

TOSHIBA

2004-3

PRODUCT GUIDE

Power MOSFETs

2004 semiconductor
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POWER MOSFETs

C O N T E N T S

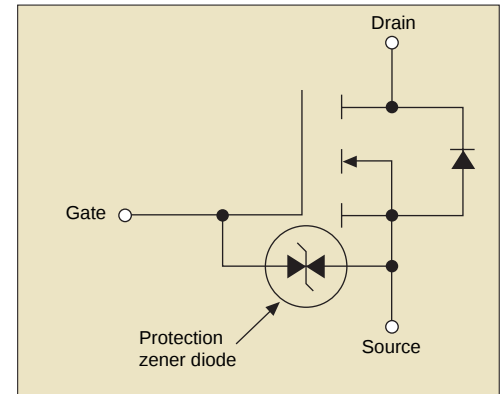
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1 Features and Structure

Power MOSFETs

All power MOSFETs have the following features:

- 1) No carrier storage effect
Superior frequency and switching characteristics
- 2) Rugged without current concentration
- 3) Low drive power due to voltage-controlling device
- 4) Easy parallel connection



■ Toshiba Power MOSFETs have the following additional features:

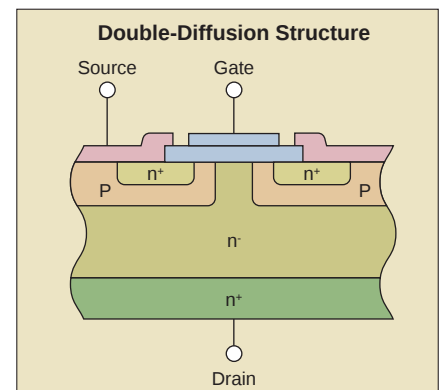
- | | |
|--|--|
| 1) Guaranteed avalanche withstand capability | ⇒ No absorber circuit required |
| 2) Improved the function of built-in diodes | ⇒ greatly expands the possibility of circuit design |
| 3) High ruggedness | ⇒ enables to take better margin for circuit design |
| 4) High-speed switching | ⇒ contributes to equipment's high-speed operation |
| 5) Low $R_{DS(ON)}$ | ⇒ reduces power consumption of equipment |
| 6) Downsized packages | ⇒ enable equipment's size to be compact and thin |
| 7) Low drive loss | ⇒ reduces power consumption of equipment |
| 8) Zener diode between gate and source | ⇒ Improved electrostatic withstand between gate and source |

■ Structure of Toshiba Power MOSFETs

● π -MOS

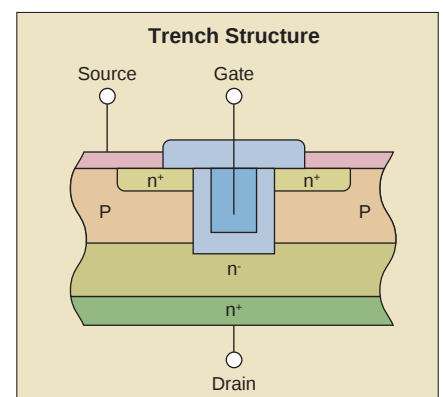
Toshiba Power MOSFETs use the double-diffusion MOS (D-MOS) structure, which produces a high-withstand voltage, to form channels. This structure is especially well suited to high-withstad voltage and high-current devices.

A high level of integration yields a high-performance power MOSFET with low On-resistance and low power loss.



● U-MOS

Higher channel density is achieved by connecting channel vertically as having a U-groove at the gate region and this structure reduces On-resistance to lower than other MOSFET structures. This is an ideal for low-voltage power MOSFETs.



2 New Power MOSFET Products

New Power MOSFET Products

All products have a protection zener diode between gate and source.

Avalanche withstand capability in single and series Power MOSFET products

SOP Series $V_{DS} = 20\text{ V to }60\text{ V}$

SOP Series products are compact and thin, and require only a small mounting area. They are suitable for lithium-ion secondary battery protection circuits and for notebook PCs.

- Applications**
- Lithium-ion secondary battery protection circuits
 - Notebook PCs
 - Portable electronic devices

VS and PS Series $V_{DS} = 12\text{ to }30\text{ V}$

VS Series and PS Series products are very compact and thin, and suitable for various items of portable electronic devices.

- Applications**
- Portable phones
 - Notebook PCs
 - Portable electronic devices

TFP (Thin Flat Package) Series

TFP (Thin Flat Package) Series is comprised of new high-performance devices with a 4-pin structure for separating input and output. TFP Series devices have the same ratings as existing TO-220SM package devices; however, the volume of them occupies only 42% of the volume of TO-220SM package devices.

- Applications**
- DC-DC converters
 - PDP drivers
 - Motor drivers

TO-220SIS Series $V_{DS} = 450\text{ to }900\text{ V}$

This series downsized 2.8-mm package height compared to the conventional package, TO220NIS. In addition, the chip design optimization, π -MOS IV / VI Series housed in this new package, reduced Q_g characteristics.

- Applications**
- DC-DC converters
 - AC adapters
 - Motor drives
 - Switching power supplies

U-MOS III Series $V_{DS} = 40\text{ V to }100\text{ V}$

High-integration is achieved using trench structure technique. Low-voltage driving ($V_{GS} = 4\text{ V}$) is possible because of ultra-low On-resistance.

- Applications**
- DC-DC converters
 - Motor drives
 - Solenoids and lamp drives

π -MOS VII Series $V_{DS} = 100\text{ V}$

With employing submicron technology and reducing gate charge, this latest series realized extremely fast speed and low $R_{DS(ON)}$.

- Applications**
- Digital amps
 - DC-DC converters
 - Motor drivers

π -MOS V Series $V_{DS} = 150\text{ V to }250\text{ V}$

The π -MOS Series is comprised of low-cost devices which are ideal for use in monitors, especially for frequency control and S-shape correction.

- Applications**
- Monitors
 - DC-DC converters
 - PDP drives

π -MOS V High-Speed Series $V_{DS} = 250\text{ V to }600\text{ V}$

π -MOS V High-Speed Series is new product series and achieves faster switching speed than π -MOS V Series which are currently well-established in the marketplace.

Two types of series are available:
High-Speed Switching Series
High-Speed Diode Series

- Applications**
- Inverters
 - Motor drives
 - AC adapters
 - Switching power supplies

π -MOS V Series $V_{DS} = 400\text{ V to }600\text{ V}$

This Series is comprised of highly integrated, high-performance, high-breakdown-voltage and low-cost products with V_{DS} in the range 400 V to 600 V which are ideal for use in 100-V AC input-switching power supplies.

- Applications**
- Switching power supplies
 - AC adapters
 - Lighting inverters

π -MOS III Series $V_{DS} = 800\text{ V to }900\text{ V}$

This Series is comprised of highly integrated, high-performance, high-breakdown-voltage and low-cost products with V_{DS} in the range 800 V to 900 V which are ideal for use in 200-V AC input-switching power supplies.

