INSTRUKCJA OBSŁUGI

REGULACJA INSTALACJI TRANSKRYTYCZNYCH CO2 (STEROWANIE CHŁODNICĄ (GASCOOLER) I ZAWORAMI HP I MP)

Firma Digitel zastrzega sobie prawo do zmian wymienionych właściwości technicznych zawartych w tej dokumentacji

Digitel SA

6. REGULACJA CO2 TRANSKRYTYCZNA

6.1. INTRODUCTION

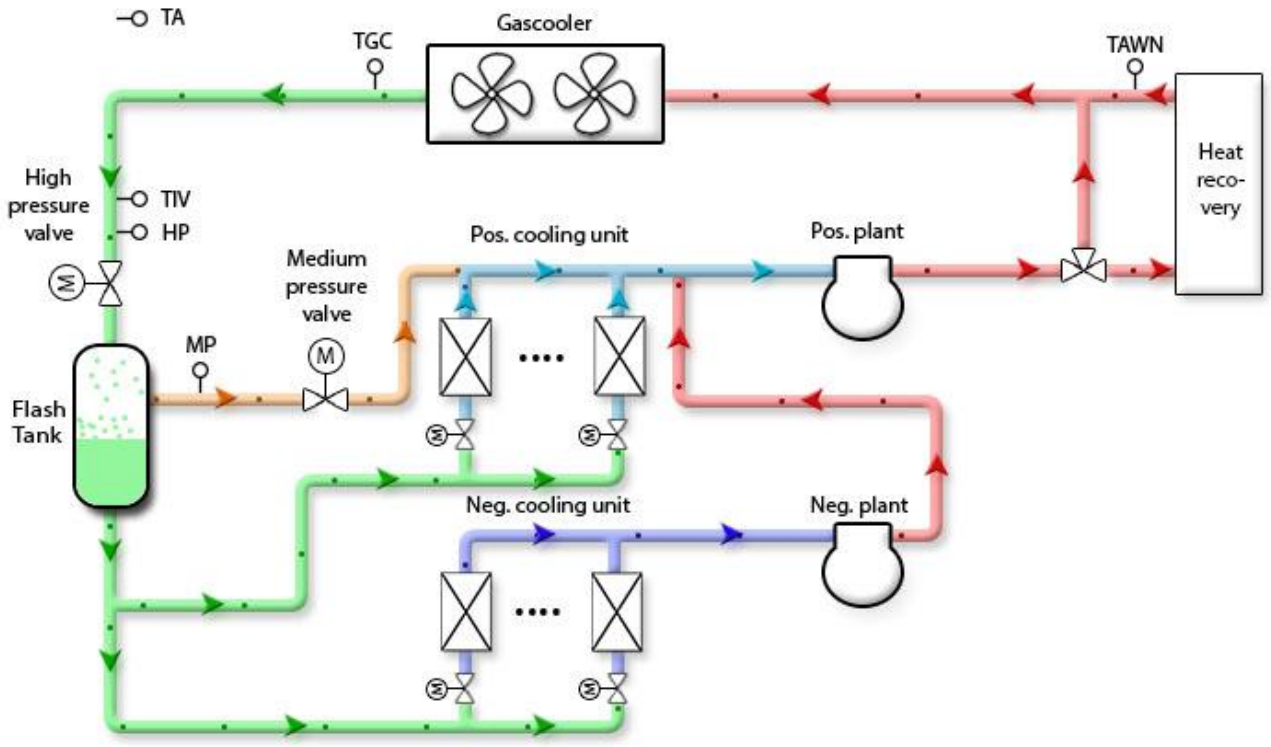
It is assumed that the reader of this document will previously have read the chapter Erreur ! Source du renvoi introuvable. Erreur ! Source du renvoi introuvable. The latter describes all the basic concepts which are essential to an understanding of the present document, and of the concept of the NEWEL3 product range in general.

