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# Lead-freeReflowOven

## LPKF ProtoFlow®E


LPKF
Laser & Electronics

## 1.1 ProtoFlowE

The ProtoFlow E is a powerful convection oven for lead-free reflow soldering. Many pre-programmedprocessprofilescanbeeasilyselectedviaaLCDdisplayandsimplekeyboard.All profileparameters,suchastemperatureandprocessduration,canbeprogrammedindividually forseparatepreheatingandreflowphases.Profilesareeasilydefinedbyusernames.Asingle or multiple PCB's up to a maximum working surface of 200x160 mm can be easily inserted.

The multiprocessor controller, combined with a sensor and two heating elements, provides even heat distribution over the whole area of the PCB. Several freely programmable zones betweenpreheatingandthefinalreflowenabletheprocessingofalmostallreflowprofilesupto 320 °C. Optionally, the USB connection provides a user-friendly way of setting up and profile-programming the process via a PC.

## 3.2 Relevantmodel : ProtoFlow E

## 3.3 Intendeduse

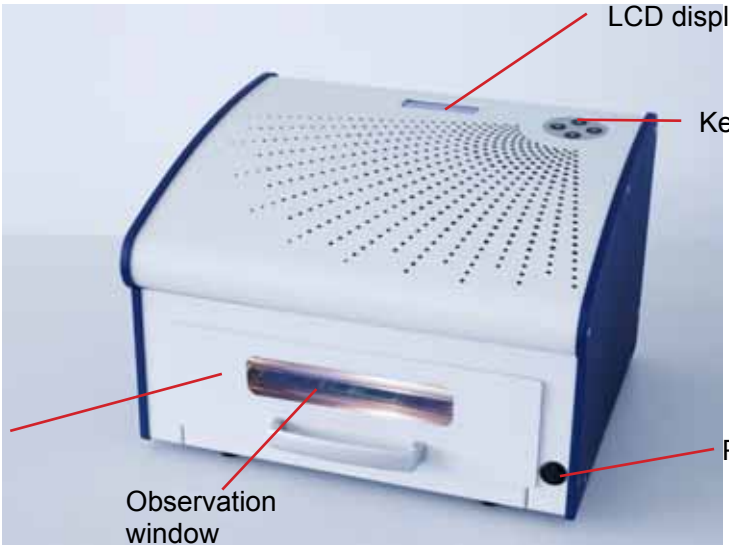
ProtoFlow E is a fully convectional oven for rapid prototyping intended for:

- lead-free reflow soldering
- curing adhesives
- hardening through-plating pastes
- hardening solder-resist masks
- drying components

## 3.4 Technicaldata

| | |
|---|---|
| Max. size of PCB | 160 x 200 mm (6.3" x 7.9") |
| Max. preheating temperature, time | 220 ºC, 999 s |
| Max. reflow temperature, time | 320 ºC, 600 s |
| Long thermal treatment temperature, time | 220 ºC, 64 h |
| Temperature stabilization time | < 5 min |
| Power supply | single phase 220-240 V, 50-60 Hz |
| Max. power consumption | 1650 W |
| Dimensions (W x H x D) | 400 x 280 x 380 mm (15.7" x 11" x 15") |
| Weight | 18 kg (40 lbs) |
| PC requirements | Hardware: Pentium 1 GHz, 512 MB RAM, 10MB disk space (just for FlowShow SE program), graphic card with 1024x768 video resolution, CD-ROM or DVD, USB 1.1 or 2.0<br>Software: Windows XP Professional SP3, Windows Vista or Windows 7 and .NET Framework 4 |
| Ambient conditions | Temperature: 15-30 ºC (59-95 ºF)<br>Relative humidity: 30-80 % |

## 5.1 Basicparts




### 5.1.1 Power switch

Thepowerswitchislocatedinthelowerrighthand corner of the front panel of the machine.

The power switch is illuminated when the power is on.

### 5.1.2 USB connection

AUSBconnectionporttypeAisplacedontherearside of the oven.

USBcommunicationsupportsbothUSB1.1and2.0 versions.

### 5.1.3 LCD display

Menu selection from the four-line LCD using the keyboard is logical, i.e. the direction arrows move the selection on the LCD in the appropriate direction.

Themenuchoicesavailableincludeoperatingmethods, and parameter adjustments.

The keys are slightly proud of the surface and have a spring click, which enables touch control.

### 5.1.4 Chamber

The heatingof the chamberis doneby 2 tube heaters with a combined power of 1500 W.

### 5.1.5 Drawer

Thealuminiumlathsslideontwo rods,whichmakes it very easy to adapt to various sizes of PCB's, up to a maximum of 160 × 200 mm (6.3″×7.9″).

Manual opening and closing of the drawer, warning display messages, sound, magnet and sensor ensure that the drawer is opened/closed correctly.

An observation window and internal illumination enable the process to be viewed at any time.

### 5.1.6 Monitoring

The integrated thermal sensor ensures excellent optimization of the reflow process.

### 5.1.7 Software

LPKFFlowShowSEenablestemperatureloggingofthecurrentprofile(chartanddata), programmingofovenprofilesfromthesaveddatabase,andupgradesoftheProtoFlowfirmware.

*Note:*
Full functionality requires licence. 30 days trial version is available.

## Installation

The oven must be placed on a flat surface of 400 × 400 mm

Theremustbeatleast400×250mm/15.7”x10”free space in front of the oven for opening the drawer.

Before starting-up the device for the first time, it is necessary to allow the device to acclimatize. Leave the unconnected device in the working area for such a period that the device adjusts to the temperature conditions in the room.

*Electric power supply (requirements):*
220-240 V / 50-60 Hz

*Main fuse specifications:*
T10A, 250 V

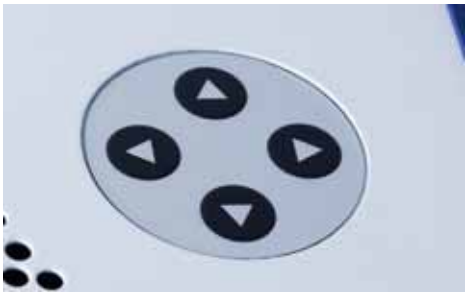
## Fixingofprintedcircuitboards

MountingofPCB'suptothesizeof160×200mm (6.3¨×7.9¨)ispossible. Thetwosecuringstripsslide easilyontocarriers.Topreventuncontrolledmotion,the strips are fixed with pin screws.

