WBMOIN0002
11.2023

IMI PNEUMATEX

BrainCube Connect

Installation | Operation***

Almost all IMI Pneumatex devices* are operated and controlled by a BrainCube Connect unit.

A separate Installation Manual is included with each product delivered.

This Installation & Operation manual applies to the BrainCube Connect operating and controlling the TecBox**.

Prior to commissioning the BrainCube Connect, the device must have been installed and connected to the heating, cooling, solar or other system according to the enclosed installation manual.

* IMI Pneumatex devices operated and controlled by BrainCube Connect are: Compresso Connect, Transfero Connect, Vento Connect, ComCube DML Connect and Pleno PI Connect.

** TecBox is the unit with all the necessary pneumatic and/or hydraulic components operated and controlled by the BrainCube Connect excluding the vessel(s).

*** The original instructions are written in German. Documents in other languages are translations of the original instructions.

IMI Hydronic Engineering

General information

Installation and operation personnel must have the appropriate skills and training. When assembling, handling and operating, it is essential to follow these installation instructions and especially the separate safety – inspection – disassembling instructions included with the product.

BrainCube Connect is an intelligent, universal, web-based control unit for all Pneumatex products with a standard operation concept. It monitors all operations, is self-optimizing with a memory function and has a self-explanatory, operation oriented menu structure.

Different BrainCube Connect units can be connected in different master-slave configurations in order to monitor water make-up, cascade functioning, volume equalization in change over systems etc.

In Master-Slave combined operation situations, the software of each participating BrainCube must be the same version. The first commissioning of a Master-Slave combined operation system must only be done by IMI-Hydronic Engineering Customer service.

The different data connections like Ethernet and RS 485 allow almost unlimited connectivity with other devices and or external BMS.

Additional information

For additional information or non “standard” or unusual settings: contact IMI-Hydronic Engineering Customer service.

Customer service

IMI Hydronic Engineering Switzerland AG Phone +41 (0)61 906 26 26
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Local offices:
www.imi-hydronic.com

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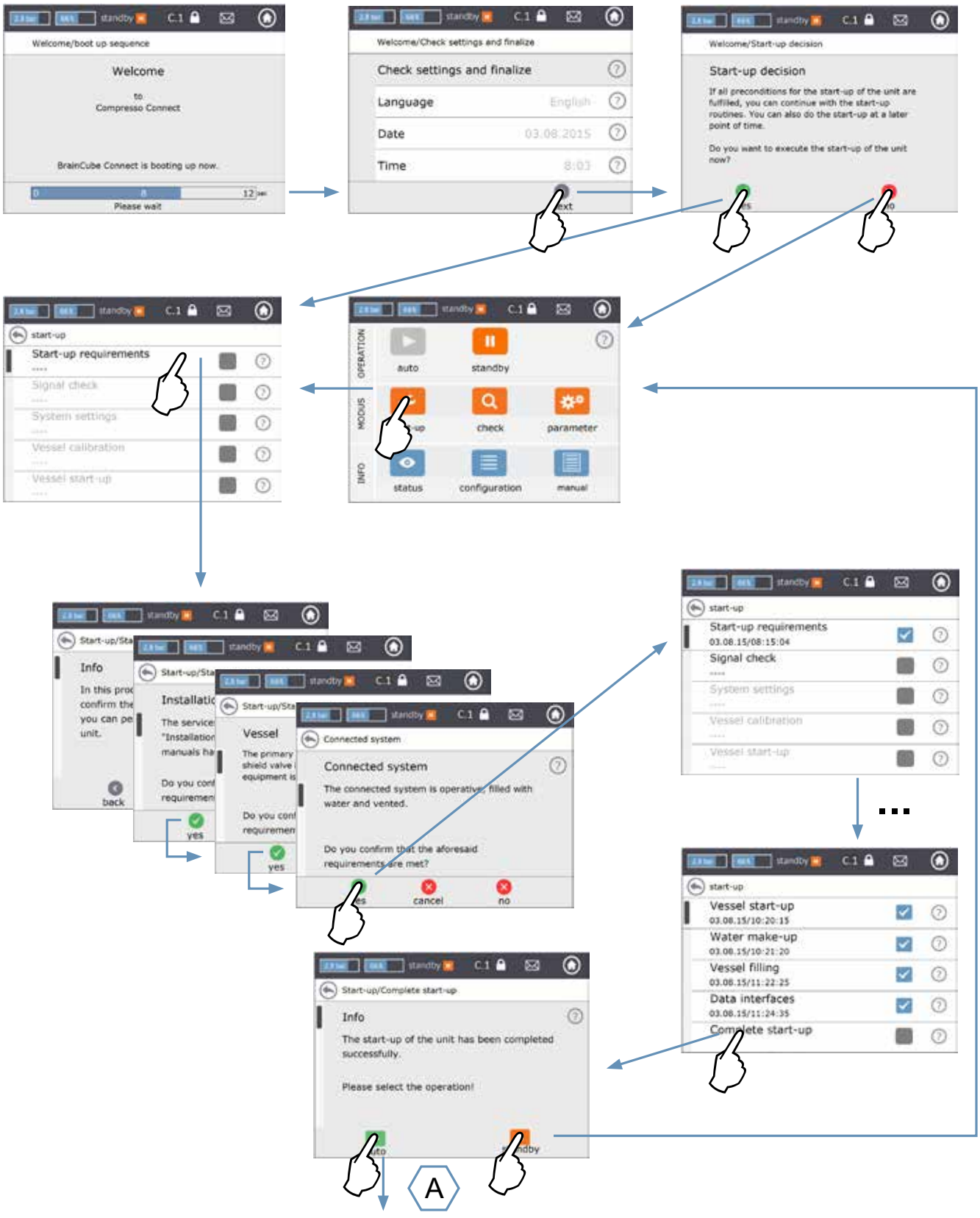
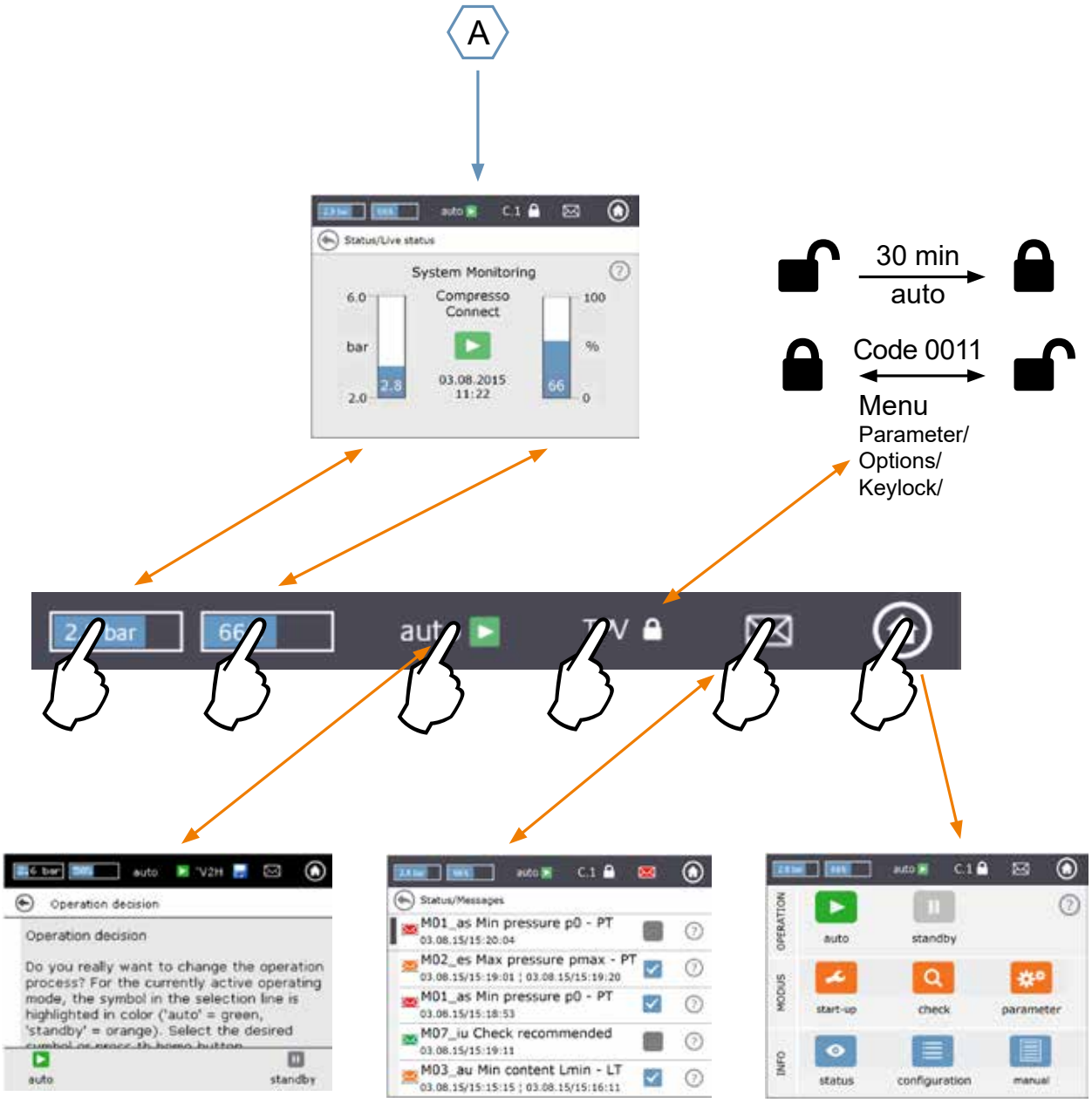
Quickstart


Welcome/boot up sequence
Welcome
to
Compresso Connect
BrainCube Connect is booting up now.
Please wait
Welcome/Check settings and finalize
Check settings and finalize
Language
English
Date
03.08.2015
Time
8:03
Welcome/Start-up decision
Start-up decision
If all preconditions for the start-up of the unit are fulfilled, you can continue with the start-up routines. You can also do the start-up at a later point of time.
Do you want to execute the start-up of the unit now?
start-up
Start-up requirements
Signal check
System settings
Vessel calibration
Vessel start-up
OPERATION
MODUS
INFO
auto
standby
check
parameter
status
configuration
manual
Info
In this proc
confirm the
you can pe
unit.
back
Installatic
The service
"Installation
manuals ha
Do you cont
requiremen
yes
Vessel
The primary
shield valve
equipment is
Do you cont
requiremen
yes
Connected system
Connected system
The connected system is operative, filled with water and vented.
Do you confirm that the aforesaid requirements are met?
yes
cancel
no
start-up
Start-up requirements
03.08.15/08:15:04
Signal check
System settings
Vessel calibration
Vessel start-up
...
start-up
Vessel start-up
03.08.15/10:20:15
Water make-up
03.08.15/10:21:20
Vessel filling
03.08.15/11:22:25
Data interfaces
03.08.15/11:24:35
Complete start-up
Start-up/Complete start-up
Info
The start-up of the unit has been completed successfully.
Please select the operation!
auto
standby
A

Quickstart


A
System Monitoring
Compresso Connect
6.0
bar
2.0
2.8
100
%
0
66
03.08.2015
11:22
30 min
auto
Code 0011
Menu
Parameter/
Options/
Keylock/
Operation decision
Operation decision
Do you really want to change the operation process? For the currently active operating mode, the symbol in the selection line is highlighted in color ('auto' = green, 'standby' = orange). Select the desired
auto
standby
Status/Messages
M01_as Min pressure p0 - PT
M02_es Max pressure pmax - PT
M01_as Min pressure p0 - PT
M07_iu Check recommended
M03_au Min content Lmin - LT
OPERATION
MODUS
INFO
auto
standby
start-up
check
parameter
status
configuration
manual

en

Electrical and signal connections

Electrical wiring and connection set-up should be carried out by a qualified electrician, in accordance with current local regulations.

The BrainCube and its potential free outputs must be disconnected from the electrical supply before working on the electrical components.

Electrical supply

For Compresso; Transfero 4/6/8/10/14; Vento 2/4/6/8/10/14 and Pleno: 1 x 230 V (+/- 10%)
For Transfero TI; Transfero TVI, Vento VI: Main voltage: 3 x 400 V – N – P (+/- 10%), control voltage: 1 x 230 V (+/- 10%)

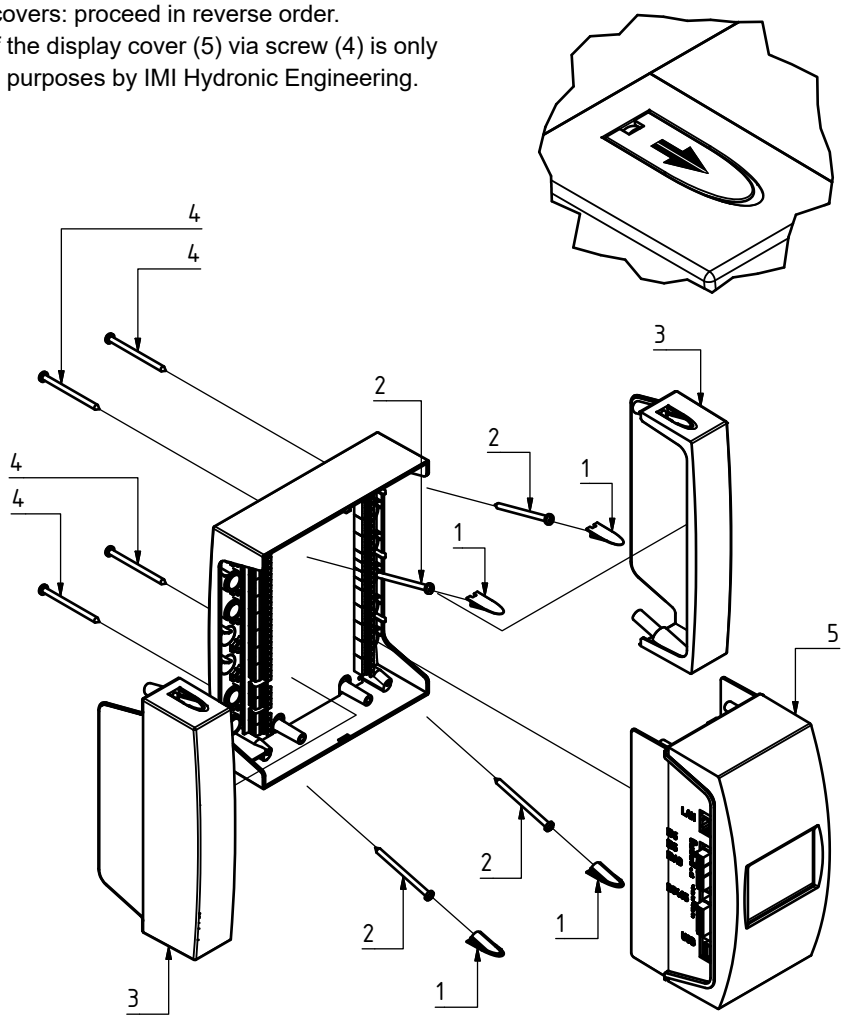
In all cases: check the electrical load, voltage, frequency and degree of protection on the type plate.
Protection to be supplied by the contractor: see safety – inspection – disassembling instructions.

Regard the electrical scheme attached with the TecBox in paper form or at www.imi-hydronic.com.

Check if the electrical supply and the measuring foot LT (in Transfero and Compresso devices) are correctly connected as described in the corresponding Installation manual included with the product.

