TRENCHSTOP™ 5
A breakthrough in IGBT innovation
Infineon Redefines „Best in class“ IGBT

Mark Thomas
Discrete IGBT Product Marketing
TRENCHSTOP™5 Target applications

- Welding
- UPS
- Solar
TRENCHSTOP™5 Target applications

- Welding
- UPS
- Solar

Boost PFC

[Diagram of a Boost PFC circuit]
TRENCHSTOP™5 Target applications

H4 Inverter

[ Circuit diagram showing components S2, S3..4, S5..6, and 230V AC connections ]
TRENCHSTOP™5 Target applications

3-Level Inverter
TRENCHSTOP™5 Target applications

Full Bridge ZVS resonant

![Diagram](image-url)
TRENCHSTOP™ 5
A breakthrough in IGBT innovation

*Introducing a technology to match tomorrow’s high efficiency demands*
Infineon is the IGBT Performance World Leader

- Coming from a solid history of IGBT innovation
- Infineon already provides the highest performance IGBTs.

**Punch Through**
- ROW: 1988

**Non Punch Through**

**TRENCHSTOP™**

Advantages
- Implanted Back-Emitter better adjustable
- Performance
  - Lower Switching losses
  - Higher Switching Robustness

Advantages
- Implanted Back-Emitter
- Thinner Base Region
- Performance
  - Lower VCEsat
  - Lower Switching losses
  - Robustness like NPT
With the highest efficiency and quality, Infineon’s current portfolio is defined to match target application requirements.

Groundbreaking innovation makes Infineon the world’s leading IGBT supplier.
TRENCHSTOP™ - 25°C Trade-off curve
$V_{ce(sat)}$ versus $E_{eff}$
TRENCHSTOP™5 - 25°C Trade-off curve Vce(sat) versus Eoff
TRENCHSTOP™5 - 25°C Trade-off curve Vce(sat) versus Eoff

Compared to Infineon’s BiC HS3, TRENCHSTOP™5 offers:

- >60% lower switching losses
- 10% lower conduction losses

all the efficiency benefits are offered with 650V Vbr
TRENCHSTOP™5 - Trade off Vcesat – Eoff Temperature stability

25°C

Trade-off previous generation

TRENCHSTOP™5

175°C

TRENCHSTOP™5
TRENCHSTOP™5 - Trade off Vcesat – Eoff
Temperature stability

25°C

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TRENCHSTOP™5 - Trade off Vcesat – Eoff
Temperature stability

Trade-off previous generation

25°C

175°C

TRENCHSTOP™5

TRENCHSTOP™5
At 175°C junction temperature the TRENCHSTOP™5 offers:

- The same $V_{ce(sat)}$ value at the TRENCHSTOP™ family
- >75% lower switching losses than HS3

TRENCHSTOP™5 has a mild positive temperature coefficient
TRENCHSTOP™ 5
A breakthrough in IGBT innovation
Introducing a portfolio that gives the designer more options
<table>
<thead>
<tr>
<th>TRENCHSTOP™1 / HS3</th>
<th>TRENCHSTOP™5</th>
</tr>
</thead>
<tbody>
<tr>
<td>5us short circuit capability*</td>
<td>no short circuit capability</td>
</tr>
<tr>
<td>600V breakthrough voltage*</td>
<td>650V breakthrough voltage*</td>
</tr>
<tr>
<td>FWD trr &gt;140ns*</td>
<td>FWD trr &lt;50ns*</td>
</tr>
<tr>
<td>60T Vce(sat) optimised</td>
<td>Vce(sat) = 60T*</td>
</tr>
<tr>
<td>HS3 switching loss optimized</td>
<td>Eoff &gt;60% lower then HS3*</td>
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</table>

### Recommended Switching Frequency per Technology

<table>
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<tr>
<th>0Hz</th>
<th>18kHz</th>
<th>100kHz</th>
<th>10kHz</th>
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<tr>
<td>60T</td>
<td>HS3</td>
<td>60T</td>
<td>HS3</td>
<td>60T</td>
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*TRENCHSTOP™5 compliments the High Speed 3 family*

*Datasheet values at 25°C*
The TRENCHSTOP™5 is available in 2 Flavors

TRENCHSTOP™5

High speed 5 (H5)
- High speed variant

High speed 5 FAST (F5)
- Highest efficiency

Plug & Play / Ease of use
- Soft high speed IGBT, optimised for gate resistor values down to 5Ω
- Designed for ease of use implementation to easily replace existing IGBTs in designs or where redesign resources are not available

Performance optimized
- Snappier IGBT compared to H5, but with low inductance designs and in combination with SiC diodes, the F5 can offer 1% higher efficiency compared to the H5
- Requires higher design in effort, but rewards are higher
F5 shows steeper $\frac{dI}{dt}$ and $\frac{dV}{dt}$, higher $V_{\text{cemax}}$, lower turn-off losses than H3 and H5!

Look at the x-axis ... nano seconds!
PFC 70 kHz: Device selection for best efficiency

- F5 + SiC: High performance, need split Rg
- H5 + Rapid Diode: Plug and Play, Rgon=Rgoff
- F5 + Rapid: best fit for low inductive design, still needs split Rg

Just replacing the HS3 with H5 brings 0.6% efficiency improvement
Case temperature

- **Single IGBT + SiC / Rapid diode** (all TRENCHSTOP™5 devices in TO220, H3 in TO247)

Efficiency improvements bring significant heatsink size reduction

- H5 have 5°C lower Tc over H3 even by smaller package, F5+SiC diode gives another 10°C down!

Efficiency improvements bring significant heatsink size reduction
**TRENCHSTOP™5 Product Spectrum - First Wave**

<table>
<thead>
<tr>
<th>Single IGBT</th>
<th>TO-220</th>
<th>TO-220FP</th>
<th>TO-247</th>
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<tbody>
<tr>
<td><strong>40A</strong></td>
<td>IGP40N65F5 / H5</td>
<td></td>
<td>IGW40N65F5 / H5</td>
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<tr>
<td><strong>50A</strong></td>
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<td>IGW50N65F5 / H5</td>
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<table>
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Continuous collector current at $T_C = 100^\circ C$

Portfolio released with 650V breakthrough voltage
Summary TRENCHSTOP™5 IGBT

- New benchmark in terms of switching losses for IGBT based technologies
- Technology platform available in two flavours
  - H5 plug & play replacement of previous IGBTs
    - Soft IGBT requiring low design in efforts
  - F5 requires low commutation loop inductance
    - best used in combination with SiC diodes
- 650V breakthrough voltage as standard
- Vce(sat) with mild positive temperature coefficient
- Temperature stable $V_F$ value of the free wheeling diode
- 1.7% efficiency PFC efficiency improvement seen over previous best in class IGBT

Can you afford to wait for the competition to catch up?
Innovative semiconductor solutions for energy efficiency, mobility and security.