This manual describes the operation of satellite units for the **regulation of transcritical C02 installations.**

6.2. GENERAL DESCRIPTION, CONNECTIONS

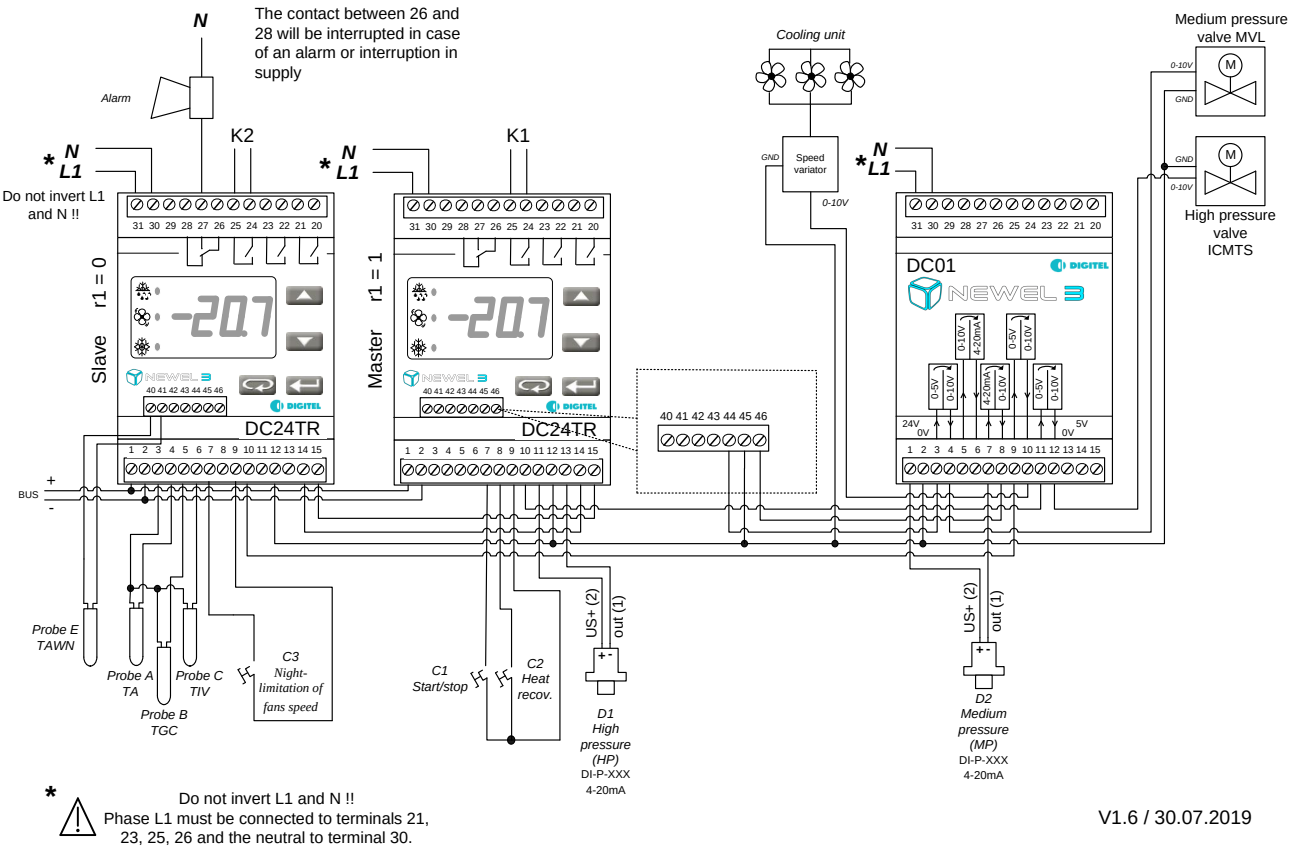
The management of transcritical CO2 installations is operated by 2 DC24TR modules. They are in charge of regulating the gascooler, high and medium pressures, as well as the interface with the heat recovery system.

