DTCV

Control valves for temperature differential control

Modbus

GENERAL DESCRIPTION

Multifunctional control ball valve for electronic temperature differential control and energy monitoring.

It improves efficiency in HVAC systems by automatically balancing the system according to the heat load and independently of pressure variations.

MAIN FEATURES AND FUNCTIONS

- **Pressure-independent flow rate control**
- **ΔT control with flow rate limitation**
- **ΔT control with power limitation**
- **Energy Monitoring**
- **Shut-off function**
- **Contact temperature sensors**
- **Flow sensor with Vortex technology**
- **Integrated control panel**
- **Datalogger function**
- **Analogue signal for remote set-point setting**
- **ModBus-RTU remote management**

APPLICATIONS AND ADVANTAGES

HVAC and industrial Heating and cooling systems.

When a heat exchange system operates under saturated conditions, an increase in flow rate will not correspond to an increase in heating or cooling capacity. The carrier fluid is no longer able to release the energy, therefore there will be a reduction in the temperature difference (ΔT) between inlet and outlet.

The use of the **DTCV** control valve makes it possible to keep the ΔT constant, at a set value, between flow and return by acting on the flow rate of the carrier flow: if the ΔT tends to decrease the flow rate will be decreased, if the ΔT tends to increase the flow rate will be increased.

The temperature differential control function is not left free to operate but is bound to act within a predetermined range of flow rate or power, in order to guarantee the service of the managed utility at all times.

Controlling ΔT has a positive impact on the efficiency of heating and cooling energy generators (e.g. cooling units or condensing boilers), and reducing flow rates has a significant impact on pumps and the system. For this reason, many energy suppliers charge costs to users who provide too high a return temperature due to too small a ΔT.

VERSIONS AND CODES

Modello	DN	Connection	Q min (3) [m³/h]	Q max (4) [m³/h]	Δp max [bar]	Kvs [m³/h]	PN (5)
DTCV2 x(1)15 x(2)	15	G1/2"B	0,05	0,9	3,4	1,2	8
DTCV2 x(1)20 x(2)	20	G3/4"B	0,11	1,9	3,4	2,8	8
DTCV2 x(1)25 x(2)	25	G1"B	0,21	3,0	3,4	4,7	8
DTCV2 x(1)32 x(2)	32	G1"1/4B	0,30	5,1	3,4	7,7	8
DTCV2 x(1)40 x(2)	40	G1"1/2B	0,54	9,0	3,4	12,4	8

Code example DTCV2**2**15**A**

(1) power supply selection: **2** = 230V 50/60 Hz • **4** = 24V 50/60 Hz.

(2) adjuster calibration selection: **A** = Radiator system • **B** = Radiant panel system • **C** = Fancoil system.

(3) minimum flow rate that can be correctly adjusted.

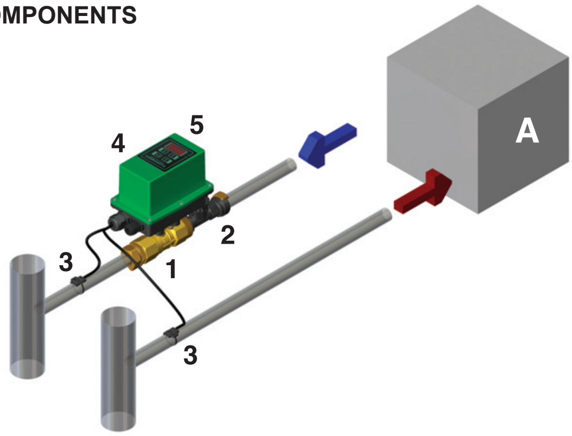
(4) maximum flow rate that can be correctly adjusted.

(5) maximum pressure for fluid temperature 80°C maximum
pressure 12 bar for fluid temperature 40°C maximum
pressure 16 bar available on request.

DTCV

Modbus

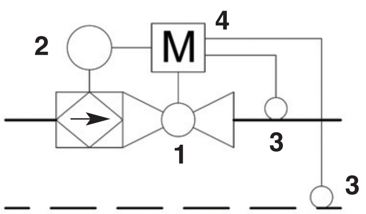
COMPONENTS



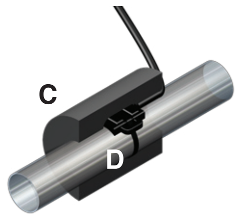
1 : 2-way equal percentage control ball valve
2 : Vortex-type flow rate sensor
3 : Contact temperature sensor
4 : Actuator with built-in electronics
5 : Keyboard and display

A : Utility

HYDRAULIC DIAGRAM



DETAIL OF CONTACT TEMPERATURE SENSOR



C : Insulation
D : Fastening band

NOTE:
The sensor must be appropriately isolated

TECHNICAL FEATURES

Functional data	
Fluid	Water, max. glycol 50%
Fluid temperature	5°C….80°C (100°C at 6 bar)
Maximum operating pressure	8 bar (12 bar at 40°C)
Maximum differential pressure	3,4 bar

