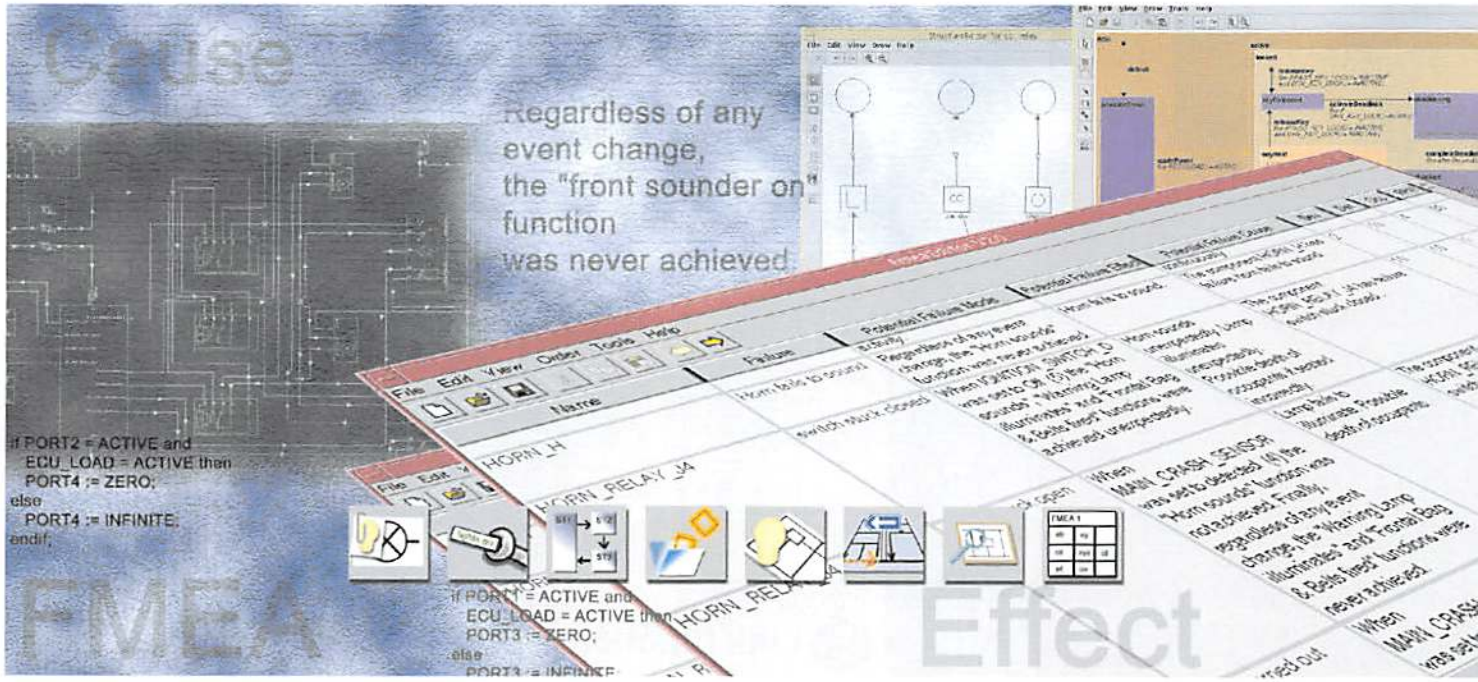
AutoSteve 2



6 steps to automated FMEA generation

Reduce the time spent producing Failure Mode and Effects Analysis (FMEA) for electrical circuits. In 6 easy steps you can transform your electrical schematics into an automatically generated FMEA report.

AutoSteve simulates the behavior of electrical circuits and automatically produces an FMEA report that describes the effect of failures on the circuit's functionality. It provides visual feedback of circuit operation to verify correct behavior and to illustrate faulty behavior. It detects sneak paths with high accuracy and minimal effort. It automates most of the previously time consuming, repetitive and laborious task of producing FMEA reports, providing important design feedback to engineers.