Connections on the BrainCube

Dismounting the lateral covers (3):
With a small screwdriver, clip the screw protection (1) away and loosen the 4 torx screws (2).
To mount the lateral covers: proceed in reverse order.
The disassembling of the display cover (5) via screw (4) is only necessary for service purposes by IMI Hydronic Engineering.



Electrical and signal connections

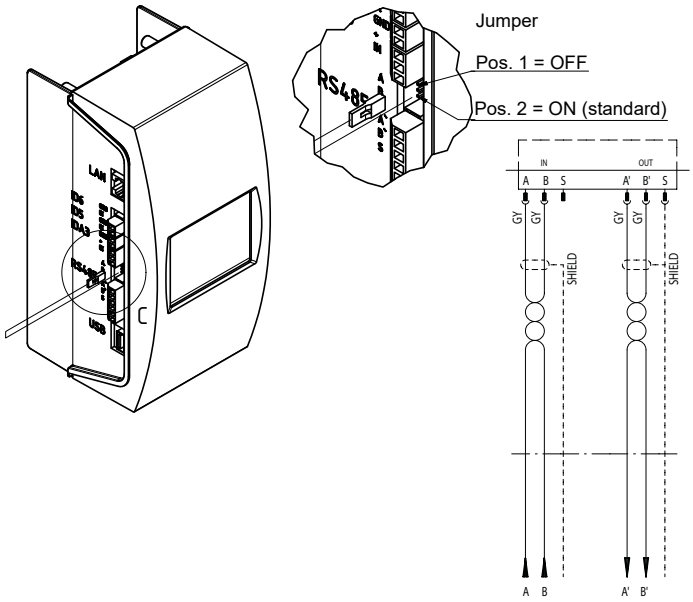
Signal connections

USB, Ethernet and RS 485 connections allow data communication between different BrainCubes or between the BrainCube and external devices.

The cabling work and parameterisation of the interfaces as well as proof of functionality (e.g. with the connected building management system BMS) are not included in the scope of delivery of IMI Hydronic Engineering and are not part of the standard scope of services of IMI Hydronic Engineering customer service.

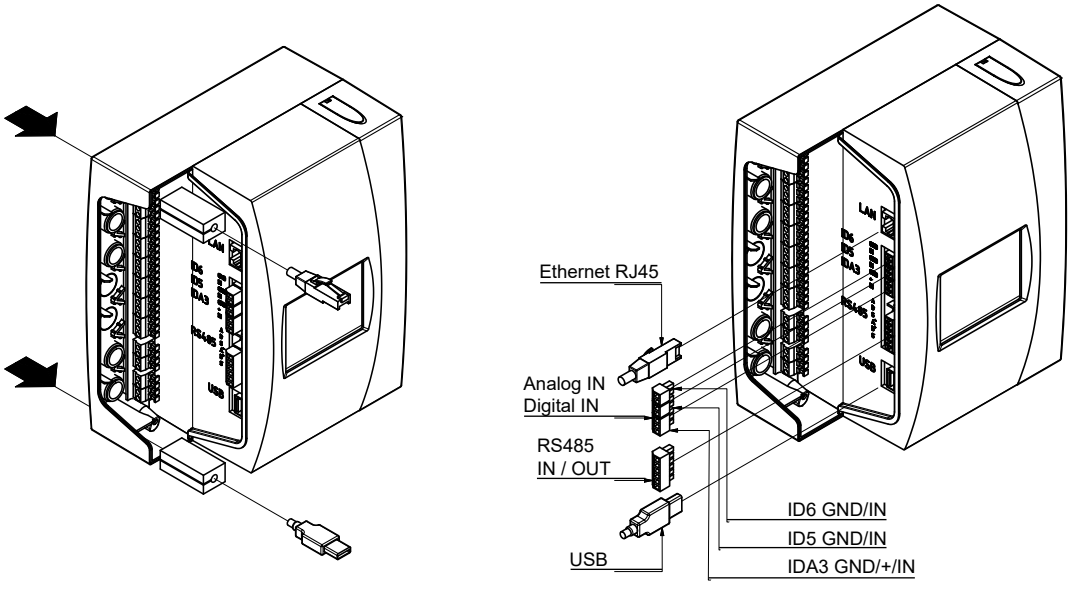
RS 485 Connection

The connection between different RS 485 gates should be made with a twisted pair cable with a wire diameter of ≥ 0.5 mm².
The maximum allowed distance is 1000 m.
A jumper can be found just under the RS 485 gates.
The terminals of the RS485 interface are labelled A, B, S and A', B', S.
A and A' are bridged. B and B' are bridged. S is the connection for the shielding.
A is designed as: Non-inverting Receiver Input and Non-inverting Driver Output. In other words:
Va - Vb > 0.2V = "1" = " + " = "non-inverted".
B is designed as: Inverting Receiver Input and Inverting Driver Output. In other words:
Va - Vb < -0.2V = "0" = " - " = "inverted".
On each terminal device (the first and the last) the jumper must be set on the ON position.
In intermediate devices, the jumper must be set on the OFF position or removed.
The shield of the twisted pair cable must be connected on one side not on the other.



Ethernet and USB connections

A rectangular opening can be found on the upper right hand side corner (view from rear). Insert the Ethernet cable through this opening, from behind. Pull the cable through, surround the cable with the insulation foam, then insert the foam into the rectangular opening to ensure it remains watertight. Repeat this procedure with the USB cable and the opening on the bottom right hand corner (view from rear). Use 90° tilted RJ45 plugs to prevent the Ethernet cable from being bent too much in the small connection cabinet.



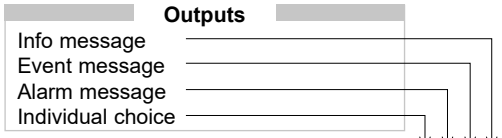
Electrical and signal connections

Digital outputs - parameterisation

- See electrical scheme attached with the TecBox in paper form or at www.imi-hydronic.com.

These potential free outputs allow you:

1. To transmit messages to external devices like a BMS or an alarm device.
2. To start and stop water make-up at an external device like Pleno or Vento.
3. To send open/close signals to the system connection valve (MS-SCV) in Master-Slave change over systems.



Info, Event and Alarm messages are defined in the BrainCube.
au = alarm unit as = alarm system
eu = event unit es = event system
iu = info unit is = info system

Message						on[1]	off [1]	C	T	V	P	DML	Remark
M01_as	Min pressure p0 - PT	-	X	-	-	PT < p0	PT > p0 + 0.1 bar	X	X	X	X	-	
M02_es	Max pressure pmax - PT	-	-	X	-	PT ≥ p0 + 0.8 bar	PT < p0 + 0.7 bar	X	-	-	-	-	
						PT ≥ p0 + 1.1 bar	PT < p0 + 1.0 bar	-	X	-	-	-	
		-	-	-	-	PT ≥ psvs*0.9+0.3 bar and PT ≥ psvs-0.2 bar (with Statico as pressurisation)	PT < psvs*0.9+0.2 bar and PT ≥ psvs-0.3 bar (with Statico as pressurisation)	-	-	X	X	-	
M03_au	Min content Lmin - LT	-	X	-	-	LT < 10%	LT > 25%	X	X	-	-	X	
M04_au	Max content Lmax - LT	-	X	-	-	LT > 90%	LT < 85%	X	X	-	-	X	
M05_eu	Min content Lmin - FT	-	-	X	-	Low water in the break tank occured several times	Acknowledge after correcting fault	-	X	X	X	-	
M06_eu	Min content Lmin - LT	-	-	X	-	No water in the break tank	Acknowledge after correcting fault	-	X	X	X	-	
M07_iu	Check recommended	-	-	-	X	date > set date for next check	Acknowledge after correcting fault	X	X	X	X	X	
M08_eu	Pressure maintenance	-	-	X	-	> 5 (C), 10 (T) on/off-switchings/min		X	X	-	-	-	
M09_eu	Flow balancing	-	-	X	-	Too low inlet flow during degassing routines	Acknowledge after correcting fault	-	X	X	-	-	
M11_es	Water make-up runtime - FT	-	-	X	-	Nonstop runtime of water make-up > 60 min	Acknowledge after correcting fault	X	X	X	X	X	2)
M12_es	Water make-up frequency - FT	-	-	X	-	4 make up requests within 10 min after water make-up shuts off	Acknowledge after correcting fault	X	X	X	X	X	5)
M13_au	Water make-up leaky - FT	-	X	-	-	FT counting although no water make-up requested	Acknowledge after correcting fault	X	X	X	X	X	5)
M14_es	Max water make-up quantity - FT	-	-	X	-	Yearly make-up quantity exceeded	Acknowledge after correcting fault	X	X	X	X	X	3), 5)
M15_eu	Water meter - FT	-	-	X	-	FT is not counting	Acknowledge after correcting fault	X	X	X	X	-	5)
M16_au	Pressure sensor - PTsys	-	X	-	-	Fault, e.g. cable defect	Automatic after repair	X	X	X	X	-	
M17_au	Content sensor - LT	-	X	-	-	Fault, e.g. cable defect	Automatic after repair	X	X	-	-	X	
M18_au	Pump P/C1	-	X	-	-	Fuse or motor protection tripped	Acknowledge after correcting fault	X	X	-	X	-	
M19_au	Pump P/C2	-	X	-	-	Fuse or motor protection tripped	Acknowledge after correcting fault	X	X	-	X	-	
M20_iu	Pump runtime P/C with unlocked pump/compressor	-	-	-	X	15 (T), 30 (C) min	Acknowledge after correcting fault	X	X	-	-	-	4)
M20_au	Pump runtime P/C with locked pump/compressor	-	X	-	-	15 (T), 30 (C) min	Acknowledge after correcting faul	X	X	-	-	-	
M21_iu	Voltage loss	-	-	-	X	Voltage loss lasting more than 30 min	Acknowledge after correcting fault	X	X	X	X	X	
M22_eu	Standby	-	-	X	-	Standby for more than 30 min	Activate Auto	X	X	X	X	X	
M24_eu	Vacuum tightness	-	-	X	-	Unit is not tight during daily vacuum tightness check procedure, not for Vento V2.1S	Finish check procedure “Tightness” successfully	-	X	X	-	-	6)
M25_eu	Master fault	-	-	X	-	“When activation of standby mode, M25, M16, M17, M18, M18 + M19, M37, M46, standby operation disabled MS combined operation function, disabled RS485 communication, wiring error of RS485 connection or voltage loss of BrainCube”	Automatically as soon as the trigger criterion is removed.	X	X	-	-	-	
M26_as	Limiter at ID6	-	X	-	-	Limiter connected on BrainCube input ID6 has responsed	Acknowledge after correcting fault	X	X	-	-	-	
M26_as	Limiter at IDA1	-	X	-	-	Limiter connected on BrainCube input IDA1 has responsed	Acknowledge after correcting fault	X	X	-	-	-	
M26_as	Limiter at IDA2	-	X	-	-	Limiter connected on BrainCube input IDA2 has responsed	Acknowledge after correcting fault	X	X	-	-	-	
M27_au	ROM	-	X	-	-	System failure BrainCube ROM	Contact customer service	X	X	X	X	X	
M28_au	RAM	-	X	-	-	System failure BrainCube RAM	Contact customer service	X	X	X	X	X	
M30_au	Internal	-	X	-	-	System failure BrainCube hardware board communication	Contact customer service	X	X	X	X	X	
M31_eu	Life time water treatm. cartridge	-	-	X	-	The life time of the water treatment cartridge is exceeded	Finish check procedure “Water treatment” successfully	X	X	X	X	X	
M32_eu	Capacity water treatment cartridge	-	-	X	-	The capacity of the water treatment cartridge is repleted	Finish check procedure “Water treatment” successfully	X	X	X	X	X	
M33_as	Max pressure PAZ+ - PT	-	-	X	-	PT > PAZ+	PT < PAZ+ - 0.1	X	X	X	X	X	
M34_es	Max final pressure pemax - PT	-	-	X	-	PT > pemax	PT≤ pemax - 0.1	X	X	X	X	-	
M35_eu	Pressure sensor - PTvv	-	-	X	-	Fault, e.g. cable defect	Automatically after repair	-	X	X	-	-	
M37_au	Motor driven valve M1	-	X	-	-	Calibration failure of M1	Finish check procedure “Calibrate Motor driven valves” successfully	-	X	-	-	-	
M38_au	Motor driven valve M2	-	X	-	-	Calibration failure of M2	Finish check procedure “Calibrate Motor driven valves” successfully	X	X	X	X	-	
M39_eu	Pressure reducing valve PRV 1	-	-	X	-	Wrong setting of pressure reducer PRV 1	Acknowledge after correcting setting	-	X	X	-	-	
M40_iu	Software upgrade	-	-	-	X	When a new software version is available	Manually	X	X	X	X	X	
M41_es	Psys < Working range pressurisation	-	-	X	-	PT < Working range	PT inside working range	X	X	-	X	-	
M42_es	Psys > Working range pressurisation	-	-	X	-	PT > Working range	PT inside working range	X	X	-	X	-	
M43_eu	Pump control valve V3/M2	-	-	X	-	V3 respectively M2 doesn’t switch open in the right way	Acknowledge after correcting fault	-	X	X	-	-	
M44_au	Pressure reducing valve PRV2	-	X	-	-	Wrong setting of pressure reducer PRV 2	Acknowledge after correcting setting	-	TVI	-	-	-	
M45_as	Max pressure pSVvv - PTvv	-	X	-	-	PTvv > 9.5 bar	PTvv ≤ 9.5 bar	-	TVI	VI	-	-	
M46_eu	Master function take over declined	-	-	X	-	This TecBox has declined to take over the Master function in MS combined operation	Automatically when Master fault is cleared	X	X	-	-	-	
M47_is	Min. pressure p0min_S_LC_PT	-	-	-	X	System pressure at Slave device too low	Automatically at high enough pressure	X	X	-	-	-	
M48_au	Data error at voltage loss	-	X	-	-	Data error at voltage loss; functions restricted	Contact customer service	X	X	X	X	X	
M49_au	Pump control valve V3 / M2	-	X	-	-	The pump control valve V3 / M2 has an issue during the pressurisation process.	Manually	-	X	-	-	-	
M51_es	Psys < Working range degassing	-	-	X	-	PT < allowed operation pressure for degassing	PT inside working range	-	X	X	-	-	6)
M52_es	Psys > Working range degassing	-	-	X	-	PT < allowed operation pressure for degassing	PT inside working range	-	X	X	-	-	6)
M56_as	Safety valve psvs - PT	-	X	-	-	PT > psvs	PT < psvs * 0.9 and PT < psvs - 0.5 bar	-	X	X	-	-	
M57_eu	Vacuum tightness test	-	-	X	-	Unit is not tight during vacuum tightness check procedure	Finish check procedure “Tightness” successfully	-	-	VS	-	-	
M58_eu	Vacuum pressure insufficient	-	-	X	-	The vacuum pressure is not deep enough during the degassing process.	Follow BrainCube advices.	-	-	X	-	-	
M61_es	Max pressure pmax_S_LC overrun – PT	-	-	X	-	PT > allowed pressure for Master-Slave LC operation	PT inside allowed working range	X	X	-	-	-	

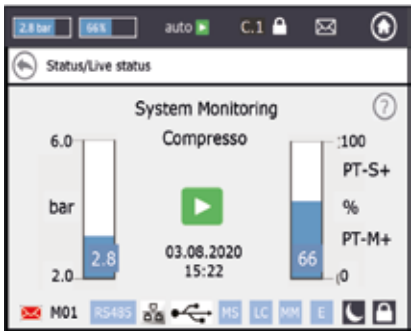
1) Values valid for factory setting
2) Water make-up Shut off point (LT = 30%) could not be reached after 60 min running time.
3) Depending on the system value calculated by the BrainCube.
4) Final pressure pe could not be reached after 30 min running time.
5) Only relevant if water make-up is active
6) Only relevant for TecBoxes with degassing function

Operating

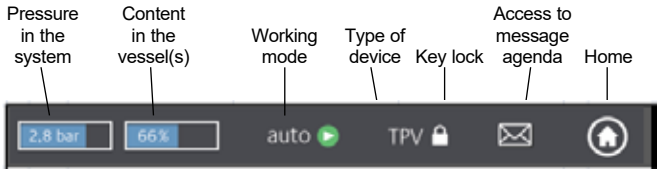
General operation - explanation of symbols

The following home screen overview is shown on the 3.5" TFT LCD screen.