- Applications**
- Switching power supplies

3 Selection Guide

V _{DSS} (V)	I _D (A)	12	16	20	30	40	50	60	100	150	180	200	250	400	450	500	600	700	800	900	1000	V _{DSS} (V)	I _D (A)	
0.5																▲2SK2998(20) ☆2SK3302(18)② ◇2SK3471(18)②							0.5	
1								◇2SJ360(0.73)④ ▲2SJ507(0.7)④	◇2SK2963(0.7)④ ▲2SK2962(0.7)④ ◇2SJ508(1.9)④ ▲2SJ509(1.9)④	▲2SK3670(1.7)	◆2SJ313(5.0) ▼2SJ338(5.0) ◆2SK2013(5.0) ▼2SK2162(5.0)	◇2SK2992(3.5)②		▼2SK3498(5.5)②	▼2SK3472(4.6)② ☆2SK3374(4.6)②		△2SK2836(9)② ▼2SK3371(9)②			■2SK2733(9.0)① ▽2SK2845(9)① ▼2SK3301(20)①			1	
1.3												⚡TPCS8004-H(0.8)⑥											1.3	
1.5																							1.5	
1.8												★TPC8012-H(0.4)⑥											1.8	
2		#◇2SJ465(0.71)② #◇2SK2549(0.29)②		◇2SK2964(0.18)④ ◇2SJ511(0.45)④				◇2SK2615(0.3)④ ▲2SK2961(0.3)④ ◇2SK3658(0.3)④					▼2SJ610(2.55)②		◆2SK3543(2.45)② ⊗2SK3757(2.45)③	☆2SK2599(3.2)② ▼2SK3373(3.2)②	☆2SK2846(5.0)② ▼2SK2865(5.0)② ◆2SK3067(5.0)② ⊗2SK3767(5.0)③						2	
2.3																							2.3	
2.5					N♥TPC6201(0.095)⑥							▼2SJ567(2.0)②								◆2SK2718(6.4)① ⊗2SK3566(4.3)③ ■2SK3762(6.4)③			2.5	
2.7				P#♥TPC6105(0.11)⑥ P*♪TPCF8301(0.11)⑥ PS*♪TPCF8801(0.11)⑥ P*♪TPCF8103(0.11)⑥																			2.7	
3				N#♪TPCF8201(0.049)⑥ NS#♪TPCF8A01(0.049)⑥ P#♪TPCF8302(0.059)⑥ P*♪TPCF8303(0.058)⑥				☆2SK2200(0.35)④ ▼2SK2201(0.35)④ △2SK2742(0.35)④					▼2SK3462(1.7)②			◆2SK2862(3.2)			■2SK2603(3.6)① ○2SK2883(3.6)①	■2SK2608(4.3)① ◆2SK2700(4.3)① □2SK2719(4.3)① ⊗2SK3564(4.3)① ■2SK3763(4.3)③			3	
3.2					CP♪TPCF8402(0.077)⑥																		3.2	
3.4					CP★TPCP8402(0.072)⑥																		3.4	
3.5				P★TPC8302(0.12)⑤	P★TPC8301(0.12)⑤												◆2SK2750(2.2)② ■2SK3085(2.2)② ⊗2SK3567(2.2)③ ■2SK3760(2.2)③			⊗2SK3798(3.5)③			3.5	
4					CN♪TPCF8402(0.05)⑥																■2SK1119(3.8) ○2SK1930(3.8)		4	
4.2					N★TPCP8201(0.05) CN★TPCP8402(0.077)⑥																		4.2	
4.5				P#♥TPC6101(0.06)⑥	P♥TPC6102(0.06)⑥ P★TPC8303(0.035)⑥ CP★TPC8401(0.035)⑥ CP★TPC8402(0.035)⑥ CP★TPC8403(0.055)⑥								▼2SK3342(1.0)⑥										4.5	
5		#▼2SJ439(0.2)② #▼2SK2493(0.1)②	★TPC8208(0.05)⑥ ⚡TPCS8209(0.03)⑥ N#⚡TPCS8205(0.045)⑥ N#⚡TPCS8210(0.03)⑥ P#★TPC8305(0.03)⑥ P⚡TPCS8302(0.035)⑥ P#⚡TPC8303(0.021)⑥	☆2SJ525(0.12) ★TPC8004(0.05)⑤ CN★TPC8402(0.05)⑤ P★TPC8104-H(0.065)⑥ ⚡TPCS8209(0.05)⑥ N♪TPCF8001(0.032)⑥			▲2SK2989(0.15)④ ▲2SJ537(0.19)④	▼2SJ668(0.17) ▼2SJ315(0.25) ▼2SJ377(0.19)④ ☆2SJ378(0.19)④ ◆2SJ438(0.19)④ ☆2SK2229(0.16)④ ▼2SK2231(0.16)④ △2SK2741(0.16)④ N★TPC8206(0.05)⑥	▼2SK2399(0.23)④ ☆2SK2400(0.23)④	▼2SK3205(0.52)		◆2SJ407(1.0)② ◆2SK2381(0.8)② ☆2SK2835(0.8)② ▼2SK2920(0.8)②	◆2SJ512(1.25)②			◆2SK2662(1.5)② ■2SK2661(1.5)② ○2SK2991(1.5)② ¥◆2SK3316(1.8)② ◆2SK3466(1.5)② ¥○2SK3417(1.8)② ∟2SK3627(1.5)② ⊗2SK3563(1.5) ■2SK3758(1.5)③		◆2SK2274(1.7)	□2SK2604(2.2)① ◆2SK2605(2.2)① ○2SK2884(2.2)①	□2SK2610(2.5)① ◆2SK2717(2.5)① ⊗2SK3565(2.5)③	□2SK1359(3.8)		5	
5.5	P#♥TPC6103(0.035)⑥ PD*★TPC8401(0.038)⑥			P#♥TPC6104(0.04)⑥	N★TPC8211(0.036)⑥									◆2SK2679(1.2)② ○2SK2838(1.2)②									5.5	
6	P*♪TPCF8101(0.028)⑥			N♥TPC6001(0.03)⑥ N#♥TPC6004(0.024)⑥ ★TPC8207(0.02)⑥ ⚡TPCS8102(0.02)⑥ ⚡TPCS8211(0.024)⑥ ⚡TPCS8204(0.017)⑥ P#⚡TPCS8102(0.02)⑥ N#⚡TPCS8212(0.024)⑥ N#⚡TPCS8208(0.017)⑥ P*♪TPCF8102(0.030)⑥	N♥TPC6002(0.03)⑥ N♥TPC6003(0.024)⑥ N#♥TPC6005(0.028)⑥ ★TPC8203(0.021)⑥ CN★TPC8401(0.021)⑥ CN★TPC8403(0.033)⑥ P⚡TPCS8101(0.025)⑥ P♪TPCF8104(0.028)⑥ NS★TPC8A01(0.025)⑥ PD★TPCP8301(0.035)(-32V)⑥										■2SK2544(1.25)② ◆2SK2545(1.25)② □2SK2602(1.25)② ○2SK2777(1.25)② ¥◆2SK3130(1.55)② ⊗2SK3562(1.25) ■2SK3761(1.25)③							6		
6.5													◆2SJ516(0.8)②										6.5	
7					N★TPC8006-H(0.027)⑥ P★TPC8105-H(0.04)⑥ N★TPC8001(0.02)⑥ N♪TPCF8001(0.023)⑥			N★TPC8206(0.05)⑥												□2SK2746(1.7)① □2SK3633(1.7)①	□2SK2749(2.0)① □2SK3700(2.5)	⊗2SK1365(1.8)		7
7.5													◆2SK2417(0.5)② ■2SK2917(0.5)②				⊗2SK3667(1.0)③						7.5	
8					N★TPC8210(0.015)⑥	P★TPC8110(0.025)⑥										■2SK2542(0.85)② ◆2SK2543(0.85)② ○2SK2776(0.85) ◆2SK3538(0.85)② ∟2SK3626(0.85)② ⊗2SK3561(0.85)③ ■2SK3759(0.85)③			⊗2SK2606(1.2)①	⊗2SK2847(1.4)①	□2SK1120(1.8) □2SK2613(1.7)②		8	
8.5					NS★TPC8A01(0.018)⑤							◆2SK2350(0.4)②	■2SK2914(0.5)②	◆2SK2952(0.55)②							⊗2SK3017(1.25)①		8.5	
9											⊗2SK2467(0.83) ⊗2SJ440(0.83)									□2SK2607(1.2)①	□2SK2611(1.4)① □2SK3473(1.6)③		9	