The FMEA results are presented in an easy to read textual form, and are similar to those that an engineer would produce. These results can be viewed on screen in the FMEA Editor, printed, or exported to FMEAplus. The results of a particular failure can be viewed graphically through coloring of the schematic and through animated component state machines.

AutoSteve uses qualitative simulation to perform FMEA; therefore, models are easy to build and don't require the detail necessary for numerical models. As a result, FMEA can be performed much earlier in the product lifecycle, giving you time to act on the results.

Using the same qualitative models you can find and eliminate hidden sneak paths in your circuit using the powerful Sneak Circuit Analysis tool.

Just because your circuit designs are complex, generating the FMEA doesn't have to be.

FIRSTEARTH
Automating Design Analysis

AutoSteve FMEA process

AutoSteve automates much of the FMEA process for electrical system designs. It does this by simulating the behavior of a circuit for each of the failure modes of each component in the design.

Once you have drawn the circuit design in your ECAD tool, for example TDT's TransCable or Mentor Graphics' LCable, you can prepare your schematic for simulation and FMEA generation.

Much of the information entered during this process is stored for re-use in future designs. This approach minimises the time, effort and cost required to prepare a circuit for FMEA.

AutoSteve simulates failures on each component in the schematic, and recognises the system level effects that occur because of those component failures. Risk priority values (severity, occurrence and detection) are assigned for each failure.

AutoSteve is able to do this at an early stage in the design process - as soon as the intended behavior of components is known. This is long before FMEA is typically completed for car systems, giving early feedback on any problems with the design.

1 Attach component models

For AutoSteve to simulate the behavior of the circuit, each component needs to be linked to a Component Model. A library of common components is supplied, containing components such as wires, lamps, motors, switches and relays. The ComponentBuilder enables you to define new models for components specific to the circuit you are working on (see box "Modeling with AutoSteve").

2 Define function labels

The next step is to describe the functions that the circuit can achieve. The functions are called *function labels* and are defined using the FunctionBuilder.

The function labels may be a single text label or combinations of other functions. The example (right) shows the functions for an airbag system, with details of the *Driver side bags fired* function. These function definitions are not associated with any specific schematic and can be reused on different versions of the same subsystem.

For each function, you specify the severity and detectability values used in the calculation of the RPN. These values are defined for both when the function fails to occur and when it occurs unexpectedly.

3 Link functions to the circuit

The final step in preparing the circuit for simulation and FMEA generation, is to link the function labels to the circuit. A particular function label model (which contains the functions for a particular subsystem) is associated with the circuit to be simulated. Next, you define how the functions are achieved in terms of the components in the circuit. An example is defining that the *Driver side bags fired* function occurs when current is flowing through the relevant airbag igniter components.

4 Simulation

Once the component models and function labels are linked to the schematic, you can run a simulation to check that the circuit is working as expected. The simulation colors the schematic to show circuit activity and current direction.

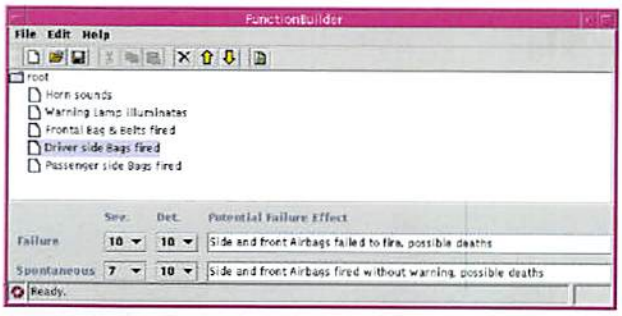
5 FMEA generation

The final step before running an FMEA is to define a scenario. This involves specifying a sequence of events, e.g. activating a switch, and the failures to be simulated. The scenario is saved and can be reused with modified versions of the schematic.

