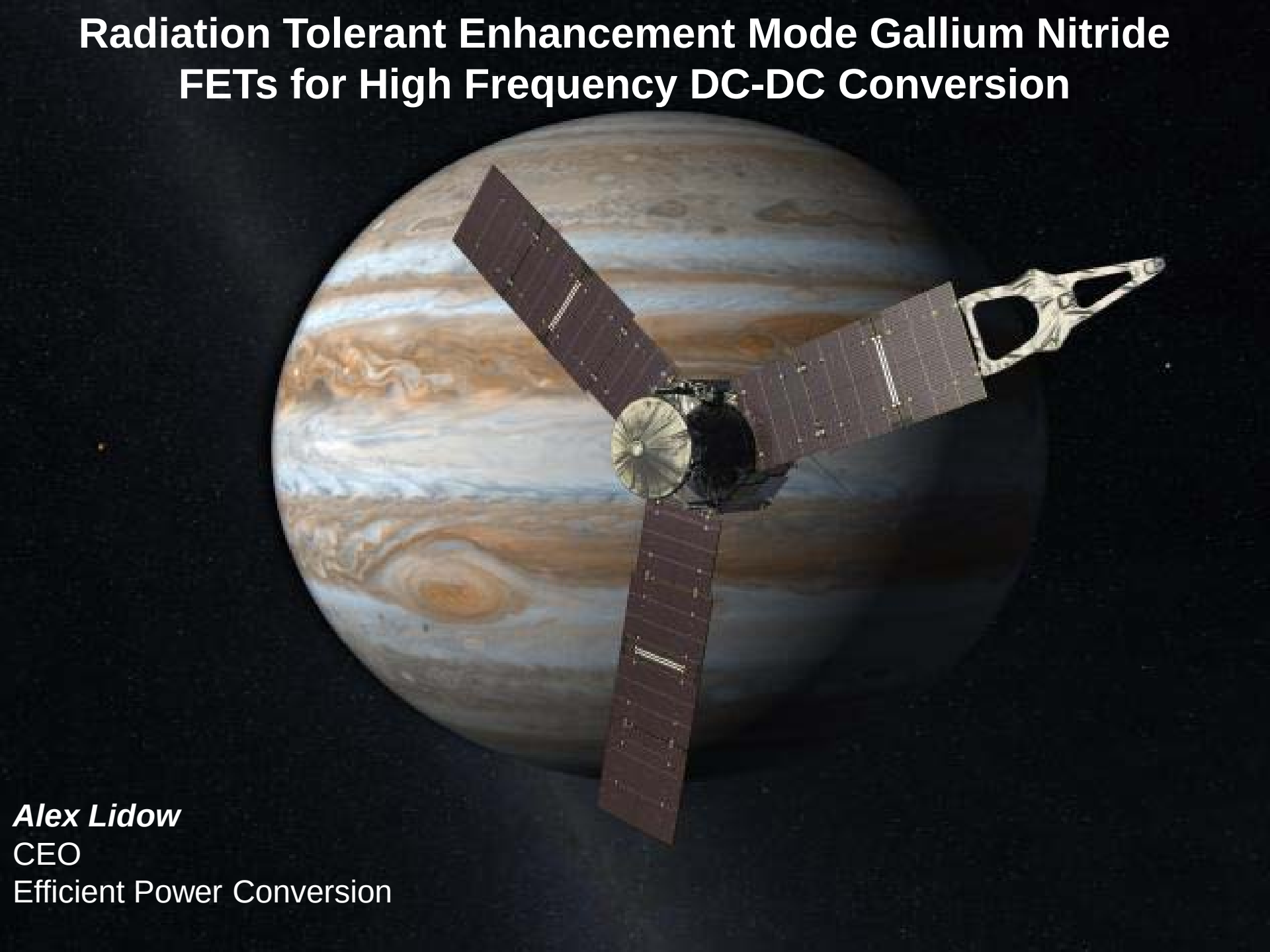
Radiation Tolerant Enhancement Mode Gallium Nitride FETs for High Frequency DC-DC Conversion



Alex Lidow
CEO
Efficient Power Conversion

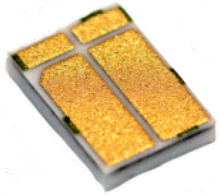
Agenda

- **Second Generation GaN FETs**
  - Electrical Characteristics
  - SEE results
  - TID results
  - DC-DC conversion at high-frequencies
- **A Look Into the Future**
- **Summary**

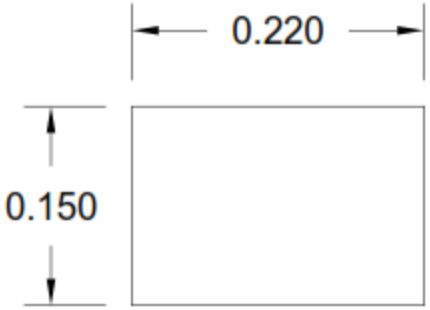
1st Gen RH GaN Product Line

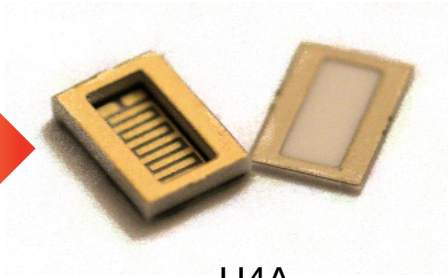
PART NO.	VOLTAGE	CURRENT	PEAK	$R_{DS(ON)}$ (mΩ)	Q_G (nC)	FOM Q_G * $R_{DS(ON)}$
MGN2915U4A	40 V	33 A	150 A	4	11.6	46.4
MGN2914U4A	40 V	10 A	40 A	16	3	48
MGN2905U4A	60 V	25 A	100 A	7	10	70
MGN2909U4A	60 V	6 A	25 A	30	2.4	72
MGN2901U4A	100 V	25 A	100 A	7	10.5	73.5
MGN2907U4A	100 V	6 A	25 A	30	2.7	81
MGN2911U4A	150 V	12 A	40 A	25	6.7	167.5
MGN2913U4A	150 V	3 A	12 A	100	1.7	170
MGN2910U4A	200 V	12 A	40 A	25	7.5	187.5
MGN2912U4A	200 V	3 A	12 A	100	1.9	190

