SUN SIMULATOR III

PRODUCTION PROGRAM V 5.01

OPERATING MANUAL

Contents :

1. Introduction :

This production program is destined to be used in conjunction with Pasan Sun Simulator III b/c equipment. It is designed to incorporate all features necesssited by modern manufacturing, namely :

- Measurement of modules incorporating serial diodes
- Advanced sorting parameters
- Serial number managing
- Computer log file
- Printed log file
- Label printing
- Excel files(licensed excel required)

It is running on modern MS-Windows XP operating system. Stored files may be accessed from distant computers through LAN or stored on servers for archiving.

New function:

- Tube management
- Reference panels parameters
- Display power curve
- Temperature panel and reference cell manage separately
- Export &Print file using in template(licensed word required)

2. Installation

If files are delivered through the Internet, first copy the self-decompressing SS3P.EXE file in a temporary directory on your hard disk. Then double-click on it to start decompression process. For convenience, choose the same temporary directory for this decompression.

You will now be fitted with a "setup.exe" file. Double-click on it to start the installation process. You will obtain the first installation screen as follows :
Now choose the installation directory. By default, it will be :
C:\program files\ss3p\

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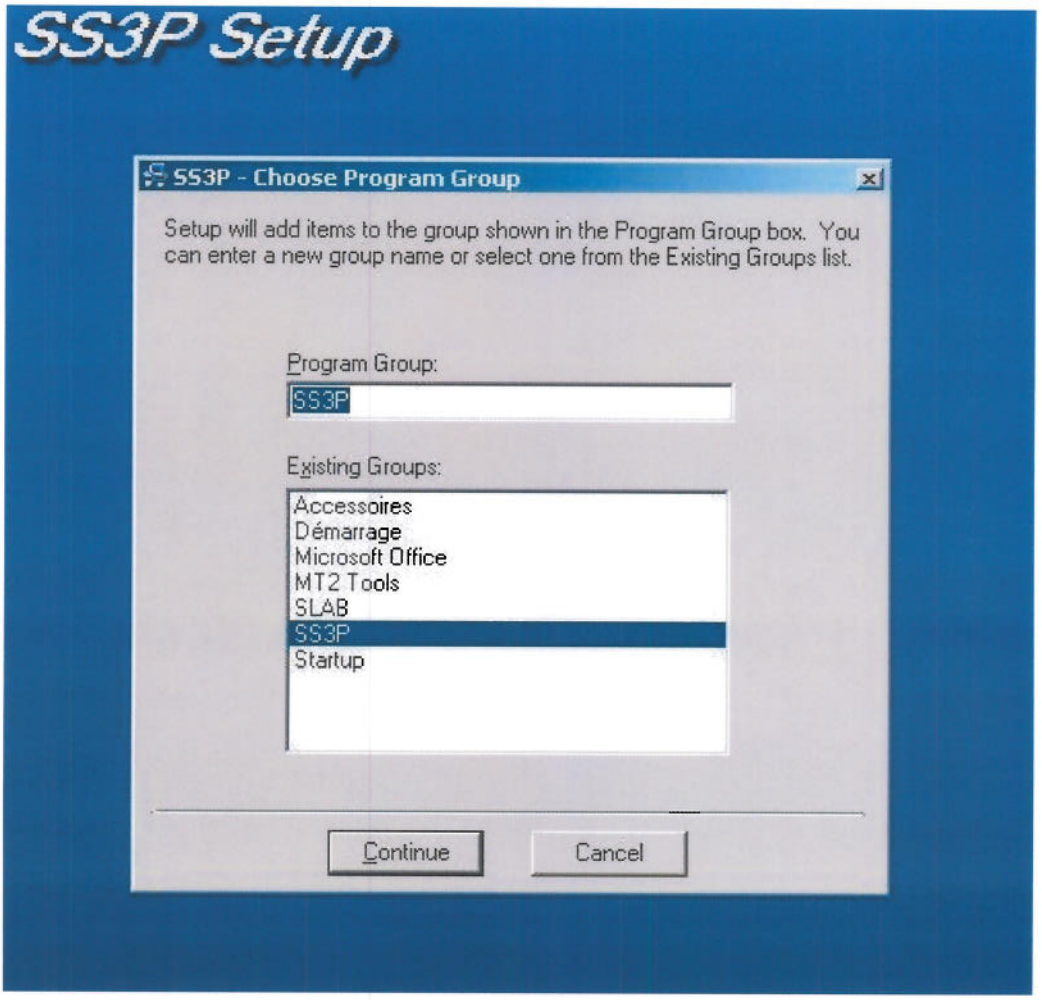
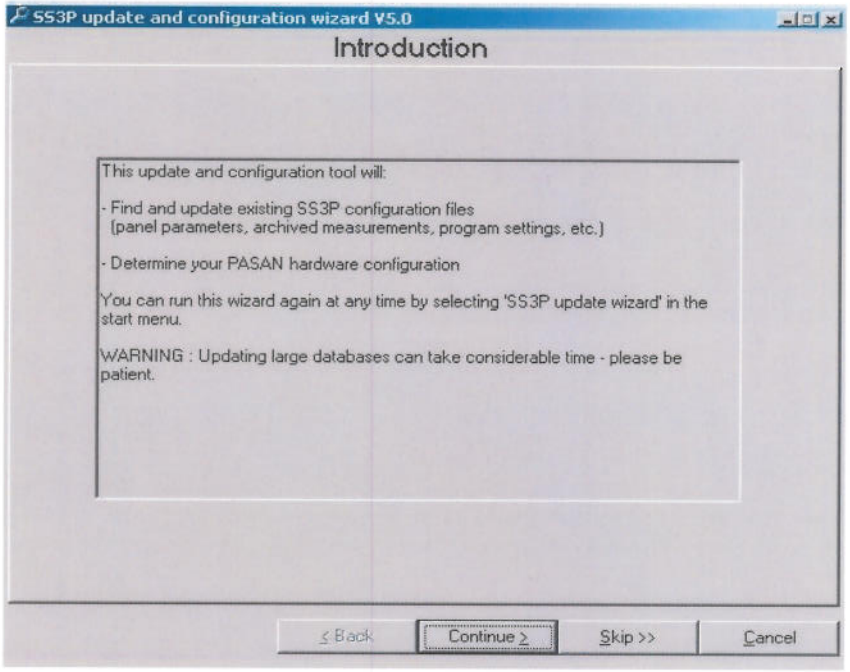
C:\program files\ss3p\

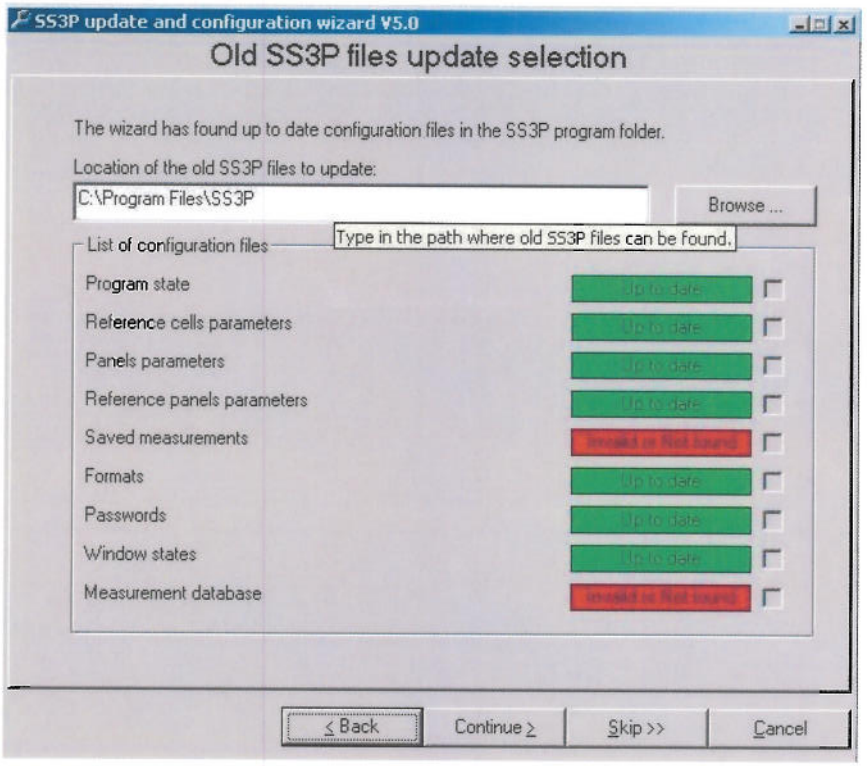


When the installation is successful, you should obtain this message

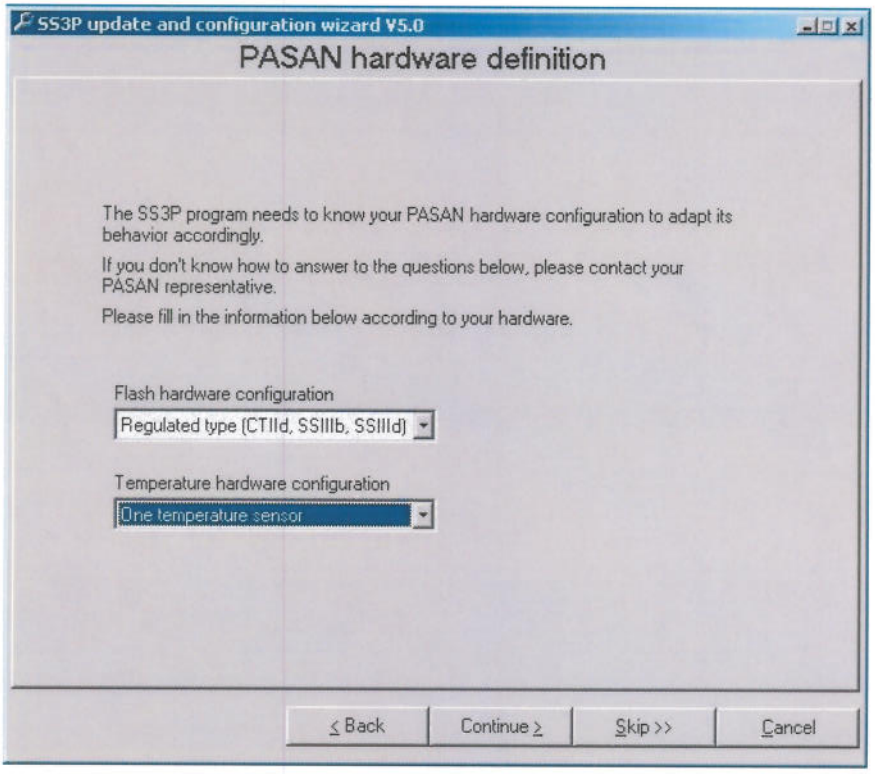
When install is completed, launch SS3P.EXE, for first starting, there is a wizard coming.