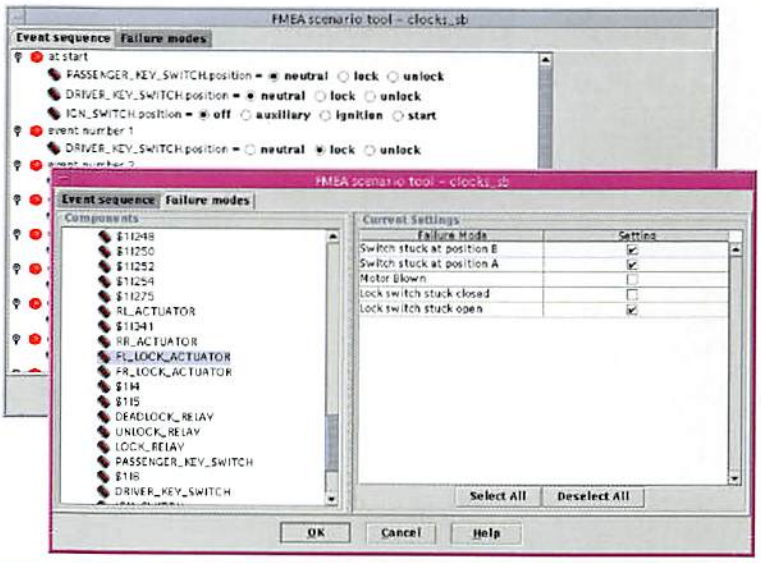
It is possible to select all possible failures to be applied, or to just apply selected types of failures. An AutoSteve FMEA can also analyse all the possible double failures or all multiple failures up to a defined occurrence threshold, the default being 10^{-9}.

6 Interactive FMEA examination

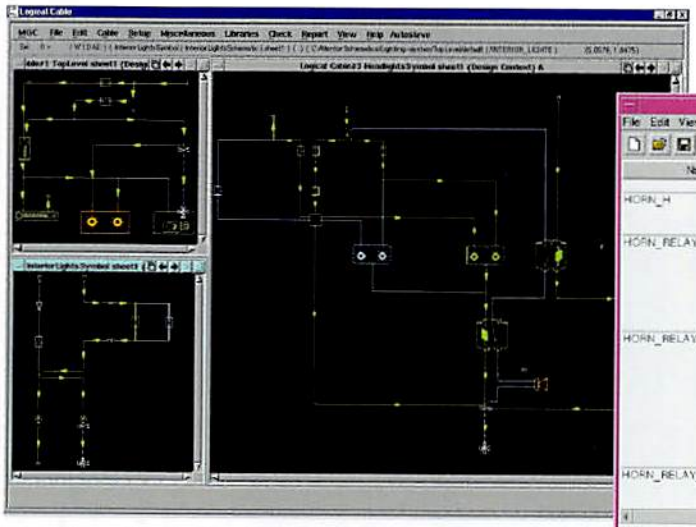
The results of the automated analysis are presented for examination and amendment. The results can be viewed on the screen in a similar format to the paper based FMEA form, but with the benefit of being able to arrange the results in several different ways. You can invoke the simulator to perform a simulation of the circuit with a particular fault present, in order to gain more information. Additionally, you can edit the RPN values of the text before printing the report or exporting it to FMEAplus.



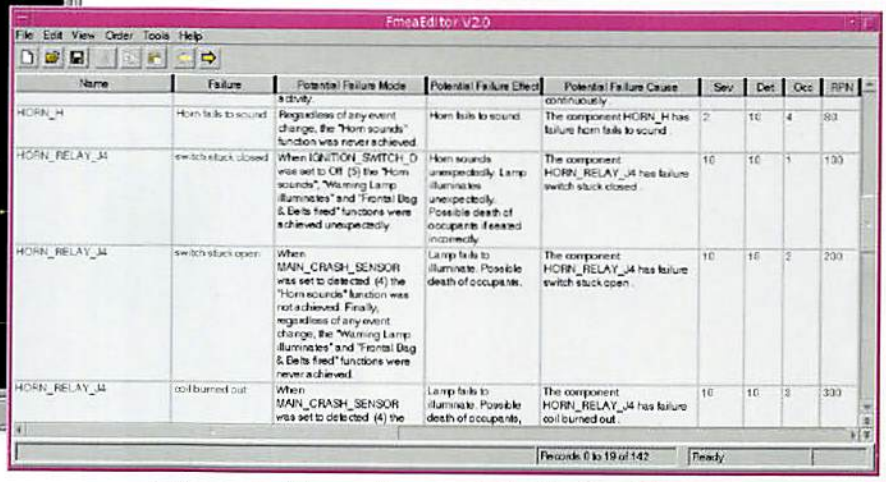
▲ Define function labels and their severity and detectability values.



