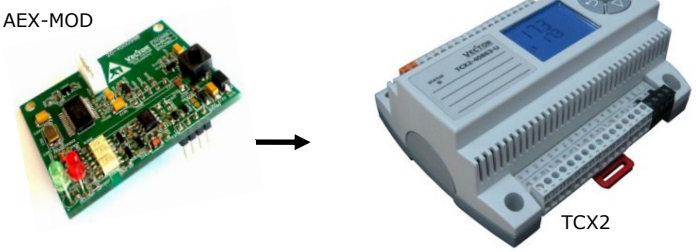
Modbus communication module for TCX2: AEX-MOD

AEX-MOD



TCX2

AEX-MOD is factory installed in TCX2 series controllers with -MOD suffix, and is also available separately upon request for customer installation in standard TCX2 series controllers.

Features

- RS485 2-wire MODBUS standard in accordance with EIA/TIA 485.
- Slave type of communication
- Supports up to 127 nodes on one network
- Galvanic isolated bus connection
- LED indicators
- Selectable transmission types:
  - **RTU** with CRC16 checksum
  - ASCII with LRC checksum
  - Baud rates: 4800, 9600, **19200**, 38400
  - Parity: No parity, odd or **even parity**.
  - Default: RTU with 8 data bits, 1 even parity bit, 1 stop bit. Baud rate 19200.

Communication Specification

Communication standard	Modbus (www.modbus.org)
Default setting	19200 Baudrate, RTU 8 data bits, 1 even parity bit, 1 stop bit
Communication speed	4800, 9600, 19200, 38400
Protocol	RTU with CRC16 checksum ASCII with LRC checksum
Parity bit	no parity, even parity, odd parity

By **default**, **RTU** uses 8 data bits, 1 parity bit with even parity and 1 stop bit; ASCII mode uses 7 data bits, 1 parity bit with even parity, and 1 stop bit.

Both modes support "No Parity" mode, in these cases a 2nd stop bit is used to keep the byte length (11bit for RTU and 10 bit for ASCII, including the Start and Stop bits) unchanged in accordance with the Modbus specification. Other possible serial port modes like Odd Parity or baud rates other than listed ones are not supported.

Supported Modbus commands:

- 03 (0x03): Read multiple registers
- 06 (0x06): Write single register
- 16 (0x10): Write multiple registers

In commands 03 and 16 the allowed number of registers ranges from 1 to 32. Although Modbus specification would allow more registers to be read and written, a maximum of 32 Modbus registers are supported in one packet. One Modbus register is 16 bits wide. The Modbus slave transmits the values as signed 16 bit integers. The least significant digit of the transmitted number is always the first digit below the decimal point, and this results in the following range of numbers that the slave module is able to transmit: from -9999.9 to 9999.9

In an event of an out-of-range command addressing or an unsupported command, the Modbus slave responds with an exception message according to the Modbus specification.

LED indicators

The Modbus slave features a green LED and a red LED for indication of traffic on the RS-485 bus. The green LED is lit when an incoming packet is received, and the red LED is lit when an outgoing packet is transmitted to the bus. At power-up, both LED blink twice simultaneously as a sign of the boot process being completed. A constantly lit LED serves as an indication of a fault condition in the reception or sending process.

Ordering

AEX-MOD is pre-installed in TCX2-40863-MOD and TCX2-40863-OP-MOD as well as any other –MOD TCX2 configuration.