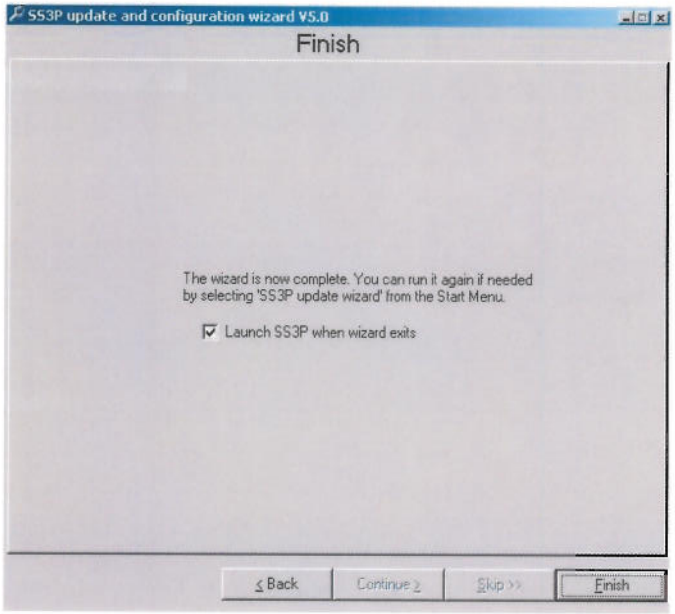
Click on continue, and you obtain another frame, where you can update your old ss3p files from an old version. You can select the data that you want update.



When you have finish to update your data, click on continue and you obtain a frame to select the right devices that you have.

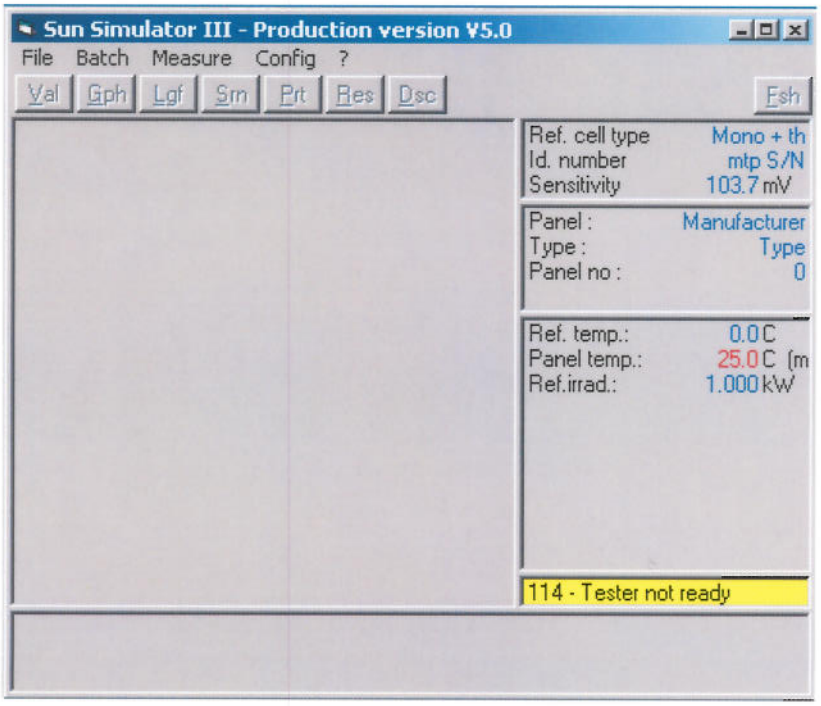


When you have finish to choice your hardware, click on continue and you have finish the installation and you can click on finish.



Follows the installation process. If any, always accept to keep the newest versions of files if an alternative is proposed. When finished, it is a good policy to restart your computer before starting to use the new program. You can now conserve or delete the installation files on temporary directory at your convenience.

Now start the new program by clicking on Start - Programs - SS3P . (For convenience, you can make a shortcut to the program to be placed on desktop). The first screen looks as follows :
Now click on "Config" "Panels" "New" and then put in the password "PASAN". You will obtain a menu you have to fill in order to give proper measurement instructions to the Sun Simulator load. The main tips are as follows :

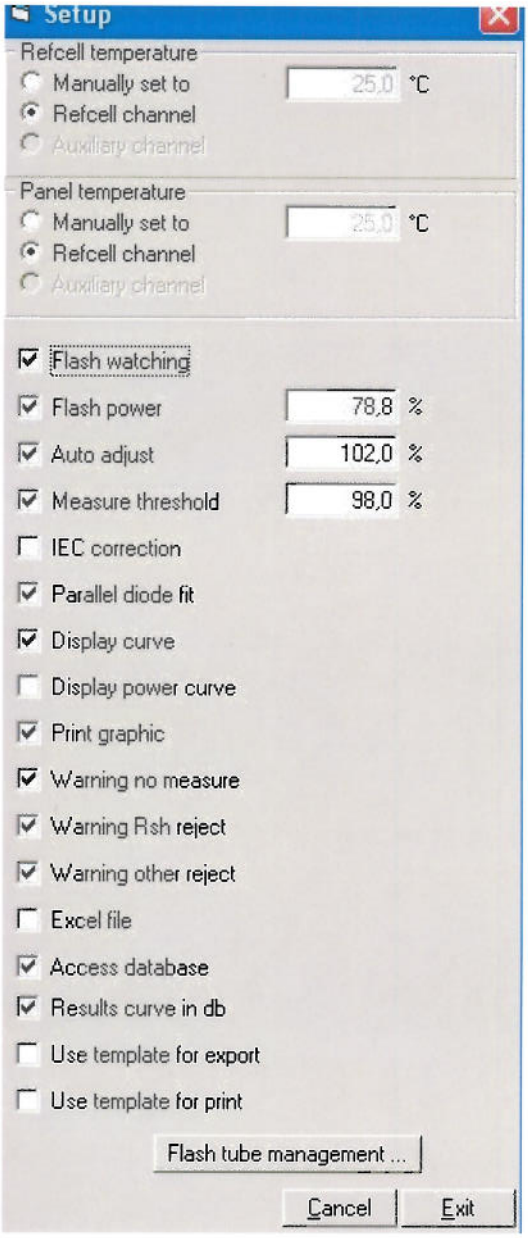


3. Setup and parameters introduction

To perform a measurement first ensure that Sun Simulator and flash Generator are powered and drive cable is properly installed. Then pull down "Config" menu and choose "Setup". You will have the choice of many topics discussed below

3.1.1 Refcell Temperature:

You can choose different way to manage the reference cell temperature:



- *Manually set to XX.X°C:*
  Choose this option if you haven't any temperature probe installed. You have to enter the actual temperature on field at right. Of course this temperature will never change until you change it manually again! Note that this value is used to correct the temperature ONLY for reference cell and don't influence the panel temperature.
- *Refcell channel :*
  Choose this option, if your reference cell has a temperature probe installed. Like that, the software use directly the actual temperature actualized by the reference cell probe. (Recommend)
- *Auxiliary channel :*
  If you have an external tempera ture probe installed.

3.1.2 Panel temperature

You can choose different way to manage the panel temperature:

- *Manually set to XX.X°C:*
  Choose this option if you haven't any temperature probe installed. You have to enter the actual temperature on field at right. Of course this temperature will never change until you change it manually again! Note that this value is used to correct the temperature ONLY for panel and don't influence the reference cell temperature.
- *Refcell channel :*
  Choose this option, if your reference cell has a temperature probe installed. Like that, the software use directly the actual temperature

- *Auxiliary channel :*
  If you have an external temperature probe installed. For that, you need an extra board on BV66 (E-Load). This option is more accuracy because you use an IR or PT1000 temperature probe allowing software to correct the values displayed with the real temperature from panel (recommend for more accuracy)

3.1.3 Flash watching :

Tick this option if you have a remote-controlled flash unit. In that case program performs full control of flash. Do not tick if you have a completely independent flash unit.

3.1.4 Flash power :

Used only to control power on remote flash. Power is defined in percent of maximum loading voltage on flash capacitors. (1500 V at 100%) and further allows to maintain desired irradiance during the flash pulse with a light stability +/-1%.

3.1.5. Auto adjust

Tick this case if you want that program automatically controls flash power. Fill the next field with desired maximum irradiance level in percent. Remember that this percent applies to defined module irradiance in panel parameters section. Usually it has to be set 2 % above desired irradiance for class A simulators, for example introduce 102 %. **Don't tick never this case.**

3.1.6 Measure threshold:

This defines the level of irradiance at which Sun Simulator starts measurement. If this level is not reached then no measurement starts and no data are available after flashing. So it is a good policy to start with a relatively low value, let say 80 % and further adjust to reach desired performance.

3.1.7 IEC correction:

Tick if you want corrections made according to IEC model. If not ticked, corrections will be made only on measured current and proportionnal to measured irradiance.

3.1.8 Parallel diode fit:

Tick this case if you have a revert diode at the output of your panel, this option will clip the current peak at the start of measurement.

3.1.9 Display curve:

Tick this case if you want to have a curve displayed on screen after measurement.

3.1.10 Display power curve:

Choose this option, if you want to have "power" curve displayed on screen after measurements(green curve on I-V curve)

3.1.11 Print graphic:

Tick this box if you want the curve to be printed along with data.

3.1.12 Warning no measure:

Tick if you need alarm when no measurement is made (Isc and/or Voc not reached or irradiance lower than minimum).

3.1.13 Warning Rsh reject:

Will display a message box if the resistance shunt is defect. When working in automatic sorting,

3.1.14 Warning other reject:

Will display a message box if the reject is different that over reject.

3.1.15 Excel file:

Tick this case if you want to export the result of measure on a microsoft excel file.

3.1.16 Access database:

Tick this case if you want to export the result of measure on a microsoft access file.

3.1.17 Results curve in db:

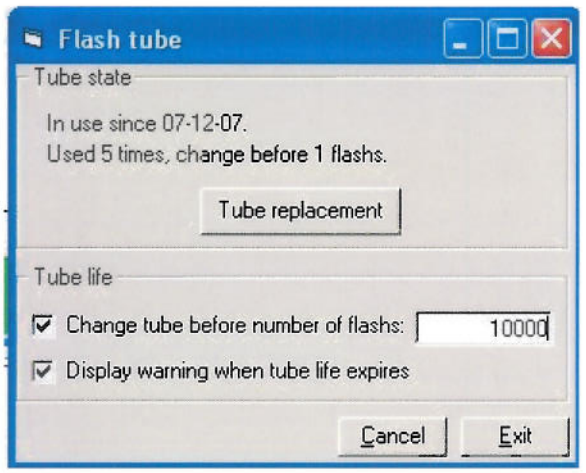
Tick this case if you want to export the V/I curve on a microsoft access file.

