TAC4 Regulation
+
SAT KNX Module

Installation and user's manual

P.LEMMENS
AIR MOVEMENT COMPANY

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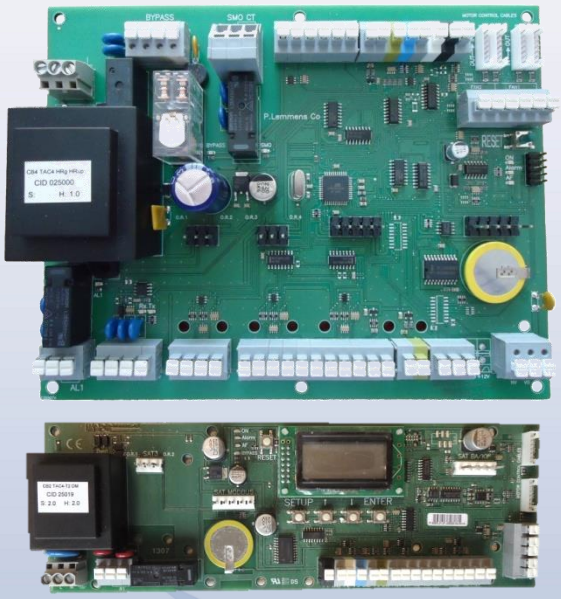

PARTNER KNX

P.LEMMENS
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1. FUNCTIONALITIES OF THE REGULATION

The TAC4 control boards are mounted in the HRglobal *[TAC4 DG]*, HRup *[TAC4 DG],* HRflat *[TAC4 DG]* and HRmural *[TAC4 DM]* units.

The functionalities of the TAC4 control boards are described in detail in the "MI TAC4 DG + RC" and "MI Regulation TAC4 DM" manuals.

The TAC4 control boards provide the following functionalities:

- Control of supply and exhaust fans in constant air flow (CA), constant pressure (CPs) and constant airflow linked to a 0-10V signal (LS) mode.
- Management of 6 time slots.
- Default, set point and pressure alarms.
- Management of airflows in case of fire alarm.
- BOOST function that helps to force the supply and exhaust airflows to a value set beforehand- overriding all configurations and conditions.
- Automatic management of the bypass for free cooling (100% bypass on HRglobal-Up-flat units and 70% bypass in HRmural unit).
- Automatic management of the opening and closing of valves mounted on the suction side (via SAT3 – OR2 on HRmural unit.
- Anti-frost protection of the heat recovery exchanger by modulation of the supply airflow or by regulating the power of the pre-heating electric coil (KWin). *[TAC4 DG] , [TAC4 DT]*
- Regulation of the post-heating water (NV) or electric (KWout) coils to maintain a constant supply temperature. *[TAC4 DG] , [TAC4 DT]*
- Display of the settings and working fans
- Analogical output signals of airflow and pressure. *[TAC4 DG] , [TAC4 DT]*
- Advanced setup

The following options can be combined with the TAC4 control board:

- Option SAT TAC4 BA/KW:
  Regulation of 2 external heat exchangers (hot and/or cold).

- SAT3 Option :
  Circuit with 2 relays for
  - Information about the « Pressure alarm » (on O.R.1)
  - Information about the « FAN ON » (or the control of damper(s) CT *[TAC4 DM]*) (on O.R.2).

  and/or *[TAC4 DG], [TAC4 DT]*
  - Status of NV option circulator (on O.R.3)
  - Information about the status of the « bypass » (on O.R.4)

- Option RC TAC4: *[TAC4 DG]*
  Local remote control that can be used for the configuration, display and control of the TAC4 unit to which it is connected.

SAT KNX option is not compatible with SAT Modbus option and so neither with GRC nor TCP/IP-GPRS option too.

To have more details, see the install manual of each option

2. OPERATING PRINCIPLE

The SAT KNX enable to link one or several TAC4 (DM, DG and DT) units on a KNX TP (Twisted Pair) type network. It will be then possible to drive and monitor the units by this network through the ETS™ software which is provided by the KNX association or through other KNX devices by group objects associations.

The units configuration should be done beforehand locally (via RC or directly on TAC4 DM).

2.1 KNX Network

2.1.1 Topology

The devices are linked on a line of the KNX network. They can reach a theoretical maximum of 256 but the real limit is 64 on KNX TP network (see KNX network specification).Each line must have a KNX power supply (24VDC and coil). 16 lines can be grouped by line couplers to form areas. Those areas can themselves be linked with area couplers till a maximum of 16 on a line called main line or «Backbone ». Figure 1 shows this topology.

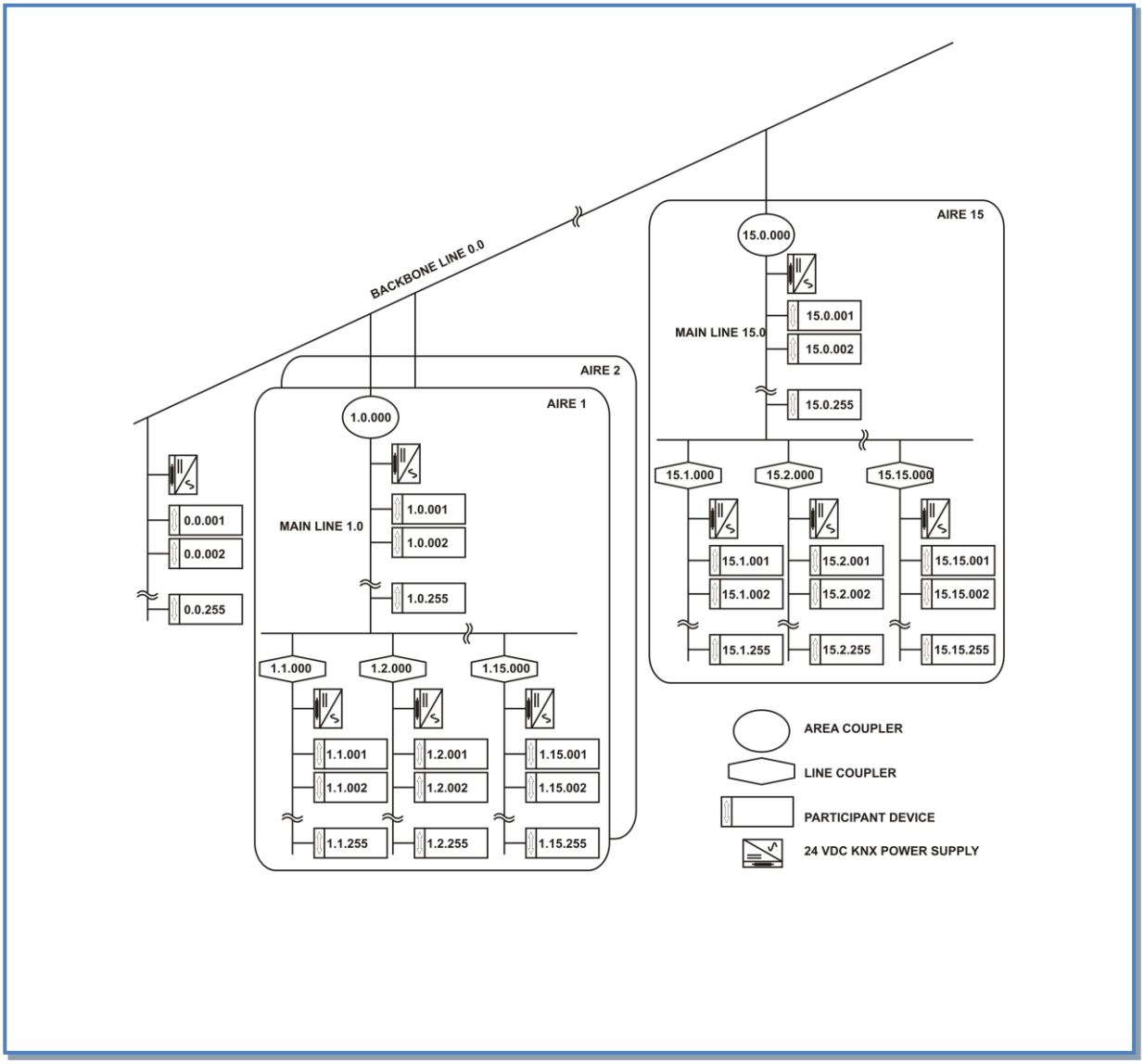


Figure 1 – KNX Network Topology

2.1.2 Individual Addresses

The devices will each have an individual address which is unique on the network. This individual address will match the location of the device in the network topology. It is made up by 4 bits identifying the area, 4 bits the line and 8 the device (see figure 2). The individual address can be programmed by ETS™.

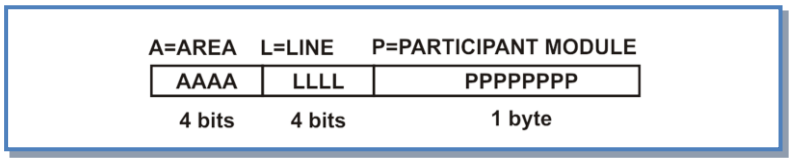


Figure 2 – Individual address structure

2.1.3 Selecting, configuring and programming

The ETS™ software supplied by the KNX association enables the KNX network management.
The different devices to connect on the network can be selected by this software and be inserted in the network according to the desired topology.
The devices parameters concerned with the network optimisation can be configured through ETS™.
ETS™ will also enable the programming of the individual address of the device upon which the programming button shall be pressed.

2.1.4 Group Objects

The KNX devices can have one or several memory locations called group objects which size can range from 1 bit to 14 bytes according to the object functionality.

The different value types are defined by the datapoints which include the data type and the size. The data type is itself based on the format and coding of the data while the size is based on the range (max and min value) and the unit (see figure 3). The datapoints are identified by a name, the DPT_NAME and by 2 numbers separated by a point (main number and sub-number), the DPT_ID. They are classified in 5 big categories detailed in annex 1. The datapoints are standardized and allow the compatibility on the bus of devices from different manufacturers (see the most frequent in annex 2).

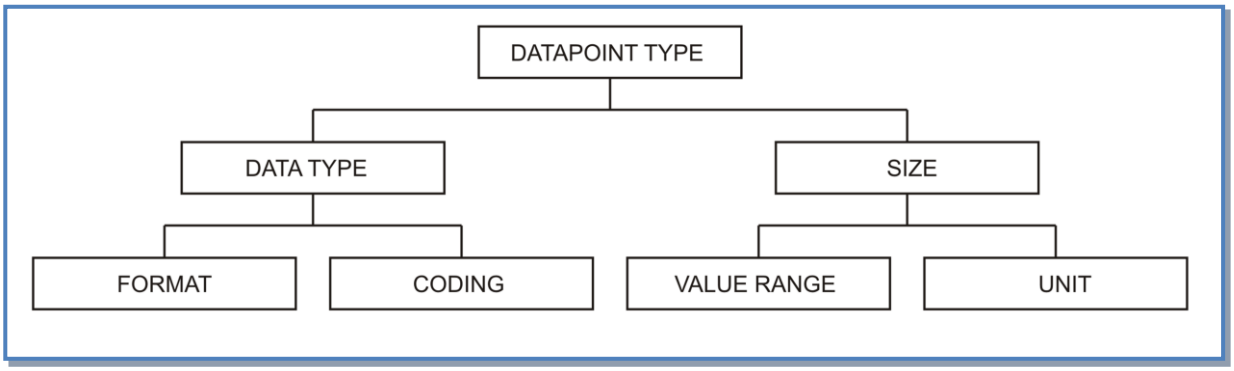


Figure 3 – datapoint composition

The value changes can be communicated on the bus by different types of telegrams and the communication related behaviour of each group object is defined by flags:

- Communication:
  - Active flag: the object has a normal link to the bus.
  - Inactive flag: The telegrams are validated. The group object is not modified.