Such an installation is illustrated in the diagram below:



Rysunek 6.2.1

Connections will be completed according to the diagram below.



Rysunek 6.2.2

The module acting as « Slave » is set to run in mode 0 (cooler management). It supplies the analogic signal converted by the DC01 module into 0-10V to command the cooler's fans.

The module acting as « Master » is set to run in mode 1 (pressure regulation). It mesures and regulates the high and medium pressures based on the analogic signals. These outputs are converted by the DC01 module into 0-10V signals that can directly steer the corresponding valves.

An installation typically includes several refrigerating circuits (at least two). A unique circuit number has to be assigned to each of these circuits. It is set using the « Refrigerating circuit number » parameter of each regulator (cooling unit and compressor plant) of said circuit.

A Booster is made of 2 circuits (positive and negative). Several boosters can be part of the same installation. TelesWin software enables the creation of an image of the installation, representing all the boosters that are part of it. It specifies which positive and negative cooling circuits belong to each Booster. It also allows the determination of the installation's behavior, by programming the following parameters:

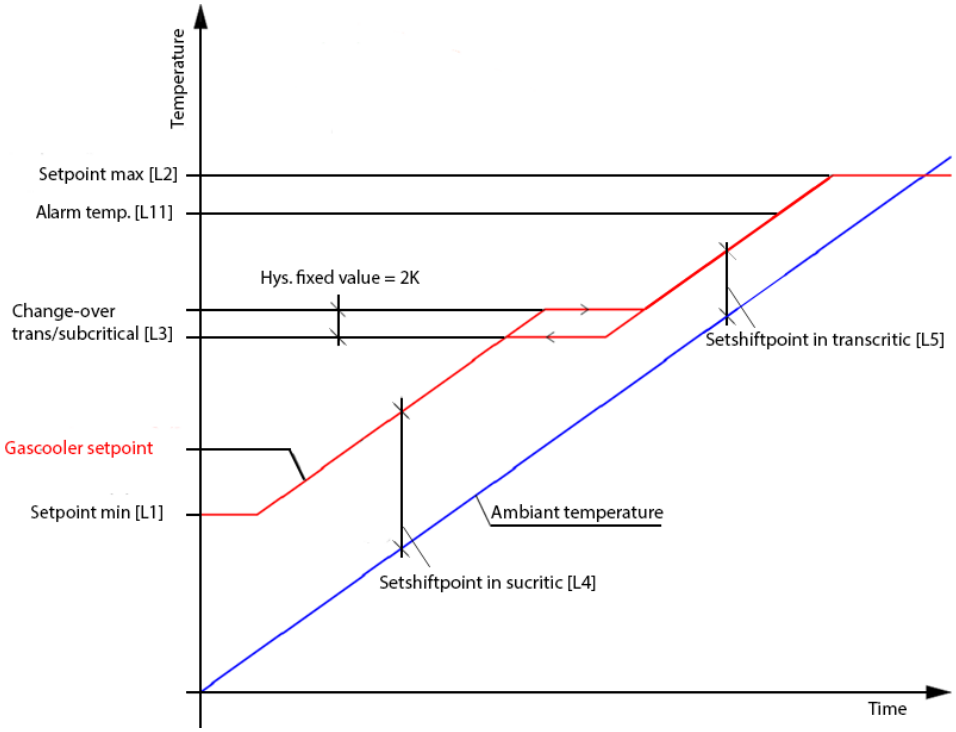
- Shutdown of all the negative circuit's compressors when the positive circuit's compressors are switched off.
- Shutdown of all the circuit's cooling units when the compressor plant is in full stop

For more information on this procedure the reader is referred to chapter **11.12.7.**

6.3. FAN MANAGEMENT

6.3.1. SHIFTSETPOINT CALCULATION

During normal operation, the fans are steered with a shifted setpoint in relation to the ambient temperature. The minimum value of the calculated setpoint is programmed using the **[L1]** parameter. The maximum value is determined by the **[L2]** parameter. Transcritical mode is activated when the outside temperature exceeds the value set using the **[L3]** parameter by 2.0°K. Subcritical mode is switched back on when the ambient temperature goes down below **[L3]**. The setpoints shifts are programmed using parameters **[L4]** and **[L5]**, respectively. Regulation can be optimized further by adjusting the PID regulation parameters.



