

STi²Fuse: A revolution in electronic smart fuses

Benefits

Electronic vs. Standard Melting Fuses



Faster: reaction time x 100

Fault tolerant: electronic fuse reset, no need to access the fuse box

Tiny: significant reduction of the fuse box size

Load shaped: cable size based on the load characteristics

Revolution in automotive



Key features and benefits



eFuse solutions



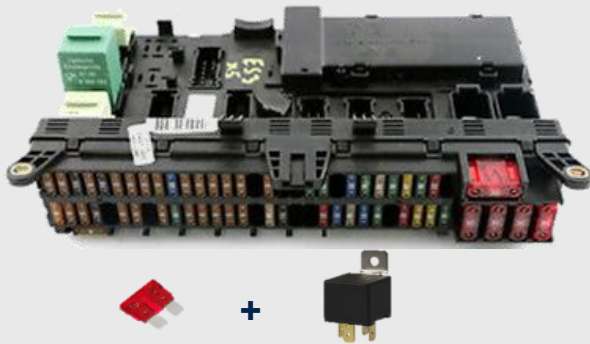


A new approach to fuse management in modern vehicles

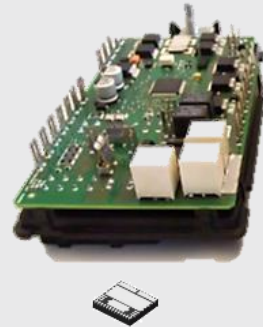
Electronic Smart Fuses

replacing both standard fuses and relays with advanced diagnostic and enhanced functional safety

Mechanical Power Distribution Module PDM

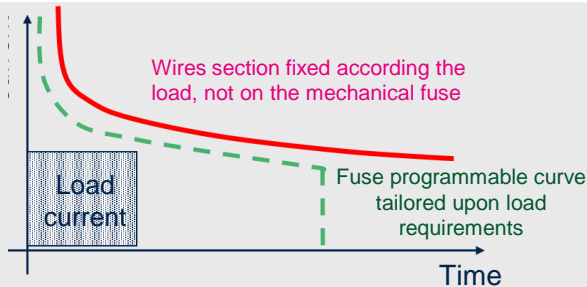


Smart Power Distribution Module S-PDM



Load Shaped: A flexible protection feature

The “Fuse” programmable curve features an intelligent circuit breaking aimed to protect PCB traces, connectors and wire harness from overheating



Electronic Smart Fuses Main Advantages

System

- FAST: Reaction time / two orders of magnitude faster
- FAULT TOLERANT: Remote reset, no need to access the fuse box for replacement
- TINY: Replacing both fuses and relays with smart fuses reduces fuse box size
- LOAD SHAPED: Cable size can be optimized based on load characteristics

Savings

- Wire harness size reduction
 - A mid size car has approx. 3km cable - 45kg for power distribution
 - An electronic Box is approx. 0.350kg lighter
- Up to 20% overall weight reduction leading to ~1g of CO2 saving

