TS24 Touch Series
PI Temperature Controllers with LCD and Touch Screen

Features

■ Wall-mount unit to match any decor
■ Extra large easy-to-read Liquid Crystal Display (LCD), with display icons and LED backlight
■ Compact touch screen with control icons
■ Choice of constant display of ambient temperature or temperature set point value
■ Configurable operating parameters
■ Choice of ºC or ºF temperature display via parameter setup menu
■ Adjustable proportional band and integral time
■ Choice of valve stroke time for 3-wire on-off/floating models
■ Field adjustable high and low occupied set point limit values
■ Field adjustable cooling and heating unoccupied set point values
■ Choice to retain last entered settings on power resumption
■ 3-wire on-off/floating and 0(2)-10 VDC output models available
■ Selectable 2-10 VDC or 0-10 VDC proportional output by jumper setting
■ Dual-output models with auto cooling/heating changeover (deadband operation) and manual override
■ Adjustable 1 to 5 K deadband for dual-output models
■ Field recalibration capability of measured temperature
■ External and seasonal changeover temperature sensor capability
■ Window contact closure to lock out all controller functions for models with standby mode (not available to models without standby mode)
■ Suitable for both American and European electrical box mounting standards

General

The TS24 Touch Series microprocessor-based temperature controllers with digital display and touch screen are available in horizontal mounting and provide 3-wire floating (incremental) and on-off control or a 0(2)-10 VDC control output. The controllers are designed for use in 2-pipe and 4-pipe air handling units and a variety of heating and cooling applications controlled by water valves and air dampers.

The microprocessor combines a proportional plus integral (PI) algorithm with advanced adaptive control logic. The proportional component of the algorithm adjusts the control output in response to changes in the measured temperature. The integral component of the algorithm adjusts the control output to eliminate offset (difference between the set point and the actual temperature). This provides precise and stable control under various system capacity and varying load conditions without the need for tuning or calibrating the control algorithm in the field. The digital display of ambient temperature, set point and operating mode provides the user with an attractive and functional controller that is easy to use.

Ordering

To order, specify model numbers of complete set, display control unit or power supply unit.

Figure 1: Model Number Selection Guide

Model Number	Outputs	Output Signal	Applications	Cooling/Heating Mode	External Seasonal Changeover	External Sensor	Operating Modes	
							Standard Version	Version with Standby mode
TS24-T1-xx	Single	3-Wire On-Off or 3-Wire Floating	Cool Only or Heat Only (2-Pipe System)	Auto by External Device	Yes	Yes	Cool or Heat	Stb-Cool 0r Heat
TS24-T1M-xx	Single	3-Wire On-Off or 3-Wire Floating	Cool Only or Heat Only (2-Pipe System)	Manual Only	No	Yes	Cool or Heat	Stb-Cool-Heat
TS24-T2-xx	Dual	3-Wire On-Off or 3-Wire Floating	Cooling and Heating (4-Pipe System)	Manual and Auto	No	Yes	Cool-Heat-Auto	Stb-Cool-Heat-Cool Auto or Heat Auto/ Stb-Cool Auto or Heat Auto
TS24-A1-xx	Single	0(2)-10 VDC Proportional	Cool Only or Heat Only (2-Pipe System)	Auto by External Device	Yes	Yes	Cool or Heat	Stb-Cool 0r Heat
TS24-A1M-xx	Single	0(2)-10 VDC Proportional	Cool Only or Heat Only (2-Pipe System)	Manual Only	No	Yes	Cool or Heat	Stb-Cool-Heat
TS24-A2-xx	Dual	0(2)-10 VDC Proportional	Cooling and Heating (4-Pipe System)	Manual and Auto	No	Yes	Cool-Heat-Auto	Stb-Cool-Heat-Cool Auto or Heat Auto/ Stb-Cool Auto or Heat Auto
TS24-AH-xx	Dual	0(2)-10 VDC Proportional + 2-Wire On-Off	Proportional Cooling and On-Off Heating (2-Pipe and Electric Heat System)	Manual and Auto	No	Yes	Cool-Heat-Auto	Stb-Cool-Heat-Cool Auto or Heat Auto/ Stb-Cool Auto or Heat Auto

Notes: xx = omitted = standard models without standby mode (thermostat is always in operating mode)
xx = SB = models with standby mode (thermostat can be switched between standby and operating mode)