- READ:
  - Active flag: the object value can be read by the bus.
  - Inactive flag: the object value cannot be read by the bus.

- WRITE:
  - Active flag: the value of the object can be modified by the bus.

    - Inactive flag: the value of the object cannot be modified by the bus.

- TRANSMIT:
    - Active flag: a telegram is transmitted when the group object value has changed.
    - Inactive flag: the group object will send an answer only after the reception of a reading request.

- UPDATE:
    - Active flag: the answer telegram values are interpreted as writing command. The value of the group object is updated.
    - Inactive flag: the answer telegram values are not interpreted as writing command. The value of the group object stays unchanged.

- READ ON INIT:
    - Active flag: the device sends independently the value read command for the initialization of the group object after the switch on.
    - Inactive flag: after the switch on, the device doesn't initialize the value of the assigned objects with value read command.

The default values of these flags should not be modified.

2.1.5 Group Address and Associations

The devices group objects can be grouped by functionalities and associated to each other for interacting provided that they are of the same datapoint type. The grouping is done by giving a group address which can have the following structures:

- Level 3 address: made of 5 bits (values ranging from 0 to 31) to identify the main group, 3 bits (values ranging from 0 to 7) to identify the middle group and 8 bits (from 0 to 255) for the subgroup.
- Level 2 address: same as level 3 without the middle group
- Free group: address id defined with the 16 available bits (from 0 to 65535).

The address 0/0/0 is reserved for broadcast messages sent to all the devices on the bus.
The ETS™ software enables to create the different groups levels and to associate the group addresses to the desired group objects.
Several group objects from different devices but with the same datapoint type can receive the same group address, this way and according to their respective communication flags, the value change of a group object at this address will be transmitted to all the other objects with the same group address and these ones, once more according to their communications flags, will update their value to the one transmitted.
It is important to distinguish the group addresses of the group objects of the device with the individual address of that device, which will be used to find it on the network and to program it. The individual address is unique on the network and associated to the device, the group address is not unique on the network and is associated to the group objects of that device. A device can have one or several group objects.

3. WIRING OF SAT KNX

Just switch off and plug the SAT KNX on the « MODBUS » connector on the TAC4 board (figure 4).

Warning: plugging the SAT KNX in the wrong connector on the TAC4 board can be fatal to both circuits!

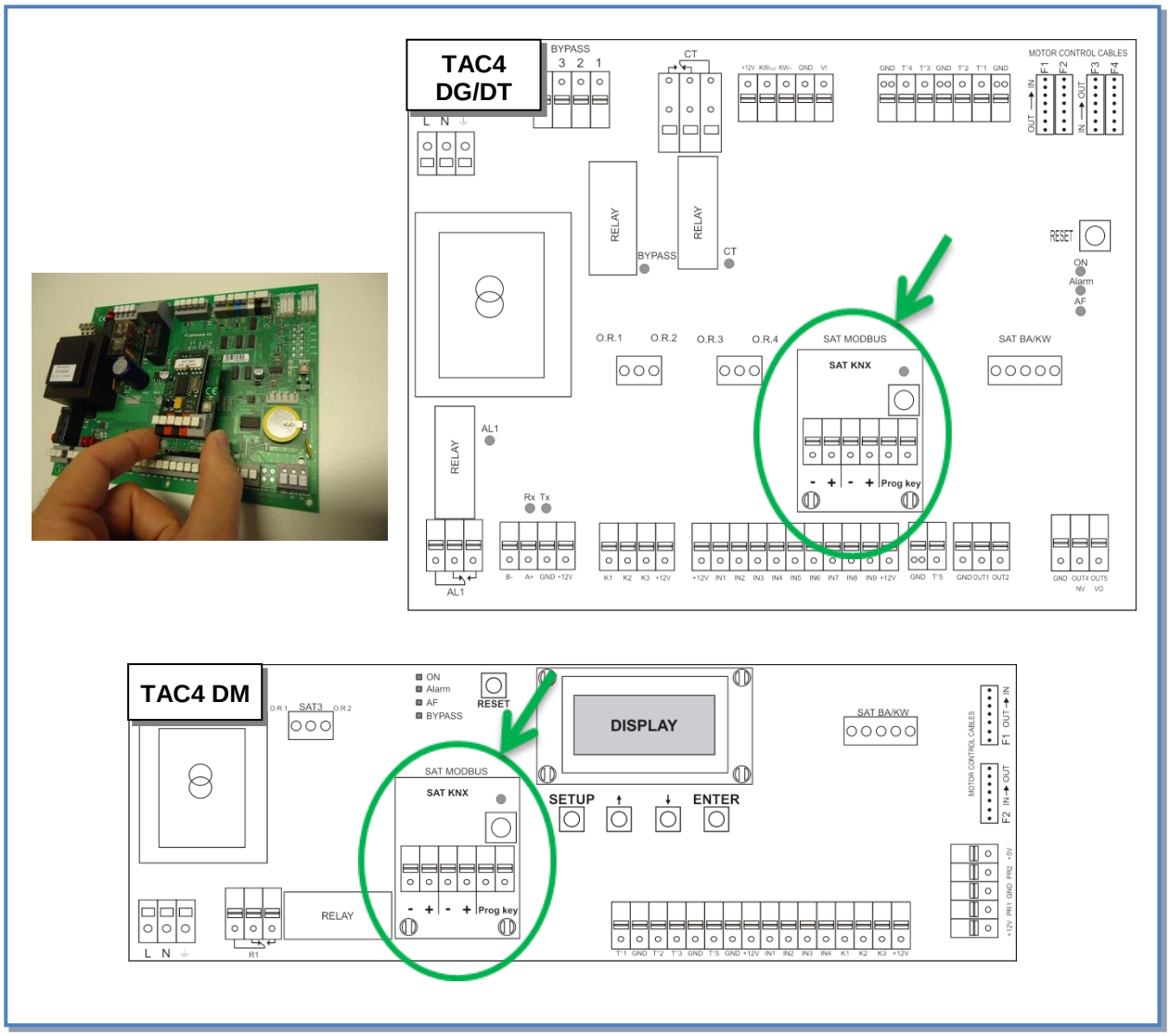


Figure 4 - Plugging of SAT KNX on the TAC4 control board

Then, connect the SAT KNX to the KNX network as shown in figure 5 and in respect with the KNX TP network specification (see point 4).

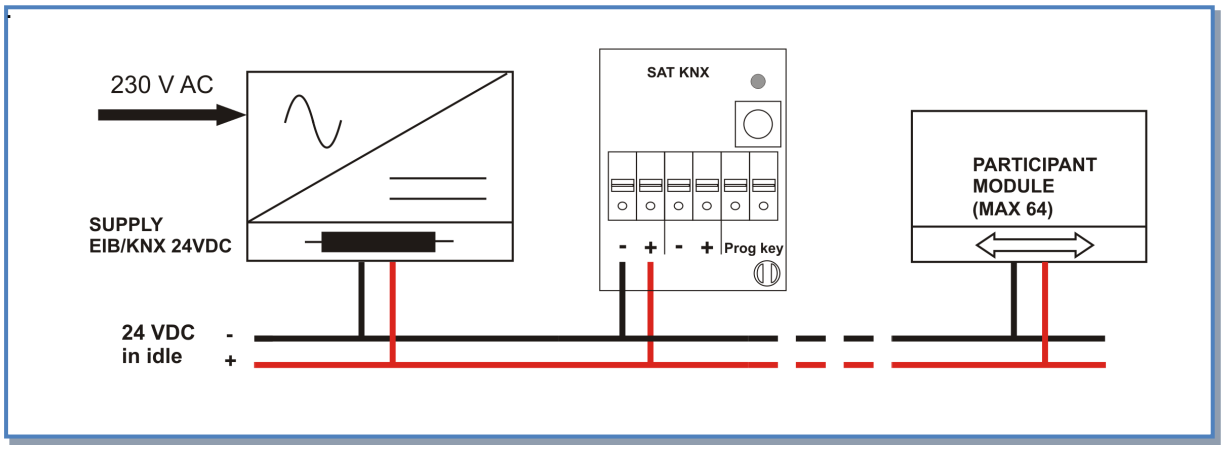


Figure 5 – Wiring to the KNX Network

4. GROUP OBJECTS OF THE SAT KNX MODULE

The group objects of the SAT KNX are listed in the following categories where the data flow direction is given by I (Input) or O (Output):

4.1 Drive

The SAT KNX group objects of the drive category are listed and detailed in table 1:

N.	Name	I/O	Size	Type (DPT)	Flags (CRWTU)	Function
1	Pilot - Main switch – Switch	I	1 bit	DPT 1.001	C-W-U	Turn fans on or off. If turned on and group object *<Airflow - Supply flow - Value>* or *<Airflow - Exhaust flow - Value>* is set to a value > 0, then the fans are started in 'constant airflow' mode. If turned on and group objects *<Airflow - Supply flow - Value>* and *<Airflow - Exhaust flow - Value>* are set to 0, then the fans are started in the mode that is configured. The intention is to control the HVAC using <u>one</u> of the following group objects: use <Pilot - Main switch - Switch> or <Pilot - Fan speed 1 on/off - Switch>..<Pilot - Fan speed 3 on/off - Switch> or <Pilot - Speed % - Value> or <Pilot - Set Supply flow % - Value> and <Pilot - Set Exhaust flow % - Value> (using a mix might get confusing)
2	Pilot - Main switch – State	O	1 bit	DPT 1.001	CR-T-	Shows if HVAC unit is currently On or Off. 'On' means fans running. Is always sent on start up.
3	Pilot - Fan speed 1 on/off - Switch	I	1 bit	DPT 1.001	C-W-U	Select fans speed 1. Writing value 1 activates speed 1 and resets the other *<Pilot - Fan speed * on/off - Switch>* group objects. Writing 0 stops fans.
4	Pilot - Fan speed 2 on/off -	I	1 bit	DPT 1.001	C-W-U	Select fans speed 2. Writing value 1 activates speed 2 and resets the other *<Pilot - Fan speed * on/off - Switch>* group objects.

