fiXtress | Virtual PCB Prototyping Tool for Stress Detection

Product Overview and Data Sheet

Overview

With today's design complexity and challenges, designers are required to deal with many complex issues. Power analysis has become an important issue in achieving design success. Today's power dissipation is a mainstream challenge and a major concern for a more reliable and cheap product with a rapid design cycle.

The fiXtress compares circuit simulation results to a component's power safe operating limits and therefore identifies problematic components. The fiXtress alerts about stressed components due to power dissipation, junction temperature and Current/Voltage violations. Power and temperature violations are a critical design delimiter. It affects the MTBF, design performance, packaging and cooling requirements.

The fiXtress leverages a broad range of sophisticated algorithms using a unique approach, which allows PCB designers the ability to perform a PCB-level simulation that includes easy to get and realistic electrical stress models. Design problems can be discovered earlier in the design process, reducing the number of prototypes needed to validate the design.

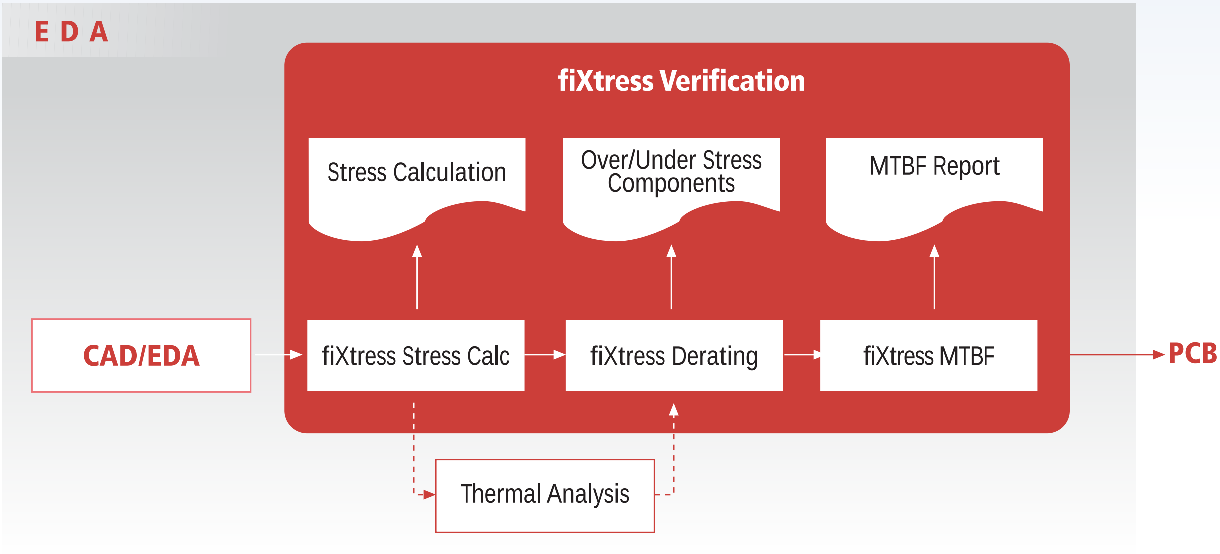
Key Benefits

- Simulates digital, analog, RF and passive components including high frequency Bus-Simulation
- Prevents PCB failure by warning which components are over stressed due to power dissipation or violation of voltage or current limits
- Reports under stress components
- Validates PCB predicted MTBF result against the MTBF design criteria
- Lets designers fine tune component rating values faster than a trial and error testing to meet exact power performance goals
- Allows electronic circuits to be simulated for detecting early design problems
- Problems can be identified in an early stage when their correction is easier and less costly
- Allows a comprehensive PCB faults verification
- Makes it easy to define any component in the circuit simply by entering available data from the component's datasheet, without the need to build time-consuming complex models, like SPICE
- Simulates and detects fan-out for IC's and connector current problems
- Accelerates PCB design cycles for rapid time to market
- Can be used and combined with any EDA tool to support advanced PCB analysis
- A short-term training, an easy-to-use software

General Introduction

With today's increasingly large and complex digital and analog system designs, power enclosure design and circuit power integrity have become the main engineering challenges, thereby influencing the device's total time-to-market.