3.1.18 Use template for export:

Choose this option, if you want to modify the export file. If you want add more parameters, move graphic, remove parameters. For more information check the section "USE TEMPLATE FILES". (Word licensed request)

3.1.19 Use template for print:

Choose this option, if you want to modify the print file. If you want add more parameters, move graphic, remove parameters. For more information check the section "USE TEMPLATE FILES". (Word licensed request)

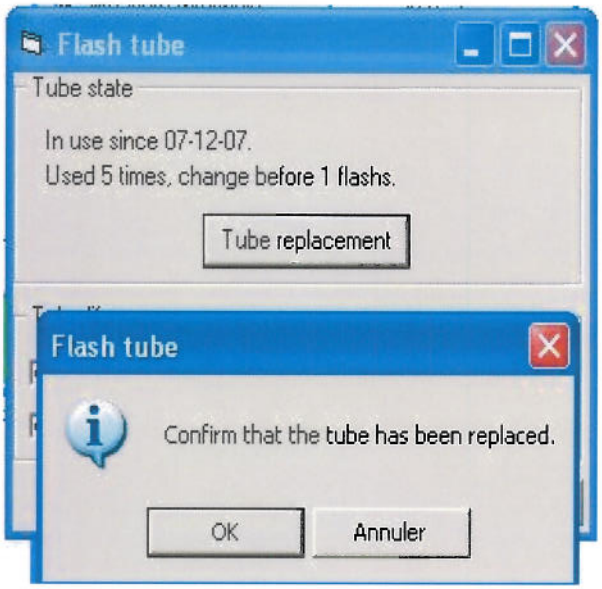


3.1.20 Flash tube management:

Click on "Flash tube management" in setup menu. Then, you obtain this window. You have two parts:

- *Tube state :*
  This part gives some information about the actual tube flash.
- *Tube life :*
  Use this part to know when you

When the pop-up is display check the number of flash already did.
Config -> Setup -> Flash tube management -> “Tube state” part (used X times). If you exceed the maximum number of flash, change the flash tubes. When you replaced the old by new flash tube go to config -> setup -> Flash tube management and then click on “tube replacement” after that the counter and date are actualized.



3.2. Modules parameters :

Before starting any measurement you have to define module and ref.cell parameters, as well as general setting of Sun Simulator. For this purpose first call modules parameters menu pull down "Config" menu. On window, click on "New" to define a new type of modules to be measured. Then file the desired fields. To perform measurement it is necessary to define all module parameters as these values are used to calculate cell and module efficiency. It is also necessary to define absolute max voltage and absolute max current to values about 20 % higher than those expected, as these values are used to choose proper scales and voltage sweep during measurement. Improper definition generally gives "No Isc" or "No Voc" error messages after measurement.

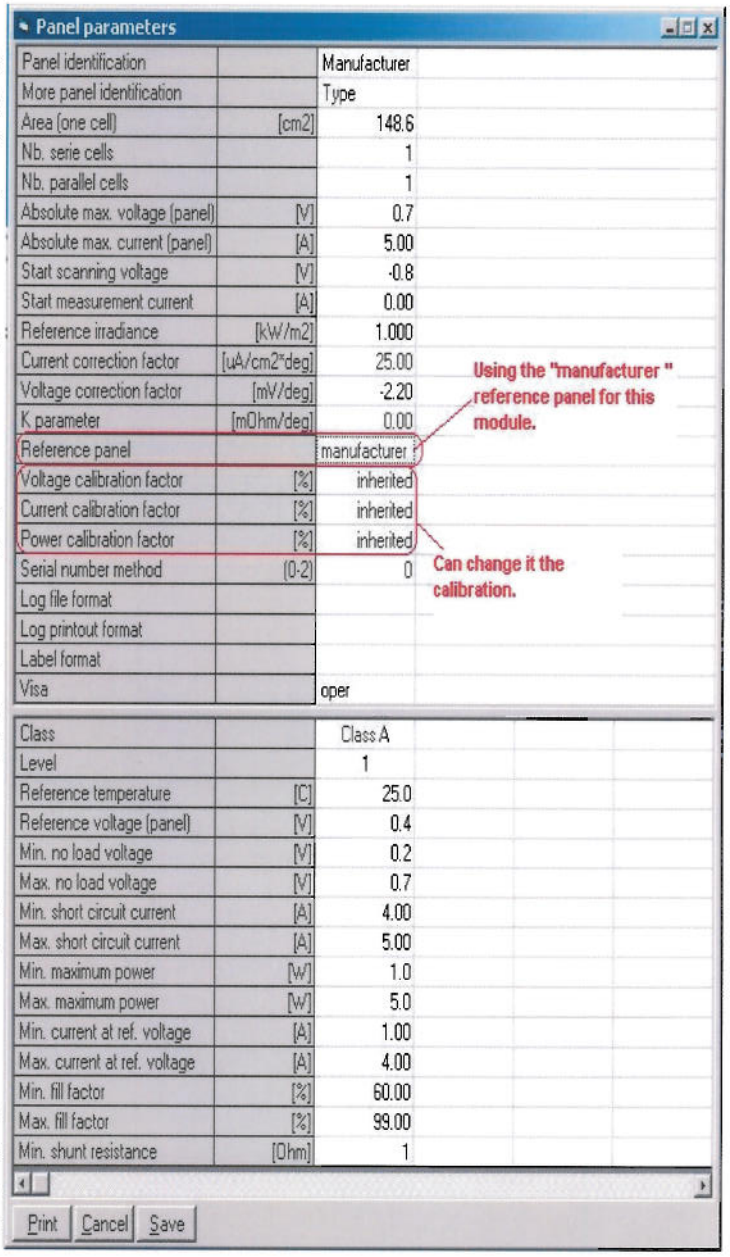
Start scanning voltage:
It's used to compensate the drop voltage from chuck, wire resistances, solders for connection between cells, etc...

Reference irradiance:
Change the light intensity range 0.7kw/m2 to 1.2kw/m2

Correction factor:
Calculate the value alpha, beta and kappa for your own production cells.
Standard value for Si cell:
These factors allow correcting the results according to temperature variation during the day.

Reference panel:
Double click on this space and then choose your golden panel parameters.

Calibration factors:
You don't need to enter these factors, if you use reference panel. It's allows adjusting the simulator according to your golden panel.



Serial number method" is as follows : "0" means no serial number; "1" means that serial number has to be introduced once; "2" means that serial number has to be introduced twice. This can be done using a barcode scanner connected in parallel with keyboard.

Now you can to introduce the log, printout and label formats. By double-clicking in corresponding case you can choose between existing models. A blank case means that you dont use the corresponding function. Ports and parameters for log printout and label printout have to be defined in "SS3P.LBL" file. See end of this manual for details.

on lower part of the module window, there is the sorting section. In this section all measured parameters can be used to perform sorting, as well as different reference temperatures. Sorting parameters are organized in columns as follows :

- First line is the label to be displayed if the set of parameters below are fullfilled.

- Second line is the sorting class for modules. It shall be a number between 1 and 12. It will be this number that is displayed on LEDS on front plate of electronic load. If two successives colums have the same number, that means the two parameters sets have to be fullfilled in order to have this class displayed. Note that only the first occurence of top label will be displayed on main screen when a class is fullfilled. The following occurences are for reference only.

LED 13 ON : Warning other reject no Voc or no Isc error
LED 14 ON : Warning Shunt resistance defect
LED 15 ON : Warning no measure No irradiance error

- You have to fill all cases in a column. If you dont want to sort against a particular parameter, simply type sufficiently low and high values for this parameter so it will never influence the sorting results. For example, if you dont want to sort against short circuit current for a module having a typical 3 amps short-circuit current, type “0” for minimum and “100 A” for maximum; you will be sure that this parameter will not influence your results.

- If you have to disable a particular column, simply type “0” in the sorting class case and this column will be disabled.

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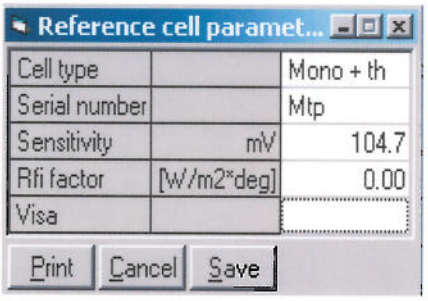
An example of filling is displayed below. In this example, to obtain “Class A1”, displayed as “1” on diode display in front of electronic load, tested module has to fullfill two sets of conditions at 25 °C and 48 °C. If these conditions are not met, a second set of conditions is available as “Class A2”. If these last conditions are not fullfilled, the module will be rejected.

When filling is completed press "Save" on bottom of window to record this parameter set.

3.2. Ref. cell parameters :

Now you have to define Ref. Cell parameters. Pull down "Config" menu and choose "Ref. Cells". Then click on "New" and then put in password "PASAN" on bottom of window and introduce the desired parameters. Notice that Ref. Cell sensitivity is used to correct measurement from irradiance and "Rfi factor" gives correction of Ref. cell sensitivity according to temperature discrepancies between actual Ref. Cell temperature and calibration temperature. This last factor has to be determined by calibration laboratory. When finished, press on "Save" to store parameters and then press "Use" to activate your ref.cell.



4 Calibration procedure

When we deliver our Ref. Cells, we give a sensitivity value that comes from our own measurements, ensuring that the cell is properly working. Although the order of magnitude is correct, this value cannot be taken as an absolute verity, because we do not maintain in permanence a lot of calibrated cells and we are not certified as calibration laboratory.

Now, in order for you to have calibrated measurement, you will have to refer to values given by a calibration laboratory. This can be done either by calibrating the reference cell, or by using a calibrated module as a reference. Let consider the two options :

a).Calibrated Reference cell. If the Reference cell itself is calibrated, you will have a good mean to measure the intensity of light falling on it. So you can adjust the power of the flash generator to obtain exactly the desired irradiance. However, as the world is not perfect, this Ref. Cell has a spectral response. The flash light has a spectral distribution that do not match perfectly the sun, and finally the module you want to test may have a different spectral sensitivity than the reference cell. It is possible, if each of these parameters are finely known, to calculate the "Mismatch factor" describing the final difference. In addition, the irradiance measurement channel, the voltage measurement channel, the current measurement channel and finally the thermometer channel adds each an error. When measuring a module, you will have to add all these errors to the final result.

