

A Revolution in Electronic Smart Fuses: STi²Fuse



**Revolution in
Automotive**



**Key Features
and Benefits**



Controller IC



Roadmap





A new approach to fuse management in modern vehicles

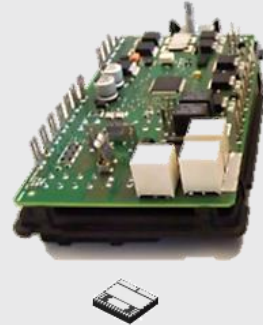
Electronic Smart Fuses

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

Mechanical Power Distribution Module PDM

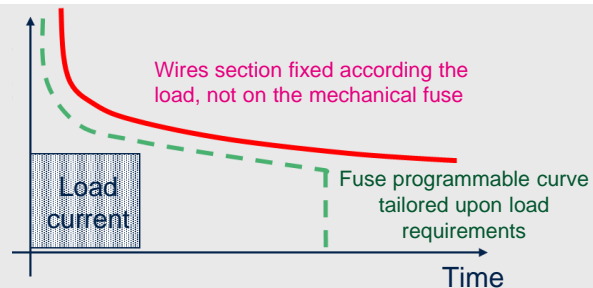


Smart Power Distribution Module S-PDM



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 CO2 saving / increased range

Enabling

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





Smart fuses for power distribution with smart digital interface



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

Cap Charging

STi²Fuse offer compatibility with large capacitive loads through a dedicated CCM feature, avoiding SW intervention and avoiding additional parallel switches for charging

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

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

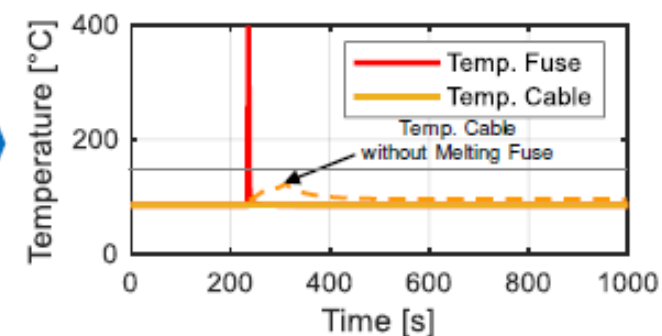
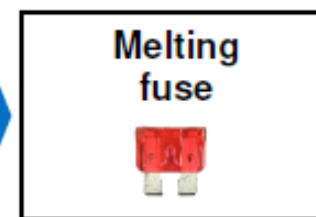
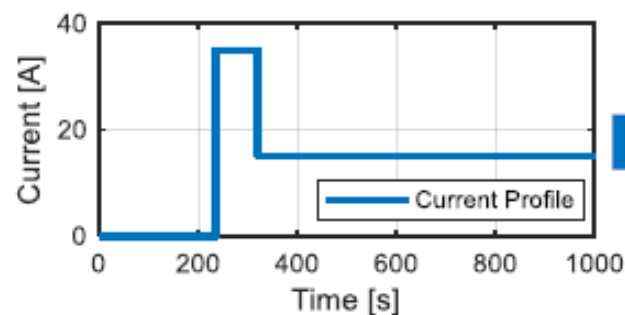
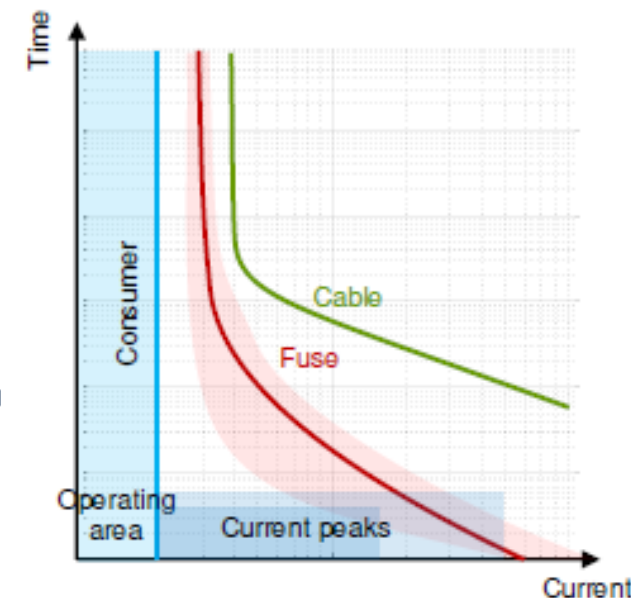
STi²Fuse ensures SW independent wire protection fully operational without uC, during POR, in failsafe condition; programmable at Tier1 or OEM assembly line





