SafeFIT

A reliability software for computation of hardware failure rates

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1   Introduction

SafeFit is part of the SafeSuite family of products, which aid in the development of projects following common industry's safety standards.

SafeFit focuses on the reliability prediction of electronic equipment. Reliability of a component is summarized in a so-called FIT value (Failure-in-time), which is calculated according to several rules from a chosen standard.

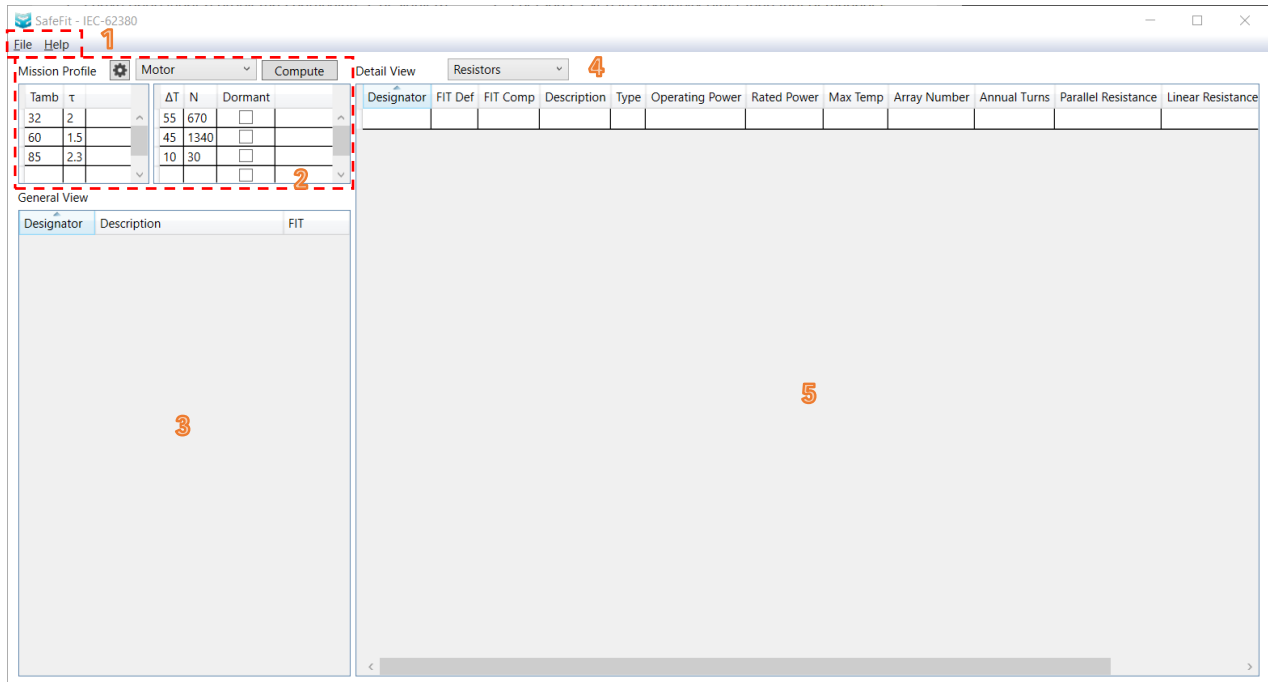SafeFit currently supports these reliability prediction standards:

- IEC 62380 (International Electrotechnical Commission)
- MIL 217F (USA Military)

1.1   Features

- Support for IEC62380, MIL217F.
- Import/Export of data in CSV for interoperability with external programs.
- Save/Load data in custom format enabling app-specific features.
- Grid-based, single-view interface.
- Fully keyboard and mouse enabled. Copy/Paste support to/from clipboard.

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2   Usage

2.1   Application parts

1. **Menu**
    a. **File > (New > (IEC-62380 | MIL-217F) | Load | Save | Import | Export | Exit)**
    b. **Help > (About | License)**
2. **Standard's global parameters**
3. **General view grid**
4. **Display component selector**
5. **Detail view grid**

The above screenshot shows the initial state of the main window, which by default uses IEC-62380.

The global parameters section is standard-specific. Further details are discussed in their own section. There is a "Compute" button for quick batch recalculation when global parameters are changed. Per component re-calculation however, is also done after any row editing.

The general view is intended for quick review of current loaded components. Supports sorting of its columns for easier navigation.

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The detail view is where all components are added/removed, and its details edited. The current component type in display is selected through a combo box. Component types depend on the standard too, but are quite similar nonetheless. The grid supports sorting and column reordering.