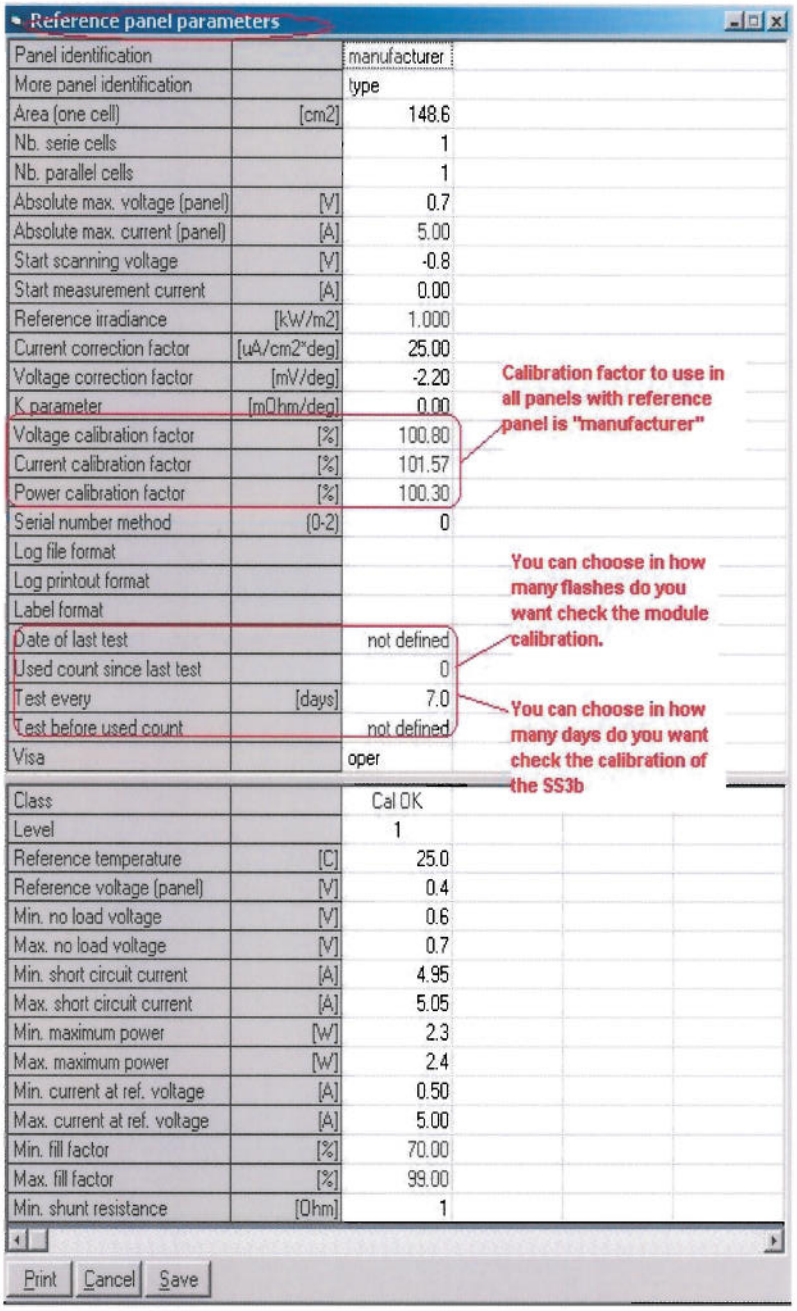
B. Calibrated reference module. If the module itself is calibrated by a reference laboratory, the procedure will consist in adjusting the flash and electronic load to obtain the same measurement than the one given by the reference laboratory. To do that, you will have to adjust the calibration factors (Called "Adjust factors" in our program) so you will obtain the same measurement than the one from reference laboratory. Doing this, you will cancel the spectral mismatch, as well as the measurement errors of each channel. So your results will be much more accurate and consistent.

In conclusion, we recommend using the reference module method. Of course, this method applies fully if the reference module is the same as the one you want to measure. If the reference module is significantly smaller or larger than the module you want to measure, or if the cell technology (= different spectral response) vary, you may introduce some additional error on one or another parameter, but the result is still more consistent than using Ref. Cell calibration.

- Install calibrated panel
- Measure Isc, Voc, and Pmax
- Change Isc, Voc and Pmax "adjust factors" until you obtain an accuracy <1%

4.1 Reference panel parameters

Same thing panel parameters but in this case you have to enter the right calibration factors. You can define when you want to check again the calibration either "X days" or according to "counter".



You should to do an iteration to obtain right calibration factor: You must always start by current and then voltage and to finish power, if it's necessary.

<u>Current calibration</u>

Icf_0: Actual Current calibration factor

Icf_1: New Current calibration factor

Isc_0: Short circuit current golden panel

Isc_1: Short circuit current measure

$$Icf_1 = (Isc_0 / Isc_1) \times Icf_0$$

<u>Voltage calibration</u>

Vcf_0: Actual Voltage calibration factor

Vcf_1: New Voltage calibration factor

Voc_0: Open circuit voltage golden panel

Voc_1: Open circuit voltage measure

$$Vcf_1 = (Voc_0 / Voc_1) \times Vcf_0$$

Power calibration

Pcf_0: Actual Power calibration factor
Pcf_1: New Power calibration factor
Mpp_0: Maximum power golden panel
Mpp_1: Maximum power measure

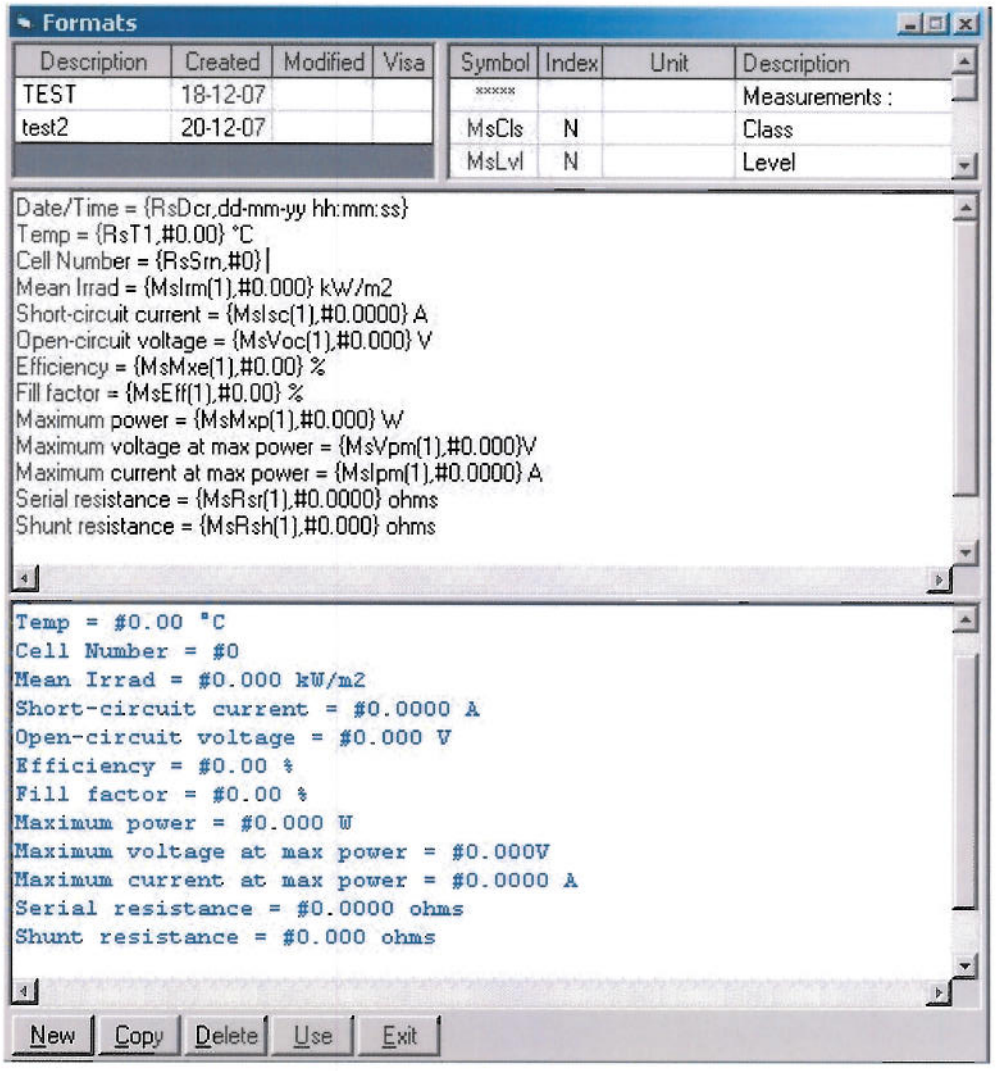
$Pcf_1 = (Mpp_0 / Mpp_1) \times Pcf_0$

The new factor must to be to insert in :
Config -> RefPanel parameters -> ... calibration factor

5 Auto saving data

5.1 Log files

Program is featured with a fully parametrable log file system. It is available through the "Formats" section of "Config" menu. Formats have to be defined by the user. Format may be different for log file stored into computer HD, for printed log and for printing of module stickers. To program these formats, pull "Formats" menu. On upper left window, you will have the available ones (perhaps blank at first start). Select "New" and fill the description and visa areas. On upper right window, you will be prompted of available parameters to introduce in the log file. Note that parameters without parenthesis are parameters unique to the measurement, while parameters with parenthesis are parameters refering to a class, maybe including values corrected to diverse temperatures. You may introduce text as you want, but parameters are to be written exactly, so the utility of upper right window.



When completed, click on "Use" and "Exit" to save the newly defined format. It is now ready to use for either computer or printed log files.

On the middle long window, write the log file format as you want. Note that on bottom long window, you will be prompted with an image of log file. If a parameter is not understood by the system, the lower text becomes red, giving an instant control of syntax. See annex 2 for formatting characters description.

To define a log file for label printing proceede of the same manner. You can introduce characters as spaces and carriage returns to position text on labels, but your character sizes are to be defined on printer level.

On the "Formats" cases, introducing of a predefined format name will give this format to be used for the predefined function. Introducing in the "Logfile format" will cause a "Logfile" to be generated using the predefined format; using the "printout" case willl cause a print to be sent either to LPT1 or COM1, and finally using the "Label" format will cause the corresponding information to be sent to the "Label printer" output maybe generating a label that can be attached to each cell.

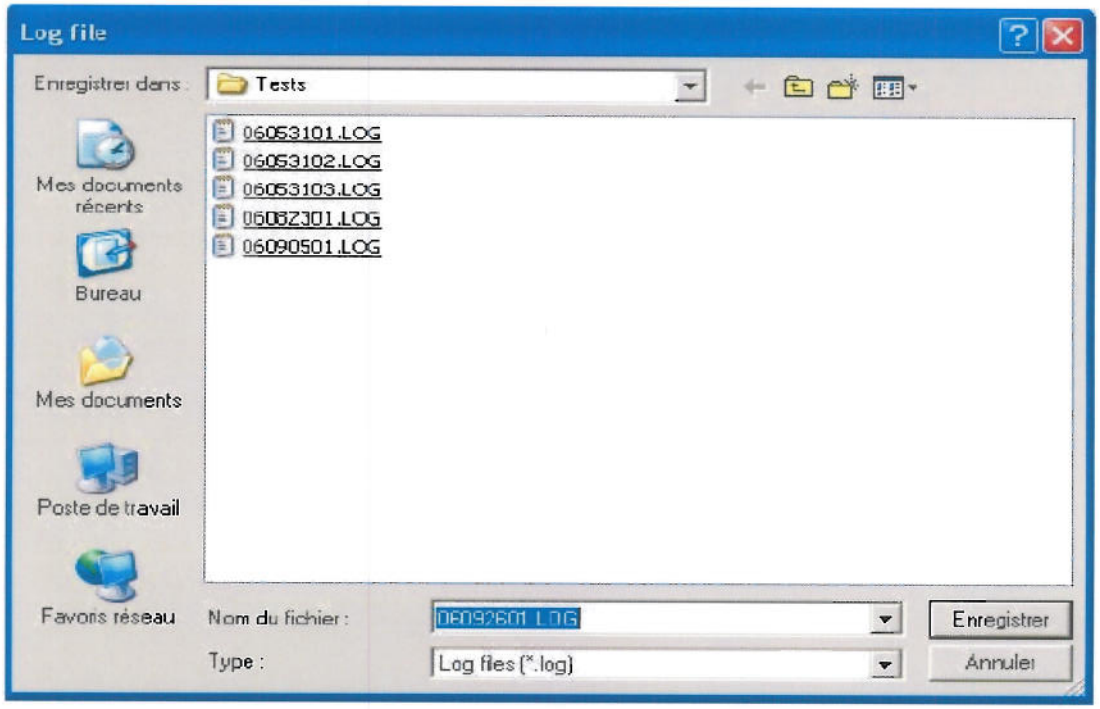
5.1.1 Logfile printout and label functions

To use these functions you must firste define a format in the "Config - Formats" menu. An example of a such format is available in the "format.txt" file joined to the present manual. This format will allow a series number, the Mpp value, the efficiency Class, the Voc, The Isc, the Series resistance and the Shunt resistance to be displayed. To test it, you may simply copy the format from the text file and paste it into the window.

