



Addendum to PAL System User Manual

Temperature Controllable Stacks / Trayholder

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Safety Information

General Considerations



The PAL System User Manual and the corresponding “Addendum” for a specific module has to be consulted by the user under any circumstances before a unit is put in use.

Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user’s authority to operate the equipment.

The user shall be made aware that if the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

When you use the PAL System, follow the generally accepted procedures for quality control and methods development.

When you use the PAL System in the field of chromatographic analysis and you observe a change in the retention of a particular compound, in the resolution between two compounds, or in peak shape, immediately determine the reason for the changes. Until you determine the cause of a change, do not rely on the separation results.



Electrical Hazards

Every analytical instrument has specific hazards, so be sure to read and comply with the following precautions. They will help ensure the safe, long-term use of your PAL System.

The Installation Category (Over voltage Category) for this instrument is Level II. The Level II Category pertains to equipment that receives its electrical power from the local level, such as an electrical wall outlet.



Only use fuses of the type and current rating specified. Do not use repaired fuses and do not short-circuit the fuse holder.



The supplied power cord must be inserted into a power outlet with a protective earth contact (ground). When using an extension cord, make sure that the cord also has an earth contact.



Do not change the external or internal grounding connections. Tampering with or disconnecting these connections could endanger you and/or damage the PAL System.

The instrument is properly grounded in accordance with these regulations when shipped. You do not need to make any changes to the electrical connections or the instrument's chassis to ensure safe operation.



The combination of a PAL System with a LC/MS System does require the safety measure as described by the LC/MS System manufacturer. Detailed instructions for the safety grounding on the LC/MS system are outlined in the corresponding operating/installation manual.

CTC Analytics recommends to use a grounding cable connected on one side at the Injection Valve, Loop or any other suitable direct metallic contact and the other side at an appropriate grounding point at the LC/MS System. This supplementary grounding measure will support the safety strategy of the LC/MS System manufacturer.



Do not turn the instrument on if you suspect that it has incurred any kind of electrical damage. Instead disconnect the power cord and contact a CTC Analytics representative for a product evaluation. Do not attempt to use the instrument until it has been evaluated. Electrical damage may have occurred if the PAL System shows visible signs of damage, exposure to any liquids or has been transported under severe stress.

Damage can also result if the instrument is stored for prolonged periods under unfavorable conditions (e.g. subjected to heat, water, etc.).



In any case disconnect the power cord(s) from the power supply or from the different power supplies if optional devices are installed before attempting any type of maintenance.

Capacitors inside the instrument may still be charged even if the instrument is turned off.

To avoid damaging electrical parts, do not disconnect an electrical assembly while power is applied to the PAL system. Once the power is turned off, wait approximately 30 seconds before you disconnect an assembly.



The instrument includes a number of integrated circuits. These circuits may be damaged if exposed to excessive line voltage fluctuations and/or power surges.



Never try to repair or replace any components of the instrument that is not described in this manual without the assistance of a CTC Analytics representative.

There are no operator-serviceable or replaceable parts inside the power supply(ies) or in the PAL System. If a power supply is not functioning, contact a CTC Analytics representative.



The power supplies for the PAL Instrument, the Stack Cooler DW, Stack Cooler MT and Tray Cooler have the symbols I/O on the label for the power switch to switch ON/OFF.

Any additional power supply for other devices like a Valve Module shows the symbols as shown below on the label for the power switch:



Power ON



Power OFF

The symbols shall warn the user that in a emergency case more than one power supply has to be turned OFF or more than one power cord has to be pulled from power supply or from the wall outlet to shut down the complete PAL System.

If the basic PAL System is installed, than is a single power supply installed only. Turning OFF the power supply or pulling this single power cord in an emergency case will stop the complete PAL System.

If a Stack Cooler DW, Stack Cooler MT or a Tray Cooler is installed in combination with a PAL System, than is a second power supply installed in the complete system. Turning OFF the power supplies or pulling the two power cords in an emergency case will stop the complete PAL System.

It is important that the power supply (ies) are in a location where the power ON and OFF switch is accessible and easy to operate, and where it is possible to unplug the AC power cord from the power supply/wall outlet in case of emergency.



Other Hazards



To avoid injury during PAL System operation, keep your hands away from the syringe.



Do not operate the PAL System without the safety shield. The safety shield must be installed for safe operation.



To avoid injury, observe safe laboratory practice when you handle solvents, change tubing, or operate the PAL System. Know the physical and chemical properties of the solvents you use. See the Material Safety Sheets from the manufacturer for the solvents in use.



Use caution when working with any polymer tubing under pressure:













- Always wear eye protection when near pressurized polymer tubing.
- Do not use polymer tubing that has been severely stressed or kinked.
- Do not use polymer tubing, in particular not PEEK or Tefzel tubing, with Tetrahydrofuran (THF), Dimethylsulfoxid (DMSO), chlorinated organic solvents, concentrated mineral acids, such as Nitric, Phosphoric or Sulfuric acids, or any related compounds to above listings.



Do not use vials without a sealing cap, Microtiter- or Deepwell-Plates without a plate seal. Vapor phase from organic solvents can be hazardous and flammable. Acidic vapor phase can cause corrosion to critical mechanical parts.



Commonly Used Symbols

	Caution or refer to User Manual
	Caution, Risk of Needle-Stick Puncture
	Caution, Hot Surface or High Temperature
	Direct Current
	Alternating Current
	Protective Conductor Terminal, Ground
	Fuse
	Electrical Power ON. Used with Main PAL Power Supply.
	Electrical Power OFF. Used with Main PAL Power Supply.
	Electrical Power ON for Only Part of the System. Used with Optional Device(s)
	Electrical Power OFF for Only Part of the System. Used with Optional Device(s)
	Caution, Risk of Electrical shock (high voltage)