(Preliminary)



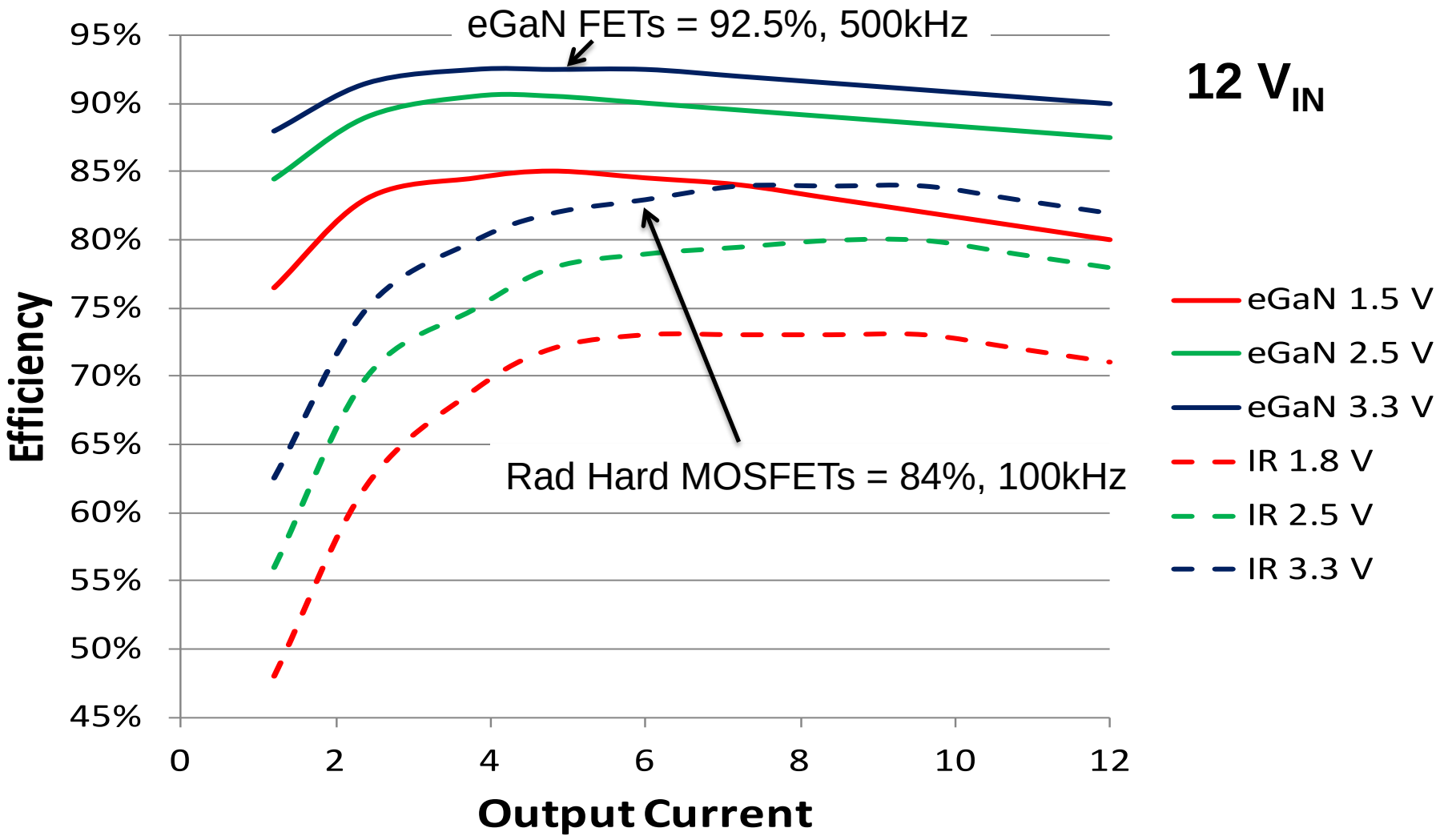
U4A





U4A

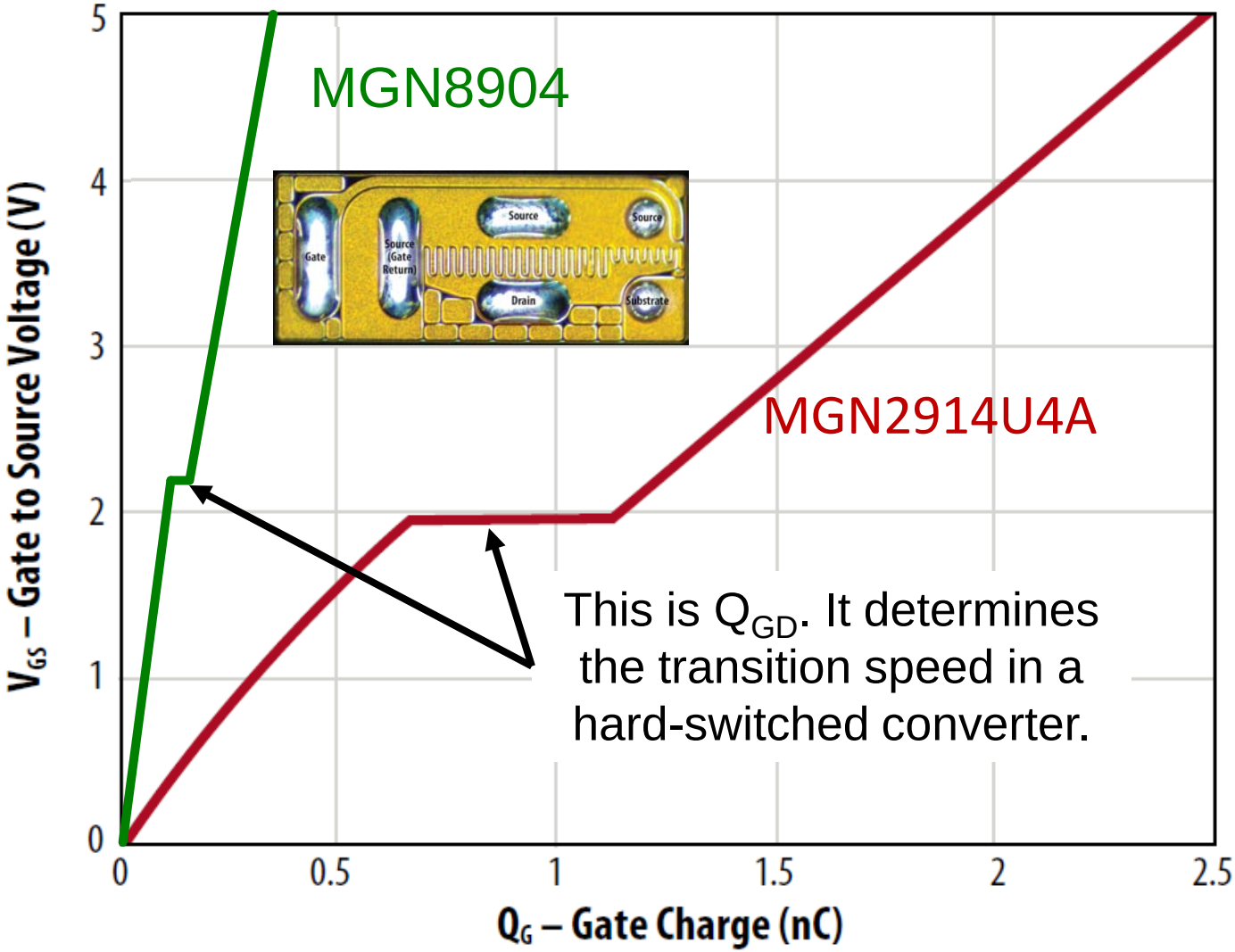
POL Efficiency Comparison



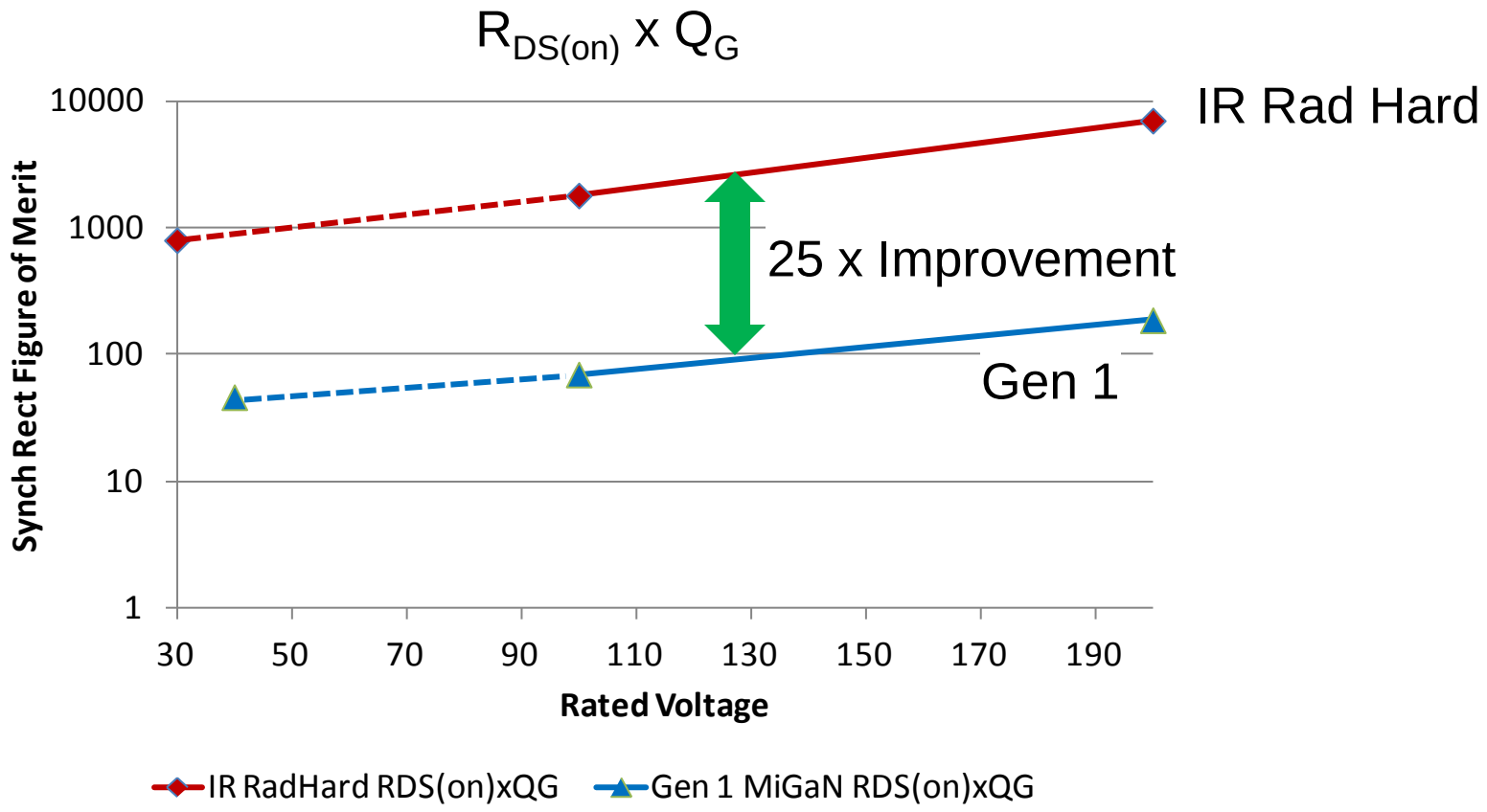
2nd Gen RH GaN Product Line

Part Number	V_{DS}	Max $R_{DS(ON)}$ (mΩ) @5V_{GS}	I_D (A)	Pulsed I_D (A)	Typical Charge (pC)					Typical Capacitance (pF)		
					Q_G	Q_{GD}	Q_{GS}	Q_{OSS}	Q_{RR}	C_{ISS}	C_{OSS}	C_{RSS}
MGN8904	40	125	4.4	7.5	358	31	110	493	0	45	17	0.4
MGN8907	40	160	3.8	6	302	25	97	406	0	39	14	0.3
MGN8908	40	325	2.7	2.9	177	12	67	211	0	25	8	0.2
MGN8909	65	138	4.1	7.5	380	36	116	769	0	47	17	0.4
MGN8905	65	275	2.9	3.8	218	18	77	414	0	29	9.7	0.2
MGN8902	65	530	2*	2	141	9.4	59	244	0	21	5.9	0.1
MGN8910	100	160	3.4	7.5	354	32	109	1509	0	47	18	0.2
MGN8903	100	300	2.5	5	315	34	110	1100	0	38	18	0.2