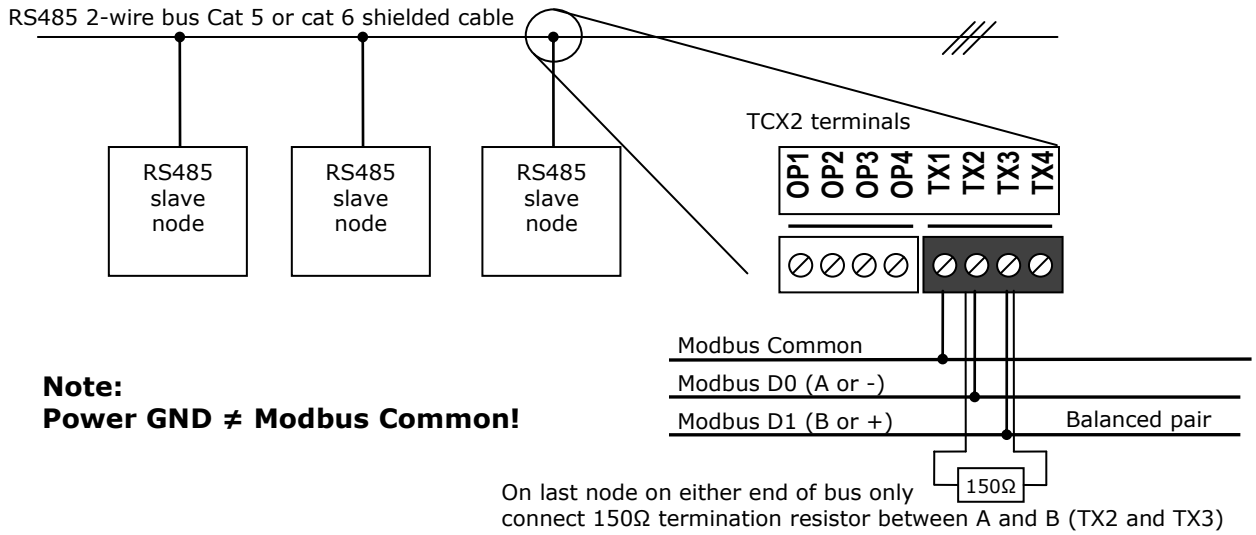
Model	Item#	Display	Loop	UI/RT	DO	AO	Description
TCX2-40863	40-11 0032	no	4	8 UI	6 Relays	3	Universal controller stand-alone
TCX2-40863-OP	40-11 0036	Yes	4	8 UI	6 Relays	3	Controller with display stand-alone
TCX2-40863-MOD	40-11 0077	no	4	8 UI	6 Relays	3	Universal controller with Modbus
TCX2-40863-OP-MOD	40-11 0078	Yes	4	8 UI	6 Relays	3	Controller with display and Modbus
TCX2-14050-MOD	40-11 0081	no	1	4 RT	5 Relays	0	Universal controller with Modbus
TCX2-14050-OP-MOD	40-11 0082	Yes	1	4 RT	5 Relays	0	Controller with display and Modbus
AEX-MOD	40-50 0013	-	-	-	-	-	Modbus communication module

Technical specifications

Notice! Failure to follow specifications and local regulations may cause equipment damage. Misapplication will void warranty.

Power Supply	Power Requirements	5VDC ±5%, 10mA max.
Network	Hardware interface Max nodes	2-wire Modbus over RS485 in accordance with EIA/TIA 485 127 devices may be connected on one network
	Cabling Impedance Nominal Capacitance Nominal Velocity	Twisted Shielded Pair (TSP) cable category 5 or 6. balanced 100 to 120 ohm 50 pF/m 16pF/ft or lower 65% or higher
	Galvanic Isolation	The output circuitry of the AEX-BAC module is galvanic isolated.
	Line termination	A line termination resistance (150 ohm) shall be connected between the terminals A and B of the furthermost slave (relatively from the Modbus master) node of the network
	Line polarization	The device needs polarization.
Modbus	Communication standard	Modbus (www.modbus.org)
	Default setting	19200 Baud rate, RTU 8 data bits, 1 even parity bit, 1 stop bit
	Communication speed	4800, 9600, 19200, 38400
	Protocol	RTU with CRC16 checksum ASCII with LRC checksum
	Parity bit	no parity, even or odd parity
Environment	Operation Climatic Conditions Temperature Humidity	To IEC 721-3-3 class 3 K5 0…50 °C (32…122 °F) <95 % r.H. non-condensing
	Transport & Storage Climatic Conditions Temperature Humidity Mechanical Conditions	To IEC 721-3-2 and IEC 721-3-1 class 3 K3 and class 1 K3 -25…70 °C (-13…158 °F) <95 % r.H. non-condensing class 2M2
Standards	CE conformity EMC Directive Low Voltage Directive	 2004/108/EC 2006/95/EC
	Product standards Automatic electrical controls for household and similar use Special requirement on temperature dependent controls	 EN 60 730 –1 EN 60 730 – 2 – 9
	Electromagnetic compatibility for industrial and domestic sector	Emissions: EN 60 730-1 Immunity: EN 60 730-1

