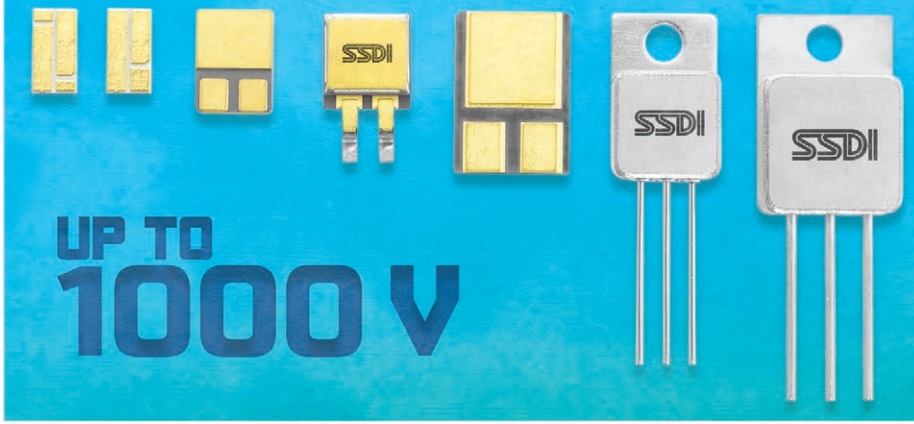
HERMETIC

31
Ga
69.723

7
N
14.007

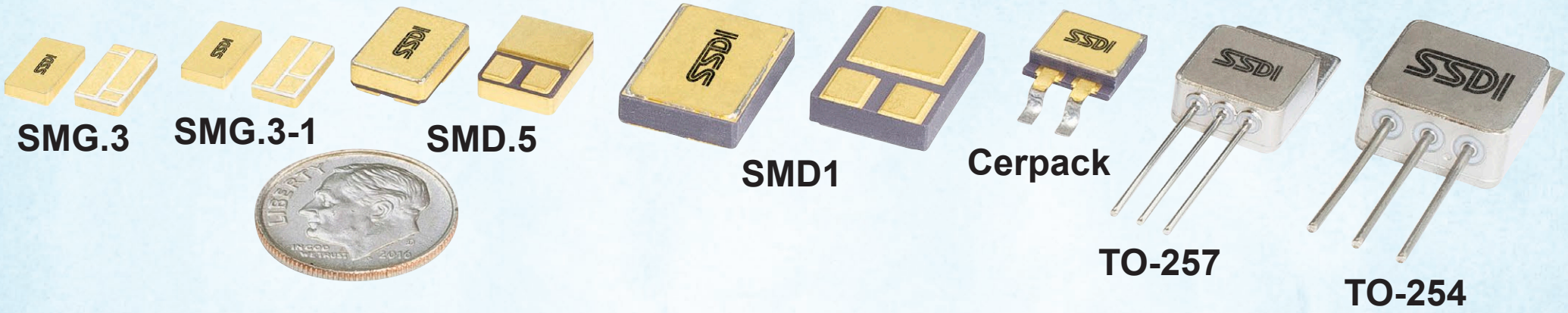
POWER FETs
FOR AEROSPACE & DEFENSE



UP TO
1000 V

SSDI
SOLID STATE DEVICES, INC.
EST. 1967

Hermetic GaN Power FETs



FEATURES

- Exceptionally low $R_{DS(ON)}$
- Low QG simplifies gate drive circuit
- Low thermal resistance
- Hermetically sealed packaging - new chip-scale package, SMG.3
- TX, TXV, and S level screening available