Whenever the industry moves from one technology node to another, existing power constraints are tightened and new constraints emerge. Power-related constraints are now being imposed throughout the entire design flow in order to maximize the performance and reliability of devices. In the case of today's extremely large and complex designs, implementing reliable power networks and minimizing power dissipation have become major challenges for design teams.



fiXtress - Automated Electrical Stress Verification Tool

Creating optimal power designs involve making tradeoffs such as reliability-versus-power and area-versus- power at different stages of the design flow. Successful power-sensitive designs require engineers to have the ability to perform these tradeoffs accurately and efficiently. In order to achieve that, engineers require access to appropriate power analysis and optimization tools, which need to be integrated with the verification process of the system design.

The sheer amount of power consumed by some devices can cause significant design problems. For example, IC fan-out is determined by the amount of input current a gate load draws, and how much output current the driving gate can supply. In reality, a limit will be reached where a gate output cannot drive any more current into subsequent gate inputs; attempting to do so will cause the voltage to fall below the level defined for the logic level on that wire, resulting a failure in design.

Another example: if the current across the resistor is increased by a fault design close to it’s maximum power rating, then the resistor will develop more voltage and therefore dissipate more power. This can cause overheating and burning of the area around the resistor, and in some cases cause the entire circuit to fail.

Today’s design requires very complex IC functionality. Low power dissipation and high operation frequency with low power consumption are just few challenges that IC circuit designers have to face. BQRs fiXtress tool can report on IC breakdown voltages, forward diode currents, power dissipation and junction temperatures - valuable inputs to the designer.

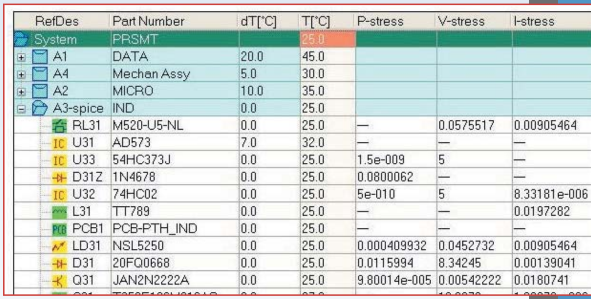
The Solution

Using sophisticated algorithms, fiXtress optimizes PCB design by eliminating stress problems. fiXtress interfaces with any leading EDA software. fiXtress provides the fastest, most accurate and highest capacity simulation engine to evaluate reliability, availability and maintainability early in the design cycle. It utilizes four analysis types - DC, AC, Bus simulation and accumulation.

fiXtress quickly identifies design errors and provides a detailed and comprehensive analysis of the PCB - including calculation of the stresses applied to all components - discrete, analog and digital ICs. As these calculated stresses are compared to de-rating curves, fiXtress highlights over-stressed and under-stressed components. Based on this information, fiXtress accurately predicts the PCB MTBF and indicates the components most likely to fail.

Stress and De-rating Analysis

PCB designers try to design their circuit for specific voltage, current and threshold values for power dissipation, output current, junction temperature and frequencies. Being given these rated values, the designer chooses to adjust the design to minimize the stress on the components. This practice, known as "de-rating", is a technique through which either stresses acting on a part are reduced, or the strength of that part is increased by replacing it with a component with higher rated values. This analysis is usually performed by hand, and summarized in a spreadsheet format. fiXtress, however, can determine the applicable stress automatically under any EDA tool. Performing this analysis before the component's placement and the manufacturing of the PCB, assures the proper component selection and saves redesign time, maximizing the circuit performance and reliability parameters.