To unblock the laths, loosen the pin screws and easily slidethelathon. Toloosenthepinscrews,usethe enclosed hex (Allen) key.

## 7.2 Menus

### 7.2.1 General description



Movingbetweenmenusisdonebypushingthebuttons on the keyboard:

| | |
|---|---|
| ▲ | UP |
| ▼ | DOWN |
| ◄ | ESCAPE |
| ► | ENTER |

### 7.2.2 Options

| | | | | |
|---|---|---|---|---|
| SELECT | PROFILE | | START PROFILE | |
| | | LF-SMALL | EDIT PROFILE | SHORT NAME |
| | | LF-MEDIUM | | EXTRA INFO |
| | | LF-LARGE | | PREH TEMP |
| | | LF2-SMALL | | PREH TIME |
| | | LF2-MEDIUM | | REFL TEMP |
| | | LF2-LARGE | | REFL TIME |
| | | PB MEDIUM | | REFL POWER |
| | | Proconduct | | COOL TIME |
| | | ProMask-PD | | SEC OR MIN |
| | | Promask-PC | | MULTIZONE |
| | SETINGS | No OF PROFILE | 10 PROF'S | |
| | | | 20 PROF'S | |
| | | | 30 PROF'S | |
| | | FACTORY PR | LOADING FACTORY DATA | |

*PROFILE:*

»**SHORT NAME**« ⇨name of profile (10 characters)

»**EXTRAINFO**«⇨ additional description of profile (10 characters)

»**PREH TEMP**«⇨ preheat temperature (ºC), from 50 ºC to max. 220 ºC
Note:inthesecondmode,thetemperatureisalwayslowerthanthe temperature of the next phase.

»**PREH TIME**«⇨ preheating time (sec. or min., max. 999 s or 999 min.

»**REFLTEMP**«⇨ reflow temperature (ºC), from 50 ºC to max. 320 ºC
in minute mode, max. 220 ºC
in second mode, max. 320 ºC
Note:inthesecondmode,thetemperaturemustbealwayshigherthanthe preheat temperature

»**REFLTIME**«⇨ reflow time (sec. or min., max. 600 s or 999 min.
Note:whenthe"MultiZone"(S1&REFL,S1&S2&REFL)optionisswitchedon, the time of all phases together is max. 600 s.

»**REFLPWR**« ⇨ reflow power, engagement of the power of heaters
(25% power, 50% power, 75% power, 100% power)

»**COOLTIME**«⇨ time of cooling a PCB (sec or min), max. 999 s or 999 min.

»**SEC OR MIN**« ⇨ time unit (sec. or min.)

»**MULTIZONE**«⇨ setting the number of reflow steps:

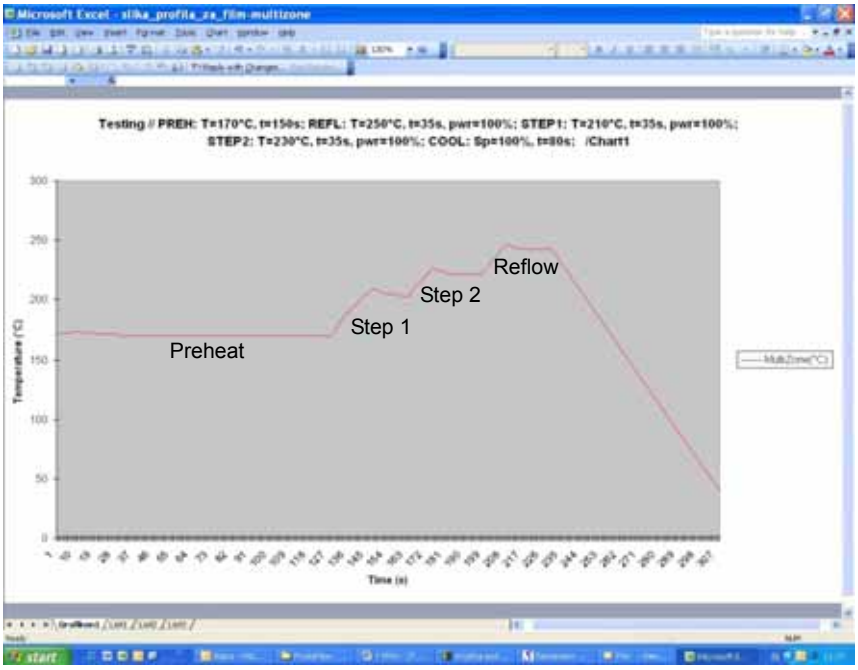
"**ONLYREFL**"- only reflow
"**STEP1&REFL**"- step1 and reflow (reflow follows step1) "**S1&S2&REFL**"- step1,step2andreflow(reflowfollowsstep2and step1)

## Description of MultiZone function:

*Settings:*
Thereflowprocessparametersofeachmultizonestepalwaysdisplayedonezoneatatime.

Multizone option "**ONLYREFL**"displays the reflow parameters of the REFLOW phase. Multizone option "**STEP1& REFL**"displays the reflow parameters of the STEP1 reflow phase. Multizone option "**S1&S2&REFL**" displays the reflow parameters of the STEP2 reflow phase. Setting of the MultiZone parameters (for all three phases):

1. Change the MultiZone option to "**ONLYREFL**"
2. Set the PREHEAT, REFLOW and COOLDOWN parameters
3. Change the MultiZone option to "**STEP1&REFL**"
4. Set the STEP1 reflow parameters
5. Change the MultiZone option to "**S1&S2&REFL**"
6. Set the STEP2 reflow parameters
7. Start the changed profile




TheMultiZonefunctionenablesrepeatingmax.threereflowsteps.Thefirstreflowstepis labelled “STEP1”, the second “STEP2”, and the last reflow step is “REFLOW”.

TheMultiZonefunctionisintendedforadvancedusersdealingwiththemost demanding reflow processes.

Almost all reflow processes can be done with the “MultiZone” function disabled.

Every MultiZone step (reflow) consists of the same reflow parameters:

- reflow (step) temperature: max. 320 ºC (in sec. mode), max. 220 ºC (in min. mode)
- reflow (step) time: 0 - 600 s; 0 - 999 min
- reflow (step) power: 25% power, 50% power, 75% power, 100% power

**SETTING:**

»**No.OFPROFILE**«⇨settingthenumberofprofiles(10,20,30)showedontheLCD (the number of current profile is visible in the right top corner)

»**FACTORYPR**« ⇨ loading of factory pre-programmed profiles and settings

Note:
Theparametersofthepre-programmedprofileshavebeenchosen, based on tests made with theAlpha® OM-338-Tlead-free soldering paste.