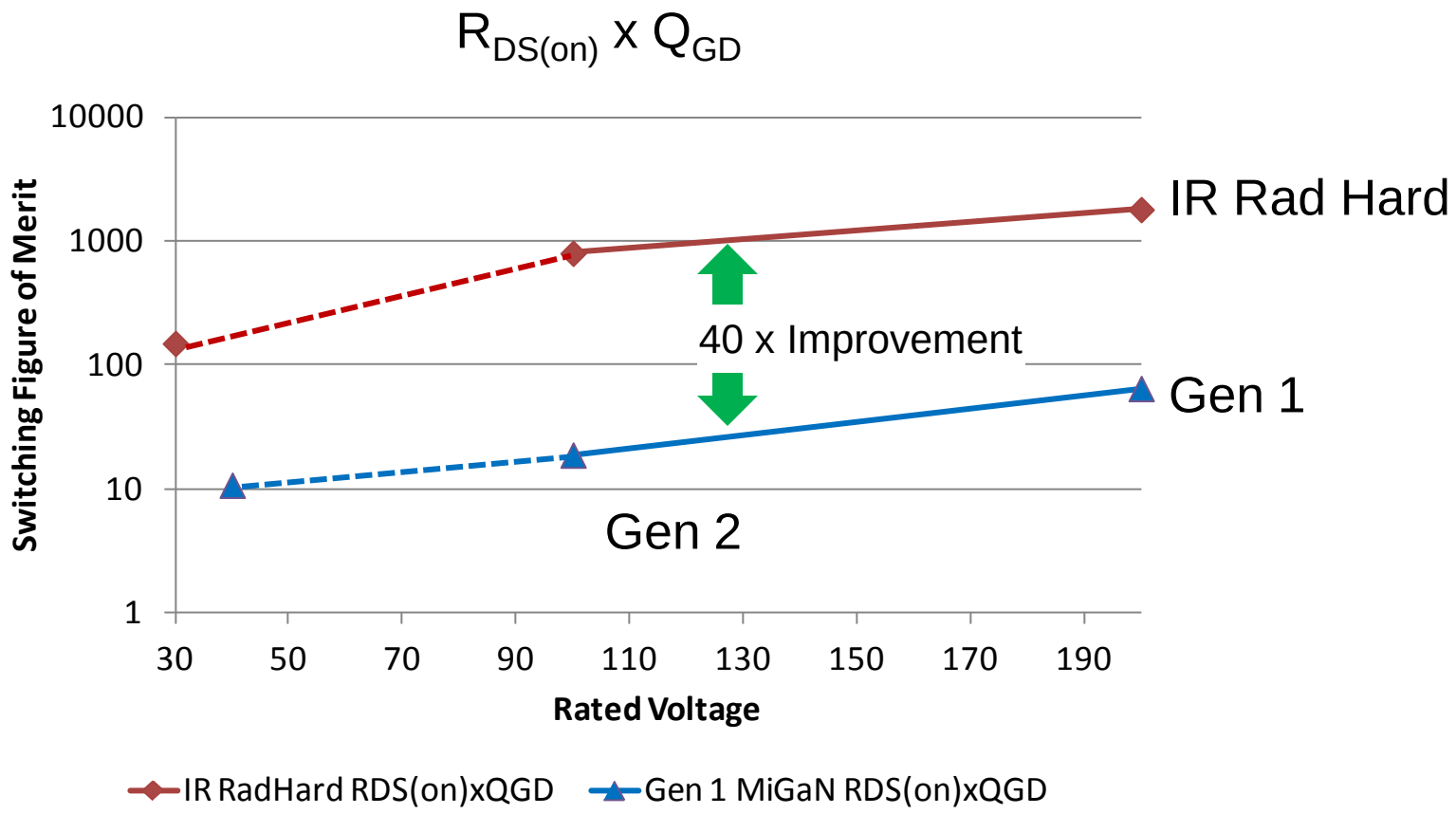
2nd Gen Rad Hard



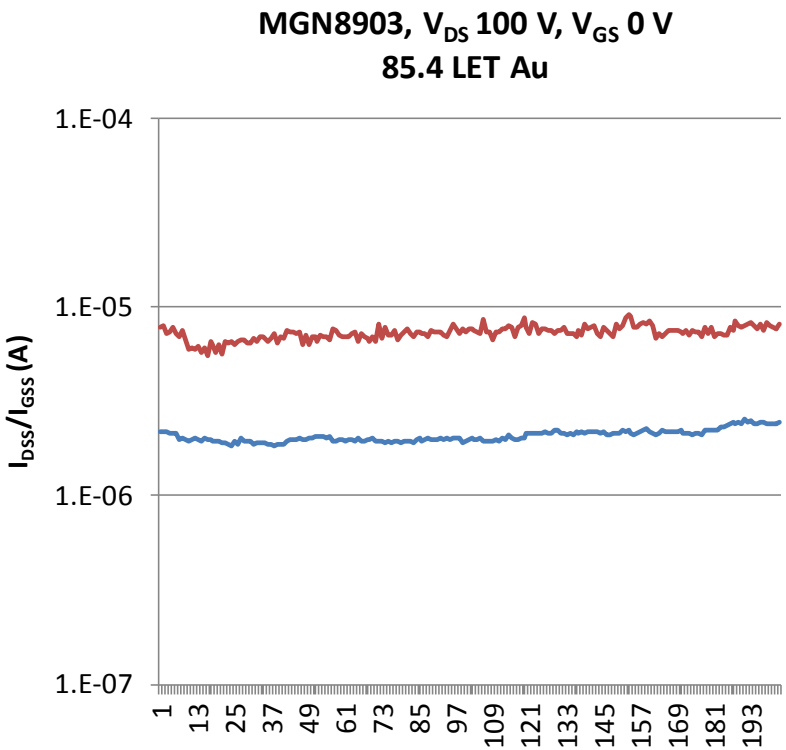
Synchronous Rectifier Figure of Merit