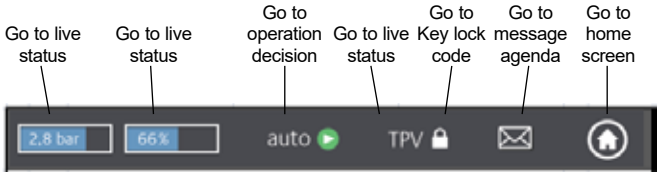
Screens displaying a scroll bar have a slide function.



The upper line of the screen is a fixed line independent of which menu you are in. It provides quick information and quick access to help, status and operation menus as well as to the message list.



By touching the buttons or little screens with values you can directly go to help menus as indicated below.



Depending on the device type some of the items mentioned in this manual are not activated. All active items for your device are shown in the BrainCube Connect windows.

Saving is in progress when the diskette symbol appears in the topline. If there is a power failure during this time, the last changes are not saved. The diskette symbol appears in the same place as the symbol for the key lock.

device is switched to night rest mode (e.g. degassing function is switched off in this mode)

the item is checked, started up or available

auto: automatic operation of the unit

standby: if the unit has been commissioned but not yet put into service

Start-up: input of all the necessary parameters for commissioning and start-up

Check: check all “working” components and functions of the device

Parameter: possibility to change all inputted parameters

Status: acces to live data, operation views and message agenda

Configuration: overview of all calculated values based on the inputted data

Manual: the Installation & operation manual is displayed in the screen

Connection with the IMI Webserver via Ethernet is active

USB device is plugged in

Various abbreviations that are displayed when required or activity is performed:

RS485 when RS485 is set to “active”

MS: Master Slave operation is active

LC: Level control operation (for MS operation)

PC: Pressure control operation (for MS operation)

LC MM: Level control operation with Max control (for MS operation)

E: Gas detected during Eco-auto operation

H: Unit is in holiday mode (e.g. no degassing during this time)

PT-S +/- Pressure at slave too high/low (for MS operation)

PT-M +/-Pressure at master too high/low (for MS operation)

PT-IO Isolated operation (for MS operation)

ECO-LC Level control operation during ECO-LC Time Slot

LC-exV Level control operation with MS-SCV valve between Transfero expansion vessels.

opens a help text with more information

back or return to the previous screen or line

informs that there is a message and indicates the importance with a colour code

- *Red envelope* = alarm message: immediate action is required. A primary functionality of the unit or the connected system is faulty.
- *Orange envelope* = event message. Faulty function or condition that is not affecting the primary functionality. A check of the unit or the system is required.
- *Green envelope* = info message: good to know information is available

Keylock = on

Keylock = off

Operating

Setting parameters

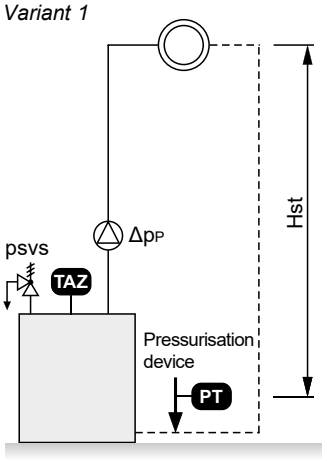
Hst – Static height
You set the actual static height.
dp_(p0-pst) - Safety margin
If you want the pressure maintenance device to run at a specified pressure value pman, you can set the safety margin as follows:
For Compresso: dp_(p0-pst) = (pman - 0.7) bar - Hst/10
For Transfero: dp_(p0-pst) = (pman - 0.8) bar - Hst/10

Example:
Actual static height : Hst = 21 m
Specified pressure : pman = 3.5 bar
Safety margin to be set : Hst = 28 m
For Compresso: dp_(p0-pst) = (3.5 - 0.7) bar - 21/10 = 0.7 bar
For Transfero: dp_(p0-pst) = (3.5 - 0.8) bar - 21/10 = 0.6 bar

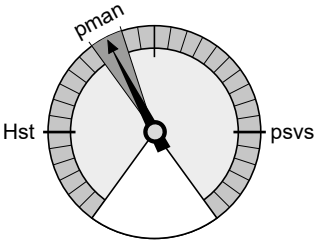
TAZ – shut-down temperature of the system. The TAZ safety device is usually mounted on the heat generator.

psvs – Safety valve response pressure. This safety device is usually mounted on the heat generator.
If the heat generator is at h (m) lower than the pressure maintenance value, then the BrainCube psvs setting is: psvs – h/10, if it is higher: psvs + h/10.

Variant 1



Variant 2



BrainCube calculations and display[1)]

Min. pressure
- p0 = Hst/10 + pv (TAZ) + dp_(p0-pst) [2)]
  If the pressure maintenance device is integrated on the suction side of the circulation pump(s).
- p0 = Hst/10 + pv (TAZ) + dp_(p0-pst) [2)] + Δpp
  If the pressure maintenance device is integrated on the pressure side, consider the differential pressure Δpp from the circulation pump(s).

Pressurisation	Compresso	Transfero	Vento	Pleno
pa initial pressure	p0+0.3 bar	p0+0.3 bar	p0+0.3 bar	p0+0.3 bar
pe final pressure	p0+0.5 bar	p0+0.7 bar	pe=psvs-0.5 bar for psvs ≤ 5 bar pe=psvs x 0.9 bar for psvs > 5 bar	

Water make-up	Compresso	Transfero	Vento	Pleno
Start	< 20%	< 20%	< p0+0.2 bar	< p0+0.2 bar
Stop	30%	30%	p0+0.4 bar	p0+0.4 bar

1) Values valid for factory setting
2) Safety margin; factory setting 0.2 bar (corresponds to recommendation according to EN 12828); can be changed in BrainCube at customer level if required (SWKI HE-301 requires 0.3 bar here).

Operating

First start

When you switch on the unit for the first time, you are guided through the Welcome section.
Select your preferred language, input the date, the time and winter-summer change. Read and acknowledge the safety instruction. The user interface tutorial shows how to operate the BrainCube Connect in only a few windows. The section ends with an overview of the inputted parameters and the possibility to proceed with the start-up itself. All set parameters can always be changed later in the sub-menu “parameter” within “MODUS”.

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Operating - MODUS

The area MODUS contains three menus:
Start-up = input of all necessary parameters to start up the device
Check = possibility to check if a component is functioning adequately
Parameter = change the set parameters directly

MODUS – Start-up	C	T	V	P	DML	*Start-up procedure*
Fast Track Start-up	X	-	-	-	-	This modus is available for Simply Compresso C 2.1-80 S. If the connected system is a heating system with safety valve psvs = 3.0 bar and this Compresso is not equipped with a secondary expansion vessel, you can do a Fast Track start-up and skip the individual start-up steps that are necessary for the other units.
Start-up requirements to be performed before commissioning	X	X	X	X	X	Check and confirm that all the required steps in the device's installation manual have been performed, that the electrical supply is connected, that the primary vessel is empty (for Compresso and Transfero) and that the device is connected properly to the HVAC system, ending with an overview window.
Signal check	X	X	X	X	X	BrainCube checks the signal automatically transmitted by the measuring foot LT. An additional screen shows if the measuring foot has not been connected. Then the signal from RS 485, Ethernet and USB port is checked, ending with an overview window.
System settings	X	X	X	X	X	All the required information regarding the connected system is inputted: a choice between a heating, cooling or solar installation, % antifreeze, response pressure of the temperature limiter, static height of the installation, connection location of the pressure maintenance device in relation to the circulation pump(s), ending with an overview window.
Vessel calibration	X	X	-	-	X	The vessel must be empty so that the measuring foot can transmit a signal corresponding to an empty vessel. If the vessel is equipped with an intelligent generation 2 measuring foot, it will transmit the type and volume of the vessel to the BrainCube. If the vessel is equipped with a generation 1 measuring foot, the type and the volume of the vessel have to be inserted manually. If the signal corresponds to the stored target value, the vessel is calibrated. If not, an additional windows will appear with instructions. If you repeat the vessel calibration at a later date and the calibration values differ from the previous calibration, you can decide whether to accept the new data or keep the previous data.
Vessel start-up	X	X	-	-	X	Input the total number of vessels, check the air connections for the Compresso when there are multiple vessels, dearate the bags, drain the condensate and open the shut off valves in the system.
Pump bleeding	-	X	X	X	-	BrainCube Connect performs a certain number of sequences for Transfero, Pleno PI.1.2 and Vento in order to deaerate the pumps and to make sure that the pump(s) and the degassing unit are filled with system water at the correct pressure.
Flow balancing pump P	-	X	X	-	-	Only Transfero TI Connect and Transfero and Vento TecBoxes of Generation 1: This is where the volume flows of the pump and the overflow line are balanced.
Water treatment	X	X	X	X	-	Decide whether you want to use a water treatment device with this unit. Specify the type, raw water hardness, system hardness, ...
Water make-up	X	X	X	X	-	Select the water make-up device if present and the interface that will start-stop it. Start the check procedure. The water make-up quantity is shown.
Vessel filling	X	X	-	-	-	Select the type of filling proces, automatic or manual. In both cases the target and actual levels are indicated on the screen. If the target is not reached, an additional window appears.
Data interface	X	X	X	X	X	The list of all possible interfaces is displayed. Select the desired data interface to communicate with BMS or IMI Hydonic Engineering's Web server.
Complete start-up	X	X	X	X	X	The device starts working automatically if auto is chosen and the status screen appears. The device is ready to start if standby is chosen and the home screen appears.
Key lock information	X	X	X	X	X	The key lock is automatically activated after 30 min. To activate or de-activate press the keylock symbol in the topline or go to: parameter/options/ key lock

Operating - MODUS

MODUS – Check	Some components like pump(s), compressor(s), valve(s), data interfaces and digital output(s) or functions like water make-up, water treatment, tightness of the device, gas content measurement of the system water, Motor driven valves M1/M2, safety valve and condensate drain are checked manually or automatically.
Attention!	Water can be hot and pressurised when testing the blow off capacity of the safety valve and when opening the drain valve! Take all the necessary safety measures!
	"Next service" allows you to program a date for a future inspection.
MODUS – Parameter	All parameters entered during the welcome, start-up sequence and many others can be changed in this section. In "Interface-communication" the software version can be upgraded if available, permission can be given for remote control, digital outputs OD* can be configured to transmit messages or to start/stop the external water make-up device. In in "options"** the key lock can be activated for various functions. The USB port can be operated from here for software and recovery file uploads, and for exporting logfiles, setting files, statistic files and recovery files.
Digital outputs OD*	All digital outputs can be freely configured in order to transmit the following possibilities:
Messages	The full list of all possible messages is displayed with a coloured envelope. red = Alarm message orange = Event message green = Information message
- Alarm messages	Triggers this digital output when at least one alarm message is pending.
- Event messages	Triggers this digital output when at least one event message is pending.
- Info messages	Triggers this digital output when at least one info message is pending.
- Individual choice	Customise the selection of messages to be transmitted with this OD.
- Switching points	Here you can switch the digital outputs OD depending on the current level or pressure e.g. switch OD "on" for level underrunning of 20% and switch "off" with level exceeding 30%.
External water make-up	This output is closed as long as make-up water is requested. It must be connected with the corresponding digital input ID from the external water make-up device. This is ID5 for BrainCube Connect devices.
MS-SCV Valve	With this setting the OD switches level depending on the system connection valve MS-SCV that is used for Master-Slave MS-IO systems.
Switch position	Symbolic indication of the position of the switch when not activated.
Switch position (standby)	Describes how the switch should work in standby. Setting "auto" is useful when the switch position is set as NC (nornally closed). In this case the switch remains in the NC position even in standby.
Operation - Switchings	Here you can switch the individual ODs depending on pump and valve operation. You can as well switch the ODs depending on the operation mode (auto/standby).
Options**	
Key lock	Lock the access to some menus.
- Key lock overall (KL1)	This key lock type is called KL1. The factory setting for this Code is 0011. An individual code can be set by IMI customer service in the service menu. It locks setting or operation mode. Only messages can be acknowledged with this key lock type. KL1 key lock is activated automatically 30 minutes after activation of the auto mode. It can be deactivated manually by Code 0011.
- Start-up	The start-up menu faded out and locked.
Suppress messages	Individual messages can be suppressed here, allowing the unit to operate within the limit range if necessary without messages appearing.
Chart Views	Here you can change the scaling of the chart views, e.g. diagrams for degassing flow capacity under Status/Degassing/Degassing flow capacity/Flow capacity history - Chart view/...

Operating - INFO

The area INFO contains three menus:
Status = displays the status of actual values
Configuration = overview of the calculated switching points based on the inputted parameters in
Modus/Start-up or Modus/Parameter
Manual = displays the installation & operation manual

INFO – Status	**C**	**T**	**V**	**P**	**DML**	***Values are displayed but cannot be changed***
Live status	X	X	X	X	X	There are different live status screens available. - Status Live view 1 displays the different components of the device as symbols and indicates in green those that are working. The bar graphs show the actual system pressure and vessel content (Compresso, Transfero/ComCube DML). - Status Live view 2 shows the bars for level (content) and pressure, too, but instead of component information about the operation status (auto/standby), it shows time, date, current process e.g "System Monitoring" and a bottom line with symbols about keylock, interfaces (USB, Ethernet, RS485), message number, ... - Status Live view 3 shows the activation status and the switching posititions of the digital outputs OD1/2/3/4. Additionally it shows the bar graphs as in Status Live view 1.
Messages	X	X	X	X	X	Active and acknowledged messages are chronologically displayed in three message lists: all messages, active messages and acknowledged messages. *For a list of all possible messages please see page 8*
Water make-up	X	X	X	X	X	Display of: - Activation status of water make-up - Current water make-up flow - Total make-up water quantity from the moment the device was installed. - Tolerable make-up quantity during the monitoring period (factory setting: 12 months). If exceeded, an M14 message is sent. - Make-up quantity during monitoring period for the previous month to the present day. Note: the tolerable make-up quantity during the monitoring period can be changed manually. If set to 0 litres, the optimal value is calculated and set by the BrainCube. Important! If higher values are set, there is a risk of corrosion in the installation. - Make-up history with chronological list of the make-up quantities inccured per day. A maximum of 30 entries are saved.
Water treatment	X	X	X	X	X	Display of: - residual capacity l x °dH, residual make-up quantity and life-time of the installed water treatment cartridge
Degassing	-	X	X	-	-	Display of: - values that are relevant for the current degassing procedure e.g. the residual time for degassing. - Chronological listing of degassing runtimes and degassing throughputs with lists and diagrams. These are displayed both in lists and graphically in diagrams. - Information on the gas content of the plant in ml/l,
Combined operation	X	X	-	-	-	Status information for the master-slave combined operation.