Notes:

WhentheovenisusedfortheProMaskprocedure,firststartthe“**ProMask-PD”**(pre-dry)and then continue with the “**ProMask-PC”** (post-cure).

Thenamesofthepre-programmedprofileshavebeencreatedinthefollowingprocedure,for example:

Short name: LF-SMALL

Extra info: FR4, 1.5 mm

“LF” - leadfree,definestheoptimizedtemperatureforpreheatandreflowphaseswiththelead free soldering paste

“SMALL” - defines the size of the PCB, ex. “small” - up to 80 × 50 mm / 3.2” x 2.0”
“medium” - up to 100 × 160 mm / 3.9” x 6.3”
“large” - above 100 × 160 mm / 3.9” x 6.3”

“FR4”- defines the selected material of the PCB

“1.5mm” - defines the thickness of the PCB

## ProtoFlowUSB driver installation instructions

Connect the PC and ProtoFlowwith the USB cable supplied (2x typeAfemale). Turn ON the oven.
Windows should install the appropriate driver.

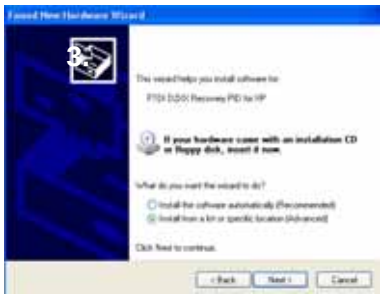
- Windows 7:
  Windows7shouldautomaticallyinstalltheappropriatedriver.Intheeventinstallationisnot successful, select Control Panel and manually update the driver. Follow the Windows XP installation procedure.
- Windows XP:
  To install the appropriate USB driver in Windows XP, follow this procedure:

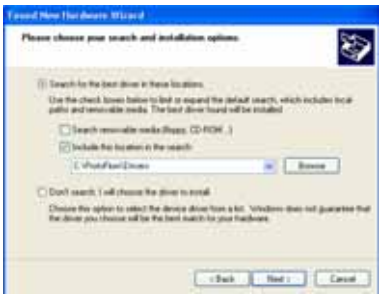
**1.**

PC shouldannounce **Foundnewhardware - ProtoFlowUSB support.**


**2.**

Waituntilthenextpageappears(select**No,notthis time** and confirm with **Next**).





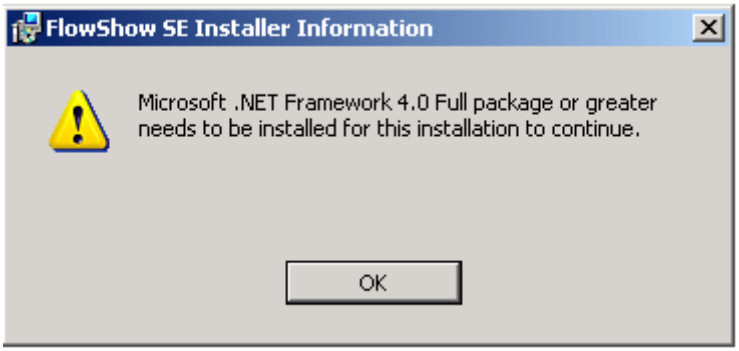



### 7.4.3 Installing the LPKF FlowShowSE

Insert the installation CD and run the Setup.exe program in the root folder.

Installationrequires.NET Framework4.0.

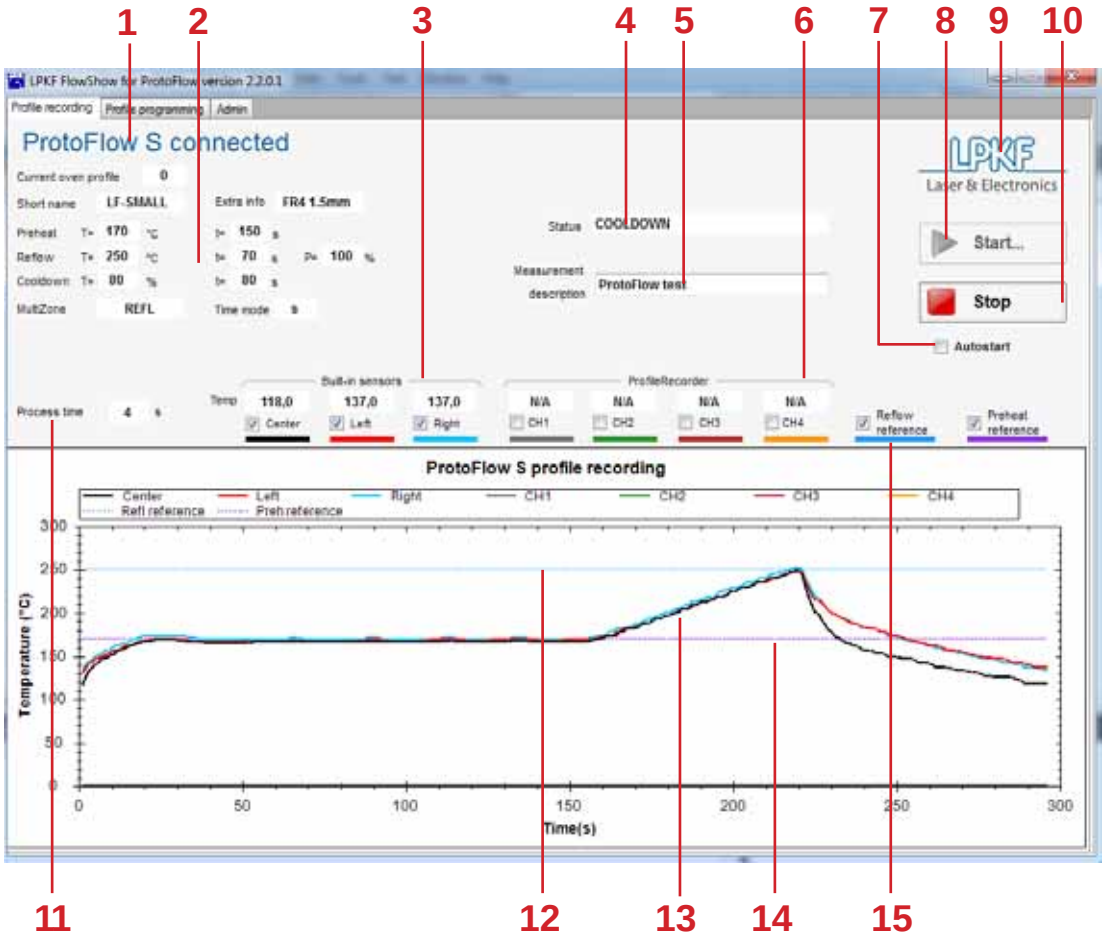
To install Framework from the CD runthe dotNetFx40_Full_x86_x64.exe file, located in the Framework folder.