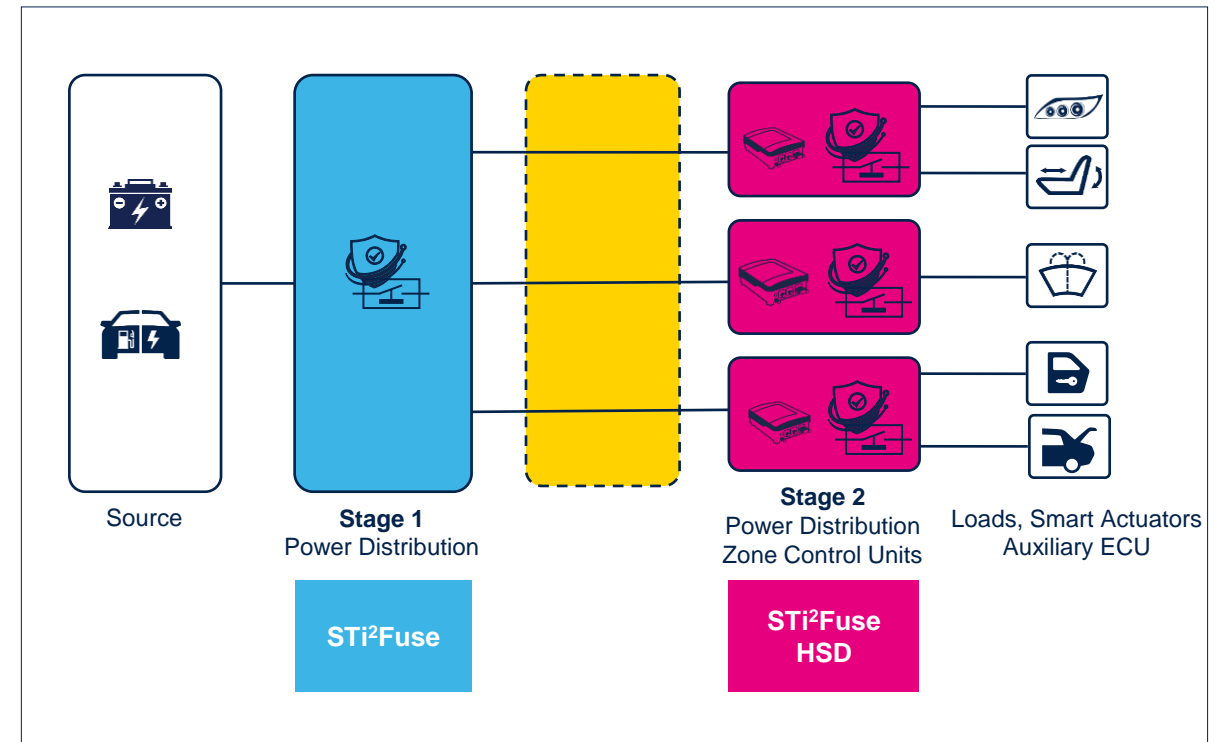
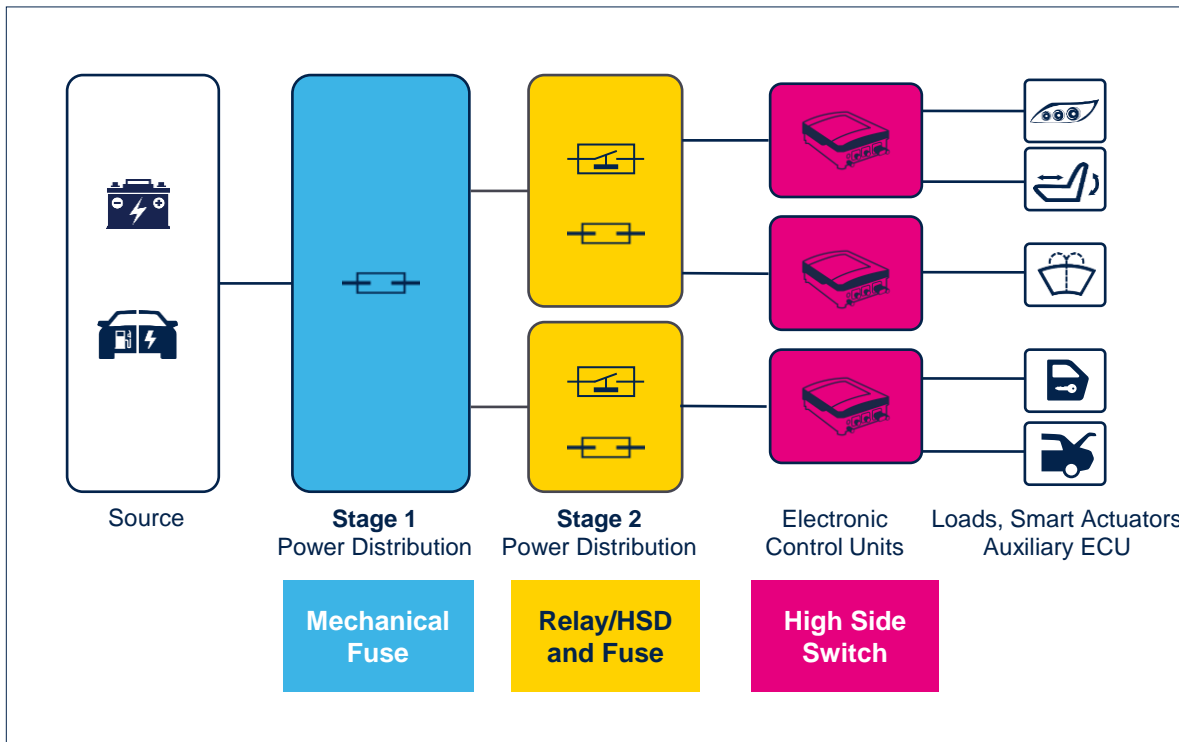
Enabling