Rysunek 6.3.1

[L1] Setpoint minimum (°C)
[L2] Setpoint maximum (°C)
[L3] Change-over trans/subcritical (°C)
[L4] Setpointshift in subcritic (°C)
[L5] Setpointshift in transcritic (°C)

6.3.2. HEAT RECOVERY SETPOINT

The heat recovery function is triggered using C2 input. The fans are steered by a fixed setpoint **[L6]**, without shift.

6.3.3. NIGHT LIMITATION OF FAN SPEED

Activating the C3 input limits the fans speed to a value set with parameter **[L7]**.

6.3.4. MAX. GAS TEMPERATURE REGULATION

When above the alarm high limit **[L11]**, an alarm is triggered after a programmable amount of time **[L12]**.

6.3.5. GASCOOLER'S DIRTYNESS MONITORING

The gascooler's dirtyness is monitored using the difference between TGC (temperature leaving the gascooler) and TA (ambient temperature). If the fans are set to 100% and the temperature differential is higher than the value programmed in **[L13]**, an alarm is triggered after an amount of time set in **[L14]**.

6.3.6. BEHAVIOR DURING PERTURBATIONS

The probes (TA / TGC) are under monitoring. In the event of a power failure or short-circuit, fans are set to 100% and an alarm is triggered.

[L6] Setpoint heat recovery (°C)
[L7] Night-limitation of fans speed (%)
[L11] Ambient temperature high limit (°C)
[L12] Delay of ambient temperature alarm (Min)
[L13] Alarm gascooler dirty - limit of temperture difference (K)
[L14] Gascooler dirty - alarm delay (min)

6.4. HIGH PRESSURE REGULATION

6.4.1. OPTIMAL HP SETPOINT CALCULATION

The setpoint for high pressure regulation is calculated based either on external temperature, or gas temperature before the high pressure valve (TIV). Parameter **[P1]** allows the user to set the reference temperature used to calculate the high pressure setpoint. The calculation involves a formula allowing the COP to remain at optimal levels. The minimal value of the setpoint can be programmed using **[P2]**, and the maximum value, using **[P3]**. PID regulation parameters allow further optimization.

6.4.2. MINIMAL OPENING

[P4] is used to set the valve's minimal opening percentage. When C1 input is opened, the valve closes completely.

6.4.3. HEAT RECOVERY SETPOINT

C2 input is used to trigger the heat recovery function. In this mode, the regulation functions with a fixed HP setpoint programmed in **[P5]**.

6.4.4. SETPOINT DURING HEAT RECOVERY

When switching to heat recovery mode, the high pressure setpoint gradually shifts until it meets the value set in **[P5]**. The speed at which the shifting occurs can be set in **[P6]** (10bar/minute, for instance). The opposite happens when switching back to normal operation.

6.4.5. MIN/MAX MEDIUM PRESSURE

When medium pressure rises above the value set in **[n9]**, the high pressure valve closes in proportion to the exceeding of the medium pressure setpoint, overriding normal high pressure regulation. When medium pressure goes below **[n7]**, the high pressure valve opens in proportion to the gap between the actual pressure and the medium pressure setpoint. The amount of correction of the HP valve's opening is inversely proportionnal to the values set in **[n10]** (in the event of MP being too high) and **[n8]** (when MP is too low). See list of parameters below.

6.4.6. MAX HIGH PRESSURE

If the high pressure rises above the value set in **[P10]**, K1 relay closes. It switches back with a hysteresis of 4bar.