Wiring



Note:
Power GND ≠ Modbus Common!

Line polarization:
The device needs line polarization. One pair of resistors may be connected on the RS-485 balanced pair:
- a Pull-Up Resistor to a 5V Voltage on D1 circuit,
- a Pull-Down Resistor to the common circuit on D0 circuit. This should be done only once at the master only. The value of those resistors must be between 450 Ohms and 650 Ohms. 650 Ohms resistors value may allow a higher number of devices on the serial line bus.

Configuration of AEX-MOD

The communication parameters may be set via TCX2-OP controllers or OPA2 terminals once the device is plugged in the TCX2 base. Login to the controller as follows:

1. Press UP/DOWN buttons simultaneously for three seconds. The display will show firmware version and revision number. Press the OPTION button to start login.
2. CODE is shown in small display.
3. Select 241 using UP/DOWN buttons.
4. Press OPTION after selecting the correct code.
5. Once logged in with 241 control modules are displayed (Lp1, Lp2, 1u, 2u, etc.) – select with UP/DOWN the communication parameters **CO** and open with OPTION. As soon as the module is open its parameters are displayed.
6. Select the parameters with the UP/DOWN buttons. Change a parameter by pressing the OPTION button. Three arrows are displayed to indicate that the parameter may be modified. Use UP/DOWN buttons to adjust the value.
7. After you are done, press OPTION to save the new value and return to the selection level (arrows disappear when selection is saved). Pressing left hand POWER button without pressing OPTION will discard the value and return without saving. For control parameters press POWER again to leave parameter selection and return to control module selection.

Press the POWER to leave the menu. The unit will return to normal operation if no button is pressed for more than 5 minutes.

COM parameters

Parameter	Description	Range	Default
CO 00	Bus plug-in id (read only)	0…255	-
CO 01	Bus plug-in software version (read only)	0…255	-
CO 02	Bus plug-in software revision (read only)	0…255	-
CO 03	Communication address (must be unique in network)	1…247	1
CO 04	Baud rate: 0 = **19200** 1 = 4800 2 = 9600 3 = 19200 4 = 38400	0…255	0
CO 05	Parity mode 0 = NO Parity 1 = **EVEN Parity** 2 = ODD Parity	0…255	1
CO 06	Mode of communication 0 = **RTU** 1 = ASCII	0…255	0
CO 07	Allow changing of static settings through communication 0 = Not allowed 1 = **Allowed**	0…255	1
CO 08	Modbus address base mode **0 = Modbus addresses are "Base 0"** 1 = Modbus addresses are "Base 1" (PLC style)	0…255	0
CO 09	User definable data storage address 00	0…255	255
CO 10	User definable data storage address 01	0…255	255
CO 11	User definable data storage address 02	0…255	255
CO 12	User definable data storage address 03	0…255	255