- Zonal Architecture: Manage and distribute multiple sources energy
- Autonomous Driving: Fault tolerances
- Predictive maintenance: Device health monitoring



Driving the transformation of E/E architecture

Evolution in automotive power distribution...





STi²Fuse value proposition

Boosting performance

12V Boardnet
stability

Fast turn-off:

STi²Fuse guarantees power network stability reacting autonomously within 100us against overload to prevent the power network to collapse

CCM
Large Capacitor
Compatibility

Capacitive Charging:

STi²Fuse offer compatibility with large capacitive loads through a dedicated CCM feature, avoiding SW intervention

State of Health -
Predictive
Maintenance

Diagnostics:

STi²Fuse have a complete I,V,T monitoring for system state of health supervision and predictive maintenance able to detect degradation before failures might occur

Adding robustness and functional safety

Current
Sensing

ASIL - CSensing:

STi²Fuse have a full range, redundant, autonomous current sense with high speed sampling and BIST protection for ASIL applications

Battery μ -cut

Immunity:

STi²Fuse keeps operating state at Functional Status A during battery μ -cuts maintaining seamless system operation and wire harness protection

Autonomous
Wire Harness
Protection

I²t Functionality:

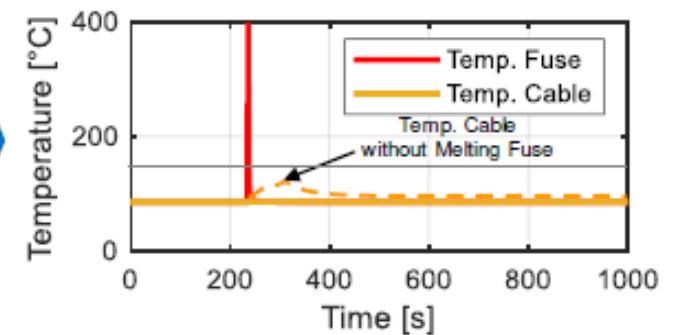
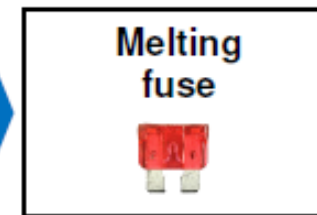
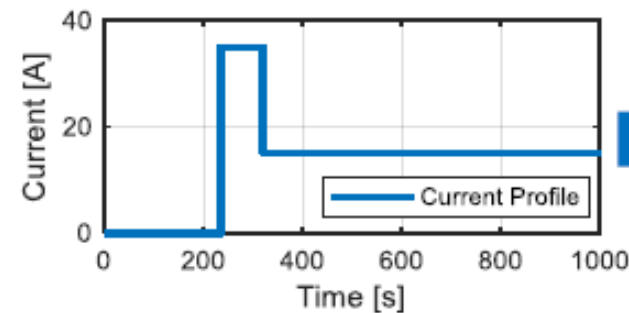
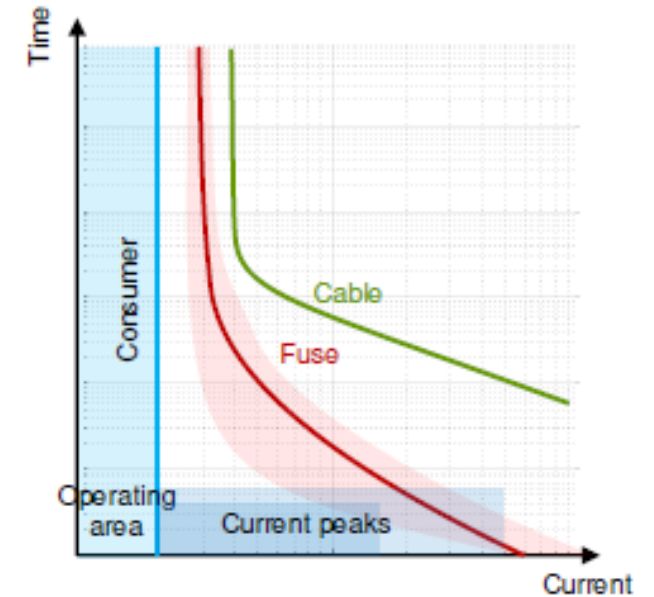
STi²Fuse ensures SW independent wire protection fully operational without an MCU, during POR, in failsafe condition; programmable at Tier1 or OEM assembly line