Melting fuses drawbacks

- 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 o
- Service
 - Non resettable
 - Requires access
 - Prone to user error

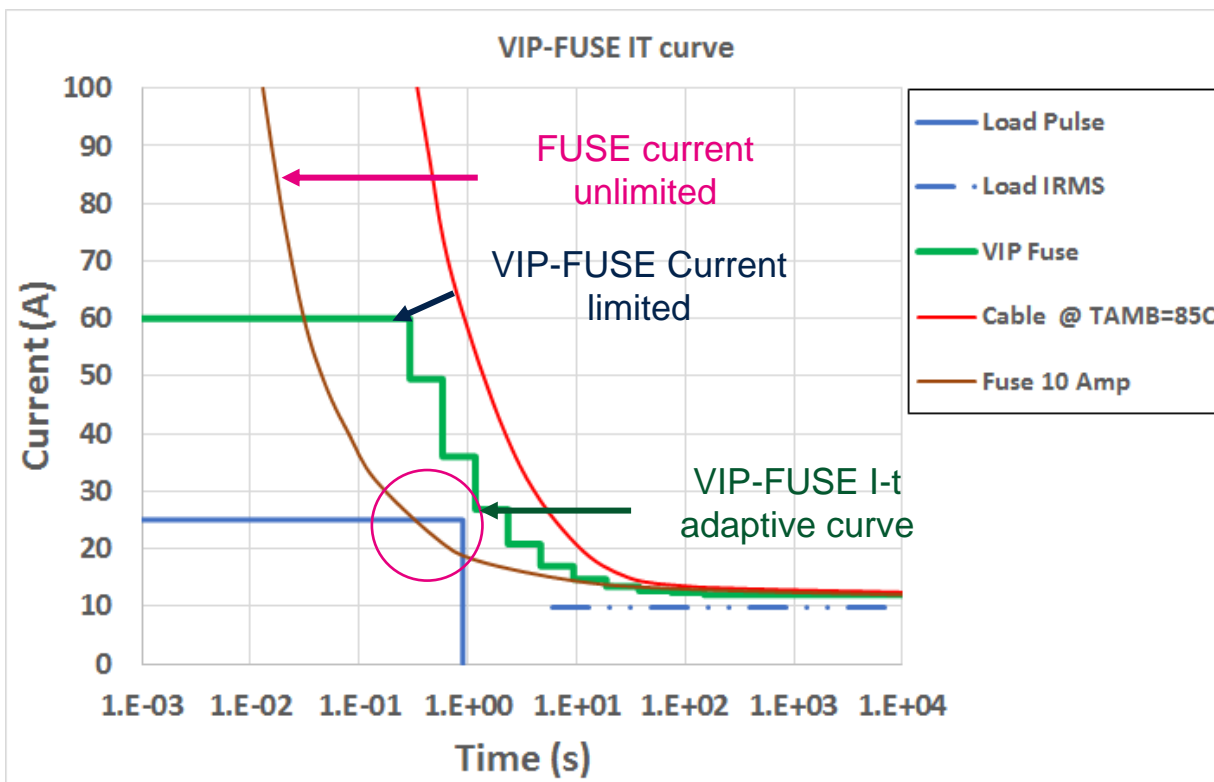




An ST invention for an absolute protection I²t programmable curve

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

