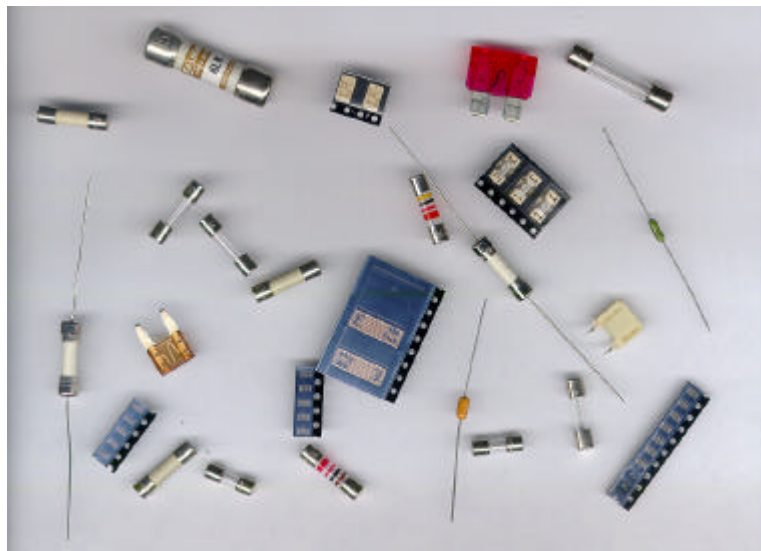


MANUAL

Littelfuse®

PULSCALC



PROGRAM

PULSCALC PROGRAM USER MANUAL

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1. Pulscalc program

1.1 Foreword

This manual gives a functional description of the *PULSCALC* program (pulscalc = abbreviation of Pulse Calculation). With this program Littelfuse presents a way to help you select fuse-links from our wide product range for your customers application. Using this program might help save extensive time that is normally required for testing.

For using and therefore to fully benefit of this program and its capabilities the following is required:

- a) Hard-copy of the applications rush-in up to maximal 1Sec [I = f (t)].

(hard-copy oscilloscope / excel graphic ¹⁾ / representative sketch).

- b) Indication of the applications nominal current [I] at $t \gg t_{\text{rush-in}}$

(hard-copy oscilloscope / excel graphic ¹⁾ / multi-meter reading).

1) Note that in case data can be read (see below) from an oscilloscope, this very well might be helpful to establish a hard-copy by using this data in for example Windows Excel.

The application tester is a help-tool for indication purposes only and Littelfuse therefore keeps all rights reserved.

1.2 Pulscalc program basic functions

The basic function of the pulscalc program is providing a way to enter **manually** the basis current criteria (rush-in & nominal) and to use this data among others (see chapter 4) to perform a proper fuse-selection. Data sometimes can be provided (=read) by oscilloscopes via for example a RS232 communication port. The problem is that this oscilloscope data often per brand differ in format and contents and therefore is not suitable for development of a (standard) program. For this reason and the added reason that as indicated also no data read-out possibility might be available at all this manual method is to be used.

To enter the rush-in current an approximation method, referring to a method of calculation and representation, is to be selected as from the options listed below. The nominal current can be entered either via the rush-in current or directly (see further on for details).

1.2.1 Rush-in current approximation methods

Since each rush-in is different from shape this program offers 3 methods you can select from to approximate (see chapters 2.4 &3) the rush-in current as closely as possible ²⁾³⁾.

I. ¼ sine waves approximation: by using ¼ period sine waves.

II. exponential approximation: by using exponential curves.

III. linear approximation: by using straight lines.

!!! 2) For an easy approximation and accordingly easy manual processing, it is **HIGHLY** recommended to simplify the rush-in & nominal current graphics first and then to select the appropriate method. Simplification means that the curves should be removed from raw edges and so become 'polished'.

3) Methods cannot be mixed.

1.3 Approximation method limits

In using the approximation methods the following limits should be taken into account:

- 1) minimum time resolution 10uS.
- 2) maximum time resolution:
 - ¼ sine wave approx. - 20mS
 - exponential & linear approx. - 200mS
- 3) minimum rush-in current total simulation time
 - ¼ sine wave approx. - 1/Hz (=>1/50=20mS or 1/60=16.66mS)
 - exponential & linear approx. - 10mS
- 4) maximum rush-in current total simulation time up to 1Sec.
- 5) minimum current value resolution 10mA (in case <> 0).
- 6) maximum current peak value up to 1000A.

1.4 Requirements to run the pulscal program

Below the requirements are listed to be able to run the pulscal program. Also described is the system by which the user is provided a 90 days period of usage and the way to renew/enable such a following period. **Without renewal after at the latest 90 days the PulsCalc program will not run.** This period is chosen to keep control over the fuse-data in use. The days remaining are displayed as soon as the program is started.

1.4.1 Software/files

The program only will run when Windows95/98 is installed. The 2 below indicated files need to be installed (=copied) for actually running of the pulscal program.