N.	Name	I/O	Size	Type (DPT)	Flags (CRWTU)	Function
	Switch					Writing 0 stops fans.
5	Pilot - Fan speed 3 on/off - Switch	I	1 bit	DPT 1.001	C-W-U	Select fans speed 3. Writing value 1 activates speed 3 and resets the other *<Pilot - Fan speed * on/off - Switch>* group objects. Writing 0 stops fans.
6	Pilot - Fan speed 1 on/off - State	O	1 bit	DPT 1.001	CR-T-	Is 'On' if fans are running with speed 1 (LOW speed)
7	Pilot - Fan speed 2 on/off - State	O	1 bit	DPT 1.001	CR-T-	Is 'On' if fans are running with speed 2 (MEDIUM speed)
8	Pilot - Fan speed 3 on/off - State	O	1 bit	DPT 1.001	CR-T-	Is 'On' if fans are running with speed 3 (HIGH speed)
9	Pilot - Speed % - Value	I	1 byte	DPT 5.001 DPT_Scaling	C-W-U	Select fans speed with a percentage value. 0 - 9%: Fans OFF 10 - 39%: LOW speed 40 - 69%: MEDIUM speed 70 - 100%: HIGH speed
10	Pilot - Speed % - State	O	1 byte	DPT 5.001 DPT_Scaling	CR-T-	Shows the current fans speed as a percentage: 0% if fans are OFF, 33% for LOW speed, 66% for MEDIUM speed, 100% for HIGH speed.
11	Pilot - Set Supply flow % - Value	I	1 byte	DPT 5.001 DPT_Scaling	C-W-U	Set supply flow as 0..100% of the fan's max flow. This overrides the normal control via the viewer OFF/I/II/III buttons. If set: forces 'constant airflow' mode with independent airflow setpoints for supply and exhaust fans. If group object *<Airflow - Supply flow - Value>* or *<Airflow - Exhaust flow - Value>* is changed and either is set to a value > 0, then the 'constant airflow' mode is activated and the fans are started. If group object *<Airflow - Supply flow - Value>* or *<Airflow - Exhaust flow - Value>* is changed and both are set to 0, then the 'constant airflow' mode is terminated and the fans are stopped. Normal control via the viewer is resumed. (DPT 5.001: Value 0..255 means 0..100%).
12	Pilot - Set Supply flow % - State	O	1 byte	DPT 5.001 DPT_Scaling	CR-T-	Feedback of group object *<Airflow - Supply flow - Value>*
13	Pilot - Set Exhaust flow % - Value	I	1 byte	DPT 5.001 DPT_Scaling	C-W-U	Set exhaust flow as 0..100% of the fan's max flow. This overrides the normal control via the viewer OFF/I/II/III buttons. If set: forces 'constant airflow' mode with independent airflow setpoints for supply and exhaust fans. If group object *<Airflow - Supply flow - Value>* or *<Airflow - Exhaust flow - Value>* is changed and either is set to a value > 0, then the 'constant airflow' mode is activated and the fans are started. If group object *<Airflow - Supply flow - Value>* or *<Airflow - Exhaust flow - Value>* is changed and both are set to 0, then the 'constant airflow' mode is

N.	Name	I/O	Size	Type (DPT)	Flags (CRWTU)	Function
						terminated and the fans are stopped. Normal control via the viewer is resumed. (DPT 5.001: Value 0..255 means 0..100%).
14	Pilot - Set Exhaust flow % - State	O	1 byte	DPT 5.001 DPT_Scaling	CR-T-	Feedback of group object <*Airflow - Exhaust flow - Value*>
15	Pilot - Fans Running - State	O	1 bit	DPT 1.002	CR-T-	Shows that all fans (that should be running) are running. Is 1 (True) if fans are running. Is always sent on start up.
16	Pilot - Working hours - State	O	2 byte unsigned	DPT 7.007	CR-T-	Shows the number of working hours of the fans. 0 .. 65535 hours. If the number of working hours internally is over 65535 hours, it will be reported as 65535 hours in KNX.
17	Pilot - Reset working hours - Trigger	I	1 bit	DPT 1.015 DPT_Reset	C-W-U	Reset Fans working hours to zero 0 = no action. 1 = reset. Is turned off automatically.
18	Pilot - Reset pending alarms - Trigger	I	1 bit	DPT 1.015 DPT_Reset	C-W-U	Perform a RESET to clear pending alarms and resume normal working. 0 = no action. 1 = reset. Is turned off automatically.
19	Pilot - Working mode - State	O	1 byte	DPT 5	CR-T-	Value that shows the current working mode. This is an enumeration. Each value represents a certain working mode. 0 = Off (OFF) 1 = Constant airflow mode (CA) 2 = Linked system mode (LS) 3 = Constant air pressure mode (CPf) 4 = Constant air pressure mode with sensor (CPs) 5 = Initializing (INIT) 6 = Constant Torque mode (CT) 7-255: reserved

Table 1 SAT KNX Group objects – Drive category

4.2 Mode and functions

The SAT KNX group objects of the Mode and functions category are listed and detailed in table 2:

N.	Name	I/O	Size	Type (DPT)	Flags (CRWTU)	Function
31	CPs mode - Supply fan setpoint - Value	I	2 byte float	DPT 9.020	C-W-U	Set voltage setpoint for CPs mode for the supply fans. Range 0 .. 10000 mV. (voltage is internally stored with 0.1V resolution)
32	CPs mode - Supply fan setpoint - State	O	2 byte float	DPT 9.020	CR-T-	Feedback of group object <*CPs mode - Supply fan setpoint - Value*>
33	CPs mode - Exhaust fan setpoint - Value	I	2 byte float	DPT 9.020	C-W-U	Set voltage setpoint for CPs mode for the exhaust fans. Range 0 .. 10000 mV. (voltage is internally stored with 0.1V resolution)
34	CPs mode -	O	2	DPT	CR-T-	Feedback of group object <*CPs mode - Exhaust fan*

N.	Name	I/O	Size	Type (DPT)	Flags (CRWTU)	Function
	Exhaust fan setpoint - State		byte float	9.020		*setpoint - Value>*
35	CPf mode - Supply fan setpoint - Value	I	2 byte float	DPT 9.006	C-W-U	Set the pressure setpoint for CPf mode for the supply fans. Range 0 .. 1999 Pa. (pressure is internally stored with 1Pa resolution)
36	CPf mode - Supply fan setpoint - State	O	2 byte float	DPT 9.006	CR-T-	Feedback of group object <*CPf mode - Supply fan setpoint - Value*>
37	CPf mode - Exhaust fan setpoint - Value	I	2 byte float	DPT 9.006	C-W-U	Set the pressure setpoint for CPf mode for the exhaust fans. Range 0 .. 1999 Pa. (pressure is internally stored with 1Pa resolution)
38	CPf mode - Exhaust fan setpoint - State	O	2 byte float	DPT 9.006	CR-T-	Feedback of group object <*CPf mode - Exhaust fan setpoint - Value*>
39	Operation mode - Automatic on/off - Switch	I	1 bit	DPT 1.001	C-W-U	Turn 'automatic' mode on or off. In automatic mode, the HVAC is controlled using a timetable. Automatic mode can only be used if a timetable is configured.
40	Operation mode - Automatic on/off - State	O	1 bit	DPT 1.001	CR-T-	Shows if 'automatic' mode is on
41	Operation mode - Boost on/off - Switch	I	1 bit	DPT 1.001	C-W-U	Force boost mode on (high air flow).
42	Operation mode - Boost on/off - State	O	1 bit	DPT 1.001	CR-T-	Shows if boost mode is on
43	Bypass function - Force bypass on - Switch	I	1 bit	DPT 1.001	C-W-U	Force the bypass on (valve open or heatwheel stop). Normally, the bypass is controlled automatically. When this group object is set to 'on' the bypass function is forced on.
44	Bypass function - Force bypass on - State	O	1 bit	DPT 1.001	CR-T-	Feedback of group object <Bypass function - Force on - Switch>
45	Bypass function - Bypass on/off - State	O	1 bit	DPT 1.001	CR-T-	Shows if the bypass is on (valve open or heatwheel stop) or off. If the bypass valve is partially open, its status is reported as 'on'.
46	Air inlet function - Valve open/close - State	O	1 bit	DPT 1.009	CR-T-	Shows the status of the air inlet valve (CT-in option). (0=open, 1=closed) While the valve is opening, the status is reported as 'open'.

Table 2 SAT KNX Group objects – Mode and Function category

4.3 Flow, Pressure, Voltage, Temperature

The SAT KNX group objects of the Flow, Pressure, Voltage, Temperature category are listed and detailed in table 3:

N.	Name	I/O	Size	Type (DPT)	Flags (CRWTU)	Function
51	Airflow - Ratio exhaust/supply flow – Value	I	1 byte	DPT 5.004 DPT_Percent_U8	C-W-U	Set the desired exhaust flow / supply flow ratio. Range 5..255%. (DPT 5.004: Value 0..255 means 0..255%)
52	Airflow - Ratio exhaust/supply flow – State	O	1 byte	DPT 5.004 DPT_Percent_U8	CR-T-	Shows the configured exhaust flow / supply flow ratio. Range 5..255%. If the ratio is configured > 255% it will be reported as 255% in KNX.
53	Airflow - Sleep mode - Value	I	1 byte	DPT 5.001 DPT_Scaling	C-W-U	Set the desired sleep mode airflow reduction percentage. Range 10..100%. (this value is internally stored with 1% resolution) (DPT 5.001: Value 0..255 means 0..100%)
54	Airflow - Sleep mode - State	O	1 byte	DPT 5.001 DPT_Scaling	CR-T-	Shows the configured sleep mode airflow reduction percentage. Range 10..100%.
55	Fan 1 - Current airflow - State	O	2 byte float	DPT 9.009	CR-T-	Shows the current airflow of fan 1. Range 0..19999 m3/h. Transmission rate is controlled by parameter <*Minimum time until next current airflow or air pressure transmission*>.
56	Fan 1 - Current airpressure - State	O	2 byte float	DPT 9.006	CR-T-	Shows the current airpressure on fan 1. Range 0..11999 Pa. Transmission rate is controlled by parameter <*Minimum time until next current airflow/airpressure/torque transmission*>.
57	Fan 2 - Current airflow - State	O	2 byte float	DPT 9.009	CR-T-	Shows the current airflow of fan 2. Range 0..19999 m3/h. Transmission rate is controlled by parameter <*Minimum time until next current airflow/airpressure/torque transmission*>.
58	Fan 2 - Current airpressure - State	O	2 byte float	DPT 9.006	CR-T-	Shows the current airpressure on fan 2. Range 0..1999 Pa. Transmission rate is controlled by parameter <*Minimum time until next current airflow/airpressure/torque transmission*>.
59	Fan 3 - Current airflow - State	O	2 byte float	DPT 9.009	CR-T-	Shows the current airflow of fan 3. Range 0..19999 m3/h. Transmission rate is controlled by parameter <*Minimum time until next current airflow/airpressure/torque transmission*>.
60	Fan 3 - Current airpressure - State	O	2 byte float	DPT 9.006	CR-T-	Shows the current airpressure on fan 3. Range 0..1999 Pa. Transmission rate is controlled by parameter <*Minimum time until next current airflow/airpressure/torque transmission*>.
61	Fan 4 -	O	2	DPT	CR-T-	Shows the current airflow of fan 4. Range 0..19999

