

GreenFET

Robust Load Switches

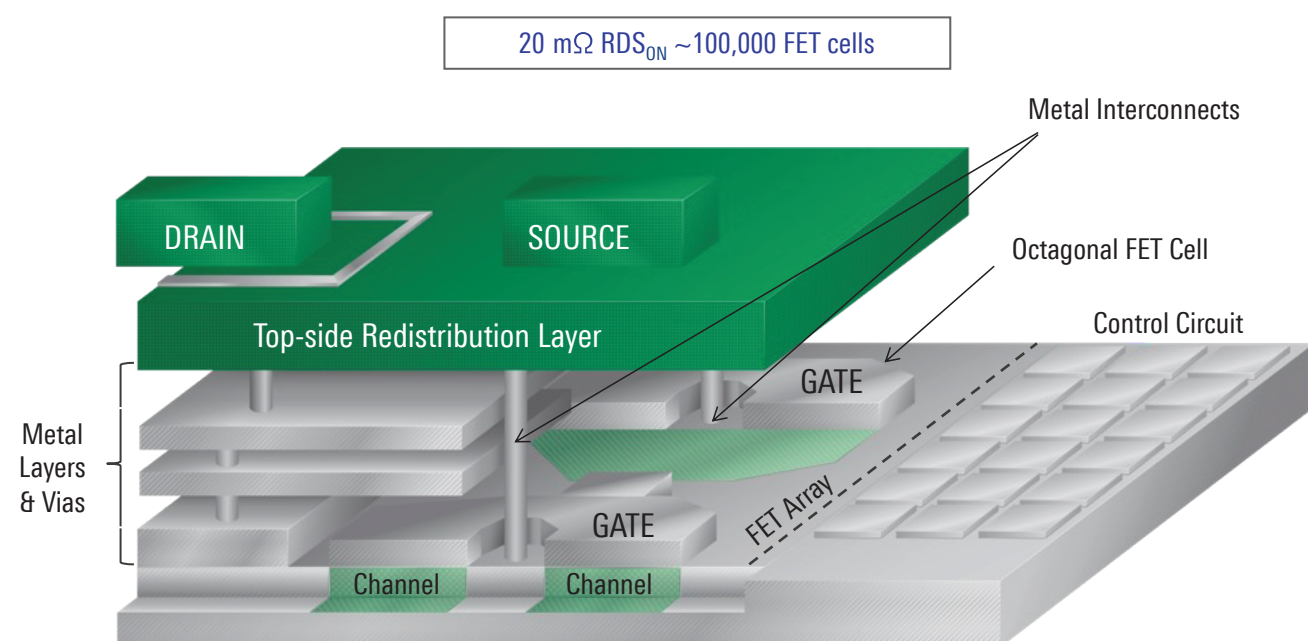


GreenFET LOAD SWITCH TECHNOLOGY

Renesas' GreenFET family of high-performance robust load switches are designed and optimized for all high-side power rail control applications from 0.25 V to 25.2 V where the load currents range from 1 A to 9 A. Using Renesas' proprietary MOSFET design, all GreenFET load switches achieve ultra-stable $R_{DS(on)}$ across wide input and supply voltage ranges.

CuFET MOSFET TECHNOLOGY

For Achieving Smallest Parts with Lowest $R_{DS(on)}$



Combining Renesas' proprietary MOSFET IP and advanced assembly techniques, these advanced state-of-the-art products are available in ultra-small PCB footprints from 0.56 mm² to 4 mm² and exhibit low thermal resistances for high-current operation. All low- and high-voltage GreenFET load switches are designed and fully characterized over the commercial (0 °C to 70 °C), extended commercial (-20 °C to 70 °C), industrial (-40 °C to 85 °C), or extended industrial (-40 °C to 125 °C) temperature ranges.

GreenFET LOAD SWITCH PORTFOLIO

GreenFET

- Single-channel nFET & pFET in STDFN & STQFN (1 mm² to 4 mm²)
- Single-channel in WLCSP (1 A to 4 A, 0.56 mm² to 1.5 mm²)
- Dual-channel nFET and pFET in STDFNs (3 mm²)

Operating input voltage range

- Maximum V_{DD} Voltage Ranges: 2 V, 3.6 V & 5.5 V
- Operating input voltage range: 0.25 V to V_{DD}
- $R_{DS(on)}$ Range: 4 mΩ to 80 mΩ
- I_{DS} Current Range: 1 A to 9 A
- UL2367 Current-Limiter Certified (select parts)