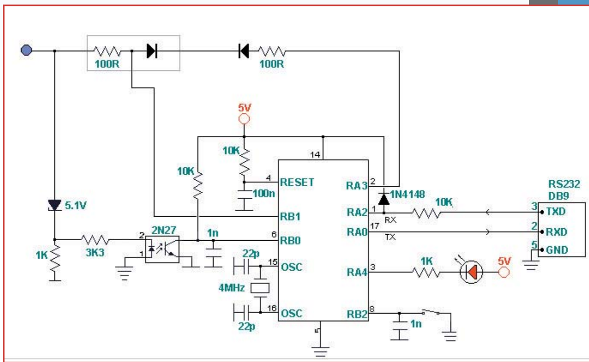


RefDes	Part Number	dT[°C]	T[°C]	P-stress	V-stress	I-stress
System	PRSMT		25.0			
A1	DATA	20.0	45.0			
A4	Mechan Assy	5.0	30.0			
A2	MICRO	10.0	35.0			
A3-spice	IND	0.0	25.0			
RL31	M520-U5-NL	0.0	25.0	—	0.0575517	0.00905464
U31	AD573	7.0	32.0	—	—	—
U33	54HC373J	0.0	25.0	1.5e-009	5	—
D31Z	1N4678	0.0	25.0	0.0800062	—	—
U32	74HC02	0.0	25.0	5e-010	5	8.33181e-006
L31	TT789	0.0	25.0	—	—	0.0197282
PCB1	PCB-PTH_IND	0.0	25.0	—	—	—
LD31	NSL5250	0.0	25.0	0.000409932	0.0452732	0.00905464
D31	20FQ0668	0.0	25.0	0.0115994	8.34245	0.00139041
Q31	JAN2N2222A	0.0	25.0	9.80014e-005	0.00542222	0.0180741

fiXtress Analysis Results

Interface Analysis

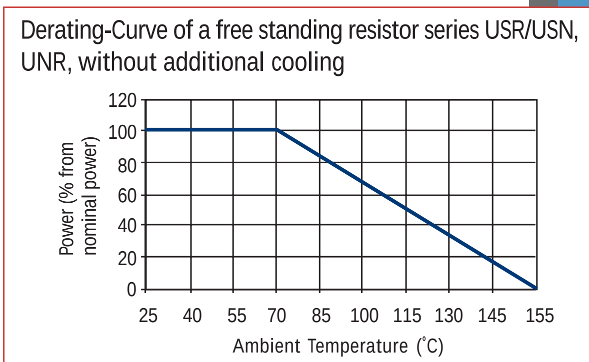
fiXtress also performs interface analysis, assuring that each interface meets the output and input requirements to perform a given function. In digital circuits, this means that every digital/analog output will be matched by a compatible input, and that the fan-out requirements are met. As an example, an interface analysis might be used to assure that FPGA pins are fully enhanced and also fully depleted in order to assure full circuit performance.



Circuit Example

Electrical Stress

To measure the electrical stress on each component in the design phase of an electrical circuit is not an easy task. Many parts have several parameters which must be assessed, including their electrical relation to adjacent components and to the entire circuit. For example, for a capacitor, working voltage as well as ripple current must be determined. For a resistor, it is power consumption as well as power-peak or voltage. For diodes, it may be reverse voltage, junction temperature, forward current and AC effects. The electrical stress information for all electrical circuit parts are fed into the fiXtress tool, which provides accurate power dissipation and thermal heat information on each component to meet reliable stress calculation and design requirements.



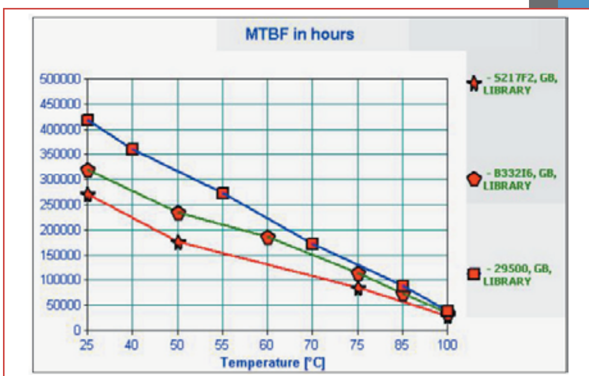
Derating curve sample

Optimal Parts Selection

Enables to select the optimal rating of each component: for an overstressed component to select a higher rating value (larger physical size generates higher reliability), and for an understressed component to select a lower rating value (smaller physical size saves PCB room).

