TOSHIBA

Leading Innovation

Semiconductor Catalog Apr. 2015

MOSFETs

SEMICONDUCTOR & STORAGE PRODUCTS

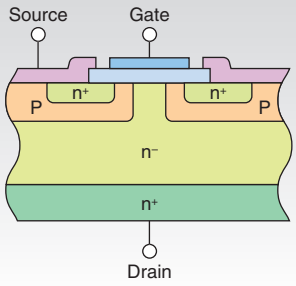
http://toshiba.semicon-storage.com/

Toshiba's MOSFETs Meet a Wide Range of Application Needs.

Toshiba offers an extensive portfolio of low-V_{DSS} and mid/high-V_{DSS} MOSFETs in various circuit configurations and packages, featuring high speed, high performance, low loss, low on-resistance, small packaging, etc.
Toshiba has decades of experience in the development and manufacturing of MOSFETs. Its main products include the mid-to high-voltage DTMOSIV Series with a V_{DSS} of 600 V or so and the low-voltage U-MOSVIII-H Series with a V_{DSS} of 30 V to 250 V.

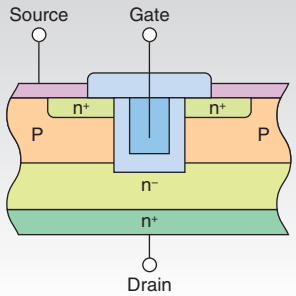
Structures of Toshiba MOSFETs

Double-Diffusion Structure



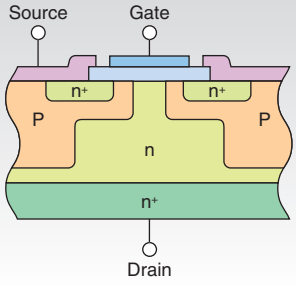
● **π-MOS**
Toshiba Power MOSFETs use a double-diffusion MOS (D-MOS) structure, which provides high withstand voltage, to form channels. This structure is especially well suited to high withstand voltage and high-current devices.
A high level of integration yields a high-performance Power MOSFET with low on-resistance and low power loss.

Trench Structure



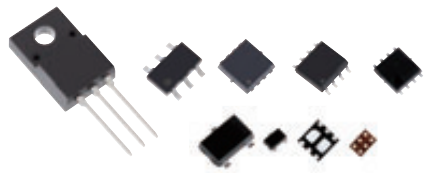
● **U-MOS**
Higher channel density is achieved by connecting channels vertically to form a U-groove at the gate region, a structure that yields a lower on-resistance than other MOSFET structures. The trench structure is primarily used for relatively low-V_{DSS} MOSFETs.

Super-Junction Structure



● **DTMOS**
The super-junction structure, which has P-type pillar layers as shown at left, realizes high withstand voltage and on-resistance lower than the conventional theoretical limit of silicon.

Low-V_{DSS} MOSFETs
V_{DSS} =12 V to 250 V



Applications
Page 4

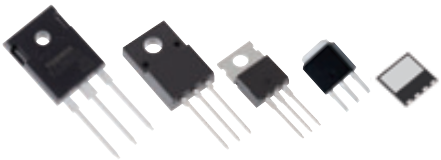
High-Speed Series for Switching Power Supply Applications
Page 7

High-efficiency MOSFET series for AC-DC and DC-DC power supplies, fabricated using the latest Gen-8 trench-gate process
- Features and available packages
- Various power supply topologies and recommended MOSFETs
- Product lineup

Low-On-Resistance Series for Load Switch and Battery Pack Protection Applications
Page 18

Low on-resistance achieved by combining advanced trench-gate process and packaging technologies
- Features and available packages
- Product lineup

Med-to High-V_{DSS} MOSFETs
V_{DSS} = 200 V to 900 V



Super-Junction DTMOS Series
Page 22

The super-junction DTMOS Series achieves low on-resistance and low gate charge (Qg) due to the use of the latest super-junction structure.
- Features and product series
- Product selection guide
- Product lineup

New π-MOS Series
Page 25

The latest addition to the π-MOS portfolio, the π-MOSVII Series offers reduced capacitances due to optimized chip design and is available with a greatly wider range of electrical characteristics.
- Features and performance comparisons
- Product selection guide
- Product lineup

Automotive MOSFETs

Automotive MOSFETs
Page 28

Automotive-grade MOSFETs feature low on-resistance, low capacitance, high current and high quality, and help improve the performance and reduce the power consumption of automotive applications.
- Toshiba's ongoing efforts for automotive MOSFETs
- Product lineup
- Applications and recommended products

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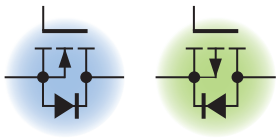
Applications

Toshiba offers U-MOSVIII-H and other series with a V_{DSS} ranging from 12 V to 250 V. These MOSFET series combine advanced trench-gate process and packaging technologies to deliver low on-resistance and high-speed switching. Our product portfolio includes an extensive array of MOSFETs in small packages suitable for various applications.

MOSFET Lineup

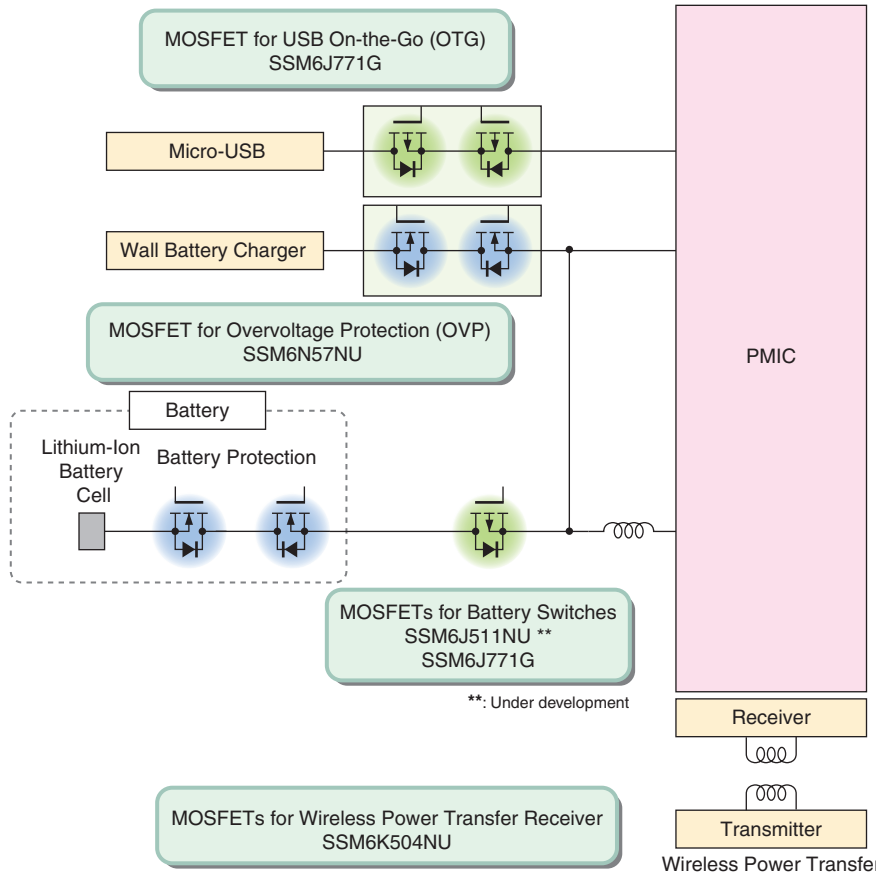
For general specifications of the MOSFETs shown in block diagrams, see the product selection tables on the following pages.

Block Diagrams	Product Lineups	Reference
AC-DC power supplies / AC adapters Isolated DC-DC converters Non-isolated DC-DC converters	The devices suitable for these applications are identified by the following symbols. High-speed switching	Pages 7 to 17 (High-speed series)
	High-speed switching Load switches	Pages 7 to 17 (High-speed series) Pages 18 to 21 (Low-on-resistance series)

Application Example for a Mobile Device

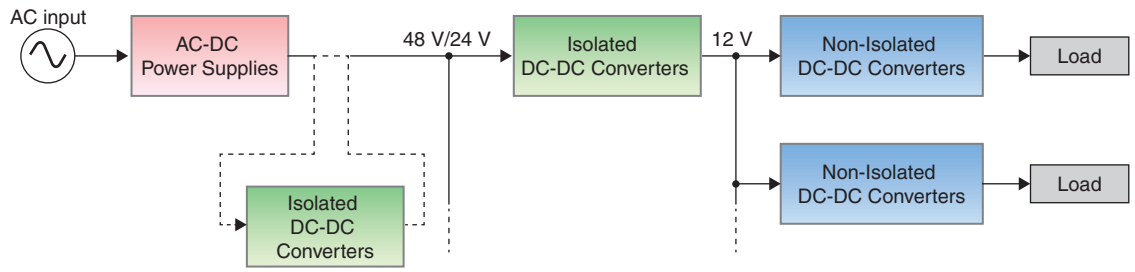
As the battery capacity for mobile devices increases, the charging current also increases. To meet the high-current need, Toshiba offers MOSFETs in small packages featuring high power dissipation. These MOSFETs are suitable for switching applications in high-current charger circuits.

Smartphone/Tablet

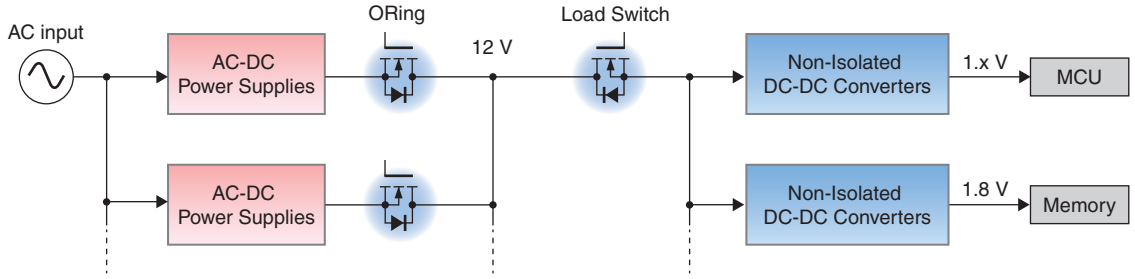


PMIC: Power Management IC

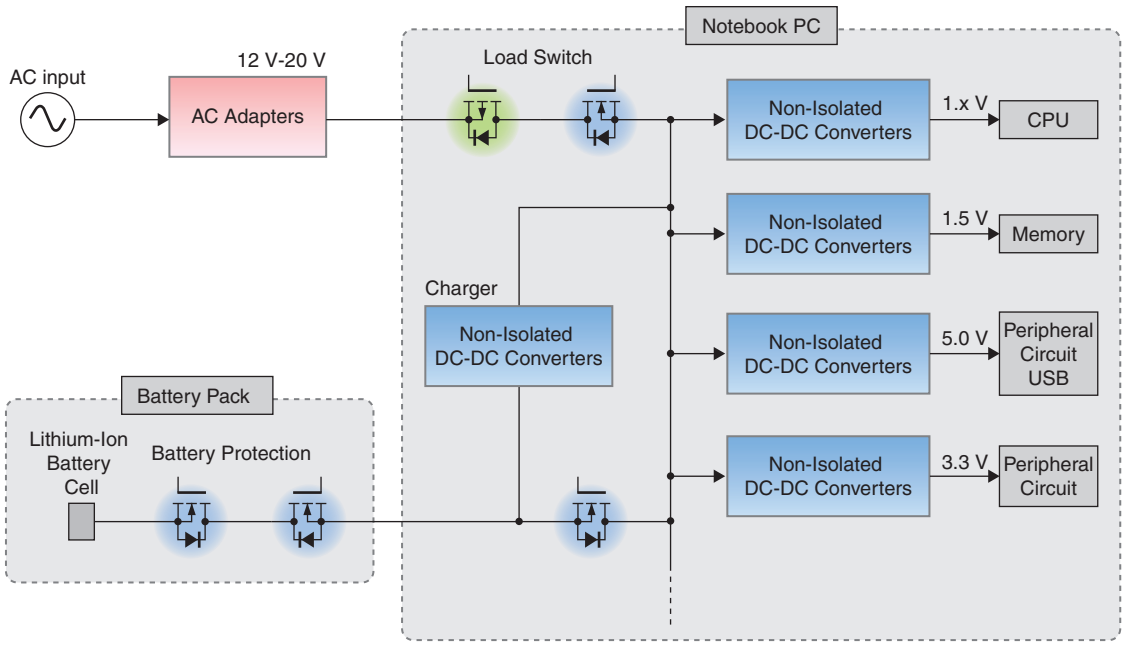
Power Supply for a Communication Base Station



Power Supply for a Server

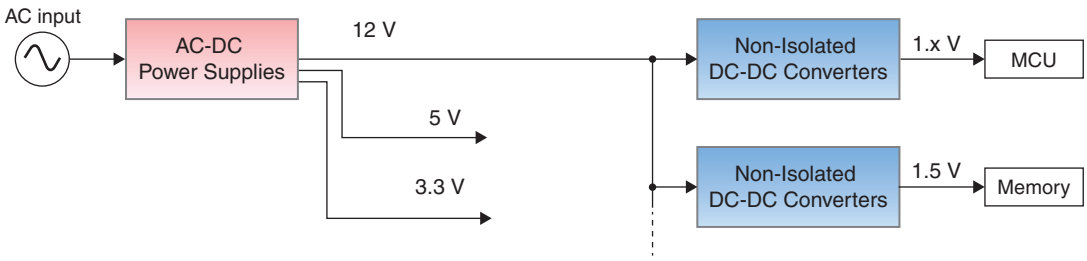


Internal Power Supply of a Notebook PC / AC Adapter / Battery Pack

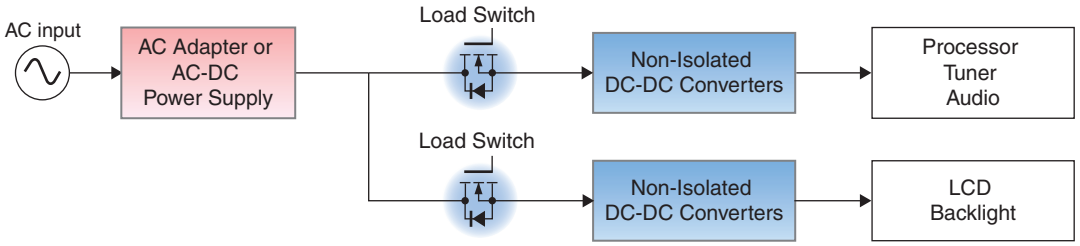


Applications

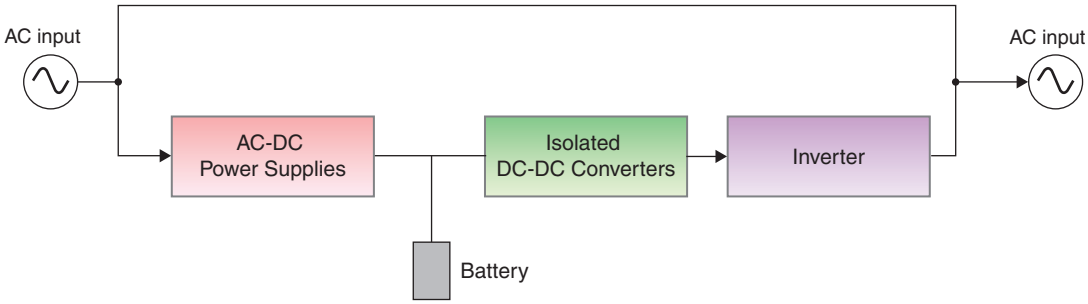
Power Supply for a Desktop PC



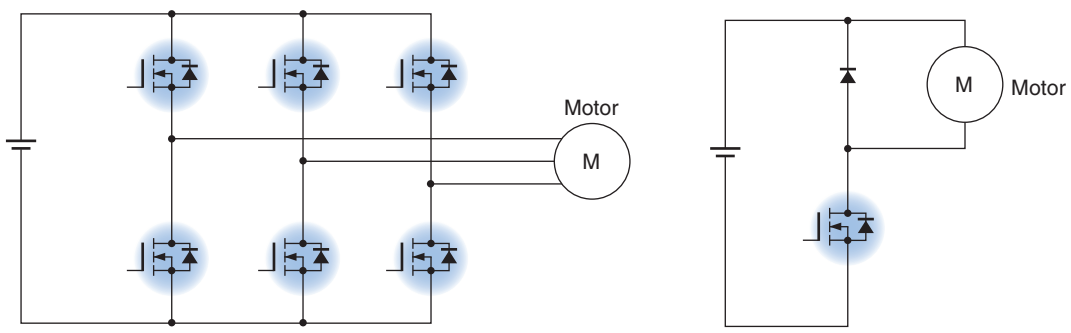
LCD Television



Uninterruptible Power Supply (UPS)



Motor Control



High-Speed Series for Switching Power Supply Applications

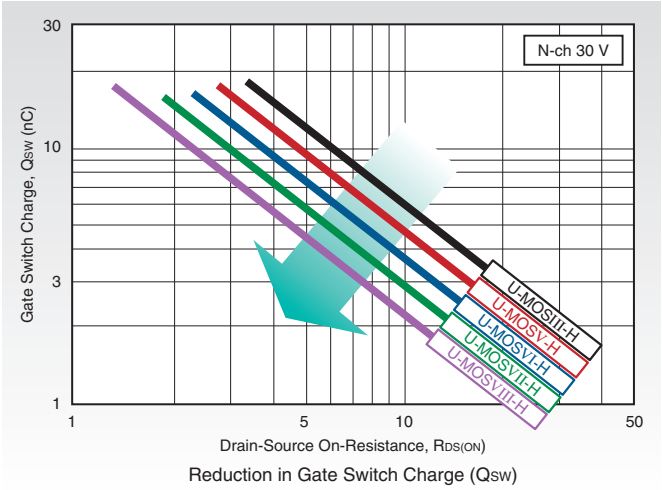
U-MOSVIII-H and U-MOSIX-H are high-efficiency MOSFET series specifically designed for use in the secondary side of AC-DC power supplies for notebook PC adapters, game consoles, servers, desktop PCs, flat-panel displays, etc., as well as DC-DC power supplies for communication equipment, servers and data centers. Fabricated with the latest Gen-8 and Gen-9 trench MOS processes, U-MOSVIII-H U-MOSIX-H will help improve the efficiency of power supplies.

U-MOSVIII-H and U-MOSIX-H: Latest-generation trench MOS series

In order to help improve the efficiency of switching power supplies, MOSFETs must exhibit not only low on-resistance but also low capacitance, which is directly related to maximum possible switching speeds. Fabricated using a state-of-the-art process, the U-MOSVIII-H Series provides on-resistance lower than 1 mΩ and a switching speed 56% faster than the U-MOSVII-H Series.

Features of the U-MOSVIII-H Series

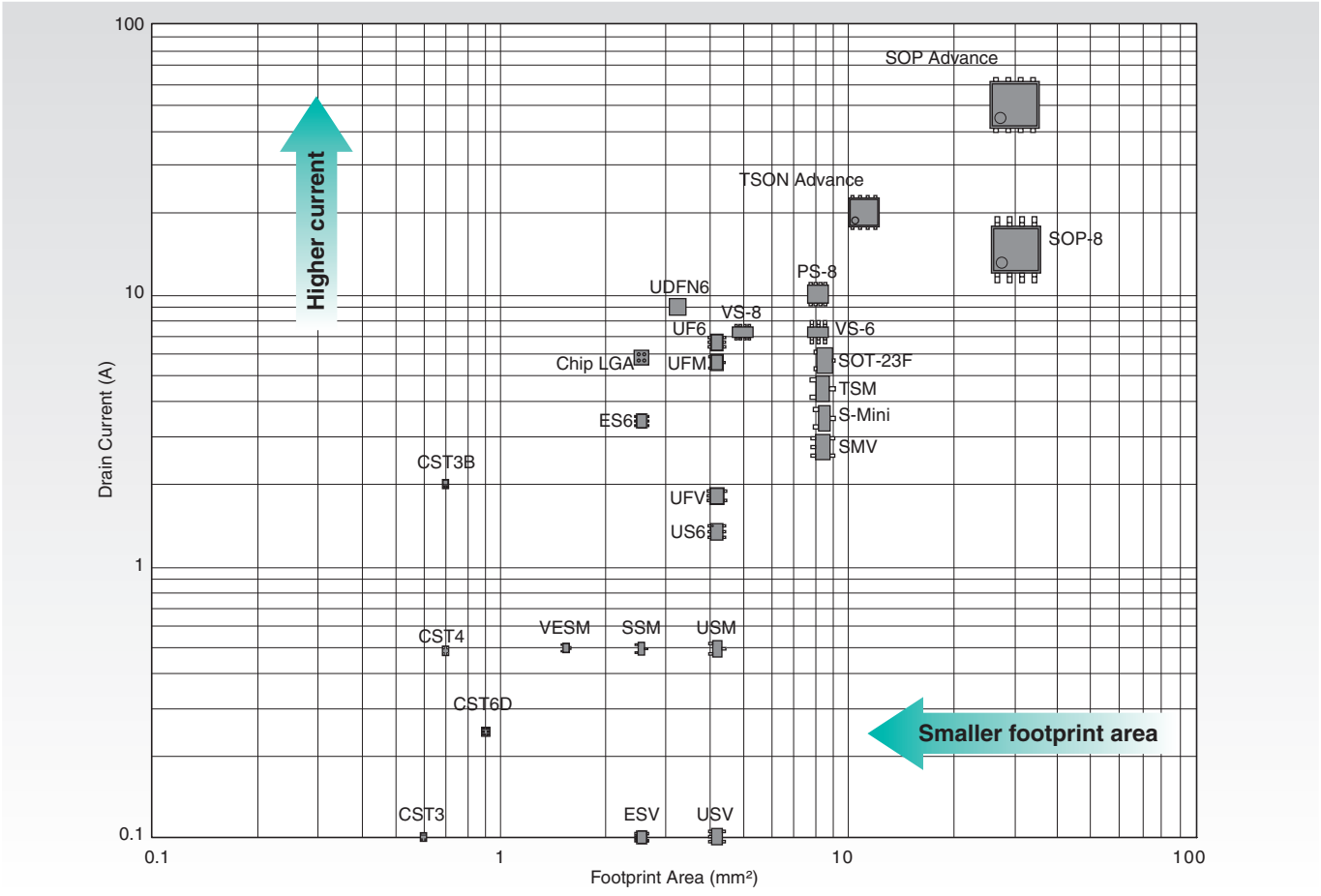
- Fabricated with a Gen-8 trench MOS process designed for various power supply applications
- On-resistance, $R_{DS(ON)}$, less than 1 mΩ
  TPHR9003NL: $R_{DS(ON)}$ = 0.77 mΩ (V_{GS} = 10 V, I_D = 30 A)
- Provides significantly better trade-offs between on-resistance and input capacitance
- Offers high avalanche ruggedness
- Available in various packages



Reduction in Gate Switch Charge (Q_{SW})

Packages for the High-Speed MOSFET Series

High-speed MOSFETs are mainly housed in small surface-mount packages that are ideal for space-critical applications.



Various Power Supply Topologies and Recommended MOSFETs

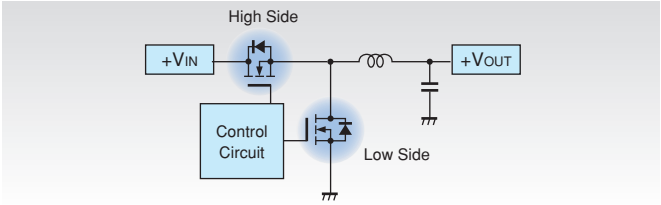
High-Speed Series for Switching Power Supply Applications

Non-isolated DC-DC Converters

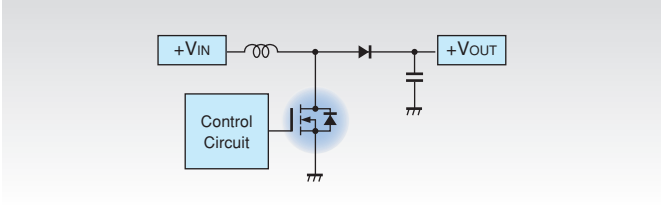
Smartphones and other sophisticated mobile devices, communication equipment and data processing devices contain many DC-DC converters. Although non-isolated DC-DC converter ICs are used for low output power applications, you can not only increase the output power by using discrete MOSFETs but also improve efficiency by combining optimal MOSFETs on the high side and low side.

Circuit Configuration Examples

- **Synchronous-rectified step-down converter**

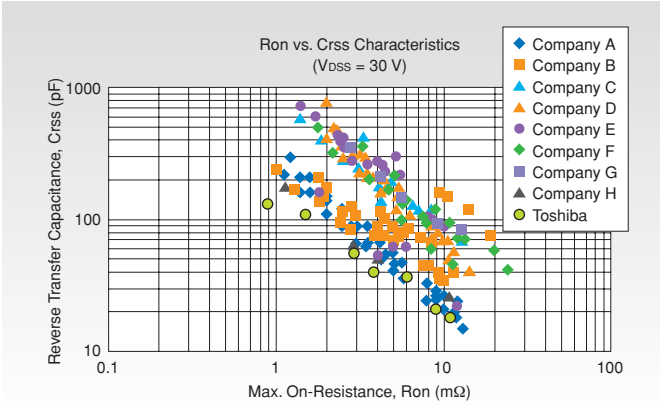


- **Step-up converter**



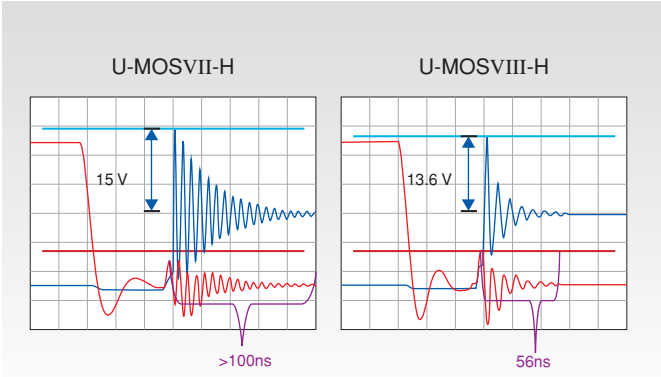
High-Speed Switching

The U-MOSVIII-H Series exhibits high-speed switching speed thanks to the industry's best Ron-Crss performance.



