

# Welcome!

## Texas Instruments New Product Update

- This webinar will be recorded and available at [www.ti.com/npu](http://www.ti.com/npu)
- Phone lines will be muted
- Please post questions in the chat or contact your sales person or field applications engineer

# **New Product Update: TI's Hall-Effect Current Sense Family**

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**June 10<sup>th</sup> 2021**

# Agenda

- Current Sensing Use-Cases
- Theory of Operation & Hall-Effect Current Sense Portfolio
- Solving the Zero-Drift Challenge
- Key Applications
- Resources

# Current & power measurement use cases

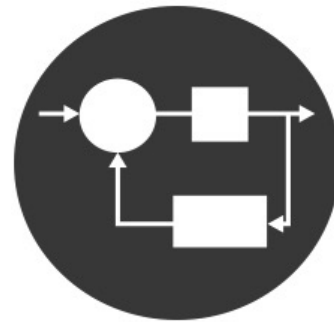
Solutions customers seek



Real-time overcurrent  
protection (OCP)



Current and power  
monitoring for system  
optimization



Current measurement for  
closed loop circuits

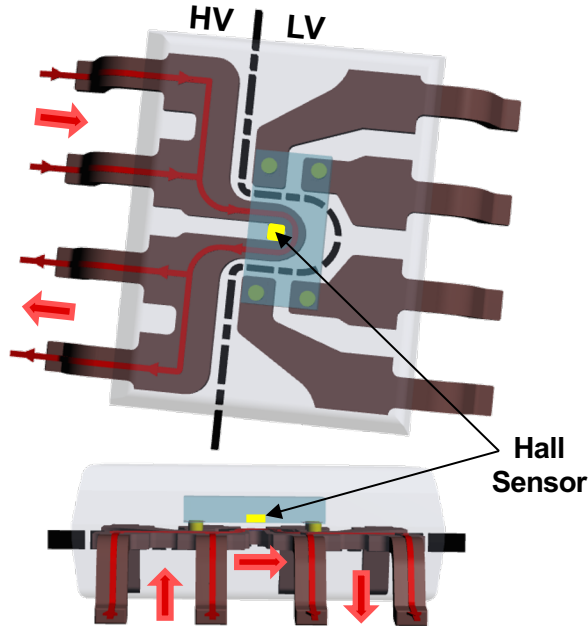
# Isolated Current Sensing Technology Comparison

	Isolated Shunt-based	Closed-loop Magnetic	In-package Hall-Effect Sensor	
			Typical Hall-Effect Device	TMCS1100 Family
Solution size	-	--	++	++
External components needed	1 to 3	2 to 5	0	0
Solution cost	-	--	++	++
Accuracy	++	++	-	+
Offset and sensitivity drift	++	+++	--	+
Insulation Lifetime	++	++	-	+

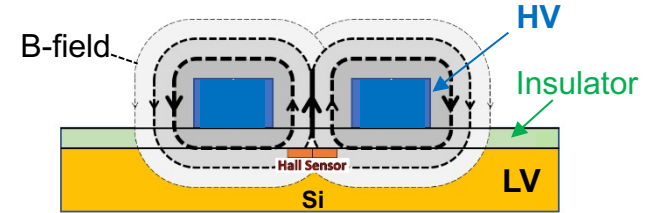
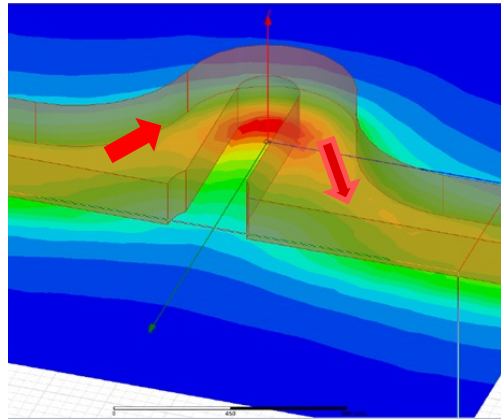
**Technical article:** [how to select the right current sense technology for your high-voltage system](#)