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A. Stack Cooler DW

Description and Installation

1. General System Overview

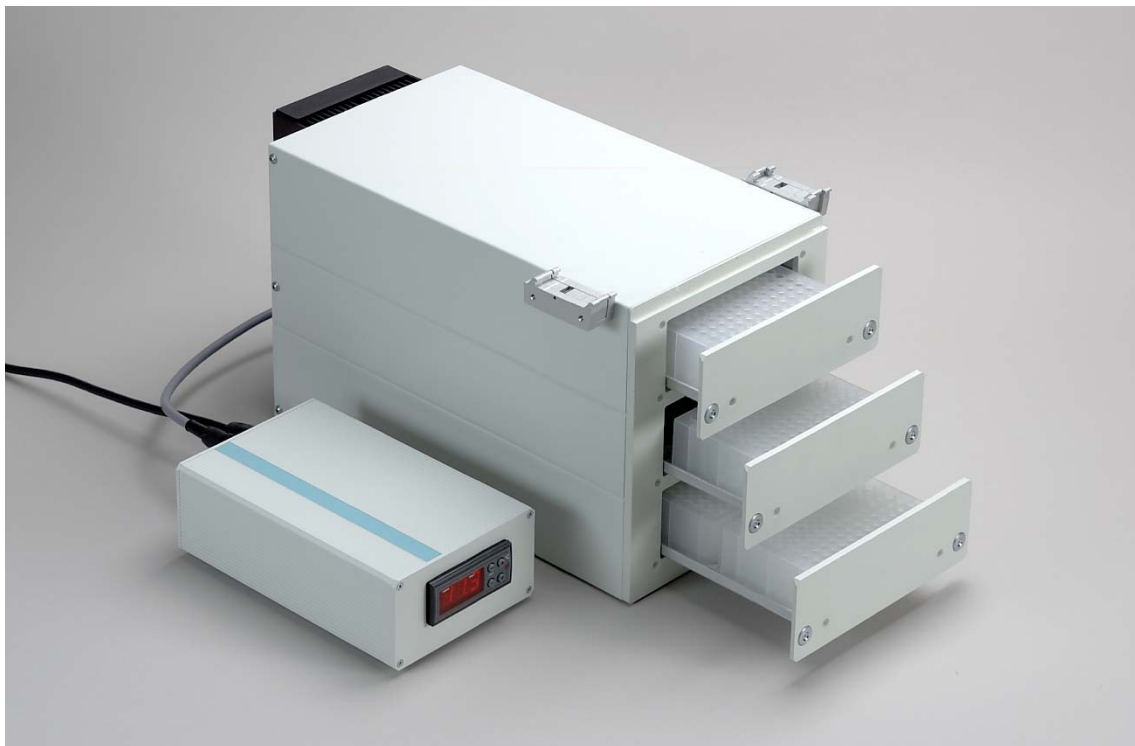


Figure 1: Stack Cooler DW and Power Supply with built-in control unit.



1.1 Specifications

Sample Capacity

6 Trays with 54 position for 2 ml Vials
or
6 Deepwell or Standard Microtiter-Plates
with 96 Positions
or
6 Microtiter-Plates with 384 Positions

Temperature Control

+4 to +40 °C in 0.1 °C increments
Peltier Element

Temperature Cooling

The specification for the Stack Cooler DW Temperature Cooling is defined as:

$T_{\Delta} = \geq 14.0 \text{ °C}$ within 60 minutes.

$$T_{\Delta} = T_{\text{Roomtemperature}} - T_{\text{Stack Cooler DW}}$$

A temperature difference in-between the room temperature ($22 \pm 2 \text{ °C}$) and the Stack Cooler DW of 14.0 °C has to be reached within 60 minutes. The control of the Stack Cooler DW (display) is relevant.

Dimensions and Weights

Stack Cooler DW	Dimensions (mm)			Weight
	Length	Depth	Height	(kg)
MC 04-01 6 Positions Stack	244	450	236	7.70
Power Supply				
MN 03-00 with built-in Control Unit	135	235	75	1.15



1.2 Electrical Specifications

Parameter	Requirement
Protection Class ^a	Class I
Over Voltage Category	II
Pollution Degree ^c	2
Moisture Protection ^d	Normal (IPXO)
Stack Cooler DW (Peltier Element)	
Input Voltage	24 VDC
Input Current	2.7 A
Power Supply for Stack Cooler DW	
Input Line Voltage	Grounded AC, 100 to 240 V
Input Line Frequency	50/60 Hz
Input Power	2 A
Output Voltage	24 VDC
Output Current	4.5 A
Output Fuse	T3.15 A/250 V

a: Protection Class I:

Protection class describes the insulating scheme used in the instrument to protect the user from electrical shock. Class I identifies a single level of insulation between live parts (wires) and exposed conductive parts (metal) panels, in which the exposed conductive parts are connected to a grounding system. In turn this grounding system is connected the third pin (ground pin) on the electrical power plug.

b: Over Voltage Category II:

Over Voltage category II pertains to instruments that receive their electrical power from a local level such as an electrical wall outlet.

c: Pollution Degree2:

This is a measure of pollution on electrical circuits that may produce a reduction of the dielectric strength or surface resistivity.

Degree 2 refers to normally only non-conductive pollution.

Occasionally, however, a temporary conductivity caused by condensation must be expected.

d: Moisture Protection:

Normal (IPXO) – IPXO means that there is NO Ingress Protection against any type of dripping or sprayed water. The X is a place holder to identify protection against dust if applicable.

Operating and environmental Requirements

Parameter	Requirements
Operating Temperature Range	4 to 40 °C (39 to 104 °F)
Maximum Relative Humidity	75%, non-condensing
Bench Space	At least 2 cm (1 in.) at the rear, space for air circulation. Access to power switch(es) and power cord(s). Clean, level and smooth surface. Solid bench plate.
Vibration	Negligible
Static electricity	Negligible
Altitude Limitations	None



2. Installation

2.1 Unpacking the Components

The Stack Cooler DW is shipped in one box.
Check for completeness for following items:

- Stack Cooler DW Module
- Power Supply with built-in control unit
- Power cable
- CD-ROM with Software to add new Objects to the PAL System (Object Manager Software)
- Addendum to PAL System User Manual for Stack Cooler DW | Stack Cooler MT | Tray Cooler

note ! The Temperature Control Unit for the Stack Cooler DW does not allow the user to enter different levels of the programming functions. The program is factory pre-set is downloaded to each Temperature Control Unit at the factory. A power supply programmed for the PAL Stack Cooler can not be used for a PAL Tray Cooler.
To identify the two units, is temporarily for the first units shipped a label on the bottom of the power supply. Later on will be on the front cover an indication similar as the revision level.