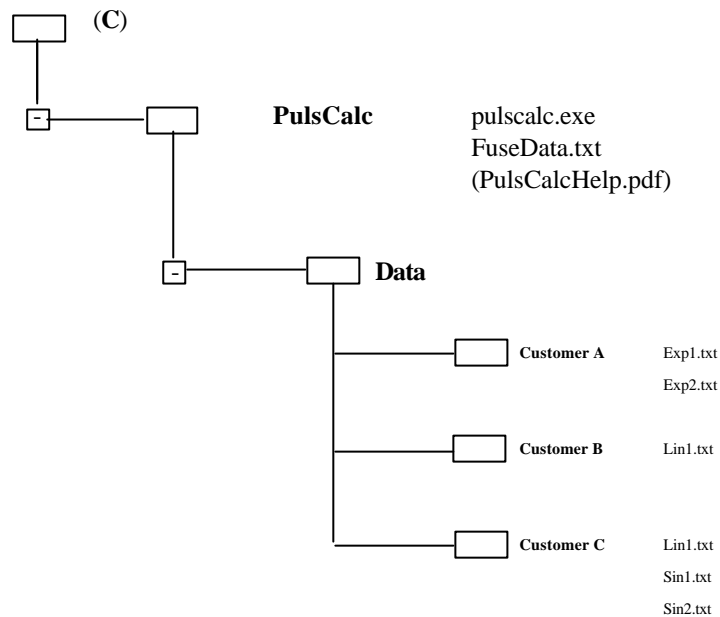
- a) *pulscal.exe*
- b) *fusedata.txt*

It is advised to create on your PC locally a main-folder *PulsCalc* and to copy **pulscal.exe** & **fusedata.txt** into this. As soon as the pulscal.exe stand-alone program is run by double clicking it, a sub-folder (directory) *data*, in case not present is created here.

It is also further advised to create via the Windows Explorer in this sub-folder 'data' manually customer related (e.g. by name) sub-folders for saving the test-results with fuse-selections (relevant data & information). See for further info on this chapter 1.5).

Note: For completion it is suggested also to copy this manual **PulsCalcHelp.pdf** into your main-folder.

As described it is advised only to use the mentioned file-structure. Graphically (explored) the advised structure looks like shown below.



1.4.1.1 Obtaining a new period of 90 day.

The data file, FuseData.txt, contains the actual control-code over the expiring period of 90 days⁴⁾. By using the following E-mail procedure an updated data file is obtained enabling a new 90 days period of use.

- a) Enter the e-mail address : mailrobot@littelfuse.nl
- b) Enter in the subject line: database
- c) Send this e-mail. No e-mail contents is required.
- d) The updated FuseData.txt file will be replied automatically.
- e) Put this FuseData.txt file into your local PC folder or replace the existing one⁵⁾

4)5) Note that it is not required to wait with the renewal until the 90 days have expired. To prevent surprises for example at your customers location it might be for the best to keep a 10 days safety margin.

1.4.2 Hardware

The following hardware components are required:

- a) Minimal PC486 / 16MB memory.
 - b) A printer in order to enable hard-copies of the results should be installed.
 - c) Monitor resolution at least 800*640 ⁶⁾
- 6) Monitors of different resolutions might result in what looks like scrolled pages. Especially in cases of higher resolutions the easiest way is probably to reduce the resolution to 800*640 via the Windows monitor setup. The result then is that the program is running in an undersized box.

1.5 Pulscale programs output

After following the step by step guidance in this manual an output is calculated. Below an example of such an output is shown. This output can be copied/pasted to for example a project documentation paper by using the Windows clipboard option (alt + print scrn).

