

# RESOLVE POWER DENSITY CHALLENGES WITH TPS25985 & TPS25990 EFUSES

New Product  
Update

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Abhinay Patil – Systems

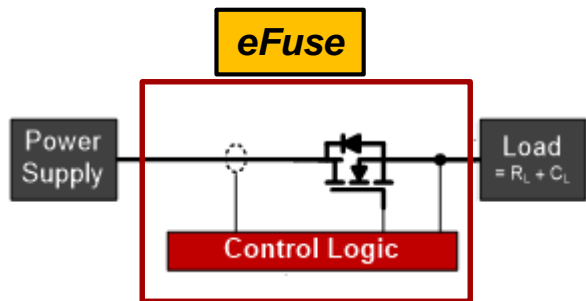
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# Agenda

- eFuses overview and TI's portfolio
- How to solve key design challenges using TPS25985 and TPS25990
  - Introducing TPS25985 and TPS25990
  - Increased power demand from same board area
  - Operating multiple high current MOSFETs eFuses in parallel
  - Optimizing design for steady state and dynamic power demands
  - Improving time to market
  - Increasing system availability
  - Reduce total costs

Please feel free to “chat” **Abhinay Patil, Systems Engineer** who is available to answer any questions you have throughout this presentation.

# eFuses overview and TI's eFuse portfolio



- Highly integrated
  - Hot-swap controller
  - MOSFET
  - Current Sense
  - Thermal protection
  - Matched FET & protection
- Reduced solution size
- Increased reliability

	>40V eFuse			
	<b>TPS2662</b> 60V, 478mΩ, 0.8A, ILIM, FLT, RPP, RCB, OVP, 3x3 SON	<b>TPS2640</b> 42V, 150mΩ, 2.2A, ILIM, RPP, RCB, OVP, 5x4.4 TSOP	<b>TPS2661x</b> ±50V, 7.5Ω, ±20mA ILOOP, ± 32mA ILIM, SOT23	<b>TPS1641x</b> 40V, 152mΩ, 1.8A, PLIM/ILIM, FET_FLT, 3x3 SON
	<b>TPS2660</b> 60V, 150mΩ, 2.2A, ILIM, FLT, RPP, RCB, OVP, 5x4.4 SOP	<b>TPS2663x</b> 60V, 31mΩ, 6A, ILIM, PG, RPP, RCB, OVP, 6.5x4.4 SOP	<b>TPS1663x</b> 60V, 31mΩ, 6A, ILIM, PGOOD, Adj. UVLO/OVP, 6.5x4.4 SOP	<b>TPS1653x</b> 58V, 31mΩ, 4.5A, ILIM, PGOOD, SHDN Ctrl, 6.5x4.4 SOP
	<30V eFuse			
	<b>TPS25910</b> 20V, 30mΩ, 6.5A, ILIM, FLT, 4x4 QFN	<b>TPS25982x</b> 24V, 2.7mΩ, 15A, ILIM, IMON, ITIMER, PG, 4x4 QFN	<b>TPS25981x</b> 16V, 6mΩ, 10A, ITIMER, 2x2 QFN	<b>TPS25990x</b> 16V, 0.8mΩ, 60A, Stackable, PMBus®, 4.5x5mm
	<b>TPS2592x</b> 13.8V, 28mΩ, 5A, OVP, ILIM, BFET Drive, 3x3 SON	<b>TPS2595</b> 18V, 34mΩ, 4A, ILIM, OVLO/OVC, FLT, 2x2 SON	<b>TPS2597x</b> 23V, 10mΩ, 7A, OVLO/OVC, ITIMER, 2x2 QFN	<b>TPS25985x</b> 16V, 0.59mΩ, 80A, Isys, Stackable, 4.5x5mm QFN
	<b>TPS25940/2/4x/-Q1</b> 18V, 42mΩ, 5.2A, ILIM, RCB, PG, OVP, 3x4 QFN	<b>TPS25947x</b> 23V, 28mΩ, 5.5A, RCB, IRPP, 2x2 QFN		
<b>Progression</b>				