[P2] Setpoint minimum (bar)
[P3] Setpoint maximum (bar)
[P4] Minimal opening (%)
[P5] Setpoint during heat recovery (bar)
[P6] Setpoint evolution ramp (recovery) (bar/min.)
[P10] HP maximum - output K1 (bar)
[n7] Medium pressure (MP) minimum (bar)
[n9] Medium pressure (MP) maximum (bar)

6.4.1. BEHAVIOR DURING PERTURBATIONS

Probes (TA/TGC) are under monitoring. In the event of a probe failure, the high pressure setpoint is set to 92bar. An alarm is triggered.

Sensor D1 is under monitoring. If an interruption or short-circuit happen, the high pressure valve closes completely, and an alarm is triggered.

6.5. MEDIUM PRESSURE REGULATION

6.5.1. OPERATION

The setpoint for medium pressure regulation is set in **[n1]**. Parameters **[n2]** and **[n3]** are used to program the minimal and maximal opening of the valve, respectively. If C1 input is no longer closed, the valve closes completely. PID regulation parameters allow for further optimization.

6.5.1. BEHAVIOR DURING PERTURBATIONS

D2 sensor's signal is under monitoring. In the event of an interruption or short-circuit, the medium pressure valve is closed and an alarm is triggered.

6.6. HEAT RECOVERY TEMPERATURE FUNCTION

6.6.1. OPERATION

The (TAWN) probe monitors the temperature after recovery when in heat recovery mode. C2 input triggers the heat recovery function. If the temperature is above the value set in **[u2]**, a programmable delay is initiated. If the temperature is still too high after this delay, K2 input closes. To avoid switching too frequentely, parameter **[u4]** can be used to chose the minimal amount of time during which K2 is closed.

6.7. CONNECTING THE DEPORTED DISPLAY DC10A

Parameter A2 :	Displayed value :	0 = TA
		1 = TGC
		2 = TIV
		4 = D1 (HP)
		5 = D2 (MP)

[n1]	Setpoint (bar)
[n2]	Minimal opening (%)
[n3]	Maximal opening (%)
[u2]	Temperature end of recovery (° C)
[u3]	Delay end of recovery (min)
[u4]	Delay of new switch on (min)

Basic configuration

Sym.	Lvl.	Function	Rem.	Default value	Min	Max
PAS	0	Password		0		
r1	3	Function mode of slave *0 = Gascooler control 1 = High/Medium pressure control 2= Heat recovery*		0		
Ad	3	Module's adress *Do not modify when the module is connected to a DI58/DC58 central unit !*				

Parameters with r1 = 0 Gascooler

	Sym.	Lvl.	Function	Rem.	Default value	Min	Max
	PAS	0	Password			0	999
Gascooler	L1	2	Setpoint minimum (°C)		10.0	0	40.0
	L2	2	Setpoint maximum (°C)		28.0	0	60.0
	L3	2	Change-over trans/subcritic (°C)		25.0	10.0	40.0
	L4	2	Setpointshift in subcritic (°C)		3.0	2.0	10.0
	L5	2	Setpointshift in transcritic (°C)		1.0	0	10.0
	L6	2	Setpoint heat recovery (°C)		20.0	0	60.0
	L7	2	Night-limitation of fans speed (%)		80	75	100
	L8	2	Regulation PID - coefficient P (%)		30	0	100
	L9	2	Regulation PID - coefficient I (%)		30	0	100
	L10	2	Regulation PID - coefficient D (%)		30	0	100
	L11	2	Ambient temperature alarm high limit (°C)		37.0	15.0	45.0
	L12	2	Delay of ambient temperature alarm (Min)		10.0	0	60.0
	L13	2	Alarm gascooler dirty - limit of temperture difference (K)		4.0	0	20.0
	L14	2	Gascooler dirty - alarm delay (min)		10.0	0	60.0
	L15	2	Setpoint filtering (0 to 15)		5	0	15