Figure 2: Optional Accessories

Description	Part No.
Probe-type Temperature Sensor	TE10-1
Duct-mount Temperature Sensor	TE10-2

Figure 3: Dimensions in mm
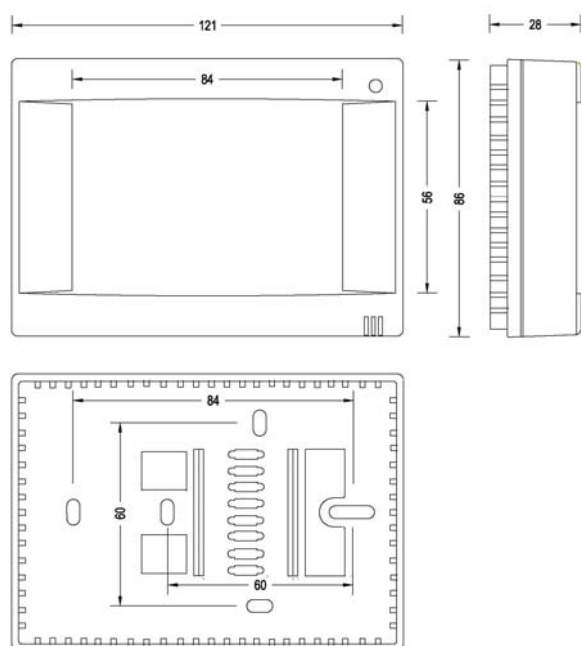
Figure 4: Jumper Locations and Settings
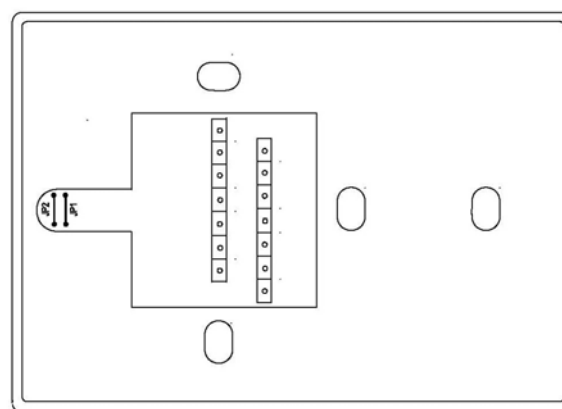
| JUMPER SETTINGS		
	JUMPER IN OPEN POSITION	JUMPER IN CLOSED POSITION
JP1	With External Sensor	With Built-in Sensor
JP2	For 2-10 VDC Output	For 0-10 VDC Output
Note: JP2 is available in 0-10 VDC/2-10 VDC output models only. Factory setting is 0-10 VDC.		