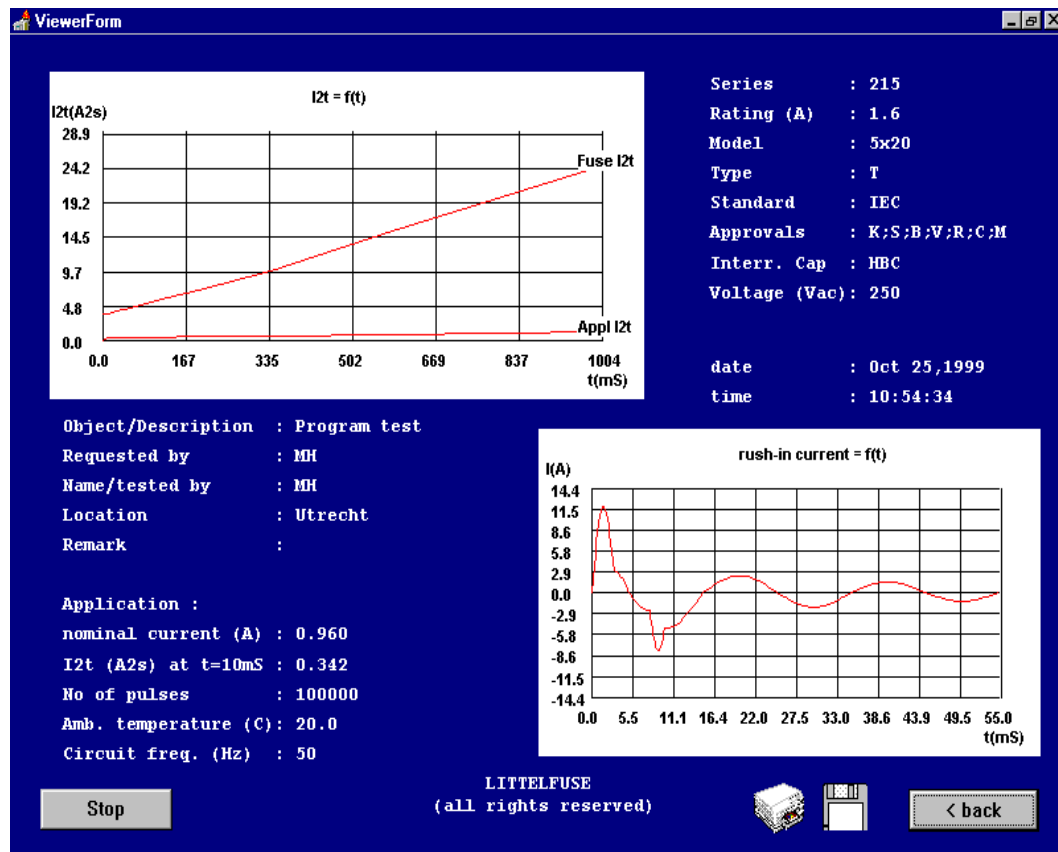


Fig. 1: output

Besides the cut/paste option the output can be hard-copied directly. Note that only previously via Windows installed printers can be used. The paper-size used for the output can be set later during the printing acting. Further there is a possibility to save all relevant data & information for later re-work/re-viewing/re-printing of this output ⁷⁾.

Please refer to chapter 4.3 for more details.

!!! 7) Previously saved files can be loaded (see load file button in chapter 3.1) for the mentioned purposes ONLY when the file-name starts with the 'starting-word' related to the approximation method chosen as shown below. If not properly used the program will crash.

'Sin' => ¼ sine wave approx. method

'Exp' => exponential approx. method

'Lin' => linear approx. method

1.5.1 Approvals

Also listed in the output are the approvals valid for the fuse selected by using abbreviations. Listed below you will find the description of the abbreviations:

B	B.S.I. Kitemark
C	CSA Accepted
CSA	CSA Certified
K	Kema Keur
M	MITI
R	UL Recognized
S	SEMKO
V	VDE
UL	UL Listed

1.6 Pulscalculator.exe program

The testers program Pulscalculator.exe consists in principle out of 2 segments. After choosing the preferred method, by the first segment the actual approximation is to be performed by entering the data manually (see chapter 3). This is then immediately followed by the second segment where the actual fuse-selection is done by using the data entered and corresponding user defined criteria (see chapter 4). All the above is initiated as soon as the program is run.

Important:

Sometimes a failure message is displayed when a new screen is built. In many of these cases the originating failure is to be considered fatal and the *pulscalculator* program must be re-started.

To prevent loss, it is therefore suggested to save via the programs button the data as soon as possible. This way the data can be recalled via the load button.

In case of questions please feel free to contact someone at our Littelfuse sales office.
Further we would like your help on improving the program and its functions. Therefore your suggestions and remarks are highly appreciated.

We thank you in advance.

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2. Running the pulscalc program

2.1 Starting-up

Once installed (=files copied) the program is started by double-clicking the pulscalc.exe file. A screen will appear with a start & stop button as well as further the time in days when the program will expire.



Fig. 2: After start up

Please press start to begin. The screen shown below appears with the approximation methods to select from as mentioned in the chapter 1.2.1.

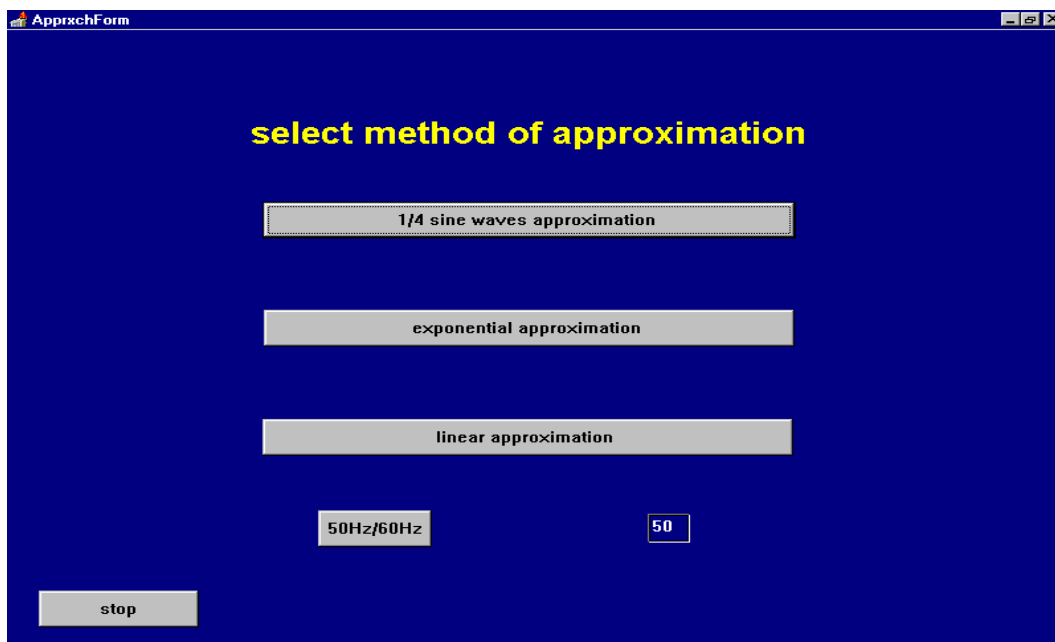


Fig 3: Approximation method choice

2.2 Frequency 50Hz/60Hz

[USA applicants]

In case this program is used in e.g. the USA the frequency is to be altered to 60Hz via the switch button. Default is set at 50Hz. Since the frequency is used for calculation of the true RMS nominal current value (see last rows / nominal current chapter) this should not be forgotten.