New product

① : π-MOSIII ③ : π-MOSVI ⑤ : L²-π-MOSVI ⑦ : π-MOSVII

series code

② : π-MOSV ④ : L²-π-MOSV ⑥ : U-MOS ⑧ : π-MOSIV

Package

◇ POWER-MINI △ SP ↗ VS-8 ♥ VS-6 ♣ PS-8

code

⊗ TO-220SIS ■ TO-220AB ♣ TFP ∟ Slim-TFP

▲ TO-92MOD ▼ POWER-MOLD ▽ DP ☆ TPS ★ SOP-8 ⚡ SOP-8 Lead clamp ◆ TO-220(NIS)

○ TO-220FL/SM □ TO-3P(N) ◎ TO-3P(N)IS ● TO-3P(L) ⚡ TSSOP-8 ⊗ TO-3P(SM) ▶ SOP Advance

Notes:

() = R_{DS(on)} max * = 1.8-V drive P = P-ch NS = N-ch + SBD PD = P-ch + Driver

\$ = 10-V drive ¥ = High-speed diode CN = Complementary N-ch PS = P-ch + SBD (load switch)

= 2.5-V drive N = N-ch CP = Complementary P-ch [] = Under development

3 Selection Guide

V _{DSS} (V) I _D (A)	20	30	50	60	100	150	180	200	250	300	400	450	500	600	700	900	1000	V _{DSS} (V) I _D (A)
10	P★TPC8115(0.01)⑥	△2SK2839(0.04)④ P★TPC8109(0.02)⑥			▼2SK3669(0.125)⑦		□2SJ200(0.83) ●2SJ440(0.83) □2SK1529(0.83) □2SK3497(0.15) □2SJ618(0.37)				■2SK2841(0.55)② ○2SK2949(0.55)② ♣2SK3499(0.55)②	◆2SK3126(0.65)② ◆2SK3309(0.65)② ◆2SK3310(0.65)② ◆2SK3407(0.65)②	□2SK2601(1.0)②	◆2SK2843(0.75)② ■2SK2866(0.75)② ○2SK2889(0.75)② ◆2SK2996(1)② ♣2SK3438(1.0)② ○2SK3437(1.0)② ○2SK3399(0.75)② ⊗2SK3569(0.75)	◆2SK3265(1.0)⑧ ⊙2SK3453(1.0)⑧	□2SK2968(1.25)①		10
11		N★TPC8014(0.014)⑥ P★TPC8108(0.013)⑥ N★TPC8010-H(0.016)⑥ P★TPC8113(0.01)⑥						◆2SK2965(0.26)②										11
12					◆2SJ380(0.21)④			●2SJ201(0.625) ●2SK1530(0.625) ○2SK3625(0.082)②					◆2SK2842(0.52)② ○2SK3068(0.52)② ¥◆2SK3313(0.62)② ♣2SK3398(0.52)② ⊗2SK3568(0.52)②	□2SK2699(0.65)②			●2SK1489(1.0)	12
13		N[◇TPC8015-H(0.008)]⑥ N★TPC8003(0.007)⑥ N★TPC8009-H(0.01)⑥ P★TPC8107(0.007)⑥ P◇TPC8112(0.006)⑥							◆2SK2508(0.25)② ○2SK2598(0.25)②			◆2SK3743(0.4)② ○2SK3403(0.4)② ♣2SK3544(0.4)②						13
14				◆2SJ304(0.12) ○2SJ312(0.12)										○2SK2916(0.4)②				14
15		N★TPC8013-H(0.0065)⑥ N◇TPC8016-H(0.0055)⑥ N◇TPC8017-H(0.0066)⑥						◆2SK2382(0.18)② ○2SK2401(0.18)②						□2SK2698(0.4)2 ¥□2SK3314(0.48)②	⊙2SK2953(0.4)②			15
16					○2SJ412(0.21)④ ♣2SJ619(0.21)④										□2SK2915(0.4)②			16
18		P◇TPC8114(0.0045)⑥ N◇TPC8018-H(0.0046)⑥			◆2SJ464(0.09)④ ♣2SJ620(0.09)④	◆2SK2882(0.12)② ♣2SK3387(0.12)④								⊙2SK2917(0.27)②				18
20			▽2SK2614(0.046)④	◆2SJ349(0.045)④ ○2SJ401(0.045)④ ▽2SK2782(0.055)④	◆2SK2391(0.085)④				○2SK2993(0.105)② ♣2SK3388(0.105)② ♣2SK3445(0.105)②				□2SK2837(0.27)② ⊙2SK3117(0.27)②					20
25			◆2SK2507(0.046)④	◆2SK2232(0.046)④ ○2SK2311(0.046)④				♣2SK3444(0.082)② ○2SK3625(0.082)②						●2SK1544(0.2)				25
27							■2SK2314(0.085)④ ○2SK2789(0.085)④											27
30				◆2SJ334(0.038)④ ○2SJ402(0.038)④	◆2SK2466(0.046)⑥ ○2SK3084(0.046)⑥	♣2SK3443(0.055)②		□2SK3176(0.052)②	□2SK2967(0.068)② ⊙2SK2995(0.068)②									30
32										●2SK1486(0.095)								32
35		■2SK2844(0.022)④ N▶TPCA8003-H(0.0066)⑥		◆2SK3236(0.02) ◆2SK3662(0.0125)⑥														35
36				◆2SK2385(0.03)④														36
40		○2SK3089(0.03)② N▶TPCA8004-H(0.0046)⑥ P▶TPCA8101-H(0.007)⑥ P▶TPCA8102-H(0.006)⑥ P▶TPCA8103(0.0042)⑥																40
45		○2SK3090(0.02)⑤ ○2SK3127(0.011)⑤ \$□2SK3506(0.02)	\$□2SK2550(0.03)④ ◆2SK2886(0.02)④ \$□2SK2744(0.02)④ \$○2SK3051(0.03)④	□2SK2233(0.03)④ ○2SK2266(0.03)④ ◆2SK2312(0.017)④ ○2SK2376(0.017)④ □2SK2398(0.03)④ ◆2SK2985(0.0058)⑥														45
50			\$□2SK2551(0.011)④ □2SK2745(0.0095)④	\$♣2SK3440(0.008)④ □2SK2173(0.017)④ \$□2SK2445(0.018)2 ○2SK2986(0.0058)⑥	□2SK1381(0.032) ♣2SK3442(0.020)⑥									¥●2SK3131(0.11)② ●2SK3132(0.09)②				50
55																		55
60		⊙2SK3125(0.007)⑤ □2SK3128(0.011)⑤	□2SK3129(0.007)③	●2SK2267(0.011)④ □2SK2313(0.011)④	●2SK1382(0.020)													60
70		♣2SK3397(0.006)		□2SK2987(0.0058)⑥														70
75		\$♣2SK3389(0.005)⑥ ♣2SK3439(0.005)⑥		♣2SK3441(0.0058)⑥														75

New product

series code

①: π-MOSIII
②: π-MOSV

③: π-MOSVI

④: L²-π-MOSV

⑤: L²-π-MOSVI

⑥: U-MOS

⑦: π-MOSVII

⑧: π-MOSIV

Package

code

◇POWER-MINI △SP ⤴VS-8 ♥VS-6 ♣PS-8
⊙TO-220SIS ■TO-220AB ♣TFP ⤴Slim-TFP

▲TO-92MOD ▼POWER-MOLD ▽DP ☆TPS ★SOP-8 ☆SOP-8 Lead clamp ◆TO-220(NIS)
○TO-220FL/SM □TO-3P(N) ⊙TO-3P(N)IS ●TO-3P(L) ✕TSSOP-8 ⊙TO-3P(SM) ▶SOP Advance