INFO – Configuration	Displays all relevant settings from start-up and parameter menu as well as calculated values and the technical data of the unit (e.g. device type, Serial number, Software versions, ...).

Operating - OPERATION

The area OPERATION contains two functions:
auto = automatic mode
standby = standby mode

Auto	In auto mode all functions are performed and monitored automatically. After start-up is completed successfully, the device should remain in auto mode all year round whether the connected heating, cooling or solar installation is switched on or not. For pressure maintenance units (Compresso, Transfero) it is a must to operate in auto mode after start-up in order to maintain the pressurisation.
Standby	In standby mode the automatic functions (pressure maintenance, degassing, water make-up) are switched off. Most fault signals (messages M01_as, M02_es, ...) are neither displayed nor registered. Digital outputs OD are in “off” position (NO). This Standby mode is particularly suitable for maintenance work. It is activated automatically when you start operating in the start-up or check menu e.g. switch pumps/valves manually. The standby mode can also be selected manually.

Remark: If a device is kept longer than 30 minutes on Standby, an M22 message will appear.

Caution: For Master-Slave pressurisation networks: note that slaves or slave systems linked to the master may take over the master function and react independently when the master Tecbox is in standby mode.

Operating - Water make-up

Water make-up function

All BrainCubes have the necessary software to enable/disable and control water make-up devices.
The water make-up quantity is measured by a flow transmitter FT.
By measuring the make-up quantity, duration and frequency, the pressure monitoring functionality required by the standard EN 12828 is provided. This monitoring is the fillsafe quality characteristic. Water make-up is locked (factory setting) as soon as one of the fillsafe criteria (time, frequency, quantity) has been activated. However, the operator can, at his own discretion and on his own responsibility, deactivate the automatic locking as well as switch off each fillsafe criterion himself. However, the latter is only advisable if it is clear that otherwise a possible emergency operating state cannot be maintained.
The water reserve in the primary vessel in pressure maintenance devices is monitored by the measuring foot LT.
If the level falls below 20%, make-up water is added by up to 30% (factory settings).

Attention: Given the water make-up devices add water, the mix ratio in installations with water glycol mixture will be affected.

Water make-up control

To enable and check the water make-up function, follow the BrainCube instructions in MODUS/Start-up/Water make-up or MODUS/Check/Water make-up respectively.

Compresso (not Simply Compresso) Water make-up with Pleno P:
Connect the solenoid valve and the water meter FT of Pleno P devices directly to the BrainCube (follow electrical scheme).

Transfero, Vento, Simply Compresso SWM + Water make-up with Pleno P BA4R or Pleno P AB5(R) devices:
Transfero, Vento and Simply Compresso SWM have the solenoid valve and flow transmitter for water make-up on board and wired with BrainCube. Do the hydraulic connection of the water make-up devices.

Water make-up with Compresso, Transfero, Vento as sender and Pleno PI/PIX, Pleno PI 1.2, Vento, other as receiver:
Connect one of the digital outputs OD of the sender device to the corresponding digital input of the external water make-up device (signal receiver) to drive the water make-up.

If no communication between pressure maintenance devices like Compresso and Transfero Connect with a BMS using MODBUS protocol is required, it is possible to configure the BrainCube Connect to use the Pneumatex RS 485 protocol in order to communicate with Pleno PI or Vento equipped with a BrainCube Generation 1.

The water make-up signal can also be transfered via the RS485 connection. For communication between BrainCube Connect and BrainCube generation 1 devices, use the “Pneumatex” protocol and not the MODBUS protocol. Don’t use the RS485 for water make-up signals if you want to communicate with a BMS through RS485.

Water treatment control

To enable/disable the water treatment control, follow the BrainCube instructions in MODUS/Start-up/Water treatment or MODUS/Check/Water treatment respectively. Here you can also define the settings for the water treatment, such as method, device type, water treatment capacity of the selected cartridge, hardness of the supply water and the system water. Here you can also decide whether you want to lock the water make-up if the cartridge is replenished or lifetime is exceeded.

Follow the BrainCube advice in MODUS/check/Water treatment to re-enable the monitoring after changing a depleted cartridge.

Operating - Master-Slave combined operation

General requirements for Master-Slave operation

- all BrainCubes involved must have the same software version
- Commissioning only by IMI Hydronic Engineering Customer Service

Background and necessity for master-slave combined operation

A master-slave combined operation is always required if more than one pressure maintenance systems are to be used in an installation or when several installations are partially or permanently hydraulically connected.
In these cases, the pressure maintenance devices must communicate with each other to keep plant pressures and vessel levels under control.
Reasons for the need for multiple pressurisations:

- Increase of the operational safety
- Better partial load behaviour by distributing the load over several pressure maintenance devices
- Insufficient space conditions,
- Heating-Cooling compound systems (change-over systems with common consumers)
- Merging of existing installations to form a complete system
- Temporary autonomous operation of sub-areas of a hydraulic network (local heating network system with secondary district decoupling)

Master-Slave operation modes

The following operating modes are possible:

- **MS-PC** = Master-Slave pressure control (PC = Pressure Control)
  Several pressurization stations operated in parallel, which operate in cascade mode.
- **MS-PCR** = Master-Slave pressure control with redundancy (PCR = Pressure Control Redundancy)
  Several pressurization stations operated in parallel, at least one of which provides full redundancy.
- **MS-LC** = Master-Slave level control (LC = Level Control)
  Two or more pressurization stations in one system, but at different locations.
- **MS-IO** = Master-Slave Isolated Operation (IO = Isolated Operation)
  Two or more independent pressurization units in separate installations that may be connected together.

The master-slave operating modes can be combined with each other.

Operating - Master-Slave combined operation

Principle and application limits

- The master leads. Slaves basically follow the signals of the master.
- Masters and slaves are organized within systems and groups. Systems are hydraulic circuits with their own circulation. Systems can be hydraulically separated or connected via valves (MS-SCV connection valves, SCV=System Connection Valve). In each system there is at least one master device. In total, up to 40 TecBoxes in 16 systems can be operated with the IMI-Pneumatex Master Slave combined operation. The following systems and groups are possible:
  - Master system MS, slave systems SS1, SS2, SS3, ..., SS15.
  - Master group MG
  - Stand-alone master G0, stand-alone slave G0
- In groups, the slaves always follow the master with the same function, e.g. with pressure control PC.
- Various TecBox families and types can be operated in a common MS combined operation. For example: Transfero TV.2, Compresso, C10.2 Compresso C10.1, Transfero TV.1, ...
- If the respective master fails due to any of the following fault messages (M16, M17, M18, M18 + M19, M30, M37, standby, RS485/Ethernet communication interruption or power failure), a slave (respectively a master in a slave system) takes over the function of the master, or can reject it and wait without pressure or level control until the assigned master has restored its master role. If a slave (or master in a slave system) has refused to assume the master role, this can be subsequently cancelled by the BMS via Modbus. This way, undesired automatisms can be avoided and control remains with the operator.
- If all Tecboxes of a system fail or refuse to take over the master role, this is called a system failure. In this case, the slave system linked to this system will look for a new link (system link change). It starts with the master system and continues to search in the direction of increasing slave system numbers. The number of permitted system link changes can be set. If this number is exceeded, the affected slave system can “decide” (adjuster) whether it takes over the role of the master system or rejects it.
- The messages minimum pressure M01 and maximum pressure M02 are generated only by the master.

Communication in master-slave combined operation

- The master-slave combined operation can be realised either via the RS485 interface with Modbus RTU protocol or, alternatively, via the Ethernet interface with multicast protocol.
- With RS485, a maximum of 40 units can be operated in a master-slave network. Only one master-slave network is possible in each RS485 network.
- In an Ethernet IP network, several master-slave network systems can be operated independently of each other via the multicast protocol. This is controlled via the multicast port numbers. Each individual network system can be operated with up to 40 devices.

Operating - Master-Slave combined operation

MS-PC Pressure control - up to 40 pressure maintenance stations in parallel in cascade operation

Use

Parallel connection of all pressure maintenance stations to ensure 100% performance

Operation

Pressure maintenance is performed by both the master and the slaves. Pressure and content signals (PT/LT) are transmitted from the master to the slaves via RS485 or Ethernet. In this way, up to 40 TecBoxes can be operated with a single primary vessel. Master and slaves all operate in the same pressure range. Staggered switching points can be set by the customer service. An individually adjustable switch-on delay of the respective slaves is also possible (factory setting: 10 seconds). This allows an optimum partial load behaviour to be realised. The runtimes of TecBoxes can be compared with each other. For each TecBox, the total runtime of its pumps is used for adjustment. The TecBox with the lowest total runtime always switches on its pumps or valves for the pressure maintenance function without delay. All other TecBoxes switch on with the time delay set for them. Whether a TecBox participates in runtime adjustment can be set individually. This way, it is possible to parametrise that one or more TecBoxes will always work for base load coverage while others only handle peak load coverage and still others only function as reserve units, or all units can have the same total runtime.
Instability of the network is avoided by the joint evaluation of the master pressure signal PT.
In the event of a fault in the level measurement LT (M17), the slaves also indicate a fault. However, as long as the master can still send the contents signal via the data interface and the slaves receive it, the slaves continue to work with this signal and maintain operation. The operating ranges of master and slaves must be parameterised at the same pressure level (HstMaster = HstSlaves).
The cable for the measuring foot LT must be disconnected for slaves in PC pressure control mode (terminal diagram).

Dimensioning

According to customer requirements: e.g. system output is proportionally divided between TecBoxes, and the expansion volume between vessels. All vessels must be of the same height.

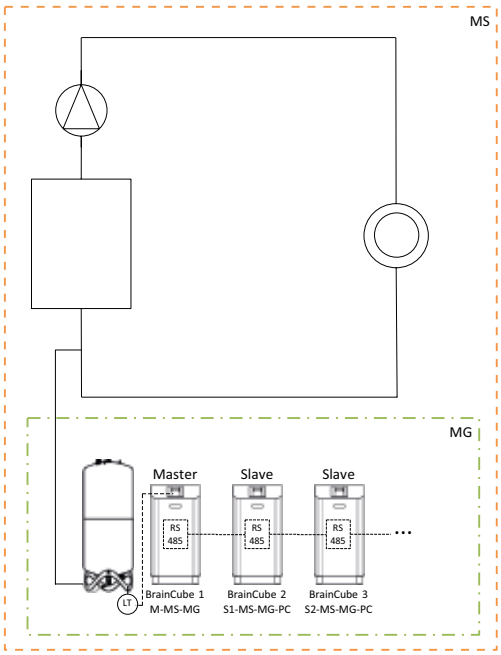
Type of pressurisation

Both compressor pressure maintenance (Compresso) and pump pressure maintenance (Transfero) are possible for this master-slave operating mode.
Mixed operation of Compresso and Transfero machines is not possible.

Hydraulic integration

Integration preferably with a common expansion line designed for the plant capacity.
With Compresso, several expansion vessels must be connected to each other on the air side
On the water side, the expansion vessels of Compresso must be connected symmetrically to a common expansion pipe.

Scheme (example)



Operating - Master-Slave combined operation

MS-PCR Pressure control with redundancy - up to 40 pressure maintenance stations in parallel in cascade operation with 100 % redundancy

Use
Parallel connection to ensure 100% output. Additionally, 100 % or more is available as a reserve. If required, this reserve is automatically switched on to increase the output up to 200 % or more. Security of supply raised to 100 % or more.

Operation
Pressure maintenance is performed by both the master and the slaves. PT pressure signals are transmitted via RS 485 from the master to the slave. Master and slaves all work in the same pressure range. Staggered switching points can be set by the customer service. An individually adjustable switch-on delay of the respective slaves is also possible (factory setting: 10 seconds). This allows an optimum partial load behaviour to be realised. The runtimes of TecBoxes can be compared with each other. For each TecBox, the total runtime of its pumps is used for adjustment. The TecBox with the lowest total runtime always switches on its pumps or valves for the pressure maintenance function without delay. All other TecBoxes switch on with the time delay set for them. Whether a TecBox participates in runtime adjustment can be set individually. This way, it is possible to parametrise that one or more TecBoxes will always work for base load coverage while others only handle peak load coverage and still others only function as reserve units, or all units can have the same total runtime.
Instability of the network is avoided by the joint evaluation of the master pressure signal PT.
At least one slave has its own primary vessel with level measurement LT. In contrast to MS-PC operation, this means that even if the level measurement LT (M17) respectively power failure on the master fails, the slave set to MS-PCR operation can maintain 100% pressure maintenance (100% redundancy in performance and components). The operating range of master and slaves must be configured to the same pressure level (Hst Master = Hst Slaves).

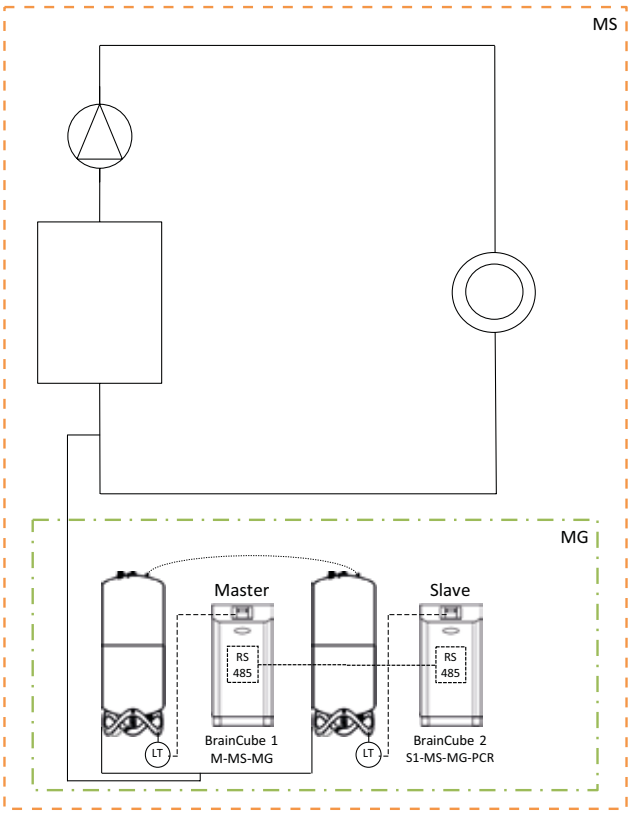
Dimensioning
According to the customer requirements: e.g. 2 TecBoxes with 100% redundancy in terms of output and components of the TecBoxes: One TecBox as master and one TecBox as slave are each designed for 100% of the total output.. Two expansion vessels with one measuring foot LT each for evaluation at TecBox 1 and TecBox 2. The total expansion volume is divided proportionately between the vessels (no redundancy for the expansion volume).

Type of pressurisation
Both compressor pressure maintenance (Compresso) and pump pressure maintenance (Transfero) are possible for this master-slave operating mode.
Mixed operation of Compresso and Transfero units is not possible.