Specifications

Product model numbers	See Fig.1: Model Number Selection Guide
Power requirements	24 V ±15%, 50/60 Hz for all models (or +24 VDC ±10% for 0(2)-10 VDC output models
Power consumption	10 VA @ 24 VAC
3-wire on-off /floating output ratings	0.3 A @24 VAC
Proportional output	Choice of 2-10 or 0-10 VDC
0(2)-10 VDC output impedance	Minimum 50,000 Ω
0(2)-10 VDC internal impedance	Maximum 1,000 Ω
Temperature display range	0-40°C in 0.5 K increments: accuracy ±1 K (32-99ºF in 0.5 R increments, accuracy ±1 R)
Temperature set point range	5-40°C in 0.5 K increments (41-99ºF in 0.5 R increments), initial factory set at 22°C (71°F)
Temperature set point limits	Field adjustable 5-40ºC (41-99ºF) in 1 K increments
Constant display on LCD	Choice of ambient temperature or temperature set point value
Offset adjustment of temperature indication (field recalibration)	+2, +1, 0, -1 and -2 K (+2, +1, 0, -1 and -2 R) throughout the range Factory setting 0
Deadband of dual-output models	Adjustable 1 to 5 K(2 to 10 R) between cooling Mode and heating Mode. Factory setting 1.5 K (± 1.5 K of set point value): when ambient temperature is 1.5 K above set point value, controller will go into cooling mode or when ambient temperature is 1.5 K below set point value, controller will go into heating mode.
Proportional band	For 0(2)-10 VDC outputs: adjustable 1 to 10 K (1 to 10 R), factory setting 3 K (3 R) For 3-wire floating control outputs: adjustable 0-10 K (0 to 10 R), factory setting 3 K (3 R); at 0 setting, the output acts in on-off control mode.
Integral time	Adjustable 0 to 30 minutes in 1 minute increments, factory setting 15 minutes. Setting = 0 means integral time being turned off.
Valve stroke time for 3-Wire floating models	Choice of 10, 60, 90, 120, 150, 180 (factory setting), 210 and 240 s, accumulatively in one direction.
Sensor sampling time	10 s
Sensing element	NTC thermistor, 10 kΩ@25ºC; accuracy ±0.5 K@25ºC
Temperature differential for on-off control mode	Fixed at 1 K (2 R)
0(2)-10 VDC output models	Choice of 0-10 VDC or 2-10 VDC output via jumper JP2. Factory setting is 0-10 VDC.
Upper and Lower Set Point Limits	Adjustable 5-40°C (41 to 99ºF)
Unoccupied mode	Input signal from external voltage-free contact For standard models, activation is always on. For models with standby mode, activation can be set in either operating mode only or in both standby and operating modes.
Unoccupied temperature set point range	Field adjustable 5-40ºC (41-99ºF) in 1 K (1 R) increments separately for cooling and heating. Factory settings: 16ºC (61ºF) for heating and 26ºC (79ºF) for cooling
Enclosure	Material: Self-extinguishing, molded ABS Finish: Off white and dark grey color
Protective class	IP30
Ambient/Storage temperature limits	0 to 50ºC / -30 to 50ºC, 10% to 90% RH non-condensing
Electrical ratings	Valve output: 24 V, 0.3 A resistive, 0.3 A inductive, 50/60 Hz
Connectors	Non-removable pluggable terminal blocks
Power wires	Wire size 1 mm^2 or 18 AWG solid copper recommended
Sensor wires	22 AWG twisted shielded pair double-insulated cable
Accessories and options	See Figure 2: Optional Accessories
Agency approval	CE Mark compliant to EMC directive pending
Dimensions	See Figure 3: Dimensions in mm
Shipping weight	0.2 kg (0.44 lb)

The performance specifications above are nominal and subject to tolerances and application variables of generally acceptable industry standards. The Manufacturer and its partners shall not be liable for damages resulting from misapplication or misuse of its products.

Touch screen and LCD Layout
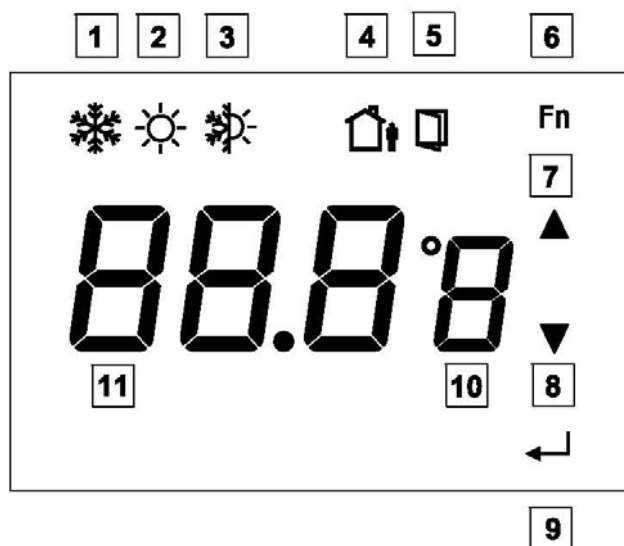
Display icons: 1, 2, 3, 4, 5, 10 and 11
Operating icons: 6, 7, 8 and 9

1 Cooling mode
2 Heating mode
3 Auto cooling/heating mode
4 Unoccupied mode
5 Window mode
6 Function touch icon
7 Temperature set point value increase touch icon (+)
8 Temperature set point value decrease touch icon (-)
9 Enter touch icon
10 ºC or ºF indication
11 Temperature indication

## Thermostat Errors Reporting

When the following errors are reported on the LED display unit, these errors will prevent the controller from normal operation and all controller functions will be locked out:

E-1   EEPROM read/write error
E-2*   Temperature sensor open-circuited
E-3   Temperature sensor short-circuited

* If jumper JP1 is cut open and external sensor is used, E-2 means the external sensor may have been disconnected from Terminals SR1 and GND. Check the external sensor's connectivity and resistive value. If E-2 error is still reported, return the thermostat to the manufacturer for repair.