Reduced Switching Noise

As a consequence of the snubber effect, the U-MOSVIII-H Series suppresses switching noise and ringing more effectively than the U-MOSVII-H Series.



* Test conditions: Switching noise test equipment (VIN = 12 V, VOUT = 5 V, IOUT = 12 A)

Recommended Products for Synchronous-Rectified Step-Down DC-DC Converter Applications

The optimal pair of a high-side and a low-side MOSFET depends on the required output current. The following table gives examples of recommended MOSFET pairs according to the output current requirement.

Input-to-output voltage ratio		Output Current					
		Up to 5 A	Up to 10 A	Up to 15 A	Up to 20 A	Up to 25 A	Up to 30 A
Up to 0.08 [VIN = 19 V, VOUT = 1 V]	High Side	SSM3K333R TPCC8067-H	SSM6K504NU TPCC8066-H	TPCC8066-H TPN11003NL	TPN11003NL TPCC8065-H	TPCC8065-H TPN8R903NL	TPN8R903NL TPN6R003NL
	Low Side	TPCC8066 TPN11003NL	TPN8R903NL	TPN6R003NL	TPN4R303NL TPCA8059-H TPH6R003NL	TPN4R303NL TPCA8057-H	TPN2R703NL TPH3R203NL TPCA8055-H
Up to 0.15 [VIN = 12 V, VOUT = 1 V]	High Side	SSM6K504NU TPCC8067-H	SSM6K504NU TPCC8066-H TPN11003NL	TPN11003NL TPCC8065-H	TPCC8065-H TPCA8065-H TPN8R903NL	TPN8R903NL TPN6R003NL	TPN6R003NL
	Low Side	TPCC8066 TPN11003NL	TPCC8065-H TPN8R903NL	TPN6R003NL	TPN4R303NL TPCA8059-H TPN6R003NL	TPN4R303NL TPCA8057-H	TPN2R703NL TPH3R203NL TPCA8055-H
Up to 0.5 [VIN = 12 V, VOUT = 5 V]	High Side	SSM6K504NU TPCC8067-H TPN11003NL	TPCC8065-H TPN8R903NL	TPN8R903NL TPN6R003NL	TPN4R303NL TPCA8059-H TPN6R003NL	TPN4R303NL TPCA8057-H	
	Low Side	SSM6K504NU TPCC8067-H TPN11003NL	TPCC8065-H TPN8R903NL	TPN6R003NL	TPN4R303NL TPCA8059-H TPN6R003NL	TPN4R303NL TPCA8057-H	

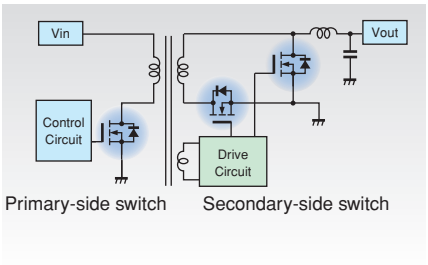
* ouptut_voltage / input_voltage

Isolated DC-DC Converters

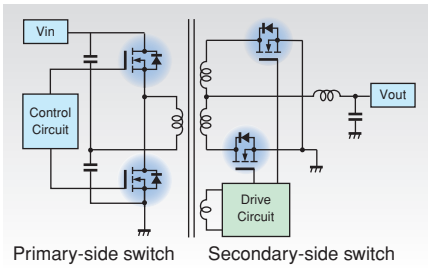
Isolated DC-DC converters are widely used for two kinds of applications: 1) applications in which the output circuit must be isolated from the input circuit, and 2) those in which there is a large difference between input and output voltages. Forward, half-bridge and full-bridge DC-DC converters are used according to the required output power.

Circuit Configuration Examples

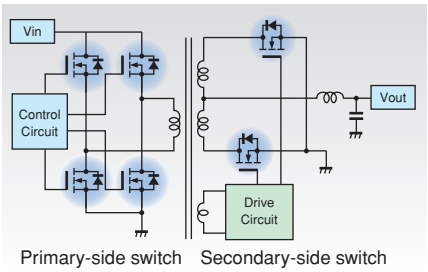
Forward



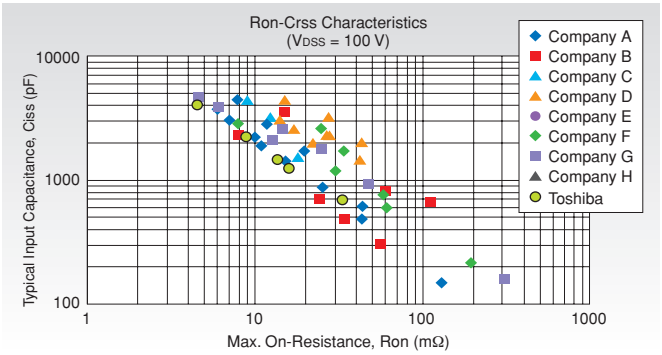
Half-Bridge



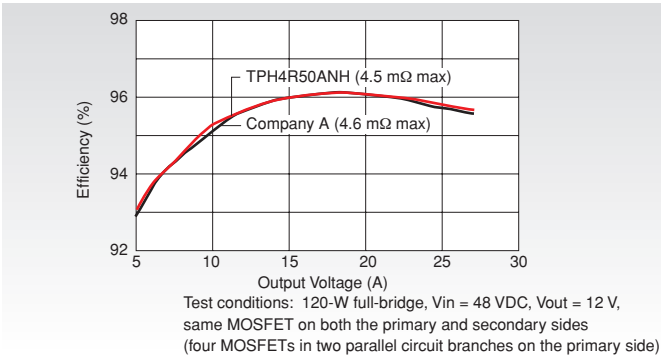
Full-Bridge



High-Speed Switching



Improved Efficiency



Test conditions: 120-W full-bridge, Vin = 48 VDC, Vout = 12 V, same MOSFET on both the primary and secondary sides (four MOSFETs in two parallel circuit branches on the primary side)

Products Recommended for Isolated DC-DC Converter Applications

Drain-Source Voltage VDSS		Output Power				
		Up to 50 W Forward	Up to 150 W Forward (Active-Clamp)	Up to 300 W Harf-Bridge	Up to 500 W Full Bridge	Up to 1000 W Full Bridge
Primary-Side Switch	60 V			TPH4R606NH	TPH2R306NH	TPH2R306NH (2parallel)
	80 V			TPH8R008NH	TPH4R008NH TPW4R008NH	TPH4R008NH(4parallel) TPW4R008NH(4parallel)
	100 V			TPH8R80ANH	TPH4R50ANH TPW4R50ANH	TPH4R50ANH(4parallel) TPW4R50ANH(4parallel)
	150 V		TPN5900CNH TPH3300CNH			
	200 V	TPN1110ENH	TPH6400ENH			
	250 V	TPH1110FNH				
Secondary-Side Switch	30 V (VOUT = 3.3 V)	TPN6R003NL TPH6R003NL TPN4R303NL TPH4R003NL	TPH1R403NL TPHR9003NL TPWR8503NL	TPHR9003NL(2parallel) TPWR8503NL	TPHR9003NL(4parallel) TPWR8503NL(2parallel)	TPHR9003NL(8parallel) TPWR8503NL(4parallel)
	40 V (VOUT = 5 V)		TPH1R204PL	TPHR8504PL	TPHR8504PL(2parallel) TPWR8004PL	TPHR8504PL(4parallel) TPWR8004PL(2parallel)
	45 V (VOUT = 12 V/5 V)			TPH1R005PL	TPH1R005PL(2parallel)	TPH1R005PL(4parallel)
	60 V (VOUT = 12 V)	TPN22006NH	TPN14006NH TPN7R506NH	TPH5R906NH TPH4R606NH	TPHR8504PL(2parallel)	TPH2R306NH(2parallel)
	75 V (VOUT = 12 V)				TPH2R608NH	TPH2R608NH(2parallel)
	80 V (VOUT = 12 V)	TPN30008NH	TPN13008NH TPH8R008NH	TPH4R008NH TPW4R008NH	TPH4R008NH(2parallel) TPW4R008NH(2parallel)	TPH4R008NH(4parallel) TPW4R008NH(3parallel)
	100 V (VOUT = 12 V)	TPN3300ANH	TPN1600ANH TPH8R80ANH	TPH4R50ANH TPW4R50ANH	TPH4R50ANH(2parallel) TPW4R50ANH(2parallel)	TPH4R50ANH(4parallel) TPW4R50ANH(3parallel)
	150 V (VOUT = 24 V)	TPN5900CNH	TPH3300CNH	TPH1500CNH	TPH1500CNH(2parallel)	TPH1500CNH(4parallel)
	200 V (VOUT = 36 V)	TPN1110ENH	TPH6400ENH	TPH2900ENH	TPH2900ENH(2parallel)	TPH2900ENH(4parallel)
	250 V (VOUT = 48 V)	TPN2010FNH	TPH1110ENH	TPH5200FNH	TPH5200FNH(2parallel)	TPH5200FNH(4parallel)

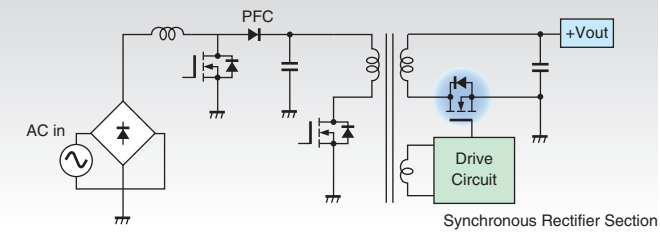
AC-DC Converters (Synchronous Rectifier Section)

Flyback power supplies have a very simple circuit configuration that consists of a minimal part count. They are suitable for low-power power supplies. Full-bridge power supplies are suitable for relatively high-power power supply applications in the range of 1 kW to 3 kW.

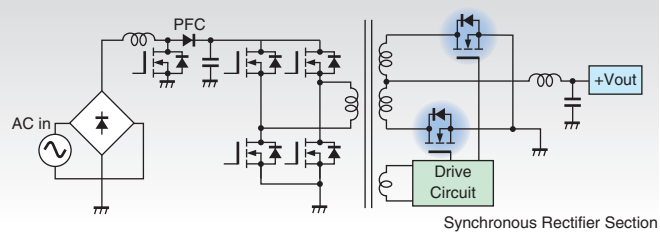
* See the section "Mid- to High-V_{DSS} MOSFETs" on pages 22 to 27 for a description and a list of MOSFETs for primary-side switching and PFC applications.

Circuit Configuration Examples

Flyback

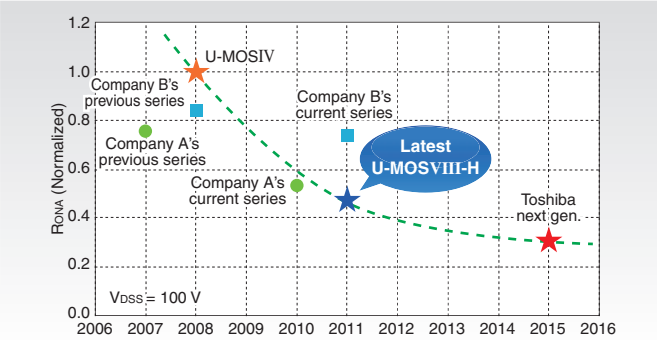


Full-Bridge



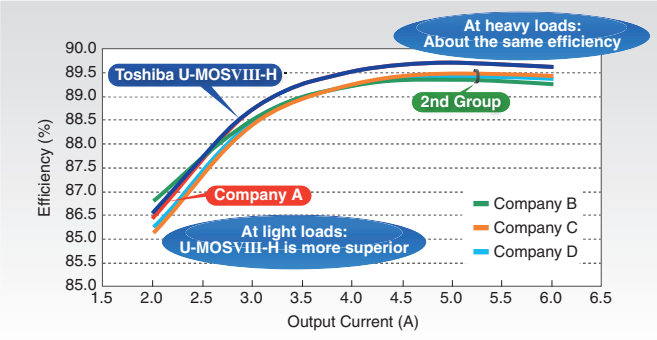
Reduction of On-Resistance

The U-MOSVIII-H Series provides the industry's highest performance in terms of on-resistance per die area (RonA), making it ideal for applications that require higher efficiency, smaller size, etc.



Improved Efficiency

The U-MOSVIII-H Series provides about the same efficiency as competitors' devices at heavy loads and higher efficiency at light loads under the test conditions shown below*.



*Test conditions: 120-W adapter, Vin = 100 Vac, Vout = 19.5 V, critical conduction mode (CRM)

Commonly Recommended Products

Synchronous Rectifier Section of Flyback Power Supplies

Drain-Source Voltage V_{DSS}	Output Power		
	Up to 20 W	Up to 50 W	Up to 100 W
60 V	TPN11006NL, TPH11006NL		
100 V		TK22A10N1, TK34A10N1 TK22E10N1, TK34E10N1	TK40A10N1, TK65A10N1, TK40E10N1, TK65E10N1 TK65G10N1
120 V		TK32A12N1, TK42A12N1 TK32E12N1, TK42E12N1	TK56A12N1, TK72A12N1 TK56E12N1, TK72E12N1

Synchronous Rectifier Section of Half-Bridge Power Supplies

Drain-Source Voltage V_{DSS}	Output Power			
	Up to 100 W	Up to 200 W	Up to 400 W	Up to 800 W
40 V		TPH1R204PL	TPHR8504PL	TPHR8504PL(2parallel)
45 V			TPH1R005PL	TPH1R005PL(2parallel)
60 V	TK30A06N1, TK30E06N1, TPN11006NL TPH11006NL, TPN14006NL, TPH14006NH	TK40A06N1, TK40E06N1 TPH7R506NH, TPN7R506NH	TK58A06N1, TK58E06N1 TPH4R606NH	TK100A06N1, TK100E06N1 TPH2R306NH
80 V	TK35A08N1, TK35E08N1 TPH12008NH, TPN13008NH	TK46A08N1, TK46E08N1 TPH8R008NH	TK72A08N1, TK72E08N1 TPH4R008NH	TK100A08N1, TK100E08N1 TPH4R008NH(2parallel)
100 V	TK34A10N1, TK34E10N1 TPH1400ANH, TPN1600ANH	TK40A10N1, TK40E10N1 TPH8R80ANH	TK65A10N1, TK65E10N1 TK65G10N1, TPH4R50ANH	TK100A10N1, TK100E10N1 TPH4R50ANH(2parallel)
120 V	TK32A12N1, TK32E12N1	TK42A12N1, TK42E12N1	TK56A12N1, TK56E12N1	TK72A12N1, TK72E12N1

Synchronous Rectifier Section of Full-Bridge Power Supplies

Drain-Source Voltage V_{DSS}	Output Power		
	Up to 1 kW	Up to 2 kW	Up to 3 kW
40 V	TPHR8504PL	TPHR8504PL(2parallel)	TPHR8504PL(4parallel)
45 V	TPH1R005PL	TPH1R005PL(2parallel)	TPH1R005PL (4parallel)
60 V	TK100A06N1, TK100E06N1 TPH2R306NH	TK100A06N1(2parallel), TK100E06N1(2parallel) TPH2R306NH(2parallel)	TK100A06N1(4parallel), TK100E06N1(4parallel) TPH2R306NH(4parallel)
75 V	TPH2R608NH	TPH2R608NH(2parallel)	TPH2R608NH(4parallel)
80 V	TK100A08N1, TK100E08N1 TPH4R008NH(2parallel)	TK100A08N1(2parallel), TK100E08N1(2parallel) TPH4R008NH(4parallel)	TK100A08N1(4parallel) TK100E08N1(4parallel)
100 V	TK100A10N1, TK100E10N1 TPH4R50ANH(2parallel)	TK100A10N1(2parallel), TK100E10N1(2parallel) TPH4R50ANH(4parallel)	TK100A10N1(4parallel) TK100E10N1(4parallel)
120 V	TK72A12N1, TK72E12N1	TK72A12N1(2parallel) TK72E12N1(2parallel)	TK72A12N1(4parallel) TK72E12N1(4parallel)

Product Lineup High-Speed Series for Switching Power Supply Applications

Semi-Power P-Channel Single MOSFETs

High-speed switching | Load Switches

Unit: mm

Package	Part Number	V_{DSS} (V)	V_{GSS} (V)	I_D (A)	$R_{DS(ON)}$ Max (mΩ) $\lvert V_{GS}\rvert$ = 1.2 V	$\lvert V_{GS}\rvert$ = 1.5 V	$\lvert V_{GS}\rvert$ = 1.8 V	$\lvert V_{GS}\rvert$ = 2.5 V	$\lvert V_{GS}\rvert$ = 4.5 V	Ciss (pF)	Series	*Internal Connections	(Note) Land Pattern Example
VESM	SSM3J56MFV	−20	±8	−0.8	4000	900	660	480	390	100	U-MOSVI		
CST3B	SSM3J46CTB	−20	±8	−2.0	—	250	178	133	103	290	U-MOSVI	TOP VIEW	
WCSP6C	SSM6J771G*	−20	±12	−5.0	—	—	—	47.5	35	870	U-MOSVI		
ES6 (SOT-563)	SSM6J216FE *	−12	±8	−4.8	—	88.1	56	39.3	32	1040	U-MOSVI		
	SSM6J212FE	−20	±8	−4.0	—	94.0	65.4	49.0	40.7	970	U-MOSVI		
	SSM6J215FE *	−20	±8	−3.4	—	154	104	79	59	630	U-MOSVI		
	SSM6J214FE	−30	±12	−3.6	—	—	149.6	77.6	57	560	U-MOSVI		
	SSM6J213FE	−20	±8	−2.6	—	250	178	133	103	290	U-MOSVI		
	SSM6J207FE	−30	±20	−1.4	—	—	—	—	491(@4V)	137	U-MOSII		
UFM	SSM3J132TU	−12	±6	−5.4	94	39	29	21	17	2700	U-MOSVI		
	SSM3J130TU	−20	±8	−4.4	—	63.2	41.1	31	25.8	1800	U-MOSVI		
	SSM3J133TU	−20	±8	−5.5	—	88.4	56	39.7	29.8	840	U-MOSVI		
	SSM3J134TU	−20	±8	−3.2	—	240	168	123	93	290	U-MOSVI		
	SSM3J135TU	−20	±8	−3.0	—	260	180	132	103	270	U-MOSVI		
	SSM3J117TU	−30	±20	−2.0	—	—	—	—	225(@4V)	280	U-MOSII		
	SSM3J118TU	−30	±20	−1.4	—	—	—	—	480(@4V)	137	U-MOSII		
	SSM3J112TU	−30	±20	−1.1	—	—	—	—	790(@4V)	86	U-MOSII		
UF6	SSM6J414TU *	−20	±8	−6	—	54	36	26	22.5	1650	U-MOSVI		
	SSM6J412TU	−20	±8	−4.0	—	99.6	67.8	51.4	42.7	840	U-MOSVI		
	SSM6J50TU	−20	±10	−2.5	—	—	205 (@2.0V)	100	64	800	U-MOSIV		
	SSM6J401TU	−30	±20	−2.5	—	—	—	—	145(@4V)	730	U-MOSIII		
	SSM6J402TU	−30	±20	−2.0	—	—	—	—	225(@4V)	280	U-MOSIII		
	SSM6J410TU	−30	±20	−2.1	—	—	—	—	393(@4V)	120	U-MOSIII		
UDFN6B	SSM6J511NU**	−12	±10	−14	—	TBD	TBD	15	10	3350	U-MOSVII		
	SSM6J505NU *	−12	±6	−12	61	30	21	16	12	2700	U-MOSVI		
	SSM6J501NU	−20	±8	−10	—	43	26.5	19	15.3	2600	U-MOSVI		
	SSM6J502NU	−20	±8	−6.0	—	60.5	38.4	28.3	23.1	1800	U-MOSVI		
	SSM6J503NU	−20	±8	−6.0	—	89.6	57.9	41.7	32.4	840	U-MOSVI		
	SSM6J507NU**	−30	−25/ +20	−10	—	—	—	—	29	1400	U-MOSVI		
SOT-23F	SSM3J328R	−20	±8	−6.0	—	88.4	56.0	39.7	29.8	840	U-MOSVI		
	SSM3J331R	−20	±8	−4.0	—	150	100	75	55	630	U-MOSVI		
	SSM3J327R	−20	±8	−3.9	—	240	168	123	93	290	U-MOSVI		
	SSM3J332R	−30	±12	−6.0	—	—	144	72	50	560	U-MOSVI		
	SSM3J334R	−30	±20	−4.0	—	—	—	—	105	280	U-MOSVI		
	SSM3J338R**	−12	±10	−6	—	TBD	TBD	25	20	TBD	U-MOSVII		
S-Mini	SSM3J325F	−20	±8	−2.0	—	311	231	179	150	270	U-MOSVI		

* The internal connection diagrams only show the general configurations of the circuits.
Note: For reference only. Land pattern dimensions should be determined empirically.

*: New Products **: Under Development

Product Lineup High-Speed Series for Switching Power Supply Applications

Semi-Power N-Channel Single MOSFETs

High-speed switching | Load Switches

Unit: mm

Package	Part Number	V_{DSS} (V)	V_{GSS} (V)	I_D (A)	$R_{DS(ON)}$ Max (mΩ) $\lvert V_{GS}\rvert$ = 1.5 V	$\lvert V_{GS}\rvert$ = 1.8 V	$\lvert V_{GS}\rvert$ = 2.5 V	$\lvert V_{GS}\rvert$ = 4.0 V	Ciss (pF)	Series	*Internal Connections	Land Pattern Example (Note)
CST3	SSM3K56CT *	20	±8	0.8	840	480	300	235 (@4.5 V)	55	U-MOSVII-H	TOP VIEW	
CST3B	SSM3K59CTB *	40	±12	2	—	420	268	228 (@4.5 V)	130	U-MOSVII-H	TOP VIEW	
VESM	SSM3K56MFV *	20	±8	0.8	840	480	300	235 (@4.5 V)	55	U-MOSVII-H		
WCSP6C	SSM6K781G	12	±8	7.0	124	47.4	23.2	18 (@4.5 V)	600	U-MOSVII-H		
SSM	SSM3K56FS *	20	±8	0.8	840	480	330	235 (@4.5 V)	55	U-MOSVII-H		
ES6 (SOT-563)	SSM6K211FE	20	±10	3.2	118	82	59	47(@4.5 V)	510	U-MOSIII		
	SSM6K204FE	20	±10	2.0	307	214	164	126	195	U-MOSIII		
	SSM6K208FE	30	±12	1.9	—	296	177	133	123	U-MOSIII		
	SSM6K217FE *	40	±12	1.8	—	400	248	208(@4.5V)	130	U-MOSVII-H		
UFM	SSM3K123TU	20	±10	4.2	66	43	32	28	1010	U-MOSIII		
	SSM3K121TU	20	±10	3.2	140	93	63	48	400	U-MOSIII		
	SSM3K122TU	20	±10	2.0	304	211	161	123	195	U-MOSIII		
	SSM3K127TU	30	±12	2.0	—	286	167	123	123	U-MOSIII		
	SSM3K116TU	30	±12	2.2	—	—	135	100(@4.5 V)	245	U-MOSIII		
	SSM3K131TU	30	±20	6.0	—	—	—	41.5(@4.5 V)	450	U-MOSIV		
	SSM3K2615TU**	60	±20	2.0	—	—	580(@3.3 V)	440	150	π-MOSV		
UF6	SSM6K403TU	20	±10	4.2	66	43	32	28	1050	U-MOSIII		
	SSM6K404TU	20	±10	3.0	147	100	70	55	400	U-MOSIII		
	SSM6K411TU	20	±12	10	—	—	23.8	12(@4.5 V)	710	U-MOSIV		
	SSM6K406TU	30	±20	4.4	—	—	—	38.5(@4.5 V)	490	U-MOSIV		
	SSM6K407TU	60	±20	2.0	—	—	—	440	150	π-MOSV		
UDFN6B	SSM6K504NU *	30	±20	9	—	—	—	26(@4.5 V)	620	U-MOSVII-H		
SOT-23F	SSM3K324R	30	±12	4.0	—	109	72	56(@4.5 V)	200	U-MOSVII-H		
	SSM3K329R	30	±12	3.5	—	289	170	126	123	U-MOSIII		
	SSM3K333R	30	±20	6.0	—	—	—	42(@4.5 V)	436	U-MOSVII-H		
	SSM3K335R	30	±20	6.0	—	—	—	56(@4.5 V)	340	U-MOSVII-H		
	SSM3K336R	30	±20	3.0	—	—	—	140(@4.5 V)	126	U-MOSVII-H		
	SSM3K339R *	40	±12	2.0	—	390	238	198(@4.5V)	130	U-MOSVII-H		
	SSM3K2615R *	60	±20	2.0	—	—	580(@3.3 V)	440	150	π-MOSV		
	SSM3K318R *	60	±20	2.5	—	—	—	145(@4.5 V)	235	U-MOSIV		
	SSM3K337R *	38	±20	2.0	—	—	—	200	120	U-MOSIV		

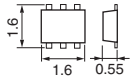
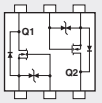
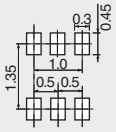
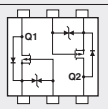
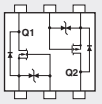
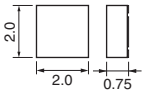
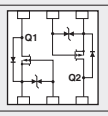
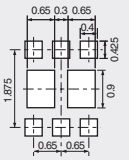
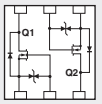
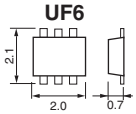
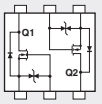
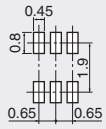
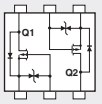
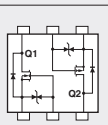
* The internal connection diagrams only show the general configurations of the circuits.
Note: For reference only. Land pattern dimensions should be determined empirically.