2.2 Assembling the Stack Cooler DW

note ! It is important that the PAL System is placed on a solid, even supporting plate.
To avoid any instability, make sure that the Stack Cooler DW stays with all 4 legs on the surface.

Installing the Stack Cooler DW in combination with a PAL System proceed as described below:

Before beginning the assembling process, determine approximately where the Stack Cooler DW shall be located. If the Stack Cooler DW will be installed with an existing PAL System, it can be possible, that the LC injection valve, the wash station or any other object (module) has to be shifted. Remember to re-position the objects again according the PAL System User Manual, Chapter 7.

1. Loosen the two Torx screws on the mounting clamps located on the left and right hand side of the Stack Cooler DW.
2. Carefully lift the X-Crossrail assembly on top of the Stack Cooler DW with the mounting clamp teeth fitting into the grooves on the bottom of the X-Crossrail.
3. Be sure that the clamps fit completely into the grooves. Alternately tighten the two Torx screws until the two mounting clamps are firmly in place.
4. Double check if the Stack Cooler DW clamps are correctly attached to the X-Crossrail (see figure 5 in the PAL System User Manual).



2.3 Electrical Connections

Installing the Power Supply

The power supply for the Stack Cooler DW has a built-in control unit with display. (Part Number: MN 03-00)

1. Locate the power supply and the AC power cable.
2. Set the power supply switch to **OFF** position,
3. Connect the open end of the DC power cable from the Stack Cooler DW to the power supply connector labeled with "**Peltier Thermostat**".
4. Connect the female end of the AC power cable to the power supply. Then connect the male end to an AC power outlet.
5. Set the switch on the power supply to the **ON** position,
6. Observe the display. It shall read the preset temperature of +10 °C.

3. PAL System Software in Combination with Stack Cooler DW

3.1 New PAL System Including a Stack Cooler DW

The PAL System will be pre-configured at the factory including the software for the Stack Cooler DW.

For the backup of the configuration see the PAL System User Manual, Chapter 11.

3.2 Stack Cooler DW Added to a PAL System

For the case, that a Stack Cooler DW will be added to an existing PAL System, use the software "PAL Object Manager" to install the Stack Cooler DW as a new Object. Follow the steps described in the "Read-me File" which is part of the software package supplied on CD-ROM. Use the Object "PAL StkCooler".

note ! The "PAL Object Manager" is shipped with every Stack Cooler DW upgrade.
The program is compatible with the PAL Firmware Revision 2.0 or higher.



4. Stack Cooler DW Object Positioning

For the Object Stack Cooler DW the X-Y-Z-Axis have to be positioned in the PAL System. Follow the instructions described in the PAL System User Manual, Chapter 7.

note ! The Y-Axis tolerance for the teaching point is limited at 129.4 mm.
Defining the position of the Stack Cooler DW, it is important to stay within this tolerance with the reference point in the top drawer.

Safety Note / Warning

Do not use vials without a sealing cap, Microtiter- or Deepwell-Plates without a plate seal.

Vapor Phase from organic solvents can be hazardous and flammable.

Acidic vapor phase can cause corrosion to critical mechanical parts.

5. Temperature Setting, Control and Alarm

5.1 Temperature Setting

Turning the power ON (I) at the power supply module brings the control unit into a self checking mode. After a few seconds it shows the set value of the temperature.

The Stack Cooler DW temperature has been preset by the factory at +10 °C. To change the value make following steps:

1. Press "**P**" shortly (less than 2 seconds) until "**SP1**" is displayed
2. Use the increment/decrement keys to select the desired value.
3. Press "**P**" again

note ! Pressing the button "**P**" for 2 seconds or longer one does reach a programming level.
Values like: "OPER", "ConF", "OFF", rEG", "tune" and "OPLO" can be reached in the menu by selecting the increment/decrement keys.
All these menu items are blocked for the user. Leaving the unit untouched for approximately 2 minutes will return the display to the actual temperature reading information. Turning off/on the device does bring back the temperature display.



The key “U” is blocked by the factory programming.

Below the digits of the display are the indicators showing which relays is in use, “OUT1” or “OUT2”.
The arrow s indicate if the unit is heating or cooling.

◀ heating — temperature within range of set point ▶ cooling

Temperature range at the extreme points approx. +/- 2 °C and within the wide range approx. +/- 1 °C.

5.2 Temperature Control and Alarm

To reach +4 °C in the analytical solution, one has to enter a lower value than +4 °C (insulation effect of Polypropylene or Polyethylene from well-plates).
The temperature range is limited to +1 to 40 °C, the controller does not allow a setting outside of this range.

The upper limit is protected with an internal alarm point at 55 °C. Reaching this point in a single fault situation, the Temperature Control Unit forces automatically to cool as much as possible. (The alarm is not audible.)
At the same time a corresponding Error message would be displayed. Explanations see point 9.

For unattended automated runs is an overheating fuse built-in.

The Peltier Element will turn off automatically at +72 ± 5°C.

A damaged Over-Temperature Fuse has to be replaced by an authorized representative from CTC Analytics.

In case of an Error, check systematically the following points:

1. Corresponding error message (see explanation point 9).
2. Has the set point of the desired temperature value been set above or below the specified working range of +1.0 to +40 °C ?
3. Turn off the power supply, wait for a few minutes, turn it on again.
The alarm should be stopped. If the alarm is still on, observe the corresponding Error message.



6. Temperature Stability

The Stack Cooler DW is basically a thermostatted sample tray to keep the analytical sample below or above ambient temperature.

CTC Analytics recommends to follow the guidelines:

- Switch on the Stack Cooler DW at least 30 minutes before the analytical routine run will be started at +10 °C or 75 minutes if operated at +4 °C.
- For High Throughput Analysis, typical cycle time of 60 seconds or less per analysis, leave the drawers in-between injections open .
- For longer cycle times it is recommended to use the PAL System option to close the drawer after each sampling.

note ! The preset mode for the Stack Cooler in combination with the PAL System is to leave the drawers open during an analytical run. To change this mode, complete the following steps starting at the top-level command from the control terminal:

Menu / select Setup / press F3 / activate Setup / Objects / Trayholders / CStack / Restore Mode
change default value "Auto" to "Sample"
press HOME.