When format is defined, save it by pressing "Exit" at the bottom of the window. It can be used in the "Cell" File. At start-up, the programm will ask for a new logfile name end location.

If selecting an existing name, the program will not erase the file, but will simply append the new measurements to the existing ones.

This windows looks as follows:



A special case is the use of a label printer as you have to introduce not only values to be displayed but equally the language of the printer. An example of this language is available on the "labelprint.txt" file joined. In that example, the printer will print the serial number, a set of values plus a barcode with the serial number that can be read using a barcode reader.

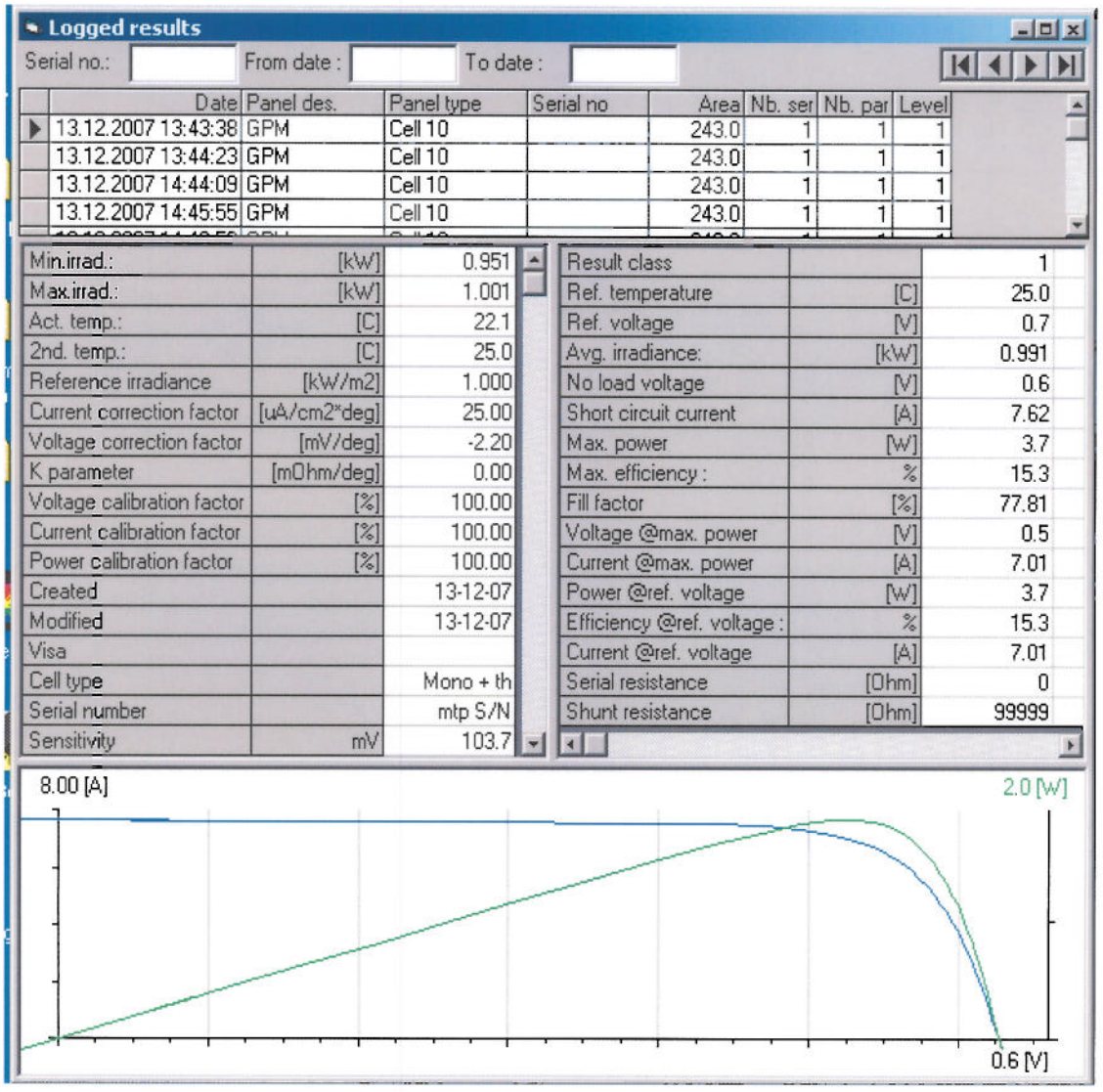
5.2 Excel files

Simply tick the "Excel file" in "Setup" menu. In order to work, this fonction necessitate to have a Microsoft Excel program installed on the computer. This program do not necessitate to be open. It should simply be installed. At start-up,

the Pasan program will ask for an Excel file name and location. When selected you can start working and it will simply put values in this Excel file. There is no mean to edit which values are stored, so we have put the most usual ones in the program. Once created, the file can be examinated through Excel or through the "Log-View Excel File" tabs. Please note that if opened through "View Excel File" menu, it shall to be closed the same way and not using the "Close" button of the Excel window. Doing this will cause programm to crash !!!!

5.3 Access database

To create an Access database, simply tick the corresponding box in the "Setup" menu. At start-up of the program, you will be promped for a name and location for this database. Examinating the content of the database is done through the "log-view database" menu. You will obtain a window as follows:



On that window, all records figuring in the active database can be displayed. It is also possible to choose certain records from date to date.

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6. Measurements.

6.1. Starting measurements.

After setup completed go to "Config" again and choose "Modules". Then choose the module you want to measure and click "Use" on bottom on window.

Next step is to choose Ref. Cell. Click on "Config", then choose "Ref. Cell", choose the Ref. Cell you want and click on "Use". Ensure it is really that cell physically connected !

You are then ready to start measurement. Verify module and ref. cell arrangement and connections and verify that flash is loaded ("Ready" indication on bottom left of main window). At first start, it may occur that flash starts in "alarm" mode. When this arrives, simply click on "Fsh" at top right of main window. This will reset flash circuitry and start loading again. Wait sufficient time to reach ready state (20-60 s according to flash setting and circuitry) and start a new flash. Although it is possible to start all measurements by using the "Fsh" button and clicking on it, it is a better policy to use a separate switch (Pedal) as this circuit includes a security feature allowing blocking of flash if it is not fully charged.

Normally you must have a measurement done. If no curve is displayed, verify that "Display curve" is well ticked in "Config" - "Setup" menu. For other problems please see Troubleshooting section below.

If corresponding options were chosen in "Panel" menus, measurement is then written on log file, a record is printed and a sticker is printed.

6.2. Editing and saving measurements.

Call "File" "Save as" from main window. The measurement is then saved in a temporary file called SS3P3.DAT in the same directory as executable currently running and a window showing all measurements saved in this file appears. Last saved measurement is located at bottom of this window. If necessary you can fill or edit the "Designation" field. If you need to edit this window this can be done by selecting measurement(s) by "CTL-Click" on the desired files and then cut and paste or append. "Paste" will locate edited measurement just above current selection location while "Append" will locate them at the end of the window. To select a zone to be edited, use "Shift-Click" on first and last measurements to be edited. Measurement between these two locations will be selected as well.

The whole file including all displayed measurements may be saved under another name. When "Measures" window is displayed, choose "File" and then you will have the possibility to save all measurements using "Save" option or to append them to

an existing file. A dialog window then appears to choose a name for that file or the file in which measurement have to be appended.

6.3. Exporting measurements.

To export one particular measurement it is necessary that measurement is displayed in main window. This can be the last measurement done and equally an old measurement that is recalled from temporary file or from an already stored measurement file. When measurement is displayed simply click "Export" from file menu or use shortkey "F12". A dialog box appears permitting to give a name on this file and to choose the directory in which store it. This file is then readable for other programs like Microsoft Excel or any text editor. Note that this file is no more readable by the Sun Simulator III program.

7 Export and Print using a template files

You can modify print out file using a template. Following this example: You ned work with WORD

Sun Simulator III – Production version {ApVsn,@@@@@@}
Measure

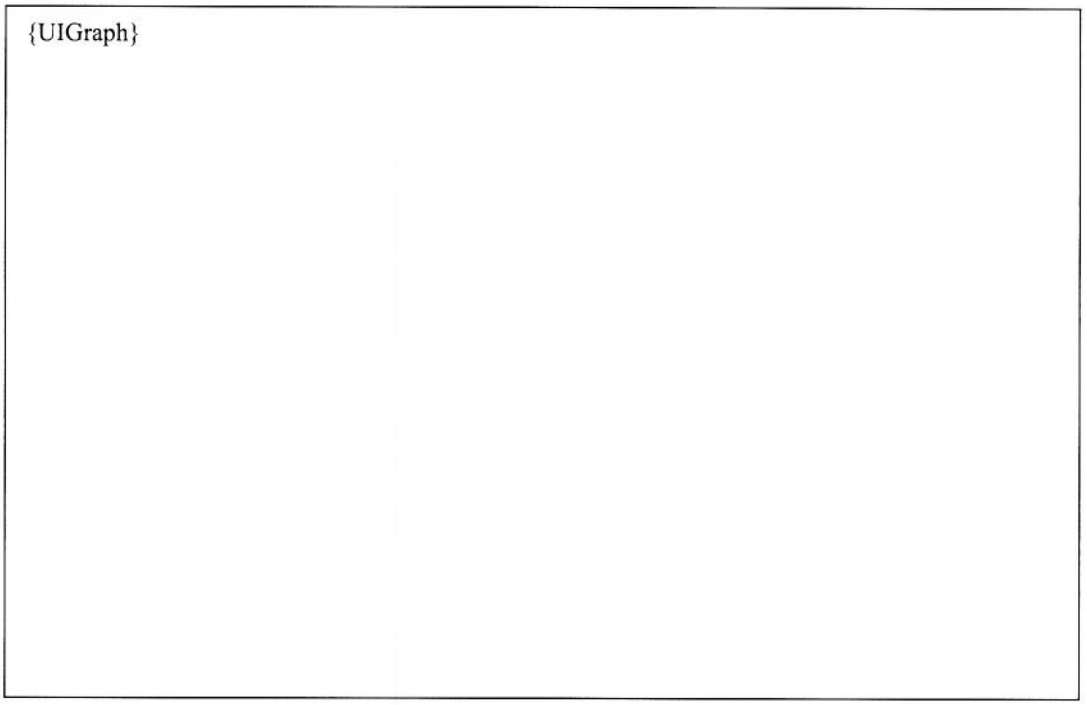
Panel : {ClLbl,@@@@@@@@@@@@@@@@@@@@}
Type : {ClTyp,@@@@@@@@@@@@@@@@@@@@}
Panel no : {RsNbm,####0}
Serial no : {RsSrn,@@@@@@@@@@@@@@@@@@@@}
Date : {RsDcr, DD-MM-YYYY}
Ref. cell type : {RcTyp,@@@@@@@@@@@@@@@@@@@@}
Id. number : {RcSrn,@@@@@@@@@@@@@@@@@@@@}
Sensitivity : {RcRcs,##0.0} mV
Act. Temp. : {RsT2,#0.0} °C
Result : Level {MsLvl,#0} – Class {MsCls,@@@@}