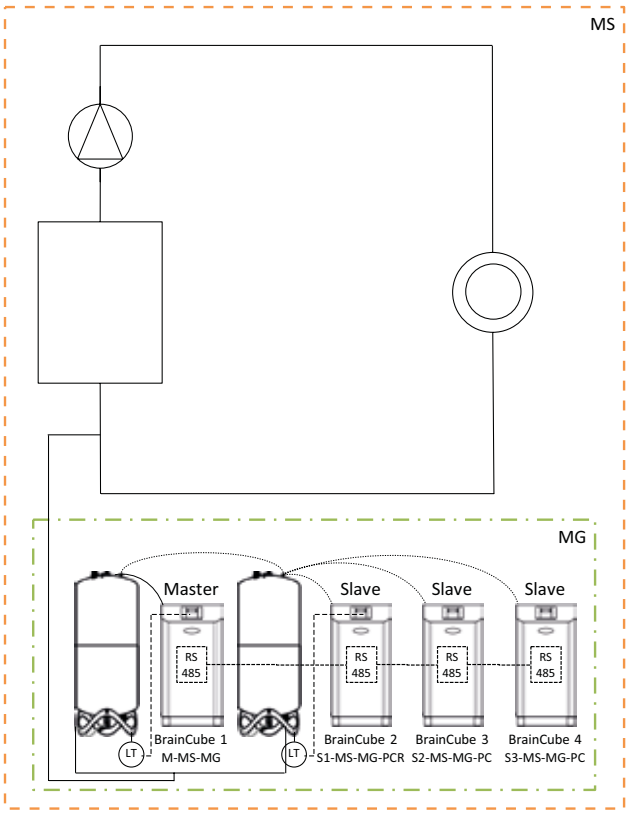
Hydraulic integration
We recommend connecting them to a common expansion pipe, which is of sufficient dimensions for system output.
With Compresso, several expansion vessels must be connected to each other on the air side. On the water side, the expansion vessels of Compresso must be connected symmetrically to a common expansion pipe.

Operating - Master-Slave combined operation

Scheme (example: : Compresso and 100% redundancy)



Scheme (example: : Compresso and >100% redundancy)



Operating - Master-Slave combined operation

MS-LC Level control

Use

- Insufficient space for extending existing installations.
- Allocation of the required expansion volume to expansion vessels at different points in the system.
- Increasing the security of supply
- Additional expansion vessels at different points in the system as volume reserve

Operation

The master or master group is defined once and takes over the complete pressure maintenance. The slaves at the other binding points in the system are only switched on for volume compensation if the level deviates more than 8 % (factory setting) from that of the master primary vessel. The slaves are controlled in such a way that both their own pressure limits and the permissible pressure range of the master are never exceeded (pressure maintenance of the master has priority over level control). In the case of slaves with two pumps/compressors, these work in alternating operation depending on the running time and not simultaneously (factory setting). The MS-LC operation does not serve to increase the output!

Dimensioning

According to the customer requirements but Master-TecBox or Master Group for in minimum 100 % of system output. Slave-TecBoxes for at least 25 % of system output each. The required nominal volume can be divided between the master and slave vessels. The dimensioning of the TecBoxes and the vessels can be different. Recommendation: Design expansion vessels in the master group for at least 50 % and expansion vessels in slave TecBoxes for at least 25 % of the required nominal volume in each case.

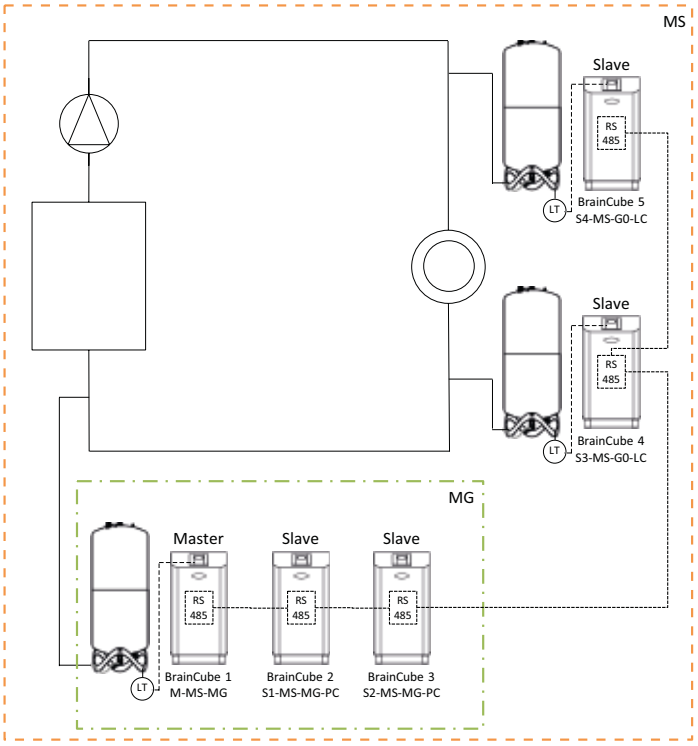
Type of pressurisation

For this master-slave operating mode, the exclusive use of pump pressure maintenance (Transfero) is recommended. When using compressor pressure maintenance (Compresso), there is the problem of undesirable and constant volume shifts caused by load changes of the circulation pumps, especially in large and widely branched systems.
Mixed operation of Compresso and Transfero units is not recommended.

Hydraulic integration

Different integration points are possible, e.g. master in the basement, slave on the roof.

Scheme (Example A)



Operating - Master-Slave combined operation

MS-IO Isolated operation

Use

Systems that can either be run separately (IO = isolated operation) or linked together, e.g.

- Heating-Cooling combined systems (change-over system),
- Merging of existing installations to form a complete system with the option of operating individual areas autonomously at times

Increase security of supply.

Operation

If the systems are isolated from each other, for example by closing a motor-driven valve, this must be communicated to the Master TecBox in the affected slave system via a potential-free switch on input ID5. This switching can also be done via Modbus TCP. Each Master TecBox or master group in the relevant slave system then operates independently with complete pressure maintenance functions and its specifically set switching points. If the systems are connected hydraulically, e.g. by opening a motor-driven valve and dropping the signal at ID5, this Master TecBox or Master Group works only for volume compensation (level control). The TecBoxes are controlled in such a way that both their own pressure limits and the permissible pressure range of the linked upstream system (e.g. the master system) are never exceeded (pressure maintenance has priority over level control).

The motor valve can be controlled either via the building management system or automatically via the digital outputs OD of the master unit in the slave system. The control takes place at the latest whenever the expansion vessels in the slave system threaten to overfill or the level becomes too low. This operation is called LCMM (Level Control Min Max).
If the ECO-LC-IC (Economic Level Control Inter-Connection) operating mode is selected, the motor valve is additionally opened in freely definable time windows and the vessel levels are brought to the same level. In a change-over system, it makes sense to do this at night, since the temperatures of the heating and cooling circuits are then equalised, the heat generator and the refrigerating machine are not active, and thus heat energy is not unnecessarily wasted.

In a change-over system, the motor valve can also be integrated between the pressureless expansion vessels when using pump pressure maintenance (Transfero). With this solution, change-over systems with different system pressures can also be realised and at the same time the vessel contents can always be balanced when it makes the most sense in terms of energy.

Operating behaviour in the event of system failures

The desired operating behaviour of systems and TecBoxes in systems can be controlled with the “Max. system link change” and “Take over M (master) function” settings. Example:
Legend:
“(1)” means: Number of Max. System link change (here: 1)
“=>” means: “follows” or “has a system link to”.
“(M)” means: “has taken over master role”.
Configuration A: SS3(2) => MS <= SS1(0) <= SS2(1)
Result variant in case of MS failure: SS3 => SS1(M) <= SS2
Result variant in case of failure of MS+SS1: SS3 => SS2(M)

Configuration B: SS3(1) => MS <= SS1(0) <= SS2(1)
Result variant in case of MS failure: SS3 => SS1(M) <= SS2
Result variant in case of failure of MS+SS1: SS3(M), SS2(M)

Dimensioning

According to the customer requirements: e.g. TecBox and vessels in classic change-over systems to be laid out in the same way for both systems and according to the system performance of the system with the largest heating load and the largest expansion volume.

Operating - Master-Slave combined operation

Type of pressurisation

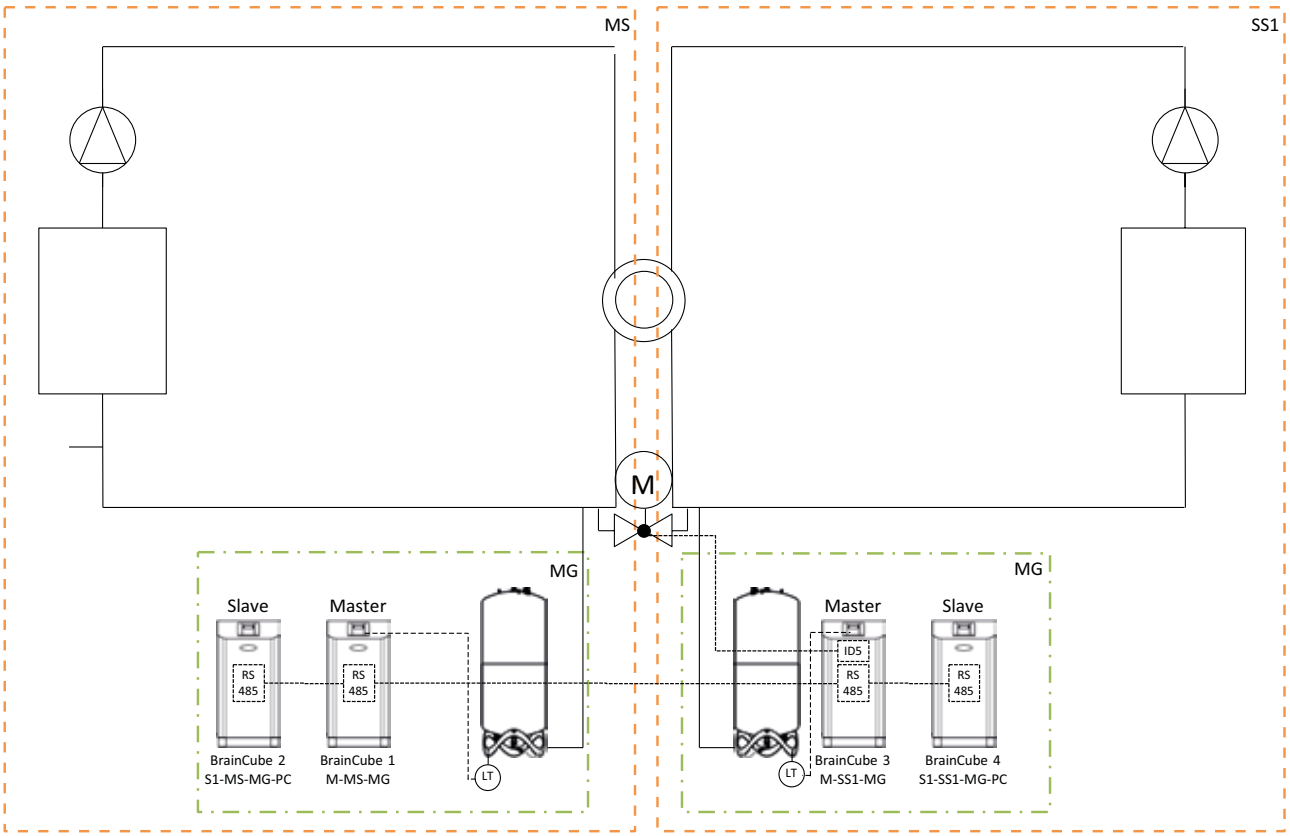
For this master-slave operating mode, the use of pump pressure maintenance (Transfero) is recommended.
When using compressor pressure maintenance (Compresso), it must be ensured that these are connected with the same pressure loss values in the expansion lines in the immediate vicinity of the motor valve and that the Compresso units operate at the same system pressures. This is important because with Compresso, pressure changes on the water side have a direct effect on the contents of the vessels.

Hydraulic integration

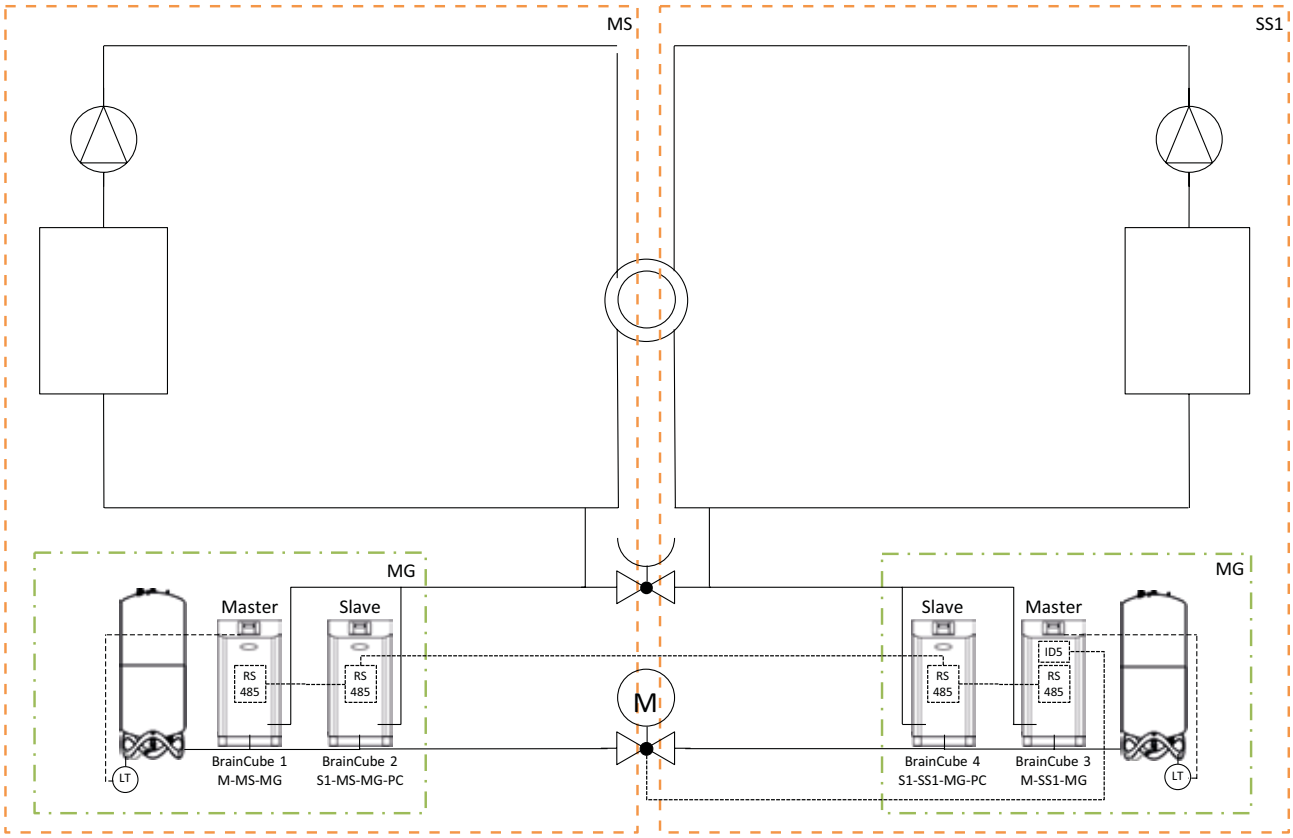
Each system receives its own pressure maintenance (master or master group).
In a change-over system, water volumes are regularly shifted from the cooling circuit to the heating circuit via the common consumers due to operational reasons. These volumes are small over the course of the day and usually do not exceed the volume available in the expansion vessels. However, experience shows that additional leakage flows occur between the two systems, which can flow in one direction or the other depending on the pressure difference. Such leakage flows can exceed the natural volume shifts several times over. If the leakage flows are so large that the pressure maintenance in the slave system would have to switch to LC/LCMM operation again and again almost continuously, a permanent hydraulic connection between the two systems must be established, e.g. by permanently opening the motor valve installed between the systems.