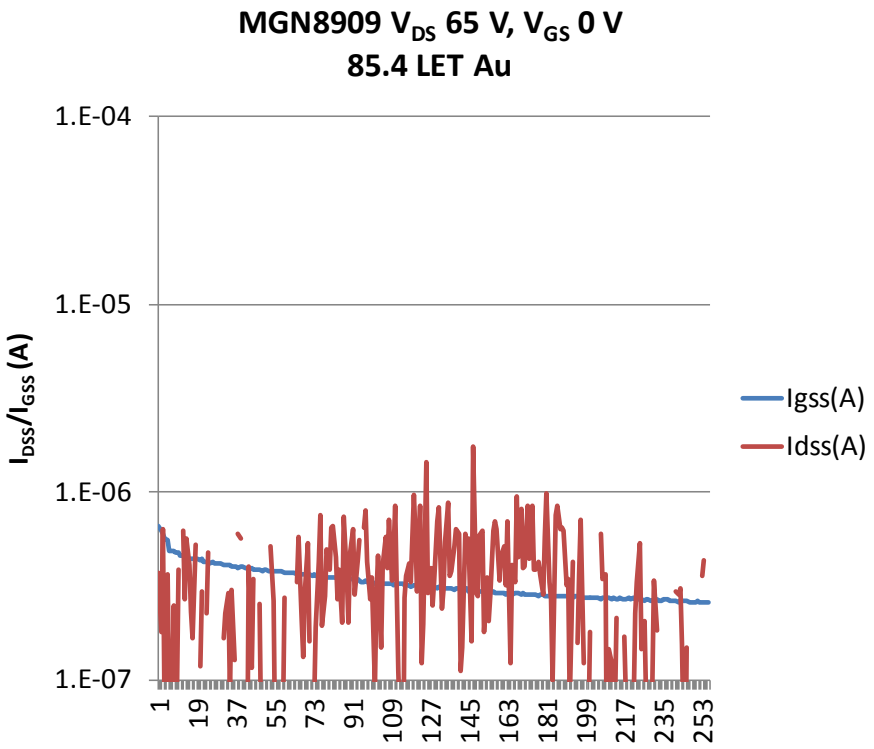


Hard Switching Figure of Merit



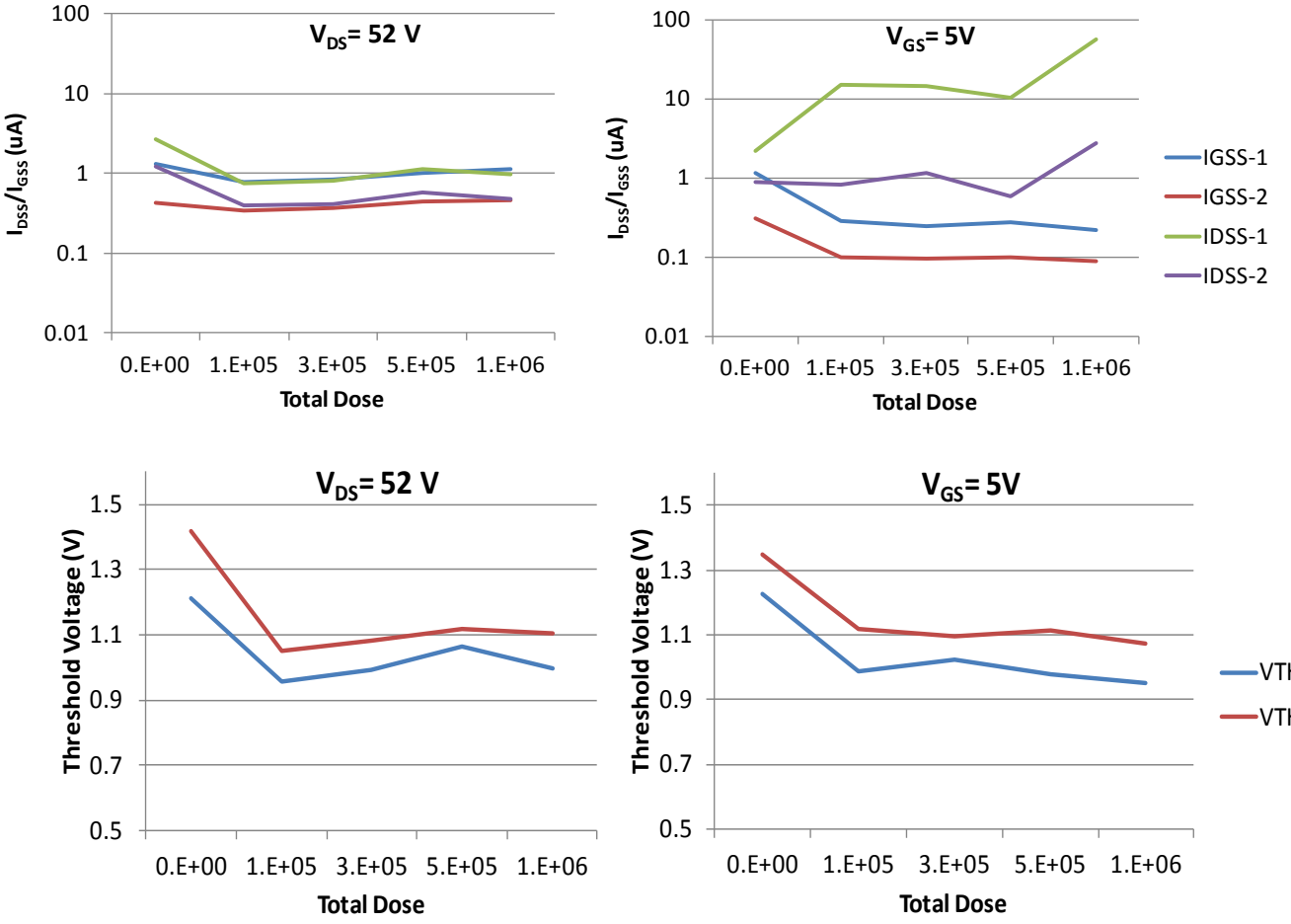