In case of a DC rush-in the frequency is not relevant and the setting has no influence.

In the following the ¼ SINE WAVES APPROXIMATION method is used as example to explain step by step the process to come to a fuse selection. The other two methods are similar. The only significant difference is that the other methods allow DC currents to be entered as well as that some limits are different .

3. Approximation methods

3.1 Data entering

The 1/4 sine wave approximation method was chosen (as for example). Now the screen as in figure 4 is displayed.

The step by step process starts by filling this data enter/input form (see chapters 3.1.1/3.1.2) assuming no file was loaded (see down below).

t0 (mS)	t1 (mS)	freq (hz)	I(A) at t0	I(A) at t1	I2t (A2s)	neg
0.00	0.00	0.0	0.00	0.00	0.0000	<input type="checkbox"/>
0.00	0.00	0.0	0.00	0.00	0.0000	<input type="checkbox"/>
0.00	0.00	0.0	0.00	0.00	0.0000	<input type="checkbox"/>
0.00	0.00	0.0	0.00	0.00	0.0000	<input type="checkbox"/>
0.00	0.00	0.0	0.00	0.00	0.0000	<input type="checkbox"/>
0.00	0.00	0.0	0.00	0.00	0.0000	<input type="checkbox"/>
0.00	0.00	0.0	0.00	0.00	0.0000	<input type="checkbox"/>
0.00	0.00	0.0	0.00	0.00	0.0000	<input type="checkbox"/>
0.00	0.00	0.0	0.00	0.00	0.0000	<input type="checkbox"/>
0.00	0.00	0.0	0.00	0.00	0.0000	<input type="checkbox"/>
0.00	0.00	0.0	0.00	0.00	0.0000	<input type="checkbox"/>
0.00	0.00	0.0	0.00	0.00	0.0000	<input type="checkbox"/>
0.00	0.00	0.0	0.00	0.00	0.0000	<input type="checkbox"/>
0.00	0.00	0.0	0.00	0.00	0.0000	<input type="checkbox"/>
0.00	0.00	0.0	0.00	0.00	0.0000	<input type="checkbox"/>
0.00	0.00	0.0	0.00	0.00	0.0000	<input type="checkbox"/>

Fig.4: Approximation data enter/input form

The rush-in current is to be divided in parts. Each part is described by 1 line as on the input screen. So by this program it is possible to describe a rush-in current by maximal 15 lines. Each part starts where the current is altering its direction and ends at the first next point the current direction alters. Note that the end of a part therefore is the start of the next part and a zero-cross is considered a direction alteration (see appendix A).¹⁾

The values as in the last lines are assumed to describe the nominal current and should therefore be considered special. See for details the chapter 3.1.3.

Pressing the **load file** button opens the Windows open dialog box by which the directory structure is shown (see chapter 1.4.1). Via selecting the preferred (customer) data directory at first all previously saved files corresponding to the selected approximation method are shown (see chapter 1.5).

Once a file is chosen the data is copied into the approximation data enter/input form and is the selected file number is displayed. Note that now the load file button is changed to **reset** button which once pressed removes the data again and restores the load file button.

Once data is loaded, clicking a random chosen data enter/input field resets the file number and is the data now considered new data. In this way previously entered data can be altered and a new fuse selection be performed as described further on in this manual.²⁾⁴⁾

After inputting data correctly taking into account all the limits and guidelines, pressing the **continue** button results in displaying this data graphically for visual check (see further on).

In case a file was loaded before, clicking/moving the cursor onto the continue button results in that the output is displayed immediately. By this way previous results can be reviewed/re-printed or even changed.³⁾⁴⁾

Is the **back** button pressed, the user is taken back to the approximation method choice form in order to select another preferred method. Was data already entered or loaded (see below) this is removed.

1) See note 2 as in chapter 1.

2)3) Both methods enable the user to change existing data and/or selected fuse-series & ratings.

4) Note that the negative sign fields remain as they were set by the file loaded and that these need to be changed manually as described below.

3.1.1 General guidelines in data entering

Besides the method limits as described in chapter 1.3 find the below. Note that in the program some entering input supports have been built-in, such as that timing and current inputs are copied to the next rows when skipped etc.

- I. Consider each peak as a positive current peak (0-180). Negative peaks as from your rush-in current need to be interpreted positive to divide your current in parts correctly. Note that for input negative peaks may be entered (chapter 3.1.3 B-3).
- II. Fields can be entered in random order (columns/rows). However it is better and quicker to enter them from top to bottom per row. This way you can benefit from most of the programs built-in input/enter support.
- III. Values are entered by double clicking or clicking another field.
- IV. Columns shown gray cannot be manually entered and will be filled and updated automatically.
- V. All 15 lines must be filled in. It is advised to fill in the relevant lines first and then to enter line 15. Lines skipped this way will be filled in as described below.
- VI. By the $\frac{1}{4}$ sine wave approximation method no zero-current level for a time period can be inputted (example: 0A for 2mS). Is such required it is advised to enter a fictive current of 10mA.