Actuator	
Power supply	230 V • 24 V AC ± 15%
Supply frequency	50/60 Hz
Maximum power consumption	15 VA
Operating time (90°)	35 s
Degree of protection	IP65
Electronic adjuster	PID
Temperature control dead band	0,7 °C
Control range dead band	0,01 m^3/h
Power control dead band	0,1 kW
Pre-calibration of regulator	Radiator / radiant panel / fancoil systems
Control interface	On-board display and keyboard
Watch buffer battery	Lithium CR2032, service life 10 years
Digital inputs	To be connected to dry contacts (free voltage) • Working voltage 0/5V dc
Digital	Transistor (NPN) - External power supply max. 24V dc Current per output max. 50mA
Relay output	Clean contact (free voltage) - External power supply max. 230V Current max. 1A
Analogue input	0-10 V DC
Analogue input impedance	20 kΩ
Auxiliary limit	Clean contact (free voltage) in closed position Current max. 1A
Switch serial	RS485
Power and control cable length interface	80 cm

DTCV

Modbus

Flow rate sensor	
Measuring principle	Vortex - piezoceramic sensor
Accuracy	< 2%, glycol 0%
Sensor paddle material	ETFE
Body material	PA6T/6I (40% GF)
Seal material	EPDM/FPM
Electrical connection	M12x1 connector - IP65

Control valve	
Type	Ball valve with regulating disc
Characteristic curve	Equal percentage
Operating angle	90°
Loss class (EN60534-4)	IV (< 0,01% Kvs)
Body, ball and rod material	Brass CW 617N – UNI EN 12420
Ball gasket	P.T.F.E 15% graphite
O-ring	EPDM
Modulator disc	PPA

Temperature sensor	
Sensing element	NTC R(25°C) 10kΩ
Accuracy class (IEC 751)	B
Material	TPE (moulded))
Degree of electrical protection	IP67
Mounting system	Pipe fixing

Communication interface	
Protocol	Modbus-RTU
Standard	EIA-RS 485 half duplex
Baud rate	19.200 baud/s

Environmental conditions	
Room temperature	-10°C…50°C, UR max. 85% - no condensation
Storage and transport	-40°C…80°C, UR max 85% - no condensation

Certifications	
EC Low Voltage Directive	2014/35/UE: 26/04/2014
Electromagnetic Compatibility Directive	2014/30/UE
EC Machinery Directive	2006/42/EC

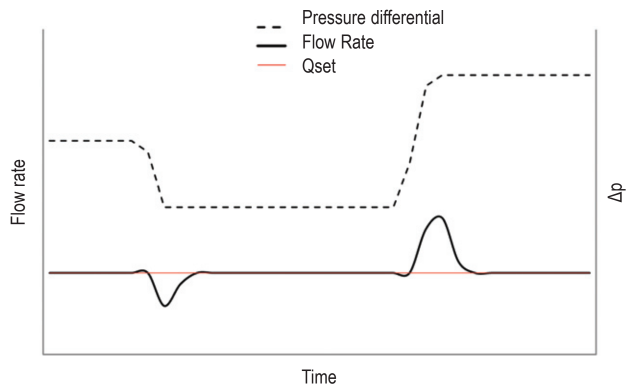
MODES OF OPERATION

The **DTCV** control valve can be programmed during installation with three different operating modes:

- Pressure-independent flow rate control
- ΔT control with flow rate limitation
- ΔT control with power limitation

• PRESSURE-INDEPENDENT FLOW RATE CONTROL

In this operating mode, the **DTCV** control valve receives a flow set-point (Q_{set}) through the on-board control panel, via an analogue 0-10V command from an external controller or via Modbus.

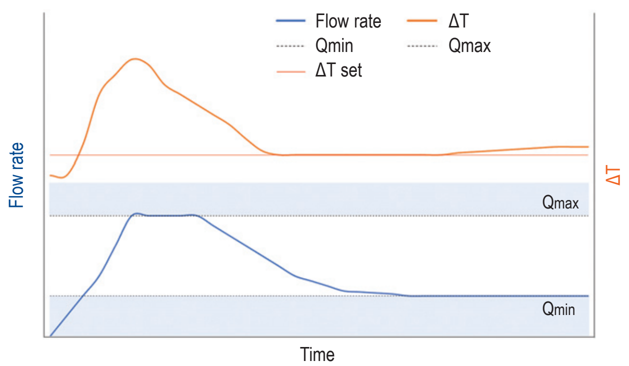


The set flow rate value (Q_{set}) is achieved and kept constant by adjusting the valve opening, thus ensuring that the system being controlled is independent of pressure variations.

The flow is constantly monitored by the integrated flow rate sensor.