Single Event Performance



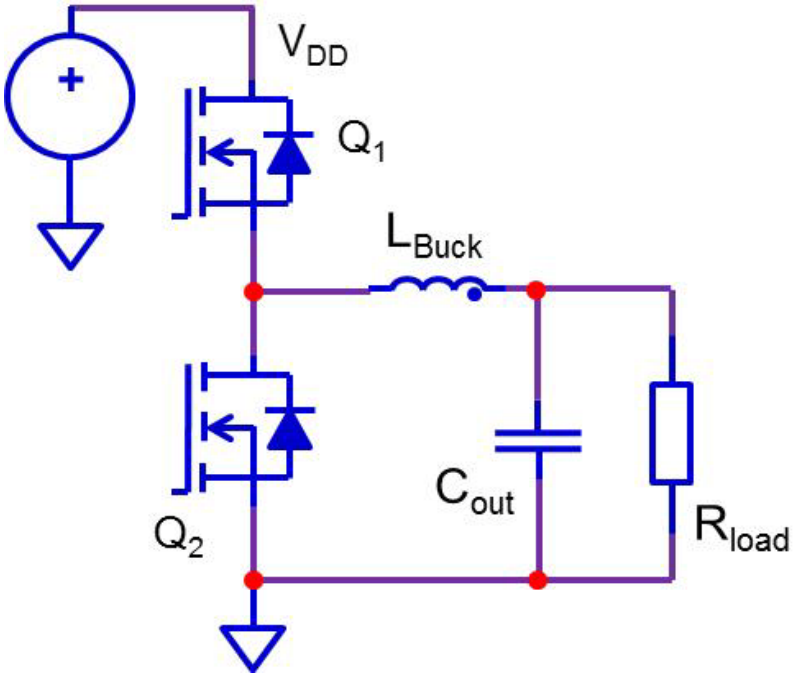


Total Dose Performance

MGN8909 MiGaN™ FET (65 V, 138 mΩ)