*: New Products **: Under Development

Semi-Power Dual MOSFETs

High-speed switching | Load Switches

Unit: mm

Package	Polarity	Part Number	V_{DSS} (V)	V_{GSS} (V)	I_D (A)	$R_{DS(ON)}$ Max (mΩ) $\lvert V_{GS}\rvert$ = 1.5 V	$\lvert V_{GS}\rvert$ = 1.8 V	$\lvert V_{GS}\rvert$ = 2.5 V	$\lvert V_{GS}\rvert$ = 4.0 V	Ciss (pF)	Series	*Internal Connections	(Note) Land Pattern Example
ES6 (SOT-563) 	N-ch x 2	**SSM6N56FE***	20	±8	0.8	840	480	300	235 (@4.5 V)	55	U-MOSVII-H		
	P-ch x 2	**SSM6P41FE**	−20	±8	−0.72	1040	670	440	300 (@4.5 V)	110	U-MOSV		
	N-ch + P-ch	**SSM6L14FE***	20	±10	0.8	600	450	330	240 (@4.5 V)	90	U-MOSIII		
			−20	±8	−0.72	1040	670	440	300 (@4.5 V)	110	U-MOSV		
UDFN6 	P-ch x 2	**SSM6P47NU**	−20	±8	−4	242	170	125	95 (@4.5 V)	290	U-MOSVI		
		SSM6P49NU*	−20	±12	−4	—	157	76	56 (@4.5 V)	480	U-MOSVI		
	N-ch x 2	**SSM6N57NU***	30	±12	4	—	82	53	39.1 (@4.5 V)	310	U-MOSVII-H		
		SSM6N58NU*	30	±12	4	—	180	117	84 (@4.5 V)	129	U-MOSVII-H		
		SSM6N55NU*	30	±20	4	—	—	—	64 (@4.5 V)	280	U-MOSVII-H		
UF6 	N-ch x 2	**SSM6N39TU**	20	±10	1.6	247	190	139	119	260	U-MOSIII		
		SSM6N24TU	30	±12	0.5	—	—	180	145 (@4.5 V)	245	U-MOSIII		
		SSM6N40TU	30	±20	1.6	—	—	—	182	180	U-MOSIII		
	P-ch x 2	**SSM6P54TU**	−20	±8	−1.2	555	350	228	—	331	U-MOSIV		
		SSM6P39TU	−20	±8	−1.5	—	430	294	213	250	U-MOSIII		
		SSM6P40TU	−30	±20	−1.4	—	—	—	403	120	U-MOSIII		
	N-ch + P-ch	**SSM6L39TU**	20	±10	1.6	247	190	139	119	260	U-MOSIII		
			−20	±8	−1.5	—	430	294	213	250	U-MOSIII		
		SSM6L12TU	30	±12	0.5	—	—	180	145	245	U-MOSIII		
			−20	±12	−0.5	—	—	430	260	218	U-MOSIII		
		SSM6L40TU	30	±20	1.6	—	—	—	182	180	U-MOSIII		
			−30	±20	−1.4	—	—	—	403	120	U-MOSIII		

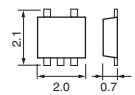
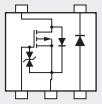
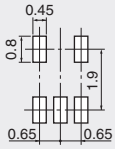
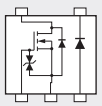
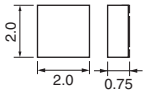
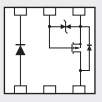
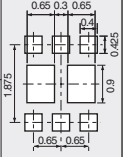
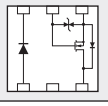
* The internal connection diagrams only show the general configurations of the circuits.
Note: For reference only. Land pattern dimensions should be determined empirically.

*: New Products

MOSFET with a Schottky Barrier Diode

High-speed switching | Load Switches

Unit: mm

Package	Polarity	Part Number	MOSFET V_{DSS} (V)	V_{GSS} (V)	I_D (A)	$R_{DS(ON)}$ Max (mΩ) $\lvert V_{GS}\rvert$ = 1.5 V	$\lvert V_{GS}\rvert$ = 1.8 V	$\lvert V_{GS}\rvert$ = 2.5 V	$\lvert V_{GS}\rvert$ = 4.0 V	Ciss (pF)	Series	SBD V_R (V)	I_O (A)	V_F Max (V)	@I_F (A)	*Internal Connections	(Note) Land Pattern Example
UFV 	P-ch+ SBD	**SSM5G09TU**	−12	±8	−1.5	—	—	200	130	550	U-MOSII	12	0.5	0.43	0.5		
		SSM5G02TU	−12	±12	−1.0	—	—	240	160	310	U-MOSII	12	0.5	0.43	0.5		
		SSM5G11TU	−30	±20	−1.4	—	—	—	403	120	U-MOSIII-H	30	0.7	0.41	0.5		
	N-ch+ SBD	**SSM5H16TU**	30	±12	1.9	—	296	177	133	123	U-MOSIII	30	0.8	0.45	0.5		
		SSM5H08TU	20	±12	1.5	—	—	220	160	125	U-MOSIII	20	0.5	0.45	0.3		
		SSM5H11TU	30	±20	1.6	—	—	—	182	180	U-MOSIII	30	0.7	0.41	0.5		
		SSM5H01TU	30	±20	1.4	—	—	—	450	106	U-MOSII	20	0.5	0.45	0.3		
UDFN6 	P-ch+ SBD	**SSM6G18NU***	−20	±8	−2.0	261	185	143	112 (@4.5 V)	270	U-MOSVI	30	1.0	0.45	0.5		
	N-ch+ SBD	**SSM6H19NU***	40	±12	2	—	390	238	198 (@4.5 V)	130	U-MOSVII-H	40	0.5	0.57	0.5		

* The internal connection diagrams only show the general configurations of the circuits.
Note: For reference only. Land pattern dimensions should be determined empirically.

*: New Products

Product Lineup High-Speed Series for Switching Power Supply Applications

Small-Signal Standard Series ($I_D \leq 500$ mA)

Single MOSFETs

High-speed switching | Load Switches

Polarity	Absolute Maximum Ratings			$R_{DS(ON)}$ Typ. (Max) (Ω)	V_{GS} (V)	Package						
	V_{DSS} (V)	V_{GSS} (V)	I_D (mA)			S-Mini (SOT-346) 2925 size, 3-pin	USM (SOT-323) 2021 size, 3-pin	UFM 2021 size, 3-pin	SSM (SOT-416) 1616 size, 3-pin	VESM (SOT-723) 1212 size, 3-pin	CST3C 0806 size, 3-pin	CST3 1006 size, 3-pin
N-ch	20	±10	180	5 (20)	1.2	—	—	—	SSM3K35FS	SSM3K35MFV	—	SSM3K35CT
	20	±10	200	2.8 (9.5)	1.2	—	—	—	—	—	SSM3K35CTC *	—
	20	±10	200	3.07(5.6)	1.5	—	—	—	SSM3K37FS	—	—	SSM3K37CT
	20	±10	250	3.07(5.6)	1.5	—	—	—	—	SSM3K37MFV	—	—
	20	±10	500	0.95 (1.52)	1.5	—	—	SSM3K36TU	SSM3K36FS	SSM3K36MFV	—	—
	30	±20	100	4.0 (7.0)	2.5	SSM3K15F	—	—	—	—	—	—
	30	±20	100	3.5 (6.0)	2.5	—	SSM3K15AFU	—	SSM3K15AFS	SSM3K15AMFV	—	SSM3K15ACT
	30	±20	100	4.0 (7.0)	2.5	—	—	—	SSM3K44FS#	SSM3K44MFV#	—	—
	30	±20	400	0.8 (1.2)	4.0	—	SSM3K09FU	—	—	—	—	—
	50	±7	100	22 (40)	2.5	—	SSM3K17FU	—	—	—	—	—
	60	±20	200	2.1 (3.3)	4.5	SSM3K7002BF	SSM3K7002BFU	—	SSM3K7002BFS	—	—	—
P-ch	–20	±10	–100	11 (44)	–1.2	—	—	—	SSM3J35FS	SSM3J35MFV	—	SSM3J35CT
	–20	±10	–200	3.3 (TBD)	1.2	—	—	—	—	—	SSM3J35CTC **#	—
	–20	±8	–330	2.23 (3.6)	–1.5	—	—	SSM3J36TU	SSM3J36FS	SSM3J36MFV	—	—
	–30	±20	–100	14 (32)	–2.5	SSM3J15F	SSM3J15FU	—	SSM3J15FS	SSM3J15FV	—	SSM3J15CT
	–30	±20	–200	3.3 (4.2)	–4.0	—	SSM3J09FU	—	—	—	—	—
	–60	±20	–200	1.3 (2.0)	–10	2SJ168	—	—	—	—	—	—

#: High ESD protection

*: New Products **: Under Development

Dual MOSFETs

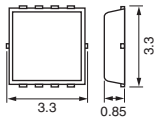
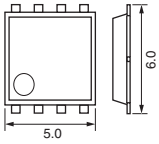
High-speed switching | Load Switches

Polarity	Absolute Maximum Ratings			$R_{DS(ON)}$ Typ. (Max) (Ω)	V_{GS} (V)	Package					Constituent Devices
	V_{DSS} (V)	V_{GSS} (V)	I_D (mA)			US6 (SOT-363) 2021 size, 6-pin	UF6 2021 size, 6-pin	USV (SOT-353) 2021 size, 5-pin	ES6 (SOT-563) 1616 size, 6-pin	ESV (SOT-553) 1616 size, 5-pin	
N-ch×2	20	±10	180	5 (20)	1.2	SSM6N35FU	—	—	SSM6N35FE	—	SSM3K35FS×2
	20	±10	100	5.2 (15)	1.5	—	—	SSM5N16FU	—	SSM5N16FE	SSM3K16FU×2
	20	±10	250	3.07 (5.6)	1.5	—	SSM6N37FU	—	SSM6N37FE	—	SSM3K37MFV×2
	20	±10	500	0.95 (1.52)	1.5	SSM6N43FU	SSM6N36TU	—	SSM6N36FE	—	SSM3K36FS×2
	30	±20	100	3.5 (6.0)	2.5	SSM6N15AFU	—	—	SSM6N15AFE	—	SSM3K15AFU×2
	30	±20	100	4.0 (7.0)	2.5	SSM6N44FU#	—	—	SSM6N44FE#	—	SSM3K44FS×2
	30	±20	100	4.0 (7.0)	2.5	—	—	SSM5N15FU	—	SSM5N15FE	SSM3K15FU×2
	30	±20	400	0.8 (1.2)	4.0	SSM6N09FU	—	—	—	—	SSM3K09FU×2
	50	±7	100	22 (40)	2.5	SSM6N17FU	—	—	—	—	SSM3K17FU×2
	60	±20	200	2.1 (3.3)	4.5	SSM6N7002BFU	—	—	SSM6N7002BFE	—	SSM3K7002BFU×2
P-ch×2	–20	±10	–100	11 (44)	–1.2	SSM6P35FU	—	—	SSM6P35FE	—	SSM3J35FS×2
	–20	±10	–100	18 (45)	–1.5	SSM6P16FU	—	SSM5P16FU	SSM6P16FE	SSM5P16FE	SSM3J16FU×2
	–20	±8	–330	2.23 (3.6)	–1.5	—	SSM6P36TU	—	SSM6P36FE	—	SSM3J36FS×2
	–30	±20	–100	14 (32)	–2.5	SSM6P15FU	—	SSM5P15FU	SSM6P15FE	SSM5P15FE	SSM3J15FU×2
	–30	±20	–200	3.3 (4.2)	–4.0	SSM6P09FU	—	—	—	—	SSM3J09FU×2
N ch+ P-ch	20	±10	180	5 (20)	1.2	SSM6L35FU	—	—	SSM6L35FE	—	SSM3K35FS
	–20	±10	–100	11 (44)	–1.2						+SSM3J35FS
	20	±10	500	0.95 (1.52)	1.5	—	SSM6L36TU	—	SSM6L36FE	—	SSM3K36FS
	–20	±8	–330	2.23 (3.6)	–1.5						+SSM3J36FS
	30	±20	400	0.8 (1.2)	4.0	SSM6L09FU	—	—	—	—	SSM3K09FU
	–30	±20	–200	3.3 (4.2)	–4.0						+SSM3J09FU

#: High ESD protection

Surface-Mount MOSFETs for General-Purpose Switching Power Supply Applications

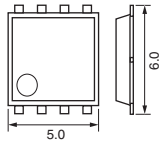
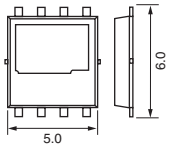
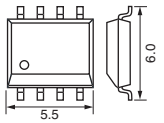
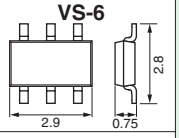
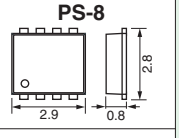
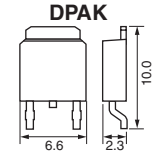
High-speed switching | Load Switches

Package	Circuit Configuration		Part Number	Absolute Maximum Ratings			RDS(ON) Max (mΩ)				Ciss Typ. (pF)	Crss Typ. (pF)	Coss Typ. (pF)	Qg Typ. (nC)	Series
				VDSS (V)	VGSS (V)	ID (A)	|VGS| = 10 V	|VGS| = 6.5 V	|VGS| = 6 V	|VGS| = 4.5 V					
TSON Advance 	N-ch	Single	TPCC8067-H	30	±20	9	25	–	–	33	690	28	120	4.7	U-MOSVII-H
			TPCC8066-H			11	15	–	–	19	1100	49	190	7.6	U-MOSVII-H
			TPCC8068-H			13	11.6	–	–	16	980	57	210	7.2	U-MOSVII-H
			TPN11003NL			11	11	–	–	16	510	18	300	3.3	U-MOSVIII-H
			TPCC8065-H			13	11.4	–	–	14.5	1350	63	240	9.9	U-MOSVII-H
			TPN8R903NL			20	8.9	–	–	12.7	630	21	350	4.4	U-MOSVIII-H
			TPCC8064-H			19	8.2	–	–	10.6	1600	78	290	11	U-MOSVII-H
			TPN6R003NL			27	6	–	–	8.3	1050	37	600	8.2	U-MOSVIII-H
			TPCC8062-H			27	5.6	–	–	7.1	2400	120	430	17	U-MOSVII-H
			TPN4R303NL			40	4.3	–	–	6.3	1110	39	640	6.8	U-MOSVIII-H
			TPN2R703NL			45	2.7	–	–	4.1	1600	53	890	9.5	U-MOSVIII-H
			TPN22006NH	60		9	22	64	–	–	710	14	235	12	U-MOSVIII-H
			TPN14006NH			13	14	41	–	–	1000	25	310	15	U-MOSVIII-H
			TPN11006NL			17	11.4	–	–	17	1500	23	350	23	U-MOSVIII-H
			TPN7R506NH			26	7.5	16	–	–	1410	28	480	22	U-MOSVIII-H
			TPN30008NH	80		9.6	30	–	–	–	710	10	170	11	U-MOSVIII-H
			TPN13008NH			18	13.3	–	–	–	1230	20	290	18	U-MOSVIII-H
			TPN3300ANH	100		9.4	33	–	–	–	680	8.8	130	11	U-MOSVIII-H
			TPN1600ANH			17	16	–	–	–	1230	18	220	19	U-MOSVIII-H
			TPN5900CNH	150		9	59	–	–	–	460	3	80	7	U-MOSVIII-H
			TPN1110ENH	200		7.2	114	–	–	–	460	3	55	7	U-MOSVIII-H
			TPN2010FNH	250		5.6	198	–	–	–	460	3	45	7	U-MOSVIII-H
SOP Advance 	N-ch	Single	TPCA8068-H	30		15	11.6	–	–	16	980	57	210	7.2	U-MOSVII-H
			TPH11003NL			11	11	–	–	16	510	18	300	3.3	U-MOSVIII-H
			TPCA8065-H			16	11.4	–	–	14.5	1350	63	240	9.9	U-MOSVII-H
			TPH8R903NL			20	8.9	–	–	12.7	630	21	350	4.4	U-MOSVIII-H
			TPCA8064-H			20	8.2	–	–	10.6	1600	78	290	11	U-MOSVII-H
			TPCA8063-H			22	6.8	–	–	8.7	1900	93	340	13	U-MOSVII-H
			TPCA8091-H			35	6	–	–	8.7	1380	100	250	9	U-MOSVII-H
			TPH6R003NL			38	6	–	–	8.3	1050	37	600	8.2	U-MOSVIII-H
			TPCA8062-H			28	5.6	–	–	7.1	2400	120	430	17	U-MOSVII-H
			TPH4R003NL			40	4	–	–	6.2	1110	39	640	6.8	U-MOSVIII-H
			TPCA8059-H			32	3.8	–	–	4.8	2900	150	530	21	U-MOSVII-H
			TPH3R203NL			47	3.2	–	–	4.7	1600	53	890	9.5	U-MOSVIII-H
			TPCA8058-H			38	3	–	–	3.8	3600	200	680	26	U-MOSVII-H
			TPCA8057-H			42	2.6	–	–	3.2	4300	240	810	31	U-MOSVII-H
			TPCA8056-H			48	2.2	–	–	2.7	5200	290	1000	38	U-MOSVII-H
			TPCA8055-H			56	1.9	–	–	2.3	6400	360	1200	47	U-MOSVII-H
			TPH1R403NL			60	1.4	–	–	2.1	3400	93	1800	20	U-MOSVIII-H
			TPHR9003NL			60	0.9	–	–	1.4	5300	130	2700	32	U-MOSVIII-H
		Single + SBD	TPCA8A11-H			35	3.6	–	–	4.6	3200	170	600	23	U-MOSVII-H
			TPCA8A10-H			40	3	–	–	3.8	4000	200	810	29	U-MOSVII-H
			TPCA8A09-H			51	2.3	–	–	2.8	5900	250	1100	41	U-MOSVII-H
		Single	TPCA8052-H	40		20	11.3	–	–	13.1	1620	85	280	25	U-MOSVI-H
			TPCA8047-H			32	7.3	–	–	8.5	2590	135	440	43	U-MOSVI-H
			TPCA8046-H			38	5.4	–	–	6.3	3545	185	600	55	U-MOSVI-H
			TPCA8045-H			46	3.6	–	–	4.1	5800	305	950	90	U-MOSVI-H
			TPH1R204PL			150	1.24	–	–	2.1	5600	130	1350	74	U-MOSIX-H
			TPHR8504PL			150	0.85	–	–	1.4	7370	58	1930	103	U-MOSIX-H
			TPH1R005PL	45		150	1.04	–	–	1.7	7350	64	1860	99	U-MOSIX-H
			TPCA8053-H	60		15	22.3	–	–	24	1620	60	200	25	U-MOSVI-H
			TPCA8050-H			24	14.2	–	–	15.3	2590	95	300	41	U-MOSVI-H
			TPH14006NH			14	14	33	–	–	1000	25	310	16	U-MOSVIII-H
			TPH11006NL			17	11.4	–	–	17	1500	23	350	23	U-MOSVIII-H
			TPCA8049-H			28	10.4	–	–	11.2	3545	130	420	55	U-MOSVI-H
			TPH7R506NH			22	7.5	19	–	–	1785	40	580	31	U-MOSVIII-H
			TPCA8048-H			35	6.6	–	–	7.1	5800	210	650	90	U-MOSVI-H
			TPH5R906NH			28	5.9	14	–	–	2340	50	750	38	U-MOSVIII-H
			TPH4R606NH			32	4.6	11	–	–	3050	60	990	49	U-MOSVIII-H
			TPH2R306NH			60	2.3	4.7	–	–	4700	64	1600	72	U-MOSVIII-H
			TPH2R608NH	75		150	2.6	–	–	–	4600	50	1100	72	U-MOSVIII-H
			TPH12008NH	80		24	12.3	–	–	–	1490	16	330	22	U-MOSVIII-H
			TPCA8051-H			28	9.4	–	–	9.8	5800	150	520	91	U-MOSVI -H
			TPH8R008NH			34	8	–	–	–	2300	23	520	35	U-MOSVIII-H
			TPH4R008NH			60	4	–	–	–	4100	32	890	59	U-MOSVIII-H

Product Lineup High-Speed Series for Switching Power Supply Applications

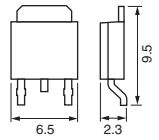
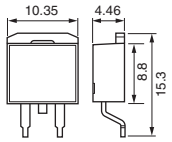
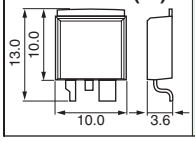
Surface-Mount MOSFETs for General-Purpose Switching Power Supply Applications

High-speed switching | Load Switches

Package	Circuit Configuration		Part Number	Absolute Maximum Ratings			$R_{DS(ON)}$ Max (mΩ)				Ciss Typ. (pF)	Crss Typ. (pF)	Coss Typ. (pF)	Qg Typ. (nC)	Series
				V_{DSS} (V)	V_{GSS} (V)	I_D (A)	$\|V_{GS}\|$ = 10 V	$\|V_{GS}\|$ = 6.5 V	$\|V_{GS}\|$ = 6 V	$\|V_{GS}\|$ = 4.5 V					
SOP Advance 	N-ch	Single	TPH1400ANH	100	±20	24	13.6	–	–	–	1440	15	260	22	U-MOSVIII-H
			TPH8R80ANH			32	8.8	–	–	–	2180	21	410	33	U-MOSVIII-H
			TPH4R50ANH			60	4.5	–	–	–	4000	31	700	58	U-MOSVIII-H
			TPH5900CNH	150		9	59	–	–	–	460	3	80	7	U-MOSVIII-H
			TPH3300CNH			18	33	–	–	–	810	3	140	10.6	U-MOSVIII-H
			TPH1500CNH			38	15.4	–	–	–	1850	7	280	22	U-MOSVIII-H
			TPH1110ENH	200		7.2	114	–	–	–	460	3	55	7	U-MOSVIII-H
			TPH6400ENH			13	64	–	–	–	810	3	90	11.2	U-MOSVIII-H
			TPH2900ENH			33	29	–	–	–	1850	7	180	22	U-MOSVIII-H
			TPH2010FNH	250		5.6	198	–	–	–	460	3	45	7	U-MOSVIII-H
			TPH1110FNH			10	112	–	–	–	810	3	75	11	U-MOSVIII-H
			TPH5200FNH			262	52	–	–	–	1850	7	140	22	U-MOSVIII-H
DSOP Advance 	N-ch	Single	TPWR8503NL	30		150	0.85	–	–	1.3	5300	130	2700	32	U-MOSVIII-H
			TPWR8004PL	40		150	0.8	–	–	1.35	7370	58	1930	103	U-MOSIX -H
			TPW4R008NH	80		116	4	–	–	–	4100	32	890	59	U-MOSVIII-H
			TPW4R50ANH	100		92	4.5	–	–	–	4000	31	700	58	U-MOSVIII-H
SOP-8 	N-ch	Single	TPC8067-H	30		9	25	–	–	33	690	28	120	4.7	U-MOSVII-H
			TPC8066-H			11	16	–	–	19	1100	49	190	7.6	U-MOSVII-H
			TPC8065-H			13	11.6	–	–	14.7	1350	63	240	9.9	U-MOSVII-H
			TP89R103NL			15	9.1	–	–	12.9	630	21	350	4.4	U-MOSVIII-H
			TPC8064-H			16	8.4	–	–	10.8	1600	78	290	11	U-MOSVII-H
			TPC8063-H			17	7	–	–	8.9	1900	93	340	13	U-MOSVII-H
			TP86R203NL			18	6.2	–	–	8.5	1050	37	600	8.2	U-MOSVIII-H
			TPC8062-H			18	5.8	–	–	7.3	2400	120	430	17	U-MOSVII-H
			TPC8059-H			18	4	–	–	5	2900	150	530	21	U-MOSVII-H
			TPC8058-H			18	3.2	–	–	4	3600	200	680	26	U-MOSVII-H
			TPC8057-H			18	2.8	–	–	3.4	4300	240	810	31	U-MOSVII-H
			TPC8056-H			18	2.4	–	–	2.9	5200	290	1000	38	U-MOSVII-H
			TPC8055-H			18	2.1	–	–	2.5	6400	360	1200	47	U-MOSVII-H
			TPC8089-H	40		7.2	32	–	–	36	850	40	145	14	U-MOSVI-H
			TPC8052-H			12	11.5	–	–	13.3	1620	85	280	25	U-MOSVI-H
			TPC8047-H			16	7.6	–	–	8.8	2590	135	440	43	U-MOSVI-H
			TPC8046-H			18	5.7	–	–	6.6	3545	185	600	57	U-MOSVI-H
			TPC8045-H			18	3.9	–	–	4.4	5800	305	950	90	U-MOSVI-H
			TPC8053-H	60		9	22.5	–	–	24.2	1620	60	200	25	U-MOSVI-H
			TPC8050-H			11	14.5	–	–	15.6	2590	95	300	41	U-MOSVI-H
			TPC8049-H			13	10.7	–	–	11.5	3545	130	420	56	U-MOSVI-H
			TPC8048-H			16	6.9	–	–	7.4	5800	210	650	87	U-MOSVI-H
			TPC8051-H	80		13	9.7	–	–	10.1	5800	150	520	85	U-MOSVI-H
		Dual	TPC8224-H	30		8	26	–	–	34	690	28	120	4.7	U-MOSVII-H
			TPC8223-H			9	17	–	–	21	1190	55	210	8.3	U-MOSVII-H
			TPC8227-H	40		5.1	33	–	–	40	640	35	115	10	U-MOSVI-H
			TPC8228-H	60		3.8	57	–	–	64	640	25	90	11	U-MOSVI-H
			TPC8229-H	80		3.2	80	–	–	87	640	17	75	11	U-MOSVI-H
VS-6 		Single	TPC6008-H	30		5.9	60	–	–	74	232	16	68	4.8	U-MOSVI-H
			TPC6009-H	40		5.3	81	–	–	98	225	13	54	4.7	U-MOSVI-H
			TPC6010-H	60		6.1	59	–	–	63	640	24	95	12	U-MOSVI-H
PS-8 			TPCP8007-H	60		5	57	–	–	64	640	25	90	11	U-MOSVI-H
		Dual	TPCP8205-H	30		6.5	26	–	–	29	830	53	177	13.8	U-MOSVI-H
DPAK 		Single	TK40P03M1	30		40	10.8	–	–	14.4	1150	85	260	9.4	U-MOSVI-H
			TK45P03M1			45	9.7	–	–	12	1500	100	320	13	U-MOSVI-H
			TK50P03M1			50	7.5	–	–	9.8	1700	125	380	13.3	U-MOSVI-H
			TK20P04M1	40		20	29	–	–	34	985	37	159	15	U-MOSVI-H
			TK40P04M1			40	11	–	–	13.4	1920	90	310	29	U-MOSVI-H
			TK50P04M1			50	8.7	–	–	10.2	2600	110	420	38	U-MOSVI-H