Dynamic Address list

Controller information

Address	Description	Range	R/W
1000	Product series information	8Bit	R
1001	Product type information	8Bit	R
1002	Controller Firmware Version	8bit	R
1003	Controller Firmware Revision	8bit	R
1004	Type of controller	16bit	R
1005	Number of control loops	16bit	R
1006	Number of binary inputs	16bit	R
1007	Number of universal inputs	16bit	R
1008	Number of virtual inputs	16bit	R
1009	Number of binary outputs	16bit	R
1010	Number of analog outputs	16bit	R
1011	Number of fan outputs	16bit	R
1012	Number of floating outputs	16bit	R
1013	Number of alarms	16bit	R
1014	Number of auxiliary functions	16bit	R
1015	Number of time schedules	16bit	R
1016	Number of switching times / time schedule	16bit	R

Controller state

1050	Operation State ON 0 = OFF, 1 = ON	1bit	R/W
1051	Operation state Standby – Comfort 0 = **Comfort**, 1 = Standby	1bit	R/W
1052	Operation State Heat – Cool 1 = **Heat**, 0 = Cool	1bit	R/W
1053	Operation state Celsius – Fahrenheit 0 = **Celsius**, 1 = Fahrenheit	1bit	R/W
1054	Operation state Fan Only 0 = **Fan Only disabled** 1 = Fan Only enabled	1bit	R/W
1055	Operation state Enable Time Schedules 0 = **Time Schedules disabled** 1 = Time Schedules enabled	1bit	R/W
1080	Year (0…99) (future feature)	BCD format	R/W
1081	Month (1…12) (future feature)	BCD format	R/W
1082	Day (1…31) (future feature)	BCD format	R/W
1083	DoW (Day of the week 1…7)	BCD format	R/W
1084	Hour (00…23)	BCD format	R/W
1085	Minute (00…59)	BCD format	R/W
1086	Second (00…59)	BCD format	R/W
1099	Broadcast packet network address change enable bit*	1bit	R/W

Changing address of controller through broadcast message:

* Address "1099" needs to be written to "1", if the ModBus master wants that the ModBus slave(s) accept the broadcast packet and value in the special case of the ModBus network address change. Trying to change the network address with a broadcast packet to its address ("13003") without writing "1" to address "1099" first will result in the value being not changed at register address "13003". The value of register at address "1099" can be read and written any time. At power-up, its value is "0". Every time a read or write of another register at any other address is performed, the value of register at address "1099" gets re-set to "0". This procedure prevents accidental broadcast messages to be accepted to set the network address of each node to the same value. Only the specific sequence of actions – as listed above – will result in a successful change of network address with a broadcast message. Please note that normal *addressed* writes to register at address "13003" will work without limitation or the requirement of specific sequence of events.