# In-Package MCS Fundamentals of Operation

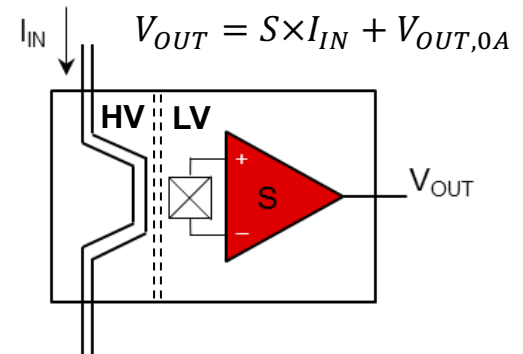
Current flows through lead frame, electrically isolated from die



Lead frame loop generates magnetic field proportional to current



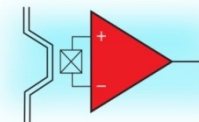
Precision Hall sensor converts magnetic field to voltage signal



# Magnetic Current Sensor Portfolio

Existing

New Release



## High-Precision In-Package:

- **Total error  $\leq 1.5\%$**
- **Sensitivity Drift  $< 50\text{ppm}/^\circ\text{C}$**
- **Offset Drift  $< 50\mu\text{V}/^\circ\text{C}$**



### TMCS1100

**$\leq 1\%$  total error** (-40 to 125°C) w/  
ext. Vref  
±600V Basic Isolation  
±20A RMS @ 105°C  
80kHz bandwidth  
SOIC-8 package  
 **$\$1.50$  ti.com pricing**



### TMCS1101

**$\leq 1.5\%$  total error** (-40 to 125°C)  
w/ int. Vref  
±600V Basic Isolation  
±20A RMS @ 105°C  
80kHz bandwidth  
SOIC-8 package  
 **$\$1.50$  ti.com pricing**

## General Purpose In-Package:

- **Total error  $\leq 3\%$**



### TMCS1107

**$\leq 3\%$  total error** (-40 to 125°C) w/  
int. Vref  
±420V Basic Isolation  
±20A RMS @ 105°C  
80kHz bandwidth  
SOIC-8 package  
 **$\$1.15$  ti.com pricing**



### TMCS1108

**$\leq 3\%$  total error** (-40 to 125°C) w/  
int. Vref  
±100V Functional Isolation  
±20A RMS @ 105°C  
80kHz bandwidth  
SOIC-8 package  
 **$\$0.80$  ti.com pricing**

## Ambient Contactless sensor:

- **0.1% Linearity**



### DRV425

Contactless fluxgate current  
sensor  
 **$\leq 0.5\%$  total error** (-40 to 125°C)  
High sensitivity:  **$2\text{mT max}$**   
Selectable BW: 47kHz / 32kHz  
3.3 to 5V supply  
4x4 WQFN package



AEC-Q100

# TMCS1107

## Bi-directional, Galvanically Isolated Current Sensor with Internal Reference

### Features

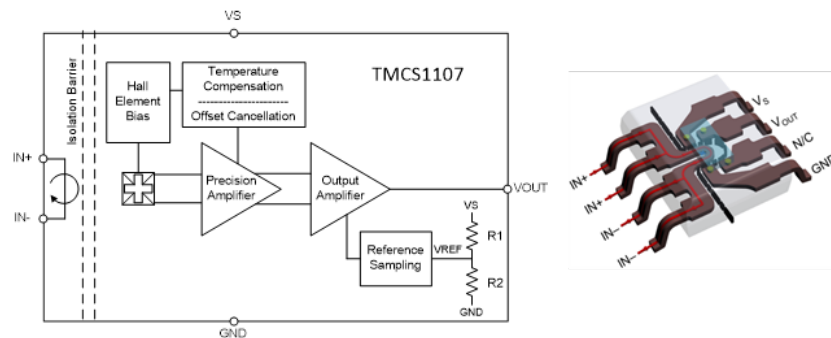
- 80 kHz signal bandwidth
- 3% Accuracy (-40 to 125°C)
- $\pm 420$  V Working Voltage, 3 kV Dielectric Isolation (IEC 60950-1)
- Operating voltage: 3.0 V to 5.5 V
- Bi-direction and uni-directional variants
- 20 A max continuous DC/RMS current (thermally limited)
- Multiple sensitivities for wide linear measurement ranges
  - TMCS1107AB/U1: 50mV/A
  - TMCS1107AB/U2: 100mV/A
  - TMCS1107AB/U3: 200mV/A
  - TMCS1107AB/U4: 400mV/A
- 8-pin SOIC package

### Applications

- Motor Control
- PV String Inverters
- Switching Converters
- Overcurrent Protection
- Power Monitoring