7. Condensation Build-up

Condensation build-up is directly related to the temperature and relative humidity/temperature in the ambient air. (Dew point). Long term tests showed very little build up of condense water in an environment of relative humidity up to 60 % and 22 +/- 2 °C ambient temperature.

Condense Water at the back side of the compartments will be channeled to the drain outlet at the lower rear of the Stack Cooler DW labeled with "**Condensation Drain**". The outlet is plugged with a paper filter. This helps for the evaporation with the excessive heat of the Peltier Element. A drain line from the outlet to a reservoir bottle is under normal condition not necessary.

note ! Safety Warning:

If a flush gas will be used as described below, it is the users responsibility to assure that a 2 stage safety pressure regulator device will be installed in-between the gas supply and the Stack Cooler.

If the Stack Cooler DW would be operated under severe conditions, a flow of dry and clean (oil-free) Air or Nitrogen could be used to dry the compartments constantly. Connect the corresponding gas line to the Swagelok fitting (1/4") at the rear side of the Stack Cooler DW labeled with "**Flush Gas**". A flow of approximately 300 to 400 ml/min would be required to keep the compartments moisture free.

If from the application acidic vapor phase has to be expected, it is recommended to use the same gas line connection to flush a gas stream of an inert gas like Nitrogen or Helium into the compartments. A stream of a few ml/min can help to avoid corrosion of the rolls.

CTC Analytics recommends to check regularly for condensation build-up. It is a good practice to clean the inside of the Stack Cooler DW during the process of changing the analytical samples. It is advisable to dry out the Stack Cooler DW at ambient temperature in regular intervals. Open the drawers 1 to 5 cm for Air circulation. The frequency to dry the compartment depends highly from the surrounding conditions.



8. Maintenance

Regularly performing maintenance helps ensure accuracy and precision of the PAL System. Suggested intervals for maintenance procedures to ensure uninterrupted operation are given below.

If you use the system heavily (for example, nights and weekends), or if you use aggressive solvents, you may need to perform the maintenance procedure more frequently.

Maintenance Step	Interval
Clean the outside of the instrument. Use only a soft lint-free paper or cloth dampened with mild soap and water.	Weekly or as needed.
Clean and dry if necessary the inside of the instrument. Compartment, rolls and rails. Use only a soft lint-free paper or cloth.	Daily or as needed.
Clean and grease the rolls and the rails.	Once a year without acidic vapor exposure. If acids are used for the sample solution and the Stack Cooler DW is exposed to the vapor, the cleaning should be done more frequently. Interval as required. A positive stream of inert gas, like Nitrogen or Helium, can prevent corrosion. See point 7, "Condensation build-up".

note ! Recommended Grease and Supplier

Grease: PAL Grease, approx. 8g (20 ml)
Temperature Range: -130 to +150/+200 °C
Supplier: CTC Analytics AG

note ! There are no operator-serviceable or replaceable parts inside the power supply(ies) or the PAL System. In case of any failure, contact a representative of CTC Analytics.



9. Error Messages

The temperature control unit for the Stack Cooler DW (Peltier Element) can display feedback messages in form of **Error Messages**.

Message	Description	Reason	Check/Solution
-----	Error Probe	DC cable disconnected or in short circuit Connection mistake. Damaged Probe.	Check of connection between power supply and Stack Cooler DW. Check of signal probe (ex: NTC measure the resistance: 25 °C = 10kOhm).
uuuu	Under range	Measured variable is below the sensor limit	Check the set point for the desired temperature.
oooo	Over range	Measured variable is above the sensor limit	Turn OFF/ON the unit. Initialize the Temp. Control Unit to normal level. Check the set point for the desired temperature.
LbA	Loop Break Alarm	Loop break alarm is interrupted	Check the set point for the desired temperature. Turn OFF/ON the unit. Initialize the Temp. Control Unit to normal level.
ErEP	EPROM	Error in Eprom	Press key "P"

Other messages "ErAT" and "noAT" are suppressed and of no use for this application.

note ! The Temperature Control Unit for the Stack Cooler DW does not allow the user to enter different levels of the programming functions. The program is factory pre-set is downloaded to each Temperature Control Unit at the factory.
A power supply programmed for the PAL Stack Cooler can not be used for a PAL Tray Cooler.

To identify the two units, is temporally for the first units shipped a label on the bottom of the power supply. Later on will be on the front cover an indication similar as the revision level.



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B. Addendum for Stack Cooler MT

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B. Stack Cooler MT

Description and Installation

1. General System Overview



Figure 2: Stack Cooler MT and Power Supply with built-in control unit.



1.1 Specifications

Sample Capacity

12 Microtiter-Plates with 96 Positions
or
12 Deepwell Microtiter-Plates with 384 Positions

Temperature Control

+4 to +40 °C in 0.1 °C increments
Peltier Element

Temperature Cooling

The specification for the Stack Cooler MT Temperature Cooling is defined as:

$T_{\Delta} = \geq 14.0 \text{ °C}$ within 60 minutes.

$$T_{\Delta} = T_{\text{Roomtemperature}} - T_{\text{Stack Cooler MT}}$$

A temperature difference in-between the room temperature ($22 \pm 2 \text{ °C}$) and the Stack Cooler MT of 14.0 °C has to be reached within 60 minutes. The control of the Stack Cooler MT (display) is relevant.