Melting fuses limitations

- Dimensioned on peak current, not on RMS current
 - Tripping much earlier than the cable reaching a critical temperature
 - Oversize cables, connectors and PCB traces
- Unlimited current capability for tens of milliseconds
 - Does not prevent fault propagation to the upstream power bus and other systems
- Service
 - Non resettable
 - Requires access
 - Prone to user error

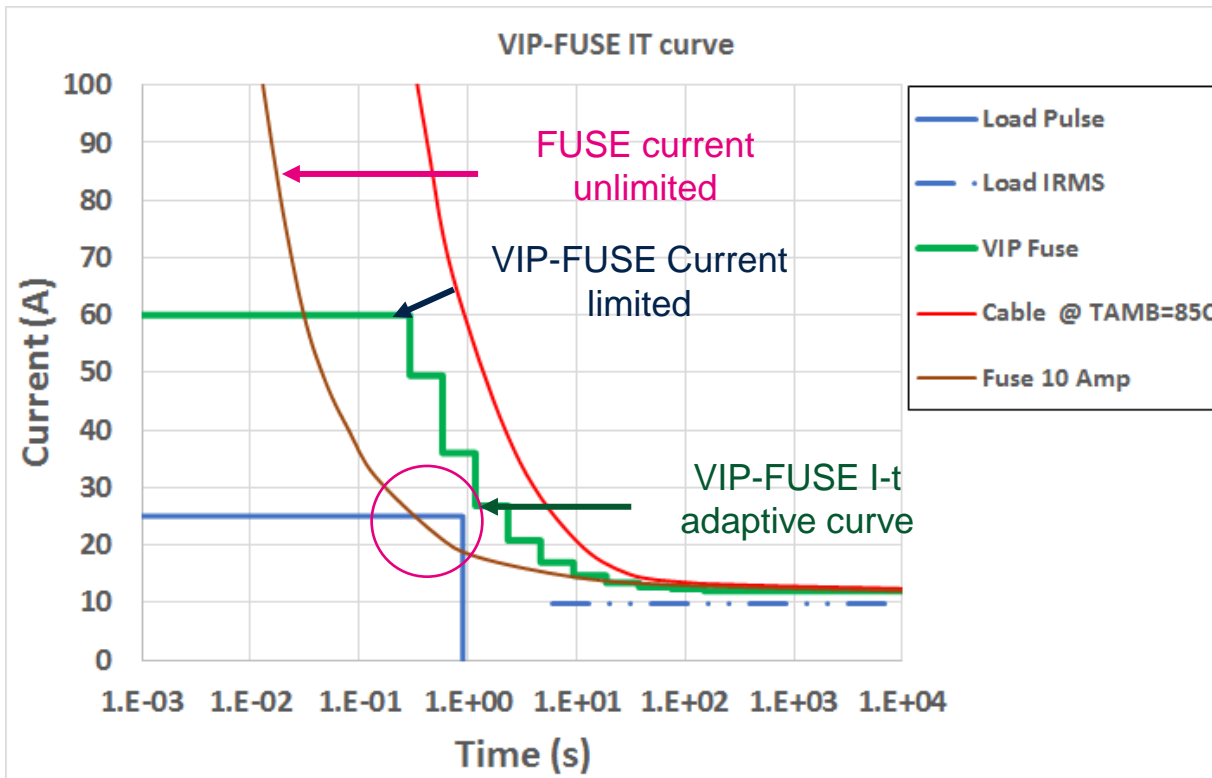




An ST invention for an absolute protection I2-t programmable curve

Whatever the electrification level or power train architecture

The concept



The advantages

- Smaller and fault tolerant
- Dimensioned on RMS load current and current limited
- Simplified, lighter and cheaper wire harness
- Reduced stand-by consumption
- Helps increasing the overall safety and reliability level with benefits for autonomous driving too:
 - SW Reset of HW fault
 - Faster Fault reaction time (<100us)
 - Real time diagnostic of critical modules and switch itself

CO₂



EV Range



ASIL





STi²Fuse vs conventional approach

System benefits

STi²Fuse vs “I2t” in the MCU + Standard HSDs

- **MCU not available:** Thanks to the embedded configurable failsafe mode, devices are fully operating, granting the cable protection, even when an MCU is not available (due to start up POR or during OTA upgrading);
- **Fault:** In case of fault, <100us reaction time granted thanks to the 16kHz current sampling frequency, able to detect fast output current change then, accurate cable temperature;
- **Cascade behavior:** Frequency range and independent output current sampling guarantee synchronization among cascaded devices on different modules – In case of fault, the eFuse switched off is the one closer to the failure point, preventing the battery line to collapse.