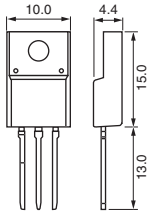
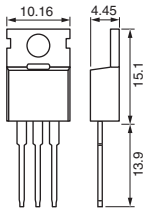
Surface-Mount MOSFETs for General-Purpose Switching Power Supply Applications

High-speed switching | Load Switches

Package	Circuit Configuration		Part Number	Absolute Maximum Ratings			RDS(ON) Max (mΩ)				Ciss Typ. (pF)	Crss Typ. (pF)	Coss Typ. (pF)	Qg Typ. (nC)	Series
				VDSS (V)	VGSS (V)	ID (A)	|VGS| = 10 V	|VGS| = 6.5 V	|VGS| = 6 V	|VGS| = 4.5 V					
DPAK+ 	N-ch	Single	TK15S04N1L	40	±20	15	17.8	–	–	37	610	50	390	10	U-MOSVIII-H
			TK65S04N1L			65	4.3	–	–	7.8	2550	130	1430	39	U-MOSVIII-H
			TK100S04N1L			100	2.3	–	–	4.5	5490	220	3000	76	U-MOSVIII-H
			TK25S06N1S	60		25	18.5	–	–	36.8	855	69	490	15	U-MOSVIII-H
			TK90S06N1S			90	3.3	–	–	5.2	5400	350	2630	81	U-MOSVIII-H
			TK33S10N1H	100		33	9.7	–	–	–	2050	140	1070	28	U-MOSVIII-H
			TK55S10N1			55	6.5	–	–	–	3280	210	1520	49	U-MOSVIII-H
D2PAK 			TK65G10N1			65	4.5	–	–	–	5400	42	950	81	U-MOSVIII-H
TO-220SM(W) 			TK200F04N1L	40		200	0.9	–	1.37	–	14920	650	7680	214	U-MOSVIII-H
			TK160F10N1	100		160	2.4	–	–	–	8510	500	3960	121	U-MOSVIII-H

Through-Hole MOSFETs for General-Purpose Switching Power Supply Applications

High-speed switching | Load Switches

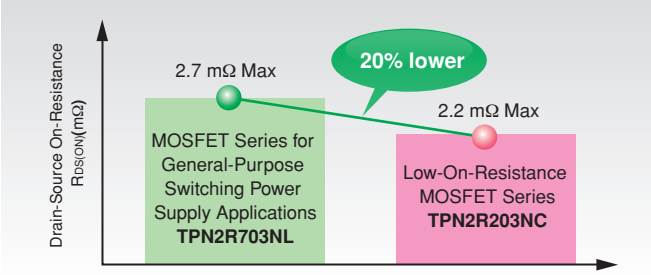
Package	Circuit Configuration		Part Number	Absolute Maximum Ratings			RDS(ON) Max (mΩ)				Ciss Typ. (pF)	Crss Typ. (pF)	Coss Typ. (pF)	Qg Typ. (nC)	Series
				VDSS (V)	VGSS (V)	ID (A)	|VGS| = 10 V	|VGS| = 6.5 V	|VGS| = 6 V	|VGS| = 4.5 V					
TO-220SIS 	N-ch	Single	TK50A04K3	40	±20	50	3.5	–	–	–	4500	900	1100	102	U-MOSIV
			TK80A04K3L			80	2.4	–	3.5	–	9400	1200	1900	190	U-MOSIV
			TK30A06N1	60		30	15	–	–	–	1050	33	400	16	U-MOSVIII-H
			TK40A06N1			40	10.4	–	–	–	1700	40	580	23	U-MOSVIII-H
			TK58A06N1			58	5.4	–	–	–	3400	45	1120	46	U-MOSVIII-H
			TK100A06N1			100	2.7	–	–	–	10500	50	3500	140	U-MOSVIII-H
			TK80A08K3	75		80	4.5	–	–	–	8200	770	1140	175	U-MOSIV
			TK35A08N1	80		35	12.2	–	–	–	1700	18	440	25	U-MOSVIII-H
			TK46A08N1			46	8.4	–	–	–	2500	22	620	37	U-MOSVIII-H
			TK72A08N1			72	4.5	–	–	–	5500	38	1300	81	U-MOSVIII-H
			TK100A08N1			100	3.2	–	–	–	9000	52	2100	130	U-MOSVIII-H
			TK8A10K3	100		8	120	–	–	–	530	55	75	12.9	U-MOSIV
			TK12A10K3			12	80	–	–	–	780	75	105	18	U-MOSIV
			TK25A10K3			25	40	–	–	–	1580	135	200	34	U-MOSIV
			TK22A10N1			22	13.8	–	–	–	1800	18	310	28	U-MOSVIII-H
			TK34A10N1			34	9.5	–	–	–	2600	23	450	38	U-MOSVIII-H
			TK40A10N1			40	8.2	–	–	–	3000	29	520	49	U-MOSVIII-H
			TK65A10N1			65	4.8	–	–	–	5400	42	950	81	U-MOSVIII-H
			TK100A10N1			100	3.8	–	–	–	8800	63	1500	140	U-MOSVIII-H
			TK32A12N1	120		32	13.8	–	–	–	2000	13	330	34	U-MOSVIII-H
			TK42A12N1			42	9.4	–	–	–	3100	16	490	52	U-MOSVIII-H
			TK56A12N1			56	7.5	–	–	–	4200	19	650	69	U-MOSVIII-H
			TK72A12N1			72	4.5	–	–	–	8100	30	1200	130	U-MOSVIII-H
TO-220 			TK30E06N1	60		30	15	–	–	–	1050	33	400	16	U-MOSVIII-H
			TK40E06N1			40	10.4	–	–	–	1700	40	580	23	U-MOSVIII-H
			TK58E06N1			58	5.4	–	–	–	3400	45	1120	46	U-MOSVIII-H
			TK100E06N1			100	2.3	–	–	–	10500	50	3500	140	U-MOSVIII-H
			TK35E08N1	80		35	12.2	–	–	–	1700	18	440	25	U-MOSVIII-H
			TK46E08N1			46	8.4	–	–	–	2500	22	620	37	U-MOSVIII-H
			TK72E08N1			72	4.3	–	–	–	5500	38	1300	81	U-MOSVIII-H
			TK100E08N1			100	3.2	–	–	–	9000	52	2100	130	U-MOSVIII-H
			TK18E10K3	100		18	42	–	–	–	1580	135	200	33	U-MOSIV
			TK22E10N1			22	13.8	–	–	–	1800	18	310	28	U-MOSVIII-H
			TK34E10N1			34	9.5	–	–	–	2600	23	450	38	U-MOSVIII-H
			TK40E10N1			40	8.2	–	–	–	3000	29	520	49	U-MOSVIII-H
			TK65E10N1			65	4.8	–	–	–	5400	42	950	81	U-MOSVIII-H
			TK100E10N1			100	3.4	–	–	–	8800	63	1500	140	U-MOSVIII-H
			TK32E12N1	120		32	13.8	–	–	–	2000	13	330	34	U-MOSVIII-H
			TK42E12N1			42	9.4	–	–	–	3100	16	490	52	U-MOSVIII-H
			TK56E12N1			56	7	–	–	–	4200	19	650	69	U-MOSVIII-H
			TK72E12N1			72	4.4	–	–	–	8100	30	1200	130	U-MOSVIII-H

Low-On-Resistance Series for Load Switch and Battery Pack Protection Applications

As smartphones, tablet PCs and other mobile devices become more sophisticated and feature-rich, their battery drive circuits are becoming more versatile and densely packed. Consequently, MOSFETs with small form factors, low on-resistance, high current ratings, low capacitance and high permissible power dissipation are required. To meet these needs, Toshiba has developed new process and packaging technologies to realize MOSFETs ideal for high-performance power supply applications.

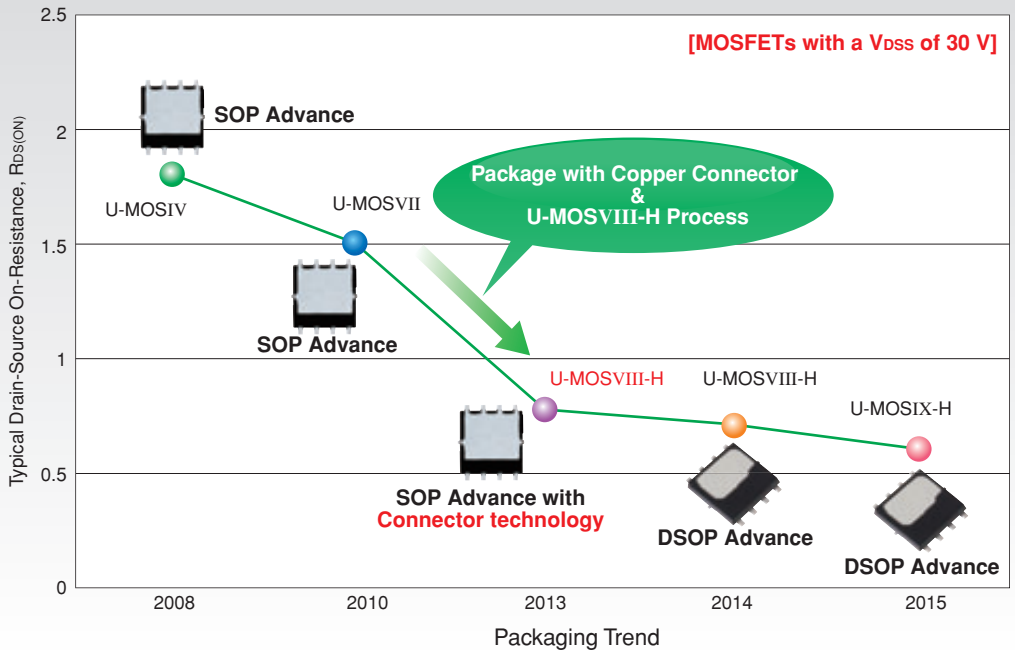
Feature

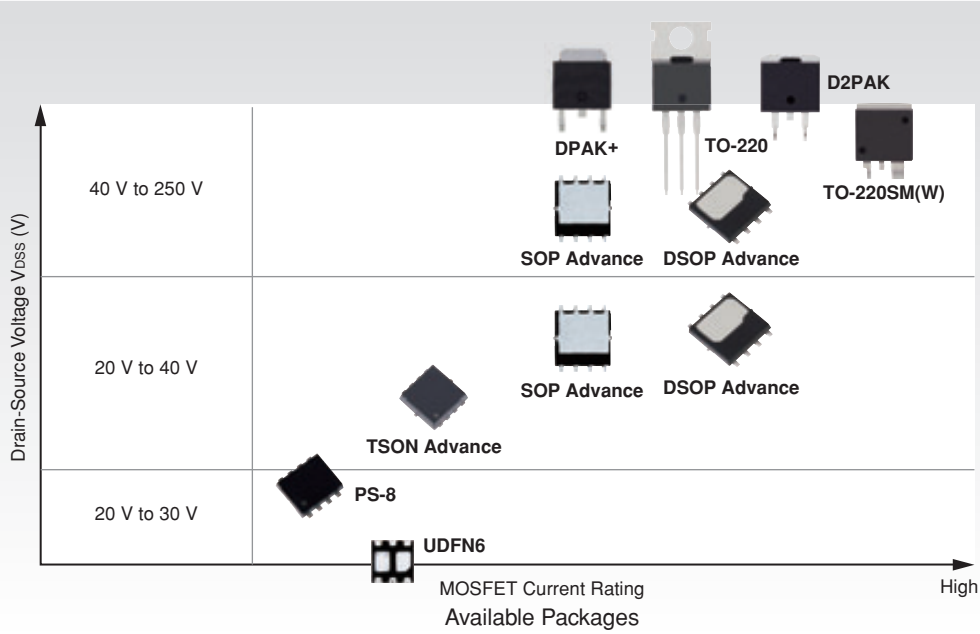
Toshiba offers MOSFETs specifically optimized for on-resistance, which exhibit lower on-resistance than those for general-purpose switching power supply applications in the same generation.



Packages

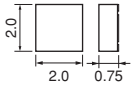
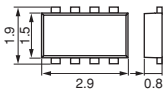
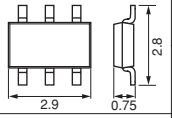
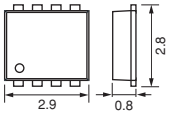
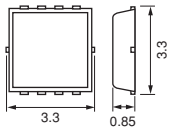
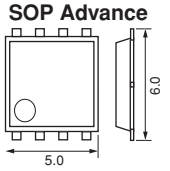
Toshiba has endeavored to reduce the MOSFET on-resistance by using the latest small-geometry process and improving package structures.





Surface-Mount MOSFETs of the Low-On-Resistance MOSFET Series

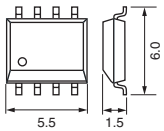
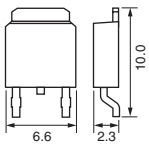
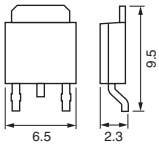
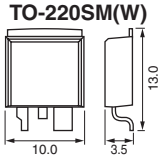
Load Switches

Package	Circuit Configuration		Part Number	Absolute Maximum Ratings			$R_{DS(ON)}$ Max (mΩ)						Series
				V_{DSS} (V)	V_{GSS} (V)	I_D (A)	$\|V_{GS}\|$ = 10 V	$\|V_{GS}\|$ = 6.5 V	$\|V_{GS}\|$ = 6 V	$\|V_{GS}\|$ = 4.5 V	$\|V_{GS}\|$ = 4.0 V	$\|V_{GS}\|$ = 2.5 V	
UDFN6 	N-ch	Single	SSM6K504NU	30	±20	9	19.5	–	–	26	–	–	U-MOSVII
	P-ch		SSM6J501NU	–20	±8	–10	–	–	–	15.3	–	19	U-MOSVI
			SSM6J502NU		±8	–6	–	–	–	23.1	–	28.3	U-MOSVI
			SSM6J503NU		±8	–6	–	–	–	32.4	–	41.7	U-MOSVI
VS-8 	N-ch		TPCF8003	20	±12	7	–	–	–	18	–	34	U-MOSIV
			TPCF8004	30	±20	7	24	–	–	30	–	–	U-MOSVII
	P-ch		TPCF8105	–20	±12	–6	–	–	–	30	–	41	U-MOSVI
			TPCF8108		±12	–7	–	–	–	26	–	37	U-MOSVI
			TPCF8107	–30	–25/+20	–6	28	–	–	38	–	–	U-MOSVI
		Dual	TPCF8305	–20	±12	–4	–	–	–	58	–	83	U-MOSVI
			TPCF8306	–30	–25/+20	–3.2	72	–	–	120	–	–	U-MOSVI
VS-6 	N-ch	Single	TPC6012	20	±12	6	–	–	–	20	–	38	U-MOSIV
			TPC6067	30	±20	6	23	–	–	29	–	–	U-MOSVII
	P-ch		TPC6130	–20	±12	–2.8	–	–	–	106	–	164	U-MOSVI
			TPC6113		±12	–5	–	–	–	55	–	85	U-MOSVI
			TPC6111		±8	–5.5	–	–	–	40	–	57	U-MOSV
			TPC6110	–30	–25/+20	–4.5	56	–	–	77	–	–	U-MOSVI
PS-8 	N-ch	Single	TPCP8011	40	±20	5	31.8	–	51.2	–	–	–	U-MOSIV
			TPCP8010		±20	6	23.8	–	38.4	–	–	–	U-MOSIV
			TPCP8009		±20	10	11.8	–	19.5	–	–	–	U-MOSIV
			TPCP8013	60	±20	4	51.8	–	77.9	–	–	–	U-MOSIV
			TPCP8012		±20	8	20.2	–	29.1	–	–	–	U-MOSIV
	P-ch		TPCP8105	–20	±12	–7.2	–	–	–	17	–	23	U-MOSVI
			TPCP8106	–30	±20	–5.2	33	–	–	44	–	–	U-MOSVI
			TPCP8109	–40	±20	–4.5	52.4	–	76.8	–	–	–	U-MOSVI
			TPCP8107		±20	–8	18	–	26.8	–	–	–	U-MOSVI
			TPCP8111	–60	±20	–3	117	–	158.4	–	–	–	U-MOSVI
			TPCP8110		±20	–5	39.5	–	53.2	–	–	–	U-MOSVI
	N-ch	Dual	TPCP8206	20	±12	6	–	–	–	24	–	35	U-MOSVII
			TPCP8204	30	±20	4.2	50	–	–	77	–	–	U-MOSIV
			TPCP8207	40	±20	5	36.3	–	62.8	–	–	–	U-MOSIV
	P-ch		TPCP8306	–20	±12	–4	–	–	–	58	–	83	U-MOSVI
			TPCP8303		±8	–3.8	–	–	–	46	–	60	U-MOSV
			TPCP8305		±12	–6	–	–	–	30	–	42	U-MOSVI
TSON Advance 	N-ch	Single	TPCC8093	20	±12	21	–	–	–	5.8	–	9.5	U-MOSVII
			TPCC8074	30	±20	20	6.3	–	–	8.5	–	–	U-MOSVII
			TPN6R303NC		±20	20	6.3	–	–	8.4	–	–	U-MOSVIII
			TPN4R203NC		±20	23	4.2	–	–	6.4	–	–	U-MOSVIII
			TPCC8073		±20	27	4.5	–	–	5.9	–	–	U-MOSVII
			TPN2R503NC		±20	40	2.5	–	–	4.1	–	–	U-MOSVIII
			TPN2R203NC		±20	45	2.2	–	–	3.7	–	–	U-MOSVIII
			TPCC8084	33	±20	21	6.7	–	–	9	–	–	U-MOSVII
			TPCC8076		±20	27	4.6	–	–	6.2	–	–	U-MOSVII
	P-ch		TPCC8136	–20	±12	–9.4	–	–	–	16	–	22	U-MOSVI
			TPCC8137		±12	–13	–	–	–	10	–	16	U-MOSVI
			TPCC8138		±12	–18	–	–	–	7.5	–	11	U-MOSVI
			TPN4R712MD		±12	–36	–	–	–	4.7	–	8.1	U-MOSVI
			TPCC8131	–30	–25/+20	–10	17.6	–	–	23	–	–	U-MOSVI
			TPCC8104		–25/+20	–20	8.8	–	–	12.4	–	–	U-MOSVI
			TPCC8103		±20	–18	12	–	–	–	25	–	U-MOSV
			TPCC8105		–25/+20	–23	7.8	–	–	10.4	–	–	U-MOSVI
			TPCC8106	–40	–20/+10	30	11.9	–	–	–	–	–	U-MOSVI
			TPCC8107	–60	–20/+10	25	29.4	–	–	–	–	–	U-MOSVI
SOP Advance 	N-ch		TPCA8082	30	±20	32	3.8	–	–	4.8	–	–	U-MOSVII
			TPCA8081		±20	38	3	–	–	3.8	–	–	U-MOSVII
			TPCA8080		±20	42	2.6	–	–	3.2	–	–	U-MOSVII
			TPCA8088		±20	48	2.2	–	–	2.7	–	–	U-MOSVII
			TPCA8087		±20	56	1.9	–	–	2.3	–	–	U-MOSVII
			TPCA8075	33	±20	48	2.4	–	–	3.1	–	–	U-MOSVII
			TPCA8078		±20	54	2.1	–	–	2.6	–	–	U-MOSVII
	P-ch		TPH1R712MD	–20	±12	–60	–	–	–	1.7	–	2.7	U-MOSVI
			TPCA8131	–30	–25/+20	–13	17	–	–	22	–	–	U-MOSVI
			TPCA8109		–25/+20	–24	9	–	–	13	–	–	U-MOSVI
			TPCA8128		–25/+20	–34	4.8	–	–	6.7	–	–	U-MOSVI
			TPCA8120		–25/+20	–45	3	–	–	4	–	–	U-MOSVI
			TPCA8124	–40	–20/+10	–35	10.5	–	–	–	–	–	U-MOSVI
			TPCA8122		–20/+10	–60	5	–	–	–	–	–	U-MOSVI
			TPCA8125	–60	–20/+10	–25	25.5	–	–	–	–	–	U-MOSVI
			TPCA8123		–20/+10	–50	11.1	–	–	–	–	–	U-MOSVI

Product Lineup Low-On-Resistance Series for Load Switch and Battery Pack Protection Applications

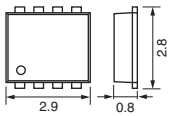
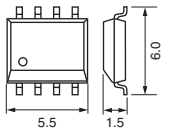
Surface-Mount MOSFETs of the Low-On-Resistance MOSFET Series

Load Switches

Package	Circuit Configuration		Part Number	Absolute Maximum Ratings			$R_{DS(ON)}$ Max (mΩ)						Series
				V_{DSS} (V)	V_{GSS} (V)	I_D (A)	$\|V_{GS}\|$ = 10 V	$\|V_{GS}\|$ = 6.5 V	$\|V_{GS}\|$ = 6 V	$\|V_{GS}\|$ = 4.5 V	$\|V_{GS}\|$ = 4.0 V	$\|V_{GS}\|$ = 2.5 V	
SOP-8 	N-ch	Single	TPC8092	30	±20	15	9	–	–	11.1	–	–	U-MOSVII
			TPC8074			17	6.5	–	–	8.7	–	–	U-MOSVII
			TPC8086			17	6.4	–	–	8.5	–	–	U-MOSVII
			TPC8073			18	4.7	–	–	6.1	–	–	U-MOSVII
			TPC8085			18	4.7	–	–	6.1	–	–	U-MOSVII
			TPC8082			18	4	–	–	5	–	–	U-MOSVII
			TPC8081			18	3.2	–	–	4	–	–	U-MOSVII
			TPC8080			18	2.8	–	–	3.4	–	–	U-MOSVII
			TPC8088			18	2.4	–	–	2.9	–	–	U-MOSVII
			TPC8087			18	2.1	–	–	2.5	–	–	U-MOSVII
			TPC8084	33		17	6.9	–	–	9.2	–	–	U-MOSVII
			TPC8076			18	4.9	–	–	6.5	–	–	U-MOSVII
			TPC8075			18	2.6	–	–	3.3	–	–	U-MOSVII
			TPC8078			18	2.3	–	–	2.8	–	–	U-MOSVII
	P-ch		TPC8129	–30	–25/+20	–9	22	–	–	28	–	–	U-MOSVI
			TPC8125			–10	13	–	–	17	–	–	U-MOSVI
			TPC8126			–11	10	–	–	14	–	–	U-MOSVI
			TPC8123			–11	9	–	–	12.5	–	–	U-MOSVI
			TPC8127			–13	6.5	–	–	8.9	–	–	U-MOSVI
			TPC8128			–16	5	–	–	6.9	–	–	U-MOSVI
			TPC8120			–18	3.2	–	–	4.2	–	–	U-MOSVI
			TPC8134	–40		–5	52	–	–	66	–	–	U-MOSVI
			TPC8132			–7	25	–	–	33	–	–	U-MOSVI
			TPC8133			–9	15	–	–	18	–	–	U-MOSVI
			TPC8124			–12	8	–	–	10	–	–	U-MOSVI
DPAK 	P-ch		TJ15P04M3			–15	36	–	–	48	–	–	U-MOSVI
DPAK+ 	N-ch		TK20S04K3L	40	±20	20	14	–	26	–	–	–	U-MOSIV
			TK35S04K3L			35	10.3	–	15	–	–	–	U-MOSIV
			TK50S04K3L			50	5.4	–	10	–	–	–	U-MOSIV
			TK65S04K3L			65	4.5	–	7.9	–	–	–	U-MOSIV
			TK80S04K3L			80	3.1	–	4.8	–	–	–	U-MOSIV
			TK20S06K3L	60		20	29	–	40	–	–	–	U-MOSIV
			TK30S06K3L			30	18	–	30	–	–	–	U-MOSIV
			TK45S06K3L			45	10.5	–	16.4	–	–	–	U-MOSIV
			TK60S06K3L			60	8	–	12.3	–	–	–	U-MOSIV
			TK80S06K3L			80	5.5	–	7.8	–	–	–	U-MOSIV
			TK40S10K3Z	100		40	18	–	–	–	–	–	U-MOSIV
	P-ch		TJ10S04M3L	–40	–20/+10	–10	44	–	–	–	–	–	U-MOSVI
			TJ20S04M3L			–20	22.2	–	–	–	–	–	U-MOSVI
			TJ40S04M3L			–40	9.1	–	–	–	–	–	U-MOSVI
			TJ60S04M3L			–60	6.3	–	–	–	–	–	U-MOSVI
			TJ80S04M3L			–80	5.2	–	–	–	–	–	U-MOSVI
			TJ15S06M3L	–60		–15	50	–	–	–	–	–	U-MOSVI
			TJ30S06M3L			–30	21.8	–	–	–	–	–	U-MOSVI
			TJ50S06M3L			–50	13.8	–	–	–	–	–	U-MOSVI
			TJ60S06M3L			–60	11.2	–	–	–	–	–	U-MOSVI
TO-220SM(W) 	N-ch		TK100F04K3	40	±20	100	3	–	–	–	–	–	U-MOSIV
			TK100F04K3L			100	3	–	4.5	–	–	–	U-MOSIV
			TK150F04K3			150	2.1	–	–	–	–	–	U-MOSIV
			TK150F04K3L			150	2.1	–	3.2	–	–	–	U-MOSIV
			TK100F06K3	60		100	5	–	–	–	–	–	U-MOSIV
			TK130F06K3			130	3.4	–	–	–	–	–	U-MOSIV
			TK80F08K3	75		80	4.3	–	–	–	–	–	U-MOSIV
	P-ch		TJ100F04M3L	–40	–20/+10	–100	3.6	–	5.4	–	–	–	U-MOSVI
			TJ150F04M3L			–150	2.8	–	4.2	–	–	–	U-MOSVI
			TJ100F06M3L	–60		–100	7.1	–	10.7	–	–	–	U-MOSVI
			TJ150F06M3L			–150	5.6	–	6.1	–	–	–	U-MOSVI