Dimensions and Weights

Stack Cooler MT	Dimensions (mm)			Weight (kg)
	Length	Depth	Height	
MC 05-01 12 Positions Stack	244	450	236	7.70
Power Supply				
MN 03-00 with built-in Control Unit	135	235	75	1.15



1.2 Electrical Specifications

Parameter	Requirement
Protection Class ^a	Class I
Over Voltage Category	II
Pollution Degree ^c	2
Moisture Protection ^d	Normal (IPXO)
Stack Cooler MT (Peltier Element)	
Input Voltage	24 VDC
Input Current	2.7 A
Power Supply for Stack Cooler MT	
Input Line Voltage	Grounded AC, 100 to 240 V
Input Line Frequency	50/60 Hz
Input Power	2 A
Output Voltage	24 VDC
Output Current	4.5 A
Output Fuse	T3.15 A/250 V

a: Protection Class I:

Protection class describes the insulating scheme used in the instrument to protect the user from electrical shock. Class I identifies a single level of insulation between live parts (wires) and exposed conductive parts (metal) panels, in which the exposed conductive parts are connected to a grounding system. In turn this grounding system is connected the third pin (ground pin) on the electrical power plug.

b: Over Voltage Category II:

Over Voltage category II pertains to instruments that receive their electrical power from a local level such as an electrical wall outlet.

c: Pollution Degree2:

This is a measure of pollution on electrical circuits that may produce a reduction of the dielectric strength or surface resistivity.

Degree 2 refers to normally only non-conductive pollution.

Occasionally, however, a temporary conductivity caused by condensation must be expected.

d: Moisture Protection:

Normal (IPXO) – IPXO means that there is NO Ingress Protection against any type of dripping or sprayed water. The X is a place holder to identify protection against dust if applicable.

Operating and environmental Requirements

Parameter	Requirements
Operating Temperature Range	4 to 40 °C (39 to 104 °F)
Maximum Relative Humidity	75%, non-condensing
Bench Space	At least 2 cm (1 in.) at the rear, space for air circulation. Access to power switch(es) and power cord(s). Clean, level and smooth surface. Solid bench plate.
Vibration	Negligible
Static electricity	Negligible
Altitude Limitations	None



2. Installation

2.1 Unpacking the Components

The Stack Cooler MT is shipped in one box.
Check for completeness for following items:

- Stack Cooler MT Module
- Power Supply with built-in control unit
- Power cable
- CD-ROM with Software to add new Objects to the PAL System (Object Manager Software)
- Addendum to PAL System User Manual for Stack Cooler DW | Stack Cooler MT | Tray Cooler

note ! The Temperature Control Unit for the Stack Cooler MT does not allow the user to enter different levels of the programming functions. The program is factory pre-set is downloaded to each Temperature Control Unit at the factory. A power supply programmed for the PAL Stack Cooler can not be used for a PAL Tray Cooler.
To identify the two units, is temporarily for the first units shipped a label on the bottom of the power supply. Later on will be on the front cover an indication similar as the revision level.

2.2 Assembling the Stack Cooler MT

note ! It is important that the PAL System is placed on a solid, even supporting plate.
To avoid any instability, make sure that the Stack Cooler MT stays with all 4 legs on the surface.

Installing the Stack Cooler MT in combination with a PAL System proceed as described below:

Before beginning the assembling process, determine approximately where the Stack Cooler Mt shall be located. If the Stack Cooler MT will be installed with an existing PAL System, it can be possible, that the LC injection valve, the wash station or any other object (module) has to be shifted. Remember to re-position the objects again according the PAL System User Manual, Chapter 7.

1. Loosen the two Torx screws on the mounting clamps located on the left and right hand side of the Stack Cooler MT.
2. Carefully lift the X-Crossrail assembly on top of the Stack Cooler MT with the mounting clamp teeth fitting into the grooves on the bottom of the X-Crossrail.
3. Be sure that the clamps fit completely into the grooves. Alternately tighten the two Torx screws until the two mounting clamps are firmly in place.
4. Double check if the Stack Cooler MT clamps are correctly attached to the X-Crossrail (see figure 5 in the PAL System User Manual).



2.3 Electrical Connections

Installing the Power Supply

The power supply for the Stack Cooler MT has a built-in control unit with display. (Part Number: MN 03-00)

1. Locate the power supply and the AC power cable.
2. Set the power supply switch to **OFF** position,
3. Connect the open end of the DC power cable from the Stack Cooler MT to the power supply connector labeled with "**Peltier Thermostat**".
4. Connect the female end of the AC power cable to the power supply. Then connect the male end to an AC power outlet.
5. Set the switch on the power supply to the **ON** position,
6. Observe the display. It shall read the preset temperature of +10 °C.

3. PAL System Software in Combination with Stack Cooler MT

3.1 New PAL System Including a Stack Cooler MT

The PAL System will be pre-configured at the factory including the software for the Stack Cooler MT.

For the backup of the configuration see the PAL System User Manual, Chapter 11.

3.2 Stack Cooler MT Added to a PAL System

For the case, that a Stack Cooler MT will be added to an existing PAL System, use the software "PAL Object Manager" to install the Stack Cooler MT as a new Object. Follow the steps described in the "Read-me File" which is part of the software package supplied on CD-ROM. Use the Object "PAL StkCooler12MT".

note ! The "PAL Object Manager" is shipped with every Stack Cooler MT upgrade. The program is compatible with the PAL Firmware Revision 2.0 or higher.



4. Stack Cooler MT Object Positioning

For the Object Stack Cooler MT the X-Y-Z-Axis have to be positioned in the PAL System. Follow the instructions described in the PAL System User Manual, Chapter 7.

note ! The Y-Axis tolerance is limited at 129.4 mm. Defining the position of the Stack Cooler MT, it is important to stay within this tolerance with the reference point in the top drawer.

Safety Note / Warning

Do not use vials without a sealing cap, Microtiter-Plates without a plate seal.

Vapor Phase from organic solvents can be hazardous and flammable.

Acidic vapor phase can cause corrosion to critical mechanical parts.

5. Temperature Setting, Control and Alarm

5.1 Temperature Setting

Turning the power ON (I) at the power supply module brings the control unit into a self checking mode. After a few seconds it shows the set value of the temperature.

The Stack Cooler MT temperature has been preset by the factory at +10 °C. To change the value make following steps:

1. Press "P" shortly (less than 2 seconds) until "SP1" is displayed
2. Use the increment/decrement keys to select the desired value.
3. Press "P" again

note ! Pressing the button "P" for 2 seconds or longer one does reach a programming level. Values like: "OPER", "CONF", "OFF", "REG", "tune" and "OPLO" can be reached in the menu by selecting the increment/decrement keys. All these menu items are blocked for the user. Leaving the unit untouched for approximately 2 minutes will return the display to the actual temperature reading information. Turning off/on the device does bring back the temperature display.