Operating - Master-Slave combined operation

Scheme (Example Change-over System MS-SS1 with motor valve on the system side)

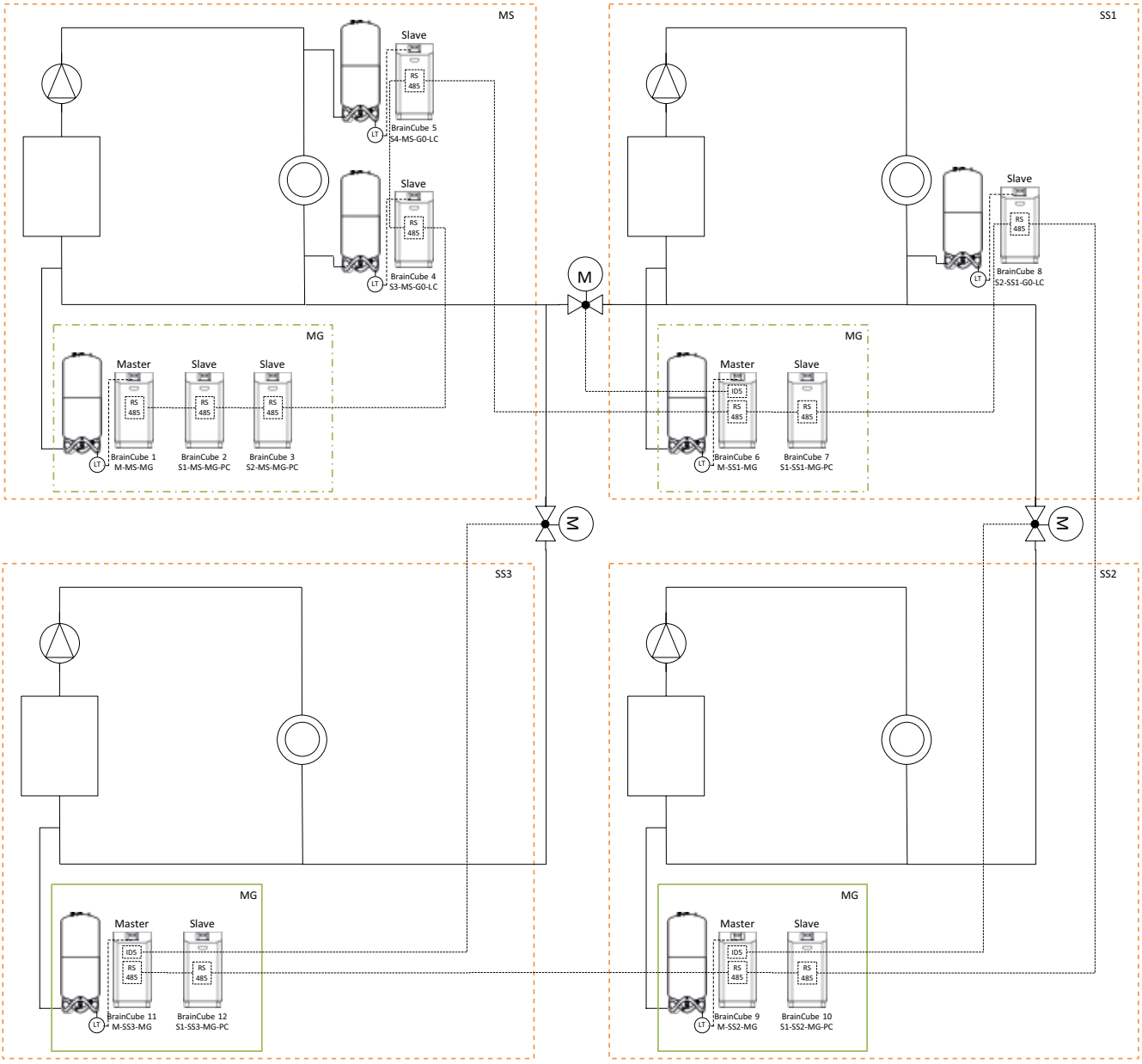


Schematic (Example change-over system MS-SS1 with motor valve between the Transfero expansion vessels)



Operating - Master-Slave combined operation

Scheme (Example of multi-system network MS-SS1-SS2-SS3)



Data Interface - Communication - OD - RS485 - Ethernet

The BrainCube Connect can communicate with a BMS.
Various data interfaces and modules are available:

- OD digital outputs
- RS485 data interface
- Ethernet data interface
- ComCube DCA communication module

Cabling to these interfaces is described in the relevant sections of this manual.
The communication options of the different interfaces are described below.

OD digital outputs

The digital outputs OD1, OD2, etc. can be configured separately. OD can be used as signal generator for external water make-up devices, as an alarm output or as a content-dependent switching contact. The digital outputs are normally open (BrainCube switched off) (NO) but can be set to normally closed NC (in idle mode). This allows the disconnected state of the BrainCube to be transmitted to the building management system. For more information on the setting options of the digital outputs OD, see chapter “Operating - Mode / Digital Outputs OD”.

RS485 data interface

The RS485 data interface is used to control group processes involving multiple TecBoxes (e.g. master-slave combined operation).
It can also be used for data transmission to the BMS. Data transmission is based on the Modbus RTU standard. For more information, see chapter “Modbus RTU protocol and operation”. To communicate with BrainCube of generation 1 the “Pneumatex” protocol type must be set in MODUS/Parameter/Interface-Communcation.

Ethernet data interface

The Ethernet data interface can be used to control group processes involving multiple TecBoxes (e.g. master-slave combined operation). This is realized via the multicast protocol. Additionally, you can use the Ethernet data interface for Modbus TCP/IP communication with your BMS (see chapter .../Modbus TCP) as well as for communication via the IMI Hydronic Engineering Web interface. This means you can view and query BrainCube data logging, error messages, etc. at any time. You can also operate one or more BrainCubes remotely using any web browser.
A connection to the IMI Hydronic Engineering web server is required in order to obtain online support from IMI Hydronic Engineering customer service. IMI Hydronic Engineering regularly upgrades the BrainCube software, adding new functions and improvements.
Requirements for Ethernet connection (with IMI HE Webserver):

- Internet access via Switch/Router/Firewall
- Firewall ports 80 (http) and 53 (DNS requests) must be enabled/unlocked
- DNS server inside/extern available (to convert the domain name “connect.imi-hydronic.com”). If the DNS function is deactivated, the address of the web server can also be set manually via the host IP in BrainCube. The host IP of the web server is: 84.19.144.208.
- 10/100Mbit LAN connected to an auto-adaptive Switch/Router

Cable requirements:

- Cable Length < 100m (BrainCube <=> Switch/Router)
- Cable standard minimum: CAT5

Recommendations for Ethernet connection:

- Accessible DHCP Service (default setting of BrainCube for plug&play connectivity to the IMI Hydronic Engineering Webserver)

For more information, see chapter IMI Hydronic Engineering Web interface.

Data Interface - Communication - USB - Internet security

USB data interface - software upgrades - Recovery files - data logs to USB

The USB functionality can be used for application software versions 2.04 and higher.
The USB port allows for software and recovery file uploads, and for exporting logfiles, setting files, statistic files and recovery files.

Software upgrades:

- Software files can be downloaded from the IMI Hydronic Engineering Website or sent via e-mail by the IMI Hydronic Engineering customer service respectively.
- BrainCube can only detect software files that are stored in the right directories of the USB memory stick. Create an MNU folder and an SW folder in the main directory of the USB stick. Copy the LNGxxx.bin file (e.g. LNG205.bin) in the MNU folder. Copy the BCxxx.hex file (e.g. BC205.hex) and the PWRxxx.hex file (e.g. PWR123.hex) into the SW folder.The number of the LNGxxx.bin file must be identical to the number of the BCxxx.hex file. The LNGxxx.bin file contains the available languages. The BCxxx.hex file containes the application software. The PWRxxx.hex file contains the Power Board software. To use the functions of the USB interface for BrainCube with lower software versions get in contact with the IMI Hydronic Engineering customer service.

Data protocols on USB:

- BrainCube logs events in so-called LOG files in the memory of the BrainCube. Events include the triggering and acknowledgement of messages, changes to the settings and much more. These LOG files can be saved to a USB stick via the USB interface. BrainCube creates a folder “LOG” for this purpose, in which data is stored daily as a TXT file and can then be further processed in a TXT editor.
- From software version V5.30 BrainCube saves statistics on degassing (run times and throughputs) and water make-up processes (make-up quantities) as daily values. These statistics are stored monthly in a folder STA_GAS (Degassing) and STA_MU (Water make-up) as CSV files. Like the LOG files, they can be exported to a USB stick and then simply opened and processed in Excel, for example.

Recovery file

- All settings of the BrainCube are stored in its memoryy, in the file PARALIST.XML. It contains a complete set of settings including the last status of all changes made.
- This file can be saved to a USB stick as a recovery file via the USB interface. The BrainCube creates a folder “PARA” for this purpose, in which data is saved in XML format.
- This recovery file can be uploaded from the USB stick at any time. This is useful, for example, if the BrainCube is to be replaced. The replacement BrainCube can then be put in operation immediately after uploading the recovery file and without any further changes to the settings.

Internet security

As soon as the BrainCube is connected via Ethernet to the IMI Webserver there is a hypothetical possibility for a hacker attack.
This is hypothetical because:

- protection by firewall and other network security measures of the local network
- protection by firewall and other network security measures of the IMI Webserver
- IMI Webserver with https (Hypertext Transfer Protocol Secure) security, ensuring that direct access to BrainCube from outside the network is not possible. Remote access to BrainCube is not possible without the IMI Webserver application. Snooping and redirecting of data traffic between local network and the IMI Webserver is extremely difficult and interpretation of the nearly impossible.
- The BrainCube doesn’t offer discovery services such as UPnP nor is it visible to other network devices
- The worst possible thing a hacker could do is upload a software file to the BrainCube. But for that he must already have access to the local network, and know not only the local IP address of this particular BrainCube, but also the local username and password or the user account where this BrainCube is registered online. This is not possible without having previously hacked the Firewall of the local network and the IMI Webserver. The software file itself can only be activated locally at this particular the BrainCube and this is only possible if BrainCube identifies this software as relevant, otherwise the BrainCube just ignores this software and doesn’t upgrade.

Data Interface - Communication - Web interface

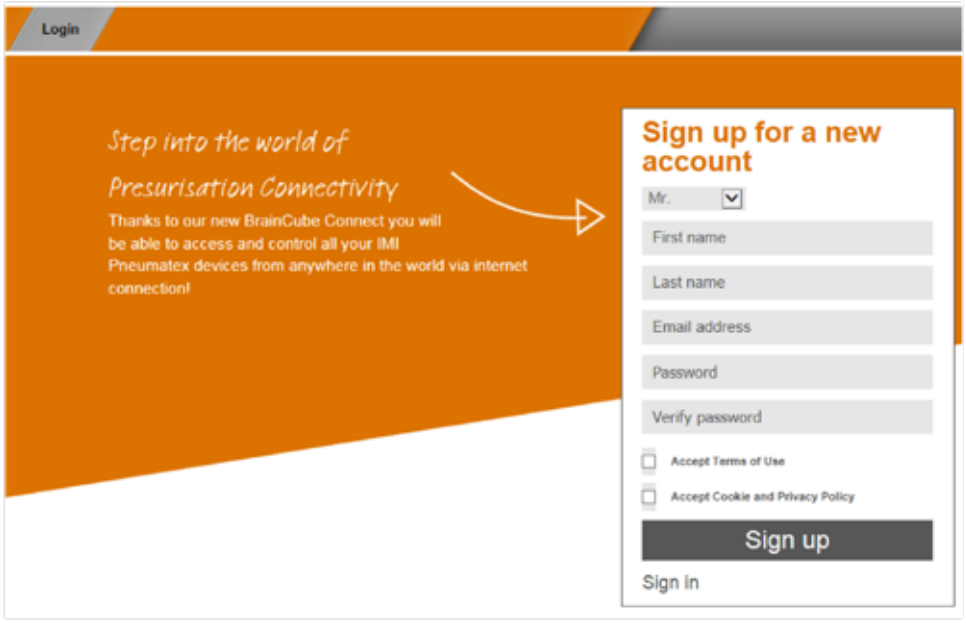
IMI Hydronic Engineering Web interface

You can operate BrainCube Connect remotely via the IMI Hydronic Engineering Web interface: https://connect.imi-hydronic.com/login
Use this address in any web browser to get to the landing page of the web interface.

Landing page with Login section

If you have already activated an account, login with the relevant e-mail address and password.
If you don't have an account yet, click "Sign up".

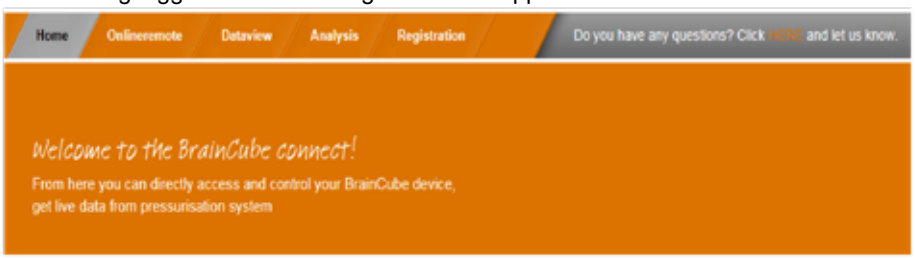
Sign up for a new account



Fill in your details, check "Accept Terms of Use" and "Accept Cookie and Privacy Policy" and then click "Sign up".
After successful sign up you will be directed back to the landing page where you can log in.
Log in with the relevant e-mail address and password.

Web interface login status

After having logged in the following screen will appear:



Data Interface - Communication - Web interface

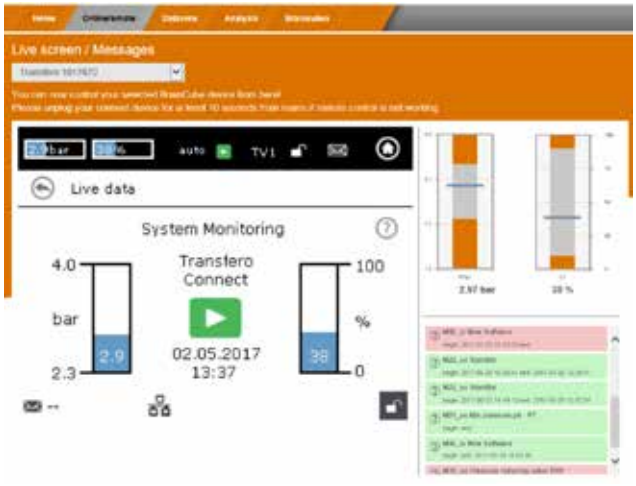
Registering a BrainCube Connect
To be able to run remote control or view data in a BrainCube, the BrainCube must be registered.
Use the tab “BrainCubes / Registration” to register a BrainCube.