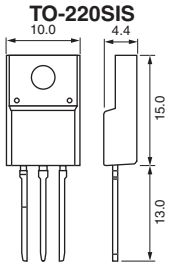
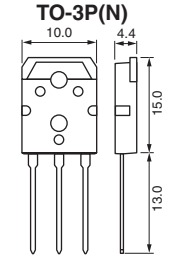
Complementary P-Channel/N-Channel MOSFETs of the Low-On-Resistance MOSFET Series

Load Switches

Package	Circuit Configuration		Part Number	Absolute Maximum Ratings			$R_{DS(ON)}$ Max (mΩ)						Series
				V_{DSS} (V)	V_{GSS} (V)	I_D (A)	$\|V_{GS}\|$ = 10 V	$\|V_{GS}\|$ = 6.5 V	$\|V_{GS}\|$ = 6 V	$\|V_{GS}\|$ = 4.5 V	$\|V_{GS}\|$ = 4.0 V	$\|V_{GS}\|$ = 2.5 V	
PS-8 	P-ch	Complementary	TPCP8404	–30	±20	–4	50	–	–	80	–	–	U-MOSV
	N-ch			30		4	50	–	–	80	–	–	U-MOSIV
	P-ch		TPCP8405	–30		–6	31.3	–	–	42	–	–	U-MOSVI
	N-ch			30		6.5	26	–	–	29	–	–	U-MOSVI-H
	P-ch		TPCP8407	–40		–4	56.8	–	82.2	–	–	–	U-MOSVI
	N-ch			40		5	36.3	–	69.2	–	–	–	U-MOSIV
	P-ch		TPCP8406	–40		–5	43.2	–	–	53.4	–	–	U-MOSVI
	N-ch			40		6	32	–	–	36	–	–	U-MOSVI-H
SOP-8 	P-ch		TPC8407	–30		–7.4	23	–	–	29	–	–	U-MOSVI
	N-ch			30		9	17	–	–	21	–	–	U-MOSVII-H
	P-ch		TPC8408	–40		–5.3	43	–	–	53	–	–	U-MOSVI
	N-ch			40		6.1	32	–	–	36	–	–	U-MOSVI-H

Through-Hole MOSFETs of the Low-On-Resistance MOSFET Series

Load Switches

Package	Circuit Configuration		Part Number	Absolute Maximum Ratings			$R_{DS(ON)}$ Max (mΩ)						Series
				V_{DSS} (V)	V_{GSS} (V)	I_D (A)	$\|V_{GS}\|$ = 10 V	$\|V_{GS}\|$ = 6.5 V	$\|V_{GS}\|$ = 6 V	$\|V_{GS}\|$ = 4.5 V	$\|V_{GS}\|$ = 4.0 V	$\|V_{GS}\|$ = 2.5 V	
TO-220SIS 	P-ch	Single	TJ9A10M3	–100	±20	–9	170	–	–	–	–	–	U-MOSV
			TJ11A10M3	–100		–11	130	–	–	–	–	–	U-MOSV
			TJ20A10M3	–100		–20	90	–	–	–	–	–	U-MOSV
TO-3P(N) 	N-ch		TK70J04K3Z	40		70	4.1	–	–	–	–	–	U-MOSIV
			TK75J04K3Z	40		75	3	–	–	–	–	–	U-MOSIV
			TK70J06K3	60		70	6	–	–	–	–	–	U-MOSIV

Fourth-Generation DTMOSIV Super-Junction MOSFET Series

Fabricated using the state-of-the-art single epitaxial process, DTMOSIV provides a 30% reduction in Ron.A, a figure of merit (FOM) for MOSFETs, compared to its predecessor, DTMOSIII. A reduction in Ron.A makes it possible to house lower-Ron chips in the same packages. This helps to improve the efficiency and reduce the size of power supplies.

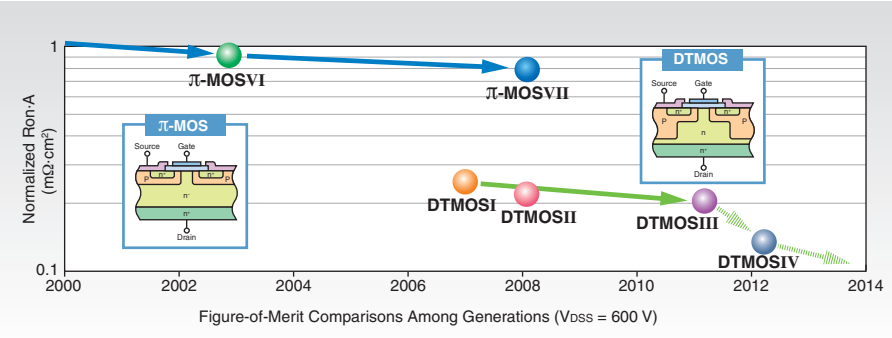
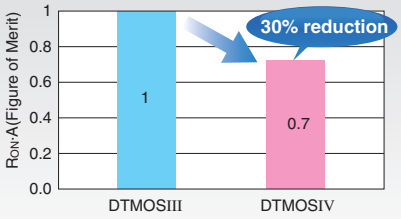


Figure-of-Merit Comparisons Among Generations (V_{DSS} = 600 V)



Reduction of RonA, a Figure of Merit for MOSFETs

DTMOSIV Lineup

Toshiba is planning to expand its MOSFET portfolio to meet diverse customer needs.

Standard DTMOSIV Series	V_{DSS} = 600 V V_{DSS} = 650 V
High-Speed Switching DTMOSIV Series	V_{DSS} = 600 V
DTMOSIV(HSD) Series with a high-speed diode	V_{DSS} = 600 V V_{DSS} = 650 V

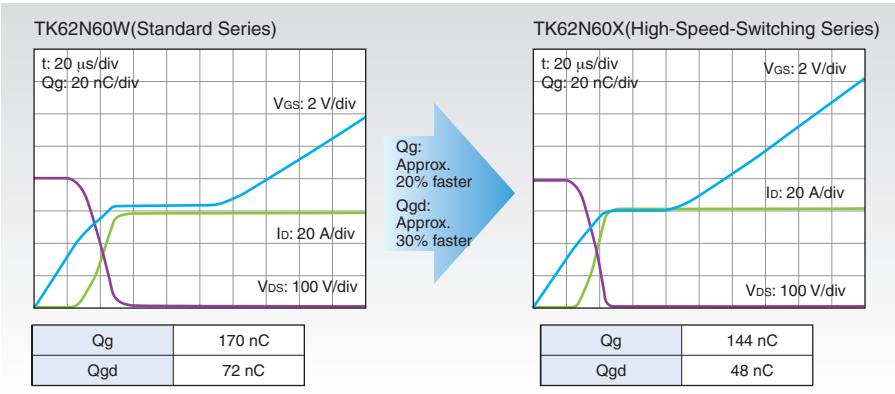
600 V Series
- Improved performance because of reduced RonA
- Helps to improve the efficiency of various power supplies

650 V Series
- Higher breakdown voltage thanks to an improvement of the 600-V version
- Easy to allow sufficient voltage tolerance margins for power supply designs

Features of the DTMOSIV-H Series

The DTMOSIV-H Series features high-speed switching performance and thus low switching loss. It provides gate-drain capacitance, Qgd, approximately 30% lower than standard MOSFET series.

Dynamic Input/Output Characteristics: Qg Curves



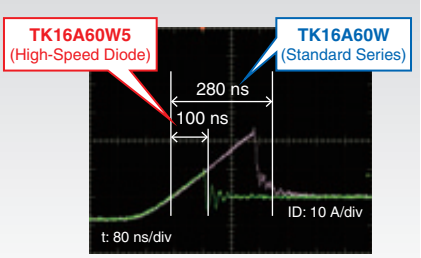
Qg	170 nC
Qgd	72 nC

Qg	144 nC
Qgd	48 nC

Features of the DTMOSIV(HSD) Series

The DTMOSIV(HSD) Series has a parasitic diode faster than that of the standard series. It delivers reverse recovery time more than 70% shorter than the standard series, and thus significantly reduces the recovery loss incurred by the parasitic diode.

Reverse-Recovery Waveform of the Parasitic Diode



[Test conditions:]
V_{DD} = 400 V, I_{DR} = 7.9 A
T_C = 25°C

Comparisons of Typical Performance Characteristics

DTMOSIV	Standard Series	High-Speed Diode
Part number	**TK16A60W**	**TK16A60W5**
Rating	600 V/15.8 A	600 V/15.8 A
On-resistance	0.19Ω Max	0.23Ω Max
Recovery time (trr)	280 ns	100 ns

Product Selection Guide

■ V_{DSS} = 600 V Standard Series

$R_{DS(ON)}$ Max (Ω)	Package									
	DPAK	IPAK	I2PAK	D2PAK	DFN8x8	TO-220	TO-220SIS	TO-3P(N)	TO-247	TO-3P(L)
0.9	**TK5P60W**	**TK5Q60W**					**TK5A60W**			
0.75 to 0.82	**TK6P60W**	**TK6Q60W**					**TK6A60W**			
0.6	**TK7P60W**	**TK7Q60W**					**TK7A60W**			
0.5	**TK8P60W**	**TK8Q60W**					**TK8A60W**			
0.38 to 0.43	**TK10P60W**	**TK10Q60W**			**TK10V60W**	**TK10E60W**	**TK10A60W**			
0.3 to 0.34	**TK12P60W**	**TK12Q60W**			**TK12V60W**	**TK12E60W**	**TK12A60W**	**TK12J60W**		
0.19			**TK16C60W**	**TK16G60W**	**TK16V60W**	**TK16E60W**	**TK16A60W**	**TK16J60W**	**TK16N60W**	
0.155 to 0.17			**TK20C60W**	**TK20G60W**	**TK20V60W**	**TK20E60W**	**TK20A60W**	**TK20J60W**	**TK20N60W**	
0.088 to 0.098					**TK31V60W**	**TK31E60W**	**TK31A60W**	**TK31J60W**	**TK31N60W**	
0.065							**TK39A60W**	**TK39J60W**	**TK39N60W**	
0.04								**TK62J60W**	**TK62N60W**	
0.018										**TK100L60W**

■ V_{DSS} = 600 V High-speed-switching (DTMOSIV-H) series

$R_{DS(ON)}$ Max (Ω)	Package				
	DFN8x8	TO-220	TO-220SIS	TO-247	TO-247 4L
0.125 to 0.13	**TK25V60X**	**TK25E60X**	**TK25A60X**	**TK25N60X**	**TK25Z60X****
0.088 to 0.098	**TK31V60X**	**TK31E60X**		**TK31N60X**	**TK31Z60X****
0.065				**TK39N60X**	**TK39Z60X****
0.040				**TK62N60X**	**TK62Z60X****

■ V_{DSS} = 600 V DTMOSIV(HSD) Series with a high-speed diode

$R_{DS(ON)}$ Max (Ω)	Package						
	DPAK	D2PAK	DFN8x8	TO-220	TO-220SIS	TO-3P(N)	TO-247
0.95 to 0.99	**TK5P60W5 ****				**TK5A60W5 ****		
0.65 to 0.67	**TK7P60W5**				**TK7A60W5**		
0.54 to 0.56	**TK8P60W5**				**TK8A60W5**		
0.45					**TK10A60W5**		
0.23 to 0.245		**TK16G60W5 ****	**TK16V60W5**	**TK16E60W5**	**TK16A60W5**	**TK16J60W5**	**TK16N60W5**
0.175 to 0.19			**TK20V60W5**	**TK20E60W5**	**TK20A60W5**	**TK20J60W5**	**TK20N60W5**
0.14 to 0.15			**TK25V60X5**	**TK25E60X5**	**TK25A60X5**		**TK25N60X5**
0.099 to 0.109			**TK31V60W5**			**TK31J60W5**	**TK31N60W5**
0.074						**TK39J60W5**	**TK39N60W5**
0.045						**TK62J60W5**	**TK62N60W5**

■ V_{DSS} = 650 V Standard Series

$R_{DS(ON)}$ Max (Ω)	Package							
	DPAK	IPAK	I2PAK	D2PAK	DFN8x8	TO-220	TO-220SIS	TO-247
1.2 to 1.22	**TK5P65W**	**TK5Q65W**					**TK5A65W**	
1.0 to 1.05	**TK6P65W**	**TK6Q65W**					**TK6A65W**	
0.78 to 0.8	**TK7P65W**	**TK7Q65W**					**TK7A65W**	
0.65 to 0.67	**TK8P65W**	**TK8Q65W**					**TK8A65W**	
0.5 to 0.56	**TK9P65W**	**TK9Q65W**					**TK9A65W**	
0.39 to 0.44	**TK11P65W**	**TK11Q65W**					**TK11A65W**	
0.25 to 0.26			**TK14C65W**	**TK14G65W**	**TK14V65W****	**TK14E65W**	**TK14A65W**	**TK14N65W**
0.2 to 0.21			**TK17C65W**		**TK17V65W****	**TK17E65W**	**TK17A65W**	**TK17N65W**
0.11 to 0.12					**TK28V65W****	**TK28E65W****	**TK28A65W**	**TK28N65W**
0.08							**TK35A65W**	**TK35N65W**
0.055								**TK49N65W**

■ V_{DSS} = 650 V DTMOSIV(HSD) Series with a high-speed diode

$R_{DS(ON)}$ Max (Ω)	Package				
	D2PAK	I2PAK	TO-220	TO-220SIS	TO-247
0.3	**TK14G65W5**	**TK14C65W5**	**TK14E65W5**	**TK14A65W5**	**TK14N65W5**
0.23				**TK17A65W5**	
0.13					**TK28N65W5**
0.095				**TK35A65W5**	**TK35N65W5**
0.057					**TK49N65W5**

**: Under development

■ V_{DSS} = 800 V Standard Series

$R_{DS(ON)}$ Max (Ω)	Package			
	DPAK	IPAK	TO-220	TO-220SIS
1.05	**TK6P80W****	**TK6Q80W****		
0.65			**TK10E80W****	**TK10A80W****
0.45			**TK12E80W****	**TK12A80W****
0.29			**TK17E80W****	**TK17A80W**

For detailed information about individual MOSFETs, visit our website or see the *SEMICONDUCTOR GENERAL CATALOG.*

■ Part Naming Conventions

TK 16 A 60 W 5

① ② ③ ④ ⑤ ⑥

⑥ Feature	
5	Incorporates a high-speed diode

⑤ Process generation	
W	DTMOSIV
X	DTMOSIV-H

④ Rated voltage (A) (V_{DSS} x 10%)	
Examples:	V_{DSS} = 600 V

③ Package	
A	TO-220SIS
C	I2PAK
E	TO-220
G	D2PAK
J	TO-3P(N)
L	TO-3P(L)
N	TO-247
P	DPAK
Q	IPAK
V	DFN8x8
Z	TO-247 4L

② Rated current (rounded off to integer)
Examples: I_D = 16 A

① Polarity	
TK	N-channel MOSFET
TJ	P-channel MOSFET

Product Lineup DTMOS Super-Junction MOSFET Series

Part Number	Absolute Maximum Ratings V_{DSS} (V)	Absolute Maximum Ratings I_D (A)	$R_{DS(ON)}$ Max(Ω) $\|V_{GS}\|$=10V	Qg Typ. (nC)	Package	Series
TK5P60W	600	5.4	0.9	10.5	DPAK	DTMOSIV
TK5P60W5 **	600	5.4	0.99	11.5	DPAK	DTMOSIV(HSD)
TK5Q60W	600	5.4	0.9	10.5	IPAK	DTMOSIV
TK5A60W	600	5.4	0.9	10.5	TO-220SIS	DTMOSIV
TK5A60W5 **	600	5.4	0.95	11.5	TO-220SIS	DTMOSIV(HSD)
TK6P60W	600	6.2	0.82	12	DPAK	DTMOSIV
TK6Q60W	600	6.2	0.82	12	IPAK	DTMOSIV
TK6A60W	600	6.2	0.75	12	TO-220SIS	DTMOSIV
TK7P60W	600	7	0.6	15	DPAK	DTMOSIV
TK7P60W5	600	7	0.67	16	DPAK	DTMOSIV(HSD)
TK7Q60W	600	7	0.6	15	IPAK	DTMOSIV
TK7A60W	600	7	0.6	15	TO-220SIS	DTMOSIV
TK7A60W5	600	7	0.65	16	TO-220SIS	DTMOSIV(HSD)
TK8P60W	600	8	0.5	18.5	DPAK	DTMOSIV
TK8P60W5	600	8	0.56	22	DPAK	DTMOSIV(HSD)
TK8Q60W	600	8	0.5	18.5	IPAK	DTMOSIV
TK8A60W	600	8	0.5	18.5	TO-220SIS	DTMOSIV
TK8A60W5	600	8	0.54	22	TO-220SIS	DTMOSIV(HSD)
TK10P60W	600	9.7	0.43	20	DPAK	DTMOSIV
TK10Q60W	600	9.7	0.43	20	IPAK	DTMOSIV
TK10V60W	600	9.7	0.38	20	DFN 8x8	DTMOSIV
TK10E60W	600	9.7	0.38	20	TO-220	DTMOSIV
TK10A60W	600	9.7	0.38	20	TO-220SIS	DTMOSIV
TK10A60W5	600	9.7	0.45	25	TO-220SIS	DTMOSIV(HSD)
TK12P60W	600	11.5	0.34	25	DPAK	DTMOSIV
TK12Q60W	600	11.5	0.34	25	IPAK	DTMOSIV
TK12V60W	600	11.5	0.3	25	DFN 8x8	DTMOSIV
TK12E60W	600	11.5	0.3	25	TO-220	DTMOSIV
TK12A60W	600	11.5	0.3	25	TO-220SIS	DTMOSIV
TK12J60W	600	11.5	0.3	25	TO-3P(N)	DTMOSIV
TK12X60U	600	12	0.4	14	TFP	DTMOSII
TK12E60U	600	12	0.4	14	TO-220	DTMOSII
TK12A60U	600	12	0.4	14	TO-220SIS	DTMOSII
TK12J60U	600	12	0.4	14	TO-3P(N)	DTMOSII
TK15X60U	600	15	0.3	17	TFP	DTMOSII
TK15E60U	600	15	0.3	17	TO-220	DTMOSII
TK15A60U	600	15	0.3	17	TO-220SIS	DTMOSII
TK15J60U	600	15	0.3	17	TO-3P(N)	DTMOSII
TK16C60W	600	15.8	0.19	38	I2PAK	DTMOSIV
TK16G60W	600	15.8	0.19	38	D2PAK	DTMOSIV
TK16V60W	600	15.8	0.19	38	DFN 8x8	DTMOSIV
TK16E60W	600	15.8	0.19	38	TO-220	DTMOSIV
TK16A60W	600	15.8	0.19	38	TO-220SIS	DTMOSIV
TK16J60W	600	15.8	0.19	38	TO-3P(N)	DTMOSIV
TK16N60W	600	15.8	0.19	38	TO-247	DTMOSIV
TK16G60W5	600	15.8	0.23	43	D2PAK	DTMOSIV(HSD)
TK16V60W5	600	15.8	0.245	43	DFN 8x8	DTMOSIV(HSD)
TK16E60W5	600	15.8	0.23	43	TO-220	DTMOSIV(HSD)
TK16A60W5	600	15.8	0.23	43	TO-220SIS	DTMOSIV(HSD)
TK16J60W5	600	15.8	0.23	43	TO-3P(N)	DTMOSIV(HSD)
TK16N60W5	600	15.8	0.23	43	TO-247	DTMOSIV(HSD)
TK20X60U	600	20	0.19	27	TFP	DTMOSII
TK20G60W	600	20	0.155	48	D2PAK	DTMOSIV
TK20V60W	600	20	0.17	48	DFN 8x8	DTMOSIV
TK20V60W5	600	20	0.19	55	DFN 8x8	DTMOSIV(HSD)
TK20C60W	600	20	0.155	48	I2PAK	DTMOSIV
TK20E60U	600	20	0.19	27	TO-220	DTMOSII
TK20E60W	600	20	0.155	48	TO-220	DTMOSIV
TK20E60W5	600	20	0.175	55	TO-220	DTMOSIV(HSD)
TK20A60U	600	20	0.19	27	TO-220SIS	DTMOSII
TK20A60W	600	20	0.155	48	TO-220SIS	DTMOSIV
TK20A60W5	600	20	0.175	55	TO-220SIS	DTMOSIV(HSD)
TK20J60U	600	20	0.19	27	TO-3P(N)	DTMOSII
TK20J60W	600	20	0.155	48	TO-3P(N)	DTMOSIV
TK20J60W5	600	20	0.175	55	TO-3P(N)	DTMOSIV(HSD)
TK20N60W	600	20	0.155	48	TO-247	DTMOSIV
TK20N60W5	600	20	0.175	55	TO-247	DTMOSIV(HSD)
TK25V60X	600	25	0.135	40	DFN 8x8	DTMOSIV-H
TK25V60X5	600	25	0.15	60	DFN 8x8	DTMOSIV-H(HSD)
TK25E60X	600	25	0.125	40	TO-220	DTMOSIV-H
TK25E60X5	600	25	0.14	60	TO-220	DTMOSIV-H(HSD)
TK25A60X	600	25	0.125	40	TO-220SIS	DTMOSIV-H
TK25A60X5	600	25	0.14	60	TO-220SIS	DTMOSIV-H(HSD)
TK25N60X	600	25	0.125	40	TO-247	DTMOSIV-H
TK25N60X5	600	25	0.14	60	TO-247	DTMOSIV-H(HSD)
TK25Z60X **	600	25	0.125	40	TO-247 4L	DTMOSIV-H
TK31V60W	600	30.8	0.098	86	DFN 8x8	DTMOSIV
TK31V60W5	600	30.8	0.109	105	DFN 8x8	DTMOSIV(HSD)
TK31V60X	600	30.8	0.098	65	DFN 8x8	DTMOSIV-H
TK31E60W	600	30.8	0.088	86	TO-220	DTMOSIV
TK31E60X	600	30.8	0.088	65	TO-220	DTMOSIV-H
TK31A60W	600	30.8	0.088	86	TO-220SIS	DTMOSIV
TK31J60W	600	30.8	0.088	86	TO-3P(N)	DTMOSIV
TK31J60W5	600	30.8	0.099	105	TO-3P(N)	DTMOSIV(HSD)