WhenFrameworkissuccessfullyinstalled, run the Setup.exe again andinstalling of the FlowShowSE software continues and finishes automatically.

### 7.4.5 Tab 1 - Profile recording (licence required)

Profilerecordingisascreenwheretheentirecurrentprocessintheovencanbefollowed. The current profile setting, current status of the oven, start and stop of the recording, following temperaturesofbuilt-inandadditionalsensors,displayingprofileinthegraphandexportingthe data recorded can be seen on this screen.




| | | | |
|---|---|---|---|
| 1 | Device connection status | 2 | Current profile parameters |
| 3 | Built-in sensor temperatures | 4 | Oven status messages |
| 5 | Description of current measurment (used in chart export) | 6 | Temperatures of additional freely mounted sensors - Profile recorder (option) (N/A whenProfilerecorderisnot available) |
| 7 | Checkboxforautomaticstartoftheoven or recording | 8 | Start profile recording and oven |
| 9 | LPKF home page(click to open) | 10 | Stop profile recording |
| 11 | Remaining time until the end of the current phase | 12 | Reflow temperature reference |
| 13 | Real-time oven temperatures | 14 | Preheat temperature reference |
| 15 | Hide/show check box | | |

| No. | Description |
|---|---|
| 1 | Connected; oven is successfully connected with PC<br>Not connected;<br>- oven is not switched ON<br>- USB cable is not connected to oven/PC<br>- USB driver on the PC is not correct |
| 2 | Profileparametersfromtheoven.Whentheovenisconnected,thecurrentovenprofile parameters are automatically downloaded |
| 3 | Display of the current temperatures of the built-in sensors.<br>ProtoFlow E shows only one sensor - CENTER |
| 4 | Different status messages are shown:<br>- WARMUP,PREHEAT,STEP1,STEP2,REFLOW,COOLDOWN,RECORDING FINISHED,STARTTHEOVEN'SPROFILEORENABLE AUTOSTARTFIRST;oven profile phases and recording status<br>- Warnings related to device connection |
| 5 | Free entry text. Default text is "ProtoFlow test". |
| 6 | DisplayofthecurrenttemperaturesatfreelymountedadditionalsensorsfromProfile recorder (option).<br>N/Ameans that the oven is not equipped with a Profile recorder<br>*This function is not available forProtoFlow E!!!* |
| 7 | CheckthetheboxtostarttheovenautomaticallybypressingtheSTARTbuttonorstartthe profile recording automatically when the process is started on the oven.<br>This function requires registration (see chapter Registration) |
| 8 | ManualStartofprofilerecordingandautomaticstartoftheovenifAutostartboxis selected. |
| 9 | Link to the LPKF web site |
| 10 | Manual Stop of the profile recording<br>*This function does not stop the oven's current profile, it has to be stopped manually.* |
| 11 | Remaining time until the end of the current phase |
| 12 | Reference line of the Reflow temperature |
| 13 | Real time temperature chart of selected sensors.<br>Separate lines can be hidden/shown. |
| 14 | Reference line of the Preheat temperature |
| 15 | Check box to show/hide the display of reference lines |

SelecttheboxtostarttheovenautomaticallybypressingtheSTARTbutton,orstarttherecording automatically when the process is started on the oven.

This function requires registration (see chapter Registration)

### START

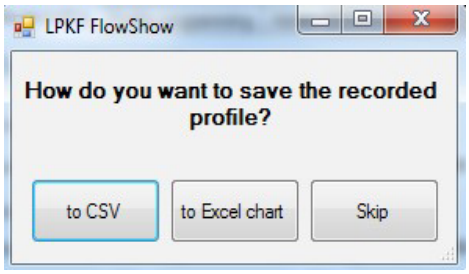
Tostarttheprofilerecording,firststarttheprocessontheovenandpresstheStartbuttonin FlowShow SE.

Optionally, When FlowShow SE has been registered,Autostart of recording can be enabled.

## STOP

Recordingcan be stopped automatically when the cooldown phase is finished, or stop it manually by pressing the Stop button.

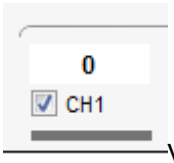
After stop, FlowShow SE offers to save the recorded data: export it to CSV, draw an Excel chart or skip exporting. When recording is not stopped manually, the export option is offered at the end of the recording.



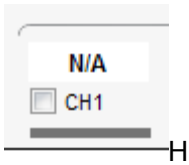

PressingtheStopbuttondoesn'tstoptheprocessontheoven.Ithastobestopped manually on the oven.

## CHART VIEW

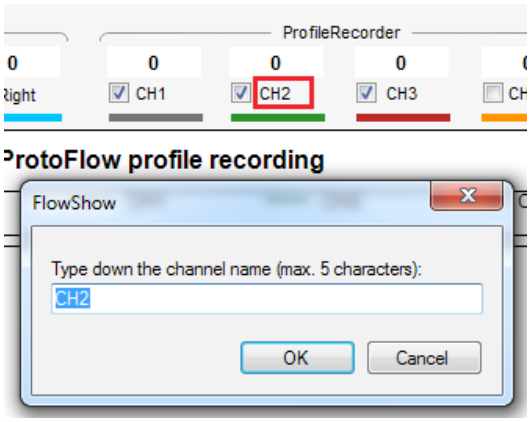
Adifferentviewofthechartispossible.Toswitchon/offthedisplayofseparatesensorsand reference temperatures, alternation of the check boxes beside the names is required.




Visible




Hidden



Changingthedisplayornamesofthesensorsisonlypossibleattheactivesensors. N/Ameans "sensor – Profile recorder not available".
ProtoFlow E shows one sensor – CENTER only.