N.	Name	I/O	Size	Type (DPT)	Flags (CRWTU)	Function
	Current airflow - State		byte float	9.009		m3/h. Transmission rate is controlled by parameter <*Minimum time until next current airflow/airpressure/torque transmission*>.
62	Fan 4 - Current airpressure - State	O	2 byte float	DPT 9.006	CR-T-	Shows the current airpressure on fan 4. Range 0..1999 Pa. Transmission rate is controlled by parameter <*Minimum time until next current airflow/airpressure/torque transmission*>.
63	Supply fan - Current flow setpoint - State	O	2 byte float	DPT 9.009	CR-T-	Shows the current flow setpoint of the supply fans. Range 0 .. 19999 m3/h. One of these (m3/h, Pa or mV) will be used. The others will be 0. Transmission rate is controlled by parameter <*Minimum time until next fan setpoint transmission*>.
64	Supply fan - Current pressure setpoint - State	O	2 byte float	DPT 9.006	CR-T-	Shows the current pressure setpoint of the supply fans. Range 0 .. 1999 Pa. One of these (m3/h, Pa or mV) will be used. The others will be 0. Transmission rate is controlled by parameter <*Minimum time until next fan setpoint transmission*>.
65	Supply fan - Current voltage setpoint - State	O	2 byte float	DPT 9.020	CR-T-	Shows the current voltage setpoint of the supply fans. Range 0 .. 10000 mV. One of these (m3/h, Pa or mV) will be used. The others will be 0. Transmission rate is controlled by parameter <*Minimum time until next fan setpoint transmission*>.
66	Exhaust fan - Current flow setpoint - State	O	2 byte float	DPT 9.009	CR-T-	Shows the current flow setpoint of the exhaust fans. Range 0 .. 19999 m3/h. One of these (m3/h, Pa or mV) will be used. The others will be 0. Transmission rate is controlled by parameter <*Minimum time until next fan setpoint transmission*>.
67	Exhaust fan - Current pressure setpoint - State	O	2 byte float	DPT 9.006	CR-T-	Shows the current pressure setpoint of the exhaust fans. Range 0 .. 1999 Pa. One of these (m3/h, Pa or mV) will be used. The others will be 0. Transmission rate is controlled by parameter <*Minimum time until next fan setpoint transmission*>.
68	Exhaust fan - Current voltage setpoint - State	O	2 byte float	DPT 9.020	CR-T-	Shows the current voltage setpoint of the exhaust fans. Range 0 .. 10000 mV. One of these (m3/h, Pa or mV) will be used. The others will be 0. Transmission rate is controlled by parameter <*Minimum time until next fan setpoint transmission*>.
69	Temperature - T1 - State	O	2 byte float	DPT 9.001	CR-T-	Shows the T1 temperature, in °C. Transmission rate is controlled by parameter <*Minimum time until next current temperature transmission*>.
70	Temperature - T2 - State	O	2 byte float	DPT 9.001	CR-T-	Shows the T2 temperature, in °C. Transmission rate is controlled by parameter <*Minimum time until next current temperature transmission*>.
71	Temperature - T3 – State	O	2 byte float	DPT 9.001	CR-T-	Shows the T3 temperature, in °C. Transmission rate is controlled by parameter <*Minimum time until next current temperature transmission*>.
72	Temperature – T4 – State	O	2 byte float	DPT 9.001	CR-T-	Shows the T4 temperature, in °C. Transmission rate is controlled by parameter <*Minimum time until next current temperature transmission*>.
73	Temperature - T5 –	O	2 byte	DPT 9.001	CR-T-	Shows the T5 temperature, in °C. Transmission rate is controlled by parameter <*Minimum*

N.	Name	I/O	Size	Type (DPT)	Flags (CRWTU)	Function
	State		float			*time until next current temperature transmission*>.
74	Temperature – T7 – State	O	2 byte float	DPT 9.001	CR-T-	Shows the T7 temperature, in °C. Transmission rate is controlled by parameter <*Minimum time until next current temperature transmission*>.
75	Temperature – T8 - State	O	2 byte float	DPT 9.001	CR-T-	Shows the T8 temperature, in °C. Transmission rate is controlled by parameter <*Minimum time until next current temperature transmission*>.

Table 3 SAT KNX Group objects – Flow, Pressure, Voltage, Temperature category

4.4 Heat/Cool exchanger

The SAT KNX group objects of the Heat/Cool exchanger category are listed and detailed in table 4:

N.	Name	I/O	Size	Type (DPT)	Flags (CRWTU)	Function
81	Postheating - On/Off - Switch	I	1 bit	DPT 1.001	C-W-U	Switch the postheating on or off. Normally, postheating is enabled. Then it is controlled automatically. Postheating can be switched off by setting this group object to 'Off'.
82	Postheating - On/Off - State	O	1 bit	DPT 1.001	CR-T-	Feedback of group object <*Postheating - On/Off - Switch*>
83	Postheating - Temperature setpoint - Value	I	2 byte float	DPT 9.001	C-W-U	Sets the desired postheating temperature. In degrees Celsius. Range 0 .. 99,9°C.
84	Postheating - Temperature setpoint - State	O	2 byte float	DPT 9.001	CR-T-	Feedback of group object <*Postheating - Temperature setpoint - Value*>
85	Postcooling - On/Off - Switch	I	1 bit	DPT 1.001	C-W-U	Switch the postcooling on or off. Normally, postcooling is enabled. Then it is controlled automatically. Postcooling can be switched off by setting this group object to 'Off'.
86	Postcooling - On/Off - State	O	1 bit	DPT 1.001	CR-T-	Feedback of group object <*Postcooling - On/Off - Switch*>
87	Postcooling - Temperature setpoint - Value	I	2 byte float	DPT 9.001	C-W-U	Sets the desired postcooling temperature. In degrees Celsius. Range 0 .. 99,9°C.
88	Postcooling - Temperature setpoint - State	O	2 byte float	DPT 9.001	CR-T-	Feedback of group object <*Postcooling - Temperature setpoint - Value*>
89	Postheating /Postcooling - Antifreeze on/off - State	O	1 bit	DPT 1.001	CR-T-	Shows if the antifreeze for the external postheating (BA+) or postcooling (BA-) units is activated.

N.	Name	I/O	Size	Type (DPT)	Flags (CRWTU)	Function
90	Postheating /Postcooling - Heating/Cooling - Switch	I	1 bit	DPT 1.100 DPT_Heat/Cool	C-W-U	Selects 'heating' or 'cooling'. If 'cooling' is selected, cooling is enabled and heating is disabled. If 'heating' is selected, heating is enabled and cooling is disabled. 0 = cooling. 1 = heating.
91	Postheating /Postcooling- Heating/Cooling - State	O	1 bit	DPT 1.100 DPT_Heat/Cool	CR-T-	Shows if heating or cooling is selected. 0 = cooling. 1 = heating.
92	Postheating /Postcooling - On/Off - State	O	1 bit	DPT 1.001	CR-T-	Shows if heating or cooling is on.
93	Postheating /Postcooling - Current setpoint - State	O	2 byte float	DPT 9.001	CR-T-	Shows the current setpoint for heating/cooling setpoint temperature. Range 0 .. 99.9 °C.
94	Heat exchanger - Antifreeze on/off - State	O	1 bit	DPT 1.001	CR-T-	Shows if the antifreeze for the internal heat exchanger or NV is activated.
95	Freecooling - Temperature setpoint - Value	I	2 byte float	DPT 9.001	C-W-U	Sets the desired freecooling temperature. In degrees Celsius. Range 0 .. 99,9°C.
96	Freecooling - Temperature setpoint – State	O	2 byte float	DPT 9.001	CR-T-	Feedback of group object <Freecooling - Temperature setpoint - Value>

Table 4 SAT KNX Group objects – Heat/Cool exchanger category

4.5 Alarms

The SAT KNX group objects of the Alarms category are listed and detailed in table 5:

N.	Name	I/O	Size	Type (DPT)	Flags CRWTU	Function
101	Alarm - Pressure - Trigger	I	1 bit	DPT 1.005	C-W-U	Force a pressure alarm. Intended for external overpressure detector. 0 = no alarm. 1 = alarm.
102	Alarm - Fire - Trigger	I	1 bit	DPT 1.005	C-W-U	Set the fire alarm on. Intended for external fire alarm I. 0 = no alarm. 1 = alarm.
103	Alarm - State	O	1 bit	DPT 1.005	CR-T-	Shows that an alarm (non-fatal or fatal) is pending. 0 = no alarm, 1 = alarm. Alarm number is in group object <*Alarm - Number - State*> Is always sent on start up.
104	Alarm - Fatal - State	O	1 bit	DPT 1.005	CR-T-	Shows that a fatal alarm is pending. Ventilation is stopped. 0 = no alarm, 1 = alarm. Alarm number is in group object <Alarm - Number -

N.	Name	I/O	Size	Type (DPT)	Flags CRWT U	Function
						State> Is always sent on start up.
105	Alarm - Number - State	O	1 byte	DPT 5	CR-T-	Value that shows the pending alarm. This is an enumeration. Each value represents a certain alarm. 0 = No alarm 1 = Software alarm: The program code in flash has a checksum error, or the configuration data in eeprom has a checksum error. Fatal. 2 = Fan alarm: a fan is defective. Fatal. 3 = Pressure alarm: overpressure. 4 = T° sensor alarm: a temperature sensor is defective. Fatal. 5 = Setpoint alarm: can't reach the requested setpoint. 6 = Service warning alarm. 7 = Stop-for-service alarm. Fatal. 8 = Fire Alarm. Fatal. 9 = Antifrost alarm: in antifreeze mode. 10 = Condensate drain pan is full. 11-255: reserved. Is always sent on start up.

Table 5 SAT KNX Group objects – Alarms category

4.6 Analogue Input/Output

The SAT KNX group objects of the Analogue Input/Output category are listed and detailed in table 6:

N.	Name	I/O	Size	Type (DPT)	Flags CRWT U	Function
111	Analog input - K2 – State	O	1 byte	DPT 5.001 DPT_ Scaling	CR-T-	Shows the actual level on analogue input K2. Range 0..100%. (DPT 5.001: Value 0..255 means 0..100%). Transmission rate is controlled by parameter <*Minimum time until next input status transmission*>.
112	Analog input - K3 – State	O	1 byte	DPT 5.001 DPT_ Scaling	CR-T-	Shows the actual level on analogue input K3. Range 0..100%. (DPT 5.001: Value 0..255 means 0..100%). Transmission rate is controlled by parameter <*Minimum time until next input status transmission*>.
113	Analog output - OUT1 - State	O	1 byte	DPT 5.001 DPT_ Scaling	CR-T-	Shows the actual level on analogue output OUT1. In %. (DPT 5.001: Value 0..255 means 0..100%). Transmission rate is controlled by parameter <*Minimum time until next output status transmission*>.
114	Analog output - OUT4 - State	O	1 byte	DPT 5.001 DPT_ Scaling	CR-T-	Shows the actual level on analogue output OUT4. In %. (DPT 5.001: Value 0..255 means 0..100%). Transmission rate is controlled by parameter <*Minimum time until next output status transmission*>.
115	Analog output - OUT7 - State	O	1 byte	DPT 5.001 DPT_ Scaling	CR-T-	Shows the actual level on analogue output OUT7. In %. (DPT 5.001: Value 0..255 means 0..100%). Transmission rate is controlled by parameter <*Minimum time until next output status transmission*>.
116	Analog	O	1	DPT	CR-T-	Shows the actual level on analogue output OUT8. In %.