Part Number	Absolute Maximum Ratings V_{DSS} (V)	Absolute Maximum Ratings I_D (A)	$R_{DS(ON)}$ Max(Ω) $\|V_{GS}\|$=10V	Qg Typ. (nC)	Package	Series
TK31N60W	600	30.8	0.088	86	TO-247	DTMOSIV
TK31N60W5	600	30.8	0.099	105	TO-247	DTMOSIV(HSD)
TK31N60X	600	30.8	0.088	65	TO-247	DTMOSIV-H
TK31Z60X **	600	30.8	0.088	65	TO-247 4L	DTMOSIV-H
TK39A60W	600	38.8	0.065	110	TO-220SIS	DTMOSIV
TK39J60W	600	38.8	0.065	110	TO-3P(N)	DTMOSIV
TK39J60W5	600	38.8	0.074	135	TO-3P(N)	DTMOSIV(HSD)
TK39N60W	600	38.8	0.065	110	TO-247	DTMOSIV
TK39N60W5	600	38.8	0.074	135	TO-247	DTMOSIV(HSD)
TK39N60X	600	38.8	0.065	85	TO-247	DTMOSIV-H
TK39Z60X **	600	38.8	0.065	85	TO-247 4L	DTMOSIV-H
TK40J60U	600	40	0.08	55	TO-3P(N)	DTMOSII
TK40M60U	600	40	0.08	55	TO-3P(N)IS	DTMOSII
TK50J60U	600	50	0.065	67	TO-3P(N)	DTMOSII
TK62J60W	600	61.8	0.04	180	TO-3P(N)	DTMOSIV
TK62J60W5	600	61.8	0.045	205	TO-3P(N)	DTMOSIV(HSD)
TK62N60W	600	61.8	0.04	180	TO-247	DTMOSIV
TK62N60W5	600	61.8	0.045	205	TO-3P(N)	DTMOSIV(HSD)
TK62N60X	600	61.8	0.04	135	TO-247	DTMOSIV-H
TK62Z60X **	600	61.8	0.04	135	TO-247 4L	DTMOSIV-H
TK100L60W	600	100	0.018	360	TO-3P(L)	DTMOSIV
TK5P65W	650	5.2	1.22	10.5	DPAK	DTMOSIV
TK5Q65W	650	5.2	1.22	10.5	IPAK	DTMOSIV
TK5A65W	650	5.2	1.2	10.5	TO-220SIS	DTMOSIV
TK6P65W	650	5.8	1.05	11	DPAK	DTMOSIV
TK6Q65W	650	5.8	1.05	11	IPAK	DTMOSIV
TK6A65W	650	5.8	1	11	TO-220SIS	DTMOSIV
TK7P65W	650	6.8	0.8	15	DPAK	DTMOSIV
TK7Q65W	650	6.8	0.8	15	IPAK	DTMOSIV
TK7A65W	650	6.8	0.78	15	TO-220SIS	DTMOSIV
TK8P65W	650	7.8	0.67	16	DPAK	DTMOSIV
TK8Q65W	650	7.8	0.67	16	IPAK	DTMOSIV
TK8A65W	650	7.8	0.65	16	TO-220SIS	DTMOSIV
TK9P65W	650	9.3	0.56	20	DPAK	DTMOSIV
TK9Q65W	650	9.3	0.56	20	IPAK	DTMOSIV
TK9A65W	650	9.3	0.5	20	TO-220SIS	DTMOSIV
TK11P65W	650	11.1	0.44	25	DPAK	DTMOSIV
TK11Q65W	650	11.1	0.44	25	IPAK	DTMOSIV
TK11A65W	650	11.1	0.39	25	TO-220SIS	DTMOSIV
TK13A65U	650	13	0.38	17	TO-220SIS	DTMOSII
TK13J65U	650	13	0.38	17	TO-3P(N)	DTMOSII
TK14C65W	650	13.7	0.25	35	I2PAK	DTMOSIV
TK14C65W5	650	13.7	0.3	40	I2PAK	DTMOSIV(HSD)
TK14G65W	650	13.7	0.25	35	D2PAK	DTMOSIV
TK14G65W5	650	13.7	0.3	40	D2PAK	DTMOSIV(HSD)
TK14V65W **	650	13.7	0.26	35	DFN 8x8	DTMOSIV
TK14E65W	650	13.7	0.25	35	TO-220	DTMOSIV
TK14E65W5	650	13.7	0.3	40	TO-220	DTMOSIV(HSD)
TK14A65W	650	13.7	0.25	35	TO-220SIS	DTMOSIV
TK14A65W5	650	13.7	0.3	40	TO-220SIS	DTMOSIV(HSD)
TK14N65W	650	13.7	0.25	35	TO-247	DTMOSIV
TK14N65W5	650	13.7	0.3	40	TO-247	DTMOSIV(HSD)
TK17A65U	650	17	0.26	27	TO-220SIS	DTMOSII
TK17J65U	650	17	0.26	27	TO-3P(N)	DTMOSII
TK17C65W	650	17.3	0.2	45	I2PAK	DTMOSIV
TK17V65W **	650	17.3	0.21	45	DFN 8x8	DTMOSIV
TK17E65W	650	17.3	0.2	45	TO-220	DTMOSIV
TK17A65W	650	17.3	0.2	45	TO-220SIS	DTMOSIV
TK17A65W5	650	17.3	0.23	50	TO-220SIS	DTMOSIV(HSD)
TK17N65W	650	17.3	0.2	45	TO-247	DTMOSIV
TK28V65W **	650	27.6	0.12	75	DFN 8x8	DTMOSIV
TK28E65W **	650	27.6	0.11	75	TO-220	DTMOSIV
TK28A65W	650	27.6	0.11	75	TO-220SIS	DTMOSIV
TK28N65W	650	27.6	0.11	75	TO-247	DTMOSIV
TK28N65W5	650	27.6	0.13	90	TO-247	DTMOSIV(HSD)
TK35A65W	650	35	0.08	100	TO-220SIS	DTMOSIV
TK35A65W5	650	35	0.095	115	TO-220SIS	DTMOSIV(HSD)
TK35N65W	650	35	0.08	100	TO-247	DTMOSIV
TK35N65W5	650	35	0.095	115	TO-247	DTMOSIV(HSD)
TK49N65W	650	49.2	0.055	160	TO-247	DTMOSIV
TK49N65W5	650	49.2	0.057	185	TO-247	DTMOSIV(HSD)
TK6P80W **	800	5.5	1.05	TBD	DPAK	HV-DTMOSIV
TK6Q80W **	800	5.5	1.05	TBD	IPAK	HV-DTMOSIV
TK12E80W **	800	12.1	0.45	TBD	TO-220	HV-DTMOSIV
TK12A80W **	800	12.1	0.45	TBD	TO-220SIS	HV-DTMOSIV
TK17E80W **	800	17	0.29	32	TO-220	HV-DTMOSIV
TK17A80W	800	17	0.29	32	TO-220SIS	HV-DTMOSIV

**: Under development

DTMOSIV: Standard series
DTMOSIV-H: High-speed-switching series
DTMOSIV(HSD): High-speed diode series

New-Generation π-MOS Series

The π-MOSVII Series, the latest addition to our π-MOS portfolio, features reduced capacitance by virtue of the optimized chip design. The π-MOSVII Series has significantly expanded our MOS product lineup.

π-MOSVII Series (V_{DSS} = 400 V to 650 V)

Features

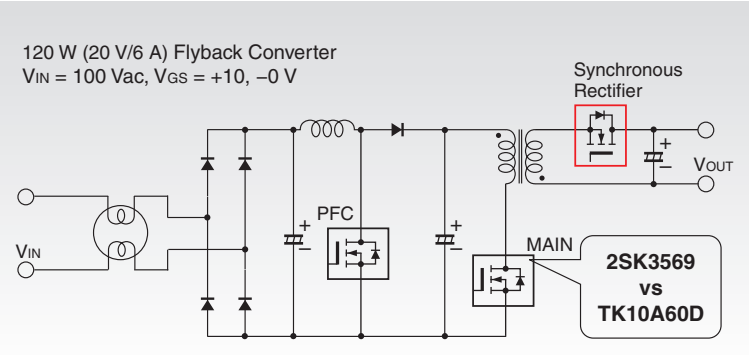
- Delivers approximately 40% lower total gate charge, Qg, than π-MOSVI
- Available in 50-V steps of V_{DSS} and in finer steps of $R_{DS(ON)}$.
- Rated avalanche and reverse recovery current capabilities

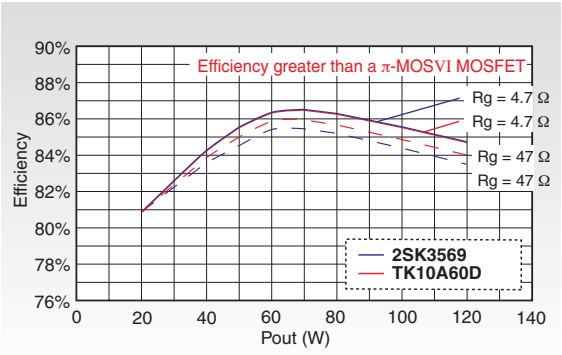
Performance Comparisons Between π-MOSVII and π-MOSVI Devices (600 V/10 A)

Series			π-MOSVII			π-MOSVI			
Part Number			TK10A60D			2SK3569			
Ratings			600 V/10 A			600 V/10 A			
Package			TO-220SIS			TO-220SIS			
Characteristic	Symbol	Test Conditions	Min	Typ.	Max	Min	Typ.	Max	Unit
Gate leakage current	± I_{GSS}	V_{GS} condition*, V_{DS} = 0 V	—	—	± 1	—	—	± 10	μA
Drain cut-off current	I_{DSS}	V_{DS} = 600 V, V_{GS} = 0 V	—	—	10	—	—	100	μA
Drain-source breakdown voltage	$V_{(BR)DSS}$	I_D = +10 mA, V_{GS} = 0 V	600	—	—	600	—	—	V
Gate threshold voltage	V_{th}	V_{DS} = 10 V, I_D = 1 mA	2.0	—	4.0	2.0		4.0	V
Drain-source on-resistance	$R_{DS(ON)}$	V_{GS} = 10 V, I_D = 5 A	—	—	0.75	—	—	0.75	Ω
Total gate charge	Qg	V_{DD} = 400 V, V_{GS} = 10 V, I_D = 10 A	—	25	—	—	42	—	nC
Diode forward voltage	V_{DSF}	I_{DR} =10 A, V_{GS} = 0 V	—	—	–1.7	—	—	–1.7	V

*: Test conditions: TK10A60D: V_{GS} = ± 30 V, 2SK3569: V_{GS} = ± 25 V

Efficiency Test Circuit





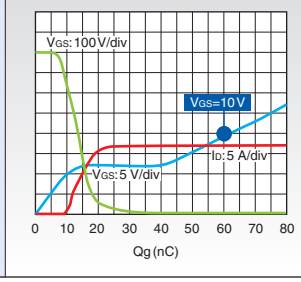
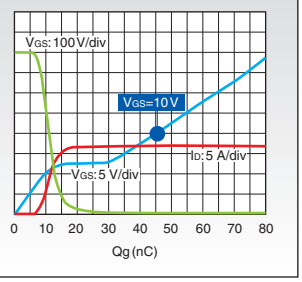
π-MOSVIII Series (V_{DSS} = 800 V to 900 V)

Features

- Exhibits approximately 25% lower total gate charge, Qg, than π-MOSVII (rated at 800 V to 900 V)
- Guarantees avalanche and reverse recovery ruggedness as current ratings.

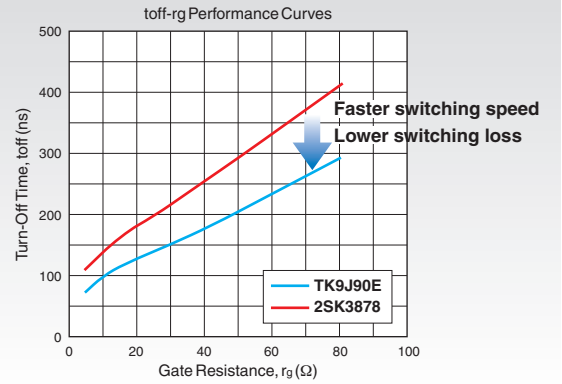
Comparisons of Total Gate Charge (Qg)

Provides approx. 25% lower Qg than the previous generation and thus reduces switching loss

Gen.	π-MOSIV	π-MOSVIII
Part Number	**2SK3878**	**TK9J90E**
Qg	60nC @V_{GS} = 10 V	46nC @V_{GS} = 10 V
V_{GS} and V_{DS}-Qg Waveforms		

Switching Waveforms

Test conditions: V_{DS} = 400 V, V_{GS} = 10 V, I_D = 4.5 A, T_C = 25°C



Product Selection Guide

I_D(A)	V_{DSS} (V)					
	200	250	300	450	500	525
3					▽ TK3P50D(3)	
4					▽ TK4P50D(2)	○ TK4A53D(1.7)
					○ TK4A50D(2)	
4.5				○ TK5A45DA(1.75)		
5					▽ TK5P50D(1.5)	▽ TK5P53D(1.5)
					○ TK5A50D(1.5)	○ TK5A53D(1.5)
5.5				○ TK6A45DA(1.35)		
6					○ TK6A50D(1.4)	▽ TK6P53D(1.3)
						○ TK6A53D(1.3)
6.5				○ TK7A45DA(1.2)		
7					▽ TK7P50D(1.22)	
					○ TK7A50D(1.22)	
7.5		▽ TK8P25DA(0.5)		○ TK8A45DA(1.1)	○ TK8A50DA(1.04)	
		○ TK8A25DA(0.5)				
8				○ TK8A45D(0.9)	○ TK8A50D(0.85)	
8.5	○ TK9A20DA(0.4)					
9				○ TK9A45D(0.77)		
10					○ TK10A50D(0.72)	
11				○ TK11A45D(0.62)	○ TK11A50D(0.6)	
12				○ TK12A45D(0.52)	○ TK12A50D(0.52)	○ TK12A53D(0.58)
12.5					○ TK13A50DA(0.47)	
13		▽ TK13P25D(0.25)		○ TK13A45D(0.46)	○ TK13A50D(0.4)	
		○ TK13A25D(0.25)				
		★ TK13E25D(0.25)				
13.5				○ TK14A45DA(0.41)		
14				○ TK14A45D(0.34)		
15	○ TK15A20D(0.18)				✱ TK15J50D(0.4)	
					○ TK15A50D(0.3)	
16				○ TK16A45D(0.27)		
17		○ TK17A25D(0.15)				
18			○ TK18A30D(0.139)		○ TK18A50D(0.27)	
19				○ TK19A45D(0.25)		
20	○ TK20A20D(0.109)	○ TK20A25D(0.1)			✱ TK20J50D(0.27)	
25	○ TK25A20D(0.07)					
30		✱ TK30J25D(0.06)				
40	✱ TK40J20D(0.044)					
50			✱ TK50J30D(0.052)			
60		✱ TK60J25D(0.038)				
70	✱ TK70J20D(0.027)					

I_D(A)	V_{DSS} (V)				
	550	600	650	800	900
1					□ TK1Q90A(9)
					■ TK1P90A(9)
2		□ TK2Q60D(4.3)	○ TK2A65D(3.26)		▽ TK2P90E(5.9)
		■ TK2P60D(4.3)			
2.5		○ TK3A60DA(2.8)	○ TK3A65DA(2.51)		○ 2SK3566(6.4)
3			○ TK3A65D(2.25)	▽ TK3P80E(4.9)	○ 2SK3564(4.3)
3.5	▽ TK4P55DA(2.45)	□ TK4Q60DA(2.2)	○ TK4A65DA(1.9)		
	○ TK4A55DA(2.45)	▽ TK4P60DA(2.2)			
		○ TK4A60DA(2.2)			
3.7		▽ TK4P60DB(2)			
		○ TK4A60DB(2)			
4	▽ TK4P55D(1.88)	▽ TK4P60D(1.7)			○ 2SK3798(3.5)
	○ TK4A55D(1.88)	○ TK4A60D(1.7)			
4.5			○ TK5A65DA(1.67)		
5	○ TK5A55D(1.7)	○ TK5A60D(1.43)	○ TK5A65D(1.43)		✱ 2SK3700(2.5)
					○ 2SK3565(2.5)
					○ 2SK3742(2.5)
5.5	○ TK6A55DA(1.48)				
6		○ TK6A60D(1.25)	○ TK6A65D(1.11)	○ 2SK4013(1.7)	○ 2SK4014(2)
				○ TK6A80E(1.7)	
6.5				✖ 2SK3880(1.7)	
7	○ TK7A55D(1.25)		○ TK7A65D(0.98)	✱ 2SK3633(1.7)	✱ 2SK4115(2)
					✱ TK7J90E(2)
					○ TK7A90E(2)
7.5	○ TK8A55DA(1.07)	○ TK8A60DA(1)			
8			○ TK8A65D(0.84)		○ 2SK3799(1.3)
8.5	○ TK9A55DA(0.86)				
9		○ TK9A60D(0.83)			✱ TK9J90E(1.3)
					○ TK9A90E(1.3)
10	○ TK10A55D(0.72)	○ TK10A60D(0.75)		○ TK10A80E(1.0)	
				✱ TK10J80E(1.0)	
11	○ TK11A55D(0.63)	○ TK11A60D(0.65)	○ TK11A65D(0.7)		
12	✱ TK12J55D(0.57)	○ TK12A60D(0.55)	○ TK12A65D(0.54)		
	○ TK12A55D(0.57)				
12.5	○ TK13A55DA(0.48)				
13		○ TK13A60D(0.43)	○ TK13A65D(0.47)		✱ 2SK4207(0.95)
14	○ TK14A55D(0.37)				
15		○ TK15A60D(0.37)			
16	✱ TK16J55D(0.37)				
	○ TK16A55D(0.33)				
19	✱ TK19J55D(0.33)				

▽ DPAK
■ New PW-Mold
□ New PW-Mold2
★ TO-220
○ TO-220SIS
✱ TO-3P(N)
✖ TO-3P(N)IS

Values enclosed in parentheses are maximum on-resistance, $R_{DS(ON)}$.

Product Lineup New-Generation π-MOS Series

Part Number	Absolute Maximum Ratings		$R_{DS(ON)}$ Max(Ω) $\|V_{GS}\|$=10V	Qg Typ. (nC)	Package	Series
	V_{DSS} (V)	I_D (A)				
TK9A20DA	200	8.5	0.4	14	TO-220SIS	π-MOSVII
TK15A20D	200	15	0.18	26	TO-220SIS	π-MOSVII
TK20A20D	200	20	0.109	43	TO-220SIS	π-MOSVII
TK25A20D	200	25	0.07	60	TO-220SIS	π-MOSVII
TK40J20D	200	40	0.044	100	TO-3P(N)	π-MOSVII
TK70J20D	200	70	0.027	160	TO-3P(N)	π-MOSVII
TK8P25DA	250	7.5	0.5	16	DPAK	π-MOSVII
TK8A25DA	250	7.5	0.5	16	TO-220SIS	π-MOSVII
TK13P25D	250	13	0.25	25	DPAK	π-MOSVII
TK13E25D	250	13	0.25	25	TO-220	π-MOSVII
TK13A25D	250	13	0.25	25	TO-220SIS	π-MOSVII
TK17A25D	250	17	0.15	43	TO-220SIS	π-MOSVII
TK20A25D	250	20	0.1	55	TO-220SIS	π-MOSVII
TK30J25D	250	30	0.06	100	TO-3P(N)	π-MOSVII
TK60J25D	250	60	0.038	160	TO-3P(N)	π-MOSVII
TK18A30D	300	18	0.139	60	TO-220SIS	π-MOSVII
TK50J30D	300	50	0.052	160	TO-3P(N)	π-MOSVII
TK5A45DA	450	4.5	1.75	9	TO-220SIS	π-MOSVII
TK6A45DA	450	5.5	1.35	11	TO-220SIS	π-MOSVII
TK7A45DA	450	6.5	1.2	11	TO-220SIS	π-MOSVII
TK8A45DA	450	7.5	1.1	12	TO-220SIS	π-MOSVII
TK8A45D	450	8	0.9	16	TO-220SIS	π-MOSVII
TK9A45D	450	9	0.77	16	TO-220SIS	π-MOSVII
TK11A45D	450	11	0.62	20	TO-220SIS	π-MOSVII
TK12A45D	450	12	0.52	24	TO-220SIS	π-MOSVII
TK13A45D	450	13	0.46	25	TO-220SIS	π-MOSVII
TK14A45DA	450	13.5	0.41	28	TO-220SIS	π-MOSVII
TK14A45D	450	14	0.34	38	TO-220SIS	π-MOSVII
TK16A45D	450	16	0.27	40	TO-220SIS	π-MOSVII
TK19A45D	450	19	0.25	45	TO-220SIS	π-MOSVII
TK3P50D	500	3	3	7	DPAK	π-MOSVII
TK4P50D	500	4	2	9	DPAK	π-MOSVII
TK4A50D	500	4	2	9	TO-220SIS	π-MOSVII
TK5P50D	500	5	1.5	11	DPAK	π-MOSVII
TK5A50D	500	5	1.5	11	TO-220SIS	π-MOSVII
TK6A50D	500	6	1.4	11	TO-220SIS	π-MOSVII
TK7P50D	500	7	1.22	12	DPAK	π-MOSVII
TK7A50D	500	7	1.22	12	TO-220SIS	π-MOSVII
TK8A50DA	500	7.5	1.04	16	TO-220SIS	π-MOSVII
TK8A50D	500	8	0.85	16	TO-220SIS	π-MOSVII
TK10A50D	500	10	0.72	20	TO-220SIS	π-MOSVII
TK11A50D	500	11	0.6	24	TO-220SIS	π-MOSVII
TK12A50D	500	12	0.52	25	TO-220SIS	π-MOSVII
TK13A50DA	500	12.5	0.47	28	TO-220SIS	π-MOSVII
TK13A50D	500	13	0.4	38	TO-220SIS	π-MOSVII
TK15A50D	500	15	0.3	40	TO-220SIS	π-MOSVII
TK15J50D	500	15	0.4	38	TO-3P(N)	π-MOSVII
TK18A50D	500	18	0.27	45	TO-220SIS	π-MOSVII
TK20J50D	500	20	0.27	45	TO-3P(N)	π-MOSVII
TK4A53D	525	4	1.7	11	TO-220SIS	π-MOSVII
TK5P53D	525	5	1.5	11	DPAK	π-MOSVII
TK5A53D	525	5	1.5	11	TO-220SIS	π-MOSVII
TK6P53D	525	6	1.3	12	DPAK	π-MOSVII
TK6A53D	525	6	1.3	12	TO-220SIS	π-MOSVII
TK12A53D	525	12	0.58	25	TO-220SIS	π-MOSVII
TK4P55DA	550	3.5	2.45	9	DPAK	π-MOSVII
TK4A55DA	550	3.5	2.45	9	TO-220SIS	π-MOSVII
TK4P55D	550	4	1.88	11	DPAK	π-MOSVII
TK4A55D	550	4	1.88	11	TO-220SIS	π-MOSVII
TK5A55D	550	5	1.7	11	TO-220SIS	π-MOSVII
TK6A55DA	550	5.5	1.48	12	TO-220SIS	π-MOSVII
TK7A55D	550	7	1.25	16	TO-220SIS	π-MOSVII
TK8A55DA	550	7.5	1.07	16	TO-220SIS	π-MOSVII
TK9A55DA	550	8.5	0.86	20	TO-220SIS	π-MOSVII

Part Number	Absolute Maximum Ratings		$R_{DS(ON)}$ Max(Ω) $\|V_{GS}\|$=10V	Qg Typ. (nC)	Package	Series
	V_{DSS} (V)	I_D (A)				
TK10A55D	550	10	0.72	24	TO-220SIS	π-MOSVII
TK11A55D	550	11	0.63	25	TO-220SIS	π-MOSVII
TK12A55D	550	12	0.57	28	TO-220SIS	π-MOSVII
TK12J55D	550	12	0.57	28	TO-3P(N)	π-MOSVII
TK13A55DA	550	12.5	0.48	38	TO-220SIS	π-MOSVII
TK14A55D	550	14	0.37	40	TO-220SIS	π-MOSVII
TK16A55D	550	16	0.33	45	TO-220SIS	π-MOSVII
TK16J55D	550	16	0.37	40	TO-3P(N)	π-MOSVII
TK19J55D	550	19	0.33	45	TO-3P(N)	π-MOSVII
TK2P60D	600	2	4.3	7	New PW-Mold	π-MOSVII
TK2Q60D	600	2	4.3	7	New PW-Mold2	π-MOSVII
TK3A60DA	600	2.5	2.8	9	TO-220SIS	π-MOSVII
TK4P60DA	600	3.5	2.2	11	DPAK	π-MOSVII
TK4Q60DA	600	3.5	2.2	11	New PW-Mold2	π-MOSVII
TK4A60DA	600	3.5	2.2	11	TO-220SIS	π-MOSVII
TK4P60DB	600	3.7	2	11	DPAK	π-MOSVII
TK4A60DB	600	3.7	2.0	11	TO-220SIS	π-MOSVII
TK4P60D	600	4	1.7	12	DPAK	π-MOSVII
TK4A60D	600	4	1.7	12	TO-220SIS	π-MOSVII
TK5A60D	600	5	1.43	16	TO-220SIS	π-MOSVII
TK6A60D	600	6	1.25	16	TO-220SIS	π-MOSVII
TK8A60DA	600	7.5	1.0	20	TO-220SIS	π-MOSVII
TK9A60D	600	9	0.83	24	TO-220SIS	π-MOSVII
TK10A60D	600	10	0.75	25	TO-220SIS	π-MOSVII
TK11A60D	600	11	0.65	28	TO-220SIS	π-MOSVII
TK12A60D	600	12	0.55	38	TO-220SIS	π-MOSVII
TK13A60D	600	13	0.43	40	TO-220SIS	π-MOSVII
TK15A60D	600	15	0.37	45	TO-220SIS	π-MOSVII
TK2A65D	650	2	3.26	9	TO-220SIS	π-MOSVII
TK3A65DA	650	2.5	2.51	11	TO-220SIS	π-MOSVII
TK3A65D	650	3	2.25	11	TO-220SIS	π-MOSVII
TK4A65DA	650	3.5	1.9	12	TO-220SIS	π-MOSVII
TK5A65DA	650	4.5	1.67	16	TO-220SIS	π-MOSVII
TK5A65D	650	5	1.43	16	TO-220SIS	π-MOSVII
TK6A65D	650	6	1.11	20	TO-220SIS	π-MOSVII
TK7A65D	650	7	0.98	24	TO-220SIS	π-MOSVII
TK8A65D	650	8	0.84	25	TO-220SIS	π-MOSVII
TK11A65D	650	11	0.7	30	TO-220SIS	π-MOSVII
TK12A65D	650	12	0.54	40	TO-220SIS	π-MOSVII
TK13A65D	650	13	0.47	45	TO-220SIS	π-MOSVII
TK3P80E	800	3	4.9	12	DPAK	π-MOSVIII
2SK4013	800	6	1.7	45	TO-220SIS	π-MOSIV
TK6A80E	800	6	1.7	32	TO-220SIS	π-MOSVIII
2SK3880	800	6.5	1.7	35	TO-3P(N)IS	π-MOSIV
2SK3633	800	7	1.7	35	TO-3P(N)	π-MOSIV
TK10J80E	800	10	1.0	46	TO-3P(N)	π-MOSVIII
TK10A80E	800	10	1.0	46	TO-220SIS	π-MOSVIII
TK1P90A	900	1	9	13	New PW-Mold	π-MOSIV
TK1Q90A	900	1	9	13	New PW-Mold2	π-MOSIV
TK2P90E	900	2	5.9	12	DPAK	π-MOSVIII
2SK3566	900	2.5	6.4	12	TO-220SIS	π-MOSIV
2SK3564	900	3	4.3	17	TO-220SIS	π-MOSIV
2SK3798	900	4	3.5	26	TO-220SIS	π-MOSIV
2SK3565	900	5	2.5	28	TO-220SIS	π-MOSIV
2SK3742	900	5	2.5	25	TO-220SIS	π-MOSIV
2SK3700	900	5	2.5	28	TO-3P(N)	π-MOSIV
2SK4014	900	6	2	45	TO-220SIS	π-MOSIV
TK7A90E	900	7	2	32	TO-220SIS	π-MOSVIII
2SK4115	900	7	2	45	TO-3P(N)	π-MOSIV
TK7J90E	900	7	2	32	TO-3P(N)	π-MOSVIII
2SK3799	900	8	1.3	60	TO-220SIS	π-MOSIV
TK9A90E	900	9	1.3	46	TO-220SIS	π-MOSVIII
TK9J90E	900	9	1.3	46	TO-3P(N)	π-MOSVIII
2SK4207	900	13	0.95	45	TO-3P(N)	π-MOSIV