Define the sequence of events and failures to be applied during the FMEA generation. AutoSteve can perform single and multiple failure FMEA. ▶



▲ Display the circuit activity for any stage of the simulation in your ECAD tool.

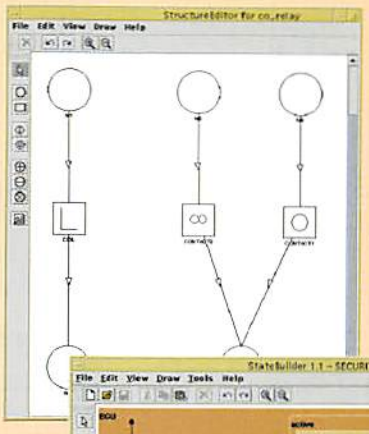


▲ View and edit the resulting report using the FmeaEditor.

Modeling with AutoSteve

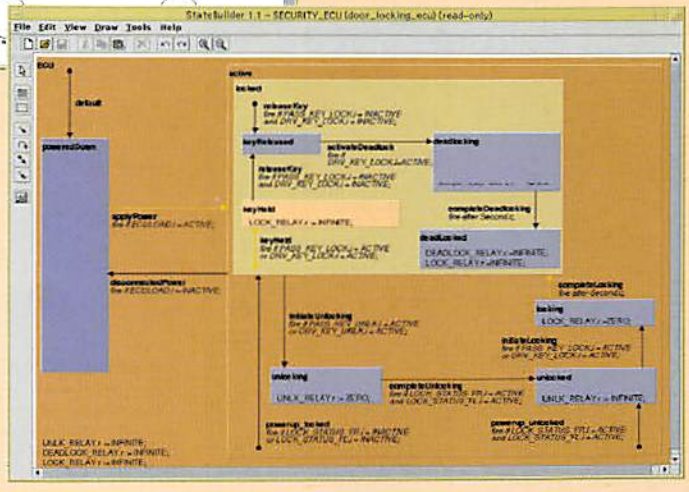
A component model is required for each class of component. This model describes the structure and behavior of a component under both normal operation and under any failure modes. The models used in AutoSteve are qualitative rather than quantitative. As such, they are much easier to define and can be built earlier in the design lifecycle.

The structure of a component is defined as a network of resistive nodes. The nodes take one of three values: ZERO, LOAD or INFINITE. These values are used during simulation to determine if current can flow through the various sections in the component. There are additional types of resistance nodes for use in modeling source and sink connections such as required in an ECU. The terminal pins correspond to the pins on the actual ECAD component drawing.



◀ Describe the structure as a network of resistive nodes. View the current direction for each step in the simulation.

▼ Use state charts to describe complex behavior. View the active states for each step in the simulation.



The behavior describes how the resistance values change as a result of the changing inputs to the component. There are two ways to provide this description:

- Expressions - define expressions that describe the state of the resistances under certain conditions. Expressions are written as if-then-else statements.
- State Charts - more complex component behaviors can be modeled as state charts.

In addition to describing the normal operation of the component, it is necessary to define the different component failure modes to be explored in the FMEA. For each failure mode, you describe the way in which the failure mode affects the component. This may be a structural change, a behavioral change or a combination of the two.