Hermetic GaN Power FETs

Enhancement Mode

SGF90N04
55 - 90 A / 40 V

SGF48N10
48 A / 100 V

SGF48N20
40 - 48 A / 200 V

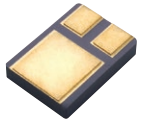
SGF06N35
6 A / 350 V

Through Hole

TO-254

Surface Mount

SMD1



SMG.3
chip-scale package

Through Hole

TO-257

Surface Mount

SMD.5

CERPACK

Cascode
Normally-Off
**Available as Normally-On*

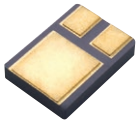
SGF46E70
46 A / 700 V

Through Hole

TO-254

Surface Mount

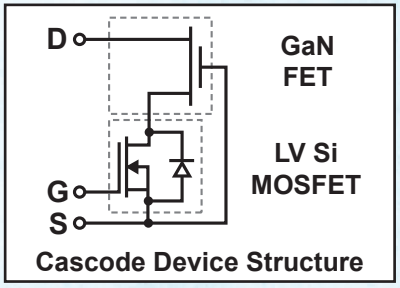
SMD1



SGF15E100
15 A / 1000 V

Through Hole

TO-257



Cascode Device Structure

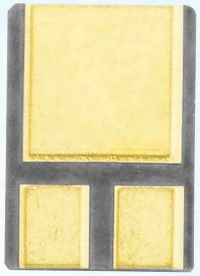
Hermetic GaN Power FETs

Hermetic Packages

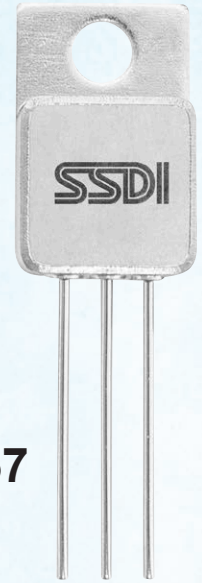
SMG.3

SMD.5

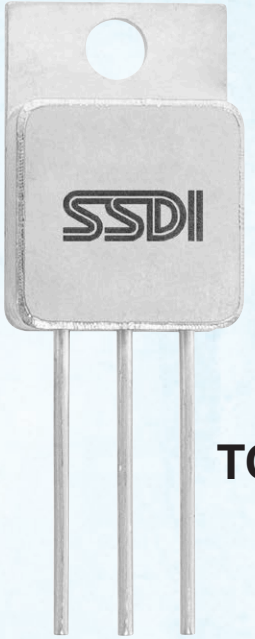
Cerpack



SMD1



TO-257



TO-254

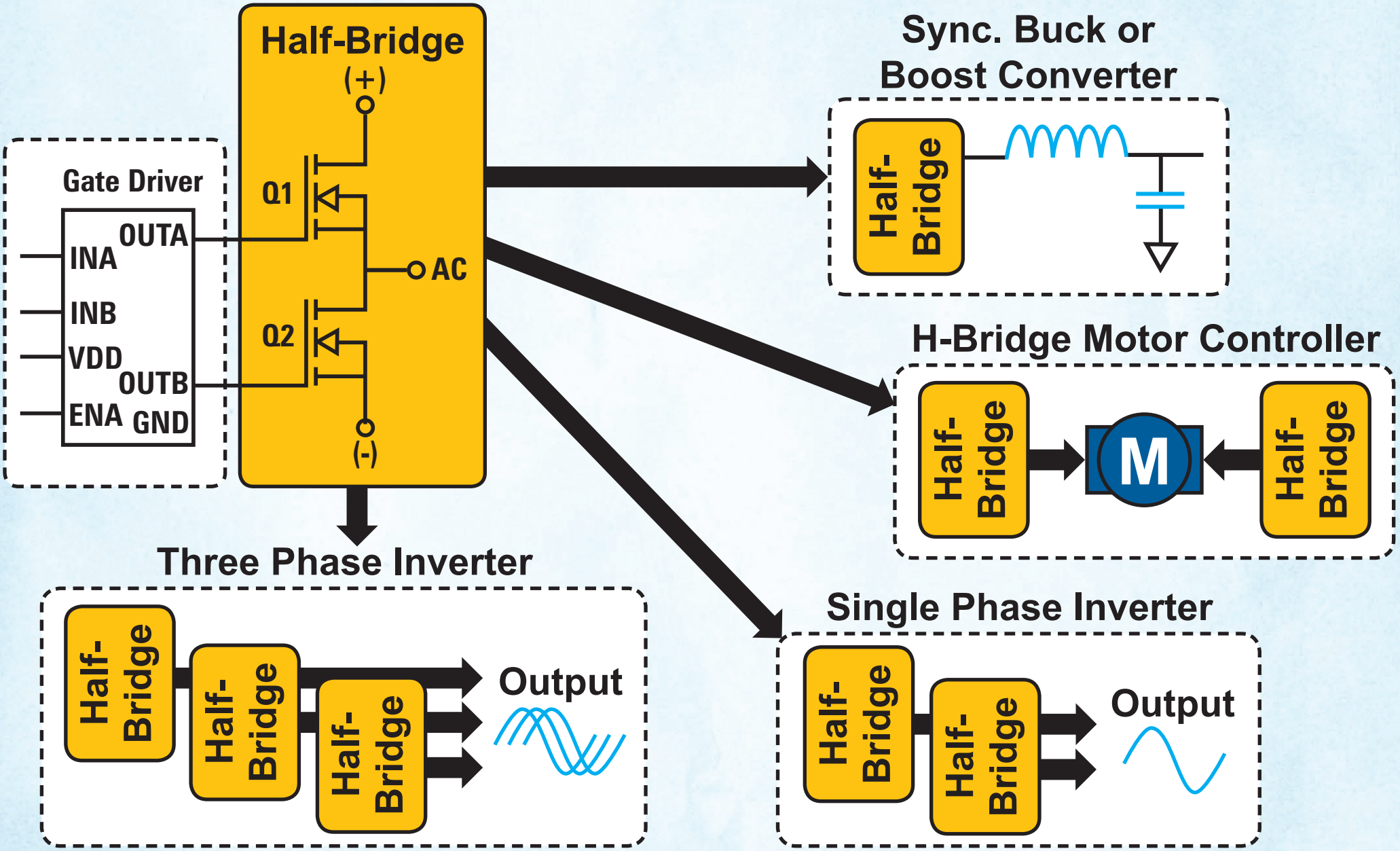
Maximum Dimensions (in.)

Package	Profile	Footprint
SMG.3	.085	.190 x .345
SMD.5	.135	.304 x .408
Cerpack	.115	.340 x .580
SMD1	.150	.455 x .630
TO-257	.210	.420 x .840
TO-254	.260	.545 x .875

