EC DRIVES IN VTS DEVICES

SPECIFICATION, PROGRAMMING, OPERATION

v1.2 (11.2023)

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Please read the following documentation carefully before installing, maintaining and operating EC drives. In case of doubt, contact the official VTS support. This manual may only be used by a qualified service representative.

1. SAFETY ISSUES

All drives described in this manual may only be operated, connected, installed, repaired and modified by qualified personnel. Failure to perform any of these operations correctly may result in death, electric shock, improper installation, or product damage. The installation should be carried out with undamaged cables and with proper grounding. Follow the pinout diagrams dedicated to your drives.

Do not open or disassemble the drive while power is connected to the device. This can cause fatal injury due to electric shock. If disassembly is necessary, wait at least 5 minutes after disconnecting from the power supply.

It is the responsibility of the user and installer to ensure that the system is properly grounded and protected in accordance with national and local standards. VTS is not responsible for any damages or injuries caused by incorrect installation, faulty electrical circuits or other failures.

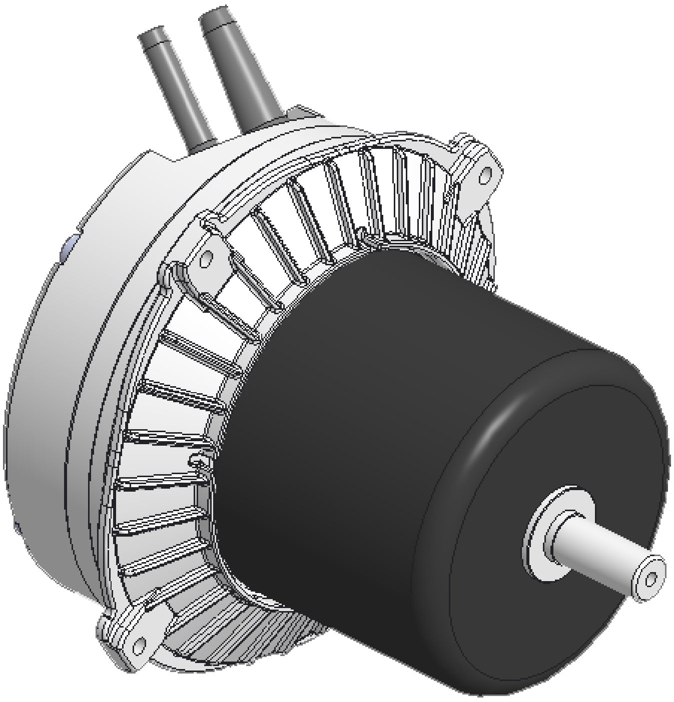
2. PRODUCT DESCRIPTION AND TECHNICAL SPECIFICATION

Air handling units and other selected VTS devices can be equipped with various configurations of EC drives, tailored to the needs and requirements of customers.

Type	Rated speed [RPM]	Maximum output power [kW]	Regulator type - power [kW]	Supply voltage [V]
Axial 444 Cross flow WING 200	1400	0.30	0.37	1x230
Axial 420	1340	0.21	0.37	1x230
Axial 315	1400	0.08	0.37	1x230
Cross flow WING 100 WING 150	1340	0.21	0.37	1x230
Plug 190	4500	0.17	0.17	1x230
Plug 225	3600	0.35	0.37	1x230
Plug 225	4500	0.76	0.75	1x230
Plug 250	3000	0.35	0.37	1x230
Plug 250	3800	0.70	0.75	1x230
Plug 315	2060	0.37	0.37	1x230
Plug 315	2600	0.72	0.75	1x230
Plug 310	3160	1.50	1.50	3x400
Plug 355	3200	2.40	2.40	3x400

Table 1 – types of EC drives

VTS reserves the right to change the given configurations without prior notice. Any modifications or configuration changes other than those proposed must first be reported and consulted with the VTS technical department.



Picture 1 – 1-phase 0.75kW EC drive

Picture 2 – 3-phase 1.5kW EC drive

3. INSTALLATION

3.1 Cable requirements

In the case of modular AHUs (without factory wiring between the drives and the electrical box), only hard wire or copper wires with ferrules should be used for wiring.

