DFCL: multizone chronothermostat for temperature regulation

DFCL module is a chronothermostat for **Domino** system allowing to regulate the ambient temperature of up to 4 separated rooms. The main characteristics are:

- regulation and displaying of the temperature of 4 separated zones (whose names can be freely set)
- displaying of the temperature of 4 additional zones (whose names can be freely set)
- internal clock with back-up battery and automatic change of daylight-saving /standard time
- summer/winter operation
- each zone allows up to 8 time-dependent intervention points for each day of the week; there are 2 groups of intervention points, one for each season, and the change from a group to the other one is automatically made when changing the season
- 6 temperature set points that can be freely set for each season
- **automatic** and **manual** mode for each zone
- display with timed back-lighting
- 6 buttons keyboard (◄ ► ▲ ▼ **OK** and **ESC**)
- control of 2 groups of 4 **Domino** output points, one for each season, for the control zone valves (or similar devices)
- control of 2 **Domino** output points, one for each season, for the general consent to the heating or cooling machine (e.g. pump, chiller consent, etc.)
- control of 1 **Domino** output point for the external signaling of failure of one or more temperature sensors
- possibility to install up to 15 DFCL modules in the same bus system
- acquisition of the zone temperatures by the **Domino** bus through DFTA or DFTE modules

In **automatic** mode (symbol) the temperature regulation of each zone follows the user defined program, while in **manual** mode (symbol) the set point of the selected zone does not depend on the time.

The summer operation is the complement of the winter one: during the winter season (symbol) an increment of the ambient temperature causes a reduction of the heat amount to be provided; during summer season (symbol) an increment of the ambient temperature causes an increment of the cool amount to be provided.

DFCL module also implements a virtual zone named "**general**" or "**global**" zone that forces the auto/man and the temperature setting to all the zones.

The **general consent** output will be activated after a delay of 12 seconds when almost 1 of the zone output is activated an it will be de-activated 5 seconds before the switch off of all zones.

When one or more temperature detection module (DFTA or DFTE) fails (module failure, short circuit of the sensor or sensor disconnected), DFCL module will activate the sensor failure output; in these cases DFCL display "------" instead of the temperature related to the fault sensor.

General settings

The display normally shows the information related to one of the zones, together to its assigned name, the temperature and the time; if that is a regulated zone, the display also shows the auto/man symbols and on/off symbols.

Starting from the displaying of the information of a zone, the button ► allows to scroll the menus according to the sequence here described. The menu system has a circular arrangement, therefore a pressing on the button ◄ causes the scrolling of the menu here described but in inverse order.

(1) Zone information (main menu)
The display shows the zone name, the automatic or manual symbol (if this is a regulated zone), the measured temperature, the day of the week and the current time.

(2) Scheduled time / set point setting of the zone
The display shows the zone name, the day of the week, the set point number (1 to 8), the scheduled time and the related set point (for the currently selected season).
To modify the program press the button **OK**: the number of the set point blinks; now it is possible to move between the fields to be modified (buttons ◄ ►). The field that can be modified, at any step, is always that is blinking.
The selected field can be modified by the buttons ▲ ▼ (inside the allowed range); once the field has reached the required value, press the button **OK** or again the button ◄ ► to confirm and to move to the next field. The button **ESC** allows to quit the editing mode, however confirming the settings shown by the display in that moment.
A symbol "-----" in the field of the scheduled time and in the field of the set point means that no longer scheduled points were programmed. To add a scheduled point, the field T- must be modified first: after this, some values will appear at the place of "-----" symbol; these values may be then modified as required. Since the programming of a zone must be repeated for each day of the week, it is recommended to program a "typical" day and to use then the function "copy day to day" described in the next paragraph.

Note: if the selected zone is an unregulated one (temperature displaying only) or if it is the "global zone", this menu will be skipped.