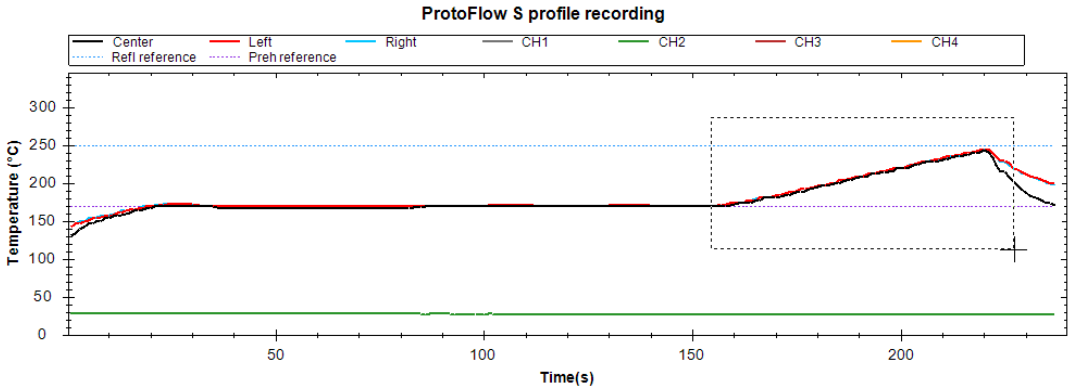
## CHART HANDLING

Whenaprofilehasbeenrecorded,thechartcanbewindow-zoomed,exportedasCSV,XLS chart, BMPimage, or printed.The special functions are available by right-clicking the mouse.

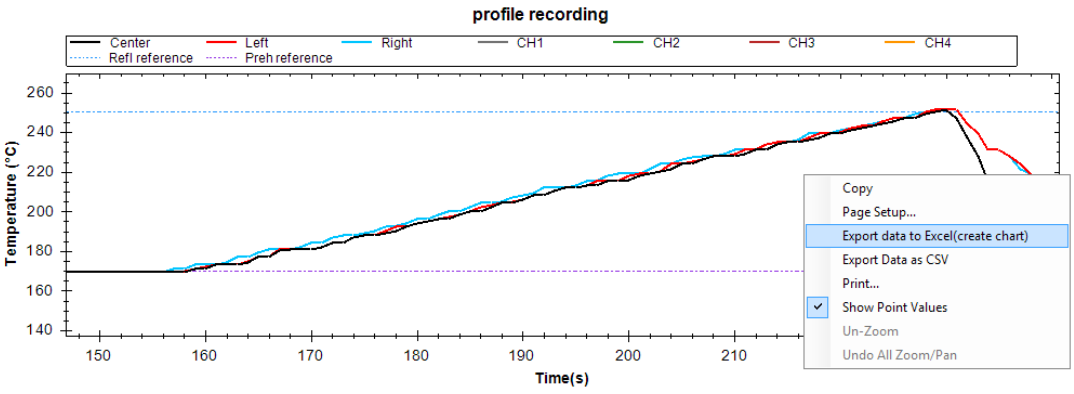
## ZOOM

For detailed checking and reviewing of the graph, a zoom function is available.

- Tozoomin:Clickanddragthemouseoverthelayoutinordertodefinethepartofchartto be zoomed.



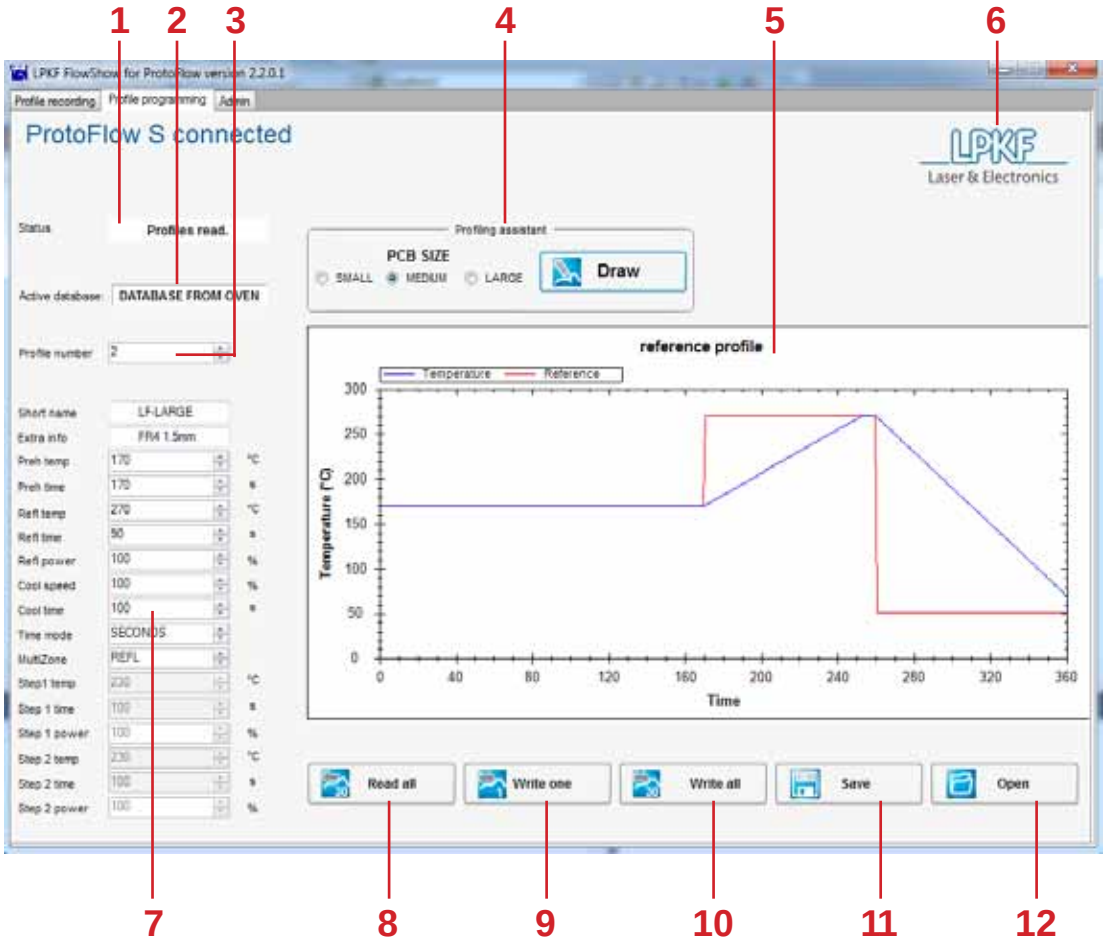

- To zoom out (1 level); click the right mouse button, select the "Zoom-out".
- To fit chart (overview); click the right mouse button, select the "Set zoom to fit chart".