The length of control cables should not exceed 20m for 0-10V control and 40m for Modbus control.

To reduce operational problems, control cables must be shielded.

Use cables that meet the voltage, current, load, and insulation requirements for the type of drive you are using.

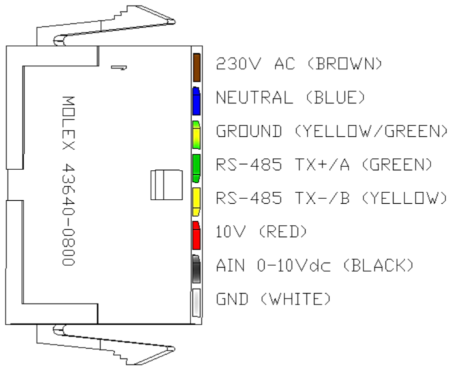
Use appropriate protection in the electrical installation. If the fuses are damaged, replace them with the same value as those used at the factory.

Before connecting the power supply, make sure that the drive specifications on the nameplate match the supply voltage.

3.2 Pinout

3.2.1 0.17 / 0.37 / 0.75kW

The 0.17kW, 0.37kW and 0.75kW drives are equipped with a common power supply and communication cable. It is terminated with a connector adapted for connection in AHU control boxes.



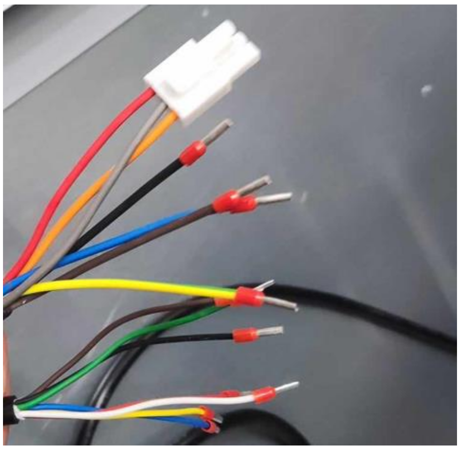
Picture 3 – 0.17 / 0.37 / 0.75kW EC drives power - control cable pinout

Color	Function	Remarks
green	RS485 A (+)	Modbus RTU
yellow	RS485 B (-)	Modbus RTU
red	10V output	-
black	0-10V input	-
white	0-10V GND	-
yellow - green	PE	-
brown	L	-
blue	N	-

Table 2 – 0.17 / 0.37 / 0.75kW EC drives pinout

3.2.2 1.5 / 2.4kW

The 1.5kW and 2.4kW drives are equipped with two separate cables: power supply and communication. They are terminated with cable sleeves and a connector. The cable with the connector (fault relay) is not used in VTS automation.



Picture 4 – 1.5 / 2.4kW EC drives power - control cable pinout

Color	Function	Remarks
brown	RS485 A (+)	Modbus RTU; there are two brown wires - the communication wire has a smaller cross-section than the power wire
black	RS485 B (-)	Modbus RTU; there are two black wires - the communication wire has a smaller cross-section than the power wire
green	RS485 GND	Modbus RTU
white	FG (pulse output)	2 pulses per rotation
red	10V output	-
yellow	0-10V input	-
blue	0-10V GND	there are two blue wires - the communication wire has a smaller cross-section than the power wire
brown	L1	there are two brown wires - the communication wire has a smaller cross-section than the power wire
blue	L2	there are two blue wires - the communication wire has a smaller cross-section than the power wire
black	L3	there are two black wires - the communication wire has a smaller cross-section than the power wire
yellow - green	PE	-
orange	NO contact of the fault relay	-
grey	COM contact of the fault relay	-
red	NC contact of the fault relay	-

Table 3 – 1.5 / 2.4kW EC drives pinout

4. COMMUNICATION OPTIONS

4.1 Factory addressing and communication type

EC drives are equipped with Modbus RTU and 0-10V control.