Sampling

Production

# TPS25985: 4.5 to 16-V, 0.59-mΩ, 80-A stackable eFuse with accurate & fast current monitor

## Features

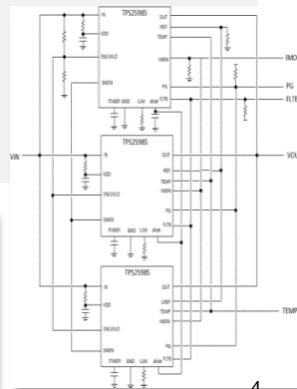
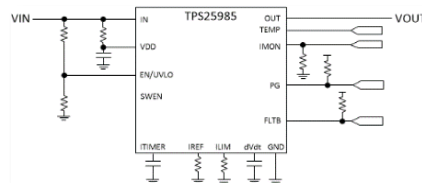
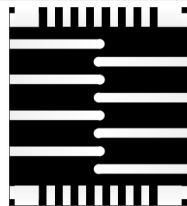
- **Low RON: 0.59 mΩ (typ)**
- **Wide input voltage range: 4.5 V to 16 V (20 V Abs Max)**
- **Adjustable Overcurrent Limit (ILIM): up to 60 A**
  - **Circuit Breaker response**
  - **Transient Overcurrent Blanking timer**
- **Accurate Fast Current Monitor:**
  - **Accuracy <2.1%**
  - **BW >500 KHz**
- **Supports paralleled operation with equal current sharing during startup and steady state**
- **Fixed Overvoltage Protection (OVP)**
- **Adjustable Slew Rate Control (dV/dt)**
- **Output Bus Discharge**
- **Dedicated Power Good and Fault Indication**
- **Thermal Shutdown**
- **4.5mm x 5mm QFN**
- **100% Pb free**

## Applications

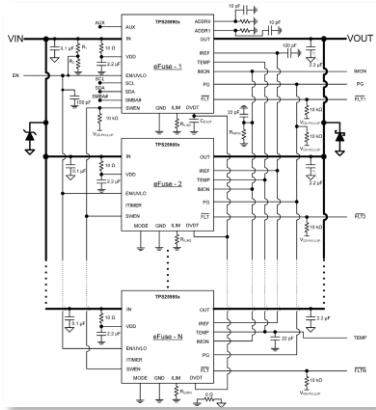
- **Server CPU/Memory power**
- **Server Add on Cards**
- **Enterprise Routers/Switches**
- **Data-Center Switches**

## Benefits

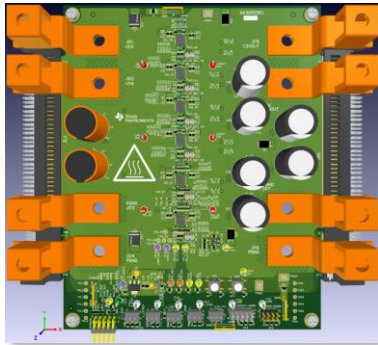
- **Very low self-heating, no derating for max current at higher ambient temperature**
- **Robust protection for load and power supply**
- **Meet line & load transient requirements. Allows peak load currents (up to 80A) for short duration without tripping.**
- **Support advanced dynamic platform power management techniques (such as Intel PROCHOT or PSYS)**
- **Increase current capability as per system needs without power supply de-rating. Maximize system throughput and power supply utilization**
- **Protect downstream from unsafe voltages**
- **Inrush current management as per system requirement**
- **No floating output voltage**
- **Facilitate power sequencing and diagnostics**
- **Guaranteed Safe Operating Area (SoA) of switch**
- **Small Footprint, high power density**
- **Fully RoHS compliant without any 7a exemptions**



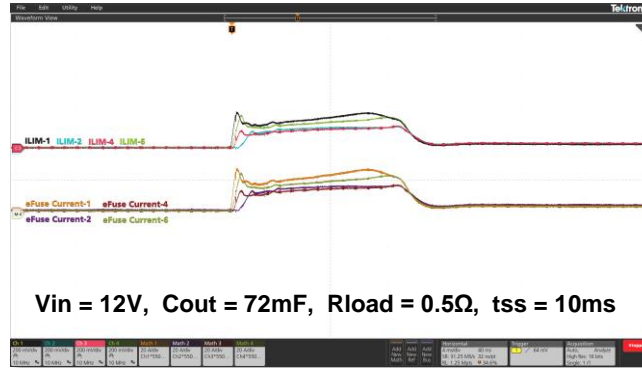
# Unlimited scalability using multiple parallel eFuses to meet higher power demands