When the error E-1 or E-3 is reported or when the error E-2 is reported without jumper JP1 being cut and external sensor being installed, return the thermostat to the manufacturer for repair.
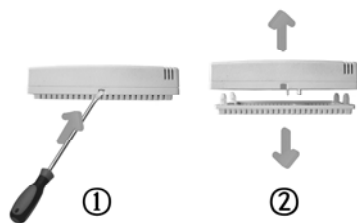
Figure 5: Mounting Details
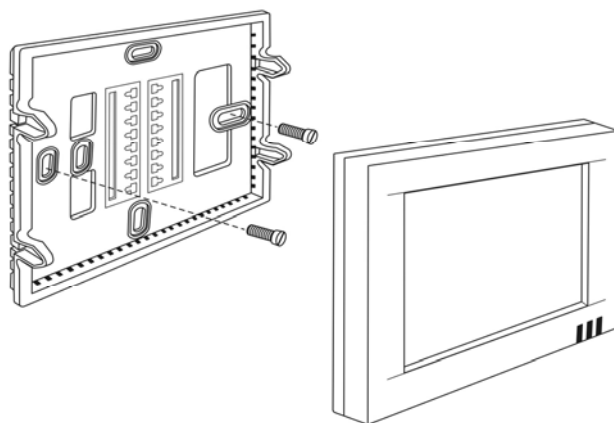
Mounting
The temperature controller can be surface mounted or secured to a standard American 2"x 4" single gang box or a standard European 75 x 75 x 35 mm electrical box.Two M3.5 mounting screws are included.

1. Poke a thin-blade screw driver into the slot between the cover and the base.
2. Slightly lever the screw driver upwards to crack open the cover from the base. Hold the base firmly with one hand and remove the cover with another hand by gently pulling away from the base.

Application Notes

- On a single-output cool only or heat only unit, i.e. a unit with only main output being available, connecting a shunting wire between terminals SR2 and GND forces the unit to go into heating mode.
- On a single-output cool only or heat only unit, connecting a TE10-1 changeover sensor between terminals SR2 and GND will automatically switch the unit between cooling and heating mode. When the sensor temperature exceeds 30ºC, the controller enters into heating mode.
- On a dual-output unit, the main output is always associated with the cooling controlled device and the secondary output with the heating controlled device.
- Cut open jumper JP1 if external sensor is wired to SR1 and GND.
- Cut open jumper JP2 if 2-10 VDC proportional output is required.
- The changeover sensor should be wrapped around the supply water pipe when associated with a water system.
- 22 or 24 AWG twisted shielded pair double-insulated cable is recommended as remote sensor wiring and its length must not exceed 25 m.
- Do not bundle and run power wiring and remote sensor wiring in the same conduit.
- Unoccupied contact closure activates unoccupied mode.
- When using either or both of the external and seasonal changeover temperature sensors, run the wires away from any electric motors or power wiring. Failure to do so may result in poor thermostat performance due to electrical noise.
- It is highly recommended that the 24 VAC power supply is interlocked to the air-conditioning system so that the controller is shut down when the air-conditioning system is turned off.

Operation Notes

- For standard models, the controller is always turned on and in active operating mode when power supply is connected.
- For models with standby mode, the controller can be switched between standby and operating mode with the Fn icon.
- When constant display of ambient temperature is selected, LCD displays ambient temperature constantly. When either ▲ or ▼ adjustment icon is tapped, the LCD reading changes to show the current temperature set point value. Increase and decrease set point value by tapping ▲ icon and ▼ icon respectively. Will return to ambient temperature display when all control icons are passive for 5 seconds.
- Tap the Fn icon momentarily to enter the desired operating mode: Cool-Heat, Cool or Heat, Cool-Heat-Auto, Standby-Cool or Heat, Standby-Cool-Heat or Standby-Cool Auto or Heat Auto, depending on the model number.
- Unoccupied mode can be activated in the following manner when the unoccupied contact closes:
  For 2-pipe models with auto seasonal changeover, the unoccupied cooling or heating mode is determined by the status of the SR2 seasonal changeover sensor and the valve output is activated according to the measured temperature.
  For 2-pipe models with manual seasonal changeover, the unoccupied cooling or heating status is determined by the last status of the occupied mode and the valve output is controlled according to the measured temperature.
  For 4-pipe models, the unoccupied cooling or heating mode is always determined by the measured temperature and valve output is also activated according to the measured temperature.
  Unoccupied mode activation in operating mode only or in both standby and operating mode will be determined by activation setting in setup menu.
  When unoccupied mode is activated, all keys are locked out and no settings can be entered.
- Window function is only available and applicable to models with standby mode. Whenever the window contact closes, all controller outputs will be cut off.
- The controller allows authorized service agent to change the following operating parameters in the field:

| Function	Symbol	Description
MCU firmware (software) revision level	0	Appears after entering the setup menu
Choice of temperature engineering unit	1	1-C = °C (factory setting) 1-F = °F
Choice to retain last entered settings on power resumption (hidden when ┌ 11 is set)	2	2On = program on (factory setting) 2OF = program off **Note:** When ┌ 12 is set and thermostat is in standby mode before power cut-off, only temperature set point values will be restored upon power resumption.
Offset adjustment of temperature indication (field recalibration of measured temperature)	3	3 2 = temperature indication plus 2 degrees 3 1 = temperature indication plus 1 degree 3 0 = no offset (factory setting) 3-1 = temperature indication minus 1 degree 3-2 = temperature indication minus 2 degrees
Adjustable proportional band for PI control	A	For 0(2)-10 VDC output models: A 1 = 1 K(1 R).......A 3 = 3 K(3 R) (factory setting)........A 10 = 10 K(10 R) For 3-wire floating control models: A 1 = 1 K(1 R).......A 3 = 3 K(3 R) (factory setting)........A 10 = 10 K(10 R); setting = A 0 means output acts in on-off control mode.
Choice of integral time for PI control	b	To set integral time from 0 (0 min) to 30 (30 min) in numeric 1 (1 min) increment, factory setting = 15 minutes. Setting = 0 means integral time being turned off.
Choice of valve stroke time for 3-wire floating models	C	Choice of 1, 6, 9,12, 15, 18, 21 and 24 C 1 = 10 s........C 18 = 180 s = factory setting........C24 = 240 s
Deadband adjustment for dual-output models only	d	d 1.0 = 1 K(d 2 = 2 R).....d 1.5 = 1.5 K(d 3 = 3 R) (factory setting)......d5.0 = 5 K (d 10 = 10 R)
Upper occupied set point limit setting	E	To set upper occupied set point limit, adjustable between current lower set point limit value and 40°C (99ºF), factory setting 40°C (99ºF). The program is set such that there is always a minimum separation of 4 degrees maintained between the upper occupied set point limit value and the lower set point limit value.
Lower occupied set point limit setting	F	To set lower occupied set point limit, adjustable between current upper set point limit value and 5°C (41ºF), factory setting 5°C (41ºF). The program is set such that there is always a minimum separation of 4 degrees maintained between the upper occupied set point limit value and the lower set point limit value.
Unoccupied cooling set point setting	G	To set unoccupied cooling set point, adjustable between current unoccupied heating set point value and 40°C (99ºF), factory setting 26°C (79ºF). The program is set such that there is always a minimum separation of 4 degrees maintained between the unoccupied cooling set point value and the unoccupied heating set point value.
Unoccupied heating set point setting	h	To set unoccupied heating set point, adjustable between current unoccupied cooling set point value and 5°C (41ºF), factory setting 16°C (61ºF). The program is set such that there is always a minimum separation of 4 degrees maintained between the unoccupied cooling set point value and the unoccupied heating set point value.
Choice of activation of unoccupied mode (hidden when ┌ 11 is set)	L	L-1 = Unoccupied mode can only be activated when thermostat is in operating mode (factory setting) L-2 = Unoccupied mode will be activated whenever the controller is energized
Choice of operating sequence for dual-output models only (hidden when ┌ 11 is set)	r	r-1 = to set operating sequence of Cool-Heat-Auto-Fan Only-Stb (factory setting) r-2 = to set operating sequence of Auto-Stb
Choice of "1" or "1M" model	t	t-1 = to set operating sequence of Cool or Heat (factory setting for "1" models) t-2 = to set operating sequence of Cool-Heat/Stb-Cool-Heat (factory setting for "1M" models)
Choice of constant display of ambient temperature or temperature set point value	u	u-1 = constant display of ambient temperature (factory setting) u-2 = constant display of set point value
Choice of with or without standby mode	┌ 1	┌ 11 = without standby mode (factory setting for standard models) ┌ 12 = with standby mode (factory setting for models with standby/operating function)
Restoration of default factory settings	rS	rS1 = Retain current settings (factory setting) rS2 = Restore default factory settings