Notes:

() = R_{DS(on)} max
\$ = 10-V drive
= 2.5-V drive

* = 1.8-V drive
¥ = High-speed diode
N = N-ch

P = P-ch
CN = Complementary N-ch
CP = Complementary P-ch

NS = N-ch + SBD
PS = P-ch + SBD
[] = Under development

PD = P-ch + Driver
(load switch)

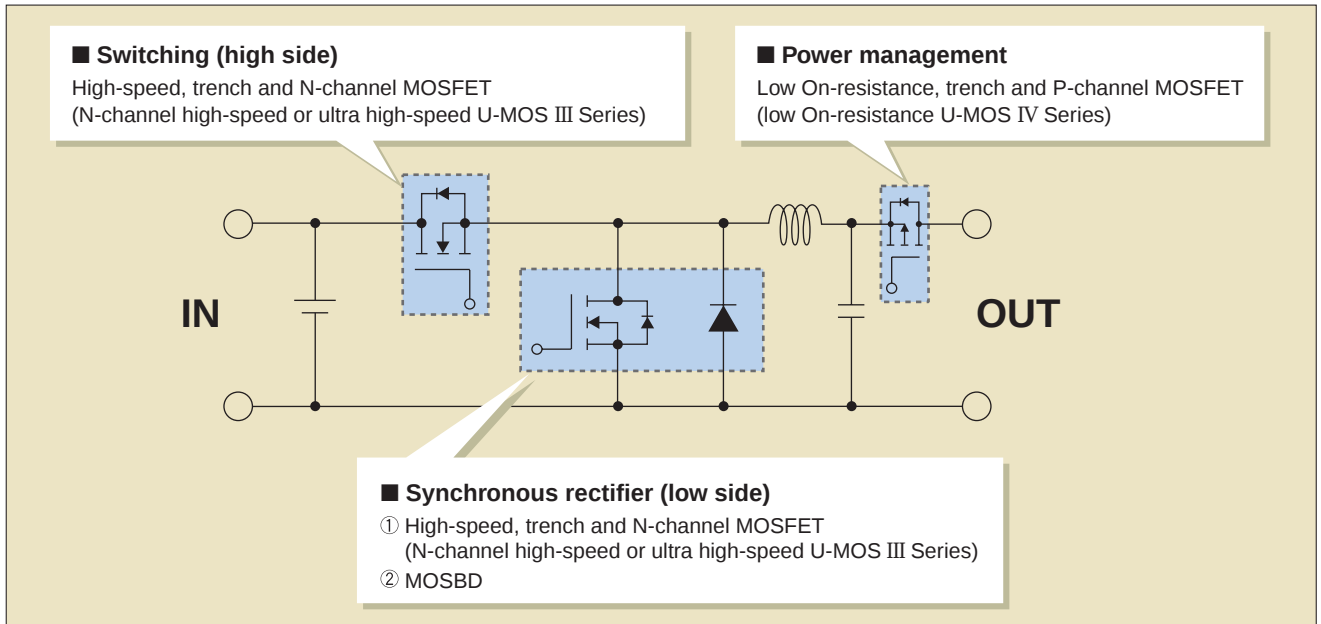
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9

4 Power MOSFET Characteristics

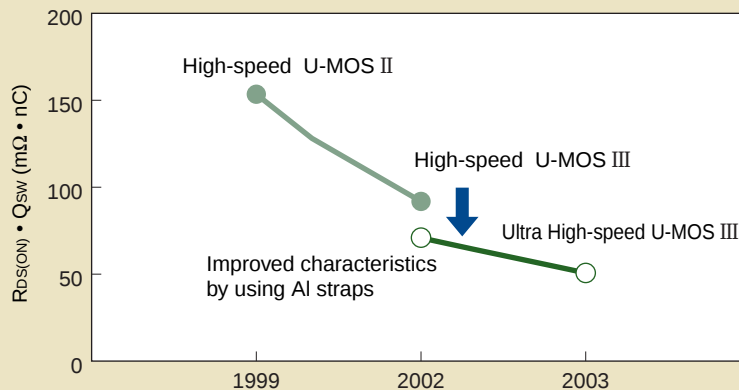
1.Features of SOP Series

① Circuit example for DC-DC Converter

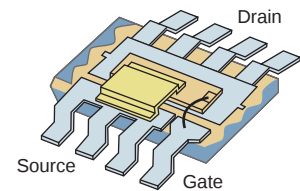


② Development Process of High-Speed U-MOS Series

Improved trade-off between On-resistance and gate switch charge due to short-channel structure, trench contact structure and Al straps.

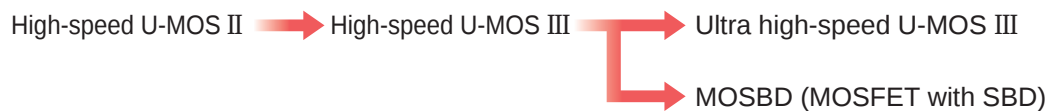


- $R_{ds(on)}$ reduction
- Reduction of package inductance



Al straps

Chip development



Package development



③ Ultra High-Speed U-MOS III Series **NEW**

■ Characteristics

- Low gate switch charge: 14% reduction compared to high-speed U-MOS III
- Low On-resistance (Al straps): 34% reduction compared to high-speed U-MOS III
- Housed in SOP Advance, high current, thin and excellent heat dissipated package

► **43% $R_{DS(ON)} \times Q_{sw}$ reduction**
(compared to high-speed U-MOS III)

■ Electrical Characteristics Comparison

	High-Speed U-MOS III TPC8009-H	Ultra High-Speed U-MOS III TPC8017-H
$R_{DS(ON)}(m\Omega)$	11	7.3
$Q_{sw}(nC)$	9.1	7.8
$C_{gd}(pF)$	250	175
$C_{gs}(pF)$	1210	1290
$R_{DS(ON)} \times Q_{sw}(m\Omega \cdot nC)$	100.1	56.9
Capacitance ratio (C_{gd} / C_{gs})	20.7%	13.6%

@ $R_{DS(ON)}$: $V_{GS} = 4.5$ V typ.

Q_{sw} : $V_{DS} = 24$ V typ.

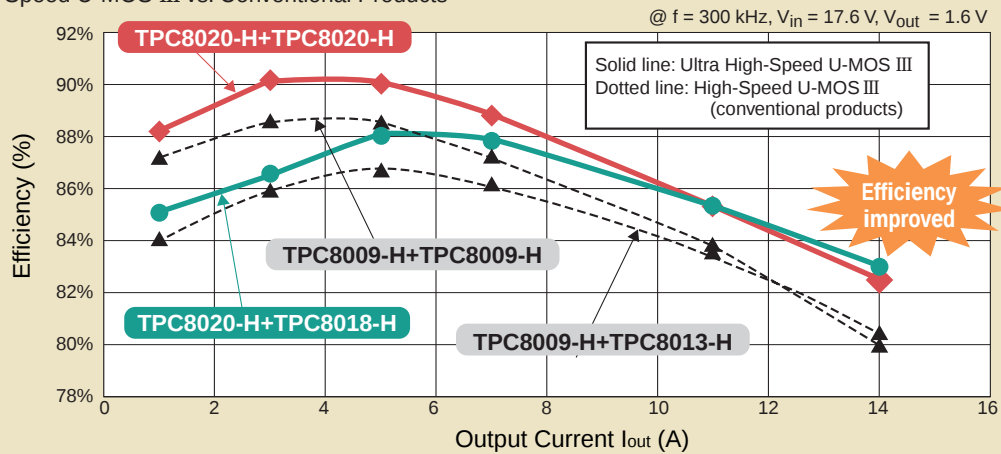
C_{gd}/C_{gs} : $V_{DS} = 10$ V typ.