• ΔT CONTROL WITH FLOW RATE LIMITATION

In this operating mode, the **DTCV** control valve receives the temperature differential set-point (ΔT_{set}) to be maintained through the on-board control panel, via an analogue 0-10V command from an external controller or via Modbus.



The set ΔT_{set} value is achieved and kept constant by adjusting the valve opening as long as the port (Q) remains within a range defined by a minimum flow rate (Q_{min}) and a maximum flow rate (Q_{max}).

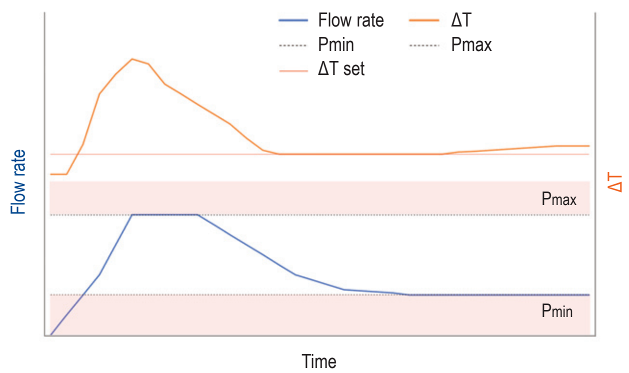
The flow and return temperatures are constantly monitored by the respective temperature sensors while the flow is constantly monitored by the integrated flow rate sensor.

Q_{min} and Q_{max} values can be programmed via the on-board control panel or via Modbus.

Q_{max} can also be programmed via an analogue 0-10V command from an external controller.

• ΔT CONTROL WITH POWER LIMITATION

In this operating mode, the **DTCV** control valve receives the temperature differential set-point (ΔT_{set}) to be maintained through the on-board control panel, via an analogue 0-10V command from an external controller or via Modbus.



The set ΔT_{set} value is achieved and kept constant by adjusting the valve opening provided that the power delivered to the consumer (P) remains within a range defined by a minimum power (P_{min}) and a maximum flow rate (P_{max}).

The flow and return temperatures are constantly monitored by the respective temperature sensors while the flow is constantly monitored by the integrated flow rate sensor.

DTCV

With this data, the system is able to calculate the instantaneous power using the following formula:

$$P = Q * Cp * |\Delta T|$$

$P\ [kW]$	power
$Q\ \left[{m^3}/{h}\right]$	flow rate
$C_p\ \left[\frac{kJ}{kg*°C}\right]$	specific heat of the fluid
$\Delta T\ [°C]$	temperature differential

Integrating the power over time, the algorithm calculates the energy (EnE) consumed by the utility by distinguishing heating from cooling based on the sign of the temperature differential between flow and return (ΔT)

$$EnE = (\int P\, dt)/1000$$

$EnE\ [MWh]$	energy
$P\ [kW]$	power

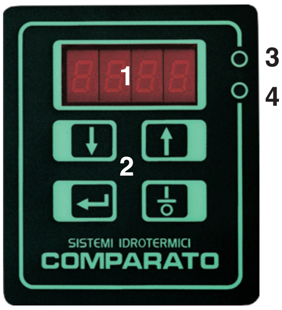
SHUT-OFF

In all operating modes, **DTCV** receives an I/0 activation command from a device with clean contacts: when the system is deactivated, the control valve is operated to fully close, thereby fulfilling the shut-off function of the controlled system.

CONTROL PANEL

Using the device's on-board control panel, the operating status can be displayed, and all setting and commissioning operations can be carried out easily and immediately.

A



1 : Display
2 : Keyboard
3 : Red LED - activation
4 : Green LED - deactivation

Display locked

To restrict access to the controller's control parameters, the display can be locked: unlocking is only possible by entering the correct password.

ANALOGUE CONTROL

With a 0-10V dc signal, the set-point value of the control variables can be adjusted:
- Flow rate control mode → Set-point FLOW
- ΔT control mode with flow rate limitation → Set-point ΔT or Set-point FLOW MAX.
- ΔT control mode with power limitation → Set-point ΔT or Set-point MAX POWER.

MODBUS

By connecting to the RS 485 serial port with the Modbus-RTU protocol, it is possible to access all the regulation parameters provided by the operating logs, supervise the status of the valve and send commands to the valve.