High voltage GreenFET

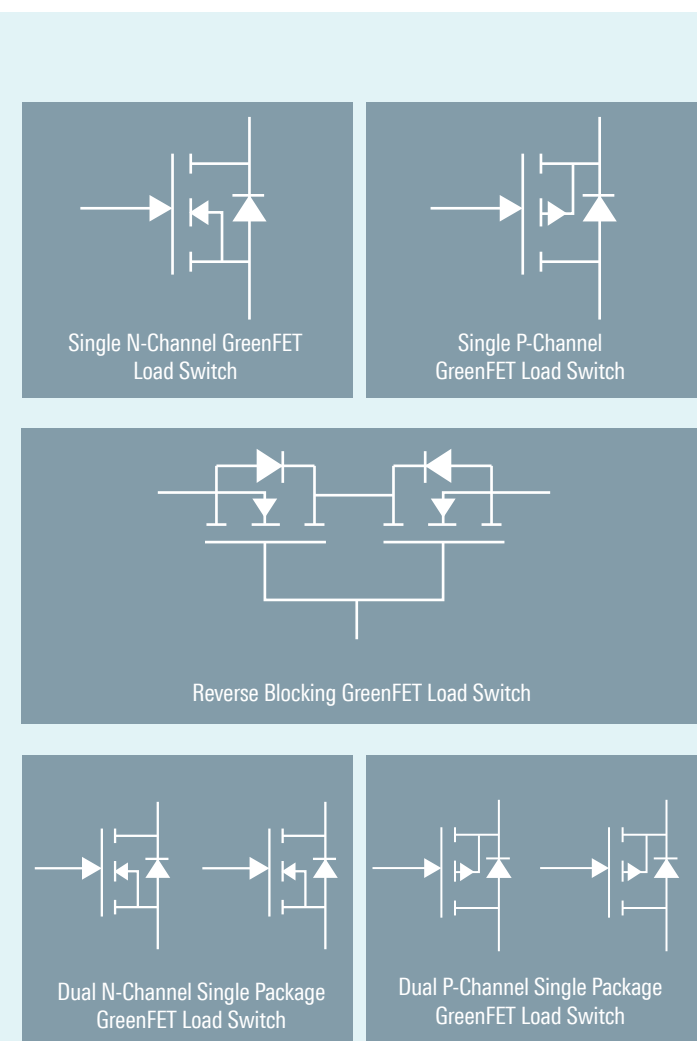
- Single channel (1.46 mm² to 5 mm²)
- Operating input voltage range: 2.5 V to 25.2 V
- $R_{DS(on)}$ Range: 13 mΩ to 70 mΩ
- I_{DS} Current Range: 1.25 A to 6 A
- WLCSP for Space-Constrained Applications
- UL2367 Current-Limiter Certified (select parts)

High Voltage GreenFET for PowerMux application

- Dual Input, Single Output
- Wide operating voltage range (2.8 V to 22 V)
- $R_{DS(on)}$ range: 40 mΩ to 67 mΩ
- Individual enable control (selected PNs)
- Robust protection
- Ideal Diode Behavior during switchover (selected PNs)
- Small FC-QFN & WLCSP packages (3.1 mm² to 5 mm²)

High Side Gate Drivers

- N-Channel MOSFET Drivers



GreenFET products combine high-performance nFET or pFET structures, high current handling capability, charge pumps, as well as multiple protection and control circuits into space-efficient single- and dual-channel products.

GreenFET LOAD SWITCH FEATURES & TARGET APPLICATIONS

Key features

- High-performance Low $R_{DS(ON)}$ nFET & pFET MOSFETs
 - From as low as 4 m Ω
- Internal Protection Features:
 - Built-in supply undervoltage lockout protection
 - Built-in supply overvoltage protection
 - Fast V_{OUT} discharge (V_{OUT} discharge delete options available)
 - Fixed and capacitor/resistor-adjustable inrush current control
 - Fixed and resistor-adjustable current limit protection
 - Built-in short-circuit current protection
 - Built-in thermal shutdown protection with auto restart or latch off
 - Reverse-current blocking using bulk switch or back-to-back FETs
 - Reverse-voltage detection (selected part numbers)
 - Safe operating area protection
- Active HIGH ON-OFF control (Active-LOW ON-OFF control available)
- Open-drain("FAULT") signaling (selected part numbers)
- Open-drain power good signaling (selected part numbers)
- Wafer-level chip-scale packaging (selected part numbers)
- UL2367 certified (select part numbers)

Applications

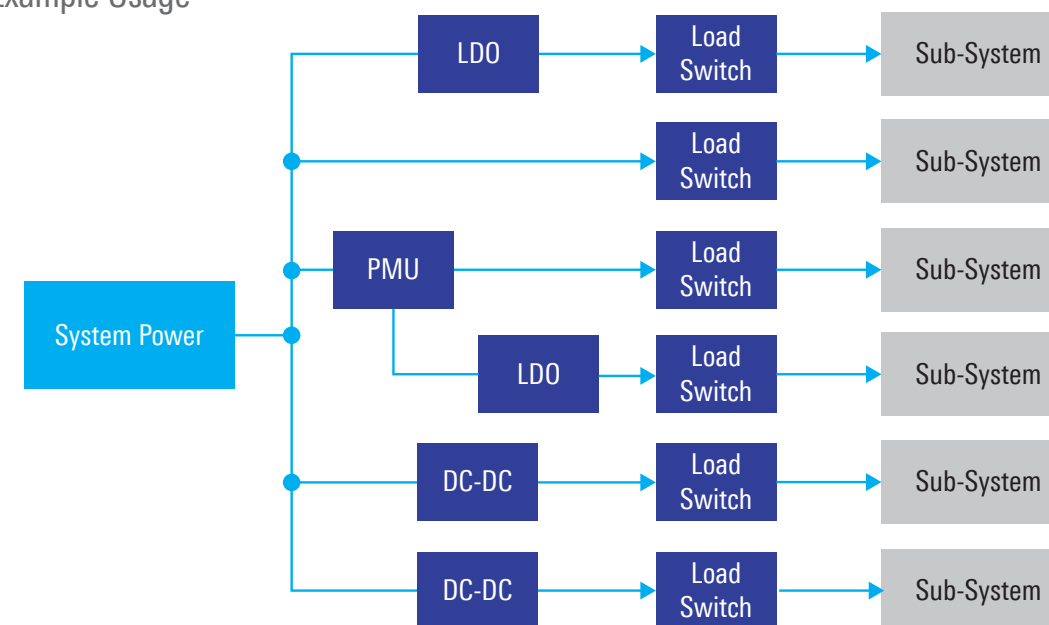
- Smartphones and fitness bands
- Notebook and tablet PCs
- Enterprise networking
- Enterprise multifunction copiers/printers
- Enterprise computing
- Set-top boxes
- HDDs and SSDs
- PCIe/PCI adapter cards
- Portable consumer electronics
- General-purpose, high-side power-rail switching/control