Design to Reliability

Unlike standard Parts Count analysis, that uses a generic default for the stress applied to each component type, fiXtress uses the actual stress applied to each component. Components in equipment may not always operate under the reference conditions (parts count). In such cases, the real operational conditions will result in failure rates different from those given for reference conditions. To be able to follow accurate design criteria, fiXtress uses actual temperature and actual electrical stress imposed on each component.



MTBF Graph

fiXtress increases system design reliability by using a four-stage analysis:

1. Performing comprehensive verification of circuit physical faults such as shorts and disconnections.
2. Complete analysis of the entire system stress characteristics, including temperature, frequencies, voltage, current, and power developed on each component and pin.
3. Comparing the stress results to de-rating curves to identify design faults. Recommendations to solve the stress problem are provided.
4. System MTBF prediction using a choice of industry standard methods to meet various environment requirements.

Key Features

- Imports PCB Bill of Materials (BOM) and Netlist directly from all major CAD tools as well as Excel/CSV import
- Allows automatic IC data import from leading CAD and design tools
- Guides users through the entire simulation process, step-by-step, by means of a friendly online Buddy-Wizard
- Takes into consideration over 40 types of component groups
- Provides the current in each IC pin and connector pin
- Provides the current needed from each external power supply
- Designers can easily investigate power dissipation and operational current of voltage regulators and DC/DC converters used in the design with changing operation frequencies
- Can use results from Signal Integrity analysis to affect the stress caused by high frequency (above 200 MHz)
- Performs a high-edge profile analysis and finds worst-case scenarios
- Designed for quick and easy changes and updates of the PCB design
- Provides recommendations when overstress is detected
- Allows user-defined de-rating curves in addition to predefined de-rating curves
- Manages project trees, the core-database and HTML reports
- Predicts failure rates according to numerous standards allowing simulation of different environments (M217, M217+, IEC62380, Bellcore, HRD5, SN-29500 and FIDES)
- Provides optimization and curve sensitivity for Ambient/Case temperature, quality levels, environments and prediction methods

fiXtress versus SPICE

Unlike SPICE, fiXtress can handle large PCB's with thousands of components, including FPGAs with more than 1,000 pins each, not only analog circuits. fiXtress provides the results in a tabulated form for easy de-rating analysis.

SPICE analysis has traditionally been used in areas such as IC design and power analog devices, which requires a high level of accuracy and wave view. However, in the PCB and systems domain, the SPICE method has several disadvantages over fiXtress for both the PCB designers and the device vendor.

SPICE normally simulates a model of a circuit at transistor level. These simulations must contain detailed information about the circuit and process parameters. Most IC vendors consider this type of information proprietary and resist making their models available to the public. Contrary to the SPICE models, fiXtress uses standard data sheets available to the public with no need for proprietary information.

SPICE simulation accuracy is typically very good. However, simulation speeds are particularly slow for transient simulation analysis, which is most often used when evaluating power dissipation and signal integrity performance. fiXtress simulation speed is much faster than SPICE simulation, and allows what-if analysis very quickly.

Finally, not all SPICE simulators are fully compatible. Often, default simulator options are not the same in different SPICE simulators. Even though there are some very powerful options which control accuracy, convergence and the algorithm type, any options which are not consistent may cause poor correlation in results across different simulators. Moreover, because of the different variants of SPICE, these models are often incompatible between simulators; thus models must be extracted for a specific simulator.

About BQR

Established in 1989, BQR provides software tools and consulting services for Reliability, Availability, Maintenance and Safety (RAMS) and Integrated Logistic Support (ILS). Over the years BQR has successfully completed thousands of projects for major customers around the world. The propriety know-how that BQR has developed over the years has been encapsulated in the fiXtress package and is now being provided for customers.

Contact Information

FlowCAD

Mozartstrasse 2
D-85622 Feldkirchen
GERMANY

Tel: +49 (89) 4563-7770
Fax: +49 (89) 4563-7790

www.FlowCAD.de
MTBF@FlowCAD.de