Enter the BrainCube’s registration code into the first input box.
The registration code must be created directly on the BrainCube itself in the menu: Parameter/Interface-communication.
Click on the line “Registration” and the registration code will appear on the same line e.g. 0FDB1B5F06.
Select and enter a name for this BrainCube in the second input box.

Enable BrainCube Connect for Remote Control
To be able to run remote control or view data in a BrainCube via the web interface, the BrainCube must be enabled for remote live screen directly on the BrainCube itself in the menu: Parameter/Interface-communication/via Ethernet Web interface/ Enable the line “Live screen” here. To be able to directly acknowledge messages without navigation through the live screen, the line “Messages” has to be enabled.

Online Remote of a BrainCube Connect
Following registration and remote control activation, you can run the BrainCube on remote control via the tab “Onlineremote”.
Select the requested BrainCube (here: “Transfero 1017670”) from the list of BrainCubes that are registered in your account.
Select the desired modus you want to remote (“Live Screen” or “Messages”).

Live screen remote



Messages remote

Data Interface - Communication - Web interface

Data view of a BrainCube Connect

After registration and remote control activation, you can view the BrainCube's live data via the tab "Dataview".
Select the desired BrainCube (here: "Transfero 1017670") from the list of BrainCubes that are registered in your account.

① Live data of the system pressure PT and the water content LT of the expansion vessel.

② Live data of pumps, compressors, valves and digital outputs of the connected BrainCube.

③ Data log of BrainCube messages.

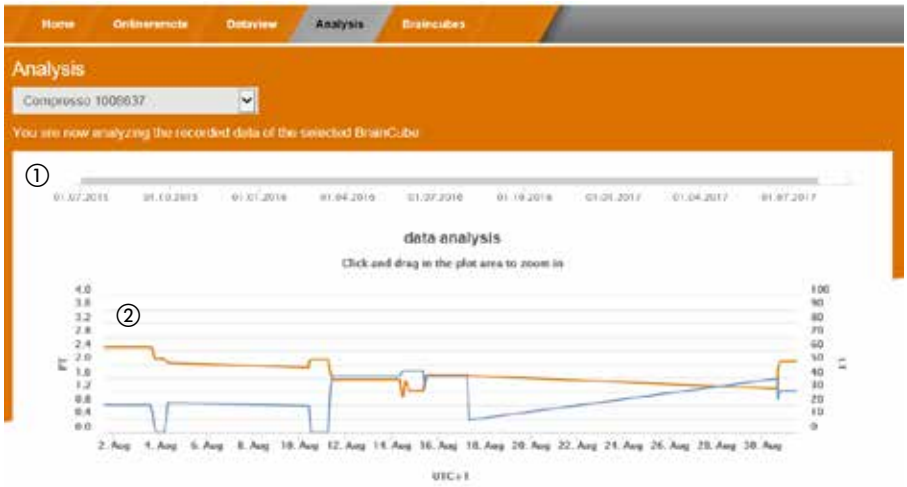
④ Data log of the system pressure PT and the water content LT of the expansion vessel.

⑤ Live screen of the connected BrainCube.

Data Interface - Communication - Web interface

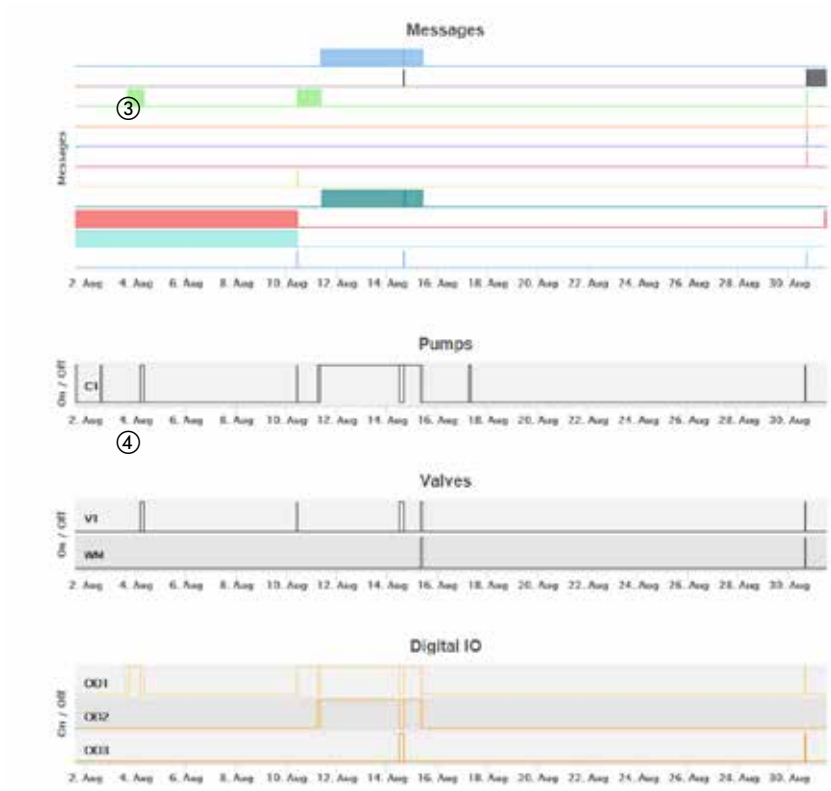
Analysis view of a BrainCube Connect

After registration and remote control activation, you can view the BrainCube's live data via the tab "Analysis".
Select the desired BrainCube (here: "Compresso 1008637") from the list of BrainCubes that are registered in your account.



① Time axis of all registered data. You can zoom in for a time section you want to see in more detail.

② System pressure and vessel content data.

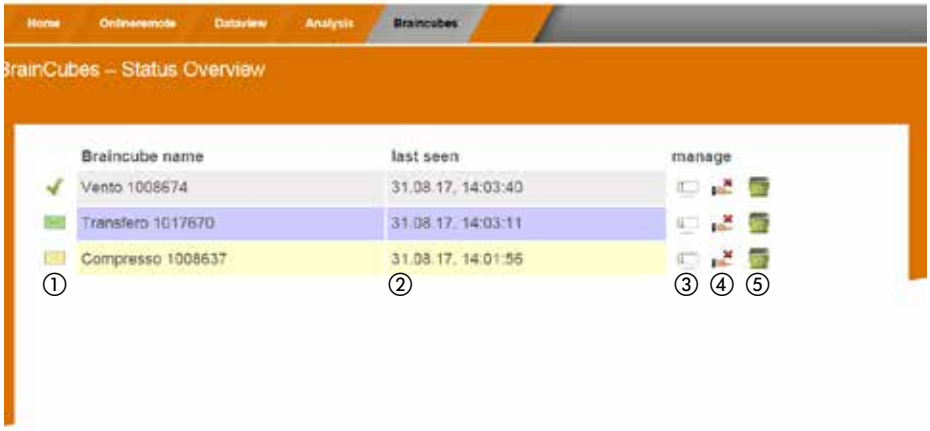


③ BrainCube messages and duration. Message numbers and short text via mouse-over function.
You can zoom in for more details.

④ Switching tracking of the electrical components/relays that are relevant for the connected TecBox.
You can zoom in for more details.

Data Interface - Communication - Web interface

Status overview, editing, sharing of your registered BrainCube devices
After registration and remote control activation, you can get a status overview of your registered BrainCube devices via the tab “BrainCubes”. You have the option of renaming your BrainCubes or deleting them from your account. Furthermore, you can share each of them individually with other accounts. Select the tab “BrainCubes / Status Overview” to get a complete list of all BrainCubes registered in your account. Use the mouse-over function for specific information about the actions you can perform for each individual symbol.



① Status information for each BrainCube about the connection with the server, active messages, ...

② Point of time of the last contact with the webserver.

③ Rename the BrainCube here.

④ Share access to BrainCube with other accounts.

⑤ Delete registration of BrainCubes from your account.

Data Interface - Communication - Web interface

BrainCube - Notifications, individual e-mail system for registered BrainCube device.
Here you can configure for each device the messages that the system will send to the user.
You can invite up to 5 additional users by pressing the add (+) button. You can set each message for each BrainCube individually for each user.

① The e-mail address in the first column is that of the account holder.
Use “+” to add up to 5 individual e-mail addresses that should receive BrainCube messages. Delete e-mail addresses from the list with “-”.

② Specify the interval at which e-mails are to be sent. If multiple messages occur in the same time interval, they are bundled in one e-mail notification.
“push” = at the latest 1 minute after the occurrence of the message, “5 min” = every 5 minutes, “10 min” = every 10 minutes, “1 hour” = once per hour, “1 day” = once per day.

③ Select the message settings (A, E, I, C) for all BrainCubes at the same time with one click, which are to be sent to the e-mail addressees of the respective column.
“A” = alarms, “E” = events, “I” = information, “C” = one or more individually selected individual messages.

④ List of BrainCubes registered for the account

⑤ Select here the message settings (A, E, I, C) for each individual BrainCube to be sent to the e-mail address of this column.
“A” = alarms, “E” = events, “I” = information, “C” = one or more individually selected individual messages.

Data Interface - Communication - Modbus RTU - Modbus TCP - Multicast

Modbus RTU / Modbus TCP / Multicast IGMP-UDP - Protocol and operation

Validity

The following information is valid for BrainCube application software Version ≥ V2.10. Write data application and registers starting with offset number 23 are available with BrainCube application software Version ≥ V3.00.
Multicast is available for BrainCube application software versions ≥ V5.70

Principles

- The RS 485 communication interface can be used for data exchange with the Modbus RTU standard.
  The communication protocol basically follows the MODBUS APPLICATION PROTOCOL SPECIFICATION V1.1b3.
  This protocol standard requires a Modbus master which is realized by a building management system (BMS) or by one BrainCube of the Braincube network in case of missing BMS.
- Modbus TCP is realized via the Ethernet RJ45 connection and can be operated in parallel to the RS 485 Modbus communication. It can also be operated in parallel with the Ethernet Multicast communication and with the Ethernet connection with the IMI-HE web interface.
- Multicast communication is only possible and intended for communication between TecBoxes. It is realised via the Ethernet RJ45 connection and can be operated in parallel with RS 485 Modbus communication if this is only used for communication with the BMS. Parallel operation with Modbus TCP communication and with the IMI HE web interface via the Ethernet connection is also possible.

Rules and conditions for a proper and stable operation

The master-slave combined operation can be realised either via the RS485 interface with Modbus RTU protocol or via the Ethernet interface with multicast protocol. In an RS485 network, a maximum of 40 units can be operated in a master-slave network. Only one master-slave network is possible in each RS485 network. In an Ethernet network, several master-slave network systems can be operated independently of each other via the multicast protocol. This is controlled by multicast port numbers. Each individual network system can be operated with up to 40 devices under a common multicast IP number and a common multicast port number. When using different multicast port numbers, several master-slave network systems (up to 40 units each) can be operated independently of each other in an Ethernet IP network.

- If the RS485 connection is used for Master-Slave combined operation or water make-up communication between TecBoxes, use the Ethernet for Modbus TCP communication for the BMS. If the master-slave combined operation is operated via Ethernet Multicast, then both RS485 and RJ45 can be used for Modbus communication with the BMS.
  In these cases for BrainCubes in Vento/Pleno, always use BrainCube numbers between 41 and 50. For Master-Slave combined operation and optional water-make-up communication with Vento/Pleno use addresses that are in the same RS485 segment.
- RTU/TCP: Modbus address numbers must be different for all Modbus participants.
  Each address has to be assigned only once.
- RTU: Baud rate must be the same for all Modbus participants.
- RTU: Consider that BrainCubes with applications Software V1.13 or BrainCubes in a BrainCube network (e.g. pressurization Master-Slave combined operation) will switch to Modbus-Master function, if the connection to the BMS Modbus-Master is interrupted for more than 7 seconds. The Modbus Master of the BMS has to be reactivated manually after an interruption. The BrainCube Modbus-Master will detect this BMS Modbus-Master and automatically switch back to its Modbus-Slave operation after about 15 seconds. **For that reason is it strongly recommended to use Modbus TCP exclusively for communication with the BMS if a pressurisation Master-Slave operation or a water make-up operation is realized in parallel via RS485/Modbus RTU.**
- RTU/TCP/Multicast: Parameter “Activate RS 485” or “Activate Modbus/TCP port” or “Activate Multicast” must be switched on.
- RTU/TCP: For writing data to BrainCube the Remote Control must be switched on by activating the parameter “via Modbus RTU/TCP”.
- RTU/TCP: A pause time of at least 200ms is recommended between Modbus requests. Communication problems may occur with shorter requests.

Data Interface - Communication - Modbus RTU - Modbus TCP - Multicast

- TCP: Network with router:
  Set DHCP (automatic IP address assignment) to active and configure router settings to fixed IP assignment in relation to the respective Brainucbe MAC address.
  Network without router:
  Deactivate DHCP and set IP address manually on BrainCubes. In this case the subnet masks of BrainCubes and the connected computer must match. Standard IP range: 192.168.x.x and standard subnet mask: 255.255.255.0. IP numbers must be unique. DHCP of the computer must be set to static IP. Other participants in this network must then also be set to “without DHCP” accordingly.
- Multicast: For each Braincube the local IP range must be identical. The first three numbers of the “local IP address”, e.g. 168.20.10.123, define the IP range, while the fourth set of digits (here: 123) is assigned by the router. A master-slave network system can also be set up using only a switch (e.g. NETGEAR ProSAFE) and independently of a router. The routers/switches used must support the Multicast IGMP-UDP protocols. Multicast IP used is: 224.0.0.100. Multicast UDP port at BrainCube: 1000 (adjustable).

BrainCube settings for Modbus RTU operation

- All relevant settings can be done in menu Parameter/Interface-Communication/RS 485 <=> BMS <=> TecBoxes.
- Available address range of the BrainCubes: 11-209.
  The address can be adjusted by changing the values for the parameter “RS 485 segment” and “BrainCube number”.
  The RS 485 segment has an offset of 20.
  E.g.:
  RS 485 Segment = 1 and BrainCube no = 1 => RS 485 address = 11
  RS 485 Segment = 2 and BrainCube no = 4 => RS 485 address = 34
  RS 485 Segment = 2 and BrainCube no = 15 => RS 485 address = 45
- Available baud rates of the BrainCubes: 115200, 57600, 38400, 19200, 9600.
- Connection parameter: 8 data bits, 1 stop bit, even parity.

BrainCube settings for Modbus TCP communication

- All relevant settings can be done in menus
  Parameter/Interface-Communication/RS 485 <=> BMS <=> Tecboxes
  Parameter/Interface-Communication/Ethernet <=> Server
  Parameter/Interface-Communication/Ethernet Modbus TCP <=> BMS
- Available address range of the BrainCubes: 11-209
  The address can be adjusted by changing the values for the parameter “RS 485 segment” and “BrainCube number”.
  The RS 485 segment has an offset of 20.
  E.g.:
  RS 485 Segment = 1 and BrainCube no = 1 => RS 485 address = 11
  RS 485 Segment = 2 and BrainCube no = 4 => RS 485 address = 34
  RS 485 Segment = 2 and BrainCube no = 15 => RS 485 address = 45
- The local IP address of BrainCube has to be unique in the network. It can be adjusted by parameter “Local IP-Address” if DHCP is switched off in BrainCube. If you only want to use Ethernet Modbus TCP and not the IMI web interface, deactivate DHCP on the BrainCUbe. Otherwise DHCP must remain enabled.
- The Modbus/TCP Port (factory setting: 502) should not be changed to guarantee a stable communication.