The table below shows the default settings of drives in VTS AHU depending on the type of the AHU:

X	Ventus		Compact			
			Standing		Suspended	
	Automation	No automation	Automation	No automation	Automation	No automation
Communication	**Modbus**	**0-10V**	**Modbus**	**Modbus**	**Modbus**	**0-10V**
Addresses	supply: 41,42,43,44,45,46,47,48,49,40 exhaust: 51,52,53,54,55,56,57,58,59,50					

Table 4 - factory settings of EC drives

To enable correct communication between EC drives and the uPC3 controller, select the appropriate drive type in the first line of settings on the I03 mask:

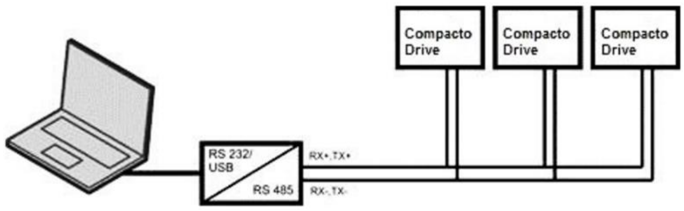
- 0.17 / 0.37 / 0.75kW: **EC**
- 1.5 / 2.4kW: **SNMU**

4.2 Modbus RTU

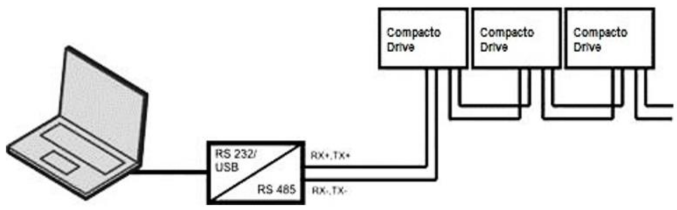
The basic method of communication between EC drives and the AHU controller used in VTS automation is a serial transmission in the Modbus RTU (RS-485) protocol with the **parameters 9600/8/n/1.**

Drives control systems can be connected to the Modbus grid only by means of shielded cables (screens should be grounded on both sides).

Use parallel or daisy chain connection when connecting EC drives to the bus.



Picture 5 – parallel connection



Picture 6 - "daisy chain" connection

4.2.1 Available Modbus registers – 0.17 / 0.37 / 0.75kW drives

Coils – read / write			
Address	**Function**	**Range**	**Remarks**
0	Motor on / off	0/1	1 = motor on (read only)
1	Controller reset	0/1	1 = controller reset

Table 5 – available Coils - 0.17 / 0.37 / 0.75kW drives

Discrete Inputs – read / write			
Address	**Function**	**Range**	**Remarks**
0	Undervoltage	0/1	1 = voltage too low to operate
1	Overvoltage	0/1	1 = voltage too high to operate
2	IGBT overcurrent	0/1	1 = overcurrent protection active
3	Motor hot	0/1	1 = temperature protection active; power reduced
4	Phase loss	0/1	1 = phase or motor sync loss
6	Checksum error	0/1	1 = parameters checksum fail (TBD)
7	Circuit fault	0/1	1 = error was detected during internal check
8	Motor fault	0/1	1 = motor does not behave as expected
9	Controller hot	0/1	1 = controller to hot to operate
10	I2R IGBT fault	0/1	1 = software IGBT protection triggerred
14	Restart fault	0/1	1 = fault condition repeated several times in a short time; controller should be power cycled
18	Waiting to stop	0/1	1 = motor should be stopped, but it is still spinning
24	RPM REG	0/1	1 = speed regulator active
25	POWER REG	0/1	1 = power limit regulator active
27	OVERMOD REG	0/1	1 = overmodulation; controller can no longer supply the voltage required by the motor
28	REGEN REG	0/1	1 = motor is in regeneration mode; RPM incerased tp avoid DC bus overvoltage
29	IPHASE REG	0/1	1 = RMS motor phase current limit reached
30	SYNC REG	0/1	1 = motor is in synchronous mode

Table 6 - available Discrete Inputs - 0.17 / 0.37 / 0.75kW drives

Holding Registers – read / write				
Address	**Function**	**Range**	**Resolution**	**Remarks**
0	Setpoint	0 - 10000	0,01%	Speed setpoint 0 = stop 10000 = maximum speed
1	Direction	0/1	1	Rotation direction 0 = clockwise 1 = anti-clockwise
2	MAX RPM	MIN RPM - RATED RPM	1	Maximum allowed speed
4	MIN RPM	10% RATED RPM - MAX RPM	1	Minimum allowed speed
5	Password	0 - 32767	1	9788 = password for changing parameters 10000 = password for saving changes