Class Id						
Temp. =	{ClTrf(1),#0.0}	{ClTrf(2),#0.0}	{ClTrf(3),#0.0}	{ClTrf(4),#0.0}	°C	
Irrad. =	{MsIrm(1),0.000}	{MsIrm(2),0.000}	{MsIrm(3),0.000}	{MsIrm(4),0.000}	kW/m2	
Isc =	{MsIsc(1),#0.00}	{MsIsc(2),#0.00}	{MsIsc(3),#0.00}	{MsIsc(4),#0.00}	A	
Voc =	{MsVoc(1),##0.00}	{MsVoc(2),##0.00}	{MsVoc(3),##0.00}	{MsVoc(4),##0.00}	V	
Eff .=	{MsMxc(1),##0.00}	{MsMxc(2),##0.00}	{MsMxc(3),##0.00}	{MsMxc(4),##0.00}	%	
FF =	{MsEff(1),##0.00}	{MsEff(2),##0.00}	{MsEff(3),##0.00}	{MsEff(4),##0.00}	%	
MPP =	{MsMxp(1),#0.000}	{MsMxp(2),#0.000}	{MsMxp(3),#0.000}	{MsMxp(4),#0.000}		W
V@MPP =	{MsVpm(1),##0.00}	{MsVpm(2),##0.00}	{MsVpm(3),##0.00}	{MsVpm(4),##0.00}		V
I@MPP =	{MsIpm(1),#0.00}	{MsIpm(2),#0.00}	{MsIpm(3),#0.00}	{MsIpm(4),#0.00}	A	
Vref =	{ClVst(1),##0.00}	{ClVst(2),##0.00}	{ClVst(3),##0.00}	{ClVst(4),##0.00}	V	
I@Vref =	{MsIav(1),#0.00}	{MsIav(2),#0.00}	{MsIav(3),#0.00}	{MsIav(4),#0.00}	A	
P@Vref =	{MsPwv(1),#0.000}	{MsPwv(2),#0.000}	{MsPwv(3),#0.000}	{MsPwv(4),#0.000}		W
Rser. =	{MsRsr(1),#0.000}	{MsRsr(2),#0.000}	{MsRsr(3),#0.000}	{MsRsr(4),#0.000}		Ohm
Rsht =	{MsRsh(1),#0.000}	{MsRsh(2),#0.000}	{MsRsh(3),#0.000}	{MsRsh(4),#0.000}	Ohm	

{UIGraph}

7 Export and Print using a template files

You can modify print out file using a template. Following this example: You need work with WORD. Choose your parameter from the format frame, in the "config" "formats"



Sun Simulator III – Production version {ApVsn,@@@@@@}
Measure

Panel : {ClLbl,@@@@@@@@@@@@@@@@@@@@}
Type : {ClTyp,@@@@@@@@@@@@@@@@@@@@}
Panel no : {RsNbm,####0}
Serial no : {RsSrn,@@@@@@@@@@@@@@@@@@@@}
Date : {RsDcr, DD-MM-YYYY}
Ref. cell type : {RcTyp,@@@@@@@@@@@@@@@@@@@@}
Id. number : {RcSrn,@@@@@@@@@@@@@@@@@@@@}
Sensitivity : {RcRcs,##0.0} mV
Act. Temp. : {RsT2,#0.0} °C
Result : Level {MsLvl,#0} – Class {MsCls,@@@@}

Class Id						
Temp. =	{ClTrf(1),#0.0}	{ClTrf(2),#0.0}	{ClTrf(3),#0.0}	{ClTrf(4),#0.0}	°C	
Irrad. =	{MsIrm(1),0.000}	{MsIrm(2),0.000}	{MsIrm(3),0.000}	{MsIrm(4),0.000}	kW/m2	
Isc =	{MsIsc(1),#0.00}	{MsIsc(2),#0.00}	{MsIsc(3),#0.00}	{MsIsc(4),#0.00}	A	
Voc =	{MsVoc(1),##0.00}	{MsVoc(2),##0.00}	{MsVoc(3),##0.00}	{MsVoc(4),##0.00}	V	
Eff .=	{MsMxe(1),##0.00}	{MsMxe(2),##0.00}	{MsMxe(3),##0.00}	{MsMxe(4),##0.00}	%	
FF =	{MsEff(1),##0.00}	{MsEff(2),##0.00}	{MsEff(3),##0.00}	{MsEff(4),##0.00}	%	
MPP =	{MsMxp(1),#0.000}	{MsMxp(2),#0.000}	{MsMxp(3),#0.000}	{MsMxp(4),#0.000}		W
V@MPP =	{MsVpm(1),##0.00}	{MsVpm(2),##0.00}	{MsVpm(3),##0.00}	{MsVpm(4),##0.00}		V
I@MPP =	{MsIpm(1),#0.00}	{MsIpm(2),#0.00}	{MsIpm(3),#0.00}	{MsIpm(4),#0.00}	A	
Vref =	{ClVst(1),##0.00}	{ClVst(2),##0.00}	{ClVst(3),##0.00}	{ClVst(4),##0.00}	V	
I@Vref =	{MsIav(1),#0.00}	{MsIav(2),#0.00}	{MsIav(3),#0.00}	{MsIav(4),#0.00}	A	
P@Vref =	{MsPwv(1),#0.000}	{MsPwv(2),#0.000}	{MsPwv(3),#0.000}	{MsPwv(4),#0.000}		W
Rser. =	{MsRsr(1),#0.000}	{MsRsr(2),#0.000}	{MsRsr(3),#0.000}	{MsRsr(4),#0.000}		Ohm
Rsht =	{MsRsh(1),#0.000}	{MsRsh(2),#0.000}	{MsRsh(3),#0.000}	{MsRsh(4),#0.000}	Ohm	

6. Common problems and troubleshooting.

6.1. **Flash doesnt start.** Ensure that flash is properly powered and connecting cable is well installed. Verify that "Flash watching" is selected in "Config" - "Setup" menu. Verify that "Flash Power" in the same menu has a minimum value of 50 %. In that case, voltage displayed on flash generator panel must be approx. 700 V for SS3a and 400 V for SS3b/c. If necessary increase this voltage until flash starts. It may arrives that if flashtube has been left in total darkness for many days, there is insufficient ions inside the tube and first flash is difficult. In that case try to maximum voltage and make many trials. If flash is fired once, it will work later without problem for full session.
If despite all trials described above flash doesnt start, consider exchange of flashtube. For that purpose see the chapter 4 in the MFG 502 Flash Generator Operating Manual

6.2. **Flash is working**, but nothing appears on main window of computer. This arrives when measure threshold on "Config" - "Setup" window is programmed too low or flash power is insufficient. Increase flash power or decrease measure threshold. Usually for Sun Simulator, setting threshold at about 95 % is convenient. Verify that reference irradiance on module is set to 1 kW/m2. If this parameter is set to a higher value, this means that power have to be increased accordingly. Verify also that reference cell is well connected and not shaded.

6.3. **Measurement seems working** well but no curve is displayed. Verify that "Display curve" is well ticked in "Config" - "Setup" menu.

6.4. **Measurement is working but a message "No Isc" or "No Voc"** is displayed on computer.
For "No Isc", verify that module is well connected and not shaded from flash, even partially. Verify also that "Max Isc" is set to a sufficient amount on module parameters. If necessary increase this value until "No Isc" message disappears. Pull the “Gph” window. Look at voltage line (the blue one). Voltage has to cross the bottom line in the first 10 points. If not, increase the negative voltage setting in “panels parameters”(“Start scaning voltage”).
For "No Voc" generally "Max Voc" on module parameters is set to an insufficient value. Increase this parameter and start again. Despite these changes, you always have “No Voc”, pull the “Gph” window and look at the current line (the red line). Current must cross the bottom line in the last 10 points. If not, increase the “start measurement current” in pannel parameters.
Remember that you can follow measurement evolution by calling "Gph" from main window. A graph is then displayed showing evolution of irradiance, voltage and current during measurement. To get useable values, voltage must cross the 0 axis from negative to positive in the first quarter of the graph, and current must cross the 0 axis from positive to negative in the last quarter of the graph. If these values doesnt cross the axis then no measurement can be displayed. If necessary adjust "Max Isc" or "Max Voc" to reach this goal. If, despite "Max Isc" adjustement it is not possible to have voltage line crossing 0 axis, verify contact resistances. If contact resistances cannot be diminued to sufficiently low values, call for servicing.