Inputs

Address	Input	Description	Range	R/W
1100	UI1	universal input 1 state, 0 = not active / error, 1 = ok	Bit	R
1101	UI1	Unit of universal input 0 = no unit 1 = % 2 = °C /°F 3 = Pa	8bit	R
1102	UI1	Value Multiplier: "**1**" means a multiplication factor of **0.1** "10" means a multiplication factor of 1 "100" means a multiplication factor of 10	8bit	R
1103	UI1	Value	16bit	R
1104	UI2	universal input 2 state, 0 = not active / error, 1 = ok	Bit	R
1105	UI2	Unit of universal input (explanation as in 1101)	8bit	R
1106	UI2	Value Multiplier (explanation as in 1102)	8bit	R
1107	UI2	Value	16bit	R
1108	UI3	universal input 3 state, 0 = not active / error, 1 = ok	Bit	R
1109	UI3	Unit of universal input (explanation as in 1101)	8bit	R
1110	UI3	Value Multiplier (explanation as in 1102)	8bit	R
1111	UI3	Value	16bit	R
1112	UI4	universal input 4 state, 0 = not active / error, 1 = ok	Bit	R
1113	UI4	Unit of universal input (explanation as in 1101)	8bit	R
1114	UI4	Value Multiplier (explanation as in 1102)	8bit	R
1115	UI4	Value	16bit	R
1116	UI5	universal input 5 state, 0 = not active / error, 1 = ok	Bit	R
1117	UI5	Unit of universal input (explanation as in 1101)	8bit	R
1118	UI5	Value Multiplier (explanation as in 1102)	8bit	R
1119	UI5	Value	16bit	R
1120	UI6	universal input 6 state, 0 = not active / error, 1 = ok	Bit	R
1121	UI6	Unit of universal input (explanation as in 1101)	8bit	R
1122	UI6	Value Multiplier (explanation as in 1102)	8bit	R
1123	UI6	Value	16bit	R
1124	UI7	universal input 7 state, 0 = not active / error, 1 = ok	Bit	R
1125	UI7	Unit of universal input (explanation as in 1101)	8bit	R
1126	UI7	Value Multiplier (explanation as in 1102)	8bit	R
1127	UI7	Value	16bit	R
1128	UI8	universal input 8 state, 0 = not active / error, 1 = ok	Bit	R
1129	UI8	Unit of universal input (explanation as in 1101)	8bit	R
1130	UI8	Value Multiplier (explanation as in 1102)	8bit	R
1131	UI8	Value	16bit	R
1132	VI9	universal input 9 state, 0 = not active / error, 1 = ok	Bit	R
1133	VI9	Unit of universal input (explanation as in 1101)	8bit	R
1134	VI9	Value Multiplier (explanation as in 1102)	8bit	R
1135	VI9	Value	16bit	R/W
1136	VI10	universal input 10 state, 0 = not active / error, 1 = ok	Bit	R
1137	VI10	Unit of universal input (explanation as in 1101)	8bit	R
1138	VI10	Value Multiplier (explanation as in 1102)	8bit	R
1139	VI10	Value	16bit	R/W

Virtual inputs

The TCX2 can operate with external inputs. To activate, program the virtual input to use it as external input of the communication module: for example 9u00 = 2 (Address 3800 = 2) or 10u00 = 2 (Address 3900 = 2, see static address list on page 8).
Set minimum and maximum display value, unit and multiplication according the inputs requirement in the universal input parameters of the TCX2.
Then program the master to write in not less than 60 seconds intervals the value to the dynamic address of the corresponding input. The time out for universal inputs is set to 130 seconds. The initial startup delay is 200 seconds. The value address for UI9 for example is 1135, for UI10 it is 1139.

Exceeding the timeout will lead to the universal input to be disabled. If the input is assigned as control input, the configuration error ERR4 will be displayed. Re-writing to the universal input, will re-enable the input but will not clear error 4. Error 4 may only be cleared by switching the controller on and off or by pressing the OPTION key with the key pad.

The ID of the virtual input follows after the physical inputs. For example a controller with 8 universal inputs and 2 virtual inputs would have the virtual inputs as address 9 and 10.

Control loop

Address	Loop	Description	Range	R/W
1200	Loop 1	Control input state	8Bit	R
1201	Loop 1	Control loop sequence 1 = heating, 0 = cooling	1bit	R
1202	Loop 1	Control input unit	8 bit	R
1203	Loop 1	Control input value	16bit	R
1204	Loop 1	Saved Setpoint	8Bit	R/W
1205	Loop 1	Calculated Setpoint	8Bit	R
1206	Loop 1	Proportional output	8bit	R
1207	Loop 1	Binary output	8Bit	R
1208	Loop 2	Control input state	8Bit	R
1209	Loop 2	Control loop sequence 1 = heating, 0 = cooling	1bit	R
1210	Loop 2	Control input unit	8 bit	R
1211	Loop 2	Control input value	16bit	R
1212	Loop 2	Saved Setpoint	8Bit	R/W
1213	Loop 2	Calculated Setpoint	8Bit	R
1214	Loop 2	Proportional output	16bit	R
1215	Loop 2	Binary output	8Bit	R
1216	Loop 3	Control input state	8Bit	R
1217	Loop 3	Control loop sequence 1 = heating, 0 = cooling	1bit	R
1218	Loop 3	Control input unit	8 bit	R
1219	Loop 3	Control input value	16bit	R
1220	Loop 3	Saved Setpoint	8Bit	R/W
1221	Loop 3	Calculated Setpoint	8Bit	R
1222	Loop 3	Proportional output	16bit	R
1223	Loop 3	Binary output	8Bit	R
1224	Loop 4	Control input state	8Bit	R
1225	Loop 4	Control loop sequence 1 = heating, 0 = cooling	1bit	R
1226	Loop 4	Control input unit	8 bit	R
1227	Loop 4	Control input value	16bit	R
1228	Loop 4	Saved Setpoint	8Bit	R/W
1229	Loop 4	Calculated Setpoint	8Bit	R
1230	Loop 4	Proportional output	16bit	R
1231	Loop 4	Binary output	8Bit	R