6	Control mode	0/2	1	0 = 0-10V control 2 = Modbus control
7	Modbus address	1 - 247	1	Address in Modbus grid
8	Communication loss reaction	0/1	1	0 = motor stop when Modbus communication lost 1 = ignore
11	AN1 MAX	0 – 1000	0,01V	Control input voltage for maximum setpoint; operation reverse if AN1 MAX < AN1 MIN
12	AN1 MIN	0 – 1000	0,01V	Control input voltage for minimum setpoint
13	AN1 STOP	0 – 1000	0,01V	Control input voltage for stop
18	Baudrate	0/1/2/3	1	1 = 9600 2 = 19200 3 = 38400

Table 7 - available Holding Registers - 0.17 / 0.37 / 0.75kW drives

Input registers - read				
Address	**Function**	**Range**	**Resolution**	**Remarks**
0	HW version	0 - 32767	1	Hardware version
1	FW version	0 - 32767	1	Firmware version
4	Speed	0 - 32767	1RPM	Actual motor speed
5	Temperature	-50 - 150	0,01°C	Controller temperature
6	DC voltage	0 - 32767	0,1V	DC bus voltage
7	Current	0 - 32767	0,001A	Motor current
8	Power	0 - 32767	0,1W	Electrical power
9	AN	-300 - 2000	0,01V	Analog input voltage
19	Fault code	0/1/2/3/4/5/6/7	1	Fault code (ordered by priority): 0 = normal operation 1 = standby 2 = overcurrent protection activated (If>4A) 3 = temperature protection activated (> 90°C speed is decreased, > 105°C motor stops) 4 = internal controller fault 5 = motor misconnected / faulty 6 = too low (<150V) or too high (>265V) supply voltage 7 = motor failed to start repeatedly
23	Operation minutes	0 – 1440	1	Minutes of operation
24	Operation days	0 - 32767	1	Days of operation (RPM > 0, no errors)

Table 8 - available Input Registers - 0.17 / 0.37 / 0.75kW drives

4.2.2 Available Modbus registers – 1.5 / 2.4kW drives

Input registers - read				
Address	**Function**	**Range**	**Resolution**	**Remarks**
26883	Status	0 - 65535	1	1 in bit 0 means that the running test has passed
26884	Sequencer state	0/1/2/3/4/5/6/7/8	1	0 = power on 1 = stop 2 = measuring offset current 3 = charging bootstrap capacitors 4 = motor running 5 = fault state

				6 = catch spin 7 = parking 8 = open loop acceleration
26885	Modbus address	0 – 255	1	Address in Modbus grid
26887	Fault flag	0 - 65535		Odczyt bitowy 0 = PWM fault 1 = DC bus critical overvoltage 2 = DC bus overvoltage 3 = DC bus undervoltage 4 = PLL fault 5 = zero speed fault 6 = temperature too high 7 = locked rotor 10 = controller error 12 = parameter load fault 13 = communication fault
26894	Speed	0 – 65535	1RPM	Actual motor speed
26895	Current	0 – 65535	0,01A	Motor current
26900	DC voltage	0 – 65535	1V	DC bus voltage
26902	IGBT temperature	-2000 – 2000	0,1°C	Transistor temperature
26904	Controller temperature	-2500 – 2500	0,1°C	Controller temperature
26908	Power on minutes	0 - 59	1min	Minutes when controller was powered
26909	Power on hours	0 – 65535	1h	Hours when controller was powered
26917	Rated speed	0 – 65535	1RPM	Rated speed of a given drive model
26918	Work minutes	0 - 59	1min	Minutes of operation
26919	Work hours	0 – 65535	1h	Hours of operation