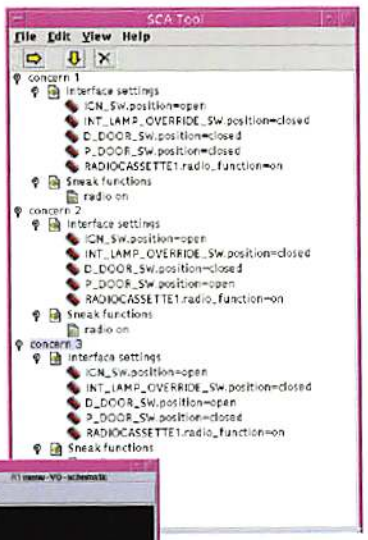
Key Features

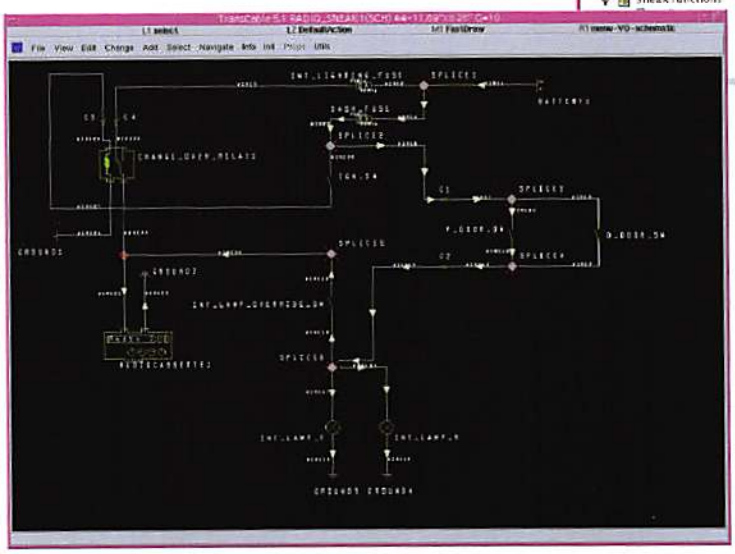
- Supports engineers by automating key stages of FMEA production.
- FMEA results are presented in an easy to read textual form, similar to those that an engineer would produce.
- Analyses a schematic in minutes.
- Information entered into AutoSteve can be reused with other schematics, therefore reducing the amount of information to be specified for new schematics.
- Models complex component behavior, e.g. ECUs, using state machines.
- Close integration with your ECAD tool.
- AutoSteve uses qualitative simulation to perform FMEA; therefore, models are easy to build and don't require the detail necessary for numerical models.
- View results of a particular failure graphically through coloring of the schematic and component state machines.
- FMEA report can be exported to other FMEA result handling software, e.g. FMEAplus.
- Find Sneak Circuits with the SCA tool.
- Perform single and multiple failure FMEA.
- AutoSteve is supplied with a library of common component models.
- Use AutoSteve's simulation tools to perform *Virtual Yellowboarding* - proving that the schematic works as designed, long before a physical prototype becomes available.
- QS9000 compliant results.

Sneak Circuit Analysis

The simulation facilities and function information in AutoSteve enable automated Sneak Circuit Analysis (SCA) with no extra modelling effort. SCA is the process of identifying and eliminating paths in a circuit that activate functions unexpectedly.

AutoSteve deals with classic examples of sneak circuits identifying problems correctly and producing no spurious sneak paths. The screen shots show a typical sneak circuit problem - interaction between an ignition switched radio cassette and internal car lighting causes the radio cassette to be powered when the ignition is off under certain circumstances. AutoSteve correctly identifies those switch settings and reports them in the SCA Tool (right).





▲ AutoSteve identifies the combination of switch settings that cause unexpected function

▲ Display the circuit activity to understand the results of the analysis.

System Requirements

AutoSteve currently works with Mentor Graphics' LCable and TDT's TransCable. Other ECAD tool ports are in development, contact us to discuss your requirements.

For Sun Workstations,

- Ultra system
- Solaris 2.6.
- 192Mb RAM (256Mb recommended).
- 250 Mb disk space

For IBM PC Compatibles,

- Pentium II or faster processor.
- Windows NT 4.
- 128Mb RAM (256Mb recommended).
- 250 Mb disk space

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