N.	Name	I/O	Size	Type (DPT)	Flags CRWTU	Function
	output - OUT8 - State		byte	5.001 DPT_Scaling		(DPT 5.001: Value 0..255 means 0..100%). Transmission rate is controlled by parameter <*Minimum time until next output status transmission*>.
117	Analog output - KWin - State	O	1 byte	DPT 5.001 DPT_Scaling	CR-T-	Shows the actual level on analogue output KWin. In %. (DPT 5.001: Value 0..255 means 0..100%). Transmission rate is controlled by parameter <*Minimum time until next output status transmission*>.
118	Analog output - KWout - State	O	1 byte	DPT 5.001 DPT_Scaling	CR-T-	Shows the actual level on analogue output KWout. In %. (DPT 5.001: Value 0..255 means 0..100%). Transmission rate is controlled by parameter <*Minimum time until next output status transmission*>.
119	Analog output - KWext - State	O	1 byte	DPT 5.001 DPT_Scaling	CR-T-	Shows the actual level on analogue output KWext. In %. (DPT 5.001: Value 0..255 means 0..100%). Transmission rate is controlled by parameter <*Minimum time until next output status transmission*>.
120	Bypass% - Position - State	O	1 byte	DPT 5.001 DPT_Scaling	CR-T-	Shows the position of the proportional bypass valve. 0% means closed, 100% means fully open. (DPT 5.001: Value 0..255 means 0..100%). Transmission rate is controlled by parameter <*Minimum time until next output status transmission*>.

Table 6 SAT KNX Group objects – Analogue Input/Output category

4.7 Constant Torque

The SAT KNX group objects of the Constant Torque category are listed and detailed in table 7:

N.	Name	I/O	Size	Type (DPT)	Flags CRWTU	Function
131	Fan 1 - Current torque - State	Output	1 byte	DPT 5.001 DPT_Scaling	CR-T-	Shows the torque on fan 1. Range 0..100%. Transmission rate is controlled by parameter <*Minimum time until next current airflow or air pressure transmission*>.
132	Fan 2 - Current torque - State	Output	1 byte	DPT 5.001 DPT_Scaling	CR-T-	Shows the torque on fan 2. Range 0..100%. Transmission rate is controlled by parameter <*Minimum time until next current airflow or air pressure transmission*>.
133	Fan 3 - Current torque - State	Output	1 byte	DPT 5.001 DPT_Scaling	CR-T-	Shows the torque on fan 3. Range 0..100%. Transmission rate is controlled by parameter <*Minimum time until next current airflow or air pressure transmission*>.
134	Fan 4 - Current torque - State	Output	1 byte	DPT 5.001 DPT_Scaling	CR-T-	Shows the torque on fan 4. Range 0..100%. Transmission rate is controlled by parameter <*Minimum time until next current airflow or air pressure transmission*>.
135	Supply fan - Current torque set point - State	Output	1 byte	DPT 5.001 DPT_Scaling	CR-T-	Shows the current torque set point of the supply fans. Range 0..100%. Transmission rate is controlled by parameter <*Minimum time until next fan set point transmission*>.
136	Exhaust fan	Out	1	DPT	CR-T-	Shows the current torque set point of the exhaust fans.

N.	Name	I/O	Size	Type (DPT)	Flags CRWT U	Function
	- Current torque setpoint - State	put	byte	5.001 DPT_ Scaling		Range 0..100%. Transmission rate is controlled by parameter <*Minimum time until next fan set point transmission*>.

Table 7 SAT KNX Group objects – Constant Torque category

4.8 Control and optimization parameters of the KNX bus

These parameters are not group objects and enable to control and to optimize the use of the KNX bus. They are listed in table 8:

N.	Name	Size /Type	Default value	Function
1	Delay before sending group objects (0 - 255 sec)	Byte	2	Delay before any group object is transmitted to the KNX bus after start up. Group objects are sent only if they change value. Range 0 .. 255 seconds.
2	Maximum number of messages sent per second (1 - 255)	Byte	10	To control KNX bus load. Limit the number of group objects transmitted per second. If the maximum number of messages sent per second is reached, further messages will be delayed until the next second. Range 1..255.
3	Minimum time until next fan setpoint transmission (0 - 255 sec)	Byte	5	To control KNX bus load. Sometimes fan setpoint values may change frequently. This parameter defines a minimum delay time before the same group object is sent again. Range 0..255 seconds.
4	Minimum time until next current airflow/airpressure/torque transmission (0 - 255 sec)	Byte	5	To control KNX bus load. The fan's current airflow and airpressure will change frequently. This parameter defines a minimum delay time before the same group object is sent again. Range 0..255 seconds.
5	Minimum time until next input status transmission (0 - 255 sec)	Byte	5	To control KNX bus load. Sometimes input values (mainly analogue inputs) may change frequently. This parameter defines a minimum delay time before the same group object is sent again. Range 0..255 seconds.
6	Minimum time until next current temperature transmission (0 - 255 sec)	Byte	30	To control KNX bus load. Sometimes temperature inputs may change frequently. This parameter defines a minimum delay time before the same group object is sent again. Range 0..255 seconds.
7	Minimum time until	Byte	5	To control KNX bus load. Sometimes output values 'mainly analogue outputs) may change frequently. This parameter defines a minimum

N.	Name	Size /Type	Default value	Function
	next output state transmission (0 - 255 sec)			delay time before the same group object is sent again. Range 0..255 seconds.

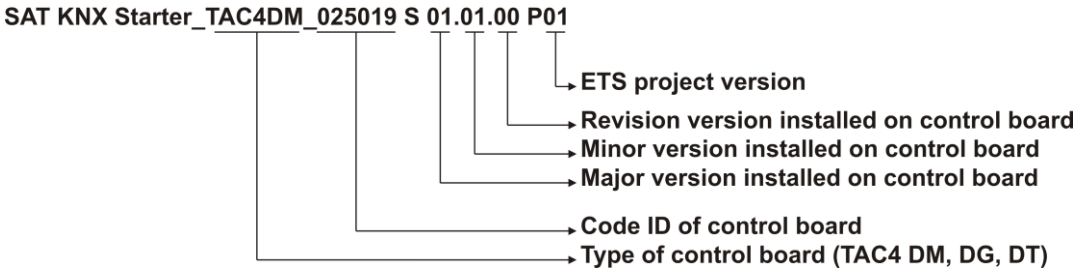
Table 8 Control and Optimization parameters of the KNX bus

5. INTEGRATION OF THE SAT KNX IN A ETS™ PROJECT (4 OR MAJOR)

The integration of the SAT KNX presumes and requires from the user the necessary knowledge of ETS™ software, version 4 or major provided by the KNX organization (see the site WWW.KNX.ORG).

5.1 SAT KNX start up project

Download from Lemmens website (www.Lemmens.com) the last SAT KNX Starter project matching the control board of the unit and the software version installed on it. In fact, the SAT KNX project are differentiated by TAC control board (TAC4 DG, TAC4 DM and TAC4 DT), by the software version installed on these boards and by the project version itself. The nomenclature of the projects on the site is as follows:



Unless stated otherwise, select the file with the highest project version and with the regulation software version identical to the one running on the board. If no matching regulation software version is available, take the one directly below in the order of the revision number, then minor version and finally major version.

Example :
The installed unit on site is HR MURAL 450 with TAC4 DM control board where software version 2.0.5 is running.

The KNX Starter projects on the website are:

- SAT KNX Starter_TAC4DG_025000 S 01.01.16 P01
- SAT KNX Starter_TAC4DG_025000 S 01.01.16 P02
- SAT KNX Starter_TAC4DG_025000 S 01.01.17 P01
- SAT KNX Starter_TAC4DM_025019 S 02.00.04 P01
- SAT KNX Starter_TAC4DM_025019 S 02.00.04 P02
- SAT KNX Starter_TAC4DM_025019 S 02.00.06 P01
- SAT KNX Starter_TAC4DT_025009 S 02.01.14 P01
- SAT KNX Starter_TAC4DT_025009 S 02.01.18 P01

SAT KNX Starter_TAC4DM_025019 S 02.00.04 P02 project must be chosen.

5.2 Include the SAT KNX device in a ETS™ project

Open the SAT KNX start up project with the ETS™ (version 4 or major) software and select the device « SAT KNX Lemmens » in the devices window. Add it then to the favourite.

Open the KNX project wherein the SAT KNX must be included and select the “SAT KNX Lemmens” device in the Favourite windows. Copy the device and paste it in the topology window at the desired row.
From now on, use the “SAT KNX Lemmens” device as any other KNX device with ETS™.

5.3 SAT KNX Commissioning

Once the project defined, the SAT KNX device can be commissioned by the ETS™ programming. Just push the SAT KNX programming button and the programming will begin. While programming, the red led will light.

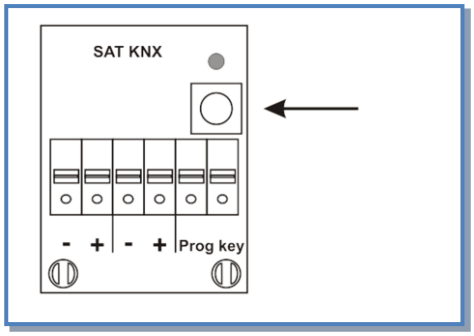


Figure 6 – Programming Button

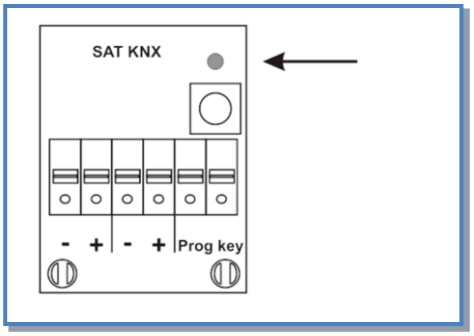


Figure 7 – Programming Led

6. KNX NETWORK SPECIFICATIONS

The KNX communication is based on the reference model OSI which define 7 layers characterized by their own functionalities. The transmitted data go from the highest layer to the lowest, each layers adding its specific information to build what is called the PDU (Protocol Data Unit). The received data go from the lowest layer to the highest, each layer using and withdrawing the data that are necessary for it and that have been added by the corresponding layer during the transmission.

The communication can be established in connected or unconnected mode.
- Connected mode: the message transmitting part first establishes a logical link for the connection with the addressed part. This link will be maintained during the entire communication.
- Unconnected mode: the transmitting part doesn’t establish a connection and send its messages to all the devices on the network during the entire communication that will last until the addressed part acknowledges the messages that are destined for it.

The 7 layers are listed here below with their description and implementation in KNX:

6.1 Layer 7 – Application

That is the application support for sending and receiving useful data. In KNX, that means on one side the use of the group object in the participating modules in unconnected communication mode, on the other side the building and treatment of the configuration messages («management service») which are sent to the modules during the commissioning phase in connected communication mode.

6.1.1 Application layer PDU - A_PDU

The different types of A_PDU in function of the 2 first bits of the T_PDU (transport layer PDU) are detailed in annex 3.

6.2 Layer 6 – Presentation

Not implemented in KNX

6.3 Layer 5 – Session

Not implemented in KNX

6.4 Layer 4 – Transport

6.4.1 In unconnected mode

Check the associations of the group objects in the bus devices with the group addresses:

6.4.1.1 During the transmission:

Ensure that the group address is sent with the value of the group object that has been modified.

6.4.1.2 During the reception:

Ensure that the values of all group objects whose group address is associated to the one received are updated.

6.4.2 In connected mode

To establish a communication in connected mode, the transmitter device will send a connection message using for destination address, the individual address of the receiving device.

During the connected mode established communication, the transport layer of each component will use the « ACK » and « NACK » messages of the transport layer to acknowledge or reject messages.

The rejected messages are repeated up to 3 times.