Aright mouse button click on the graph provides other functions as well:

- Copy the graph to clipboard
- Page setup
- Export data to Excel chart
- Export data as CSV
- Print
- Show point values

## Tab 2 - Profile programming (licence required)




| | | | |
|---|---|---|---|
| 1 | Oven status messages | 2 | Nameofthelatestread/loadeddatabase |
| 3 | ProfilenumberfromOvenprofilenumber | 4 | Profiling assistant |
| 5 | Theoretical profile created from parameters entered | 6 | LPKF home page |
| 7 | Profile parameters | 8 | Read entire database from oven |
| 9 | Write selected profile to oven | 10 | Write entire database to oven |
| 11 | Save current read/loaded database | 12 | Open saved database |

| No. | Description |
|---|---|
| 1 | The current status of the oven is shown. |
| 2 | The name of latest read/loaded database is shown. Possible status: database from oven, database from disk... |
| 3 | Thenumberofovenprofileparametersthatcanbeshownandmodifiedinprofile parameters table.The number of profile can be selected by scrolling the menu. Amaximum 30 profiles can be stored in the oven database. |
| 4 | Profilingassistantisausefultoolforoptimizingprofileparameters(seeexplanation below) |
| 5 | A theoreticalprofilecreatedfromtheprofileparametersentered(reference)andtemp/ time profile expected (temperature) in the oven regarding the ramp rate. |
| 6 | Automatic connection to the LPKF web site |
| 7 | Profile parameters, which can be modified.The set parameters are shown as reference inthe“referenceprofile”chart.Adjustingofparametersisnecessarytoobtainthecorrect profile (see explanation bellow). |
| 8 | All 30 profiles can be transferred from the currently connected ProtoFlow S/E. The current oven profile is also updated in the Profile recording tab. |
| 9 | Write the currently shown profile in the database to the selected profile in the oven. The profile will be set as the current profile of the oven. |
| 10 | All 30 profiles in the selected database can be written back to the oven. |
| 11 | Save all 30 database profiles to a selected file location on computer (.fsp extension). |
| 12 | Open the database from the selected location in the computer (.fsp extension). |

## PROFILING ASSISTANT

Profiling assistant is a useful tool for profile parameter optimization, before the profile is sent to the oven and tested.

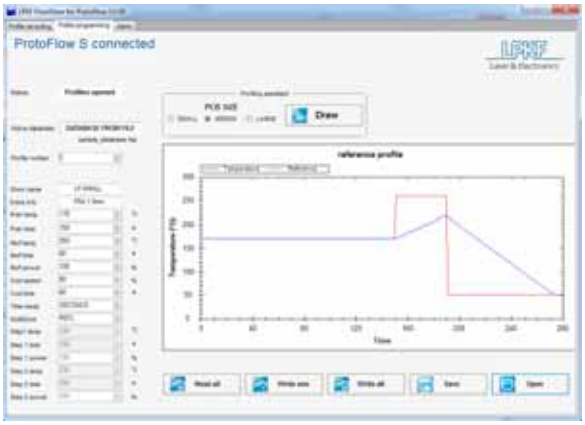
TouseProfilingassistantselectthePCBsizewhichismostfrequentlylinkedwithyourPCBand press the DRAW button.

ToselecttheadequatePCBsize,movethemousecursortoaname,SMALL,NORMALor LARGE, to obtain more information of the PCB size.

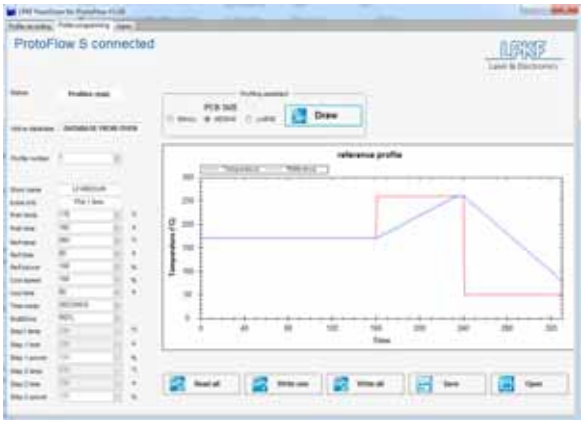
Profileassistantcalculatesthesetparametersandovenspecificramprate. Thecalculation,a theoreticalprofileforselectedPCB,isshowninthechartas“temperature”.Calculationusesthe default ramp rate.

Result of the calculation can be seen on the next page.

To make profile calculations more accurate, ramp optimization can be achieved by using the specificramprateoftheconnectedoven. Toobtainthisramp,theovencanbeoptimized. The OptimzefunctionisavailableintheAdmintab.Youcanfindmoredetailsinchapter7.4.7“Tab 3 –Admin, Optimize description”.