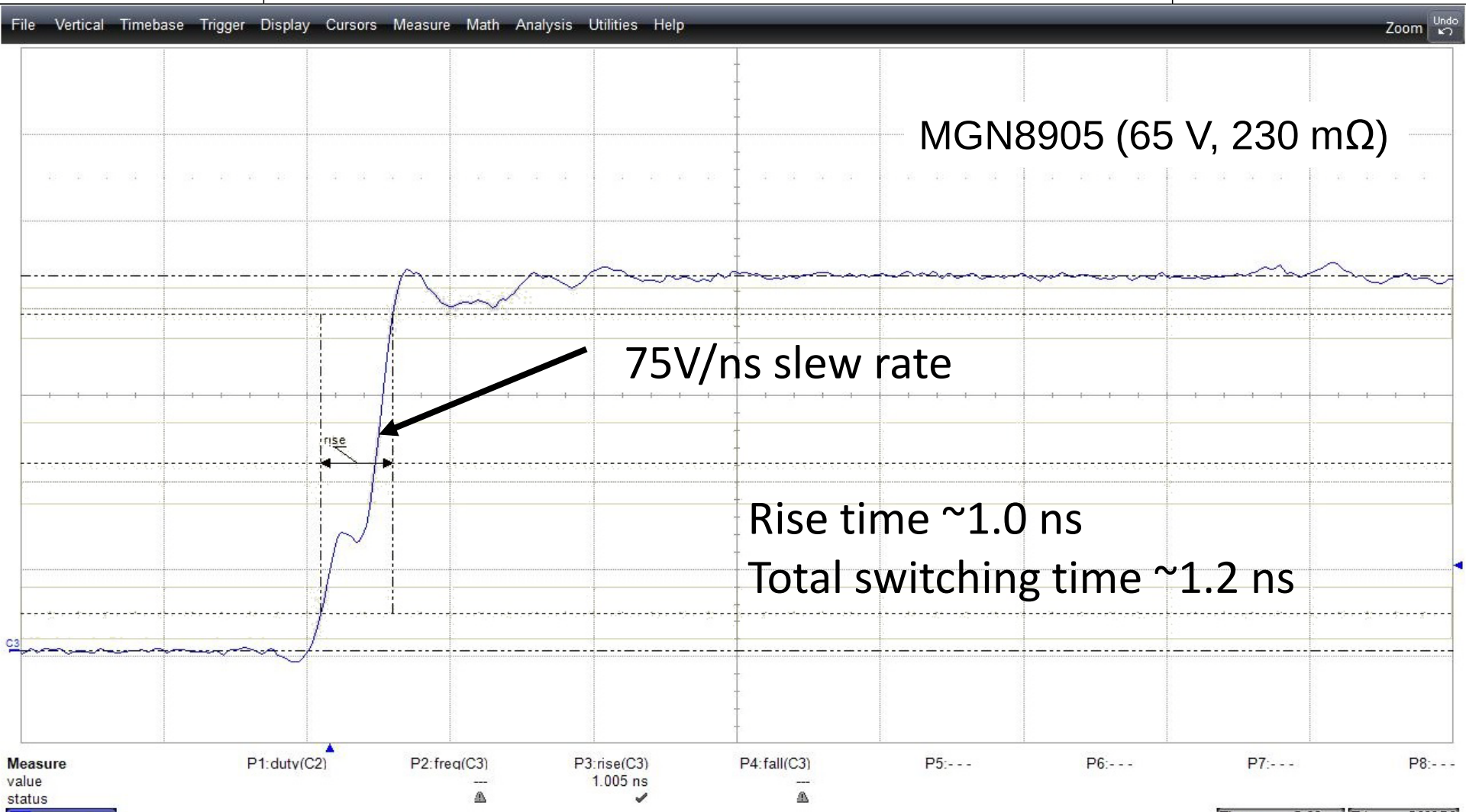
Buck Converter



V_{IN} = 42 V V_{OUT} = 20 V

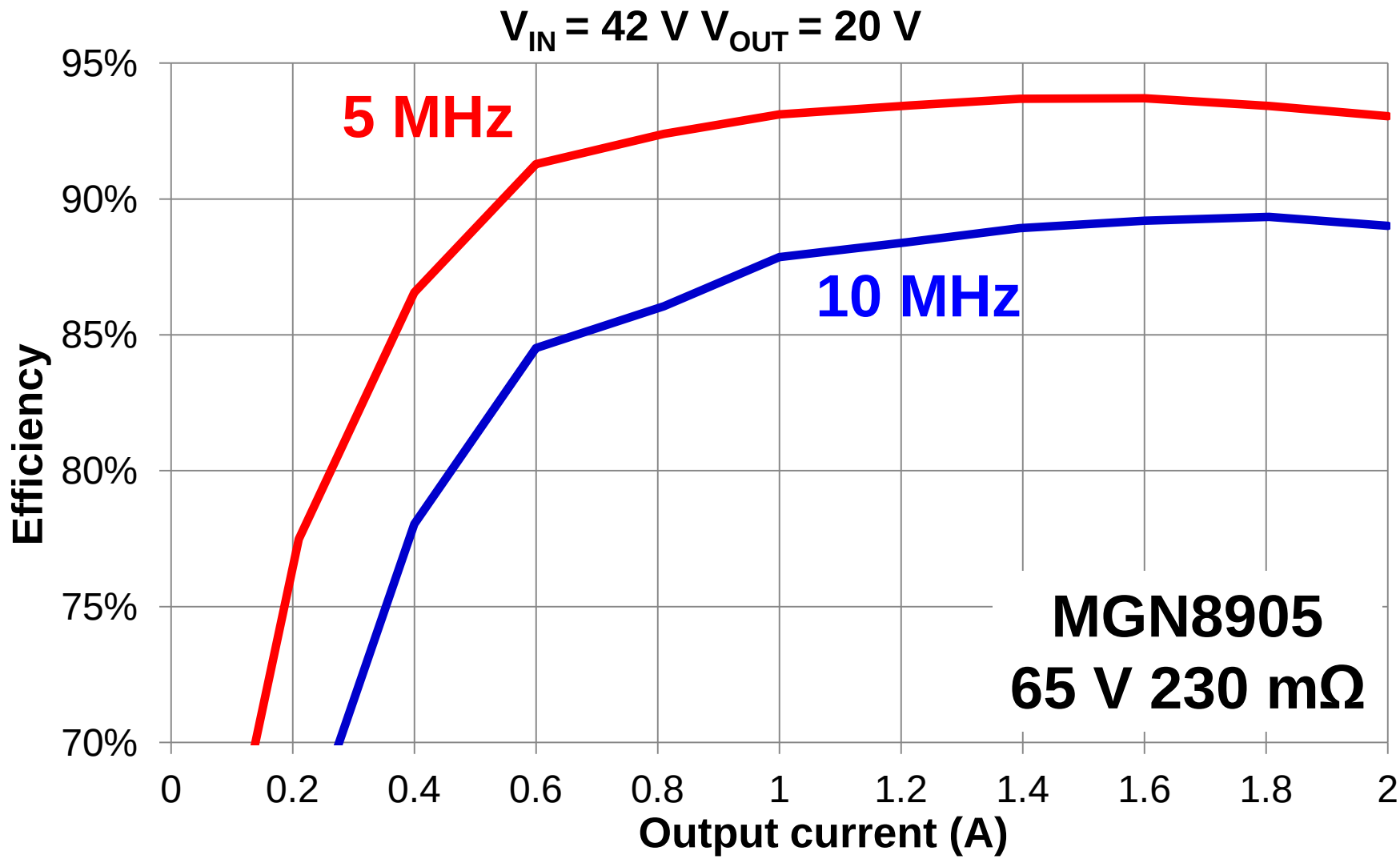
Q1, Q2 = MGN8905 (65 V 230 mΩ)

$42V_{IN}$ at $1A_{OUT}$



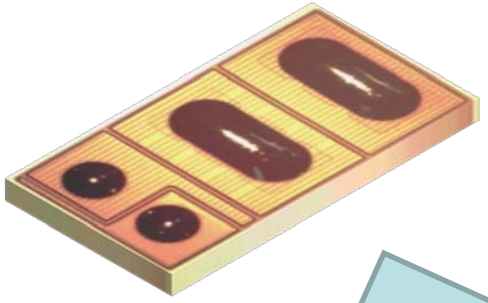
2 ns/div and 10 V/div, 1 GHz 100:1 1pF TM probe

Efficiency

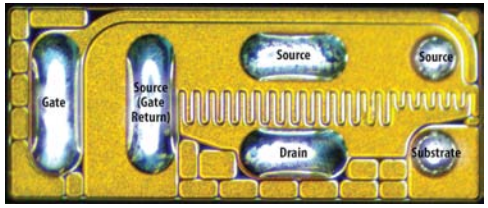

V_{IN} = 42 V V_{OUT} = 20 V
5 MHz
10 MHz
MGN8905
65 V 230 mΩ
Efficiency
95%
90%
85%
80%
75%
70%
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
Output current (A)

Rad Hard Into the Future

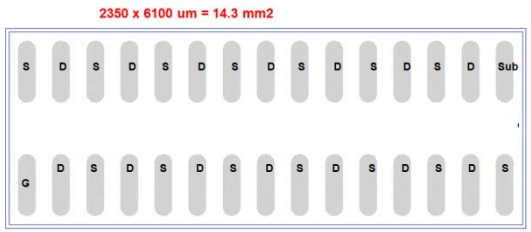
First Rad Hard Generation
40 V - 200 V
~500 MHz



Ultra High Frequency Family
1 - 3 GHz

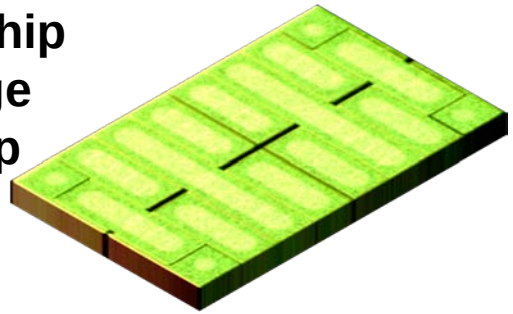


Higher Current
45 A



Higher Voltage
600 V

More functions on a chip
Monolithic half bridge
Driver on power chip



Next Generation Devices
2 x FOM Improvement

Summary

- **Moore's Law is (finally) alive and well in Rad Hard power conversion.**
- **Second generation GaN FETs are very radiation tolerant.**
- **Hard-switched DC-DC converters operating at 10 MHz+ are now possible.**
- **This is just the beginning for GaN technology in space!**

The end of the road for silicon…..

is the beginning of the eGaN FET journey!