On-Off/Floating Controller
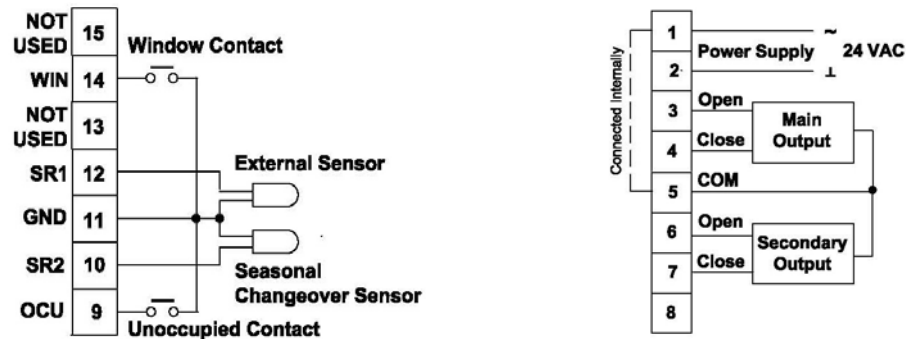
0(2)-10 VDC Proportional Controller
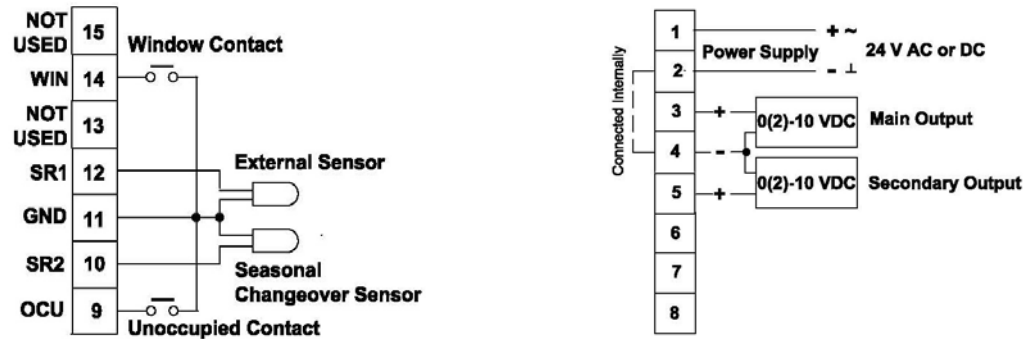
NOTE: Seasonal changeover sensors only applicable to TS24-T1and TS24-A1 models

0(2)-10 VDC Proportional and 24 VAC On-Off Dual-Output Controller

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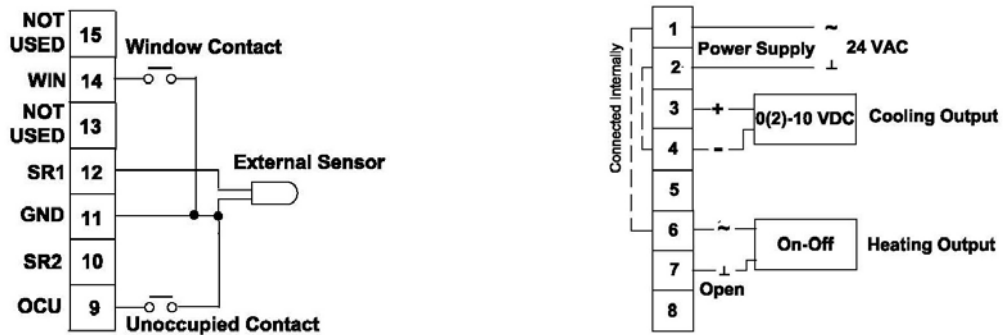
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