Toshiba's Ongoing Efforts for Automotive MOSFETs

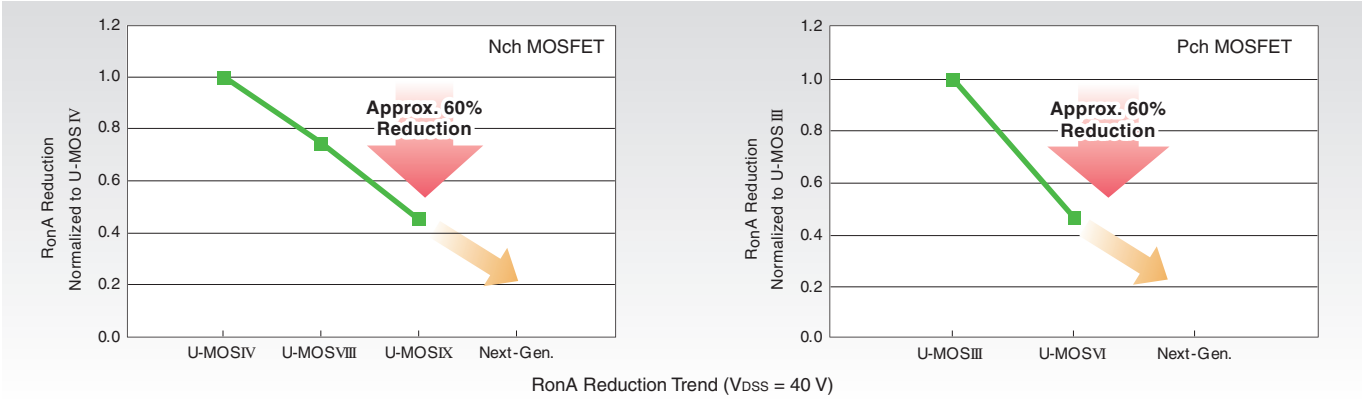
Toshiba offers an extensive line of power devices such as power MOSFETs for various automotive applications, including 12-V battery and motor control systems.
The combination of low-ON-resistance and fast switching speed makes Toshiba's power MOSFETs an ideal solution for reducing system losses, thereby contributing to the energy-saving of automotive applications.

Features

- Reduced RonA due to the small-geometry trench process
- The DPAK+ and TO-220SM(W) Series provide a current drive capability approx. twice that of their predecessors due to the use of a Cu connector structure.
- Expanding portfolio of MOSFETs qualified up to 175°C according to AEC-Q101
- For applications rated at 60 A or less, expanding portfolio of power MOSFETs in SOP packages (SOP Advance, TSON Advance, PS-8), which have been well proven for consumer applications
- All devices are tested and guaranteed for avalanche breakdown protection.
- Zener diode between gate and source for ESD protection (except some devices)

Low ON-Resistance

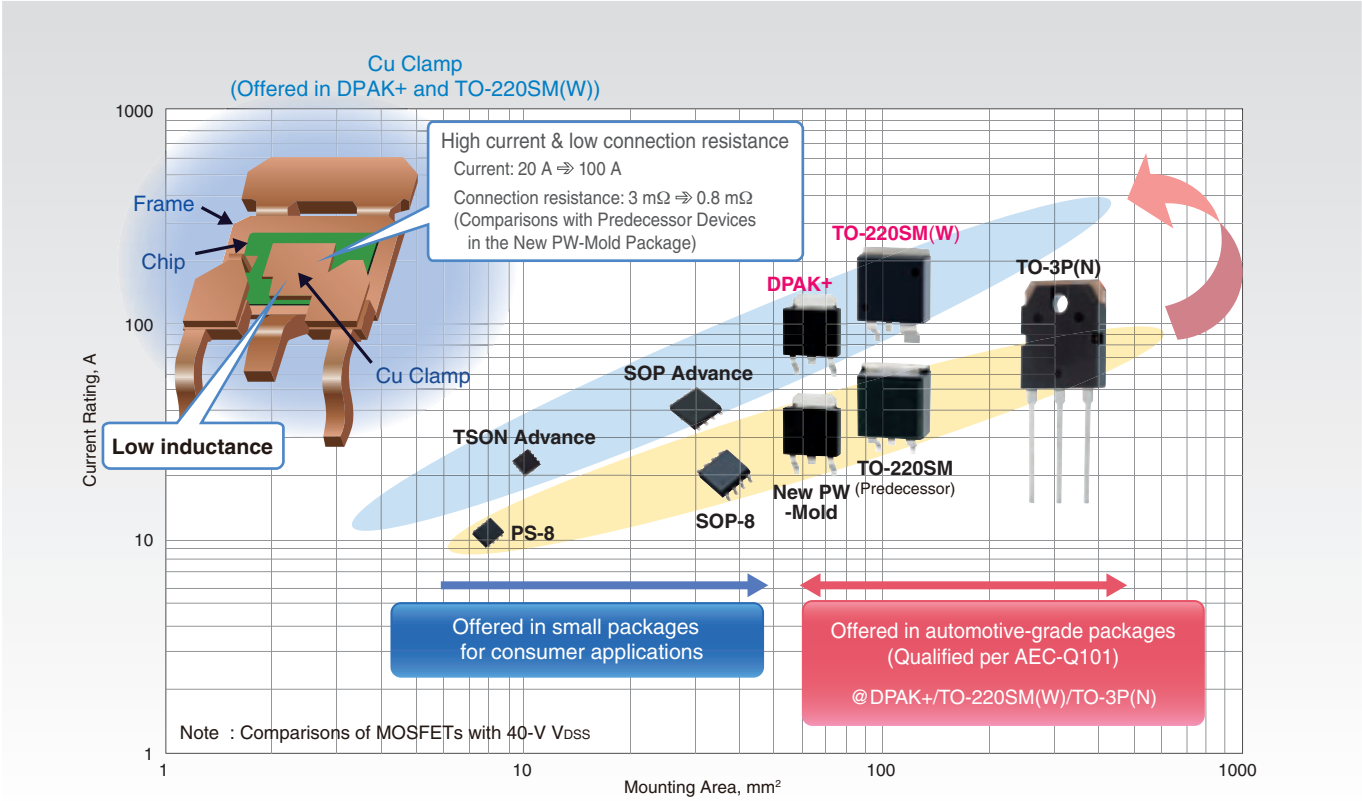
Industry's lowest ON-resistance due to the combined use a small-geometry trench structure and a Cu connector



RonA Reduction Trend (V_{DSS} = 40 V)

Packaging Trend

Increased current density due Cu clamp structure



Product Lineup

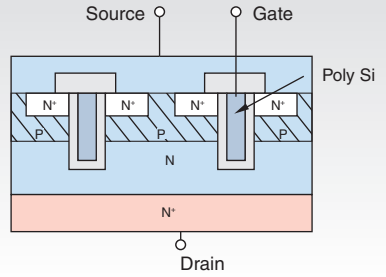
U-MOS (Trench Type) Series for Automotive Applications

Fabricated using a trench structure, the U-MOS Series realizes ultra-high integration density and thus ultra-low on-resistance.

Features

- High density through the use of submicron technology
- Guaranteed avalanche capability and improved di/dt rate
- AEC-Q101-qualified at a channel temperature (Tch) of 175˚C, except some devices (See the Tch column below.)

Trench (U-MOS) Structure



Product Lineup

Applications	Part Number	Absolute Maximum Ratings				Package	$R_{DS(ON)}$ Max (mΩ)				Q_g Typ. (nC)	Tch (˚C)	Series
		V_{DSS} (V)	V_{GSS} (V)	I_D (A)	P_D (W)		$\|V_{GS}\|$ = 10 V	$\|V_{GS}\|$ = 6 V	$\|V_{GS}\|$ = 4.5 V	$\|V_{GS}\|$ = 4 V			
Motor drive Solenoids Lamp drivers DC-DC converters	**TJ10S04M3L #**	–40	–20/+10	–10	27	DPAK+	44	62	—	—	19	175	U-MOSⅥ
	TJ20S04M3L #	–40	–20/+10	–20	41	DPAK+	22.2	32	—	—	37	175	
	TJ40S04M3L #	–40	–20/+10	–40	68	DPAK+	9.1	13	—	—	83	175	
	TJ60S04M3L #	–40	–20/+10	–60	90	DPAK+	6.3	9.4	—	—	125	175	
	TJ80S04M3L #	–40	–20/+10	–80	100	DPAK+	5.2	7.9	—	—	158	175	
	TJ100F04M3L #	–40	–20/+10	–100	250	TO-220SM(W)	3.6	5.4	—	—	250	175	
	TJ200F04M3L **	–40	–20/+10	–200	375	TO-220SM(W)	1.8	2.6	—	—	460	175	
	TJ8S06M3L #	–60	–20/+10	–8	27	DPAK+	104	130	—	—	19	175	
	TJ15S06M3L #	–60	–20/+10	–15	41	DPAK+	50	63	—	—	36	175	
	TJ30S06M3L #	–60	–20/+10	–30	68	DPAK+	21.8	28	—	—	80	175	
	TJ50S06M3L #	–60	–20/+10	–50	90	DPAK+	13.8	17.4	—	—	124	175	
	TJ60S06M3L #	–60	–20/+10	–60	100	DPAK+	11.2	14.5	—	—	156	175	
	TJ100F06M3L #	–60	–20/+10	–100	250	TO-220SM(W)	7.1	10.7	—	—	250	175	
	TJ150F06M3L #	–60	–20/+10	–150	300	TO-220SM(W)	5.6	6.1	—	—	420	175	
	TJ15S10M3	–100	–20/+10	–15	75	DPAK+	130	—	—	—	69	175	
	TK20S04K3L #	40	±20	20	38	DPAK+	14	26	—	—	18	175	U-MOSⅣ
	TK35S04K3L #	40	±20	35	58	DPAK+	10.3	15	—	—	28	175	
	TK50A04K3 #	40	±20	50	42	TO-220SIS	3.5	—	—	—	102	175	
	TK50S04K3L #	40	±20	50	68	DPAK+	5.4	10	—	—	42	175	
	TK80A04K3L	40	±20	80	48	TO-220SIS	2.4	3.5	—	—	190	175	
	TK100F04K3	40	±20	100	200	TO-220SM(W)	3.0	—	—	—	102	175	
	TK100F04K3L #	40	±20	100	200	TO-220SM(W)	3.0	4.5	—	—	105	175	
	TK8S06K3L #	60	±20	8	25	DPAK+	54	80	—		10	175	
	TK20S06K3L #	60	±20	20	38	DPAK+	29	40	—	—	18	175	
	TK30S06K3L #	60	±20	30	58	DPAK+	18	30	—	—	28	175	
	TK45S06K3L #	60	±20	45	68	DPAK+	10.5	16.4	—	—	41	175	
	TK80S06K3L #	60	±20	80	100	DPAK+	5.5	7.8	—	—	85	175	
	TK100F06K3	60	±20	100	180	TO-220SM(W)	5.0	—	—	—	98	175	
	TK130F06K3	60	±20	130	300	TO-220SM(W)	3.4	—	—	—	170	175	
	TK80F08K3	75	±20	80	300	TO-220SM(W)	4.3	—	—	—	175	175	
	TK15S04N1L#	40	±20	15	40	DPAK+	17.8	—	37	—	10	175	U-MOSⅧ
	TK65S04N1L #	40	±20	65	68	DPAK+	4.3	—	7.8	—	39	175	
	TK100S04N1L	40	±20	100	100	DPAK+	2.3	—	4.5	—	78	175	
	TK200F04N1L	40	±20	200	375	TO-220SM(W)	0.9	1.37	—	—	214	175	
	TK25S06N1L **#	60	±20	25	53	DPAK+	(18.5)	—	(368)	—	15	175	
	TK90S06N1L	60	±20	90	157	DPAK+	3.3	—	5.2	—	81	175	
	TK7S10N1Z #	100	±20	7	45.4	DPAK+	48	—	—	—	7.1	175	
	TK33S10N1Z #	100	±20	33	78.9	DPAK+	9.7	—	—	—	28	175	
	TK55S10N1	100	±20	55	100	DPAK+	6.5	—	—	—	49	175	
	TK160F10N1	100	±20	160	375	TO-220SM(W)	2.4	—	—	—	121	175	

#: With protection Zener diode between gate and source

******: Under Development

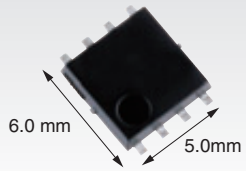
Note: If you want to use any devices listed above for "Unintended Use" including automotive applications, contact your local Toshiba sales representative.

Product Lineup

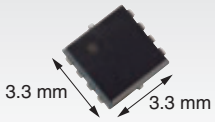
MOSFETs Qualified for Automotive Grade (Except Some Devices) in Small Packages with a Tch Range of up to 175°C

The MOSFETs listed below are housed in small packages for commercial applications and support channel temperatures (Tch) up to 175°C.

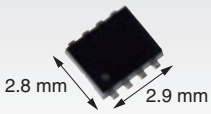
SOP Advance t = 0.95 mm
Outline Dimensions



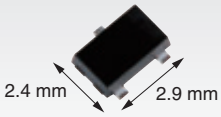
TSON Advance t = 0.85 mm
Outline Dimensions



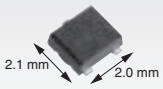
PS-8 t = 0.8 mm
Outline Dimensions



SOT-23F t = 0.8 mm
Outline Dimensions



UFM t = 0.7 mm
Outline Dimensions



Features

- Guaranteed up to 175°C

SOP Advance

Thin, thermally enhanced package with the same size as SOP-8 suitable for medium-power applications

Product Lineup

Polarity	Part Number	Absolute Maximum Ratings			$R_{DS(ON)}$ Max (mΩ)		Ciss Typ. (pF)	Crss Typ. (pF)	Qg Typ. (nC)	Tch (°C)	Series
		V_{DSS} (V)	V_{GSS} (V)	I_D (A)	$\|V_{GS}\|$ = 10 V	$\|V_{GS}\|$ = 6 V					
N-ch	**TPCA8083**	40	±20	60	3.3	5.6	4540	530	83	175	U-MOSIV
	TPCA8085		±20	40	5.7	10.4	2050	250	41	175	U-MOSIV
	TPCA8084	60	±20	60	5.3	8.0	4480	400	83	175	U-MOSIV
	TPCA8086		±20	35	11.2	16.6	1990	170	41	175	U-MOSIV
P-ch	**TPCA8122**	–40	–20/+10	–60	5.0	7.2	7340	770	152	175	U-MOSVI
	TPCA8124		–20/+10	–35	10.5	14.6	3750	370	77	175	U-MOSVI
	TPCA8123	–60	–20/+10	–50	11.1	14.9	7000	540	163	175	U-MOSVI
	TPCA8125		–20/+10	–25	25.5	34.4	3650	260	78	175	U-MOSVI

TSON Advance

Small, thermally enhanced package with about the same power dissipation as and 64% less footprint area than SOP-8

Product Lineup

Polarity	Part Number	Absolute Maximum Ratings			$R_{DS(ON)}$ Max (mΩ)		Ciss Typ. (pF)	Crss Typ. (pF)	Qg Typ. (nC)	Tch (°C)	Series
		V_{DSS} (V)	V_{GSS} (V)	I_D (A)	$\|V_{GS}\|$ = 10 V	$\|V_{GS}\|$ = 6 V					
N-ch	**TPCC8069**	40	±20	30	8.1	14.1	1640	200	34	175	U-MOSIV
	TPCC8070	60	±20	30	13.5	21.3	1600	150	34	175	U-MOSIV
P-ch	**TPCC8106**	–40	–20/+10	–30	12.3	18.9	3100	320	66	175	U-MOSVI
	TPCC8107	–60	–20/+10	–25	30.5	42.9	2930	230	63	175	U-MOSVI

PS-8

Small package suitable for small-power applications such as small motor and solenoid control

■ Product Lineup

Circuit Configuration	Part Number	Absolute Maximum Ratings			$R_{DS(ON)}$ Max (mΩ)		Ciss Typ. (pF)	Crss Typ. (pF)	Qg Typ. (nC)	Tch (°C)	Series
		V_{DSS} (V)	V_{GSS} (V)	I_D (A)	$\|V_{GS}\|$ = 10 V	$\|V_{GS}\|$ = 6 V					
N-ch Single	**TPCP8009**	40	±20	10	11.8	19.5	1250	165	25.1	175	U-MOSⅣ
	TPCP8010		±20	6	23.8	38.4	600	75	13.1	175	U-MOSⅣ
	TPCP8011		±20	5	31.8	51.2	505	66	11.8	175	U-MOSⅣ
	TPCP8012	60	±20	8	20.2	29.1	1160	120	26.6	175	U-MOSⅣ
	TPCP8013		±20	4	51.8	77.9	515	48	12	175	U-MOSⅣ
P-ch Single	**TPCP8107**	–40	–20/+10	–8	18	26.8	2160	238	44.6	175	U-MOSⅥ
	TPCP8109		–20/+10	–4.5	52.3	76.8	810	85	18	175	U-MOSⅥ
	TPCP8110	–60	–20/+10	–5	39.5	53.2	2075	150	45	175	U-MOSⅥ
	TPCP8111		–20/+10	–3	117	158.4	760	60	17	175	U-MOSⅥ
N-ch dual	**TPCP8207**	40	–20/+10	5	36.3	62.8	505	66	11.8	175	U-MOSⅥ
N-ch + P-ch	**TPCP8407**	40/ –40	±20/–20/+10	5/–4	36.3/56.8	62.8/82.2	505/810	66/85	11.8/18	175	U-MOSⅣ/ U-MOSⅥ
N-ch + ZNR	**TPCP8R01**	60	±20	2	330	440 (@V_{GS} = 4 V)	140	20	5.0	150	π-MOSⅤ

SOT-23F

The following MOSFETs are suitable for small-relay, solenoid and motor drive applications. The SOT-23F package provides approximately 1.6 times better thermal dissipation than the conventional package.

■ Product Lineup

Polarity	Part Number	Absolute Maximum Ratings			$R_{DS(ON)}$ Max (mΩ)		Ciss Typ. (pF)	Crss Typ. (pF)	Qg Typ. (nC)	Tch (°C)	Series
		V_{DSS} (V)	V_{GSS} (V)	I_D (A)	$\|V_{GS}\|$ = 10 V	$\|V_{GS}\|$ = 4.0 V					
N-ch	**SSM3K337R**	43 ± 5	±20	2	150	200	120	7.2	3.0	150	U-MOSⅣ
N-ch	**SSM3K2615R**	60	±20	2	330	440	150	25	70	150	π-MOSⅤ

UFM

The following MOSFET is suitable for small-relay, solenoid and motor drive applications. It is housed in a small package ideal for high-density board assembly.

■ Product Lineup

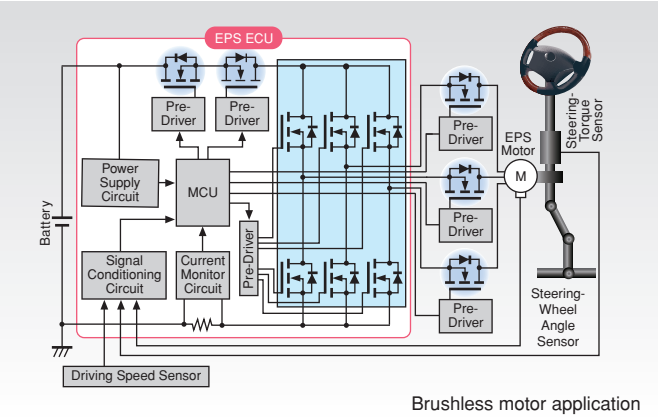
Polarity	Part Number	Absolute Maximum Ratings			$R_{DS(ON)}$ Max (mΩ)		Ciss Typ. (pF)	Crss Typ. (pF)	Qg Typ. (nC)	Tch (°C)	Series
		V_{DSS} (V)	V_{GSS} (V)	I_D (A)	$\|V_{GS}\|$ = 10 V	$\|V_{GS}\|$ = 4.0 V					
N-ch	**SSM3H137TU**	36 ± 2	±20	2	240	295	119	8	3.0	150	U-MOSⅣ

Applications and Recommended Products

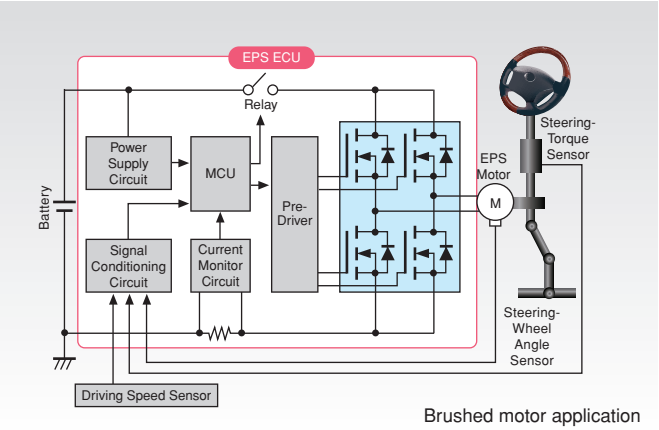
Electronic Power Steering (EPS) System

EPS systems are finding widespread use in automobiles to improve mileage. Here are block diagrams of EPS systems that use power MOSFETs for motor driver, power supply and motor relay applications in EPS systems.

System Block Diagram



Brushless motor application



Brushed motor application

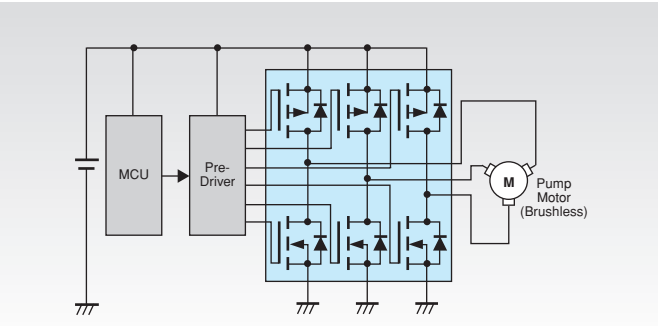
Recommended Products

Block	Package	Part number	Feature	Rel. Level
Motor control Semicon. relays	DPAK+	**TK65S04N1L**	Nch, 40 V/65 A, 4.3 mΩ, T_{ch} = 175˚C	AEC-Q101 Under consideration
		TK100S04N1L	Nch, 40 V/100 A, 2.3 mΩ, T_{ch} = 175˚C	AEC-Q101 Under consideration
	TO-220SM(W)	**TK100F04K3L**	Nch, 40 V/100 A, 3.0 mΩ, T_{ch} = 175˚C	AEC-Q101 qualified
		TK200F04N1L	Nch, 40 V/200 A, 0.9 mΩ, T_{ch} = 175˚C	AEC-Q101 Under consideration
	TO-220SIS	**TK80A04K3L**	Nch, 40 V/80 A, 2.4 mΩ, T_{ch} = 175˚C	–

Pump Motors

Electric motor pumps are becoming increasingly used in various automotive applications in order to improve mileage.
The DPAK+ Series features ultra-low ON-resistance due to the use of a nanoscale silicon process and a low-resistance Cu connector structure.