Comparison of SSDI GaN FET with Competitor's MOSFET

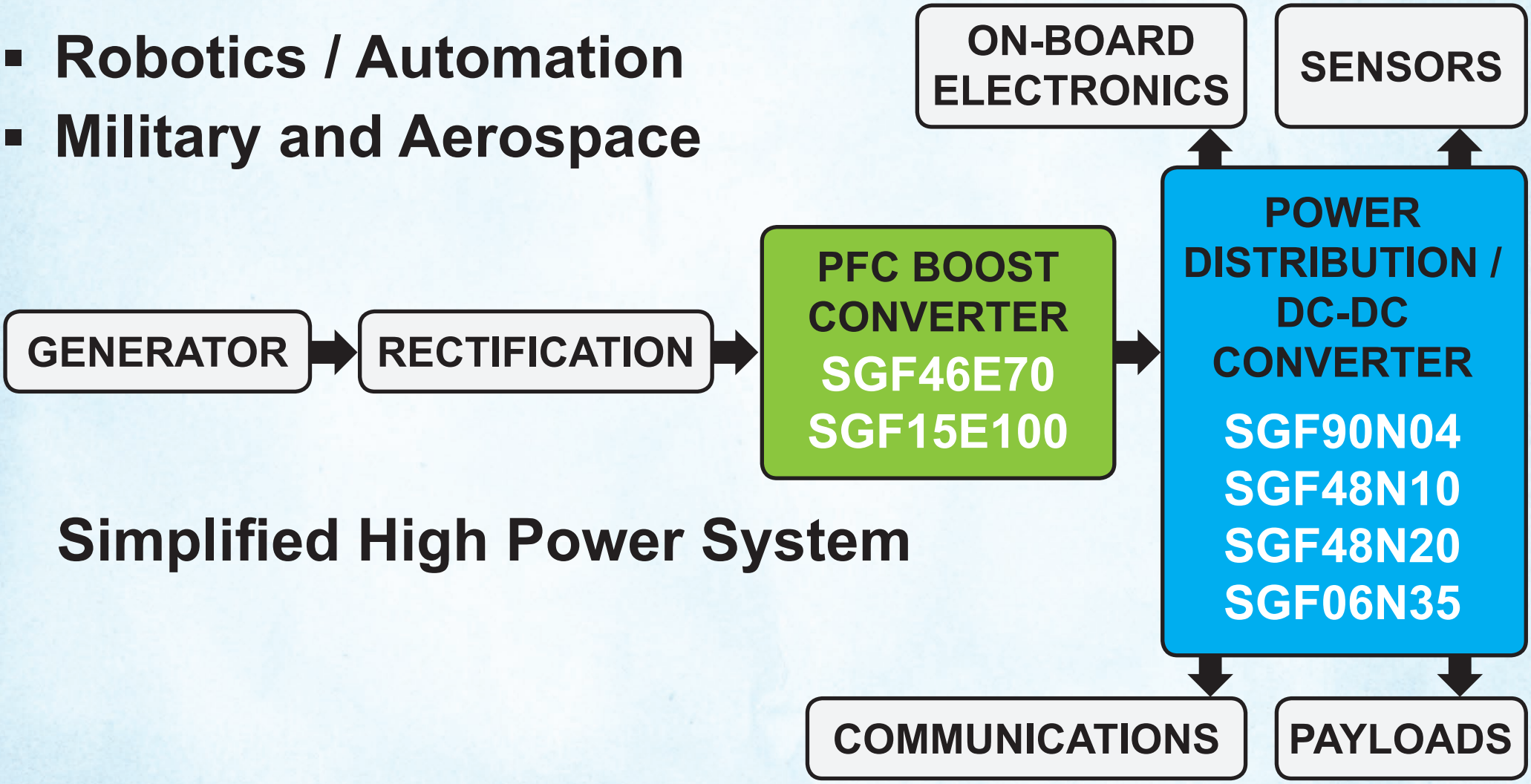
Parameters / Electrical Characteristics		SGF46E70	Competitor's MOSFET
Continuous Drain Current, I_D		**46 A**	**46 A**
Drain-Source Breakdown Voltage, $V_{(BR)DSS\ MIN}$		**700 V**	**650 V**
Drain to Source On State Resistance, $R_{DS(ON)}$ V_{GS} = 10 V, I_D = 30 A, T_J = 25°C	Typ Max	**30 mΩ** (@ 32 A) **41 mΩ** (@ 32 A)	**40 mΩ** (@ 24.9 A) **45 mΩ** (@ 24.9 A)
Total Gate Charge, Q_G V_{DS} = 400 V, T_J = 25°C	Typ	**24 nC** (@ 32 A)	**93 nC** (@ 24.9 A)
Source to Drain Reverse Recovery Time, t_{RR} V_{DS} = 400 V, T_J = 25°C	Typ	**65 ns** (@ 30 A, di/dt = 1000 A/µs)	**725 ns** (@ 46 A, di/dt = 60 A/µs)
Reverse Recovery Charge, Q_{RR} V_{DD} = 400 V, T_J = 25°C	Typ	**178 nC** (@ 30 A, di/dt = 1000 A/µs)	**13,000 nC** (@ 46 A, di/dt = 60 A/µs)
Package		**SMD1, TO-254**	**TO-247**