(3) Copy day -> day
This function is useful to set quickly the scheduled points, because it avoids to set the parameters for each day individually, especially   if the day scheduling is similar or equal each one to the other. In this menu the display shows the zone name and the days of the weeks separated by an arrow. Press **OK** to enable this function: the day on the left side begins to blink. By the buttons ▲ ▼ select the day to be get as "model"; by the buttons ◄ ► move to the day on the right side and select the day to which copy the "model". Move then on the arrow and press **OK** to make the copy; note that, at the end of the copy, the next day will be shown on the right side, therefore to make more copies of the "model", press more times the button **OK**. The button **ESC** allows to quit this function.
Note: if the selected zone is an unregulated one (temperature displaying only) or if it is the "global zone", this menu will be skipped.

(4) Season, language, ID
The display shows the summer/winter symbol, the language for the day of the week and the identification of DFCL module (reserved to the installer, see later). To modify the fields proceed as for the other menus (but in this case the button ▼ has not any effect); the button **OK** enters into the editing mode and the button **ESC** quit it. To assign the identification number to DFCL, the function "Set Address" of BDTools (from Programming menu) must be used, entering the desired number (in the range 1 to 15) and pressing the Set button while the Id field on DFCL display is blinking.

(5) Clock
The display shows the day of the week, the hour, the minutes and the date. To modify the fields proceed as for the other menus; the button **OK** enters into the editing mode and the button **ESC** quit it.

(6) Temperature values of the set points
The display shows the symbol of the set point (To, T1, T2, T3, T4 and T5) and the related temperature value. By the buttons ▲ ▼ select the Tx to be modified; press then **OK** to enter the editing mode (the displayed value starts to blink). By the buttons ▲ ▼ select the desired value and then press **OK** or **ESC** to quit the editing mode.
Warning: the set point values are different for summer and winter season, so before to modify these values, be sure to have properly selected the season.
The temperature values related to the Tx level can be freely set in the range +6 ÷ +40 °C. One of the T (named To) levels is normally reserved to the **anti-freeze** function. These value has meaning for the winter season and it grants a minimum temperature level to the zone. The To level is also defined for the summer season and it can be intended as maximum energy saving level.

Note: regardless of the selected menu, after 1 minute about of inactivity on the buttons, the displaying returns automatically to the main menu, however storing the last settings.

Automatic/Manual setting

When the display is showing the information related to a regulated zone, the pressing of the button **OK** allows to enter the automatic/manual setting and the desired set point for that zone.
When the zone is set to manual mode, the related Tx level point will be held until the zone will be restored to automatic mode.

When the zone is set to automatic mode, a Tx level different from the scheduled one can be forced. The Tx level will be restored to the value given by the program when the next scheduled point will occur.
This feature is useful to temporarily set a Tx level different from the scheduled one for that time, however avoiding to change the program.

Global zone setting

This menu allows to modify the auto/man setting and the temperature level simultaneously for all the 4 regulated zones.
Press the button **OK** while the display is showing the "global zone" to enter the auto/man and Tx level setting for all the zones.
Therefore it is possible to switch all the regulation system among automatic and manual mode, assigning the same Tx level to all the zones or leaving the Tx levels assigned before to each zone (in this case the display shows T---). Quitting the global zone setting while the display is showing the symbol ⊡ means that no change was made in respect to the previous condition.

Regulation algorithm

DFCL module regulates the temperature by the modulation of the opening time of the zone valves (or other devices) on a fixed period. At the beginning of each regulation cycle, the module evaluates the difference between the ambient temperature and the current set point Tx. The ratio time_ON/time_OFF will be then adjusted according to this evaluated difference.

Clock

DFCL module has a timekeeper chip and a back-up battery in order to allow the clock operation even if the module is not connected to the bus.
DFCL module automatically handles the change between the daylight-saving and standard time.

If a DFCK module is connected on the same **Domino** bus, then DFCL module synchronizes itself on its time; a change of the time on DFCK will be automatically reported on DFCL and vice-versa.

In addition, if more DFCL module are connected to the same bus, a change of date and time on a module will be automatically reported on the others.

Setting up

For setting up DFCL module (with firmware 4.0 or higher) , BDTools support program *release 4.0.6 or higher* is needed.