Performance Index:
improved 43%

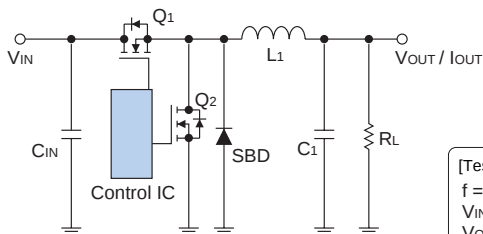
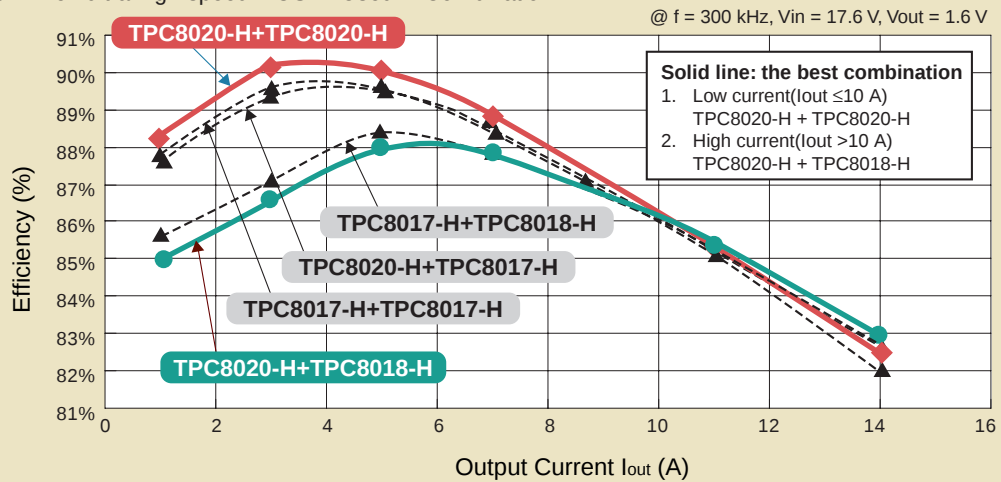
Control shoot-through current

■ DC-DC Converter Efficiency Comparison

- Ultra High-Speed U-MOS III vs. Conventional Products



- Comparison when ultra high-speed MOS III Used in Combination



[Test conditions]
 $f = 300$ kHz
 $V_{in} = 17.6$ V
 $V_{out} = 1.6$ V

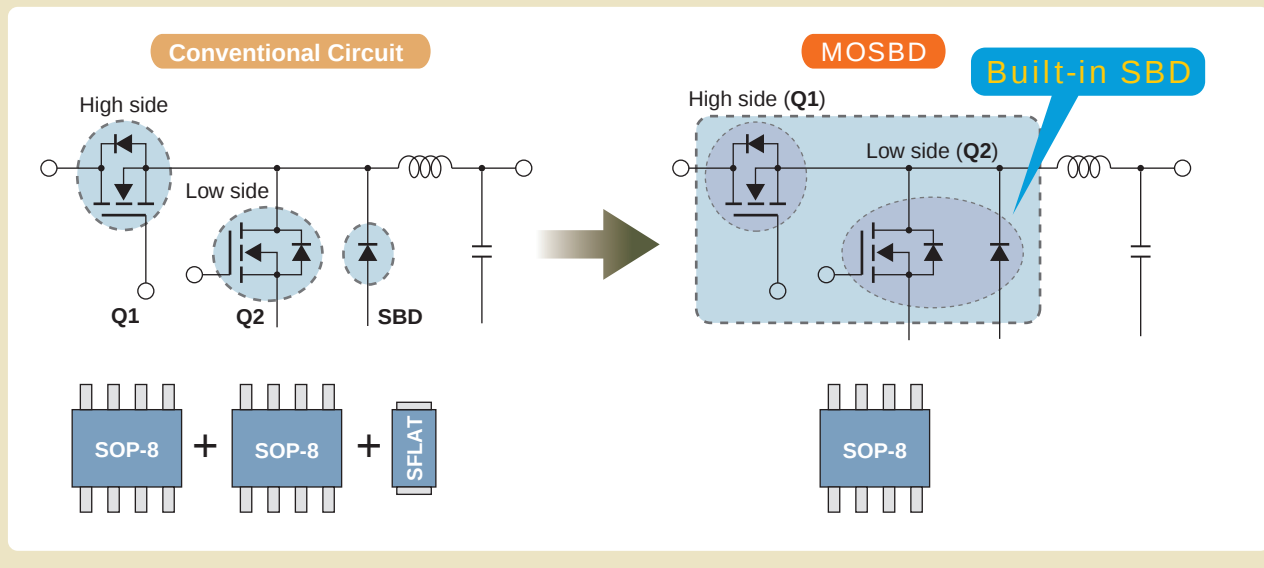
		$R_{DS(ON)}(m\Omega)$ @ $V_{GS} = 4.5$ V	$Q_{sw}(nC)$ @ $V_{DS} = 24$ V
Ultra High-Speed U-MOS III	TPC8020-H	9.5	6.9
	TPC8017-H	7.3	7.8
	TPC8018-H	5.0	12.0
High-Speed U-MOS III	TPC8009-H	11.0	9.1
	TPC8013-H	6.6	15.6

4 Power MOSFET Characteristics

④ MOSBD (MOSFET with SBD) NEW

■ Characteristics

- **Compact size**
Integrated three devices (two MOSFETs and one SBD) into a single package
- **High-performance device**
High side: high-speed MOSFET (high-speed U-MOS III)
Low side: MOSBD (U-MOS III MOSFET with a SBD)



■ Applications

- Portable devices: DC-DC converters for notebook PCs

■ Product Line-up

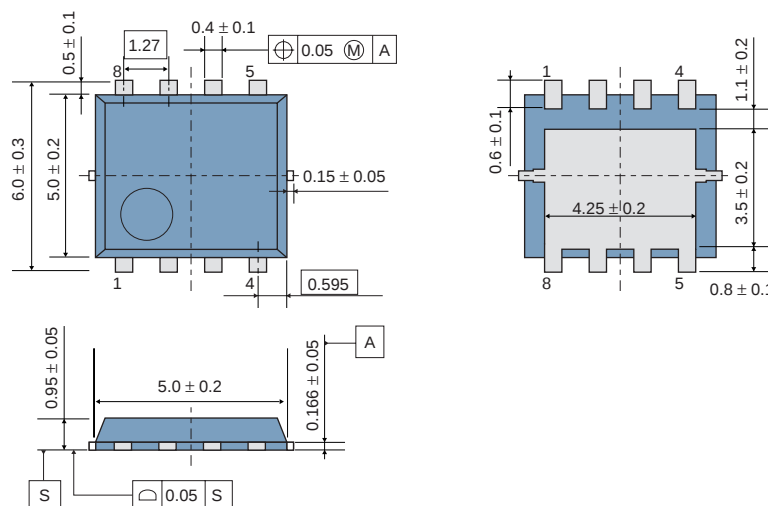
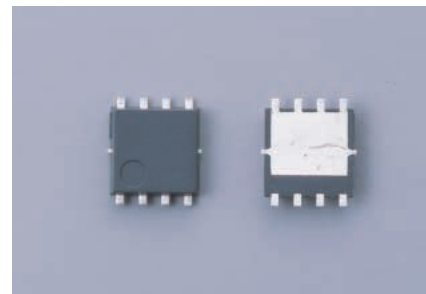
Part Number	Maximum ratings		Circuit Configuration	R _{DS(ON)} max (mΩ)		Q _g typ. (nC)	C _{iss} typ. (pF)	Remark
	V _{DSS} (V)	I _D (A)		10V	4.5V			
TPC8A01	30	6	N-ch/ N-ch+SBD	25	30	17	940	High-speed U-MOS III
	30	8.5/1		18	21	49	2295	U-MOS III