The Modbus address table can be downloaded from www.comparato.com

DATALOGGER

The device stores the activation time. Each day, when 24:00 hours are reached, the following information package is stored:

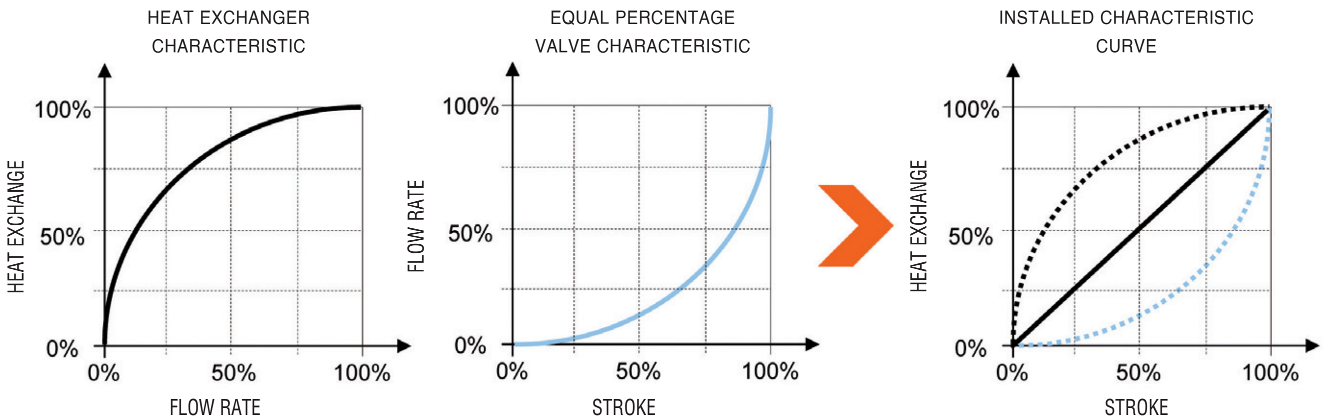
• Date (day/month/year)

• Activation time (hours:minutes)

When the memory is used up, the information packets are overwritten starting with the oldest. Data remain in stored even with no power supply, thanks to the buffer battery, and are transmitted via Modbus-RTU when requested by the network master.

CONTROL FEATURE

The control valve is equipped with an equal percentage characteristic curve, obtained by means of special modulation discs, which makes it possible to compensate for the non-linearity of heat exchange and to obtain a constant-gain system.



ENERGY MONITORING

In the ΔT control mode with power limitation, the **DTCV** control valve calculates the thermal energy consumption in MWh and saves it to the EEPROM memory every 12 minutes:

EnEh = heating energy

EnEc = cooling energy

The system automatically saves the energy consumed in "EnEh" or "EnEc" according to the sign of the temperature differential between flow and return:

Positive ΔT (flow T > return T) = EnEh - heating

Negative ΔT (flow T < return T) = EnEc - cooling

The energy metering function is only active when the device receives the activation signal and the value is only stored if the absolute value of the temperature differential between flow and return is ≥ 3°C.

When the maximum storable value (9,999 MWh) is reached, the energy value is reset to zero.

If a power failure occurs during accounting, the values of the last 12 minutes may be lost. EnEh and EnEc values can be displayed via the control panel and via the Modbus-RTU connection.

Note: The device does not meet the compliance requirements of MID 2014/32/EU and therefore cannot be used instead of an energy meter for energy billing.

The expected measurement error compared to a MID-certified meter is < 10% with non-glycolised water fluid.

SIZING

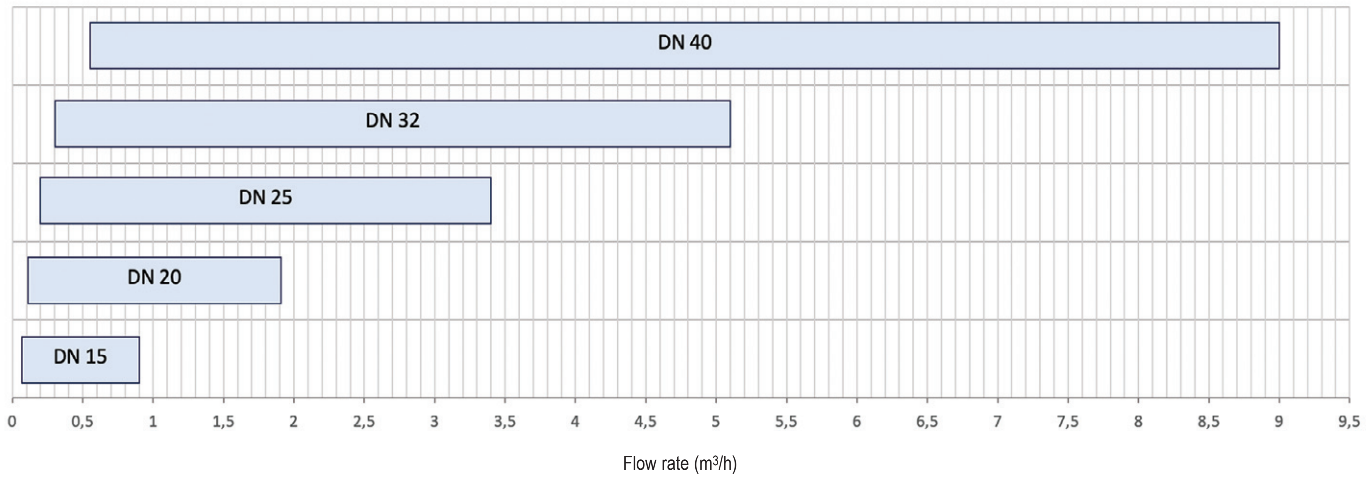
The choice of calibration implies a different set of parameters for the PID controller in order to optimise regulation according to the group of utilities for which the device will be applied.