3.1.2 Data entering for an actual rush-in current

Find below the step-by-step procedure to enter a rush-in current:

- A) Divide your rush-in current as by current altering in parts (up to maximal 15 positive current peaks).
- B) Repeat the following 3 steps for each part found:
 - 1) Determine the part 'end' time.
 - 2) Enter the 'end' time in the 2nd time column indicted t1 in the line corresponding to the part number.

This entered value automatically will become the 'begin' time, indicated t_0 (=gray column), for the next part/line. Note further that the last part time, $t_0 - t_1$, automatically will be copied to all the following remaining fields and that a frequency is calculated and shown for indication.

- 3) Enter in the 2nd current column indicated I(A) at t_1 , to the line corresponding current peak value.

As soon as a current value is entered this value will be in reverse order with the current indicated in the I(A) at t_0 field (gray) automatically copied into the current fields for the next line/part. In case lines of current fields are skipped or forgotten these can be filled in automatically. For the $\frac{1}{4}$ sine wave approximation, the skipped fields will be filled (in reverse order) with the values as inputted in the last previous line. For the linear and exponential approximation methods only skipped current value fields will be filled in if the last value (zero allowed) is equal to the current value of the line skipped to. All in between fields will be set at the same current value assuming DC.

Only for the best looking rush-in current (hard)copy it is advised to enter negative values in case of a negative current peak. In case a negative current value is entered the corresponding field in the 'neg' column is marked indicating a negative sign while the current is shown absolute.

Note that it is easier to add negative signs later by activating the 'neg' sign marks by moving the cursor over the relevant mark-fields. Was a mark already set it is then removed. Notice that the mark-field is extremely sensitive for the cursor-movements and that so mistakes are made easily.

Also calculated and shown for indication is the I_2t value of the parts. Further, as mentioned earlier, note that the inputs of the last lines are special. For more details see the below chapter.

3.1.3 Last rows / nominal current

The last set of input lines should be taken care of in a special way because these are assumed to describe the true RMS nominal current. In case of the linear as well as the exponential approximation methods in the last input rows, 15 and before, for a time period of at least 20mS an equal current is entered this is assumed the DC value. If the total simulation time is less then 20mS the current value entered as in line 15 is assumed the DC value.

For the $\frac{1}{4}$ sine wave approximation method the last entered time frame of 1/Hz sec is assumed to describe the AC value. As mentioned before no total simulation time of less then 1/Hz can be entered.

The RMS value is calculated by the program and then extrapolated to 1s (1004ms). Later on this value can be altered manually via the fuse criteria screen (see chapter 4) for example when the actual value was measured before by using a multimeter. Note that a minimum RMS of 1mA is assumed automatically (this is not visible in data enter/input form).

3.1.4 Example

In the appendix A an example for the $\frac{1}{4}$ sine wave approximation is shown. In figure A is found the rush-in curve divided in parts as well as the current peak values for that specific part and in figure B the corresponding filled-out approximation data/enter form.

3.2 Data graphically

Assuming all the 15 lines as on approximation data enter/input form have been filled-in correctly and continue was pressed, the curve ⁵⁾ as entered is graphically displayed as shown below.