⑤ SOP Advance

NEW

■ Characteristics

- Mounting area is identical with that of SOP-8.
- On-resistance reduction and thin package (1.0 mm max) employing flat leads and Al straps
- Achieved high current and high power dissipation by attaching an exposed heat sink on the bottom of the package
($I_{D(DC)} = 40\text{ A}$, $P_D = 45\text{ W}$)



1,2,3: Source
4: Gate
5,6,7,8: Drain

		SOP-8	SOP Advance	Features of SOP Advance
PCB area	(mm ²)	30	30	The same PCB area as SOP-8
Total height (max)	(mm)	1.9	1.0	Low profile, $t = 0.9\text{ mm}$
$r_{th}(ch-a)$ ($t = 10s$) ^(Note 1)	(°C / W)	65.8	44.6	High-power dissipation
$r_{th}(ch-c)$	(°C / W)	—	2.78	
Current rating	(A)	18	40	High-current guarantee
Package resistance ^(Note 2)	(mΩ)	1.6	0.5	Al straps

Note 1: When mounted on a glass epoxy board (25.4 mm X25.4 mm x1.6 mm) Note 2: without chip resistance

■ Applications

- Portable devices: DC-DC converters for notebook PCs

■ Product Line-up

Part Number	Maximum Ratings		Circuit Configuration	$R_{DS(ON)}$ max(mΩ)			Q_g typ. (nC)	C_{iss} typ. (pF)	Remark
	$V_{DSS}(V)$	$I_D(A)$		10V	4.5V	4.0V			
TPCA8005-H ★	30	27	N-ch Single	9	13	—	24	1395	Ultra high-speed U-MOS III
TPCA8003-H	30	35		6.6	9.5	—	25	1465	Ultra high-speed U-MOS III
TPCA8004-H	30	40		4.6	6.2	—	37	2265	Ultra high-speed U-MOS III
TPCA8102	−30	−40	P-ch Single	6	—	14	109	4600	U-MOS III
TPCA8103	−30	−40		4.2	—	6.8	184	7880	U-MOS IV

★: Under development

4 Power MOSFET Characteristics

⑥ SOP-8 Series Line-up [Part Number: TPC8xxx]

■ Features

- Low On-resistance and high-speed switching series are lined up.
Low On-resistance Series: U-MOS III / IV
High-speed switching series: high-speed U-MOS III, ultra high-speed U-MOS III
- On-resistance reduction employing Al straps



■ Product Line-up

Part Number	Maximum Ratings		Circuit Configuration	R _{DS(ON)} max (mΩ)				Q _g typ. (nC)	C _{iss} typ. (pF)	Remark
	V _{DSS} (V)	I _D (A)		10V	4.5V	4V	2.5V			
TPC8004	30	5	N-ch Single	50	—	80	—	16	475	π-MOS VI
TPC8001	30	7		20	—	30	—	40	1250	π-MOS VI
TPC8006-H	30	7		27	—	40	—	16	790	High-speed U-MOS II
TPC8020-H *★	30	13		9	13	—	—	23	1395	Ultra high-speed U-MOS III
TPC8014	30	11		14	22	—	—	39	1860	U-MOS III
TPC8010-H	30	11		16	25	—	—	18	1020	High-speed U-MOS III
TPC8003	30	13		7	—	13	—	90	4380	U-MOS II
TPC8015-H *	30	13		8	12	—	—	29	1460	High-speed U-MOS III
TPC8017-H *	30	15		6.6	9.5	—	—	25	1465	Ultra high-speed U-MOS III
TPC8016-H *	30	15		5.7	7.5	—	—	46	2380	High-speed U-MOS III
TPC8018-H *	30	18		4.6	6.2	—	—	38	2265	Ultra high-speed U-MOS III
TPC8012-H	200	1.8		400	—	—	—	11	440	π-MOS V
TPC8208	20	5	N-ch Dual	—	—	50	70	9.5	780	U-MOS III
TPC8207	20	6		—	—	20	30	22	2010	U-MOS III
TPC8209	30	5		40	—	60	—	15	600	U-MOS II
TPC8211	30	5.5		36	44	—	—	25	1250	U-MOS III
TPC8203	30	6		21	—	32	—	40	1700	U-MOS II
TPC8210	30	8		15	20	—	—	75	3530	U-MOS III
TPC8206	60	5	P-ch Single	50	—	75	—	17	800	U-MOS II
TPC8104-H	-30	-5		65	—	120	—	17	730	High-speed U-MOS II
TPC8105-H	-30	-7		40	—	60	—	32	1440	High-speed U-MOS II
TPC8109	-30	-10		20	—	30	—	45	2260	U-MOS III
TPC8108	-30	-11		13	—	23	—	77	3510	U-MOS III
TPC8111	-30	-11		12	—	18	—	107	5710	U-MOS IV
TPC8113	-30	-11		10	—	18	—	107	4500	U-MOS IV
TPC8107	-30	-13		7	—	15	—	130	5880	U-MOS III
TPC8112 *	-30	-13		6	—	14	—	130	5880	U-MOS III
TPC8114 *	-30	-18		4.5	—	6.8	—	180	7480	U-MOS IV
TPC8115	-20	-10		—	10	—	14	115	9130	U-MOS IV
TPC8110	-40	-8	P-ch Dual	25	—	35	—	48	2180	U-MOS III
TPC8305	-20	-5		—	30	—	50	24	2030	U-MOS II
TPC8303	-30	-4.5	N-ch/ P-ch	35	—	65	—	28	970	U-MOS II
TPC8401	30	6		21	—	32	—	40	1700	U-MOS II
	-30	-4.5		35	—	65	—	28	970	U-MOS II
TPC8402	30	5		50	—	80	—	16	475	π-MOS VI
	-30	-4.5		35	—	65	—	28	970	U-MOS II
TPC8403	30	6		33	—	46	—	17	850	U-MOS II
	-30	-4.5		55	—	90	—	18	940	U-MOS II
TPC8A01	30	6	N-ch/ N-ch+SBD	25	30	—	—	17	940	High-speed U-MOS III
	30	8.5/1		18	21	—	—	49	2295	U-MOS III

*: Al Strap type ★: Under development

⑦ TSSOP-8 Series Features

■ Features

- Achieved $R_{DS(ON)} = 17\text{m}\Omega$ for TPCS8204 employing U-MOS III design
- Common-drain types are available:
Ideal use for lithium-ion battery protection and reverse current protection

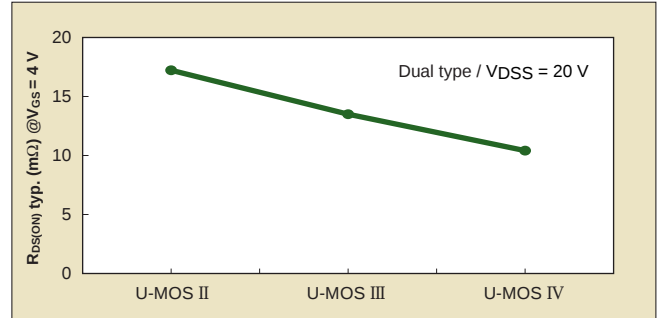


Low On-resistance

★ N-channel 20-V device (TSSOP-8 / dual type)