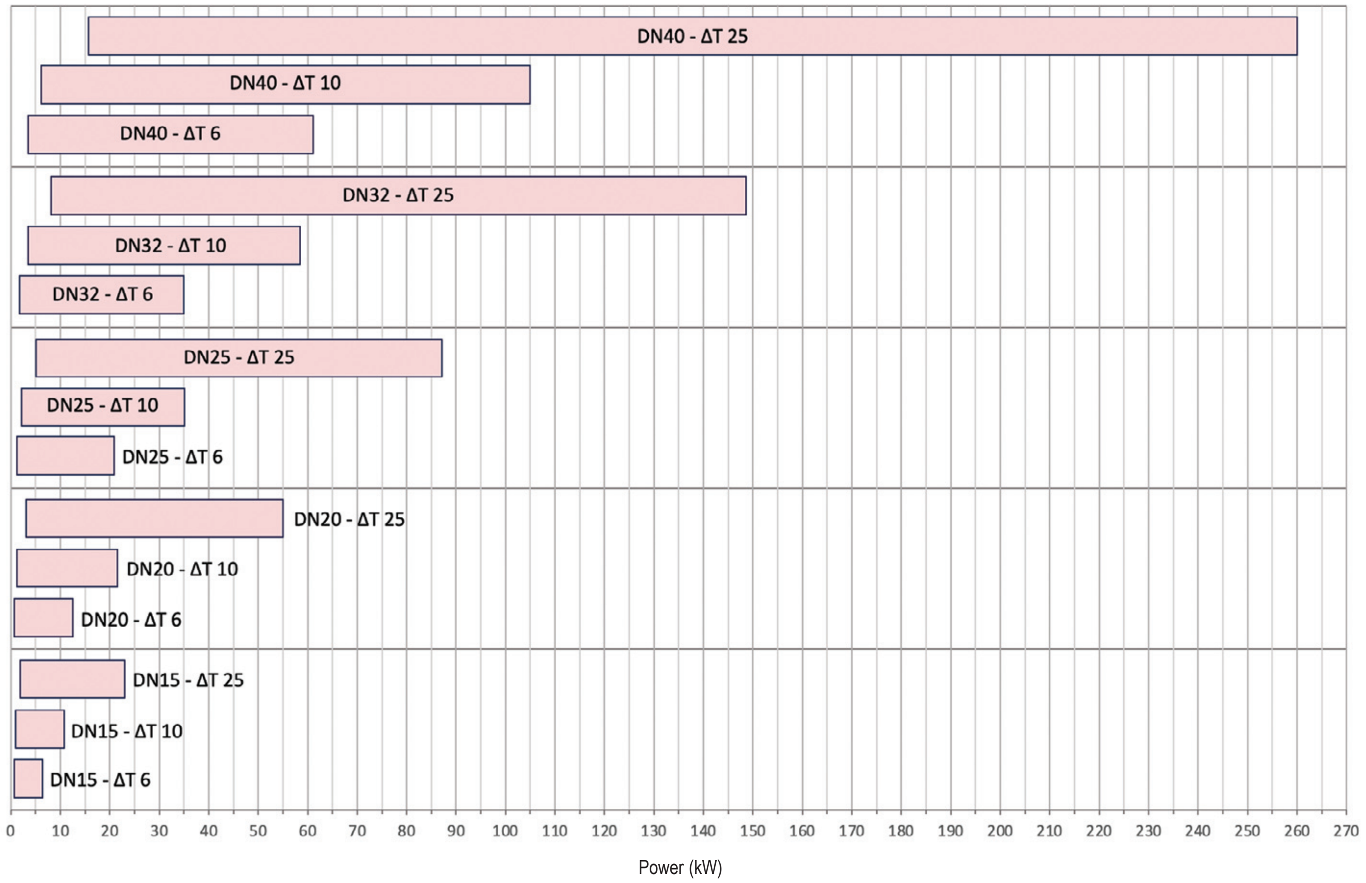
A • radiator-type systems operating with high temperature differentials

B • radiant type systems for heating and/or cooling (floor, wall, ceiling)

C • fancoil-type systems for heating and/or cooling involving heat exchange via mechanical ventilation

The valve diameter is selected on the basis of the flow rate and/or power output to be delivered to the utility the **DTCV** needs to serve.