GaN and Si FET Applications



GaN FET Applications

- High Efficiency DC-DC / PoL Converters
- Motor Controller
- Robotics / Automation
- Military and Aerospace



Simplified High Power System

Hermetic GaN Power FETs

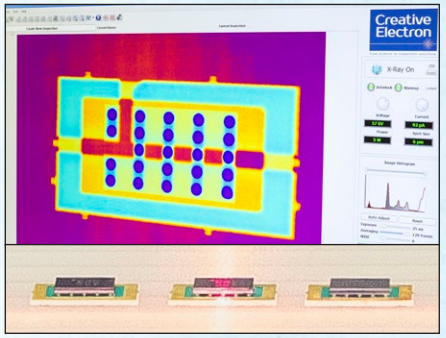
Pre-Qualification Testing

SGF48N10

1. Temperature Cycle: 100 cycles, -55°C to +150°C
2. HTRB: 48 hours, 150°C, V_{DS} = +80 V_{DC}, V_{GS} = 0 V
3. HTGB: 48 hours, 150°C, V_{GS} = +4 V_{DC}, V_{DS} = 0 V

SGF46E70

1. Temperature Cycle: 100 cycles, -55°C to +150°C
2. HTRB: 240 hours, 150°C, V_{DS} = +520 V_{DC}, V_{GS} = 0 V
3. HTGB: 48 hours, 150°C, V_{GS} = +16 V_{DC}, V_{DS} = 0 V

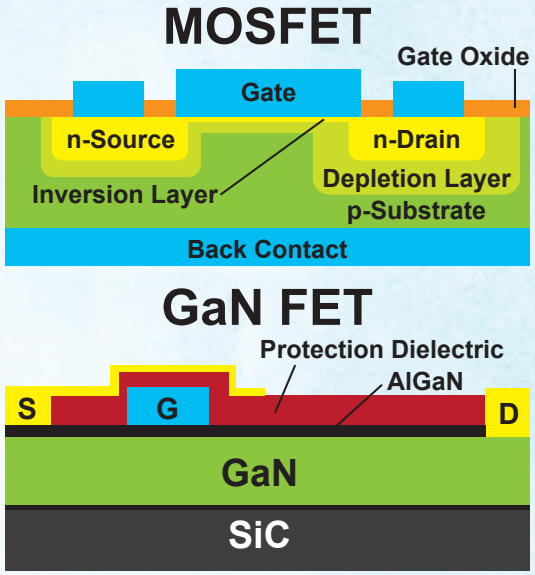


Radiation Tolerance

1. Inherent tolerance based on physical attribute

- MOSFETs: gate oxide layer susceptible to formation of traps (holes) when exposed to gamma radiation

- GaN Transistors: no gate oxide layer; bulk GaN material is radiation hard compared to Si and GaAs, and close to that of SiC



2. Radiation testing by die manufacturers / agencies

- TID up to 10.8 kGy: 40 V & 200 V GaN have shown considerable hardness
- Accelerated SEB (total fluence = 1.3E+09 neutron/cm^2)
    - 700 V GaN device: no failures
    - Superjunction Si MOSFET: failed

Challenges Facing GaN Transistor

Radiation Data

- High cost
- Myriad of test conditions / largely dependent on mission
- SSDI plans to conduct radiation testing on its own or in partnership with potential customers

Challenges Facing GaN Transistor

Gate Drivers

Enhancement Mode Series V_{GS} rating of +6 V and -4 V

- **Exceeding this rating can lead to failure - typically manifested by off-state drain leakage current increase**
- **Commercial gate drivers available: fast and regulated to the proper voltage level** (i.e. TI's LMG1205, LMG1210 and UCC27611; Intersil's rad hardened ISL70040SEH)
- **Cascode series does not have gate drive limitation due to built-in Si MOSFET driver**