If for a zone the scheduling times have not been defined, then To set point, constant on 24h for all days of the week, will be forced.

The setting of the scheduled points may be made both by the PC and by the keyboard of DFCL module.

Main parameters setting
From the main menu of BDTools, select "Programming" and then "DFCL (Ver.4) Configuration"; the window shown in Fig.1 will appear.

A first set of main information must be entered in this window; these are:

➢ Id (1-15): obligatory field to identify DFCL module to be set (to assign the Id to DFCL see point (4) on page 2)

➢ I/O Address: optional field to assign a **Domino** bus "base" address to DFCL to execute some special functions (see in the next); if the base address is zero, then DFCL does not take any bus address

➢ Zone 1..4: enter in the Description column the name of zone 1..4 as it must appear on the DFCL display, in the 2nd column the address of related DFTA/E, in the 3rd one the output point controlling the zone during winter and in the last column the output point controlling the zone during summer

➢ Extern 1..4: enter in the Description column the name of external zone 1..4 as it must appear on the DFCL display and in the 2nd column the address of related DFTA/E

➢ Global Settings: enter in the 1st column the name to be assigned to "Global Zone" as it must appear on the DFCL display. Enter in the 2nd column the output point for the probe failure signaling (for regulated and unregulated zones), in the 3rd column the output point controlling the general consent during winter and in the last column the output point for the general consent during summer

Fig.2 shows an example of this window.

If one or more zones are not used, then left blank the address setting of the related temperature detection module: in this way the zone will not appear on the DFCL display.

Some buttons in the DFCL CONFIGURATION window allow the following functions:

➢ Time Table: a button for each zone, enabling the window for the configuration of scheduling times for the related zone, both for summer and winter season (see in the next)

➢ Read: reading of the configuration (but not scheduling times) currently loaded in DFCL module

➢ Program: send to DFCL module the configuration currently shown in the window (the scheduling time will not be transferred)