WrongsetReflowtime;timeis60s-tooshort




CorrectsetReflowtime;timeis90s-excellent

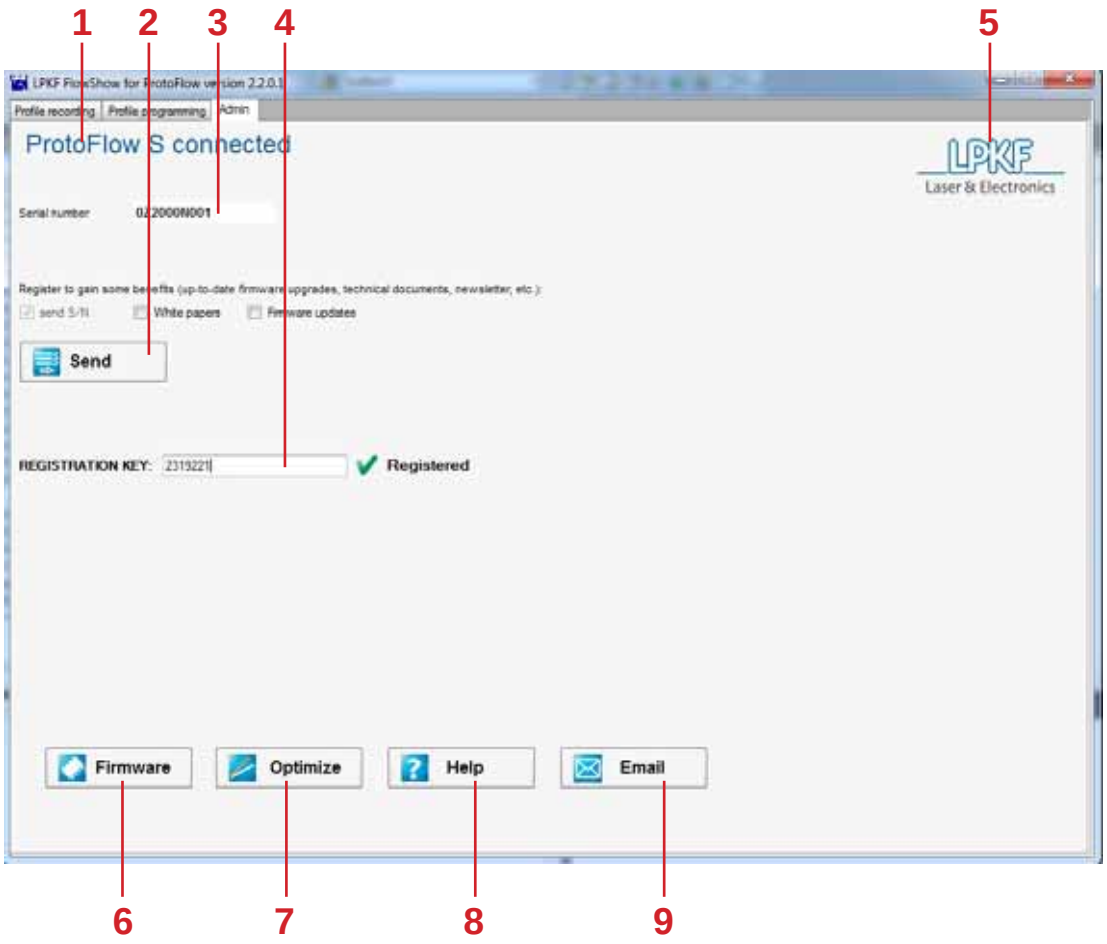
## PROFILE PARAMETERS

Profile parameters can be inserted/modified with the same restrictions as on the oven, and mustbeidentical. AllparametersexceptShortnameandExtrainfocanbemodifiedbyusing thescrollmenu,orcanbewritten.Thesetparametersareshowninthe“referenceprofile”chart as “reference”.

## PROGRAMMING PROCEDURE

- Read all profiles from the oven (press the “Read all” button)
- Adjustthecurrentandallotherprofileparameters,ifnecessary(useProfilingassistantfor help)
- Write the profile (profiles) to the oven and/or computer database.

## Tab 3 - Admin




| | | | |
|---|---|---|---|
| 1 | Device connection status | 2 | Sendserialnumberofovenandother details to LPKF for registration |
| 3 | Serial number of currently connected oven | 4 | Registration key field |
| 5 | LPKF home page | 6 | Upload firmware to oven |
| 7 | Optimizereflowramp-uprate(requires registration) | 8 | Open user manual |
| 9 | Send email to LPKF support | | |

| No. | Description |
|---|---|
| 1 | The current status of the oven is shown. |
| 2 | Default email client creates a new email which contains the registration data. Theregistrationfieldallowstheusertosendtheregistrationrequestbyemail.They canselectoptionstheyshouldreceiveafterregistration. Theserialnumberandsender e-mail are generated automatically. |
| 3 | The serial number of the currently connected oven. |
| 4 | The registration key field allows insertion of the registration key, which is sent to the senderbyLPKF. Theregistrationkeybringssomeadditionalbenefits.(formoredetails see the Registration paragraph) |
| 5 | Automatic connection to the LPKF web site |
| 6 | The button allows the user to upgrade the firmware on the oven. |
| 7 | OPTIMIZEbuttonsautomaticallystarttheLF-SMALL ovenprofileandmeasurethe rampsinthereflowphase. Themeasureddataisusedtocalculaterampsin PROFILE ASSISTANTchart drawing. |
| 8 | The HELPbutton opens the User manual in pdf format.APDF reader is required. |
| 9 | Send email to LPKF support team |

## REGISTRATION &LICENCE

### Registration

Free registration brings some benefits, like whitepapers and firmware updates. To

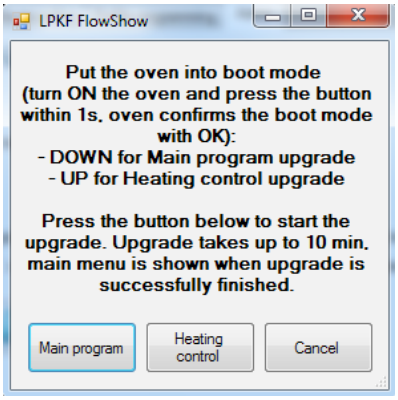
register follow these steps:

- connect the oven
- wait until the serial number has been read
- select check the desired options (whitepapers, firmware and program updates)
- press SEND
- Fill the registration form (all fields are required


The default email client creates a new email containing the registration data.

## FIRMWARE UPDATE

Firmware updating will bring improvements or new features into the oven. To update follow this procedure:




To upgrade oven firmware:

- press the Firmware button
- turn ON the oven
- press the desired button on the oven within 1s to enter the boot mode

  ⇩DOWN for Main program upgrade

  ⇧UPfor Heating control upgrade

- Clicktherightfirmwareupgradebuttonandselectthe.HEXfiletobeupgraded(i.e. ProtoFlowE_Main program V2.0.hex).

FlowShow SE and ProtoFlow S/E cannot be used during this time.
Firmware upgrade takes up to 10 minutes.
Do not cancel the procedure.