The key “U” is blocked by the factory programming.

Below the digits of the display are the indicators showing which relays is in use, “OUT1” or “OUT2”.
The arrow s indicate if the unit is heating or cooling.

◀ heating — temperature within range of set point ▶ cooling

Temperature range at the extreme points approx. +/- 2 °C and within the wide range approx. +/- 1 °C.

5.2 Temperature Control and Alarm

To reach +4 °C in the analytical solution, one has to enter a lower value than +4 °C (insulation effect of Polypropylene or Polyethylene from well-plates).
The temperature range is limited to +1 to 40 °C, the controller does not allow a setting outside of this range.

The upper limit is protected with an internal alarm point at 55 °C. Reaching this point in a single fault situation, the Temperature Control Unit forces automatically to cool as much as possible. (The alarm is not audible.)
At the same time a corresponding Error message would be displayed. Explanations see point 9.

For unattended automated runs is an overheating fuse built-in.

The Peltier Element will turn off automatically at +72 ± 5°C.

A damaged Over-Temperature Fuse has to be replaced by an authorized representative from CTC Analytics.

In case of an Error, check systematically the following points:

1. Corresponding error message (see explanation point 9).
2. Has the set point of the desired temperature value been set above or below the specified working range of +1.0 to +40 °C ?
3. Turn off the power supply, wait for a few minutes, turn it on again.
The alarm should be stopped. If the alarm is still on, observe the corresponding Error message.



6. Temperature Stability

The Stack Cooler MT is basically a thermostatted sample tray to keep the analytical sample below or above ambient temperature.

CTC Analytics recommends to follow the guidelines:

- Switch on the Stack Cooler MT at least 30 minutes before the analytical routine run will be started at +10 °C or 75 minutes if operated at +4 °C.
- For High Throughput Analysis, typical cycle time of 60 seconds or less per analysis, leave the drawers in-between injections open .
- For longer cycle times it is recommended to use the PAL System option to close the drawer after each sampling.

note ! The preset mode for the Stack Cooler in combination with the PAL System is to leave the drawers open during an analytical run. To change this mode, complete the following steps starting at the top-level command from the control terminal:

Menu / select Setup / press F3 / activate Setup / Objects / Trayholders / CStack / Restore Mode
change default value "Auto" to "Sample"
press HOME.



7. Condensation Build-up

Condensation build-up is directly related to the temperature and relative humidity/temperature in the ambient air. (Dew point). Long term tests showed very little build up of condense water in an environment of relative humidity up to 60 % and 22 +/- 2 °C ambient temperature.

Condense Water at the back side of the compartments will be channeled to the drain outlet at the lower rear of the Stack Cooler MT labeled with "**Condensation Drain**". The outlet is plugged with a paper filter. This helps for the evaporation with the excessive heat of the Peltier Element. A drain line from the outlet to a reservoir bottle is under normal condition not necessary.

note ! Safety Warning:

If a flush gas will be used as described below, it is the users responsibility to assure that a 2 stage safety pressure regulator device will be installed in-between the gas supply and the Stack Cooler.

If the Stack Cooler MT would be operated under severe conditions, a flow of dry and clean (oil-free) Air or Nitrogen could be used to dry the compartments constantly. Connect the corresponding gas line to the Swagelok fitting (1/4") at the rear side of the Stack Cooler MT labeled with "**Flush Gas**". A flow of approximately 300 to 400 ml/min would be required to keep the compartments moisture free.

If from the application acidic vapor phase has to be expected, it is recommended to use the same gas line connection to flush a gas stream of an inert gas like Nitrogen or Helium into the compartments. A stream of a few ml/min can help to avoid corrosion of the rolls.

CTC Analytics recommends to check regularly for condensation build-up. It is a good practice to clean the inside of the Stack Cooler MT during the process of changing the analytical samples. It is advisable to dry out the Stack Cooler MT at ambient temperature in regular intervals. Open the drawers 1 to 5 cm for Air circulation. The frequency to dry the compartment depends highly from the surrounding conditions.



8. Maintenance

Regularly performing maintenance helps ensure accuracy and precision of the PAL System. Suggested intervals for maintenance procedures to ensure uninterrupted operation are given below.

If you use the system heavily (for example, nights and weekends), or if you use aggressive solvents, you may need to perform the maintenance procedure more frequently.

Maintenance Step	Interval
Clean the outside of the instrument. Use only a soft lint-free paper or cloth dampened with mild soap and water.	Weekly or as needed
Clean and dry if necessary the inside of the instrument. Compartment, rolls and rails. Use only a soft lint-free paper or cloth.	Daily or as needed.
Clean and grease the rolls and the rails.	Once a year without acidic vapor exposure. If acids are used for the sample solution and the Stack Cooler MT is exposed to the vapor, the cleaning should be done more frequently. Interval as required. A positive stream of inert gas, like Nitrogen or Helium, can prevent corrosion. See point 7, "Condensation build-up".

note ! Recommended Grease and Supplier

Grease: PAL Grease, approx. 8g (20 ml)
Temperature Range: -130 to +150/+200 °C
Supplier: CTC Analytics AG

note ! There are no operator-serviceable or replaceable parts inside the power supply(ies) or the PAL System. In case of any failure, contact a representative of CTC Analytics.



9. Error Messages

The temperature control unit for the Stack Cooler MT (Peltier Element) can display feedback messages in form of **Error Messages**.

Message	Description	Reason	Check/Solution
-----	Error Probe	DC cable disconnected or in short circuit Connection mistake. Damaged Probe.	Check of connection between power supply and Stack Cooler MT. Check of signal probe (ex: NTC measure the resistance: 25 °C = 10kOhm).
uuuu	Under range	Measured variable is below the sensor limit	Check the set point for the desired temperature.
oooo	Over range	Measured variable is above the sensor limit	Turn OFF/ON the unit. Initialize the Temp. Control Unit to normal level. Check the set point for the desired temperature.
LbA	Loop Break Alarm	Loop break alarm is interrupted	Check the set point for the desired temperature. Turn OFF/ON the unit. Initialize the Temp. Control Unit to normal level.
ErEP	EPROM	Error in Eprom	Press key "P"

Other messages "ErAT" and "noAT" are suppressed and of no use for this application.

note ! The Temperature Control Unit for the Stack Cooler DW does not allow the user to enter different levels of the programming functions. The program is factory pre-set is downloaded to each Temperature Control Unit at the factory.
A power supply programmed for the PAL Stack Cooler can not be used for a PAL Tray Cooler.