The communication is monitored by timers. If a telegram cannot be transmitted between a certain time interval or if neither a « ACK » nor a « NACK » have been received by the other part, the established communication is broken.

The connection is monitored by a sequence number that goes from 0 to 15 and if the sequence is not respected, the receiver will break the established communication.

6.4.3 Transport layer PDU - T_PDU

La T_PDU contains :

- 2 bits to indicate the communication type at transport level (00=Unnumbered Data Packet-UDP, 01=Numbered Data Packet-NDP, 10=Unnumbered Control Data-UCD, 11=Numbered Control Data-NCD)
- 4 bits for the sequential number (only for «Numbered » communication type, otherwise meaningless and set to 0).
- The rest of the T_PDU is the A_PDU, Application PDU (see point 6.1.1).

6.5 Layer 3 – Network

Ensures the routing of the data through the network nodes which are interconnected by links. In a KNX network, the links are the segment while the nodes are the area and the line couplers.
Loops between 2 lines are not allowed.
The network layer will add to the transmitted telegram a routing counter whose value will be evaluated only by the network layer of the coupler and by the modules.

For a value of 7, the telegram will always be routed to the receiving coupler. This value is allowed only for ETS™.

For a value from 1 to 6, the telegram will be routed by the coupler when:

In connected mode: the individual address present in the telegram as destination address is the one of a component placed at the opposite side than the one of the line or the area of the receiving coupler. During routing, the coupler will decrement the value of the routing counter.

In unconnected mode: the group address used in the telegram as destination address is inside its filter table.

With a 0 value, the telegram will not be routed by the area or line coupler.

6.5.1 Network layer PDU - N_PDU

The N_PDU is composed by the data of the network and the higher layers. The specific data for the network layer are represented by:

- Tb (1 bit) : it is a bit that indicates that the address of the receiver of the layer 2 data link PDU must be interpreted as an individual address or as a group address (see point 6.6.1.3).
- Rb (3 bits) : routing counter.
- Lb (4 bits) : useful length of the telegram
- T_PDU: Transport PDU (see point 6.4.3).

6.6 Layer 2 – Data link

Ensures the transmission of a telegram between 2 network nodes. The errors control informations will be inserted at this level.
This layer ensures also the collisions control due to simultaneous transmission and uses here the CSMA/CA system (Carrier Sense Multiple Access with Collision Avoidance). The maximum delay for collision detection is 10 µs.

6.6.1 Data link PDU - L_PDU

KNX telegram structure of the link layer (L_PDU) :

<table>
<tr><td rowspan="3">Control field (8 bits)</td><td rowspan="3">Source address (16 bits)</td><td rowspan="3">Receiver address (16 bits)</td><td colspan="3">N_PDU</td><td rowspan="3">Check field (8 bits)</td></tr>
<tr><td>8 bits</td><td colspan="2">T_PDU</td></tr>
<tr><td></td><td>6 bits</td><td>A_PDU</td></tr>
</table>

6.6.1.1 Control Field of the L_PDU

Structure (D7 to D0 represent 1 bit and D0 is the first sent):

D7	D6	D5	D4	D3	D2	D1	D0
1	0	/R	1	P	P	0	0

The values 0 or 1 must be kept otherwise the telegram is rejected.
D0 and D1 serve as preamble to the telegram and avoid interpreting the tension spikes as start bit.
The 2 bits P set the priority (00= Priority 1-system functions; 10=Priority 2-alarms functions; 01=Priority 3-normal mode, high priority; 11=Priority 4-normal mode, low priority). This priority is referred to the ones defined at level 7 for group objects and is passed through the layers down to layer 2.
The bit /R indicates that a telegram is repeated when its value is 0.
The priority bits have this value because a telegram with the first bit to 0 has the priority in case of collision (see layer 1).

6.6.1.2 Source address of the L_PDU

It is the individual address of the transmitter device.
Structure (D15 to D0 represent 1 bit and D0 is the first sent):

D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
Area 0=backbone 1 to 15=area				Line 0=main line 1 to 15=line				Device address 0=coupler 1 to 64=device >64=line extension, other line segment							

6.6.1.3 Receiver address of the L_PDU

It can be either the group address (in unconnected mode) or the individual address (in connected mode) of the receiver device. The indication will be done on the first bit of the N_PDU field (see below).
If this bit is 0, then the receiver address is its individual address and the structure is the same as the individual source address.
If this bit is 1, then the receiver address is its group address (with 2 or 3 levels hierarchy) and the structure is the following (D15 to D0 represent 1 bit and D0 is the first sent):

D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
	Main group				Sub group										
	Main group				Middle group			Sub group							

6.6.1.4 N_PDU field of the L_PDU

See point 6.5.1.

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6.6.1.5 Check field of the L_PDU

The technic for the errors detection is the «Cross check » that is the combination between the vertical parity check (parity bit per character) and the horizontal parity check (a control character whose each bit value is the parity of the character obtained by taking the corresponding bits on each transmitted character).

6.6.2 Telegrams acknowledge

The telegrams acknowledge is also supported by the link layer. The bus device or the area/line coupler sends an acknowledge between a specified time (« IACK », « INACK »). The « BUSY » acknowledge type controls the data flow. If the layer 2 of the emitter receives an INACK or BUSY message or an incorrect message or no IACK message, then it sends again the telegram. The repeated telegrams are marked with the bit 5 of the control field.

6.7 Layer 1 – Physical

This layer is concerned by the physical nature of the signal and converts the received bits of layer 2 in electrical signal in this case. The specifications and protocols of the media are supported by this layer.
The KNX network uses a serial bus and a time multiplexing: TDM (Time Division Multiplexing). The data transmission type is the base band one where the binary information is transmitted as bipolar rectangular pulses for ‘0’ bits, no pulse for ‘1’ bits and this allows the collision detection during simultaneous transmission since a device will read a ‘0’ on the bus while it is transmitting a ‘1’. The binary signals shape is illustrated in figure 8.

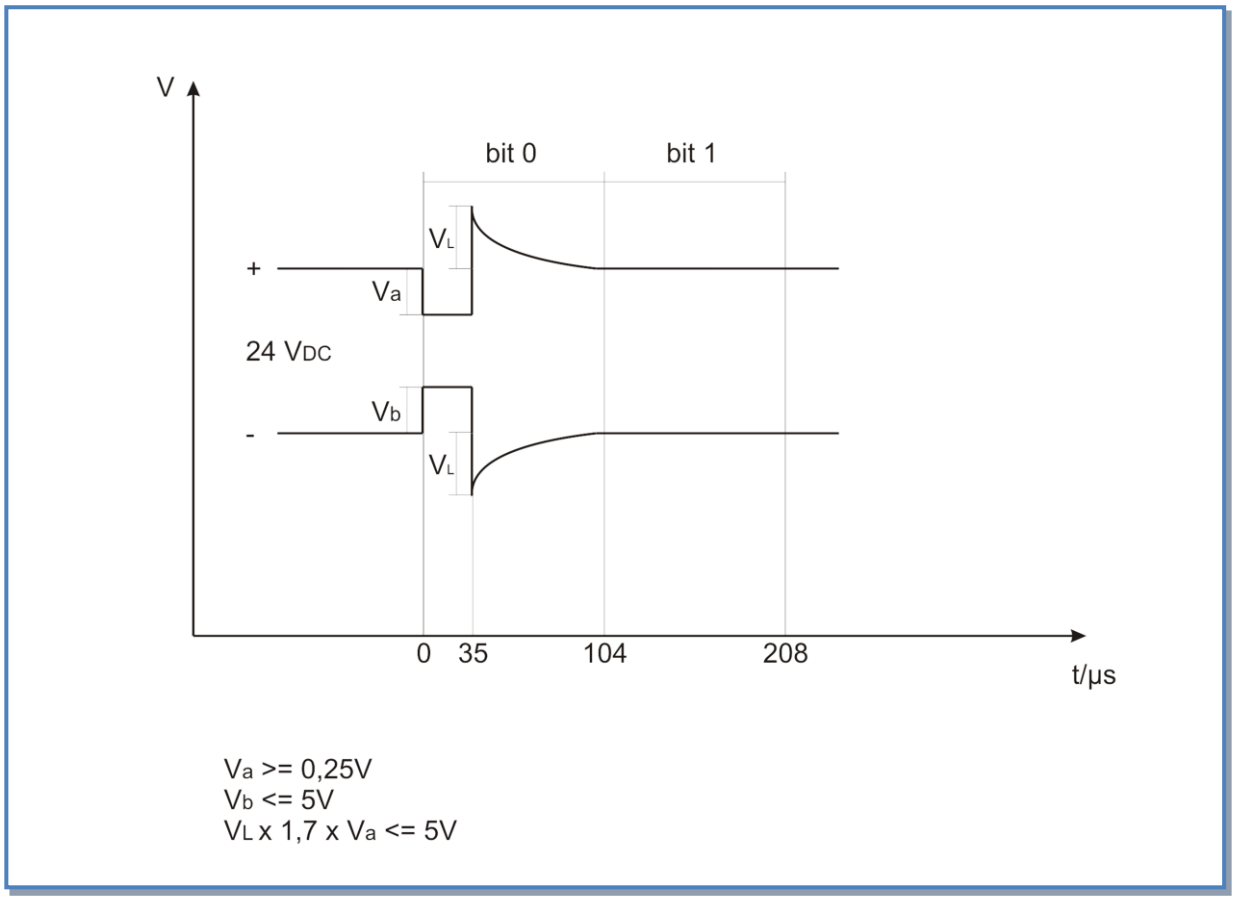

Figure 8 – KNX binary signals shape

The bus device transmits a half wave (Va-Vb) and the other half wave is produced in great part with the supply coil and that explains the maximum distance of 350 m between device and supply.
The transmission speed on the KNX bus is so of 1/104 µs = 9600 bit/s.

For a KNX TP network (Twisted pair) used by this application, the physical layer is characterized as follows:

. The network has one or several electrical segment with each one or two supplies but without line coupler.
. Random topology
. Total capacitance of a segment (measured at 10 KHz):
Without bus device, line coupler, line repeater: 100 nF max
With bus device, line coupler, line repeater: 120 nF max
. Bus line resistance between supply and device, line coupler or repeater: 25 Ω max.
. Bus line resistance between two devices, line coupler or repeater: 50 Ω max.
. Minimum resistance between two supplies: 15 Ω.
. Bus line minimum length between two supplies: 200 m.
. Tension drop on bus line between supply and device or line coupler: 5 V.
. Maximum length of a bus line segment: 1000 m
. Maximum length between 2 devices: 700 m (due to maximum delay for the collision detection of 10 µs)
. Line maximum length between supply and device: 350 m
. No terminal resistor needed.
. The bus devices are fed with a supply of 24 V DC by the bus.
. Maximum number of devices on a segment: 64.