- **Sense Accuracy:** Extended sense accuracy in the whole output current range (preventing current saturation), allows optimization with no need of additional margin on cable section sizing.
- **ASIL Level:** ASIL B cable protection is granted due to the embedded redundancy and BIST on current sense chain.

STi²Fuses: more than an HSD with embedded I2t algorithm

- Redundancy and BIST circuit to ensure safety – ASIL B at device level
- Independent Failsafe mode configurability with OTP programmable I2t curve
- Advanced (I, V, T) Diagnostic in both ON and OFF state
- Very low current consumption in standby to support the parking / Idle mode





STi²Fuse tailored for power distribution

Monolithic devices

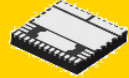
2x Dual channel
1x Quad channel
Available



QFN 6x6

System in Package

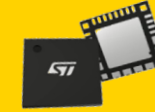
3x Single channel
2x Dual channel
In roadmap



PowerQFN
7x8.5

Driver + Ext. MOSFET

2x Single channel
1x Dual channel
Available

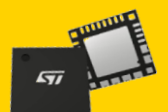


QFN 5x5

Companion Chip

(Implementing Active Stand-by functionality)

1 product with 8 ch.
supporting stby-on
In roadmap



QFN 5x5

STi²Fuse: Electronic fuse with advanced diagnostic and enhanced functional safety replacing both standard fuses and relays

Zonal Architecture Advantages

- Reduced number of ECUs and easy integration / weight and CO2 reduction
- Modular platform management / Safe and fault tolerant
- Multi energy source compatible / Ready for health monitoring & predictive maintenance

LVIP product offer and application coverage