### Benefits

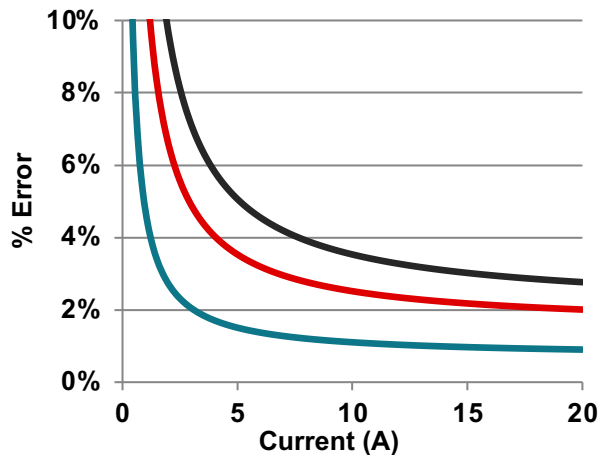
- Galvanically isolated measurements for ac or dc current
- Bandwidth suitable for switching power supplies and in-line motor applications
- 420V Lifetime working voltage isolation in 8-pin SOIC
- Internally generated reference voltage for bi-directional or uni-directional current sensing
- In-package sensing simplifies PCB design





# Benefits of designing with TI TMCS portfolio

## Precision: Guaranteed over temperature

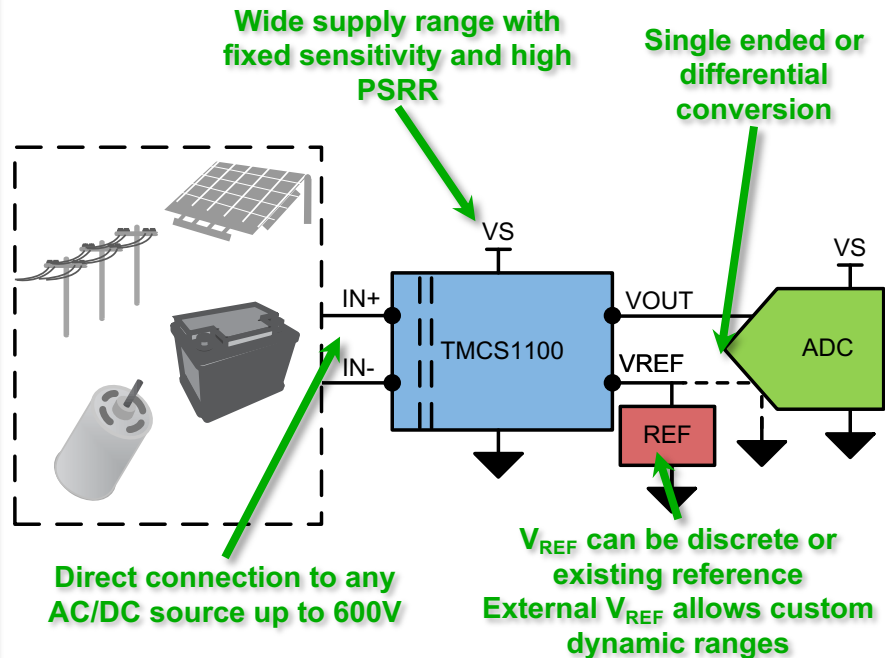


No ratiometry error

0.1% typical linearity

<1% Total error over full temperature range

## Optimized implementation & signal chain

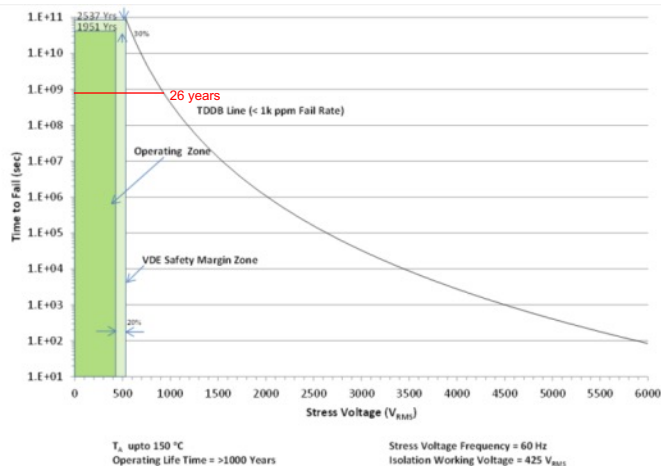


\*calculated from Datasheet specifications

# Benefits of designing with TI TMCS portfolio

## Isolation: Built-in Quality & Reliability

### TMCS1100 600V Lifetime Insulation



## Solving System Level Challenges

- <1% error over temp, <0.7% lifetime drift
- 600V working voltage in SOIC-8
- Only supplier to provide insulation lifetime (TDDB)
- Devices specified and tested per VDE 0884-11
- Specified with margin, tested aggressively:  
100% TMCS1100 3.6kV Production test (900V standard)