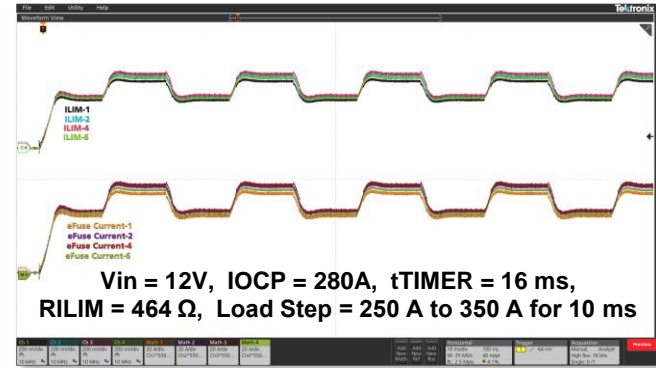
6xTPS25985 demo board



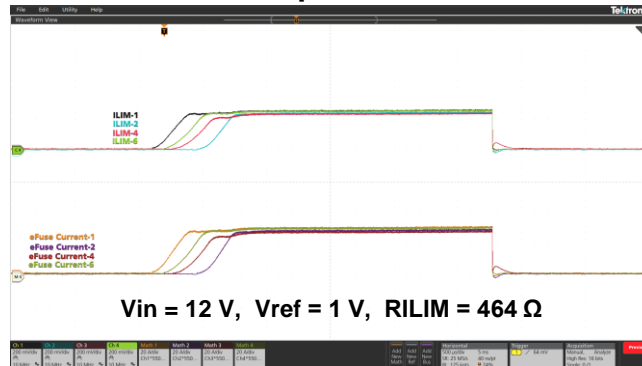
Start-up



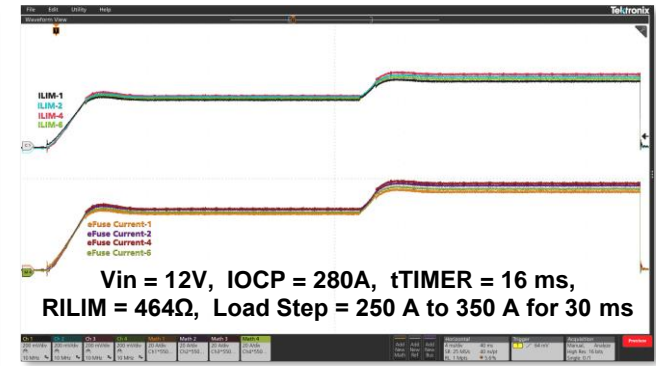
Transient Overload



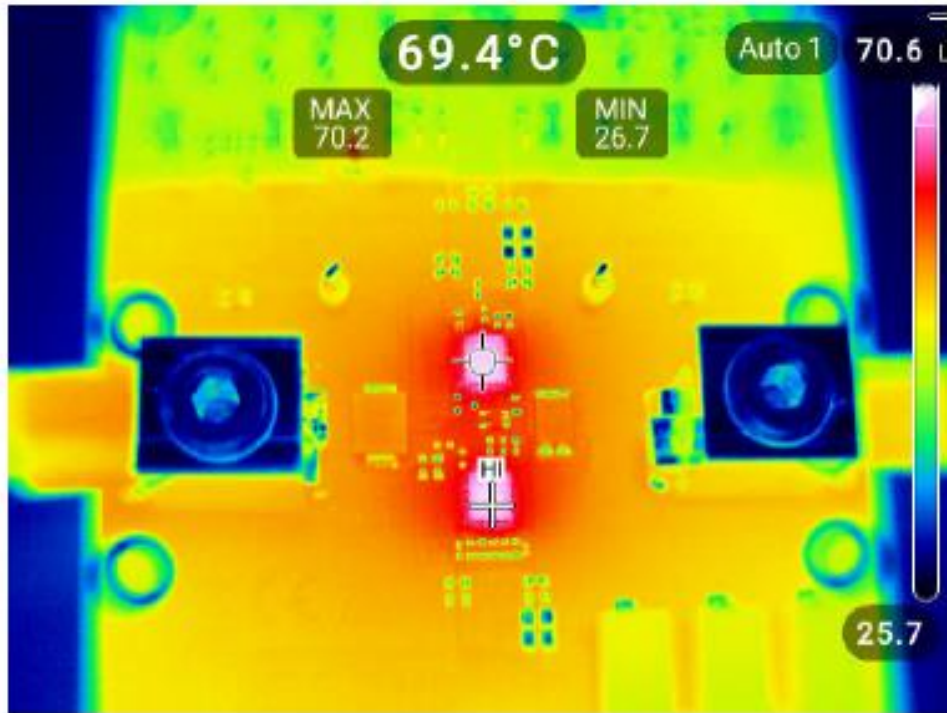
Power-up in a Short



Circuit Breaker Operation



# Minimum self-heating and enhanced package thermal performance for simplified thermal management in high power density systems