GreenFET LOAD SWITCH USAGE EXAMPLES

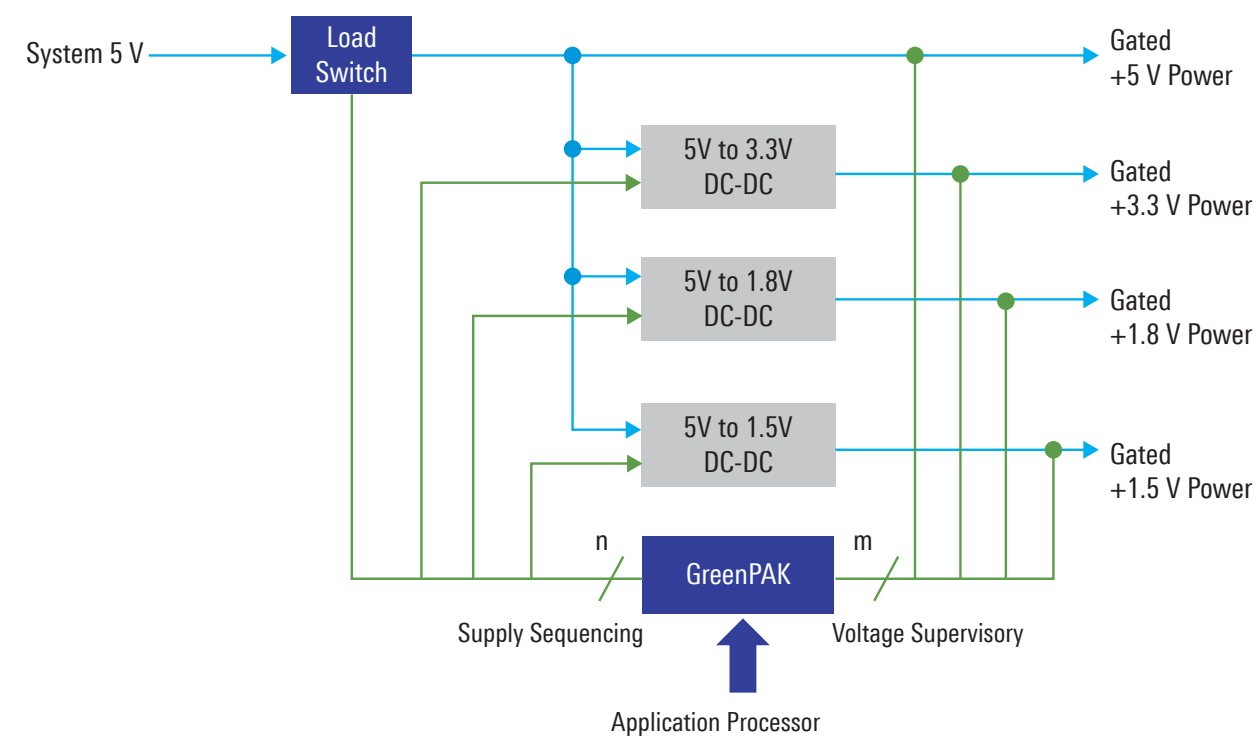
Power Distribution Application

Load Switch Example Usage



Power Control Application

Load Switch Example Usage



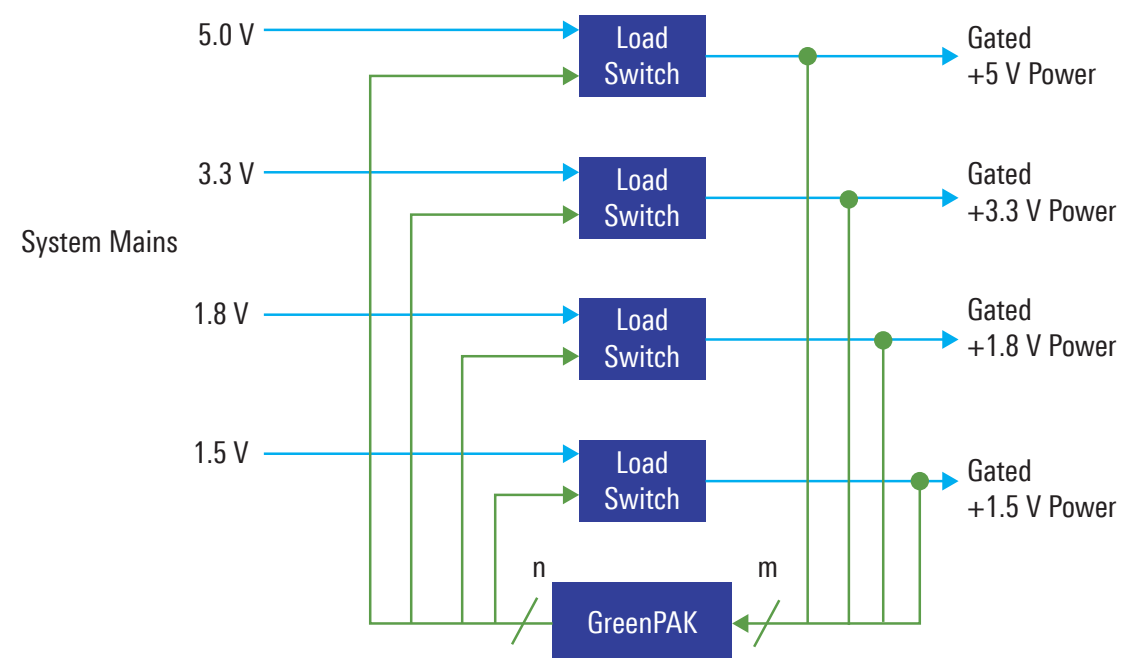
■ Power

■ Signal

GreenFET LOAD SWITCH USAGE EXAMPLES

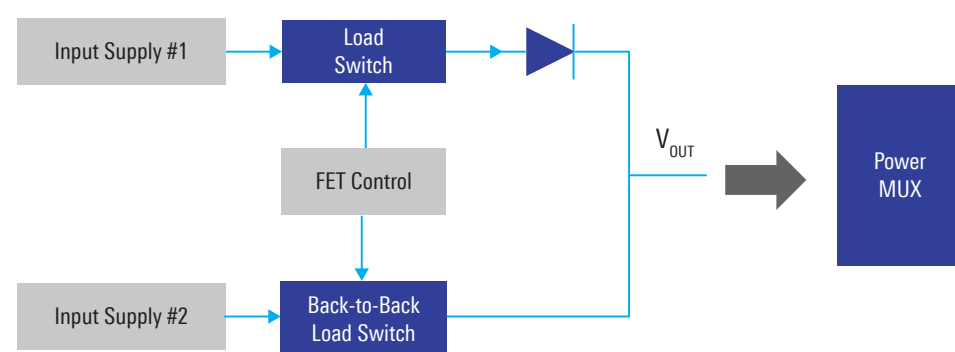
Power Sequencing Application

Load Switch Example Usage