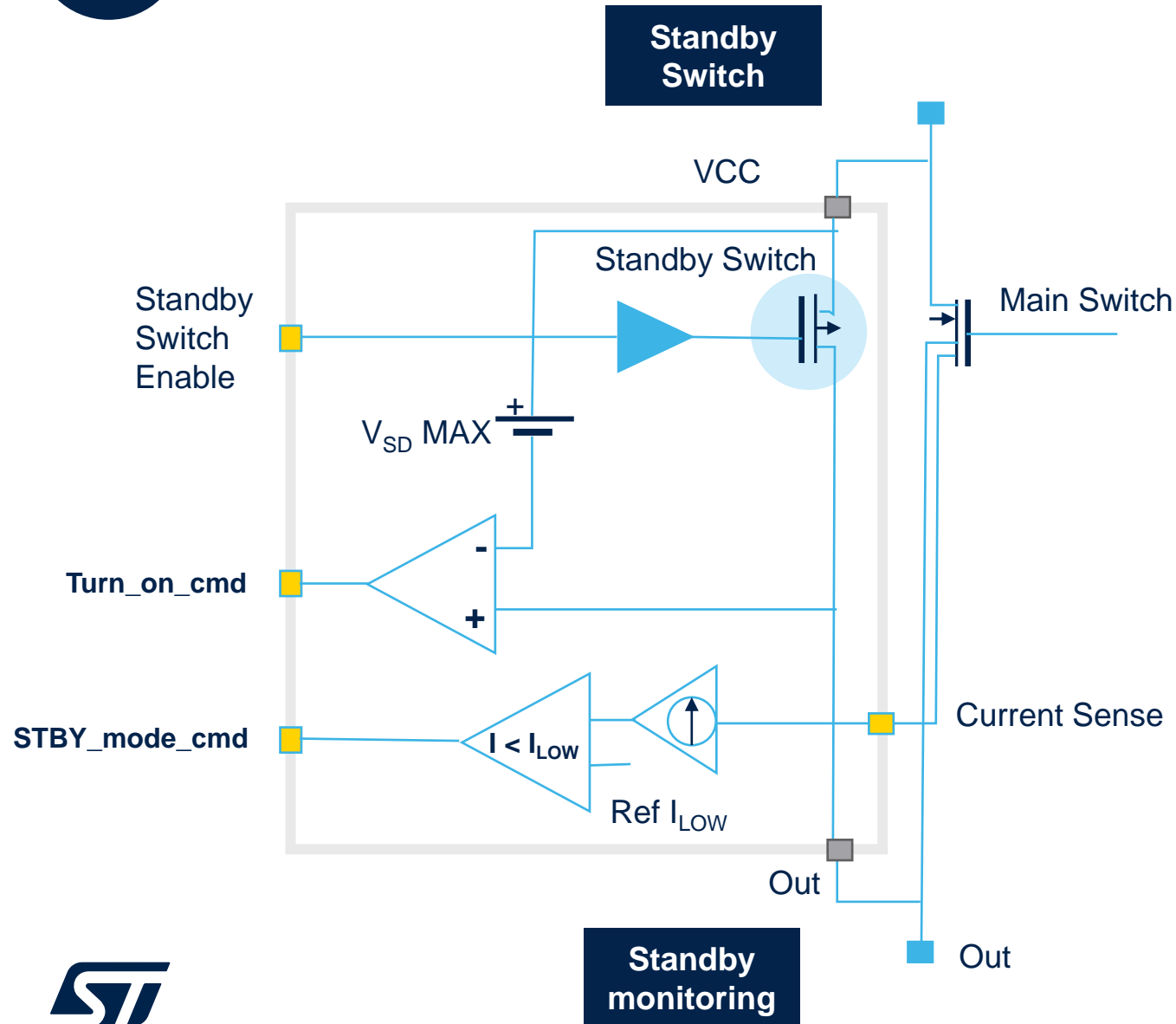


ASIL





Active stand-by ON



- **Reduced stand-by consumption in sleeping modules** (e.g. parking functions)
- Standby Switch Normally-ON with low quiescent current
- Up to 600mA current capability
- Fast self wake up
- Device configuration saved during standby