2.2   Licensing

The application has three licensing states:

- Unlicensed/invalid/expired license: in other words, no license.
- Demo license: expires after a time interval (14 days).
- Full license: lifetime license.

The "No license" state blocks the Save, Import, Export features. Loading is still possible for demo purposes, but severely limits the application's usability.

A license can be requested with the "Help > License" dialog. The dialog shows brief instructions, which are hereby developed:

1. Select the desired license type: either "Demo" or "Full". The full license requires an order ID.
2. Click the "Generate" button, which creates several files and opens their location on disk.
3. Send the file named "LicenseRequest.dat" to the e-mail address support@safetwice.com
4. The e-mail will be replied (if all is correct) with a file "License.dat". Copy this file to the same place where the request is located.
5. Close and reopen the program for the license to get detected.

> NOTICE: the license folder can be quickly found with the "Find" button in the "License" dialog. It should be in "C:\Users\<USER>\AppData\Local\SafeTwice\SafeFit\License".

> NOTICE: to be able to regenerate the license request, if required, delete from disk the files "LicenseRequest.dat" and "PrivateKey".

> NOTICE: the ".dat" extension is important. Add it in case it is missing in the "LicenseRequest" or "License" files. Otherwise the application will not properly recognize the license.

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> **NOTICE:** a license is only valid for the computer it was generated in.the ".dat" extension is important. Add it in case it is missing in the

2.3   Standard selection

The currently used standard can be selected through the "File > New" menu. This clears current data and initializes the workspace for such standard.

Additionally, when loading a project file, the appropriate standard for the project is loaded seamlessly.

The current standard is always indicated in the app's title bar.

2.4   Detail view workflow

There are four common columns used by all components:

- Designator
- FIT Def
- FIT Comp
- Description

The designator value depends on the selected component and the standard. Valid values are shown in this document. However, they follow the rule: "<name><number>[<subitem>]" (R1, C1, U1A, …).

- Name: standard designator, e.g. R – Resistor, C – Capacitor, etc.
- Number: any positive number.
- Subitem: optional upper-case letters for further categorization.
- "FIT Def" stands for defined FIT, which is an independent cell included for reference/comparison purposes.
- "FIT Comp" stands for computed FIT. These cells are not directly editable, but change according to the calculated FIT for the current input parameters.

In general, a cell with invalid data, e.g. negative value for a positive only decimal value, is marked with a red border.

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The application, according to the standard in use, groups components into single or groups of several electronic components, e.g. resistors or optoelectronics.

The "Type" column is somewhat special and indicates the actual component type in groups of components, or component subgroup. This is very intuitive in general.

Some columns may appear grayed out, meaning that its value is not necessary for the calculation of the FIT for the selected type.

When all required values are filled in, the FIT is automatically computed. This is also the case when editing an existing value. However, global parameter changes require batch recomputation with the "Compute" button.

The grid supports copy/paste both between itself and external programs, since it uses the system's clipboard. Hence, data in the clipboard with tabular format (e.g. Excel) can be easily pasted into the program. Either row, column or rectangle selection is supported. Pasting however, will only work when the input data and the target cells have the same data types. The user can move data to/from Excel this way, for instance, and experiment with the feature.

> **QUICK TIPS:**
>
> - Cells can be empty. Press "Backspace" key with a cell selected in order to clear it.
> - Rows are added filling in the cells of the last row and pressing "Enter" key.
> - A single row can be deleted fully selecting by clicking on the row header and pressing the "Del" key.
> - All rows of the displayed component can be deleted with "Right Click" > "Delete Rows".
> - All cells of a column can be cleared with "Right Click" > "Clear Column".
> - Similarly, copy and paste operations are available through the context menu ("Right Click") as well as with the system's usual "Ctrl-C", "Ctrl-V" key shortcuts.

2.5   Import/export

The application can read and write CSV files. This enables interoperability with external programs like Excel for instance. However, this becomes more interesting with the fact that PCB board designers like "Altium Designer" can export the BOM (bill of materials) in CSV with extra,

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configurable parameters per component. Thanks to this, once the external program is correctly configured, the calculation of the FIT of all components in the BOM is quick and error-free.