Figure 9 shows the dimension limitations of the KNX network:

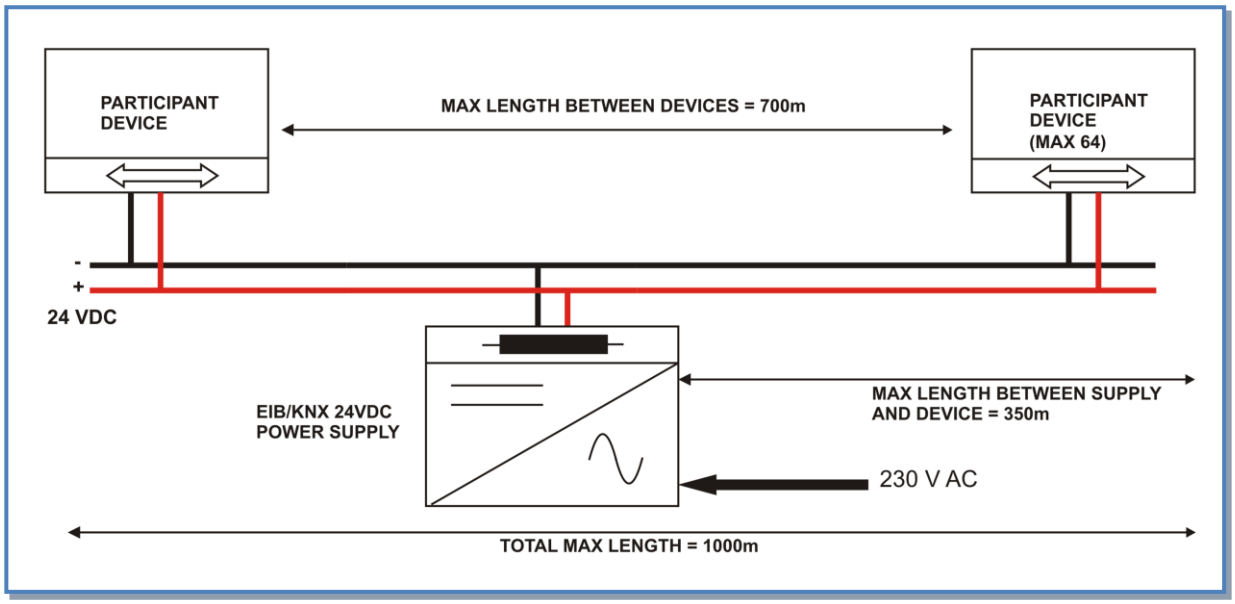

Figure 9 – maximum dimensions in KNX network

For more information, see the documentation provided by the KNX association on the web site WWW.KNX.ORG

7. CABLE SPECIFICATIONS

They result from the physical layer characteristics of the physical layer seen above. Use KNX green cable or a cable that match these criteria:

- Twisted pair, 2 pairs. Use one pair to connect – and +.
- Load resistance per line: max 37 Ω/km (loop 74 Ω/km)
- Load capacitance per line: max 100 nF/km (800 Hz)
- Shielded
- Twist numbers: min. 5/m
- Section 0,5 mm²
- Place this cable far from power cable of the installation
- If the unit is installed outside, take care to use an adapted cable (weather and UV protected, …).

8. ANNEXES

8.1 Annex 1: Datapoints types

Symbol	Field
A	Character
A[n]	Character string
B	Boolean / Bit set
C	Control
E	Exponent
F	Float value
N	eNumerator
r	Reserved bit or field
U	Unsigned value
V	2nd complement signed value
Z8	Standardized status/B8 command. Encoded as DPT_StatusGen

8.2 Annex 2: most used datapoints

DPT_ID	Format	DPT_Name
1.001	B1	DPT_Switch
1.002	B1	DPT_Bool
1.003	B1	DPT_Enable
1.004	B1	DPT_Ramp
1.005	B1	DPT_Alarm
1.006	B1	DPT_BinaryValue
1.007	B1	DPT_Step
1.008	B1	DPT_UpDown
1.009	B1	DPT_OpenClose
1.010	B1	DPT_Start
1.011	B1	DPT_State
1.012	B1	DPT_Invert
1.013	B1	DPT_DimSendStyle
1.014	B1	DPT_InputSource
1.015	B1	DPT_Reset
1.016	B1	DPT_Ack
1.017	B1	DPT_Trigger
1.018	B1	DPT_Occupancy
1.019	B1	DPT_Window_Door
1.021	B1	DPT_LogicalFunction
1.022	B1	DPT_Scene_AB
1.023	B1	DPT_ShutterBlinds_Mode
1.100	B1	DPT_Heat/Cool
2.001	B2	DPT_Switch_Control
2.002	B2	DPT_Bool_Control
2.003	B2	DPT_Enable_Control
2.004	B2	DPT_Ramp_Control
2.005	B2	DPT_Alarm_Control
2.006	B2	DPT_BinaryValue_Control
2.007	B2	DPT_Step_Control
2.008	B2	DPT_Direction1_Control
2.009	B2	DPT_Direction2_Control
2.010	B2	DPT_Start_Control
2.011	B2	DPT_State_Control
2.012	B2	DPT_Invert_Control
3.007	B1U3	DPT_Control_Dimming
3.008	B1U3	DPT_Control_Blinds
4.001	A8	DPT_Char_ASCII
4.002	A8	DPT_Char_8859_1
5.001	U8	DPT_Scaling
5.003	U8	DPT_Angle
5.004	U8	DPT_Percent_U8
5.005	U8	DPT_DecimalFactor
5.006	U8	DPT_Tariff

DPT_ID	Format	DPT_Name
5.010	U8	DPT_Value_1_Ucount
6.001	V8	DPT_Percent_V8
6.010	V8	DPT_Value_1_Count
6.020	B5N3	DPT_Status_Mode3
7.001	U16	DPT_Value_2_Ucount
7.002	U16	DPT_TimePeriodMsec
7.003	U16	DPT_TimePeriod10MSec
7.004	U16	DPT_TimePeriod100MSec
7.005	U16	DPT_TimePeriodSec
7.006	U16	DPT_TimePeriodMin
7.007	U16	DPT_TimePeriodHrs
7.010	U16	DPT_PropDataType
7.011	U16	DPT_Length_mm
7.012	U16	DPT_UElCurrentmA
7.013	U16	DPT_Brightness
8.001	V16	DPT_Value_2_Count
8.002	V16	DPT_DeltaTimeMsec
8.003	V16	DPT_DeltaTime10MSec
8.004	V16	DPT_DeltaTime100MSec
8.005	V16	DPT_DeltaTimeSec
8.006	V16	DPT_DeltaTimeMin
8.007	V16	DPT_DeltaTimeHrs
8.010	V16	DPT_Percent_V16
8.011	V16	DPT_Rotation_Angle
9.001	F16	DPT_Value_Temp
9.002	F16	DPT_Value_Tempd
9.003	F16	DPT_Value_Tempa
9.004	F16	DPT_Value_Lux
9.005	F16	DPT_Value_Wsp
9.006	F16	DPT_Value_Pres
9.007	F16	DPT_Value_Humidity
9.008	F16	DPT_Value_AirQuality
9.010	F16	DPT_Value_Time1
9.011	F16	DPT_Value_Time2
9.020	F16	DPT_Value_Volt
9.021	F16	DPT_Value_Curr
9.022	F16	DPT_PowerDensity
9.023	F16	DPT_KelvinPerPercent
9.024	F16	DPT_Power
9.025	F16	DPT_Value_Volume_Flow
9.026	F16	DPT_Rain_Amount
9.027	F16	DPT_Value_Temp_F
9.028	F16	DPT_Value_Wsp_kmh
10.001	N3N5r2N6r2N6	DPT_TimeOfDay
11.001	r3N5r4N4r1U7	DPT_Date

DPT_ID	Format	DPT_Name
12.001	U32	DPT_Value_4_Ucount
13.001	V32	DPT_Value_4_Count
13.010	V32	DPT_ActiveEnergy
13.011	V32	DPT_ApparantEnergy
13.012	V32	DPT_ReactiveEnergy
13.013	V32	DPT_ActiveEnergy_kWh
13.014	V32	DPT_ApparantEnergy_kVAh
13.015	V32	DPT_ReactiveEnergy_kVARh
13.100	V32	DPT_LongDeltaTimeSec
14.000	F32	DPT_Value_Acceleration
14.001	F32	DPT_Value_Acceleration_Angular
14.002	F32	DPT_Value_Activation_Energy
14.003	F32	DPT_Value_Activity
14.004	F32	DPT_Value_Mol
14.005	F32	DPT_Value_Amplitude
14.006	F32	DPT_Value_AngleRad
14.007	F32	DPT_Value_AngleDeg
14.008	F32	DPT_Value_Angular_Momentum
14.009	F32	DPT_Value_Angular_Velocity
14.010	F32	DPT_Value_Area
14.011	F32	DPT_Value_Capacitance
14.012	F32	DPT_Value_Charge_DensitySurface
14.013	F32	DPT_Value_Charge_DensityVolume
14.014	F32	DPT_Value_Compressibility
14.015	F32	DPT_Value_Conductance
14.016	F32	DPT_Value_Electrical_Conductivity
14.017	F32	DPT_Value_Density
14.018	F32	DPT_Value_Electric_Charge
14.019	F32	DPT_Value_Electric_Current
14.020	F32	DPT_Value_Electric_CurrentDensity
14.021	F32	DPT_Value_Electric_DipoleMoment
14.022	F32	DPT_Value_Electric_Displacement
14.023	F32	DPT_Value_Electric_FieldStrength
14.024	F32	DPT_Value_Electric_Flux
14.025	F32	DPT_Value_Electric_FluxDensity
14.026	F32	DPT_Value_Electric_Polarization
14.027	F32	DPT_Value_Electric_Potential
14.028	F32	DPT_Value_Electric_PotentialDifference
14.029	F32	DPT_Value_ElectromagneticMoment
14.030	F32	DPT_Value_Electromotive_Force
14.031	F32	DPT_Value_Energy
14.032	F32	DPT_Value_Force
14.033	F32	DPT_Value_Frequency
14.034	F32	DPT_Value_Angular_Frequency
14.035	F32	DPT_Value_Heat_Capacity

DPT_ID	Format	DPT_Name
14.036	F32	DPT_Value_Heat_FlowRate
14.037	F32	DPT_Value_Heat_Quantity
14.038	F32	DPT_Value_Impedance
14.039	F32	DPT_Value_Length
14.040	F32	DPT_Value_Light_Quantity
14.041	F32	DPT_Value_Luminance
14.042	F32	DPT_Value_Luminous_Flux
14.043	F32	DPT_Value_Luminous_Intensity
14.044	F32	DPT_Value_Magnetic_FieldStrength
14.045	F32	DPT_Value_Magnetic_Flux
14.046	F32	DPT_Value_Magnetic_FluxDensity
14.047	F32	DPT_Value_Magnetic_Moment
14.048	F32	DPT_Value_Magnetic_Polarization
14.049	F32	DPT_Value_Magnetization
14.050	F32	DPT_Value_MagnetomotiveForce
14.051	F32	DPT_Value_Mass
14.052	F32	DPT_Value_MassFlux
14.053	F32	DPT_Value_Momentum
14.054	F32	DPT_Value_Phase_AngleRad
14.055	F32	DPT_Value_Phase_AngleDeg
14.056	F32	DPT_Value_Power
14.057	F32	DPT_Value_Power_Factor
14.058	F32	DPT_Value_Pressure
14.059	F32	DPT_Value_Reactance
14.060	F32	DPT_Value_Resistance
14.061	F32	DPT_Value_Resistivity
14.062	F32	DPT_Value_SelfInductance
14.063	F32	DPT_Value_SolidAngle
14.064	F32	DPT_Value_Sound_Intensity
14.065	F32	DPT_Value_Speed
14.066	F32	DPT_Value_Stress
14.067	F32	DPT_Value_Surface_Tension
14.068	F32	DPT_Value_Common_Temperature
14.069	F32	DPT_Value_Absolute_Temperature
14.070	F32	DPT_Value_TemperatureDifference
14.071	F32	DPT_Value_Thermal_Capacity
14.072	F32	DPT_Value_Thermal_Conductivity
14.073	F32	DPT_Value_ThermoelectricPower
14.074	F32	DPT_Value_Time
14.075	F32	DPT_Value_Torque
14.076	F32	DPT_Value_Volume
14.077	F32	DPT_Value_Volume_Flux
14.078	F32	DPT_Value_Weight
14.079	F32	DPT_Value_Work
15.000	U4U4U4U4U4U4B4N4	DPT_Access_Data