To identify the two units, is temporally for the first units shipped a label on the bottom of the power supply. Later on will be on the front cover an indication similar as the revision level.



C. Addendum for Tray Cooler

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C. Tray Cooler

Description and Installation

1. General System Overview



Figure 3: Tray Cooler and Power Supply with built-in control unit.



1.1 Specifications

Sample Capacity

1 PAL Tray2ml
or
1 PAL Tray1ml
or
1 Microtiter- or Deepwell-Plate (96 wells)

Temperature Control

+4 to +70 °C in 0.1 °C increments
Peltier Element

Temperature Cooling

The specification for the Tray Cooler Temperature Cooling is defined as:

$T_{\Delta} = \geq 14.0 \text{ °C}$ within 60 minutes.

$$T_{\Delta} = T_{\text{Roomtemperature}} - T_{\text{TrayCooler}}$$

A temperature difference in-between the room temperature ($22 \pm 2 \text{ °C}$) and the Tray Cooler of 14.0 °C has to be reached within 60 minutes. The control of the Tray Cooler (display) is relevant.

Dimensions and Weights

Tray Cooler	Dimensions (mm)			Weight (kg)
	Length	Depth	Height	
MC 03-01 Standard Trays 1/2 ml	135	350	155	3.90
MC 02-02 Special Mounting Kit	135	350	155	3.90
MC 03-03 Standard Trays 10/20 ml	135	350	175	4.30
Power Supply				
MN 03-00 with built-in Control Unit	135	235	75	1.15



1.2 Electrical Specifications

Parameter	Requirement
Protection Class ^a	Class I
Over Voltage Category	II
Pollution Degree ^c	2
Moisture Protection ^d	Normal (IPXO)
Tray Cooler (Peltier Element)	
Input Voltage	24 VDC
Input Current	2.7 A
Power Supply for Tray Cooler	
Input Line Voltage	Grounded AC, 100 to 240 V
Input Line Frequency	50/60 Hz
Input Power	2 A
Output Voltage	24 VDC
Output Current	4.5 A
Output Fuse	T3.15 A/250 V

a: Protection Class I:

Protection class describes the insulating scheme used in the instrument to protect the user from electrical shock. Class I identifies a single level of insulation between live parts (wires) and exposed conductive parts (metal) panels), in which the exposed conductive parts are connected to a grounding system. In turn this grounding system is connected the third pin (ground pin) on the electrical power plug.

b: Over Voltage Category II:

Over Voltage category II pertains to instruments that receive their electrical power from a local level such as an electrical wall outlet.

c: Pollution Degree2:

This is a measure of pollution on electrical circuits that may produce a reduction of the dielectric strength or surface resistivity.

Degree 2 refers to normally only non-conductive pollution.

Occasionally, however, a temporary conductivity caused by condensation must be expected.

d: Moisture Protection:

Normal (IPXO) – IPXO means that there is NO Ingress Protection against any type of dripping or sprayed water. The X is a place holder to identify protection against dust if applicable.

Operating and environmental Requirements

Parameter	Requirements
Operating Temperature Range	4 to 70 °C
Maximum Relative Humidity	75%, non-condensing
Bench Space	At least 2 cm (1 in.) at the bottom, space for air circulation. Access to power switch(es) and power cord(s).
Vibration	Negligible
Static electricity	Negligible
Altitude Limitations	None



2. Installation

2.1 Unpacking the Components

The Tray Cooler is shipped in one box.
Check for completeness for following items:

- Tray Cooler Module
- Power Supply with built-in control unit
- Power cable
- CD-ROM with Software to add new Objects to the PAL System (Object Manager Software)
- Addendum to PAL System User Manual for Stack Cooler DW | Stack Cooler MT | Tray Cooler

note ! The Temperature Control Unit for the Tray Cooler does not allow the user to enter different levels of the programming functions. The program is factory pre-set is downloaded to each Temperature Control Unit at the factory. A power supply programmed for the Tray Cooler can not be used for a PAL Stack Cooler
To identify the two units, is temporarily for the first units shipped a label on the bottom of the power supply. Later on will be on the front cover an indication similar as the revision level.

2.2 Assembling the Tray Cooler

note ! It is important that the PAL System is placed on a solid, even supporting plate.

Installing the Tray Cooler in combination with a PAL System proceed as described below:

Before beginning the assembling process, determine approximately where the Tray Cooler shall be located. If the Tray Cooler will be installed with an existing PAL System, it can be possible, that the LC injection valve, the wash station or any other object (module) has to be shifted. Remember to re-position the objects again according the PAL System User Manual, Chapter 7.

1. Loosen the two Torx screws on the mounting clamps located on the left and right hand side of the Tray Cooler
2. Carefully lift the X-Crossrail assembly on top of the Tray Cooler with the mounting clamp teeth fitting into the grooves on the bottom of the X-Crossrail.
3. Be sure that the clamps fit completely into the grooves. Alternately tighten the two Torx screws until the two mounting clamps are firmly in place.
4. Double check if the Tray Cooler clamps are correctly attached to the X-Crossrail (see figure 5 in the PAL System User Manual).



2.3 Electrical Connections

Installing the Power Supply

The power supply for the Tray Cooler has a built-in control unit with display. (Part Number: MN 03-00)

1. Locate the power supply and the AC power cable.
2. Set the power supply switch to **OFF** position,
3. Connect the open end of the DC power cable from the Tray Cooler to the power supply connector labeled with "**Peltier Thermostat**".
4. Connect the female end of the AC power cable to the power supply. Then connect the male end to an AC power outlet.
5. Set the switch on the power supply to the **ON** position,
6. Observe the display. It shall read the preset temperature of +10 °C.

3. PAL System Software in Combination with Tray Cooler

3.1 New PAL System Including a Tray Cooler

The PAL System will be pre-configured at the factory including the software for the Tray Cooler.