7. SS3P. LBL parameters and captions file description

```
{SerNum}                                    Section header
"Serial number"                             Window title
"&Cancel","&Save"                           Buttons labels
{Cells list}                                Section header
"Panels list"                               Window title
"Designation","000000000000"                Title and size of column
"Type","000000000000"
"Surface","##,##0.0"
"Created","dd-mm-yy"
"Modified","dd-mm-yy"
"Visa","0000"
"&New"                                      Buttons labels
"&Copy"
"&Modify"
"&Delete"
"&Use"
"&Exit"
"Confirm delete"
{Cells}                                     Section header
"Panel parameters"                          Window title
"Panel identification","",""                Title and size of lines
"More panel identification","",""
"Surface (one
cell)","[cm2]","##,##0.0"
"Nb. serie cells","","###,##0"
"Nb. parallel cells","","###,##0"
"Absolute max. voltage
(panel)","[V]","##0.0"
"Absolute max. current
(panel)","[A]","#0.00"
"Start scanning vol-
tage","[V]","##0.0"
"Start measurement cur-
rent","[A]","#0.00"
"Reference irradiance","[kW/
m2]","#0.000"
"Current correction factor","[uA/
cm2*deg]","##0.00"
"Voltage correction factor","[mV/
deg]","##0.00"
"K parameter","[mOhm/
deg]","##0.00"
"Serial number method","(0-2)",""
"Log file format","",""
"Log printout format","",""
"Label format","",""
"Visa","",""
"Class","",""
"Level","",""
"Reference tempera-
ture","[C]","##0.0"
"Reference voltage
(panel)","[V]","##0.0"
"Min. no load vol-
tage","[V]","##0.0"
"Max. no load vol-
tage","[V]","##0.0"
"Min. short circuit cur-
rent","[A]","#0.00"
"Max. short circuit cur-
rent","[A]","#0.00"
"Min. maximum po-
wer","[W]","###0.0"
"Max. maximum po-
wer","[W]","###0.0"
```

```
"Min. current at ref. vol-
tage","[A]","#0.00"
"Max. current at ref. vol-
tage","[A]","#0.00"
"Min. fill factor","[%]","#0.00"
"Max. fill factor","[%]","#0.00"
"Min. shunt resis-
tance","[Ohm]","###0"
"&Print"                                Buttons labels
"&Cancel"
"&Save"
{Ref cells list}                        Section title
"Reference cells list"                  Window title
"Cell type","000000000000"              Title and size of lines
"Serial nb.","000000000000"
"Sensitivity","##0.0"
"Created","dd-mm-yy"
"Modified","dd-mm-yy"
"Visa","0000"
"&New"                                  Buttons labels
"&Copy"
"&Modify"
"&Delete"
"&Use"
"&Exit"
"Confirm delete"
{Ref cells}                             Section title
"Reference cell parameters"             Window title
"Cell type","",""                       line titles
"Serial number","",""
"Sensitivity","mV","##0.0"
"Rfi factor","[W/m2*deg]","##0.00"
"Visa","",""
"&Print"                                Buttons labels
"&Cancel"
"&Save"
{Values}                                Section title
"List of measured points"               Window title
"Point","####"                          Columns titles
"Vimp","##0.0"
"Vread","##0.0"
"Iread","#0.00"
"Irrad","0.000"
"Uc","##0.0"
"Ic","#0.00"
"&Print"                                Buttons labels
"&Exit"
{Values G}                              Section title
"Measured points"                       Window title
"Um [V]","##0.0"                        Colums labels
"Im [A]","#0.00"
"Irrad [kW]","0.000"
{Setup}                                 Section title
"Setup"                                 Window title
"Manual temperature","C","##0.0"        Parameters labels
"Dual temperature","",""
"Flash watching","",""
"Flash power","%","##0.0"
"Auto adjust","%","##0.0"
"Measure threshold","%","##0.0"
"IEC correction","",""
"Display curve","",""
"Print graphic","",""
"Warning no measure","",""
"Warning Rsh reject","",""
"Warning other reject","",""
"&Cancel","&Exit"                       Buttons labels
{Results}                               Section title
"Batch results"                         Window title
```

```
"Processed"                                lines labels
"Good"
"Rejected"
"Shunt"
"First s/n"
"Last s/n"
"Class",""
"Number",""
"Fr. %","##0.00"
"Fc. %","##0.00"
"&Print"
"&Exit"
{Measures}                                 Section title
"Measures"                                 Window title
"Designation","000000000000"               Columns labels and formats
"Panel des.","000000000000"
"Panel type","000000000000"
"Surface","##,##0.0"
"Created","dd-mm-yy"
"&Add"                                     Buttons labels
"&Insert"
"&Delete"
"&Use"
"&Exit"
"Confirm delete"
{Formats}                                  Section title
"Formats"                                  Window title
"Description","000000000000"               colums labels and formats
"Created","dd-mm-yy"
"Modified","dd-mm-yy"
"Visa","0000"
"Symbol","Index","Unit","Descripti
on"
"******","","","Measurements :"
"MsCls","N","","Class"
"MsLvl","N","","Level"
"MsIrm","Y","kW/m2","Mean irra-
diance"
"MsVoc","Y","V","No load voltage"
"MsIsc","Y","A","Short circuit
current"
"MsMxp","Y","W","Maximum power"
"MsMxe","Y","%","Maximum effi-
ciency"
"MsEff","Y","%","Fill factor"
"MsIav","Y","A","Current at preset
voltage"
"MsPwv","Y","W","Power at preset
voltage"
"MsEfv","Y","%","Efficiency at
preset voltage"
"MsVpm","Y","V","Voltage at maxi-
mum power"
"MsIpm","Y","A","Current at maxi-
mum power"
"MsRsr","Y","Ohm","Serie resis-
tance"
"MsRsh","Y","Ohm","Shunt resis-
tance"
"******","","","Results :"
"RsSrn","N","","Serial number"
"RsNbm","N","","Number of measured
cells"
"RsT1","N","C","Measured tempera-
ture #1"
"RsT2","N","C","Measured tempera-
ture #2"
"RsDcr","N","","Measurement date"
"******","","","Parameters :"
```

```
"ClLbl","N","","Panel designation"
"ClTyp","N","","Panel type"
"ClSrf","N","cm2","Panel area"
"ClNcs","N","","Number of cells in
series"
"ClNcp","N","","Number of cells in
parallel"
"ClMxv","N","V","Maximum voltage"
"ClMxi","N","A","Maximum current"
"ClVsm","N","V","Start scanning
voltage"
"ClIth","N","A","Minimum detection
current"
"ClCcf","N","uA/cm2*deg","Current
correction factor"
"ClVcf","N","mV/deg","Voltage cor-
rection factor"
"ClKcf","N","mOhm/deg","K factor"
"ClIrr","N","kW/m2","Reference ir-
radiance"
"ClTrf","Y","C","Reference tempe-
rature"
"ClVst","Y","V","Preset voltage"
"ClVocM","Y","V","Min. no load
voltage"
"ClVocX","Y","V","Max. no load
voltage"
"ClIscM","Y","A","Min. short cir-
cuit current"
"ClIscX","Y","A","Max. short cir-
cuit current"
"ClMxpM","Y","W","Min. maximum po-
wer"
"ClMxpX","Y","W","Max. maximum po-
wer"
"ClIavM","Y","A","Min. current at
preset voltage"
"ClIavX","Y","A","Max. current at
preset voltage"
"ClEffM","Y","%","Min. fill fac-
tor"
"ClEffX","Y","%","Max. fill fac-
tor"
"ClRshM","Y","Ohm","Min. shunt re-
sistance"
"ClDcr","N","","Creation date"
"ClDmd","N","","Modification date"
"ClVis","N","","Visa"
"******","","","Reference cell :"
"RcTyp","N","","Cell type"
"RcSrn","N","","Serial number"
"RcRcs","N","mV","Sensitivity"
"RcVcf","N","W/m2*deg","Voltage
correction factor"
"RcDcr","N","","Creation date"
"RcDmd","N","","Modification date"
"RcVis","N","","Visa"
"","","",""
"&New"                                  Buttons labels
"&Copy"
"&Delete"
"&Use"
"&Exit"
"Confirm delete"
{About}                                 Section title
"About..."                              Window title
"Sun Simulator III - Production
version "
"Designed by :",1
```

```
"Logma SA",1
"Le Locle (Switzerland)",0
{Help}                                  Section title
"Pasan Cell tester IIc help to-         Window title
pics"
{Exceptions}                            Section title
"Configuration file"                    Window title
"Ref. cells database"
"Panel database"
"Results database"
"Formats database"
"Bad or corrupted file"
"Version mismatch"
{Main}                                  Section title
"Sun Simulator III - Production         Window title
version "
"##0.0","[V]","#0.00","[A]"             Line labels and formats
"Ref. cell type","",""
"Id. number","",""
"Sensitivity","mV","##0.0"
"Panel :","",""
"Type :","",""
"Panel no :","",""
"Serial no :","",""
"Act. temp.:","C","##0.0"
"2nd. temp.:","C","##0.0"
"Fsh.pwr.:","%","##0.0"
"Ref.irrad.:","kW","#0.000"
"Min.irrad.:","kW","#0.000"
"Max.irrad.:","kW","#0.000"
"Voc :","V","##0.0"
"Isc :","A","#0.00"
"Mxp :","W","###0.0"
"Mxe :","%","##0.0"
"FF :","%","##0.0"
"Rser :","Ohm","#0.00"
"Rsht :","Ohm","###0"
"Man. temp.:","C","##0.0"
"00 - Class"
"01 - Reject"
"02 - Shunt"
"03 - No Isc"
"04 - No Voc"
"05 - Irradiance error"
"10 - Printer port error"
"11 - Label print port error"
"12 - Panel error : identity"
"13 - Panel error : surface"
"14 - Panel error : scales"
"15 - Panel error : thresholds"
"16 - Panel error : irrad."
"17 - Panel error : ref.temp."
"18 - Panel error : min.shunt"
"19 - Ref. cell not defined"
"20 - Ref. cell error : sensiti-
vity"
"21 - Panel error : classes"
"100 - Ready"
"101 - Alarm flash"
"102 - Loading"
"103 - Flash not ready"
"104 - Measuring..."
"105 - Measuring temp..."
"110 - Serial number not defined"
"111 - Log file not defined"
"112 - Tester not ready"
"&Val","List of measured points"
"&Gph","Graphic of measured
points"
```

```
"&Lgf","Change log file"
"&Srn","Change serial number"
"&Prt","Print measure"
"&Res","Show batch results"
"&Dsc","Discard last measure"
"&Fsh","Trig flash"
"Confirm exit"
"Alarm flash"
"Alarm load"
"No measures received; maybe irra-
diance less than minimum value"
"Log file"
"LOG"
"Log files (*.log)|*.log|All files
(*.*)|*.*"
{Export}
"Open export file"
"asc"
"Export files (*.asc)|*.asc|All
files (*.*)|*.*"
"Sun Simulator III - Production
version "
"No, Umeas[V], Imeas[V], Ir-
rad.[kW/m2], Ucorr.[V], Icorr.[A]"
"###0.000","##0.000","###0.000","#
#0.000","0.000"
{Menus}                                 Section title
"&File"                                 Buttons labels
"&Batch"
"&Measure"
"&Config"
"&?"
"&New"
"&Load"
"Save &as"
"-"
"&Print"
"&Export"
"-"
"&Quit"
"&Clear"
"-"
"Log &file"
"Serial &number"
"-"
"&Result"
"&Print"
"&Display"
"-"
"&Discard"
"-"
"&Values"
"&Graphic"
"&Panels"
"&Parameters"
"&Ref. cells"
"&Ref. params"
"-"
"&Formats"
"-"
"&Setup"
"&Help"
"-"
"&About"
"&Off"
"&Single"
{Logo}                                  Section title
"Belval"                                Window title
1000                                    Display time of logo in ms
```

```
{Config}                                  Section title
&h210                                     Basic address of interface card
10                                        Measurement speed (1 = 4 µs)
100                                       Internal delay for relays.
5                                         Int. delay for temperature meas.
100                                       Scanning delay for flash occurence
1000                                      Minimum cycle duration in ms
1000
60                                        Delay for temperature measurements
0.7, 1.0, 3.0, 10.0, 30.0, 100.0,         Voltage scales
300.0
0.1, 0.3, 1.0,  3.0, 10.0,  30.0,         Current scales
100.0
2.0,5                                     Ticks for graphical presentations;
2.5,4                                     number of small ticks for one
5.0,2                                     large.
10.0,5
"LPT1"                                    Port for log printer
"LABELS.LST"                              Port for label printer (In present
                                          case a temporary file.

                                          If a "com" port is used, you have
                                          to specify port parameters, as
                                          example :
                                          "COM1:9600,N,8"
```