Data Interface - Communication - Modbus RTU - Modbus TCP - Multicast

Modbus protocol – Read data

Data transmission from the BrainCube is realized by the Modbus function code “Read holding registers” (0x03).
The read register address starts with 0200 hexadecimal (decimal: 512). The register numbers are offset numbers.
Example:

Register 0 => address_dec = 512; address_hexadec = 0x0200
Register 1 => address_dec = 513; address_hexadec = 0x0201

Example for transmitting/receiving data to/from BrainCube:

Transmit data to BrainCube:
[TX] - 0B 03 02 00 00 32 C5 0D

Receive data from BrainCube:
[RX] - 0B 03 64 00 01 00 00 00 00 00 20 01 28 01 32 00 00 00 00 00 00 00 E6 00 28 00 00 00 00 01 04 01 36 01 54 00 00 00 01 01 2C 00 00 00 00 00 00 00 00 FF FE 00 0A 00 01 00 01 00 00 00 00 00 00 01 C6 00 00 00 00 00 00 00 00 3E 7F 00 00 03 24 00 78 00 30 03 7A 01 90 07 D0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 5A 72

Example for monitoring messages

Register offset	Description	Length	Request (Addr=11)	Response	Bitnumber															Messages
					15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
7	Error word of active errors M32…M17	2 Byte	0B 03 02 07 00 01 34 D9	0B 03 02 **00 00** 20 45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	no message
			0B 03 02 07 00 01 34 D9	0B 03 02 **80 00** 41 85	**1**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	M32
			0B 03 02 07 00 01 34 D9	0B 03 02 **00 01** E1 85	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	M17
8	Error word of active errors M16…M01	2 Byte	0B 03 02 08 00 01 04 DA	0B 03 02 **80 00** 41 85	**1**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	M16
			0B 03 02 08 00 01 04 DA	0B 03 02 **00 01** E1 85	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	M01
21	Error word of active errors M64…M49	2 Byte	0B 03 02 15 00 01 94 DC	0B 03 02 **00 02** A1 84	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	M50
22	Error word of active errors M48…M33	2 Byte	0B 03 02 16 00 01 64 DC	0B 03 02 **80 00** 41 85	**1**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	M48
			0B 03 02 16 00 01 64 DC	0B 03 02 **00 01** E1 85	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	M33

Content of master´s request (read all registers):

Description	Length	Value	Register offset
Device address	1 Byte	11-209	–
Function Code	1 Byte	0x03	–
Start address	2 Byte	0x0200 (02 = high byte; 00 = low byte)	–
Number of registers	2 Byte	<= 0x0032 (00 = high byte; 32 = low byte)	–
Checksum	2 Byte	CRC16	–

Content of BrainCube´s response (all registers):

Description	Length	Value	Register offset
Device address	1 Byte	11-209	–
Function Code	1 Byte	0x03	–
Number of bytes	1 Byte	<= 0x64	–

Content of BrainCube´s response (all registers):

Description	Length	Value	Register offset
BrainCube No.	2 Byte	1 … 19	0
Main function in Pressurization	2 Byte	0: master	1
Master-Slave operation		1: slave	

Data Interface - Communication - Modbus RTU - Modbus TCP - Multicast

Description	Length	Value	Register offset
TecBox device type	4 Byte	TecBox Connect Range C.1 0x00000100 3 C.2 0x00000200 3 CX 0x00080000 2 C.1-80 0x00800000 2 C.1-80WM 0x01000000 2 V.1 0x00000400 3 VI.1 0x00400000 2 TV.1H 0x00000002 3 TV.1 0x00000004 3 TV.2H 0x00000020 3 TVI.1 0x00100000 2 TVI.2 0x00200000 2 TI.2 0x10000000 2 PIX 0x08000000 2 PI.1 0x00002000 3 PI.2 0x00008000 3 DML 0x02000000 2 DMLP 0x04000000 2 TecBox Generation 1 (TB1) Range with BrainCube Connect C.1 0x00000100 3 C.2 0x00000200 3 CPV 0x00004000 3 CX 0x00080000 2 V(P).1 0x00000800 3 VP.2 0x00010000 2 V.1HP 0x00020000 2 VP.1HP 0x00040000 2 T.1 0x00000001 3 TPV.1 0x00000008 3 T.2 0x00000010 3 TPV.2 0x00000080 3 TI.2 0x10000000 2 PI 0x00001000 3 PI.1 0x00002000 3 PI.2 0x00008000 3	2 (high word) 3 (low word)
Current pressure value PT (IA2)	2 Byte	in 10E-2 bar	4
Current level value LT (IA4)	2 Byte	in 10E-1 %	5
Operation Mode in Pressurization Master-Slave operation	2 Byte	0: pressure control (PC) 1: level control (LC) 2: level control min/max (LCMM)	6
BrainCube messages (alarms, events, infos)	4 Byte	Bit 0: M01 Bit 1: M02 Bit 2: M03 … Bit n-1: Mn [1)] … Bit 31: M32	7 (high word) 8 (low word)
Minimum pressure p0	2 Byte	in 10E-2 bar	9
Safety valve pressure psvs	2 Byte	in 10E-1 bar	10

1) Message “M26_as Limiter at ID6” corresponds to M26 on Modbus => Register_offset: 7; Bit 25.
Message “M26_as Limiter at IDA1” corresponds to M54 on Modbus => Register_offset: 21; Bit 21.
Message “M26_as Limiter at IDA2” corresponds to M55 on Modbus => Register_offset: 21; Bit 22

Data Interface - Communication - Modbus RTU - Modbus TCP - Multicast

Description	Length	Value	Register offset
Current state of digital outputs	2 Byte	Bit 0: PK1 Bit 1: PK2 Bit 2: V1 Bit 3: V2 Bit 4: V3 Bit 5: V4 Bit 6: WM Bit 7: OD1 Bit 8: OD2 Bit 9: OD3 Bit 10: OD4 Bit 11: reserved Bit 12: reserved Bit 13: reserved Bit 14: reserved	11
Master Info	2 Byte	Bit 0-7: Master index Bit 8: PT-M+ Bit 9: PT-M- Bit 10: PT-S+ Bit 11: PT-S-	12
Initial pressure pa	2 Byte	in 10E-2 bar	13
Final pressure pe	2 Byte	in 10E-2 bar	14
Maximum pressure pmax (=> message M02)	2 Byte	in 10E-2 bar	15
Combined system configuration	2 Byte	0: master system 1: slave system 1 2: slave system 2 … n: slave system n	16
Combined group configuration	2 Byte	0: stand-alone master 1: master group 2: stand-alone slave	17
SW Version of application software	2 Byte	e.g. 113d for V1.13	18
Secondary function of combined operation	2 Byte	0: offline 1: master control (M) 2: pressure control (PC) 3: pressure control + LT master 4: level control (LC) 5: Level Control by Min-Max limits (LCMM) 6: IO control (ID5 = off) 7: master failed “M-fail” 8: master in standby “M-stby” 9: LC + LT_master 10: LCMM + LT_master 11: M46 master role rejected	19

Data Interface - Communication - Modbus RTU - Modbus TCP - Multicast

Description	Length	Value	Register offset
Request for water make-up (start/stop)	2 Byte	0: inactive 1: active	20
BrainCube messages (alarms, events, infos)	4 Byte	Bit 0: M33 Bit 1: M34 Bit 2: M35 … Bit: Mn [1)] … Bit 31: M64	21 (high word) 22 (low word)
Pressure sensor PTvv at IA3	2 Byte	10E-2 bar	23
Status input at ID1 –ID8	2 Byte	Bit 0: ID1 Bit 1: ID2 … Bit 7: ID8	24
Status input at IDA1	2 Byte	0: Min. water on 1: Min. water off	25
Status input at IDA2 (PS-eco)	2 Byte	0: off 1: on	26
Water make-up total amount	4 Byte	litre	27 (high word) 28 (low word)
Water make-up max quantity FT/12M	4 Byte	litre	29 (high word) 30 (low word)
Water make-up quantity FT last (time period)	2 Byte	months	31
Water make-up quantity FT during last months	4 Byte	litre	32 (high word) 33 (low word)
Water treatment residual capacity	4 Byte	l * °dH	34 (high word) 35 (low word)
Water treatment residual quantity	4 Byte	litre	36 (high word) 37 (low word)
Water treatment residual live time	2 Byte	months	38
Degassing residual time	2 Byte	hours	39
Signal LT live	2 Byte	mA	40
Signal LT 0%	2 Byte	mA	41
Signal LT 100%	2 Byte	mA	42
Operation mode: auto, standby	2 Byte	0: standby 1: auto	43
Safety margin p0-pst	2 Byte	in 10E-1 bar	44
System degassing	2 Byte	0: off 1: on	45
System degassing mode	2 Byte	1: eco 2: interval 3: continuous	46
Water make-up	2 Byte	0: off 1: on	47
Flow meter observation	2 Byte	0: off 1: on	48

1) Message “M26_as Limiter at ID6” corresponds to M26 on Modbus => Register_offset: 7; Bit 25.
Message “M26_as Limiter at IDA1” corresponds to M54 on Modbus => Register_offset: 21; Bit 21.
Message “M26_as Limiter at IDA2” corresponds to M55 on Modbus => Register_offset: 21; Bit 22

Data Interface - Communication - Modbus RTU - Modbus TCP - Multicast

Description	Length	Value	Register offset
Water make-up degassing	2 Byte	0: off 1: on	49
Checksum	2 Byte	CRC16	
Operation mode: system monitoring	2 Byte	0 : off 1 : on	50
Operation mode: pressurisation	2 Byte	0 : off 1 : on	51
Operation mode: water make-up	2 Byte	0 : off 1 : on	52
Operation mode: degassing	2 Byte	0 : off 1 : on	53
Operation mode: level monitoring	2 Byte	0 : off 1 : on	54
Operation mode: level control	2 Byte	0 : off 1 : on	55
water make-up process: start / stop	2 Byte	0 : off 1 : on	56

Modbus protocol – Write data

Data transmission to the BrainCube is realized by the Modbus function code “Write single register” (0x06).
Write register address starting with 0400 hexadecimal.
Example for setting operation mode from standby to auto:

- Transmit data to BrainCube: TX 0B 06 04 2B 00 01 39 98
- Receive data from BrainCube: RX 0B 06 04 2B 00 01 39 98

Example for the acknowledgement of messages via Modbus:

Register offset	Description	Length	Request (Addr=11)	Response	Bitnumber																message case
					15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
57	acknowledge errors M32…M17	2 Byte			equivalent to register 7																
			0B 06 04 39 00 01 99 9D	0B 06 04 39 00 01 99 9D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**	acknowledge M17
58	acknowledge errors M16…M01	2 Byte			equivalent to register 8																
59	acknowledge errors M64…M49	2 Byte			equivalent to register 21																
60	acknowledge errors M48…M33	2 Byte			equivalent to register 22																

Please note that the following messages cannot be acknowledged via Modbus: M07, M24, M26, M31, M32, M37, M38.

!!! Note that for all data you write to BrainCube via Modbus there is no plausibility check available!!!
!!! IMI-Hydronic Engineering will meet no guarantee or costs for service actions or damage at the unit or the connected installation caused by wrong or non-plausible values!!!

Data Interface - Communication - Modbus RTU - Modbus TCP - Multicast

Content of master´s request:

Description	Length	Value	Register offset
Device address	1 Byte	0x0B (default)	–
Function Code	1 Byte	0x06	–
Start address	2 Byte	0x0400	–
Data to write	2 Byte	0x0001	–
Checksum	2 Byte	CRC16	–

Content of BrainCube´s response:

Description	Length	Value	Register offset
Device address	1 Byte	0x0B (default)	–
Function Code	1 Byte	0x06	–
Start address	2 Byte	0x0400	–
Data response	2 Byte	0x0001	–
Checksum	2 Byte	CRC16	–

Content of BrainCube´s response:

Description	Length	Value	Register offset
Operation mode: auto, standby	2 Byte	0: standby 1: auto	43
Safety margin p0-pst	2 Byte	in 10E-1 bar	44
System degassing	2 Byte	0: off 1: on	45
System degassing mode	2 Byte	0: sleep 1: eco 2: interval 3: continuous 4: water make-up	46
Water make-up	2 Byte	0: off 1: on	47
Flow meter observation	2 Byte	0: off 1: on	48
Water make-up degassing	2 Byte	0: off 1: on	49
water make-up process: start / stop	2 Byte	0: off 1: on	56 [1)]

Description	Length	Value	Register offset
Acknowledge messages; Clear error word 1H	2 Byte	Bit 0 : M17 .... Bit 15: M32	57
Acknowledge messages; Clear error word 1L	2 Byte	Bit 0 : M01 .... Bit 15: M16	58
Acknowledge messages; Clear error word 2H	2 Byte	Bit 0 : M49 .... Bit 15: M64	59
Acknowledge messages; Clear error word 2L	2 Byte	Bit 0 : M33 .... Bit 15: M48	60

[1)] For Pleno and Vento: Type of pressurisation must be set to (Compresso/Transfero)

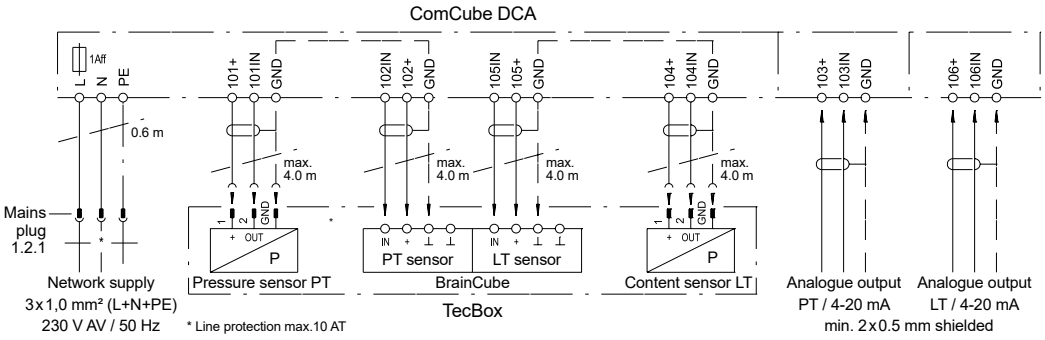
The software “Modbus Master” is a tool for driving the Modbus from BMS with BrainCube(s).
This software is freeware and can be downloaded. For more information see the manual “Manual BrainCube Connect with Modbus Master”.

Data Interface - Communication - ComCube DCA

ComCube DCA

The ComCube DCA communication module can be used to provide 2 galvanically isolated 4-20 mA analogue outputs. This allows the PT pressure and LT content signals to be easily transferred to the BMS.
⏭ Installation | Operation ComCube

ComCube DCA should be mounted on the wall. PT pressure and LT content sensors can be galvanically separated through the ComCube DCA in the form of 4-20 mA signals for the control and communications system. The existing connecting cables for PT BrainCube and LT BrainCube must be disconnected and re-connected to the ComCube DCA. The total length of the connecting cables PT-LT-BrainCube or PT-LT-ComCube DCA must be no more than 4 m each. A twisted-pair shielded cable with wire section area ≥ 0.5 mm^2 should be used (for example, Belden Type 9501).
⏭ Installation | Operation ComCube



Example:
Electrical connection BrainCube with ComCube DCA

en

Wiring diagram

See wiring diagrams for each individual TecBox on imi-hydronic.com. The wiring diagram is also part of each delivered product in paper mould.

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