➢ Set-Point & I/O: enables the window for setting the temperature values Tx and input/output points for the special functions (remote control and monitoring of DFCL module, see in the next); Fig.4 shows an example of this window where some set points have been set both for winter and summer
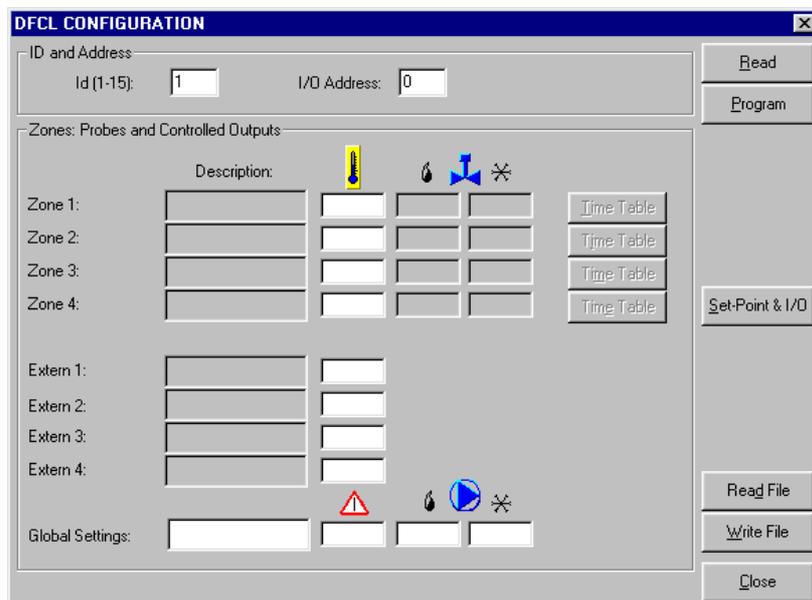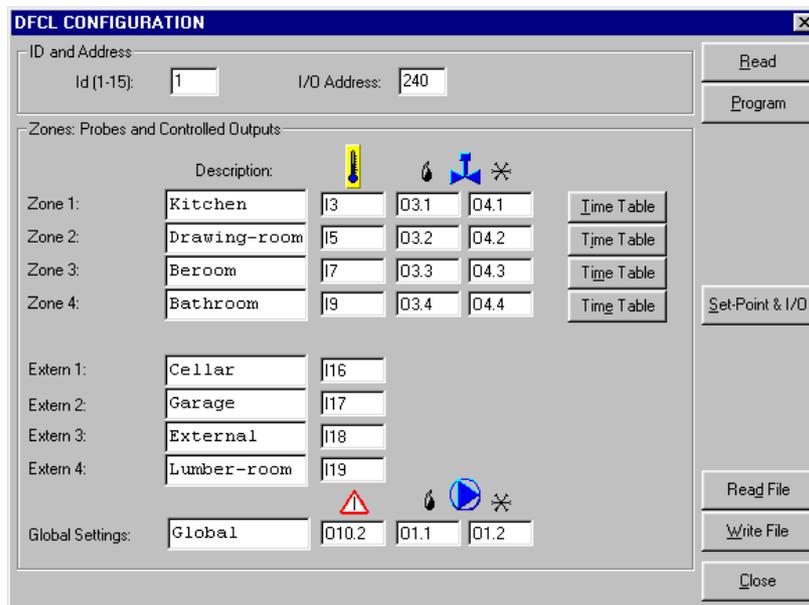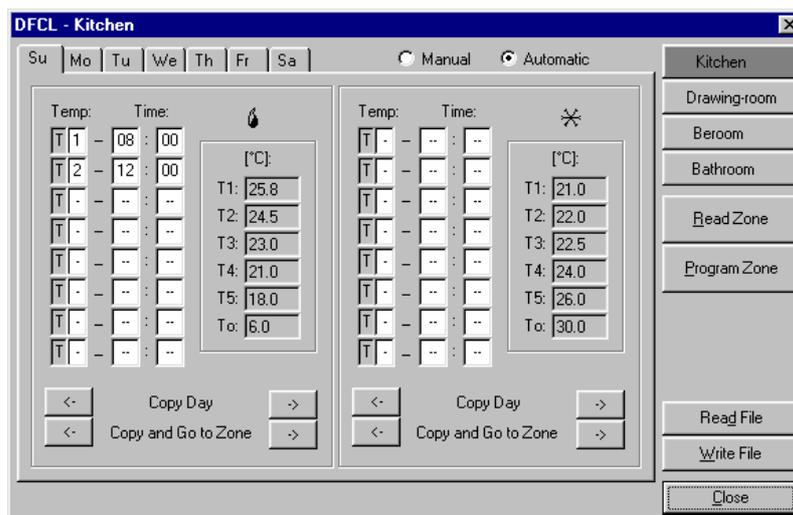

Fig.1

Fig.2

Fig.3

➢ Read File and Write File: saves on file all the main settings or reads from file the main settings; the file has .DCL extension and it can contain also the scheduling times (if defined)

Scheduling times

Pressing one of the "Time Table" buttons in the DFCL CONFIGURATION window, the window shown in Fig.3 will be loaded. This window is divided in 2 sections (winter and summer), allowing to define 2 groups of scheduling times for each season. A desired Tx must be specified for each day of the week (corresponding to each TAB of the window); this is done by specifying the number of the Tx and the time when it must be recalled.

To erase a scheduling time, enter a "-" symbol instead of the Tx number. Some buttons allow the copy of a day on the following one or on the previous one (in respect to that currently displayed).

The scheduling times can be also copied from a zone to the following or to the previous one. Note that, in this case, the zone where the settings were copied to becomes the currently selected one.

The name of the currently selected zone is reported in the upper left side of the window; in addition, the button related to the currently selected zone, on the right side of the window, has a different background color. It is also possible the setting of the operating mode for each zone (Manual or Automatic).

The buttons Read Zone and Program Zone allow reading/writing the times into DFCL module and they affect only the selected zone, therefore the reading/writing of times may be performed zone by zone.

