000E shows a system that contains an internal HMI and extension modules X2 and X3.

4.4.6 Dip switches

This registers contains the status of the dip switches on the Arc Monitor in its least significant byte.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Dip switch	-	-	-	-	-	-	-	-	-	-	CSU22	CSU21	X3	X2	External HMI	Internal HMI

Example: the value 0x0004 indicates that dip switch 3, TripMatrix 4, is On and all others are Off.

4.4.7 Version information

Software (SW) and CPLD versions are specified with three numbers XX.YY.ZZ. Each version is presented using two Modbus registers, one for the first two numbers and one for the last.

4.4.7.1 Arc Monitor SW version XXYY

This registers contains the first number of the version in the most significant byte and the second number of the version in the least significant byte.

Example: If the Arc Monitor software version is 00.03.43 this register has value 0x0003.

4.4.7.2 Arc Monitor SW version ZZ

This registers contains the third number of the version in the least significant byte.

Example: If the Arc Monitor software version is 00.03.43 this register has value 0x002B.

4.4.7.3 Arc Monitor HW version
This register contains the Arc Monitor hardware version in the least significant byte.

4.4.7.4 Arc Monitor CPLD version XXYY
This registers contains the first number of the version in the most significant byte and the second number of the version in the least significant byte.

Example: If the Arc Monitor CPLD version is 00.02.01 this register has value 0x0002.

4.4.7.5 Arc Monitor CPLD version ZZ
This registers contains the third number of the version in the least significant byte.

Example: If the Arc Monitor software version is 00.02.01 this register has value 0x0001.

4.4.7.6 Arc Monitor ID, byte x
The ID number is presented using 5 bytes.

Each register contains one byte in the least significant byte.

The first part of the ID number is static, it is always “1S16010”.

Then byte 4, 3 and 2 follows in decimal format with 2 digits for each number.

Finally a 16-bit word constructed from byte 1 as most significant and byte 0 as least significant is added as a 4 digit decimal number (byte 1 << 8 | byte 0).

Example: If the Arc Monitor ID registers contains the following values:

Arc Monitor ID, byte 0	0x00D9	
Arc Monitor ID, byte 1	0x0007	**This corresponds to ID**
Arc Monitor ID, byte 2	0x0012 (18)	**1S16010 72 14 18 2009**
Arc Monitor ID, byte 3	0x000E (14)	**0x48 0x0E 0x12 0x07D9**
Arc Monitor ID, byte 4	0x0048 (72)	

HMI SW version XXYY

The HMI is the HMI that is queried on the Modbus network.

See 4.4.7.1 Arc Monitor SW version XXYY above.

4.4.7.7 HMI SW version ZZ
See 4.4.7.2 Arc Monitor SW version ZZ above.

4.4.7.8 HMI HW version
See 4.4.7.3 Arc Monitor HW version above.

4.4.7.9 HMI ID, byte x
See 4.4.7.6 Arc Monitor ID, byte x above.

4.4.7.10 Other HMI SW version XXYY
Other HMI is the HMI that is not queried on the Modbus network.

See 4.4.7.1 Arc Monitor SW version XXYY above.

4.4.7.11 Other HMI SW version ZZ
See 4.4.7.2 Arc Monitor SW version ZZ above.

4.4.7.12 Other HMI HW version
See 4.4.7.3 Arc Monitor HW version above.

4.4.7.13 Other HMI ID, byte x
See 4.4.7.6 Arc Monitor ID, byte x above.

4.4.7.14 X2 HW version
See 4.4.7.3 Arc Monitor HW version above.

4.4.7.15 X2 and X3, extension module, version E6-S, SW version XXYY
This registers contains the first number of the version in the most significant byte and the second number of the version in the least significant byte.

Example: If the Arc Monitor software version is 04.03.43 this register has value 0x0403 (=1027 = 4 in first byte and 3 in second byte).

4.4.7.16 X2 and X3, extension module, version E6-S, SW version ZZ
This registers contains the third number of the version in the least significant byte. Example: If the Arc Monitor software version is 04.03.43 this register has value 0x2B (43).

4.4.7.17 X2 and X3 HW version
See 4.4.7.3 Arc Monitor HW version above.

4.4.7.18 X2 and X3 CPLD version XXYY
See 4.4.7.4 Arc Monitor CPLD version XXYY above.

4.4.7.19 X2 and X3 CPLD version ZZ
See 4.4.7.5 Arc Monitor CPLD version ZZ above.

4.4.7.20 X2 and X3 ID, byte x
See 4.4.7.6 Arc Monitor ID, byte x above.

4.4.8 Reset

Write value 1 to this register to reset currently active trip, if any.

4.4.9 System date

Read or update the system date. The date is stored in the Arc Monitor so if updated it will take up to 2 seconds for the change to reflect in the HMI.

The date is expressed as number of days since January 1, 1970.

Example: the value 0x42B6 (17078) corresponds to October 4, 2016.

4.4.10 System time HHMM

Read or update the system time. The time is stored in the Arc Monitor so if updated it will take up to 2 seconds for the change to reflect in the HMI.

The time is expressed in 24h format as a 16 bit value where the most significant byte contains the hours and the least significant the minutes.

Example: the value 0x0922 (2338) corresponds to 09:34.

4.4.11 Modbus failure register

This register contains the PDU Address of the Modbus register that was involved in the last Modbus exception.

Example: if one attempts to read System date and System time HHMM (PDU addresses 1100, 1101) but accidently specifies 3 registers instead of 2, one will get an Illegal Data Address exception as response since also address 1102 will be queried. The Modbus failure register will contain value 0x044E (1102).