STi²Fuse controller: VNF1048F

Focus Applications:

1. Power Distribution
2. Fuses replacement
3. High current loads

Unique ST patented I²t programmable curve (eFuse) and Active Standby ON

Unique broad range of operating voltage (6 to 60V)

Full programmability and diagnostics via SPI

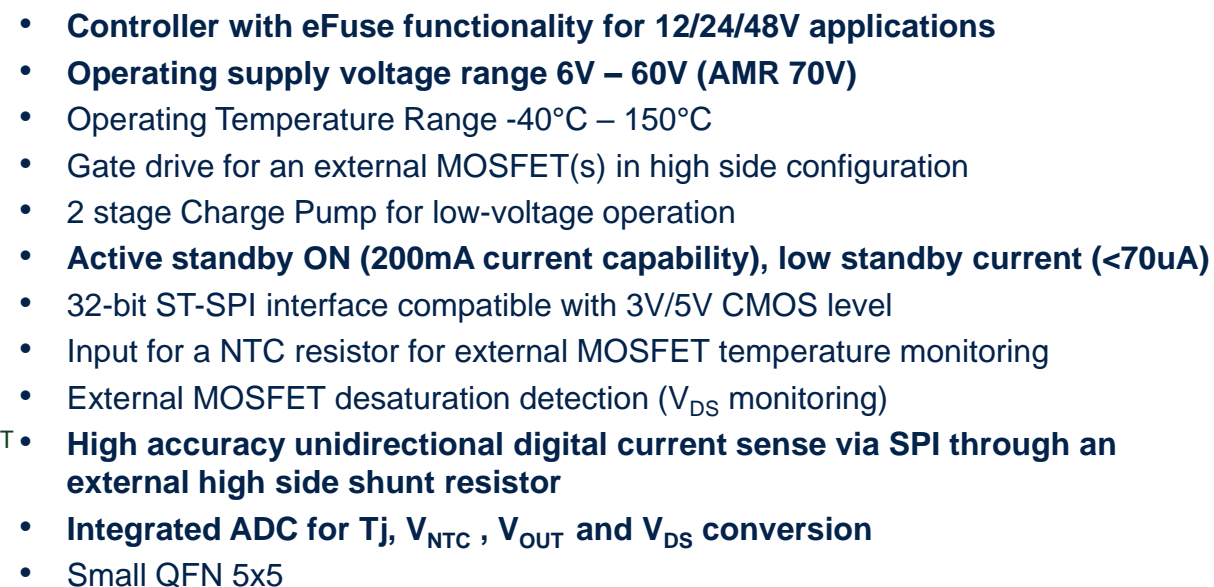
Enhanced protections and failsafe features (ASIL B)

Small QFN package (5 x 5 mm)





Main Features



- I²t curve configurable via SPI (eFuse functionality)
- Hard short circuit latch-off configurable via SPI
- Battery under-voltage shut down
- Device Over-Temperature shutdown
- External MOSFET Over-Temperature shutdown
- External MOSFET desaturation shutdown configurable