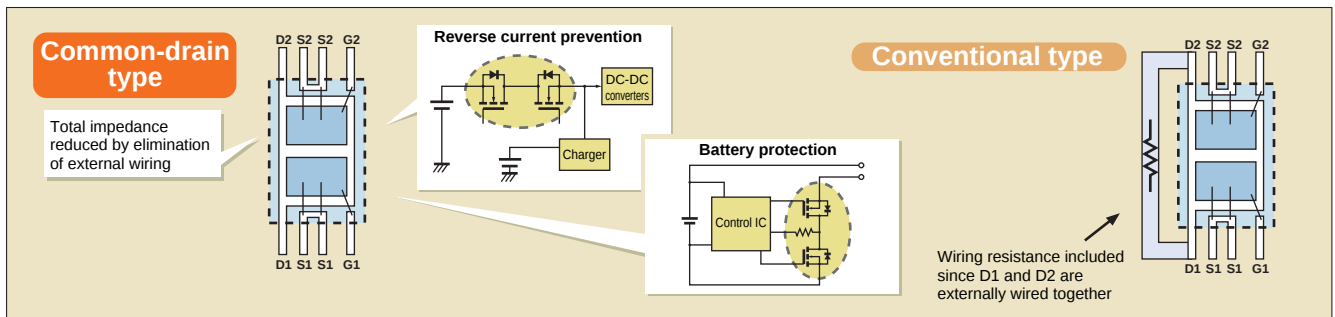
■ Characteristics

- Employed the third generation design of ultra-high cell density trench technology (18 Mcell/cm^2)
- Reduced On-resistance by 25% than that of conventional products (in comparison with Toshiba U-MOS II device)



Common-drain Type

★ Common-drain series suitable for reverse current prevention in mobile devices and lithium ion secondary battery protection



■ Product Line-up

Part Number	Maximum Ratings		Circuit Configuration	$R_{DS(ON)}$ max (mΩ)				Q_g typ. (nC)	C_{iss} typ. (pF)	Remark
	$V_{DS}(V)$	$I_D(A)$		10V	4V	2.5V	2.0V			
TPCS8004	200	1.3	N-ch Single	800	—	—	—	12	380	π -MOS V
TPCS8007 ★	200	1.9		500	—	—	—	10	630	π -MOS V
TPCS8006	250	1.1		1000	—	—	—	11	380	π -MOS V
TPCS8008 ★	250	1.8		550	—	—	—	—	—	π -MOS V
TPCS8102	-20	-6	P-ch Single	—	20	38	—	37	2740	U-MOS II
TPCS8101	-30	-6		25	40	—	—	37	1810	U-MOS II
TPCS8104	-30	-11		12	18	—	—	107	5710	U-MOS IV
TPCS8105	-30	-11		13.5	19.5	—	—	107	5710	U-MOS IV
TPCS8205	20	5	N-ch Dual	—	45	60	90	11	760	U-MOS II
TPCS8209	20	5		—	30	40	60	15	1280	U-MOS III
TPCS8210 *	20	5		—	30	40	60	15	1280	U-MOS III
TPCS8204	20	6		—	17	22	35	22	2160	U-MOS III
TPCS8208 *	20	6		—	17	22	35	22	2160	U-MOS III
TPCS8211	20	6		—	24	29	45	20	1590	U-MOS III
TPCS8212 *	20	6		—	24	29	45	20	1590	U-MOS III
TPCS8302	-20	-6	P-ch Dual	—	35#	60	95	28.5	1590	U-MOS III
TPCS8303	-20	-5		—	21#	30	80	33	2560	U-MOS IV

*: Common-drain ★: Under development

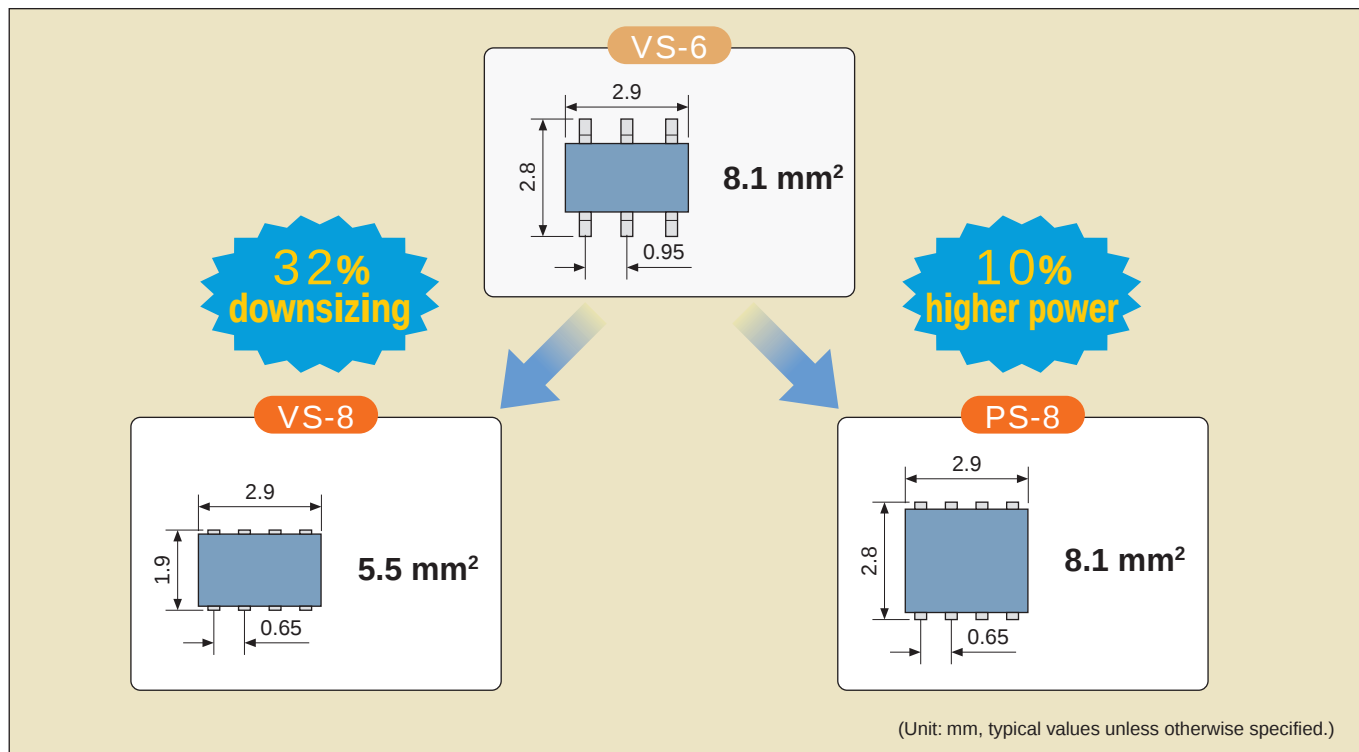
4 Power MOSFET Characteristics

2. VS Series

■ Package

★ The VS Series that achieves the one of the industries' thinnest class package (height: 0.85 mm max).

- VS-6 Series: Standard size (2.9 mm x 1.6 mm) that is suitable for general-purpose use.
- VS-8 Series: The flat package offers more powers as compared with the VS-6 package, and the On-resistance is reduced by 20% while the mounting area is reduced by 32%. In addition, the power dissipation is improved by 14%.
- PS-8 Series: Achieving the same mounting area as the VS-6 Series, PS-8 is improved chip mounting capability, widen mold width using flat leads. This Series is also reduced the On-resistance by 70%.



■ Main Applications

- **DC-DC converters:** notebook PCs, LCDs, PPDAs
- **Switches:** Cell phones, notebook PCs, USB switches, power management switches
- **Motor drives:** HDDs



① VS-6 Series Line-up [Part Number: TPC6xxx]

■ Features

- Achieved ultra low-On resistance employing U-MOS II design
- Zener diode between gate and source for all products
- Thin package whose height is as low as 0.85 mm (max) on a board.