Heat recovery	u1	2	Heat recovery function? 0 = no 1 = yes		0	0	1
	u2	2	Temperature end of recovery (° C)		35.0	0	150
	u3	2	Delay end of recovery (min)		3.0	0	60.0
	u4	2	Delay of new switch on (min)		15.0	0	60.0
	u5	2	Alarm low limit (°C)		0.0	-12	12.7
	u6	2	Alarm high limit (°C)		90.0	-12	12.7
	u7	2	Alarm delay (min.)		30.0	0	51.1

Hour, date	H1	1	Hour setting		4	0	23
	H2	1	Minutes setting		57	0	59
	H3	2	Day of the month setting		1	1	31
	H4	2	Month setting		1	1	12
	H5	2	Year setting		0	0	99
	H6	2	Day of the week setting		5	1	7

Alarms	Alarm codes	
	3	Gascooler dirty
	4	Gascooler temperature too high
	7	Temperature of probe E too high
	8	Temperature of probe E too low
	20	Room temperature probe defect
	21	TGC probe defect (probe B)
	22	TIV probe defect (probe C)
	24	Probe E defect

Parameters with r1 = 1 Pressure regulation

	Sym.	Lvl.	Function	Rem.	Default value	Min	Max
	PAS	0	Password			0	999
(HP)	P1	2	Type of regulation : *0 = depending on ext. temp. TA 1 = temp. Before HP valve TIV*		0	0	1
	P2	2	Setpoint minimum (bar)		50.0	20.0	120
	P3	2	Setpoint maximum (bar)		100	20.0	120
	P4	2	Minimal opening (%)		3	0	100
	P5	2	Setpoint during heat recovery (bar)		80.0	0	150
	P6	2	Setpoint evolution ramp (recovery) (bar/min.)		10.0	1.0	30.0
	P7	2	PID - Proportional coefficient (%)		30	0	100
	P8	2	PID - Integration coefficient (%)		30	0	100
	P9	2	PID - Differential coefficient (%)		30	0	100
	P10	2	HP maximum - output K1 (bar)		90.0	-1.0	16.0
	P11	2	Setpoint filtering (0 to 15)		3	0	15

(MP)	n1	2	Setpoint (bar)		35.0	0	80.0
	n2	2	Minimal opening (%)		0	0	100
	n3	2	Maximal opening (%)		100	0	100
	n4	2	PID - Proportional coefficient (%)		30	0	100
	n5	2	PID - Integration coefficient (%)		30	0	100
	n6	2	PID - Differential coefficient (%)		30	0	100
	n7	2	Medium pressure (MP) minimum (bar)		32.0	0	80.0
	n8	2	Correction band of HP-valve during MP too low (bar)		4.0	0	80.0
	n9	2	Medium pressure (MP) maximum (bar)		37.0	0	80.0
	n10	2	Correction band of HP-valve during MP too high (bar)		3.0	0	80.0

Settings	o1	2	Lower limit of measuring range of pressure sensor(bar)		0.0	-1	150
	o2	2	Upper limit of measuring range of pressure sensor (bar)		12.0	-1	150
	o3	2	Correction of pressure sensor (bar)		0.0	-99	99.9
	o4	2	Lower limit of measuring range of pressure sensor MP (bar)		0.0	-1	150
	o5	2	Upper limit of measuring range of pressure sensor MP (bar)		60.0	-1	150
	o6	2	Correction of pressure sensor MP (bar)		0.0	-99	99.9

Hour, date	H1	1	Hour setting		5	0	23
	H2	1	Minutes setting		3	0	59
	H3	2	Day of the month setting		1	1	31
	H4	2	Month setting		1	1	12
	H5	2	Year setting		0	0	99
	H6	2	Day of the week setting		5	1	7

Alarms	Code des alarmes
	3 HP pressure sensor defect
	4 MP pressure sensor defect