Dual In, Single Out Power Multiplexer

Load Switch Example Usage

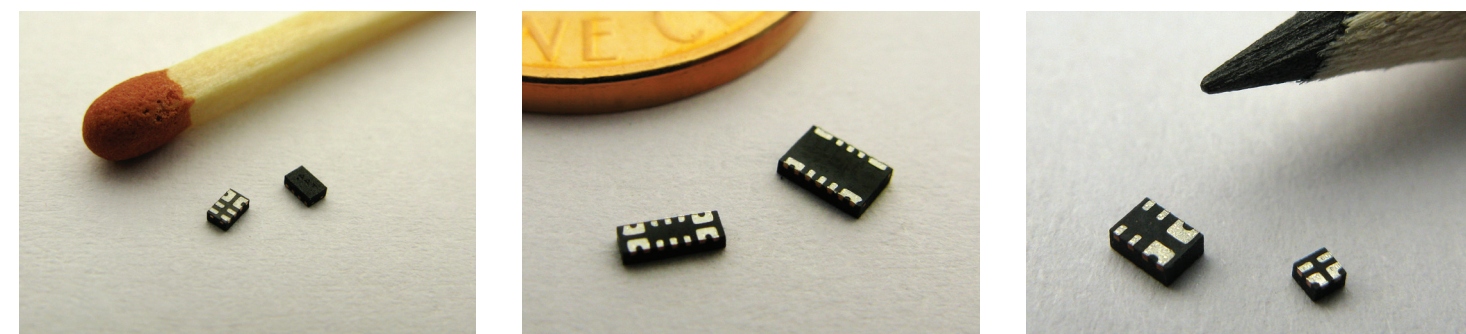


■ Power

■ Signal

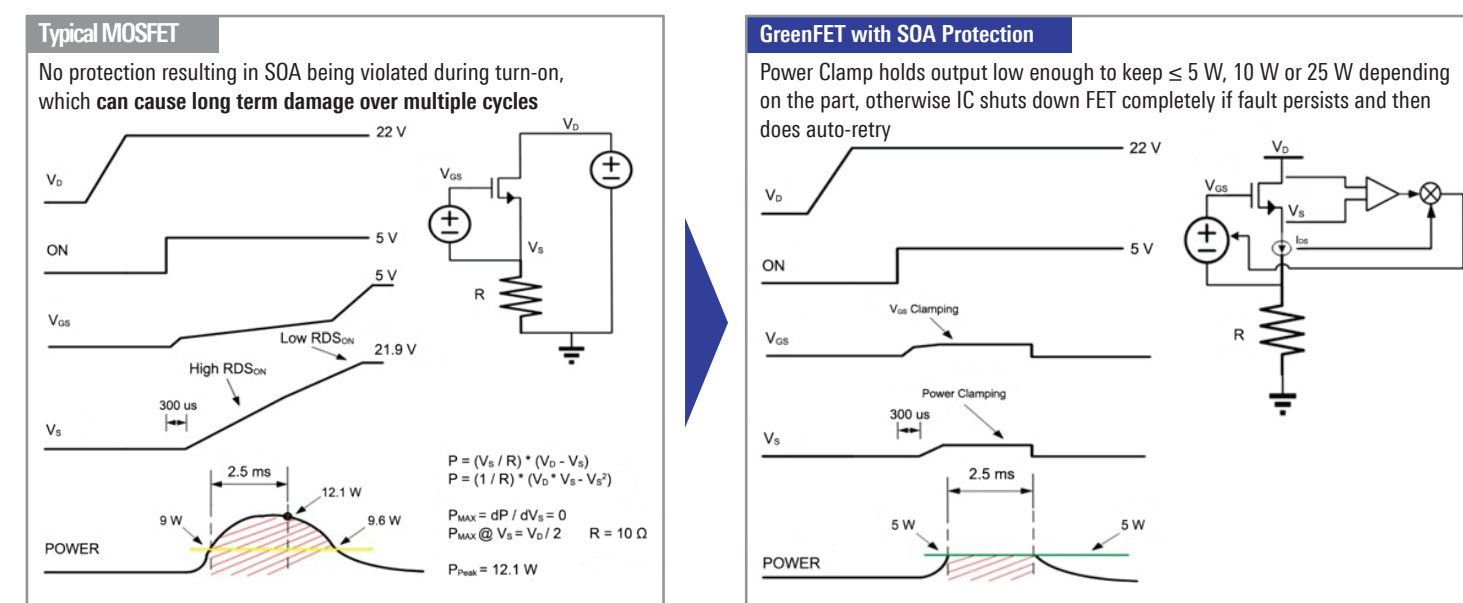
GreenFET ADVANTAGES

- Highest Current per mm². CuFET™ MOSFET technology utilizes a unique architecture, layout, and inverted die packaging to increase circuit packaging density.