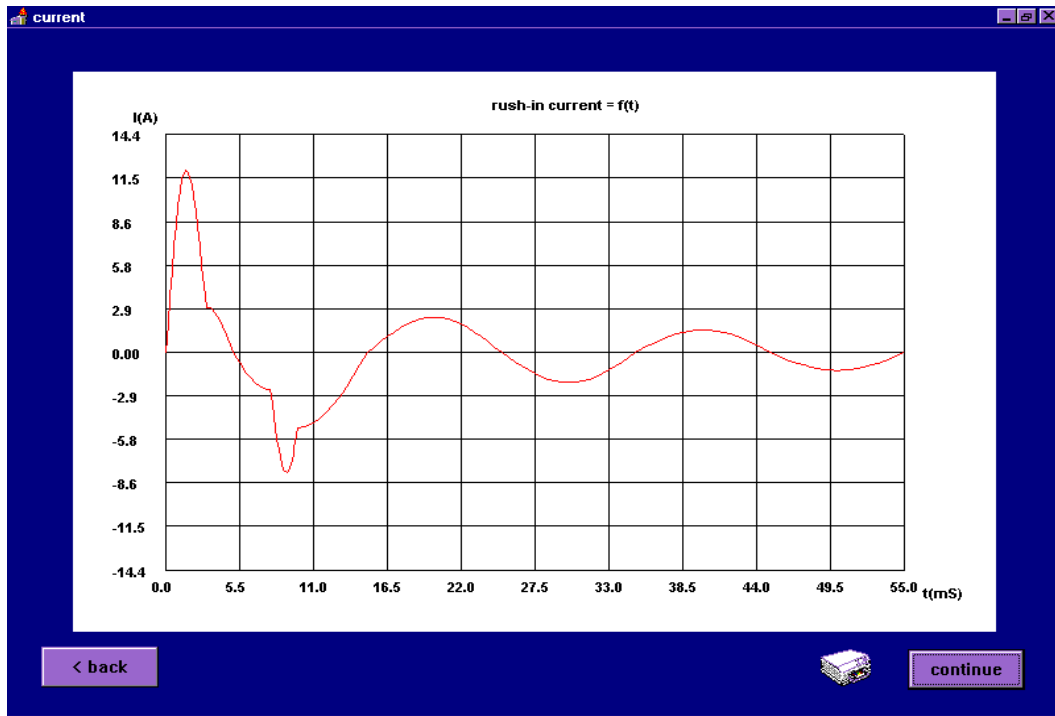


fig. 5: Approximation data graphically

In case the graphic shows faulty (non-preferred) inputs these can be corrected⁶⁾ via the data enter/input form which re-appears when the **back** button is pressed.

Further shown on this screen is a **printer symbol** button that in case pressed creates a hard-copy of the graphic for documentation purposes of your application.

Pressing the **continue** button, the current as function of time result is accepted and will take the user to the fuse-selection part of the program.

5) For plotting this curve a polynom (=line type) method is used which in some cases might introduce some slight swinging/waves.

!!! 6) Note that in case new data is entered, the data in the line 15 needs to be (re)confirmed by double clicking to ensure all the results, as for example all the I2t values, to become re-calculated

Appendix A: Example of approximation

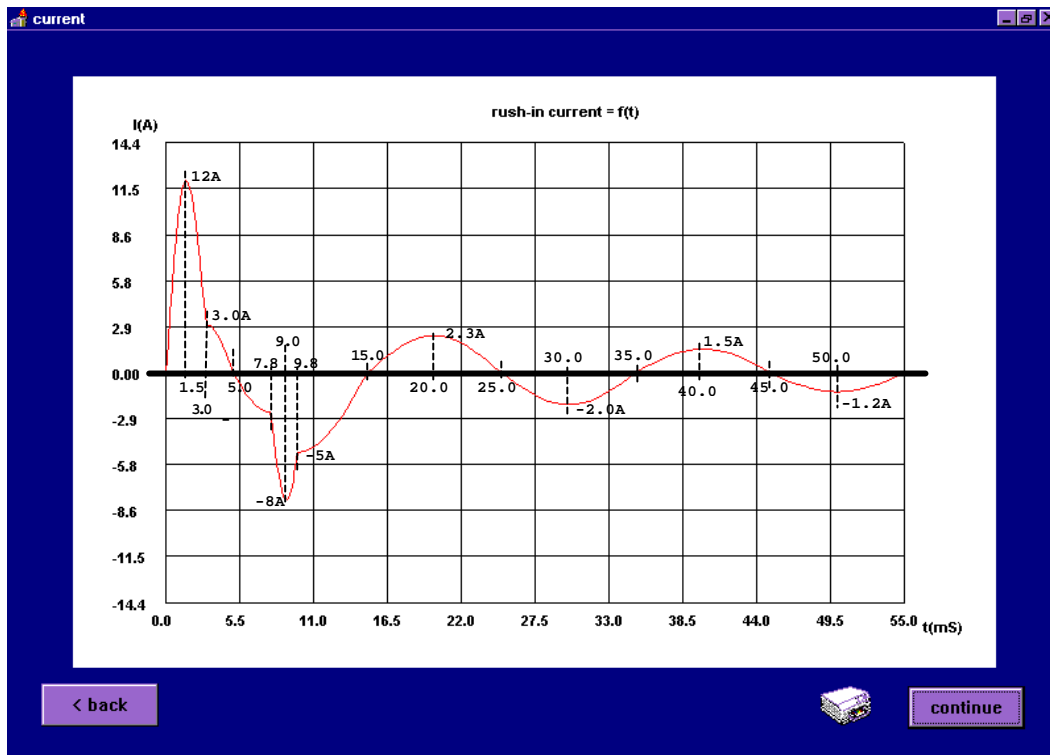


Fig A: Dividing rush-in current into parts

1/4 sine waves approximation

1/4 SINE WAVES APPROXIMATION

t0 (mS)	t1 (mS)	freq (hz)	I(A) at t0	I(A) at t1	I2t (A2s)	neg
0.00	1.50	166.7	0.00	12.00	0.1080	<input type="checkbox"/>
1.50	3.00	166.7	12.00	3.00	0.2338	<input type="checkbox"/>
3.00	5.00	125.0	3.00	0.00	0.2428	<input type="checkbox"/>
5.00	7.80	89.3	0.00	2.50	0.2516	<input checked="" type="checkbox"/>
7.80	9.00	208.3	2.50	8.00	0.2982	<input checked="" type="checkbox"/>
9.00	9.80	312.5	8.00	5.00	0.3371	<input checked="" type="checkbox"/>
9.80	15.00	48.1	5.00	0.00	0.4021	<input checked="" type="checkbox"/>
15.00	20.00	50.0	0.00	2.30	0.4153	<input type="checkbox"/>
20.00	25.00	50.0	2.30	0.00	0.4286	<input type="checkbox"/>
25.00	30.00	50.0	0.00	2.00	0.4386	<input checked="" type="checkbox"/>
30.00	35.00	50.0	2.00	0.00	0.4486	<input checked="" type="checkbox"/>
35.00	40.00	50.0	0.00	1.50	0.4542	<input type="checkbox"/>
40.00	45.00	50.0	1.50	0.00	0.4598	<input type="checkbox"/>
45.00	50.00	50.0	0.00	1.20	0.4634	<input checked="" type="checkbox"/>
50.00	55.00	50.0	1.20	0.00	0.4670	<input checked="" type="checkbox"/>