Table 9 - available Input Registers – 1.5 / 2.4kW drives

Holding Registers – read / write				
Address	**Function**	**Range**	**Resolution**	**Remarks**
26627	Baudrate	9600 / 19200	1	9600 = baudrate 9600 19200 = baudrate 19200
26628	Control mode	0/1	1	0 = Modbus control 1 = 0-10V control
26629	Failsafe speed	0 – MAX RPM	1RPM	Motor target speed when in failsafe mode
26630	Fire speed	0 – MAX RPM	1RPM	Motor target speed when in fire mode
26632	MAX RPM	0 – RATED RPM	1RPM	Maximum allowed speed
26641	Communication loss alarm delay	0 – 65000	0,01s	Time before communication alarm is activated
26644	Parity	0/1/2	1	0 = no parity check 1 = odd 2 = even
26645	Stop bits	1/2	1	1 = 1 stop bit 2 = 2 stop bits

26648	Setpoint	10% RATED RPM – MAX RPM	1RPM	Speed setpoint
26653	Communication alarm source	0/1/2	1	0 = Modbus 1 = 0-10V 2 = none
26662	Alarm relay function	0/1/2	1	0 = fault indication function 1 1 = running operation 2 = fault indication function 2
26668	Failsafe voltage level	0-100	0,1V	Control voltage level, below which alarm is activated when HR26653 = 1
26669	Modbus address	0-255	1	Address in Modbus grid

Table 10 - available Holding Registers – 1.5 / 2.4kW drives

4.3 0-10V

In addition to Modbus RTU, VTS EC drives have the ability to be controlled using 0-10V analog signal.

Terminals to which the control signal should be connected are indicated in *3.2 Pinout* chapter.

One should also make sure that the drive control mode is set to 0-10V:

- 0.17 / 0.37 / 0.75kW: **Holding Register 6 = 0**
- 1.5 / 2.4kW: **HR 26628 = 1**

5. Adaptation of new EC drives to work with VTS automation

When ordering individual EC drives as spare parts, they will have the following settings:

X	0.17 / 0.37 / 0.75kW	1.5 / 2.4kW
address	1	129
baudrate	9600	19200
parity control	none	even
stop bits	1	1

Table 11 - default settings for EC drives ordered as spare parts

In order to adapt a new EC drive, ordered as a spare part, to work with a given air handling unit, the following are necessary:

-USB-RS485 converter (e.g. Ultima TRB-0611 or other based on FTDI chipset)

-power cable to the motor (L1+N+PE for 0.17 / 0.37 / 0.75kW (1-phase) drives; L1+L2+L3+PE (3-phase) for 1.5 / 2.4kW drives)

- Modbus master software (e.g. Modbus Poll)

Attention! VTS units are delivered with factory-adapted drives. The following steps only apply to drives ordered separately as spare parts.

After connecting the motor to the power supply and the converter, establish a connection with the motor in the Modbus Poll program in accordance with the default parameters presented in *Table 11*, and then, respectively:

- **for 0.17 / 0.37 / 0.75kW (1-phase) drives:**
  - set Holding Register 5 to value 9788 (password for changing parameters)
  - set HR 6 to 2 (control mode = Modbus)
  - set HR 8 to 0 (communication loss reaction = motor stop)
  - set HR 7 to the value corresponding to the drive address in the AHU - after this change, the connection with the drive should be re-established at the selected address with the following parameters: baudrate 9600, no parity check, 1 stop bit
  - set HR 5 to 10000 (password for saving changes)

For 0.17 / 0.37 / 0.75kW (1-phase) drives there is also the possibility of adaptation using HMI Advanced (without using a converter). To do this, enter the old (default 1) and new (according to *Table 5*) address on the I15 mask and start the setting procedure by selecting the *YES* option. Note that only one drive should be powered up at a time during the procedure.

- **for 1.5 / 2.4kW (3-phase) drives:**
  - set Holding Register 26628 to value 0 (control mode = Modbus)
  - set HR 26629 to 0 (failsafe speed = 0)
  - set HR 26653 to 0 (communication alarm source = Modbus)
  - set HR 26627 to 9600 (baudrate = 9600) - after this change, the connection with the drive should be re-established at address 129 with the following parameters: baudrate 9600, even parity, 1 stop bit
  - set HR 26644 to 0 (no parity check) - after this change, the connection with the drive should be re-established at address 129 with the following parameters: baudrate 9600, no parity check, 1 stop bit
  - set HR 26669 to the value corresponding to the drive address in the AHU