DPT_ID	Format	DPT_Name
16.000	A112	DPT_String_ASCII
16.001	A112	DPT_String_8859_1
17.001	r2U6	DPT_SceneNumber
18.001	B1r1U6	DPT_SceneControl
19.001	U8[r4U4][r3U5][U3U5][r2U6][r2U6]B16	DPT_DateTime
20.001	N8	DPT_SCLOMode
20.002	N8	DPT_BuildingMode
20.003	N8	DPT_OccMode
20.004	N8	DPT_Priority
20.005	N8	DPT_LightApplicationMode
20.006	N8	DPT_ApplicationArea
20.007	N8	DPT_AlarmClassType
20.008	N8	DPT_PSUMode
20.011	N8	DPT_ErrorClass_System
20.012	N8	DPT_ErrorClass_HVAC
20.013	N8	DPT_Time_Delay
20.014	N8	DPT_Beaufort_Wind_Force_Scale
20.017	N8	DPT_SensorSelect
20.100	N8	DPT_FuelType
20.101	N8	DPT_BurnerType
20.102	N8	DPT_HVACMode
20.103	N8	DPT_DHWMode
20.104	N8	DPT_LoadPriority
20.105	N8	DPT_HVACContrMode
20.106	N8	DPT_HVACEmergMode
20.107	N8	DPT_ChangeoverMode
20.108	N8	DPT_ValveMode
20.109	N8	DPT_DamperMode
20.110	N8	DPT_HeaterMode
20.111	N8	DPT_FanMode
20.112	N8	DPT_MasterSlaveMode
20.113	N8	DPT_StatusRoomSetp
20.600	N8	DPT_Behaviour_Lock_Unlock
20.601	N8	DPT_Behaviour_Bus_Power_Up_Down
201.000	N8	DPT_CommMode
201.001	N8	DPT_AddInfoTypes
201.002	N8	DPT_RF_ModeSelect
201.003	N8	DPT_RF_FilterSelect
21.001	B8	DPT_StatusGen
21.002	B8	DPT_Device_Control
21.100	B8	DPT_ForceSign
21.101	B8	DPT_ForceSignCool
21.102	B8	DPT_StatusRHC
21.103	B8	DPT_StatusSDHWC
21.104	B8	DPT_FuelTypeSet

DPT_ID	Format	DPT_Name
21.105	B8	DPT_StatusRCC
21.106	B8	DPT_StatusAHU
211.000	B8	DPT_RF_ModeInfo
211.001	B8	DPT_RF_FilterInfo
211.010	B8	DPT_Channel_Activation_8
22.100	B16	DPT_StatusDHWC
22.101	B16	DPT_StatusRHCC
221.000	B16	DPT_Media
221.010	B16	DPT_Channel_Activation_16
23.001	N2	DPT_OnOff_Action
23.002	N2	DPT_Alarm_Reaction
23.003	N2	DPT_UpDown_Action
23.102	N2	DPT_HVAC_PB_Action
24.001	A[n]	DPT_VarString_8859_1
251.000	U4U4	DPT_DoubleNibble
26.001	r1b1U6	DPT_SceneInfo
27.001	B32	DPT_CombinedInfoOnOff
28.001	A[n]	DPT_UTF-8
29.010	V64	DPT_ActiveEnergy_V64
29.011	V64	DPT_ApparantEnergy_V64
29.012	V64	DPT_ReactiveEnergy_V64
301.010	B24	DPT_Channel_Activation_24
31.101	N3	DPT_PB_Action_HVAC_Extended
200.100	B1Z8	DPT_Heat/Cool_Z
200.101	B1Z8	DPT_BinaryValue_Z
201.100	N8Z8	DPT_HVACMode_Z
201.102	N8Z8	DPT_DHWMode_Z
201.104	N8Z8	DPT_HVACContrMode_Z
201.105	N8Z8	DPT_EnablH/Cstage_Z DPT_EnablH/CStage
201.107	N8Z8	DPT_BuildingMode_Z
201.108	N8Z8	DPT_OccMode_Z
201.109	N8Z8	DPT_HVACEmergMode_Z
202.001	U8Z8	DPT_RelValue_Z
202.002	U8Z8	DPT_UCountValue8_Z
203.002	U16Z8	DPT_TimePeriodMsec_Z
203.003	U16Z8	DPT_TimePeriod10Msec_Z
203.004	U16Z8	DPT_TimePeriod100Msec_Z
203.005	U16Z8	DPT_TimePeriodSec_Z
203.006	U16Z8	DPT_TimePeriodMin_Z
203.007	U16Z8	DPT_TimePeriodHrs_Z
203.011	U16Z8	DPT_UFlowRateLiter/h_Z
203.012	U16Z8	DPT_UCountValue16_Z
203.013	U16Z8	DPT_UElCurrentµA_Z
203.014	U16Z8	DPT_PowerKW_Z
203.015	U16Z8	DPT_AtmPressureAbs_Z

DPT_ID	Format	DPT_Name
203.017	U16Z8	DPT_PercentU16_Z
203.100	U16Z8	DPT_HVACAirQual_Z
203.101	U16Z8	DPT_WindSpeed_Z DPT_WindSpeed
203.102	U16Z8	DPT_SunIntensity_Z
203.104	U16Z8	DPT_HVACAirFlowAbs_Z
204.001	V8Z8	DPT_RelSignedValue_Z
205.002	V16Z8	DPT_DeltaTimeMsec_Z
205.003	V16Z8	DPT_DeltaTime10Msec_Z
205.004	V16Z8	DPT_DeltaTime100Msec_Z
205.005	V16Z8	DPT_DeltaTimeSec_Z
205.006	V16Z8	DPT_DeltaTimeMin_Z
205.007	V16Z8	DPT_DeltaTimeHrs_Z
205.100	V16Z8	DPT_TempHVACAbs_Z
205.101	V16Z8	DPT_TempHVACRel_Z
205.102	V16Z8	DPT_HVACAirFlowRel_Z
206.100	U16N8	DPT_HVACModeNext
206.102	U16N8	DPT_DHWModeNext
206.104	U16N8	DPT_OccModeNext
206.105	U16N8	DPT_BuildingModeNext
207.100	U8B8	DPT_StatusBUC
207.101	U8B8	DPT_LockSign
207.102	U8B8	DPT_ValueDemBOC
207.104	U8B8	DPT_ActPosDemAbs
207.105	U8B8	DPT_StatusAct
209.100	V16B8	DPT_StatusHPM
209.101	V16B8	DPT_TempRoomDemAbs
209.102	V16B8	DPT_StatusCPM
209.103	V16B8	DPT_StatusWTC
210.100	V16B16	DPT_TempFlowWaterDemAbs
211.100	U8N8	DPT_EnergyDemWater
212.100	V16V16V16	DPT_TempRoomSetpSetShift[3]
212.101	V16V16V16	DPT_TempRoomSetpSet[3]
213.100	V16V16V16V16	DPT_TempRoomSetpSet[4]
213.101	V16V16V16V16	DPT_TempDHWSetpSet[4]
213.102	V16V16V16V16	DPT_TempRoomSetpSetShift[4]
214.100	V16U8B8	DPT_PowerFlowWaterDemHPM
214.101	V16U8B8	DPT_PowerFlowWaterDemCPM
215.100	V16U8B16	DPT_StatusBOC
215.101	V16U8B16	DPT_StatusCC
216.100	U16U8N8B8	DPT_SpecHeatProd
217.001	U5U5U6	DPT_Version
218.001	V32Z8	DPT_VolumeLiter_Z
219.001	U8N8N8N8B8B8	DPT_AlarmInfo
220.100	U16V16	DPT_TempHVACAbsNext
221.001	N16U32	DPT_SerNum

DPT_ID	Format	DPT_Name
222.100	F16F16F16	DPT_TempRoomSetpSetF16[3]
222.101	F16F16F16	DPT_TempRoomSetpSetShiftF16[3]
223.100	V8N8N8	DPT_EnergyDemAir
224.100	V16V16N8N8	DPT_TempSupply AirSetpSet
225.001	U16U8	DPT_ScalingSpeed
225.002	U16U8	DPT_Scaling_Step_Time
229.001	V32N8Z8	DPT_MeteringValue
230.1000	U16U32U8N8	DPT_MBus_Address
231.001	A8A8A8A8	DPT_Locale_ASCII
232.600	U8U8U8	DPT_Colour_RGB
234.001	A8A8	DPT_LanguageCodeAlpha2_ASCII
234.002	A8A8	DPT_RegionCodeAlpha2_ASCII

8.3 Annex 3: A_PDU type

A_PDU is the PDU (Protocol Data Unit) of the application layer and is meaning depends on the 2 first bits of the T_PDU (transport layer PDU)

1- The 2 first bits of T_PDU are of UCD type (Unnumbered Control Data) = 00,
   a. The first 2 bits of A_PDU are 00: by mean of this telegram, a point to point connection of the transport layer is established from the indicated emitter to the receiver.
   b. The first 2 bits of A_PDU are 00: by mean of this telegram, a point to point connection of the transport layer is terminated/broken from the indicated emitter to the receiver.
2- 2 first bits of T_PDU are of NCD type (Numbered Control Data) = 11,
   a. The first 2 bits of A_PDU are 10: by mean of this telegram, the transport layer of the emitter confirms to the receiver the reception of a previous telegram.
   b. The first 2 bits of A_PDU are 11: by mean of this telegram, the transport layer of the emitter does not confirm to the receiver the reception of a previous telegram.
3- The 2 first bits of T_PDU are of UDP type (Unnumbered Data Packet) = 00 or NDP type (Numbered Data Packet) = 01. In this case, the bits of A_PDU form the APCI which is a 4 bits code for differentiating the services of the application layer.

APCI encoding

The application layer manages the group objects values in function of the application program. It treats the group telegrams and the management functions that ensure the bus configuration. For those functions, a communication in connected mode (point to point) or broadcast (group address = 0/0) is used. The APCI used during configuration are shown in table 9.

APCI	Name
0011	IndividualAddrWrite
0100	IndividualAddrRequest
0101	IndividualAddrResponse
0110	AdcRead
0111	AdcResponse
1000	MemoryRead
1001	MemoryResponse
1010	MemoryWrite
1011	UserMessage
1100	MaskVersionRead
1101	MaskVersionResponse
1110	Restart
1111	Escape

Table 9 APCI used during configuration

After configuration, during the communication in execution, the most used APCI are shown in table 10.

APCI	Name
0000	GroupValueRead
0001	GroupValueResponse
0010	GroupValueWrite

Table 10 APCI used during execution

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