reset

< back

C:\PULSECHT\DATA\EXAMPLES\SINEXAM.TXT

continue

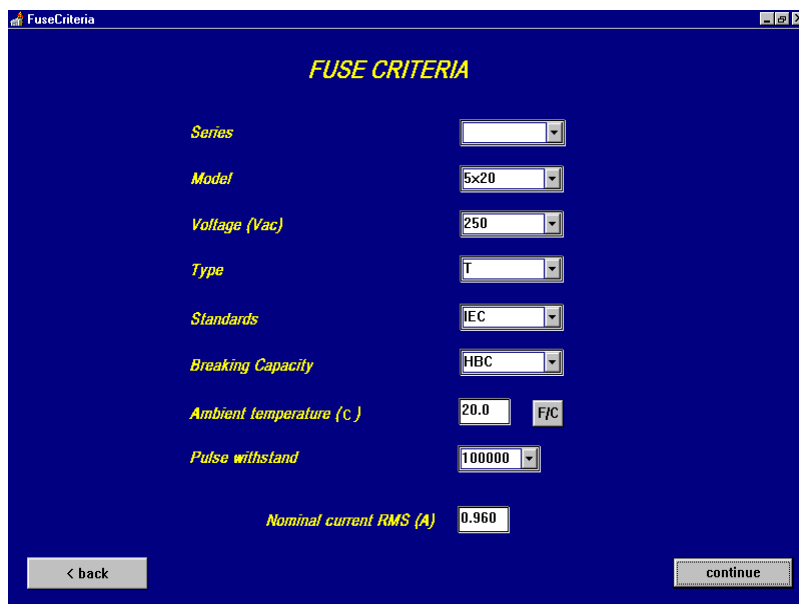
Fig. B: Approximation data enter/input form.

For details see chapter 3.

4. Fuse selection

4.1 Fuse-criteria

After finishing the previous part in which the actual approximation has been performed and accepted the actual fuse selection ¹⁾ is to be done.



The screenshot shows a software window titled "FuseCriteria" with a dark blue background and yellow text. The window is titled "FUSE CRITERIA" in yellow. It contains several input fields for fuse selection criteria:

- Series:** A dropdown menu.
- Model:** A dropdown menu with "5x20" selected.
- Voltage (Vac):** A dropdown menu with "250" selected.
- Type:** A dropdown menu with "T" selected.
- Standards:** A dropdown menu with "IEC" selected.
- Breaking Capacity:** A dropdown menu with "HBC" selected.
- Ambient temperature (C):** A text input field with "20.0" and a unit selector "F/C".
- Pulse withstand:** A dropdown menu with "100000" selected.
- Nominal current RMS (A):** A text input field with "0.960".

At the bottom left, there is a "< back" button, and at the bottom right, there is a "continue" button.

Fig.10: Fuse criteria

To perform a fuse selection, specific fuse-criteria need to be set ²⁾³⁾. The following 2 procedures for this are available:

A) The user, you, needs minimal to set the **model**, **voltage** and **type** fuse-criteria ⁴⁾.

The criteria **standards & breaking capacity** are optional and need not strictly to be set.

B) Set the preferred **series** only ⁵⁾.

Other criteria such as **pulse withstand & ambient temperature** are pre-filled and can be altered here when preferred (default settings: 100k pulses & 20°C ⁶⁾).

The down below box on the screen shows pre-filled the **nominal current** true **RMS** in Amps as derived from the data input (last rows /nominal current chapter 3.1.3).

Sometimes the actual nominal current for an application takes time to settle (several seconds). In such a situation it might be preferred to use for the fuse-selection a current value taken from a multi-meter reading. For this the pre-filled value can be altered manually by clicking the box and entering a new value. Note that a minimum nominal current RMS value of 0.5mA is required.

As soon as **continue** is pressed the criteria are used to fit fuse series & rating. In case no fit is found a message like **no series available** is displayed. The cause often is to be looked for in the criteria.

For example **model** SMF & **breaking cap** HBC are criteria which do not match. Further note that the breaking capacity options LBC,EBC & HBC are strictly related to IEC standards and cannot therefore be used for UL

fuses. Also note that as soon as a criterion box is clicked, even without setting one specific, an option is assumed chosen and therefore might cause no fit to be found. So to disregard a certain criterion the box may not be clicked. In case of such a failure it is suggested to re-start this screen via the previously shown approximation curve screen via the back button or clicking in case present the *.* option.

In case on pressing continue more than one fit is found the series options to select from are displayed at the bottom of the screen. The one preferred is to be chosen first. So with this program only one in the time fuse series & rating can be selected.