The CSV format requires a minimal compulsory header of just one column: "Designator". All other columns are optional. Values of optional columns are also optional, i.e. empty values are allowed.
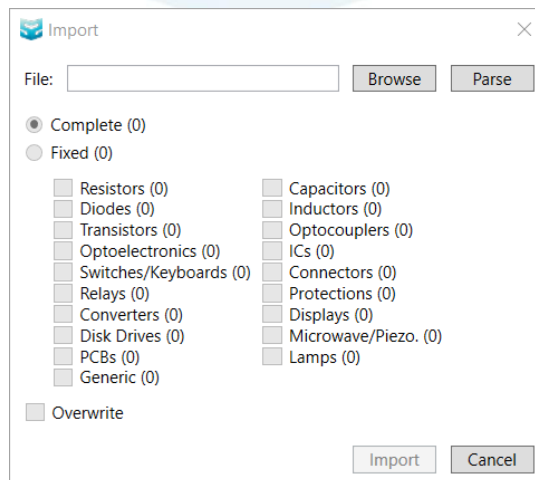
There are columns of various types:

- String: accepts any value, since CSV data is text by definition.
- Decimal: integral or decimal values, in exponential notation too.
- Enumerable (list): accepts either an integral value in the range of index values (zero-based), or the exact string value of one of the items in the list.

The type of a column is predefined and can be reviewed in the appendix of a given standard (in this document). Watch out for units in numeric values.

Note: when importing CSV data, make sure that the app's selected standard matches that of the CSV, or else there will be import errors (likely interrupting the import process).

2.5.1   Import dialog

A CSV file is selected by clicking "Browse" and searching for it with the usual system's file explorer.

The file is automatically parsed when browsed. If a path exists in the textbox and the user wants to reload it, it can be done by clicking "Parse".

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File contents can be imported completely ("Complete" option) or in parts ("Fixed" option plus individual component checkbox selection).

Imported data components type and number can be reviewed easily.

Imported data can either be appended ("Overwrite" unchecked) to existing data or it can replace existing data ("Overwrite" checked).

Final importing into the current project dataset is done by clicking "Import".

2.5.2   Export dialog

The current data set can be exported completely ("Complete" option) or in parts (other options).

Included column headers depend on the selected option. "Complete" includes all columns. "Fixed" includes only those selected, independently of having existing items or not. "Current" exports current selected component in the detail view. "Compact" exports all with existing items.

Select "Existing Only" to export only selected components with non-zero items.

Click "Export" to accept and finish the export operation.

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2.6   Save/load

The project file has ".sfit" extension. This file enables app-specific functionality that CSV import/export features cannot provide. Among other features, it stores the current standard in use and its global parameters.

Save/load of project files is done through the "File" menu.

3   IEC 62380

Global parameters for IEC-62380 are called "Mission Profile". These include several thermal phases (each characterized by an Ambient Temperature and a time ratio Tau) and several thermal cycles (each characterized by a temperature Delta, a Number of cycles, and a Dormant parameter).

Standard mission profiles from the IEC 62380 TR can be easily selected through the "cog" button (mission profile settings). After any change, the "Compute" button must be clicked for a complete recalculation.

The "Delta Temperature" parameter of the mission profile can be overridden in some components of the standard that include an auto-heating term in their FIT formulae. The appropriate column is "Delta T" (in Celsius).

> NOTICE: "Delta T" override functionality can be used to apply a complex thermal scheme to the calculated system. When empirical auto-heatings are not available, SafeFIT will use calculated predictions based on component characteristics and electrical operating conditions.

> NOTICE: "Dormant" check box can be used to define a thermal cycle for a dormant or off state of the system (no auto-heating considered). Please check IEC 62380 TR for further information.

For a complete list of components, designators, parameters and values, see the appropriate standard reference for SafeFit.

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4   MIL 217F

This standard's global parameters are only "Ambient Temperature" and "Environment" type.

Many components have "Type" and "Style" (or subtype) columns. Parameter values that are input via a list require a component's type to be committed before allowing further input. Make sure to press enter (commit) after creation of a component with its type before filling in the rest of the parameters. This also sets up the appropriate parameter vs. type sensitivities.

In general, "Type", "Style" and "Quality" columns are shared among most of the components of the standard.

The profile's ambient temperature is overridable in many components using the "Tamb" column.

> NOTICE: "Tamb" override functionality can be used to apply a complex thermal scheme to the calculated system. When empirical temperature measures are not available, SafeFIT will use calculated predictions based on component characteristics and electrical operating conditions.

Several components with an auto-heating factor provide two ways to input the auto-heating required parameters: either use "Power" and "Rth", or "Tj" (junction temperature – has precedence).

> NOTICE: When "Tj" is provided, SafeFit will use it to calculate component's self-heating. When it is not provided, SafeFit will do calculations based on thermal resistance (Rth) and electrical power (Power).

For a complete list of components, designators, parameters and values, see the appropriate standard reference for SafeFit.

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