For the backup of the configuration see the PAL System User Manual, Chapter 11.

3.2 Tray Cooler Added to a PAL System

For the case, that a Tray Cooler will be added to an existing PAL System, use the software "PAL Object Manager" to install the Tray Cooler as a new Object. Follow the steps described in the "Read-me File" which is part of the software package supplied on CD-ROM. Use the Object "PAL TrayCooler".

note ! The "PAL Object Manager" is shipped with every Tray Cooler upgrade.
The program is compatible with the PAL Firmware Revision 2.0 or higher.



4. Tray Cooler Object Positioning

For the Object Tray Cooler (Cooler) the X-Y-Z-Axis have to be positioned in the PAL System. Follow the instructions described in the PAL System User Manual, Chapter 7.

note ! Use the Objects for the Trays marked with "C", example "VT98C" as listed in the Object Manager Revision H or higher.

note ! The Y-Axis tolerance is limited at 129.4 mm. Defining the position of the Tray Cooler, it is important to stay within this tolerance with the reference point in the top drawer.

Safety Note / Warning

Do not use vials without a sealing cap, Microtiter-Plates without a plate seal.

Vapor Phase from organic solvents can be hazardous and flammable.

Acidic vapor phase can cause corrosion to critical mechanical parts.

5. Temperature Setting, Control and Alarm

5.1 Temperature Setting

Turning the power ON (I) at the power supply module brings the control unit into a self checking mode. After a few seconds it shows the set value of the temperature.

The Tray Cooler temperature has been preset by the factory at +10 °C. To change the value make following steps:

1. Press "P" shortly (less than 2 seconds) until "SP1" is displayed
2. Use the increment/decrement keys to select the desired value.
3. Press "P" again

note ! Pressing the button "P" for 2 seconds or longer one does reach a programming level. Values like: "OPER", "CONF", "OFF", "rEG", "tune" and "OPLO" can be reached in the menu by selecting the increment/decrement keys. All these menu items are blocked for the user. Leaving the unit untouched for approximately 2 minutes will return the display to the actual temperature reading information. Turning off/on the device does bring back the temperature display.



The key “U” is blocked by the factory programming.

Below the digits of the display are the indicators showing which relays is in use, “OUT1” or “OUT2”.
The arrow s indicate if the unit is heating or cooling.

◀ heating — temperature within range of set point ▶ cooling

Temperature range at the extreme points approx. +/- 2 °C and within the wide range approx. +/- 1 °C.

5.2 Temperature Control and Alarm

To reach +4 °C in the analytical solution, one has to enter a lower value than +4 °C (insulation effect of glass or polymers from sample container).

The temperature range is limited to +1 to 70 °C, the controller does not allow a setting outside of this range.

The upper limit is protected with an internal alarm point at 72 °C. Reaching this point in a single fault situation, the Temperature Control Unit forces automatically to cool as much as possible. (The alarm is not audible.)
At the same time a corresponding Error message would be displayed. Explanations see point 9.

In case of an Error, check systematically the following points:

1. Corresponding error message (see explanation point 9).
2. Has the set point of the desired temperature value been set above or below the specified working range of +1.0 to +70 °C ?
3. Turn off the power supply, wait for a few minutes, turn it on again.
The alarm should be stopped. If the alarm is still on, observe the corresponding Error message.



6. Temperature Stability

The Tray Cooler is basically a thermostatted sample tray to keep the analytical sample below or above ambient temperature.

CTC Analytics recommends to follow the guideline:

- Switch on the Tray Cooler at least 30 minutes before the analytical routine run will be started at +10 °C or 75 minutes if operated at +4 °C.

7. Condensation Build-up

Condensation build-up is directly related to the temperature and relative humidity/temperature in the ambient air. (Dew point). Long term tests showed very little build up of condense water in an environment of relative humidity up to 60 % and 22 +/- 2 °C ambient temperature.

CTC Analytics recommends to check regularly for condensation build-up. It is a good practice to clean the inside of the Tray Cooler during the process of changing the analytical samples. It is advisable to dry out the Tray Cooler at ambient temperature in regular intervals.

8. Maintenance

Regularly performing maintenance helps ensure accuracy and precision of the PAL System. Suggested intervals for maintenance procedures to ensure uninterrupted operation are given below.

If you use the system heavily (for example, nights and weekends), or if you use aggressive solvents, you may need to perform the maintenance procedure more frequently.

To clean,

Maintenance Step	Interval
Clean the outside of the instrument. Use only a soft lint-free paper or cloth dampened with mild soap and water.	Weekly or as needed
Clean and dry if necessary the inside of the instrument. Use only lint-free paper or cloth	Daily or as needed.

note ! There are no operator-serviceable or replaceable parts inside the power supply(ies) or the PAL System. In case of any failure, contact a representative of CTC Analytics.



9. Error Messages

The temperature control unit for the Tray Cooler (Peltier Element) can display feedback messages in form of **Error Messages**.

Message	Description	Reason	Check/Solution
-----	Error Probe	DC cable disconnected or in short circuit Connection mistake. Damaged Probe.	Check of connection between power supply and Tray Cooler
uuuu	Under range	Measured variable is below the sensor limit	Check of signal probe (ex: NTC measure the resistance: 25 °C = 10kOhm). Check the set point for the desired temperature.
oooo	Over range	Measured variable is above the sensor limit	Turn OFF/ON the unit. Initialize the Temp. Control Unit to normal level. Check the set point for the desired temperature.
LbA	Loop Break Alarm	Loop break alarm is interrupted	Check the set point for the desired temperature. Turn OFF/ON the unit. Initialize the Temp. Control Unit to normal level.
ErEP	EPROM	Error in Eprom	Press key "P"

Other messages "ErAT" and "noAT" are suppressed and of no use for this application.

note ! The Temperature Control Unit for the Tray Cooler does not allow the user to enter different levels of the programming functions. The program is factory pre-set is downloaded to each Temperature Control Unit at the factory.
A power supply programmed for the Tray Cooler can not be used for a PAL Stack Cooler.

To identify the two units, is temporally for the first units shipped a label on the bottom of the power supply. Later on will be on the front cover an indication similar as the revision level.



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