- 
- OFN32L 5x

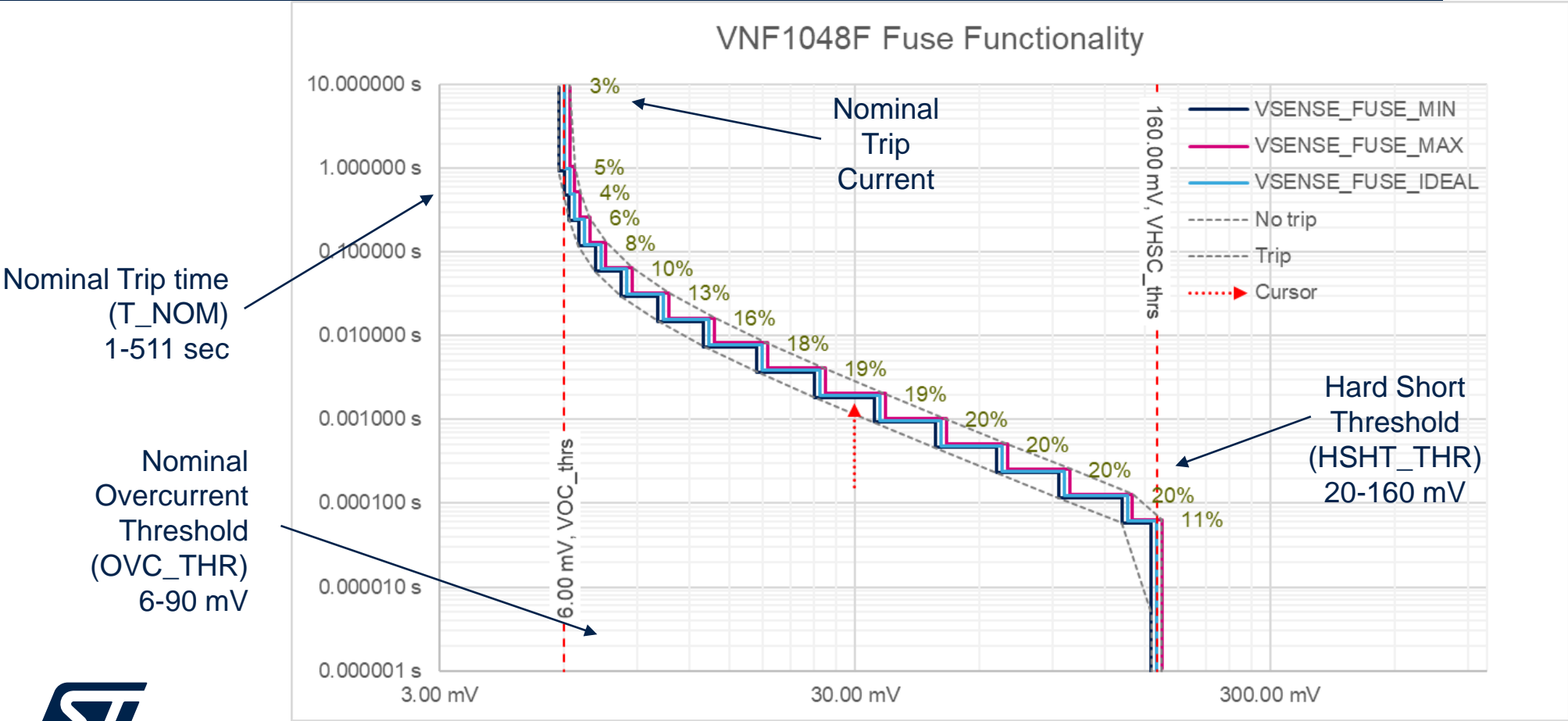
Standby Switch





VNF1048F eFuse functionality

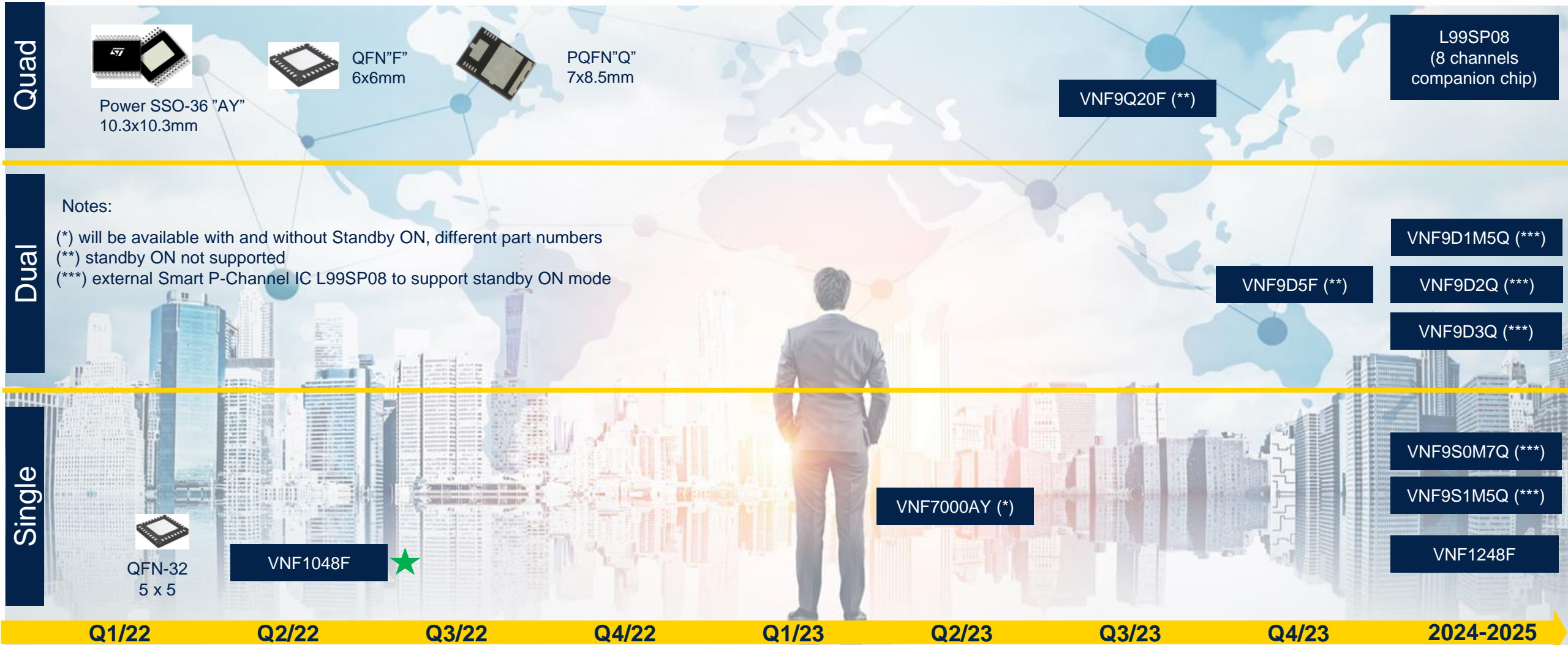
eFuse simulator tool and evaluation kit with GUI available





STi2Fuse Portfolio & Roadmap

Qualification Schedule



★ Qualified

Date: December 2022

Timeline Information can be subject to variations without advance notification





VIPower for Power Distribution

STi²Fuse roadmap

Application Segment

Electronic Smart Fuses

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

A flexible protection feature

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

Products Roadmap

• Monolithic devices in QFN 6x6

M0-9 SPI technology



QFN 6x6

Double ch

VNF9D5F

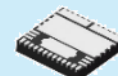
Quad ch

VNF9Q20F

Qualified by: H2 2023

• Hybrid devices in PowerQFN 7x8.5

First two products qualified in 2024



PowerQFN

Single ch

VNF9S0M7Q

Double ch

VNF9D1M5Q

VNF9S1M5Q

VNF9D3Q

VNF9D2Q

• Controller + Ext. MOSFET – 12V, 24V, 48V

1st release in production

VNF1048F

Single channel

2nd release in development

VNF1248F

Single channel