- Industry-Leading RDS_{ON}. Extensive use of all copper layers, interconnect, and lead frame generate extremely low thermal gradients across PCB.
- ≤ 1 Failure Incident per 75 Mu Shipped. Integrating extensive protection features protect the IC itself and circuits connected to it, making systems more robust and reliable.



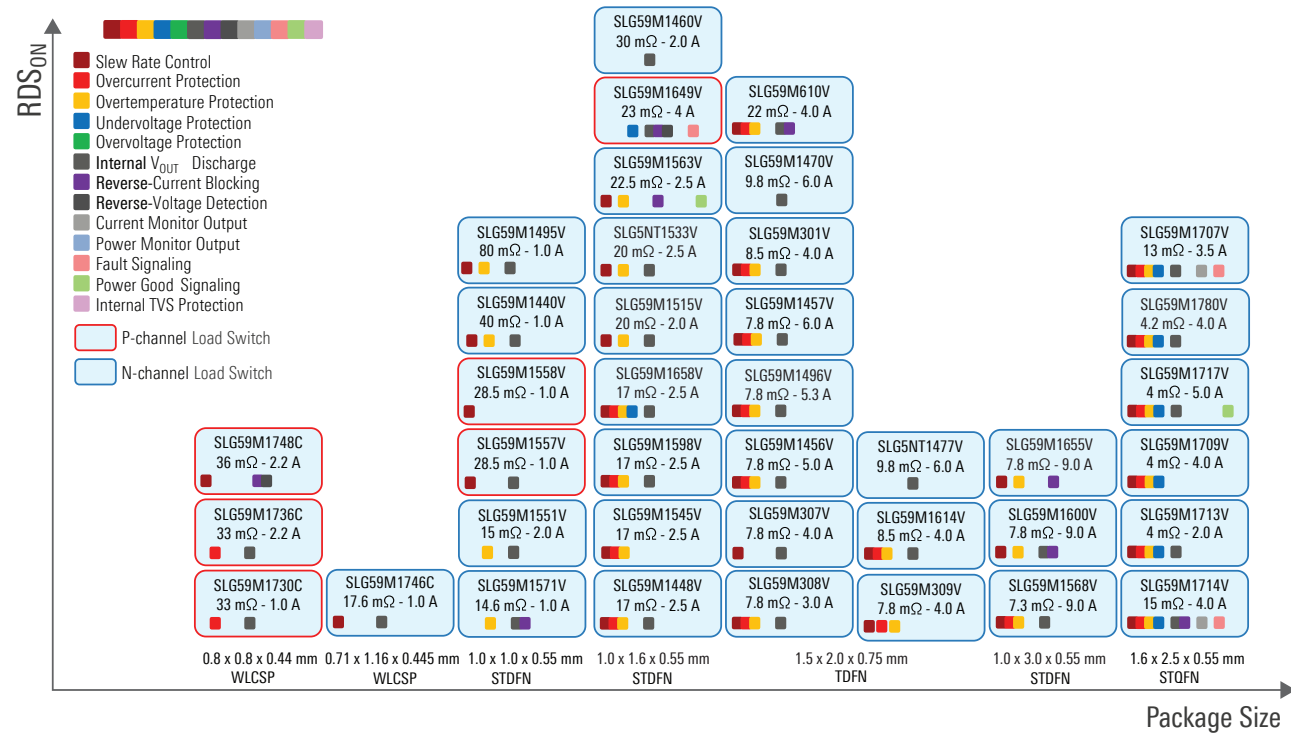
GreenFET SAFE OPERATING AREA (SOA) PROTECTION