System Block Diagram



Brushless motor application

Recommended Products

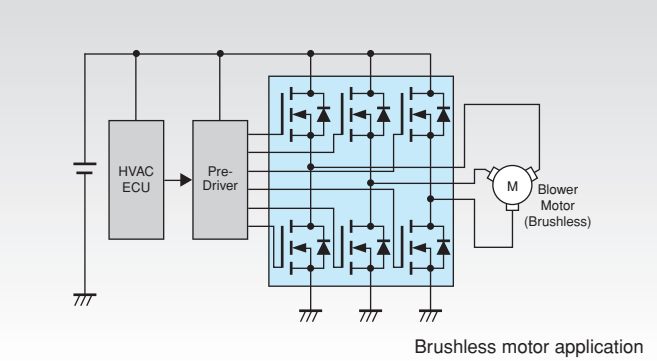
Block	Package	Part number	Feature	Rel. Level
Motor control Reverse battery protection	DPAK+	**TK35S04K3L**	Nch, 40 V/35 A, 10.3 mΩ, T_{ch} = 175˚C	AEC-Q101 qualified
		TK65S04N1L	Nch, 40 V/65 A, 4.3 mΩ, T_{ch} = 175˚C	AEC-Q101 Under consideration
		TJ40S04M3L	Pch, -40 V/-40 A, 9.1 mΩ, T_{ch} = 175˚C	AEC-Q101 qualified
		TJ60S04M3L	Pch, -40 V/-60 A, 6.3 mΩ, T_{ch} = 175˚C	AEC-Q101 qualified
	SOP Advance	**TPCA8085**	Nch, 40 V/40 A, 5.7 mΩ, T_{ch} = 175˚C	AEC-Q101 Under consideration
		TPCA8083	Nch, 40 V/60 A, 3.3 mΩ, T_{ch} = 175˚C	–
		TPCA8124	Pch, -40 V/-35 A, 9.5 mΩ, T_{ch} = 175˚C	AEC-Q101 Under consideration
		TPCA8122	Pch, -40 V/-60 A, 5.0 mΩ, T_{ch} = 175˚C	AEC-Q101 Under consideration
	TSON Advance	**TPCC8069**	Nch, 40 V/30 A, 8.1 mΩ, T_{ch} = 175˚C	AEC-Q101 Under consideration
		TPCC8106	Pch, -40 V/-30 A, 12.3 mΩ, T_{ch} = 175˚C	AEC-Q101 Under consideration

Heating, Ventilation and Air-Conditioning (HVAC)

HVAC systems are migrating to brushless motors to improve mileage. The power MOSFETs for HVAC applications feature ultra-low ON-resistance due to the use of a nanoscale silicon process and a low-resistance Cu connector structure, reducing the power consumption of the electronic control unit (ECU).

Additionally, the Cu connector structure provides a higher power cycling capability than aluminum (Al) wire bonding.

System Block Diagram



Brushless motor application

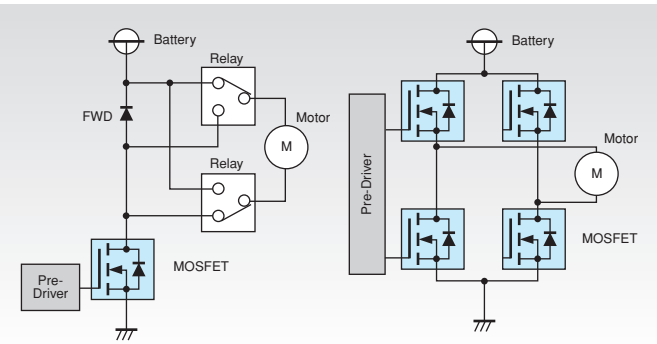
Recommended Products

Block	Package	Part number	Feature	Rel. Level
Motor control Reverse battery protection	DPAK+	**TK65S04N1L**	Nch, 40 V/65 A, 4.3 mΩ, T_{ch} = 175˚C	AEC-Q101 Under consideration
		TK100S04N1L	Nch, 40 V/100 A, 2.3 mΩ, T_{ch} = 175˚C	AEC-Q101 Under consideration
		TK60S06K3L	Nch, 60 V/60 A, 8.0 mΩ, T_{ch} = 175˚C	AEC-Q101 qualified
		TK80S06K3L	Nch, 60 V/80 A, 5.5 mΩ, T_{ch} = 175˚C	AEC-Q101 qualified
		TK90S06N1L	Nch, 60 V/90 A, 3.3 mΩ, T_{ch} = 175˚C	AEC-Q101 Under consideration
	TO-220SM(W)	**TK100F04K3L**	Nch, 40 V/100 A, 3.0 mΩ, T_{ch} = 175˚C	AEC-Q101 qualified
		TK100F06K3	Nch, 60 V/100 A, 5.0 mΩ, T_{ch} = 175˚C	AEC-Q101 qualified
		TK160F10N1	Nch, 100 V/160 A, 2.4 mΩ, T_{ch} = 175˚C	AEC-Q101 Under consideration
	TO-220SIS	**TK50A04K3**	Nch, 40 V/50 A, 3.5 mΩ, T_{ch} = 175˚C	–

Electric parking brake (EPB), power sliding doors, precrash seat belt tensioners

Nowadays, more and more automotive applications rely on electronic control, including electric parking brakes (EPB), power sliding doors and precrash seat belt tensioners. The H-bridge circuit configuration is most commonly used to drive motors for these applications. Fabricated using the latest silicon process, the DPAK+ MOSFET Series for motor drive applications delivers low on-resistance, as well as low wiring resistance by the use of a Cu connector. These characteristics combine to help reduce the system power consumption.

System Block Diagram



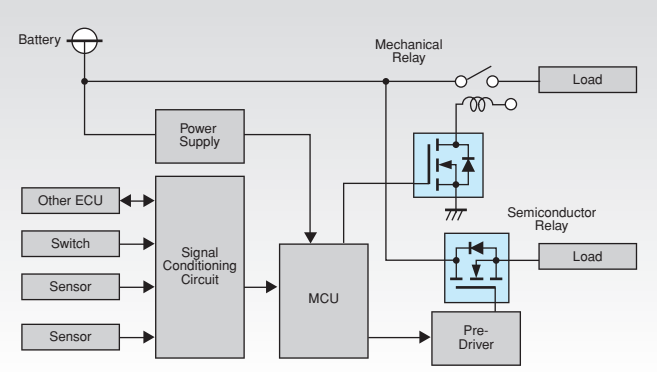
Recommended Products

Block	Package	Part number	Feature	Rel. Level
Motor control	DPAK+	**TK65S04N1L**	Nch, 40 V/65 A, 4.3 mΩ, T_{ch} = 175˚C	AEC-Q101 Under consideration
		TK100S04N1L	Nch, 40 V/100 A, 2.3 mΩ, T_{ch} = 175˚C	AEC-Q101 Under consideration
		TK60S06K3L	Nch, 60 V/60 A, 8.0 mΩ, T_{ch} = 175˚C	AEC-Q101 qualified
		TK90S06N1L	Nch, 60 V/90 A, 3.3 mΩ, T_{ch} = 175˚C	AEC-Q101 Under consideration
	TO-220SM(W)	**TK100F04K3L**	Nch, 40 V/100 A, 3.0 mΩ, T_{ch} = 175˚C	AEC-Q101 qualified
		TK200F04N1L	Nch, 40 V/200 A, 0.9 mΩ, T_{ch} = 175˚C	AEC-Q101 Under consideration
		TK100F06K3	Nch, 60 V/100 A, 5.0 mΩ, T_{ch} = 175˚C	AEC-Q101 qualified
		TK130F06K3	Nch, 60 V/130 A, 3.4 mΩ, T_{ch} = 175˚C	AEC-Q101 qualified

Junction Box

Automotive junction boxes come in two types: those using mechanical relays and those using MOSFETs as semiconductor relays. To meet the needs of mechanical-relay drive applications, Toshiba has developed the SSM3K337R, a MOSFET in a small package (with 85% of the mounting area of the predecessor) that has active clamping circuitry for inductive loads. Toshiba also offers power MOSFETs in DPAK+ and TO-220SM(W) packages suitable for semiconductor relay applications.

System Block Diagram



Recommended Products

Block	Package	Part number	Feature	Rel. Level
Mechanical Relay	SOT-23F	**SSM3K337R**	Activeclamp MOSFET, 43 V/2 A, 0.2 Ω@4.0 V	AEC-Q101 qualified
		SSM3K2615R	MOSFET, 60 V/2 A, 0.58 Ω@3.3 V	AEC-Q101 qualified
	UFM	**SSM3H137TU**	MOSFET+ Ze, 36 V/2 A, 0.295 Ω@4.0 V	AEC-Q101 qualified
Semicon. Relay	DPAK+	**TK100S04N1L**	Nch, 40 V/100 A, 2.3 mΩ, T_{ch} = 175˚C	AEC-Q101 Under consideration
	TO-220SM(W)	**TK200F04N1L**	Nch, 40 V/200 A, 0.9 mΩ, T_{ch} = 175˚C	AEC-Q101 Under consideration
Power Supply	DPAK+	**TK25S06N1L****	Nch, 60 V/25 A, (18.5) mΩ, T_{ch} = 175˚C	AEC-Q101 Under consideration

**: Under development

Web Simulator

Toshiba offers the Web Simulator that allows you to perform various analyses online.
After user registration, you will be granted free access to it.

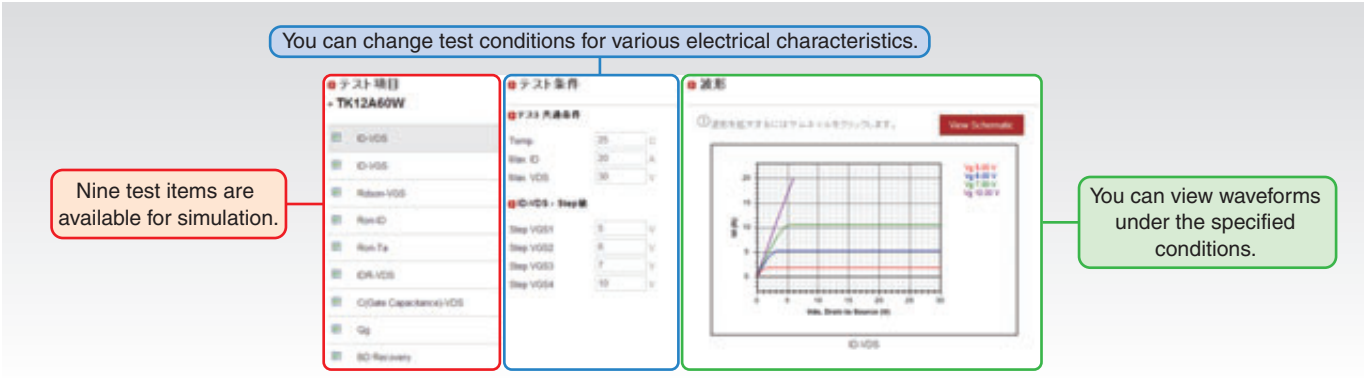
A video clip introducing the Web Simulator is available on YouTube.

- The Web Simulator allows you to simulate the MOSFET performance under various voltage and temperature conditions.
- You can analyze the switching waveforms and power efficiencies of MOSFETs in AC/DC and DC/DC converter applications.
- You can also simulate PFC, full-bridge, flyback and synchronous buck converters.
- In addition, you can simulate the behaviors of LDO regulators and load switch ICs.

Functions for MOSFET Analysis

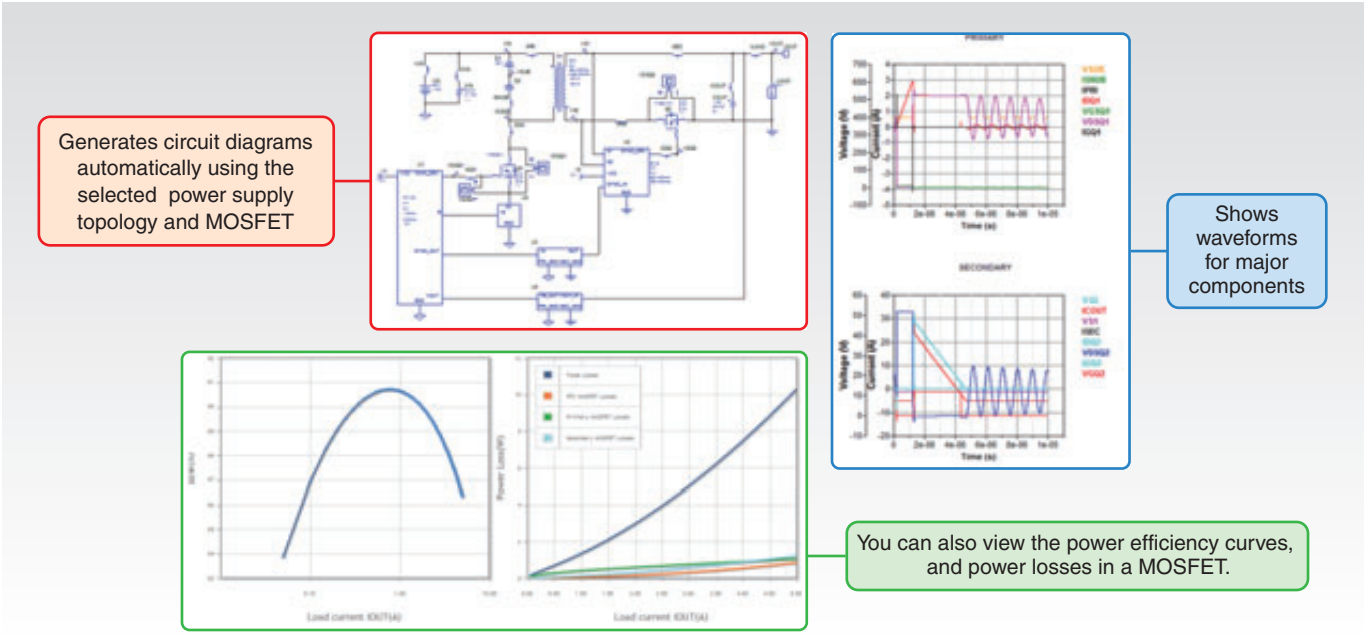
INTERACTIVE DATASHEET <Device characteristics simulation>

You can view performance curves in a datasheet under various conditions.



APPLICATION DESIGNER <Circuit simulation>

You can simulate various power supply topologies for AC-DC and DC-DC converters.



Part Numbering Schemes

Small-Signal MOSFET (SSM) Series

SSM 3 K 101 TU

- **Package**
  - <3-pin>
    - F: S-Mini
    - FU: USM
    - FS: SSM
    - FV: VESM
    - T: TSM
    - TU: UFM
    - CT: CST3
    - CTB: CST3B
    - R: SOT-23F
  - <4-pin>
    - CT: CST4
  - <5-pin>
    - F: SMV
    - FU: USV
    - FE: ESV
    - TU: UFV
  - <6-pin>
    - FU: US6
    - FE: ES6
    - TU: UF6
    - CTD: CST6D
    - NU: UDFN6/UDFN6B
- Serial number of the products
- Polarity and internal configuration
  - K: N-channel, single
  - J: P-channel, single
  - N: N-channel, dual
  - P: P-channel, dual
  - L: N-channel and P-channel (dual)
  - E: N-channel and P-channel (pre-wired as a load switch)
  - H: N-channel and SBD
  - G: P-channel and SBD
  - Q: PNP and P-channel
- Pin count
- Small-Signal MOSFET (Initials of "Small-Signal MOS)

Conventional Multi-Pin Series

TPC8 0 01 -H

- -H: High-speed type
  - None: Low-on-resistance type
- Serial number of the products
- 0: N-channel, single
- 1: P-channel, single
- 2: N-channel, dual
- 3: P-channel, dual
- 4: N-channel and P-channel, dual
- A: N-channel and SBD
- B: P-channel and SBD
- J: P-channel and NPN
- TPC6: VS-6 Series
- TPCF8: VS-8 Series
- TPCP8: PS-8 Series
- TPCC8: TSON Advance Series
- TPC8: SOP-8 Series
- TPCA8: SOP Advance Series
- TPCL4: Chip LGA

Conventional 3-Pin Series

2SK ＊＊＊＊

- N-channel MOS

2SJ ＊＊＊＊

- P-channel MOS

New Multi-Pin Series

TPH 4R6 0 6 N H

- Additional information
  - 1 to 5: Serial number of the products
  - A: V_{GS} = 10 V
  - C: V_{GS} = 4.5 V
  - D: V_{GS} = 2.5 V
  - E: V_{GS} = 2.0 V
  - F: V_{GS} = 1.8 V
  - H: Low-rg, 6-V drive
  - M: Low-rg, 6-V drive
  - L: Low-rg, 4.5-V drive
  - Q: Tch(max) = Guaranteed up to 175°C + ZD
  - R: Tch(max) = Guaranteed up to150°C + ZD
  - S: Tch(max) = Guaranteed up to175°C
  - T: Tch(max) = Guaranteed up to150°C
- Series
  - G: U-MOSVII
  - M: U-MOSVI
  - N: U-MOSVIII
  - P: U-MOSIX
- Maximum rated voltage
  - 2: 15 to 24 V
  - 3: 25 to 34 V
  - 4: 35 to 44 V
  - B: 125 to 149 V
  - 5: 45 to 54 V
  - C: 150 to 179 V
  - 6: 55 to 64 V
  - D: 180 to 199 V
  - 7: 65 to 74 V
  - E: 200 to 249 V
  - 8: 75 to 84 V
  - F: 250 to 299 V
  - A: 95 to 124 V
- Polarity / Configuration
  - 0: Single N-ch
  - 1: Single P-ch
  - 2: Dual N-ch
  - 3: Dual P-ch
  - 4: Dual N-ch + P-ch
  - A: Dual N-ch MOS + SBD
  - B: Dual P-ch MOS + SBD
- Max. on-resistance (at max drive conditions)
  - R46 = 0.46 mΩ
  - 4R6 = 4.6 mΩ
  - 100 = 10 x 10^0 = 10 mΩ
  - 101 = 10 x 10^1 = 100 mΩ
- Package
  - TP6: VS-6 Series
  - TPF: VS-8 Series
  - TPP: PS-8 Series
  - TPN: TSON Advance Series
  - TPW: DSOP Advance Series
  - TPZ: DSON Advance Series
  - TP8: SOP-8 Series
  - TPH: SOP Advance Series

New 3-Pin Series

TK 55 A 10 J 1

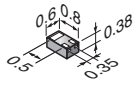
- Additional information
  - 1: Low-capacitance type
  - 3: Low-on-resistance type
  - 5: Fast body diode type
- Series
  - A: π-MOSIV
  - C: π-MOSVI
  - D: π-MOSVII
  - E: π-MOSVIII
  - J: U-MOSIII
  - K: U-MOSIV
  - M: U-MOSVI
  - N: U-MOSVIII
  - U: DTMOSII
  - V: DTMOSIII
  - W: DTMOSIV
  - X: DTMOSIV-H
- 10% of max. rated voltage (V_{DSS})
- Package
  - A: TO-220SIS
  - C: I2PAK
  - E: TO-220
  - F: TO-220SM(W)
  - G: D2PAK
  - J: TO-3P(N)
  - L: TO-3P(L)
  - M: TO-3P(N)IS
  - N: TO-247
  - P: DPAK/New PW-Mold
  - Q: IPAK/ New PW Mold2
  - S: DPAK+
  - V: DFN8x8
  - Z: TO-247 4L
- Current rating
- TK: N-channel
- TJ: P-channel

List of Packages

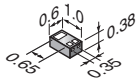
Surface-mount package

3-Pin Packages

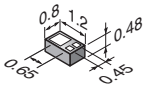
CST3C



CST3 (SOT-883)



CST3B



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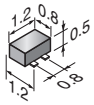

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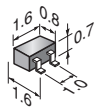

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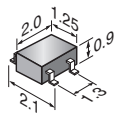

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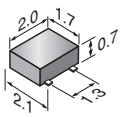
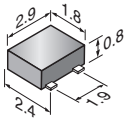
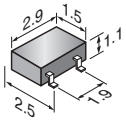


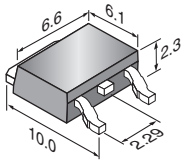
SOT-23F



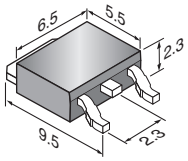
S-Mini (SOT-346)(SC-59)



DPAK



DPAK+



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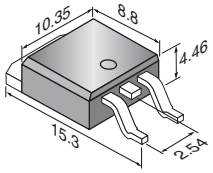
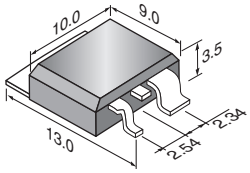
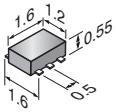


TO-220SM(W)



5-Pin Packages

ESV (SOT-553)(SC-107BB)



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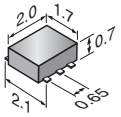
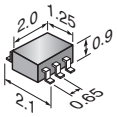
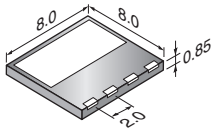


USV (SOT-353)(SC-88A)

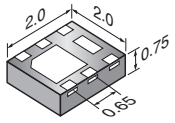


DFN8x8

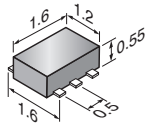


6-Pin Packages

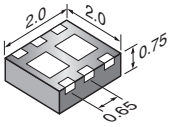
UDFN6B (SOT-1220)



ES6 (SOT-563)(SC-107C)



UDFN6 (SOT-1118)



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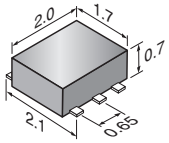
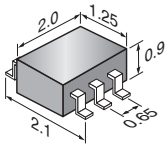
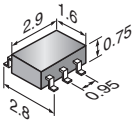


US6 (SOT-363)(SC-88)

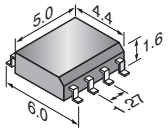


VS-6



8-Pin Packages

SOP-8



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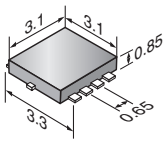
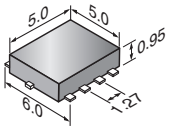


SOP Advance



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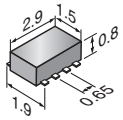
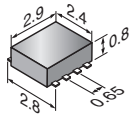
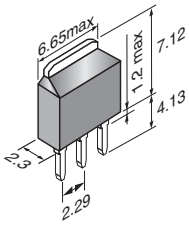


PS-8

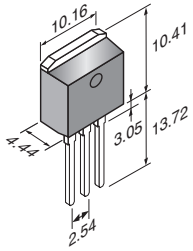


Through-hole package

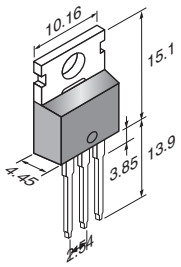
IPAK



I2PAK



TO-220



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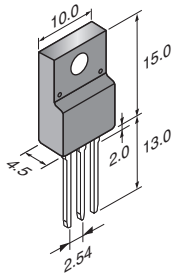

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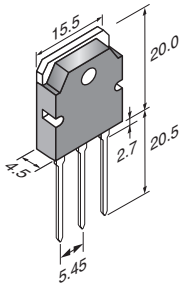
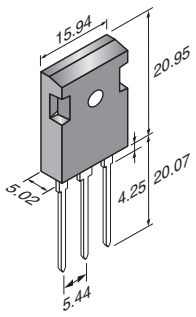
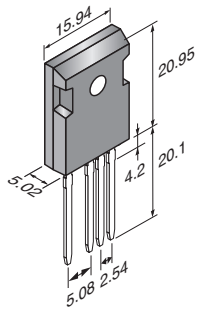


TO-247



TO-247 4L



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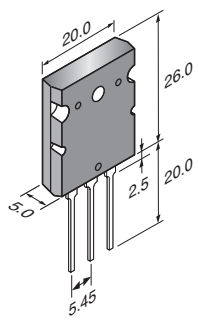

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- **easy to navigate around**

point 1 Wide Key Visual Area

You can find new arrivals and latest products here.

point 2 News

The latest news and new product highlights are available here.

point 3 Extensive product lineups

You can find the lineups and details or our products by category.

point 4 Web Simulator

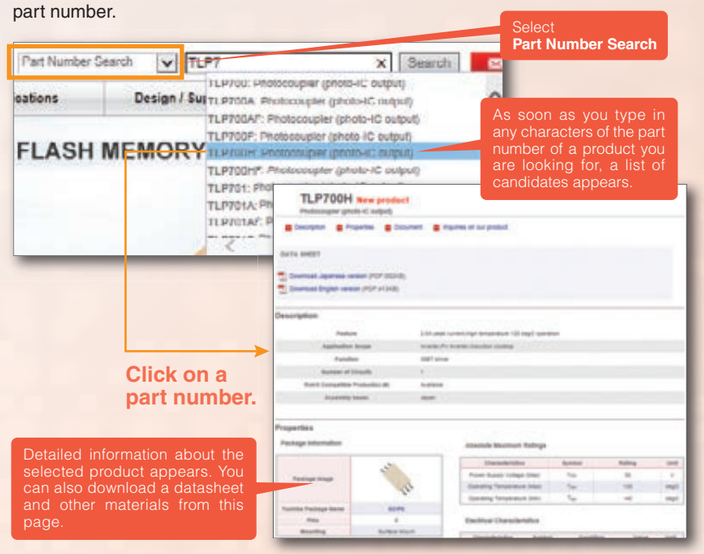
This online tool allows you to simulate our MOSFETs, LDO reguators and load switch ICs under various conditions.

point 5 Various search features

You can find products matching your search criteria.

Part number search

You can find infomation about any of our products by typing in any characters of the part number.

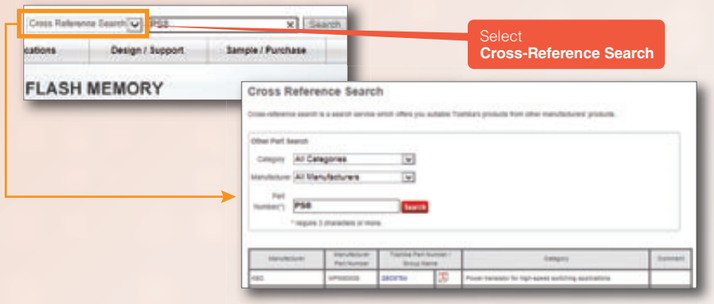


Parametric search

You can successively narrow down a list of products by choosing a product category and electrical characteristics.

Cross-reference search

As soon as you type in any characters of the part number of another company's product, a list of Toshiba products with similar specifications appears.



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