4.4.12 System state

This register contains a 4-bit bit field that reflects the system state.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	-	-	-	-	-	-	-	-	-	-	-	-	Diagnostics running	System start sequence	There is an active error	There is an active trip

4.4.13 Diagnostic Trouble Code, number x

These registers contain the same data as Diagnostics error DTC number x and y but with only one byte per register. It might be easier to retrieve the information this way.

See 4.4.3.4 Diagnostics error DTC above for more information.

5 Troubleshooting

5.1 Visual diagnostics

The yellow Com LED flashes when a Modbus request is received.

5.2 Example of reading with modpoll

Using the application modpoll [3] from a windows environment, it is easy to query the Arc Guard System™ TVOC-2.

The following command is an example of how the TVOC-2 status can be read:

```
C:\Windows\System32>REM This connects to a slave with Modbus id 247 on COM1
C:\Windows\System32>modpoll -m rtu -0 -a 247 -r 1300 COM1
RTU protocol, pdu addressing, Modbus id, register, com_port

modpoll 3.4 - FieldTalk(tm) Modbus(R) Master Simulator
Copyright (c) 2002-2013 proconX Pty Ltd
Visit http://www.modbusdriver.com for Modbus libraries and tools.

Protocol configuration: Modbus RTU
Slave configuration...: address = 247, start reference = 1300 (PDU), count = 1
Communication.........: COM35, 19200, 8, 1, even, t/o 1.00 s, poll rate 1000 ms
Data type.............: 16-bit register, output (holding) register table

-- Polling slave... (Ctrl-C to stop)
[1300]: 0
-- Polling slave... (Ctrl-C to stop)
[1300]: 0
```

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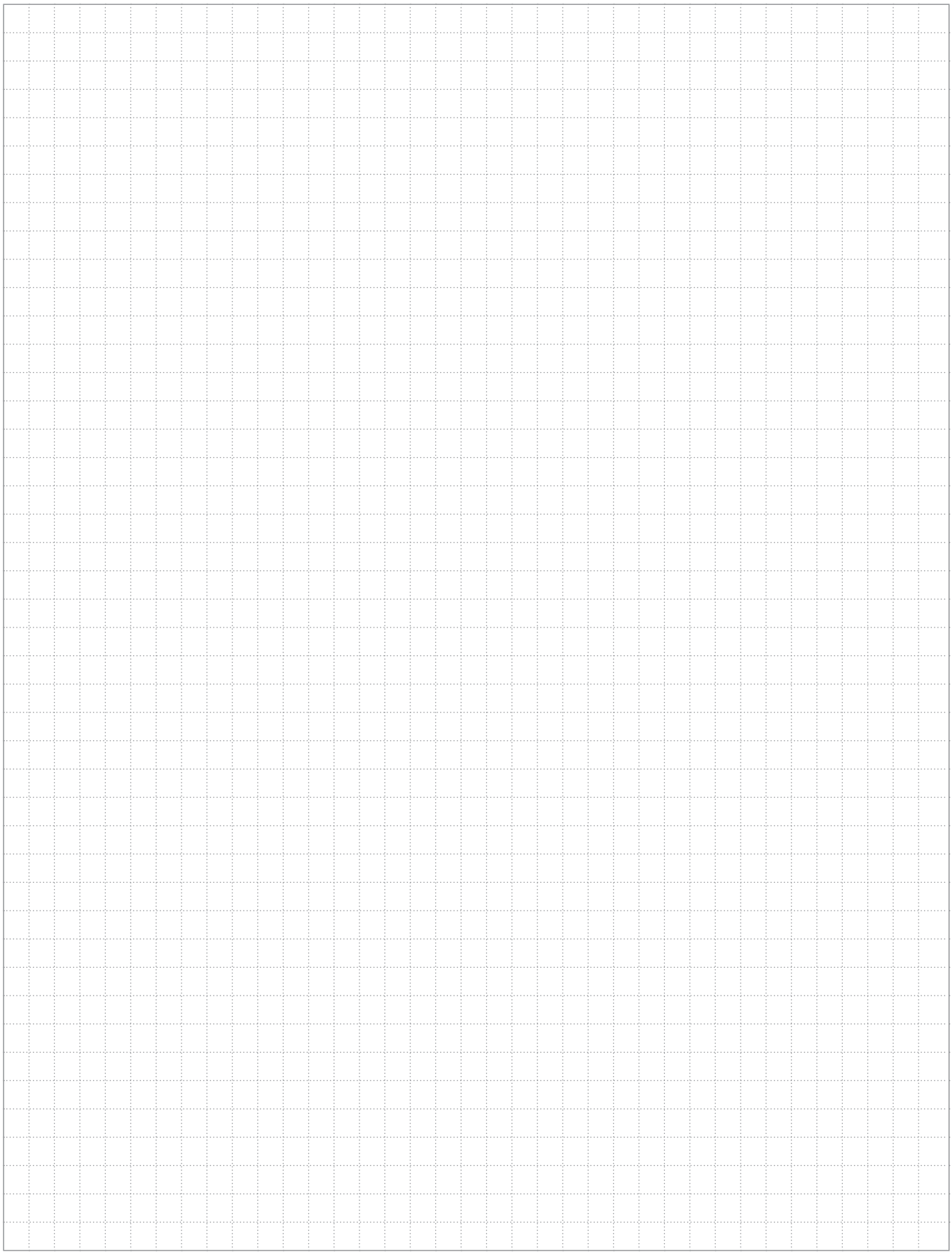

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