Power Limiting Protection Circuitry



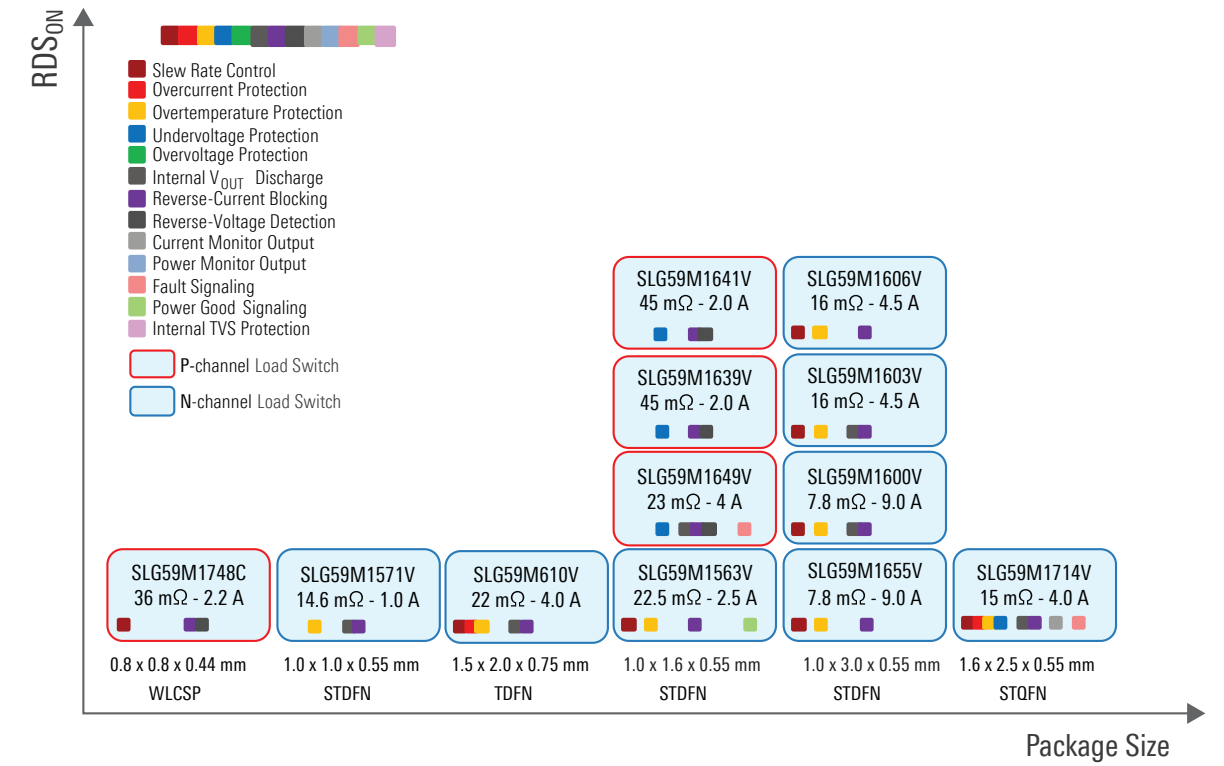
GreenFET LOAD SWITCH PRODUCT CHART

Single-Channel GreenFET Load Switch

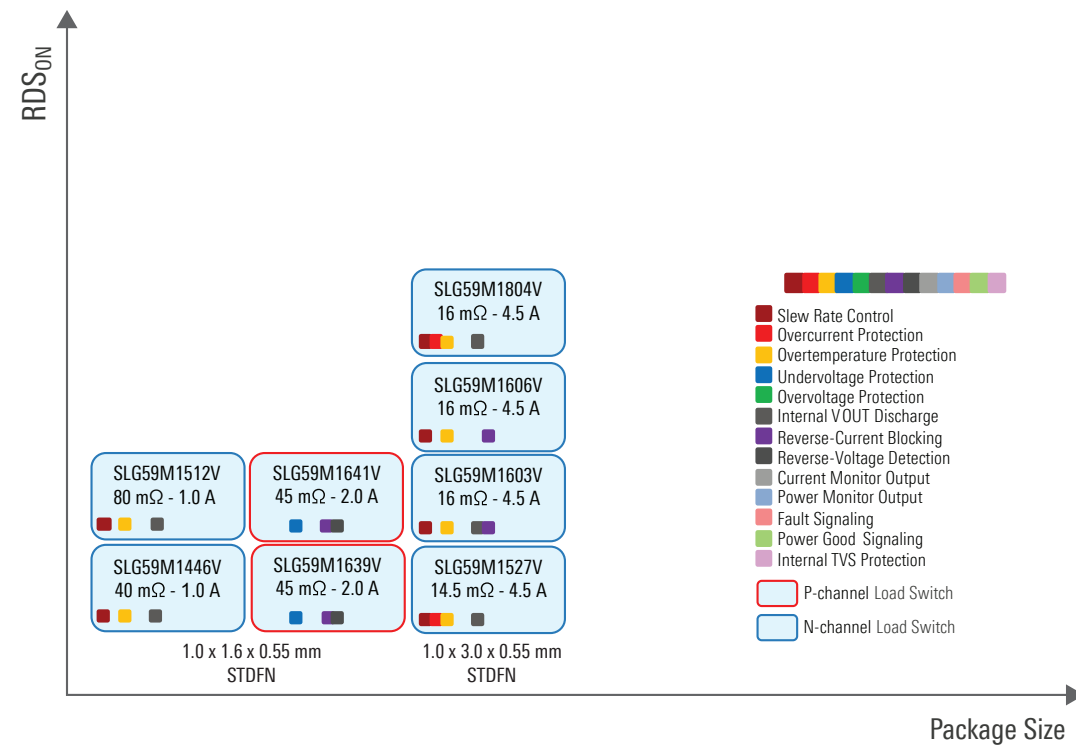


GreenFET LOAD SWITCH PRODUCT CHART

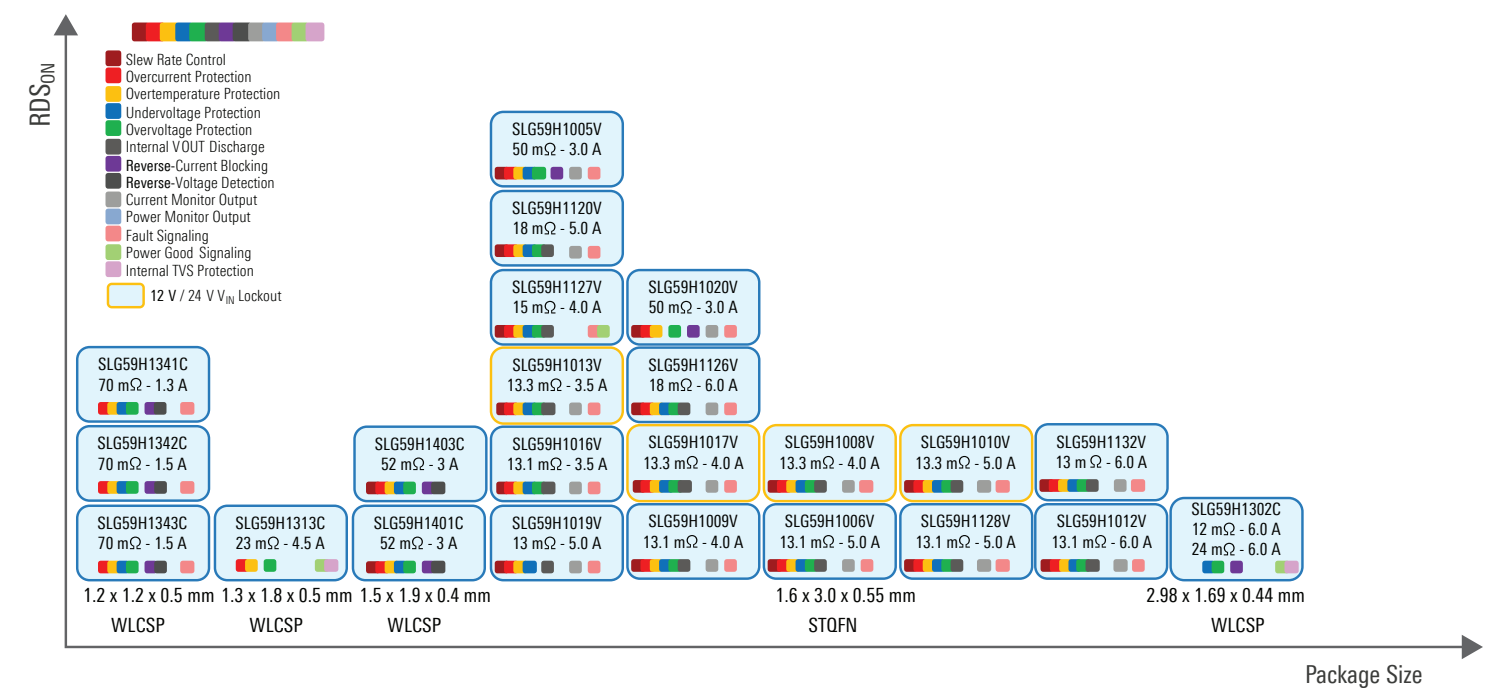
Reverse-Blocking GreenFET Load Switch



Dual-Channel GreenFET Load Switch



High Voltage GreenFET Load Switch



GreenFET ROBUST LOAD SWITCHES

Visit renesas.com/load-switches for more details on the complete portfolio of products, including the product selection guide, eval boards and samples.



GreenFET Product Selection Guide

HIGH-VOLTAGE GreenFET HIGH-VOLTAGE, HIGH CURRENT, ULTRA LOW RDS_{ON} LOAD SWITCHES

High-performance load switches include high-voltage capability for all high-side, 4.5 V to 24 V power rail applications up to 6 A. Using Renesas' proprietary MOSFET IP and advanced assembly techniques, these products are available in very space-efficient footprint packages. These products combine high-performance nFET structures, charge pumps, multiple protection, and control circuits into feature-rich packages available in low thermal resistance, RoHS-compliant packaging or wafer level chip scale packaging (WLSCP).