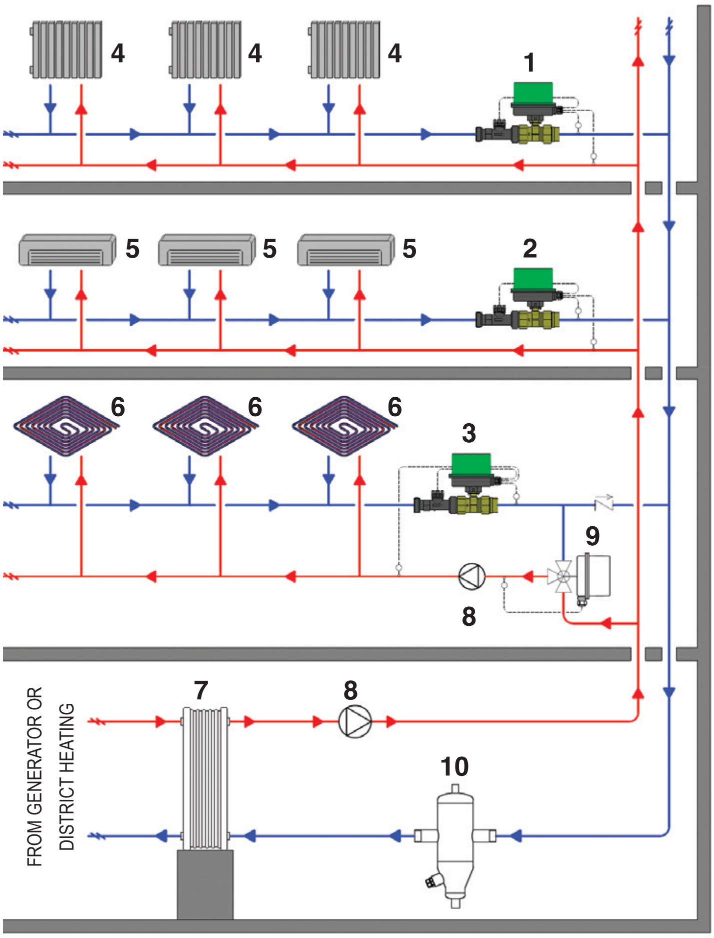

DN 40
DN 32
DN 25
DN 20
DN 15
0
0,5
1
1,5
2
2,5
3
3,5
4
4,5
5
5,5
6
6,5
7
7,5
8
8,5
9
9,5
Flow rate (m3/h)


DN40 - ΔT 25
DN40 - ΔT 10
DN40 - ΔT 6
DN32 - ΔT 25
DN32 - ΔT 10
DN32 - ΔT 6
DN25 - ΔT 25
DN25 - ΔT 10
DN25 - ΔT 6
DN20 - ΔT 25
DN20 - ΔT 10
DN20 - ΔT 6
DN15 - ΔT 25
DN15 - ΔT 10
DN15 - ΔT 6
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
250
260
270
Power (kW)