# Common Hall-Effect Current Sense Applications

## High-voltage AC or DC applications

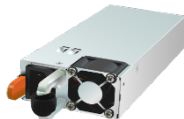
### Automotive



#### On-board charging

- PFC: feedback element
- AC current sense at input for diagnostics

### Industrial



#### Power Supplies

- PFC: feedback element



#### Motor Drives / Robotics

- Isolated high-side overcurrent monitoring (DC link)
- Isolated current control (in-line to motor)



#### Solar Inverter / Tracker



#### Train Control & Mgmt

- Servo drives
  - High-voltage DC link
  - In-line



#### Audio

- Overcurrent protection
- Output current monitoring, tuning audio



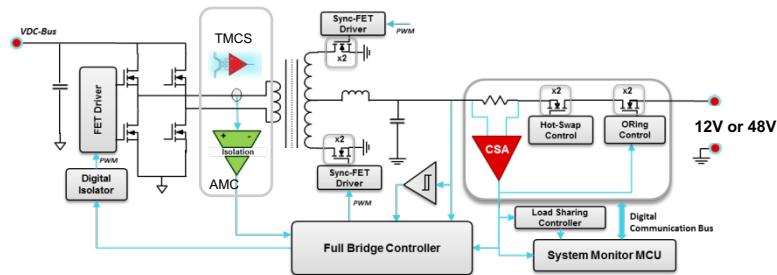
#### Thermostat

- Current monitoring for temperature compensation
- AC current sense at input

# Common Hall-Effect Current Sense Applications

## PFC and Motor/Inverter Control

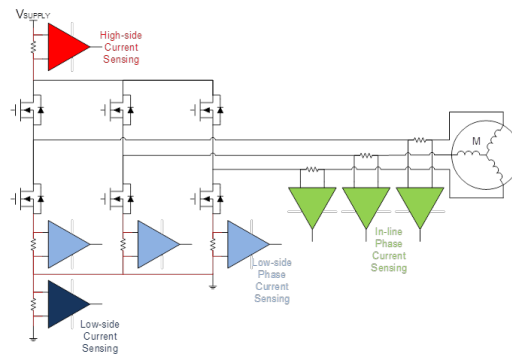
**PFC**



Current sensing in power supplies for accurate current measurement for control loops and quick over-current detection.

- Isolation for high voltage applications
- Ability to measure DC current and high frequency signals
- Detection of fault conditions

## Motor / Inverters



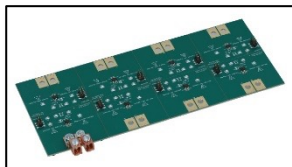
## Measure current for motor control and protection

- Current measurement information to MCU for torque calculation
- Isolation from HV supply

Accurately measuring the current in-line allows for less post-processing at MCU & more advanced torque control

# Resources

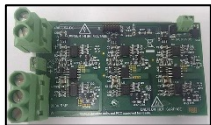
## Hardware / Reference Designs



**Evaluation Models**  
(TMCS1100, TMCS1101,  
TMCS1107, TMCS1108)



**Reference Design**  
PFC



**Reference Design**  
230Vac motor drive

## Design Tools

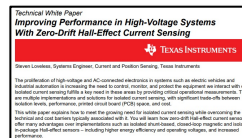


**Simulation Models**  
(TINA, PSpice)

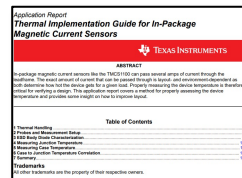
## Documentation



**Technical Article**  
How to select the right  
current sense technology  
for your HV system



**White Paper**  
Improving HV systems  
with HV Zero Drift Hall-  
Effect Current Sensing



**Application Report**  
Thermal  
Implementation Guide  
for In-Package Hall-  
Effect Current Sensors

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