Analog Outputs

Address	AO	Description	Range	R/W
1300	AO1	State Bit 0: 0 = not active / error, 1 = ok Bit 1: 0 = automatic mode, 1 = manual mode	8Bit	R
1301	AO1	Current value	16bit	R
1302	AO1	Override value (Only applies if output set to manual)	16bit	R/W
1303	AO2	State, 0 = not active / error, 1 = ok	8Bit	R
1304	AO2	Current value	16bit	R
1305	AO2	Override value (Only applies if output set to manual)	16bit	R/W
1306	AO3	State, 0 = not active / error, 1 = ok	8Bit	R
1307	AO3	Current value	16bit	R
1308	AO3	Override value (Only applies if output set to manual)	16bit	R/W

Digital Outputs

Address	DO	Description	Range	R/W
1400	DO1	State Bit 0: 0= Floating mode is OFF, 1 = Floating mode is ON Bit 1: 0= not active / error, 1 = active and ok Bit 2: 0 = automatic mode, 1 = manual mode Bit 3: 0 = PWM not active, 1 = PWM active Bit 6: 0 = Run time totalizer disabled, 1 = Run time totalizer ON Bit 7: 0 = Run time limit not reached, 1 = Run time limit reached Bit 3 to 7 only apply if Bit 0 = 0 (non floating output)	8Bit	R
1401	DO1	Current value	1bit	R
1402	DO1	Override value (Only applies if output set to manual)	1bit	R/W
1403	DO2	State, as on 1400	8Bit	R
1404	DO2	Current value	1bit	R
1405	DO2	Override value (Only applies if output set to manual)	1bit	R/W
1406	DO3	State, as on 1400	8Bit	R
1407	DO3	Current value	1bit	R
1408	DO3	Override value (Only applies if output set to manual)	1bit	R/W
1409	DO4	State, as on 1400	8Bit	R
1410	DO4	Current value	1bit	R
1411	DO4	Override value (Only applies if output set to manual)	1bit	R/W
1412	DO5	State, as on 1400	8Bit	R
1413	DO5	Current value	1bit	R
1414	DO5	Override value (Only applies if output set to manual)	1bit	R/W
1415	DO6	State, as on 1400	8Bit	R
1416	DO6	Current value	1bit	R
1417	DO6	Override value (Only applies if output set to manual)	1bit	R/W

Fans

Address	FAN	Description	Range	R/W
1500	FAN1	State Bit 0/1:= Current fan output Bit 2: 0= not active / error, 1 = active and ok Bit 3: automatic mode, 1 = manual mode Bit4/5: = Total number of fan speeds Bit 6: 0 = Fan startup delay pending, 1 = fan startup delay expired Bit 7: 0 = no fan alarm, 1 = Fan feedback alarm pending	8Bit	R
1501	FAN1	Current value	1Bit	R
1502	FAN1	Override value	16bit	R/W
1503	FAN2	State, 0 = not active / error, 1 = ok	8Bit	R
1504	FAN2	Current value	1Bit	R
1505	FAN2	Override value	16Bit	R/W