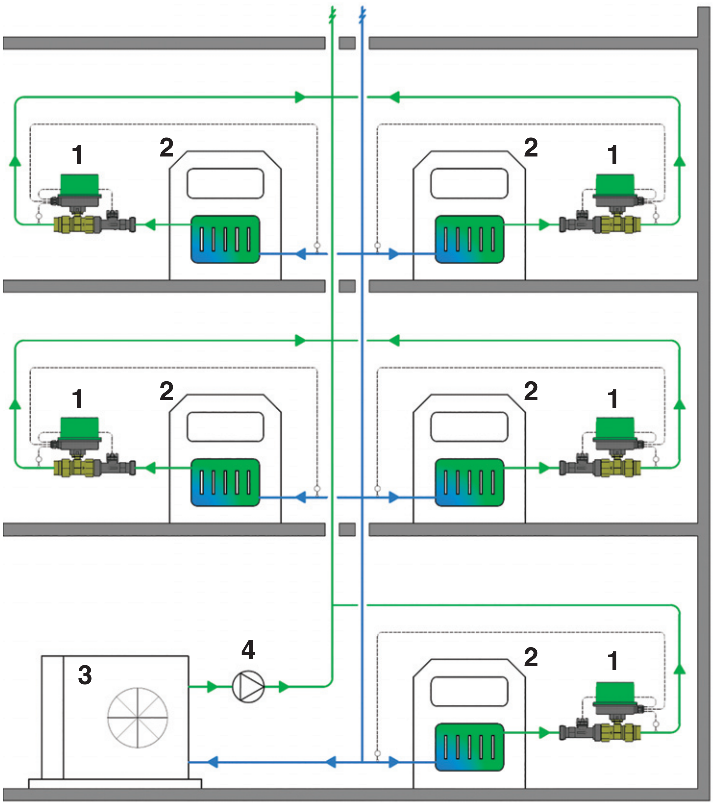
DTCV

Modbus

APPLICATION EXAMPLE



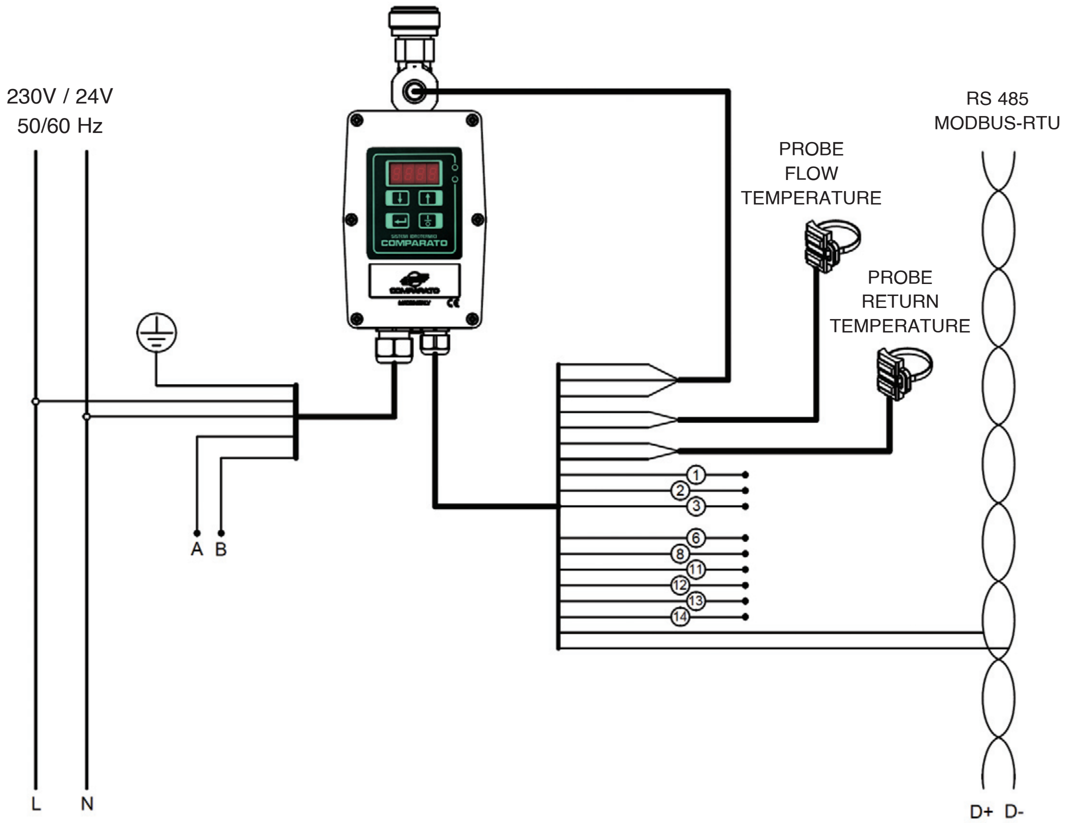
1 : Valve for electronic differential temperature control **DTCV** (calibration for radiators)
2 : Valve for electronic differential temperature control **DTCV** (calibration for fancoils)
3 : Valve for electronic differential temperature control **DTCV** (calibration for radiant panels)
4 : Radiator
5 : Fancoil
6 : Radiant panel
7 : Heat exchanger
8 : Circulator
9 : **DIAMIX PR** / **COMPAMIX PR** mixing valve
10 : **DIADEF MAGNETIC** deposit



1 : Valve for electronic differential temperature control **DTCV**
2 : Utility
3 : Chiller
4 : Circulator