8. Description of printing parameters file SS3PP.LBL

```
"Sun Simulator III - Production          Printed pages main label
version "
{Main}                                   Section title
4,8,"Measure"                            Upper and left margins, page title
20
"Panel :"                                Designations and printing formats
"Type :"
"Panel no :"
"Serial no :"
"Date :"
"Ref. cell type :"
"Id. number :"
"Result :"
8,8,1,12                                 Widths for designations, widths
                                         for values, Unities spacing, pla-
                                         cing of second column.

"Sensitivity","mV","##0.0"               Designations and printing formats
"Act. temp.:","C","##0.0"
"Temp. =","C","##0.0"
"Irrad.=","kW","#0.000"
"Isc   =","A","##0.00"
"Voc   =","V","##0.00"
"Eff.  =","%","##0.00"
"FF    =","%","##0.00"
"MPP   =","W","#0.000"
"V@mpp =","V","##0.00"
"I@mpp =","A","##0.00"
"Rser. =","Ohm","#0.000"
"Rsht  =","Ohm","#0.000"
18                                       Spacing between graph and frame
"00 - Class"                             Messages
"01 - Reject"
"02 - Shunt"
"03 - No Isc"
"04 - No Voc"
"05 - Irradiance error"
"10 - Printer port error"
"11 - Label print port error"
"12 - Panel error : identity"
"13 - Panel error : surface"
"14 - Panel error : scales"
"15 - Panel error : thresholds"
"16 - Panel error : irrad."
"17 - Panel error : ref.temp."
"18 - Panel error : min.shunt"
"19 - Ref. cell not defined"
"20 - Ref. cell error : sensiti-
vity"
"21 - Panel error : classes"
{Results}
4,8,"Batch results"
12,8
"Processed :"
"Good :"
"Rejected :"
"Shunt :"
"First s/n :"
"Last s/n :"
5,"Class",""
8,"Number",""
8,"Fr. %","##0.00"
8,"Fc. %","##0.00"
{Cells}                                  Section label
4,8,"Panel parameters"                   Line titles and formats
```

```
40,8,1
"Panel identification :","",""
"More Panel identification
:","",""
"Surface (one cell)
:","[cm2]","##,##0.0"
"Nb. serie cells","","###,##0"
"Nb. parallel cells","","###,##0"
"Absolute max. voltage (panel)
:","[V]","##0.0"
"Absolute max. current (panel)
:","[A]","#0.00"
"Start scanning vol-
tage","[V]","##0.0"
"Start measurement cur-
rent","[A]","#0.00"
"Reference irradiance :","[kW/
m2]","#0.000"
"Current correction factor
:","[uA/cm2*deg]","##0.00"
"Voltage correction factor
:","[mV/deg]","##0.00"
"K parameter :","[mOhm/
deg]","##0.00"
"Serial number method","",""
"Log file format","",""
"Log printout format","",""
"Label format","",""
"Visa","",""
40,8
"Class","",""
"Level","",""
"Reference tempera-
ture","[C]","##0.0"
"Reference voltage
(panel)","[V]","##0.0"
"Min. no load vol-
tage","[V]","##0.0"
"Max. no load vol-
tage","[V]","##0.0"
"Min. short circuit cur-
rent","[A]","#0.00"
"Max. short circuit cur-
rent","[A]","#0.00"
"Min. maximum po-
wer","[W]","###0.0"
"Max. maximum po-
wer","[W]","###0.0"
"Min. current at ref. vol-
tage","[A]","#0.00"
"Max. current at ref. vol-
tage","[A]","#0.00"
"Min. fill factor","[%]","#0.00"
"Max. fill factor","[%]","#0.00"
"Min. shunt resis-
tance","[Ohm]","##0.00"
{Ref cells}                          Section title
4,8,"Reference cell parameters"      Window title
40,8,1                               Parameters and formatting
"Cell type :","",""
"Serial number :","",""
"Sensitivity :","mV","##0.0"
"Rfi factor :","[W/
m2*deg]","##0.00"
"Visa","",""
{Values}                             Section title
4,8,4,"List of measured points"      Window title
5,"Point","##0"                      colums labels and formats
7,"Vimp","##0.00"
```

```
7,"Vread","##0.00"
7,"Iread","##0.00"
7,"Irrad","##0.00"
7,"Uc","##0.00"
7,"Ic","##0.00"
```

9. Control characters for format definition

User-Defined String Formats (Format Function)

You can use any of the following characters to create a format expression for strings:

Character	Description
@	Character placeholder. Display a character or a space. If the string has a character in the position where the at symbol (@) appears in the format string, display it; otherwise, display a space in that position. Placeholders are filled from right to left unless there is an exclamation point character (!) in the format string.
&	Character placeholder. Display a character or nothing. If the string has a character in the position where the ampersand (&) appears, display it; otherwise, display nothing. Placeholders are filled from right to left unless there is an exclamation point character (!) in the format string.
<	Force lowercase. Display all characters in lowercase format.
>	Force uppercase. Display all characters in uppercase format.
!	Force left to right fill of placeholders. The default is to fill placeholders from right to left.

User-Defined Date/Time Formats (Format Function)

The following table identifies characters you can use to create user-defined date/ time formats:

Character	Description
(:)	Time separator. In some locales, other characters may be used to represent the time separator. The time separator separates hours, minutes, and seconds when time values are formatted. The actual character used as the time separator in formatted output is determined by your system settings.
(/)	Date separator. In some locales, other characters may be used to represent the date separator. The date separator separates the day, month, and year when date values are formatted. The actual character used as the date separator in formatted output is determined by your system settings.
c	Display the date as ddddd and display the time as ttttt, in that order. Display only date information if there is no fractional part to the date serial number; display only time information if there is no integer portion.
d	Display the day as a number without a leading zero (1 – 31).
dd	Display the day as a number with a leading zero (01 – 31).
ddd	Display the day as an abbreviation (Sun – Sat).
dddd	Display the day as a full name (Sunday – Saturday).
ddddd	Display the date as a complete date (including day, month, and year), formatted according to your system's short date format setting. For Microsoft Windows, the default short date format is m/d/yy.

dddddd	Display a date serial number as a complete date (including day, month, and year) formatted according to the long date setting recognized by your system. For Microsoft Windows, the default long date format is mmmm, dd, yyyy.
w	Display the day of the week as a number (1 for Sunday through 7 for Saturday).
ww	Display the week of the year as a number (1 – 54).
m	Display the month as a number without a leading zero (1 – 12). If m immediately follows h or hh, the minute rather than the month is displayed.
mm	Display the month as a number with a leading zero (01 – 12). If m immediately follows h or hh, the minute rather than the month is dis played.
mmm	Display the month as an abbreviation (Jan – Dec).
mmmm	Display the month as a full month name (January – December).
q	Display the quarter of the year as a number (1 – 4).
y	Display the day of the year as a number (1 – 366).
yy	Display the year as a 2-digit number (00 – 99).
yyyy	Display the year as a 4-digit number (100 – 9999).
h	Display the hour as a number without leading zeros (0 – 23).
hh	Display the hour as a number with leading zeros (00 – 23).
n	Display the minute as a number without leading zeros (0 – 59).
nn	Display the minute as a number with leading zeros (00 – 59).
s	Display the second as a number without leading zeros (0 – 59).
ss	Display the second as a number with leading zeros (00 – 59).
t t t t t	Display a time as a complete time (including hour, minute, and second), formatted using the time separator defined by the time format recognized by your system. A leading zero is displayed if the leading zero option is selected and the time is before 10:00 A.M. or P.M. For Microsoft Windows, the default time format is h:mm:ss.
AM/PM	Use the 12-hour clock and display an uppercase AM with any hour before noon; display an uppercase PM with any hour between noon and 11:59 P.M.
am/pm	Use the 12-hour clock and display a lowercase AM with any hour before noon; display a lowercase PM with any hour between noon and 11:59 P.M.
A/P	Use the 12-hour clock and display an uppercase A with any hour before noon; display an uppercase P with any hour between noon and 11:59 P.M.
a/p	Use the 12-hour clock and display a lowercase A with any hour before noon; display a lowercase P with any hour between noon and 11:59 P.M.
AMPM	Use the 12-hour clock and display the AM string literal as defined by your system with any hour before noon; display the PM string literal as defined by your system with any hour between noon and 11:59 P.M. AMPM can be either uppercase or lowercase, but the case of the string displayed matches the string as defined by your system settings. For Microsoft Windows, the default format is AM/PM.

User-Defined Numeric Formats (Format Function)

The following table identifies characters you can use to create user-defined number formats:

Character Description

None Display the number with no formatting.

(0) Digit placeholder. Display a digit or a zero. If the expression has a digit in the position where the 0 appears in the format string, display it; other wise, display a zero in that position.If the number has fewer digits than there are zeros (on either side of the decimal) in the format expression, display leading or trailing zeros. If the number has more digits to the right of the decimal separator than there are zeros to the right of the decimal separator in the format expression, round the number to as many decimal places as there are zeros. If the number has more digits to the left of the decimal separator than there are zeros to the left of the decimal separator in the format expression, display the extra digits without modification.

(#) Digit placeholder. Display a digit or nothing. If the expression has a digit i n the position where the # appears in the format string, display it; other wise, display nothing in that position.This symbol works like the 0 digit placeholder, except that leading and trailing zeros aren't displayed if the number has the same or fewer digits than there are # characters on either side of the decimal separator in the format expression.

(.) Decimal placeholder. In some locales, a comma is used as the decimal separator. The decimal placeholder determines how many digits are displayed to the left and right of the decimal separator. If the format expression contains only number signs to the left of this symbol, numbers smaller than 1 begin with a decimal separator. To display a leading zero displayed with fractional numbers, use 0 as the first digit placeholder to the left of the decimal separator. The actual character used as a decimal placeholder in the formatted output depends on the Number Format recognized by your system.

(%) Percentage placeholder. The expression is multiplied by 100. The percent character (%) is inserted in the position where it appears in the format string.

(,) Thousand separator. In some locales, a period is used as a thousand separator. The thousand separator separates thousands from hundreds within a number that has four or more places to the left of the decimal separator. Standard use of the thousand separator is specified if the format contains a thousand separator surrounded by digit placeholders (0 or #). Two adjacent thousand separators or a thousand separator immediately to the left of the decimal separator (whether or not a decimal is specified) means "scale the number by dividing it by 1000, rounding as needed." For example, you can use the format string "##0,," to represent 100 million as 100. Numbers smaller than 1 million are displayed as 0. Two adjacent thousand separators in any position other

than immediately to the left of the decimal separator are treated simply as specifying the use of a thousand separator. The actual character used
as the thousand separator in the formatted output depends on the Number Format recognized by your system.

(:) Time separator. In some locales, other characters may be used to represent the time separator. The time separator separates hours, minutes, and seconds when time values are formatted. The actual character used as the time separator in formatted output is determined by your system settings.

(/) Date separator. In some locales, other characters may be used to represent the date separator. The date separator separates the day, month, and year when date values are formatted. The actual character used as the date separator in formatted output is determined by your system settings.

(E- E+ e- e+) Scientific format. If the format expression contains at least one digit placeholder (0 or #) to the right of E-, E+, e-, or e+, the number is displayed in scientific format and E or e is inserted between the number and its exponent. The number of digit placeholders to the right determines the number of digits in the exponent. Use E- or e- to place a minus sign next to negative exponents. Use E+ or e+ to place a minus sign next to negative exponents and a plus sign next to positive exponents.

- + $ ( ) Display a literal character. To display a character other than one of those listed, precede it with a backslash (\) or enclose it in double quotation marks (" ").

(\) Display the next character in the format string. To display a character that has special meaning as a literal character, precede it with a backslash (\). The backslash itself isn't displayed. Using a backslash is the same as enclosing the next character in double quotation marks. To display a backslash, use two backslashes (\\).Examples of characters that can't be displayed as literal characters are the date-formatting and time-formatting characters (a, c, d, h, m, n, p, q, s, t, w, y, / and :), the numeric-formatting characters (#, 0, %, E, e, comma, and period), and the string-formatting characters (@, &, <, >, and !).

("ABC") Display the string inside the double quotation marks (" "). To include a string in format from within code, you must use Chr(34) to enclose the text (34 is the character code for a quotation mark (")).