Alarms

Address	ALARM	Description	Range	R/W
1600	ALA1	Alarm active 0 = not active, 1 = active	1Bit	R
1601	ALA1	Alarm confirmed, 0 = confirmed, 1 = not confirmed	1Bit	R/W*
1602	ALA2	Alarm active 0 = not active, 1 = active	1Bit	R
1603	ALA2	Alarm confirmed, 0 = confirmed, 1 = not confirmed	1Bit	R/W*
1604	ALA3	Alarm active 0 = not active, 1 = active	1Bit	R
1605	ALA3	Alarm confirmed, 0 = confirmed, 1 = not confirmed	1Bit	R/W*
1606	ALA4	Alarm active 0 = not active, 1 = active	1Bit	R
1607	ALA4	Alarm confirmed, 0 = confirmed, 1 = not confirmed	1Bit	R/W*
1608	ALA5	Alarm active 0 = not active, 1 = active	1Bit	R
1609	ALA5	Alarm confirmed, 0 = confirmed, 1 = not confirmed	1Bit	R/W*
1610	ALA6	Alarm active 0 = not active, 1 = active	1Bit	R
1611	ALA6	Alarm confirmed, 0 = confirmed, 1 = not confirmed	1Bit	R/W*
1612	ALA7	Alarm active 0 = not active, 1 = active	1Bit	R
1613	ALA7	Alarm confirmed, 0 = confirmed, 1 = not confirmed	1Bit	R/W*
1614	ALA8	Alarm active 0 = not active, 1 = active	1Bit	R
1615	ALA8	Alarm confirmed, 0 = confirmed, 1 = not confirmed	1Bit	R/W*

*) Writable to 0 = confirmed only if state is 1 = not confirmed;

Static Address List

With these addresses the settings may be changed of the controller. They correspond with the parameter settings for the addressed TCX2 controller. The address is calculated by the parameter number of the controller, the number of the function minus 1 and then multiplied with 100 and the table below. For example the address for parameters for universal input 3 start at address: (3-1) x 100 + 3000 = 3200.

Description	1	2	3	4	5	6	7	8	9	10	11	12
User settings	2000											
Universal input	3000	3100	3200	3300	3400	3500	3600	3700	3800	3900		
Control Loop	5000	5100	5200	5300								
Analog Output	6000	6100	6200									
Binary Output	7000	7100	7200	7300	7400	7500						
Fan output	8000	8100										
Alarm	9000	9100	9200	9300	9400	9500	9600	9700				
Functions	10000	10100	10200	10300	10400							
Time Schedules	11100	11200	11300	11400	11500	11600	11700	11800	11900	12000	12100	12200
Communication	13000											

Time schedule Settings

Time schedules are slightly special as they do not operate with parameters. Time Schedules addresses start at address 11000. To remotely change time schedule settings, follow the table below.

Address	Module	Description	Range	R/W
11000	General	Enable time schedules	1bit	R/W
Table+0	SCHED1	Time of time schedule event	time	R/W
Table+1	SCHED1	Active days of time schedule event (bits) Bit 0 = Day 1 (Monday) Bit 1 = Day 2 (Tuesday) Bit 2 = Day 3 (Wednesday) Bit 3 = Day 4 (Thursday) Bit 4 = Day 5 (Friday) Bit 5 = Day 6 (Saturday) Bit 6 = Day 7 (Sunday)	8bit	R/W
Table+2	SCHED1	Type of time schedule: 0 = Disabled 1 = Operation mode 2 = Control loop setpoint 3 = Analog output setpoint 4 = Fan output 5 = Binary output	8bit	R/W
Table+3	SCHED1	ID of time schedule: Will show only if type of schedule is not operation mode.	8bit	R/W
Table+4	SCHED1	Type of times schedule is operation mode: 0 = OFF, 1 = Economy, 2 = ON For all other types: Setpoint	8bit	R/W