The buttons Read File and Write File allow reading/saving the scheduling times in the same file (.DCL extension) containing the main settings of DFCL module.
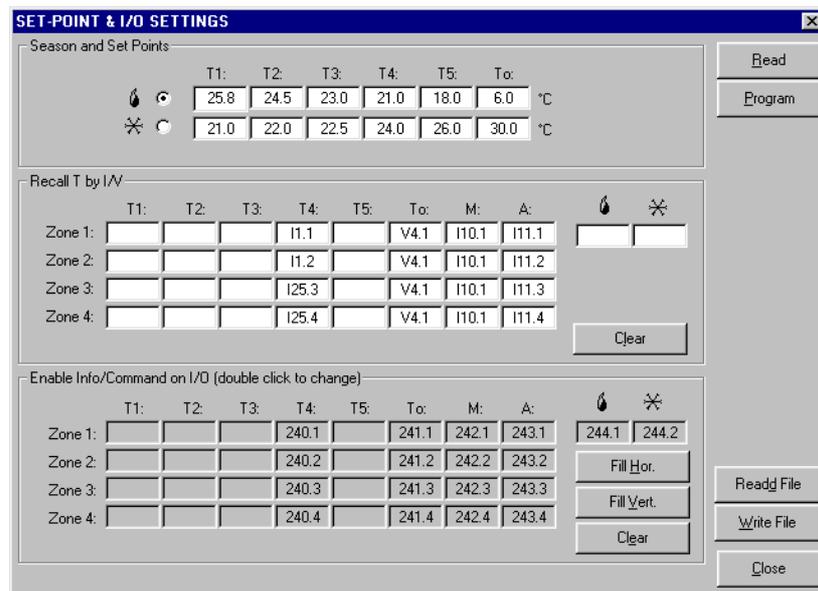

Fig.4

Remote control

As said before, the pressing of the "Set Point & I/O" button in the configuration window will enable the window shown in Fig.4. This window, in addition to the set points described before, allow setting some information useful for the remote control of DFCL module (Fig.4 shows an example) as described in the following paragraphs.

Control by input points (Recall T by I/V)

This function is very useful, for instance, to change the settings of DFCL module acting on the buttons (or other devices) connected to **Domino** bus input module.

The middle section of the window shown in Fig.4 ("Recall T by I/V") allows to specify the real or virtual **input** points which at their activation must recall a given Tx for a given zone (in the example of Fi.4, I1.1 will recall T1 on zone 1). In addition, two input points for each zone can be specified to impose, respectively, the manual and the automatic mode and two further input points to impose the winter and summer operation.

These (optional) input points can be assigned as desired; a text box left blank in this section of the window means that the related function on the related zone is not foreseen to be performed by an input point.

Note 1: DFCL module evaluates only the variations from OFF to ON of the input points specified for the remote control feature here described. This characteristic avoid conflicts when more inputs related to the same zone are ON.

Note 2: remember that Tx and the other settings can be however changed by the keyboard on the front panel of DFCL, without conflicts with the remote control function.

Note 3: the specified input points can be repeated for more zones; in this way the input will cause more actions. In the example in Fig.4, the point I10.1 will cause the switching to the manual mode of all zones.

Control by Supervisor or Touch Screen Terminal (Info/Command)

The section "Enable Info/Command on I/O" (on the bottom side of the window in Fig.4) allow to force the settings as for the input point described in the previous paragraph (section "Recall T by I/V"), but in this case the forcing of the several parameter (Tx, automatic and manual mode, season) will be performed by sending a command to DFCL module following the same method when sending a command to a common digital output point. This is therefore useful to control, in a very easy way, DFCL module from a supervisor PC or from a touch screen terminal.

In addition, thanks to this feature, the current settings of DFCL module can be easily reported to the supervisor or to the touch screen terminal.

To enable the section Info/Command of this window, an "I/O address" (other than zero) must be set in the main configuration window (see Fig.1).