Description	Max IDS (A)	RDS _{ON} (mΩ)	VD/VIN Min (V)	
Surge-protected, 28V tolerant USB Type C Power Splitter/Switch with charge pump, LDO and PG signal output	OUT: 6 SYS: 6	OUT: 12 SYS: 24	3	
1.46 mm ² surge-protected, 29V tolerant nFET load switch with internal 100V TVS and Adjustable OVP in WLSCP	5	23	3	
SL659H1341C	1.46 mm ² load switch with VIN undervoltage protection, VOUT overvoltage protection, reverse-current blocking, reverse-voltage detection, and FLT Output	1	70	3
SL659H1342C	1.46 mm ² load switch with VIN undervoltage and overvoltage protection, reverse-current blocking, reverse-voltage detection, and FLT Output	2	70	3
SL659H1401C	3.15 mm ² power multiplexer with VIN[1,2] undervoltage protection, resistor-adjustable overvoltage protection, true reverse-current blocking, and channel status indication	3	52	3

GreenFET ULTRA-LOW RDS_{ON} LOAD SWITCH SELECTION GUIDE

Reverse-Current Blocking Load Switches

Part Number	Description	Max I _{DS} (A)	RDS _{ON} (mΩ)	V _{DS} Min (V)	V _{GS} Max (V)	Power Supply (V _{DD}) Voltage Range (V)	Output Voltage (Sense Resistor)	Protection Features*	Current Monitor Output	Power Good/FAULT Indicator	Output Discharge Circuit	Operating Temperature Range (°C)	Package Size (mm)
SL659M1600V	3 mm ² load switch with reverse-current blocking, charge pump, ramp control, output discharge, and protection	9	8	0	VDD	2.5–5.5	Capacitor	TSD, RCB	No	No	Yes	-40 to +85	STDFP-14 (1.8 x 3.0)
SL659M1650V	3 mm ² load switch with reverse-current blocking, charge pump, ramp control, and protection	9	8	0	VDD	2.5–5.5	Capacitor	TSD, RCB	No	No	No	-40 to +85	STDFP-14 (1.8 x 3.0)
SL659M1631V	1 mm ² low-voltage load switch with reverse-current blocking, charge pump, output discharge, protection, and 4-pin package	1	15	0	2	–	No	TSD, RCB	No	No	Yes	-40 to +85	STDFP-4 (1.8 x 1.0)
SL659M1714V	4 mm ² load switch with reverse-current blocking, charge pump, I _{DS} current monitor output, output discharge, and protection	4	15	0	VDD	2.5–5.5	Internally Fixed	UVLO, ACL(R), SCL, TSD, RCB	Yes	FAULT	Yes	-40 to +85	STDFP-16 (1.8 x 2.5)
SL659M1603V	3 mm ² dual-channel load switch with reverse-current blocking, charge pump, ramp control, output discharge, and protection	5	16	0	VDD	2.5–5.5	Capacitor	TSD, RCB	No	No	Yes	-40 to +85	STDFP-14 (1.8 x 3.0)
SL659M1609V	3 mm ² dual-channel load switch with reverse-current blocking, charge pump, ramp control, and protection	5	16	0	VDD	2.5–5.5	Capacitor	TSD, RCB	No	No	No	-40 to +85	STDFP-14 (1.8 x 3.0)
SL659M1610V	3 mm ² load switch with reverse-current blocking, charge pump, ramp control, output discharge, and protection	4	22	1	VDD	2.5–5.5	Capacitor	ACL, SCL, TSD, RCB	No	No	Yes	-40 to +85	TDFP-8 (1.5 x 2.0)
SL659M1611V	3 mm ² load switch with reverse-current blocking, charge pump, ramp control, and protection	4	22	1	VDD	2.5–5.5	Capacitor	ACL, SCL, TSD, RCB	No	No	No	-40 to +85	TDFP-8 (1.5 x 2.0)
SL659M1563V	1.6 mm ² load switch with reverse-current blocking, charge pump, and PG signal output	3	23	1	VDD	1.5–5.5	Internally Fixed	TSD, RCB	No	PG	No	-40 to +85	STDFP-8 (1.8 x 1.0)
SL659M1649V	1.6 mm ² load switch with reverse-current blocking, reverse-voltage detection, and output discharge	4	23	2	6	–	No	UVLO, RCB, RVD	No	FAULT	Yes	-40 to +85	STDFP-8 (1.8 x 1.0)
SL659M1748C	0.64 mm ² load switch with reverse-current blocking, reverse-voltage detection, and ramp control	2	36	2	5	–	Internally Fixed	RCB, RVD	No	No	No	-40 to +85	WLSCP-4 (0.8 x 0.8)
SL659M1639V	1.6 mm ² dual-channel load switch with reverse-current blocking, reverse-voltage detection, and active low ON-OFF control	2	45	2	6	–	No	UVLO, RCB, RVD	No	No	No	-40 to +85	STDFP-8 (1.8 x 1.0)
SL659M1641V	1.6 mm ² dual-channel load switch with reverse-current blocking, reverse-voltage detection, and active low ON-OFF control	2	45	2	6	–	No	UVLO, RCB, RVD	No	No	No	-40 to +85	STDFP-8 (1.8 x 1.0)

* Notes (Please consult product specifications for additional information):
 1. ACL – Internally Fixed Active Current Limit
 2. ACL(R) – External resistor adjustable Active Current Limit
 3. SCL – Internally Fixed Overcurrent Current Limit
 4. Fixed ICL – Internally Fixed Inrush Current Limit
 5. RVD – Reverse-voltage Detection

6. RCB – Reverse-current Blocking
 7. TSD – Overtemperature protection (Thermal Shutdown)
 8. UVLO – Undervoltage Protection
 9. DVO – Overvoltage protection
 10. TVS – Internal Transient Voltage Suppressor



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