In case one fit is found on clicking continue the following screen Data logs is opened. On clicking the **back** button the tester is taken back to the approximation data enter/input form (see chapter 3) to re-start the enter/input process for example for checking other pulses. Note that the present results will be lost in case not saved (see chapter 4.3).

!!! 1) In general to come to a fuse-selection technical back-ground info and knowledge is required on the application such as primary or secondary circuitry.

2) set = select by single click from pull down menu options (criterion box):

3) The less criteria the less chance of no fits will be found (see below).

4) Fuse-criteria as determined by the application

- Which model [SMF, 5*20mm etc] ?
- Which voltage [250V, 125V etc] ? [voltage set = minimum voltage rating]
- What type [F/T] ?

5) All fuse-criteria are set depending on the fuse-series. As soon as the series box is clicked all other criterion boxes, set or not, are removed because these are not relevant anymore.

6) To change the temperature units press the F(ahrenheit) / C(elcius) button.

4.2 Data filing logs

A single fit (see previous chapter) was found and the user is now requested into this screen to enter some logs (description of selection) for filing purposes (data logs).

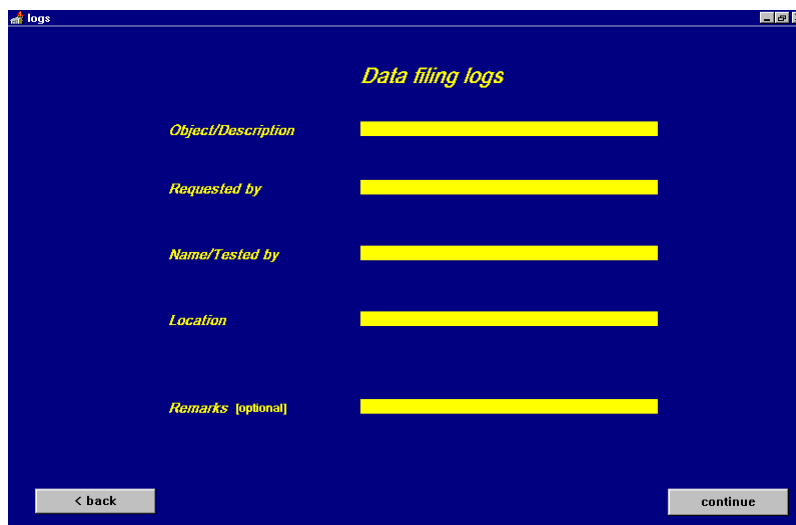


Fig.6: Data logs

When the Data logs screen is filled in, remark note not required, and **continue** is clicked, the final output is displayed. In case in the Data logs screen the **back** button is clicked, the user is taken back to the previous fuse selection screen.

4.3 Output

In case the final output (see also example in chapter 1.5) is shown and the **back** button is clicked the user is taken back to the fuse selection screen (see chapter 4.1) to change for example the fuse series & rating selected.

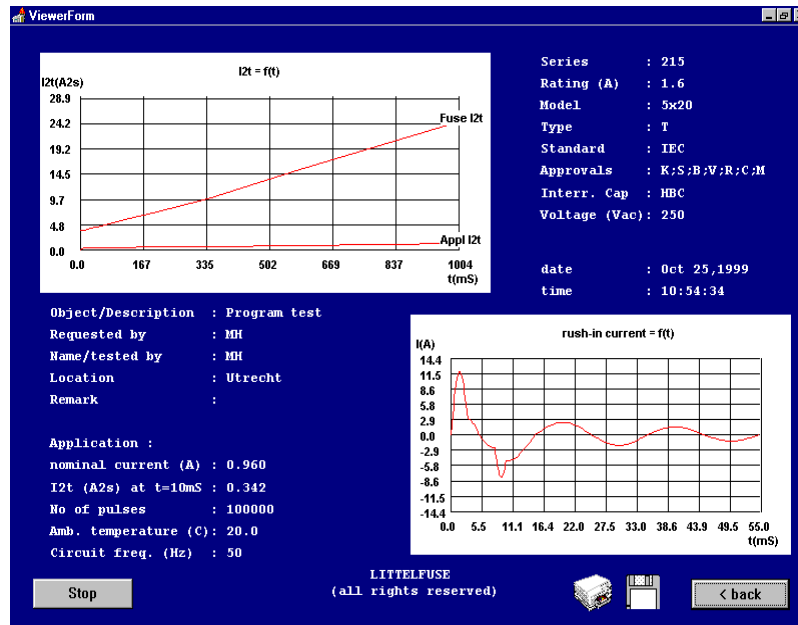


Fig.7 Output

The output can be hard-copied by pressing the **printer symbol** (=similar to button). When the printer symbol is pressed the user is requested via a standard Windows dialog box to enable the printer installed and to select a paper size.

In cases only of a new measurement or a new fuse-selection a **save symbol** (=similar to button) is shown. By pressing this save symbol all relevant information can be stored in preferably a customer related sub-folder (see chapter 1.4.1).

For completion also shown are the date & time as well as the logs entered previously. Note that further for indication purposes only the I2t value is shown for the application after 10mSec.

If the **stop** button is pressed before saving the results these are lost because a full program stop is performed.

As for all Windows dialog boxes, pressing cancel results in that the active program form is re-displayed. This is helpful when for example the screen is destroyed partly by running an other (Windows) application.

- END -