Each double-click in a cell of the grid, will progressively insert or erase an address/point (x.y) with the following meaning:

➢ as output (Ox.y), this point allow to force the related parameter (Tx or other); in the example shown in Fig.4, the writing to point O241.3 will recall To on zone 3

➢ as input (Ix.y), this point allow to know the current status of the related parameter (T or other); in the example of Fig.4, if the point I241.3 is ON, then To is currently active on zone 3

The value of each address/point will be chosen by BDTools in automatic mode, and it corresponds to the first free point starting from the assigned base address. In this mode, DFCL module will take 0, 1 or more addresses depending on the settings entered in the "Info/Command" table, and therefore on the amount of information that must be available on the **Domino** bus.

The maximum amount of addresses taken by a DFCL module is 9; in this case all possible information will be available on the bus.

The buttons "Fill Hor." And "Fill Vert." in the window shown in Fig.4 allow to assign all possible information to the needed points, following a line or column arrangement respectively. The button "Clear" will remove all assignments.

As for the points described in the previous paragraph ("Recall T by I/V"), DFCL is sensible to OFF to ON variation of these points (not to the level).
The output points in the "Info/Command" section cannot be controlled by equations.

DFCL module can be therefore controlled in several ways:
> by the keyboard on the front panel
> by real or virtual input points: each OFF to ON variation on a well specified input causes an action on DFCL module
> by command messages to output points: each OFF to ON command on a well defined output point causes an action on DFCL module

Module connection

DFCL module needs only the connection to the bus as shown in the following schematic diagram.
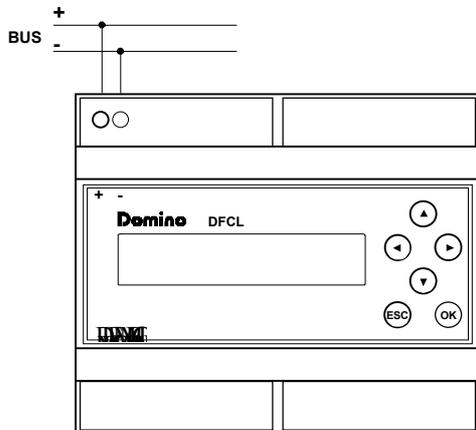

Technical characteristics

Power supply (bus side)	By specific centralized power supply Mod. DFPW
Display	LCD 2 lines / 16 characters with automatic back lighting
Display contrast	Fixed
Amount of regulated zones	Up to 4
Amount of unregulated zones (temperature displaying only)	Up to 4
Regulation algorithm	PID
Daily scheduled points for each regulated zone	8 for each day of the week
Amount of set points	6 for winter and 6 for summer
Internal battery	NiMH 3.6V 11mAh
Housing	Standard DIN 6M for DIN rail
Operating temperature	-5 ÷ +50 °C
Storage temperature	-20 ÷ +70 °C
Protection degree	IP20

Warning: DFCL module contains a NiMH rechargeable battery: remove this battery before to throw the device. The battery must be eliminated in a safe way according to current laws.

Outline dimensions
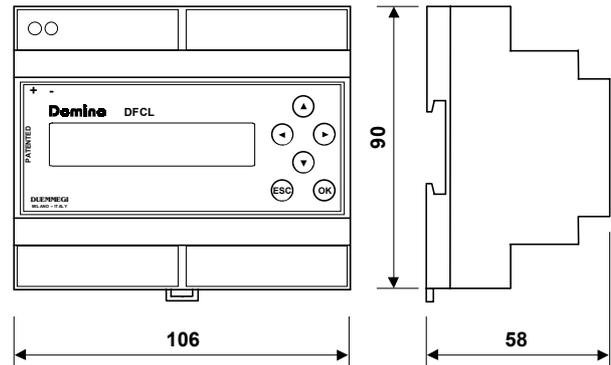
Note: all instructions and features reported in this technical sheet apply to DFCL module with firmware release 4.0 or higher. The firmware of DFCL module can be updated on the field (via bus) in any moment.
For more details on the updating procedure of DFCL module, please contact **DUEMMEGI** offices.