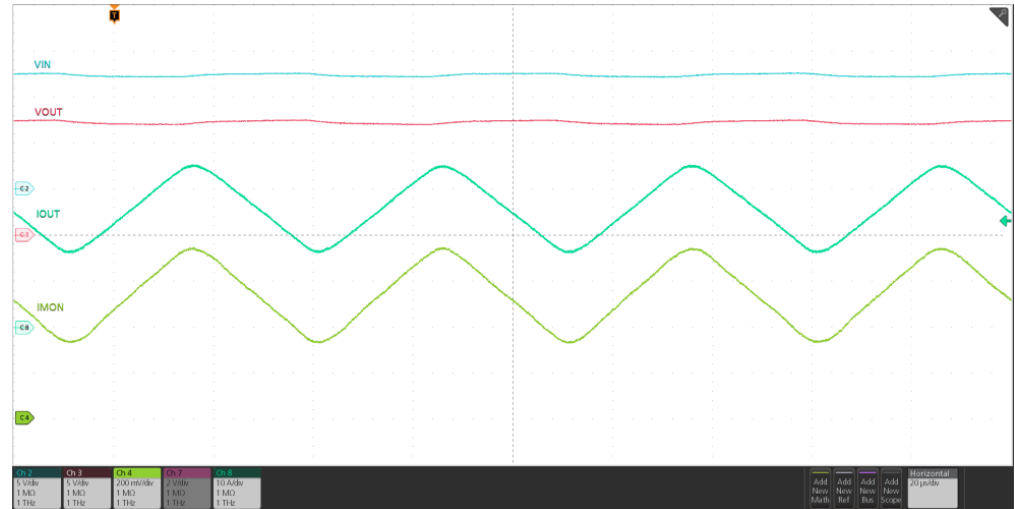
2xTPS25985 in parallel, 100 A DC load, No Air-flow

# Fully integrated precise current monitor for dynamic platform power management

**1% (typ) Accuracy**

LOAD %	I <sub>OUTSET</sub> (A)	% error between actual I <sub>OUT</sub> and calculated using VIMON
10%	5	-0.43
20%	10	-0.21
30%	15	-0.09
40%	20	-0.04
50%	25	-0.03
60%	30	-0.01
70%	35	0.02
80%	40	0.02
90%	45	0.03
100%	50	0.01

**1MHz (typ) Bandwidth**



- ✓ Intel® PSYS
- ✓ PROCHORT

# TPS25990: 2.9 to 16-V, 0.79-mΩ, 60-A, eFuse with PMBus®

## Features

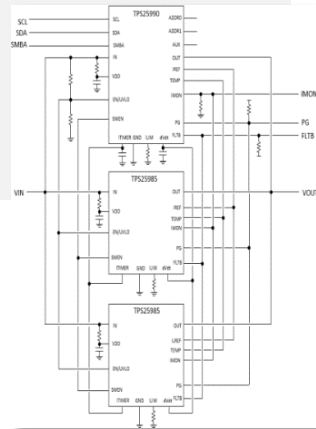
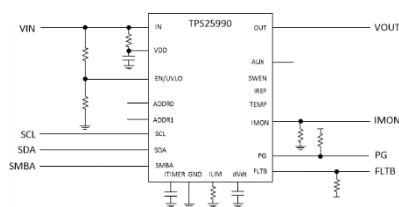
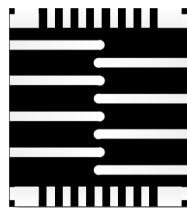
- **Low RON: 0.79 mΩ (typ)**
- **Wide input voltage range: 2.9V to 16V (20V Abs Max)**
- **PMBus® interface for Telemetry, Control, Configuration and Debug**
  - **PIN/EIN/VIN/VOUT/IIN/Temperature/Fault Monitoring**
  - **Programmable Overcurrent Limit (ILIM): up to 50A**
    - **Circuit Breaker response**
    - **Transient Overcurrent Blanking timer**
  - **Programmable Overvoltage Protection (OVP)**
  - **Thermal Shutdown**
  - **Programmable Slew Rate Control (dV/dt)**
  - **Programmable Power Good & Fault Indication**
  - **Power Cycle with single command**
  - **Blackbox Fault recording with non-volatile memory**
- **Accurate Fast Current Monitor:**
  - **Accuracy <2.1%**
  - **BW >500KHz**
- **Output Bus Discharge**
- **4.5mm x 5mm QFN**
- **100% Pb free**

## Applications

- **Server CPU/Memory power**
- **Server Add on Cards**
- **Enterprise Routers/Switches**
- **Data-Center Switches**