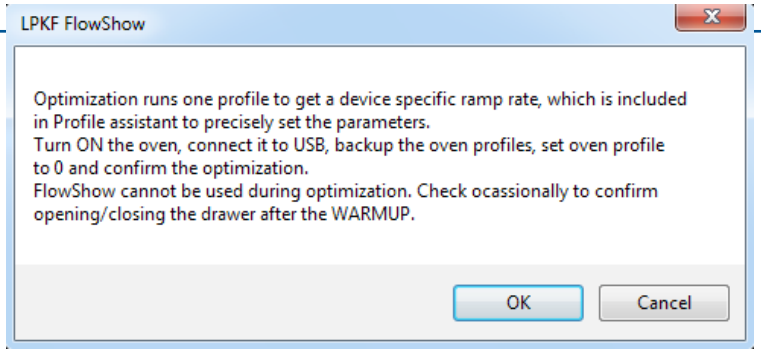
## OPTIMIZE

This function requires licence.

Optimization runs one profile to measure a specific ramp-up rate on the connected oven. Profileassistantincludesthemeasuredramp-upratewhencalculatingprofilesandhelpsyouto precisely set profile parameters.

To start optimization:

- turn ON the oven
- connect it to the PC via USB
- backup the oven profiles, use tab “Profile programming”
- open the “Admin” tab
- press the “Optimze” button
- read the instructions carefully




The oven profile must be backed up before this operation.

Confirm optimization and wait for the profile to be completed. The "Optimization in progress. Please wait" window is flashing


Checkoccasionallytoconfirmopening/closingofthedrawerafterthewarmup phase.

Other FlowShow SE functions cannot be used during optimization

## HELP

The FlowShow SE program is supported by help files. Help files bring you:

- Opening of user manuals
- "How to" documents
- DifferentwhitepaperswithnewinformationaboutFlowShowSE,processes,ovens,other devices.

Clickthebuttontoopenthedefaultfolderwiththeusermanual,whitepapers,andselectthe appropriate manual.

To open the document, a PDF Reader is required.

## EMAIL

Foranycomplains,problems,questions,suggestions,anemailinthedefaultemailclientcanbe created.The LPKF Slovenia support team will be automatically contacted.

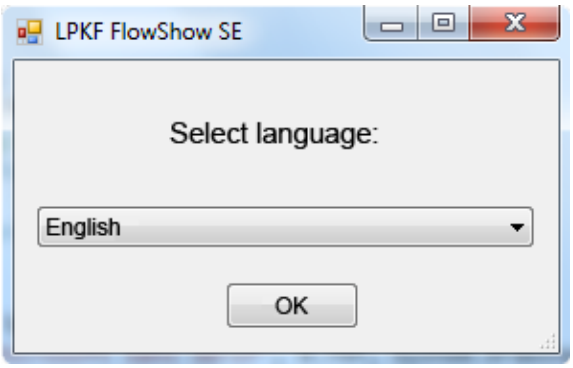
## LANGUAGE

Program FlowShow SE is a multilingual program.

The language can be selected at the first start of the FlowShow SE program after the installation.

From the dropdown menu select the preferred language for the program.

Default language is English.

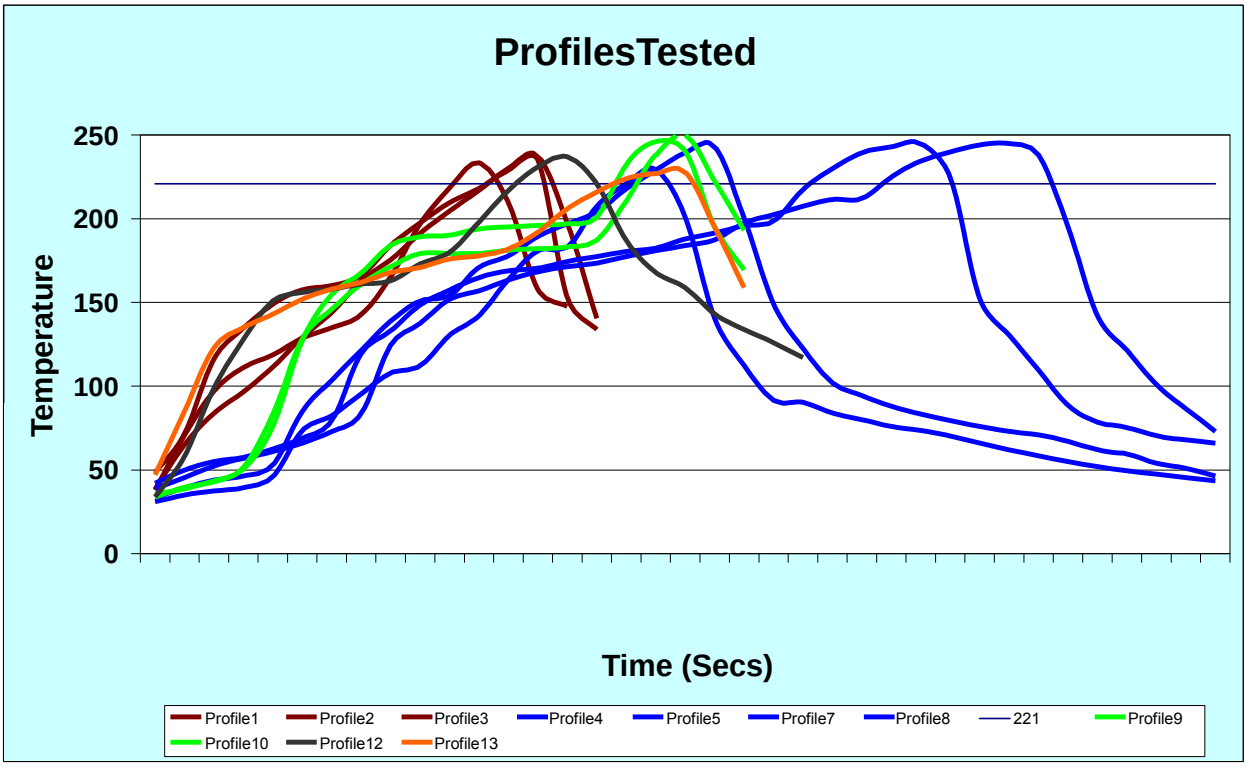


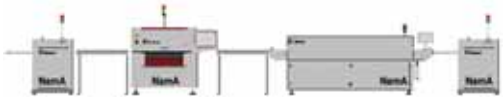

Language selection is available only at the firststart of the program. If you would like to change it later, the program has to be uninstalled and installed back again.

In TAB 1 – profilerecording, the section “Current profileparameters” is not translated as names of parameters are connected with oven’s Firmware.

Cookson Electronics ASSEMBLY MATERIALS

**Figure #1 –ReflowEnvelope**





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