DTCV

ELECTRICAL CONNECTIONS

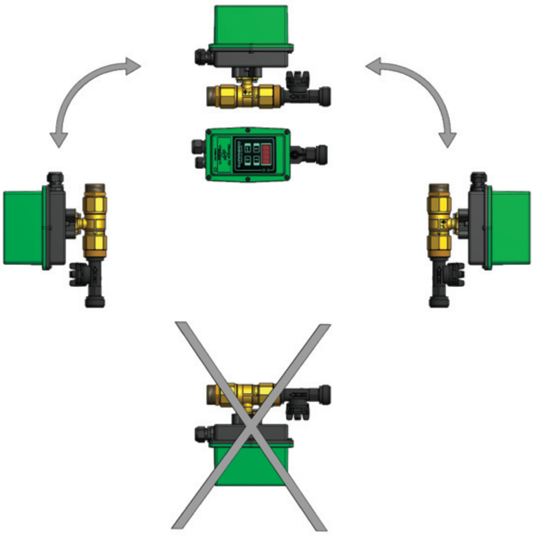


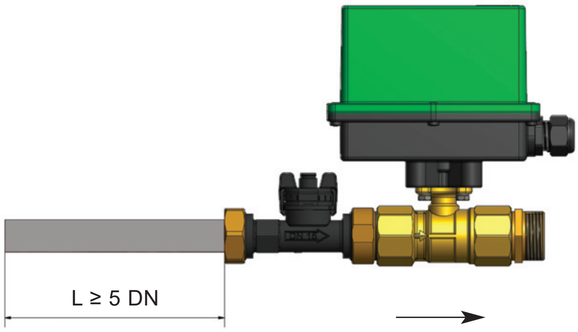
N°	Type	Description
A	Relay output	Activation signal
B	Relay output	Activation signal
1	Digital output	ΔT decrease signal
2	Digital output	Signal out of range
3	Digital output	Signal out of power range
6	Digital output	Activation command
8	GND	Common for digital inputs/outputs
11	Analogue input	0-10V (+)
12	Analogue input	0-10V (-)
13	Aux limit switch	Closed valve signal
14	Aux limit switch	Closed valve signal

Electrical connections must be made inside a suitable derivation box (not included).

DTCV

INSTALLATION





The device can be installed on both the flow line and the return line.

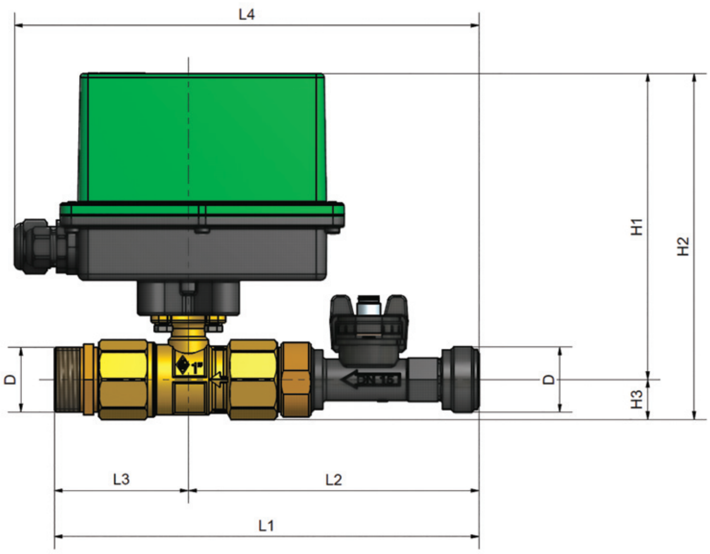
CAVITATION

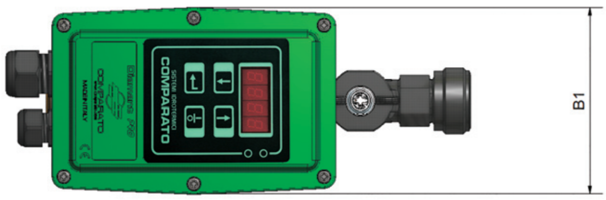
To avoid the phenomenon of cavitation, it is necessary that the static pressure (P_{static}) remains above the value calculated below:

$$P_{static} \geq 5{,}5 * \Delta p$$

$$\Delta p = differential\ pressure = \left(\frac{Flow\ rate}{Kvs}\right)^2$$

OVERALL SIZE





Type	DN (mm)	D	L1	L2	L3	L4	H1	H2	H3	B1
DTCV2_15_	15	1/2"	216	161	55	250	154	170	16	95
DTCV2_20_	20	3/4"	192	135	57	224	154	170	17	95
DTCV2_25_	25	1"	216	148	68	236	156	176	20	95
DTCV2_32_	32	1"1/4	256	176	80	265	166	192	26	95
DTCV2_40_	40	1"1/2	270	193	77	281	166	195	29	95

DTCV

Modbus

ACCESSORIES

Shell insulation

Material: cross-linked closed-cell polyethylene insulation

CODE	DN
INSULATION	
CBCV15	15
CBCV20	20
CBCV25	25
CBCV32	32
CBCV40	40

EXAMPLE OF SPECIFICATIONS

DTCV ELECTRONIC TEMPERATURE DIFFERENTIAL CONTROL VALVE, equal percentage 2-way ball valve with shut-off function, contact temperature probes, Vortex flow sensor, integrated monitoring and control interface, RS485 serial with Modbus-RTU protocol, DN25, PN8, Kvs 4.7 mc/h, min/max flow rate 0,21 ÷ 3,0 mc/h, regulator setting for fancoil systems, power supply 230V 50/60Hz.

Brand: **COMPARATO**

Model: **DTCV**

Code: **DTCV2225C**

UPDATED DATA SHEETS AVAILABLE AT www.comparato.com

HYDROTHERMAL SYSTEMS
COMPARATO NELLO s.r.l.
17014 CAIRO MONTENOTTE (SV) ITALIA VIALE DELLA LIBERTÀ • LOCALITÀ FERRANIA • Tel. +39 019 510.371
www.comparato.com e-mail:info@comparato.com UNI EN ISO 9001:2015 CERTIFIED COMPANY