## Benefits

- **Very low self-heating, no derating for max current at higher ambient temperature**
- **Complete Configurability/Control through SW commands**
- **Robust protection for load and power supply**
- **Meet line & load transient requirements. Allows peak load currents (up to 60A) for short duration without tripping.**
- **Guaranteed Safe Operating Area (SOA) of switch**
- **Inrush current management as per system requirement**
- **Facilitate power sequencing and diagnostics**
- **Easier debug of field failures/returns**
- **Support advanced dynamic platform power management such as Intel™ PSYS and PROCHOT**
- **No Floating output**
- **Small Footprint, high power density**
- **Fully RoHS compliant without any 7a exemptions**





# Advanced design tools for faster time to market

**Easy to use GUI**

TPS25990x | Options | Help

Hardware Device Connected

PEC: ON I2C Bus Speed: 400 Kbps Manufacture Info

Quick Info

PMBUS DEVICE ADDRESS: 0x40

OPERATION ON

POWER CYCLE

WRITE PROTECT: UNLOCK

CLEAR FAULTS

IMPORT

EXPORT

Update Status

Device State: PGOOD

**Device parameters**

**Config**

**Telemetry**

**Register map**

**System Average Power**

Important Device Parameters:

- Input Voltage (V): 12.14
- Output Voltage (V): 12.10
- Output Current (A): 39.87
- Input Power (W): 481.94
- Average Power (W): 481.94
- Temperature (°C): 38.57

Important Fault Status:

- Damaged FET Fault: 0
- OC Fault: 0
- VIN UV Fault: 0
- VIN OV Fault: 0
- OT Fault: 0
- Output SC Fault: 0
- Communication Error: 0
- Other Faults: 1

**Fault status**

Block Diagram

# Advanced system level debug capabilities

## Minimize system downtime through predictive maintenance

TPS25990x | Options | Help

Blackbox Hardware Device Not Connected PEC  I2C Bus Speed 100 KBPS Manu

PMBUS DEVICE ADDRESS  OPERATION ON  WRITE PROTECT  UNLOCK IMPORT

POWER CYCLE  STORE USER ALL RESTORE USER ALL RESTORE DEFAULTS CLEAR FAULTS EXPORT

EEPROM | RAM

1 DETECT EEPROM 2 FETCH EEPROM 3 READ EEPROM **Store fault information in non-volatile memory** EEPROM DETECTED CHECKSUM ERASE BLACKBOX Blackbox Configure

**Record seven events with relative time-stamp**

Device Status Information

VOUT Fault Status	NORMAL	FET Drive Status	ENABLED
IOUT Fault Status	NORMAL	OC Fault	NORMAL
VIN Fault Status	NORMAL	VIN UV Fault	NORMAL
MFR Fault Status	NORMAL	OT Fault	FAULTY

Read OUT Status Information

OC Fault	NORMAL
OC Warning	NORMAL
Single Point Failure	NORMAL
SC Fault	NORMAL

Manufacturer Status Information

FET Gate to Drain Fault	NORMAL
FET Gate to Source Fault	NORMAL
FET Drain to Source Fault	NORMAL
BR RAM Fill Status	NOT YET RECORDED

Powered By C

# Getting started

You can start evaluating these devices leveraging the following:

Content type	Content title	Link to content or more details
Product folder	TPS25985 TPS25990	<a href="https://www.ti.com/product/TPS25985">https://www.ti.com/product/TPS25985</a> <a href="https://www.ti.com/product/TPS25990">https://www.ti.com/product/TPS25990</a>
EVM	TPS25985 Evaluation Module TPS25990 Evaluation Module	<a href="https://www.ti.com/tool/TPS25985EVM">https://www.ti.com/tool/TPS25985EVM</a> <a href="https://www.ti.com/tool/TPS25990EVM">https://www.ti.com/tool/TPS25990EVM</a>
Design Calculator	TPS25985 Design Calculator TPS25990 Design Calculator	<a href="https://www.ti.com/lit/zip/slvrb12">https://www.ti.com/lit/zip/slvrb12</a> <a href="https://www.ti.com/lit/zip/slvrb10">https://www.ti.com/lit/zip/slvrb10</a>
Technical Article	How a fully-stackable eFuse can help meet ever-increasing power needs of servers	<a href="https://e2e.ti.com/blogs_/b/powerhouse/posts/meet-ever-increasing-power-needs-in-server-designs-with-a-scalable-efuse-solution">https://e2e.ti.com/blogs_/b/powerhouse/posts/meet-ever-increasing-power-needs-in-server-designs-with-a-scalable-efuse-solution</a>
Application Note	How eFuse Ensures Integrated FET Operation in Safe Operating Area	<a href="https://www.ti.com/lit/an/slvaff0/slvaff0.pdf">https://www.ti.com/lit/an/slvaff0/slvaff0.pdf</a>

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