■ Product Line-up

Part Number	Maximum Ratings		Circuit Configuration	R _{DS(ON)} max (mΩ)					Q _g typ. (nC)	C _{iss} typ. (pF)	Marking	Remark
	V _{DSS} (V)	I _D (A)		10V	4.5V	2.5V	2.0V	1.8V				
TPC6001	20	6	N-ch Single	—	30	45	60	—	15	755	S2A	U-MOS II
TPC6004	20	6		—	24	32	37	—	17	1400	S2C	U-MOS III
TPC6002	30	6		30	50	—	—	—	13	610	S2B	U-MOS II
TPC6003	30	6		24	32	—	—	—	25	1250	S2D	U-MOS III
TPC6005	30	6		—	28	35	41	—	19	1420	S2E	U-MOS III
TPC6201	30	2.5	N-ch Dual	95	145	—	—	—	4.7	170	S4A	U-MOS II
TPC6103	-12	-5.5		—	35	55	—	90	20	1520	S3C	U-MOS III
TPC6105	-20	-2.7	P-ch Single	—	110	160	—	300	6	470	S3E	U-MOS III
TPC6101	-20	-4.5		—	60	100	180	—	12	830	S3A	U-MOS II
TPC6104	-20	-5.5		—	40	60	—	120	19	1430	S3D	U-MOS III
TPC6102	-30	-4.5		60	100	—	—	—	11	500	S3B	U-MOS II



② VS-8 Series Line-up [Part Number: TPCF8xxx]

■ Features

- Achieved ultra low-On resistance employing U-MOS III design
- Zener diode between gate and source for all products
- Thin package whose height is as low as 0.85 mm (max) on a board.
- 32% mounting area reduction compared to VS-6 (TSOP-6) employing flat package with high cell density
- P_D = 2.5 W @ t = 5s when a device mounted on a glass epoxy board

■ Product Line-up

Part Number	Maximum Ratings		Circuit Configuration	R _{DS(ON)} max (mΩ)					Q _g typ. (nC)	C _{iss} typ. (pF)	Marking	Remark
	V _{DSS} (V)	I _D (A)		10V	4.5V	2.5V	2.0V	1.8V				
TPCF8001	30	7	N-ch Single	23	31	—	—	—	25.4	1270	F2A	U-MOS III
TPCF8101	-12	-6	P-ch Single	—	28	40	—	85	18	1600	F3A	U-MOS III
TPCF8103	-20	-5.5		—	110	160	—	300	6	470	F3C	U-MOS III
TPCF8102	-20	-6		—	30	41	—	90	19	1550	F3B	U-MOS III
TPCF8104	-30	-6		28	38	—	—	—	34	1760	F3D	U-MOS IV
TPCF8201	20	3	N-ch Dual	—	49	66	100	—	7.5	590	F4A	U-MOS III
TPCF8301	-20	-2.7	P-ch Dual	—	110	160	—	300	6	470	F5A	U-MOS III
TPCF8302	-20	-3		—	59	95	200	—	11	800	F5B	U-MOS IV
TPCF8303	-20	-3		—	58	87	—	250	11	860	F5C	U-MOS IV
TPCF8304	-30	-3.2		72	105	—	—	—	16	600	F5D	U-MOS IV
TPCF8402	30	4	N-ch + P-ch	48	77	—	—	—	10	470	F6B	U-MOS III
	-30	-3.2		72	105	—	—	—	14	600		U-MOS IV
TPCF8A01	20	3.0	N-ch+SBD	—	49	66	100	—	7.5	590	F7A	U-MOS III
TPCF8B01	-20	-2.7	P-ch+SBD	—	110	160	—	300	6	470	F8A	U-MOS III



③ PS-8 Series Line-up [Part Number: TPCP8xxx]

■ Features

- The same mounting area as the VS-6 (TSOP-6) Series
- Using flat leads and the latest process, U-MOS, VS-6 Series is able to offer a 70% R_{DS(ON)} reduction compared to VS-6 Series.
- Zener diode between gate and source

■ Product Line-up

Part Number	Maximum Ratings		Circuit Configuration	R _{DS(ON)} max (mΩ)				Q _g typ. (nC)	C _{iss} typ. (pF)	Remark
	V _{DSS} (V)	I _D (A)		10V	4.5V	2.5V	1.8V			
TPCP8201	30	4.2	N-ch Dual	50	77	—	—	10	470	U-MOS III
TPCP8401	20	0.1	N-ch / P-ch Load Switch	—	3(4V)	4	—	—	9.3	π-MOS VI
	-12	-5.5		—	38	58	103	20	1520	U-MOS III
TPCP8402	30	4.2	N-ch + P-ch	50	77	—	—	10	470	U-MOS III
	-30	-3.4		72	105	—	—	14	600	U-MOS IV
TPCP8J01	-32	-6.0	N-ch + NPN	35	49(4V)	—	—	34	1762	U-MOS IV
	50	0.1		—	—	—	—	—	—	NPN



4 Power MOSFET Characteristics

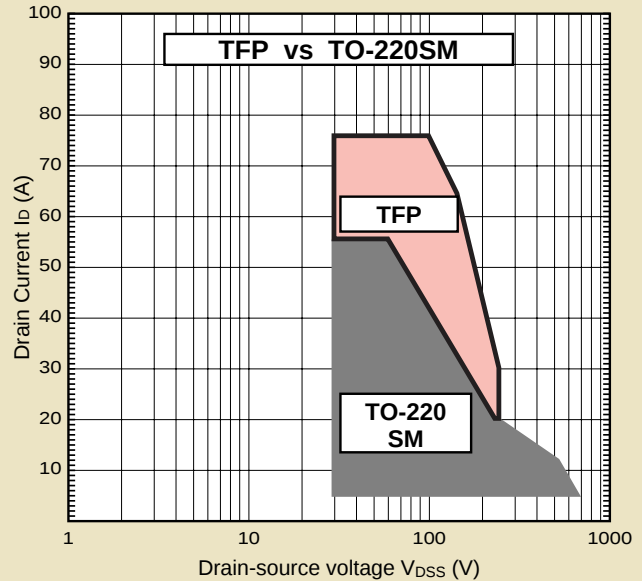
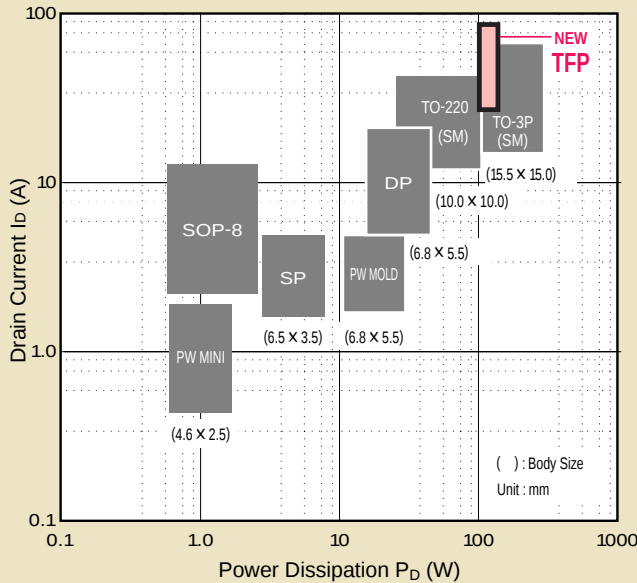
3. TFP (Thin Flat Package) Series

■ Features

TFP ----- Stands for Thin Flat Package

- Thin flat package has a mounting volume 58% less than that of the TO-220SM.
- Separate package inputs and outputs enable stable equipment operation.
- Improved heat dissipation characteristic enables mounting of higher-power devices.

Package range for surface-mount devices



■ Applications

■ DC-DC converters

■ Motherboards

■ Automotive equipment

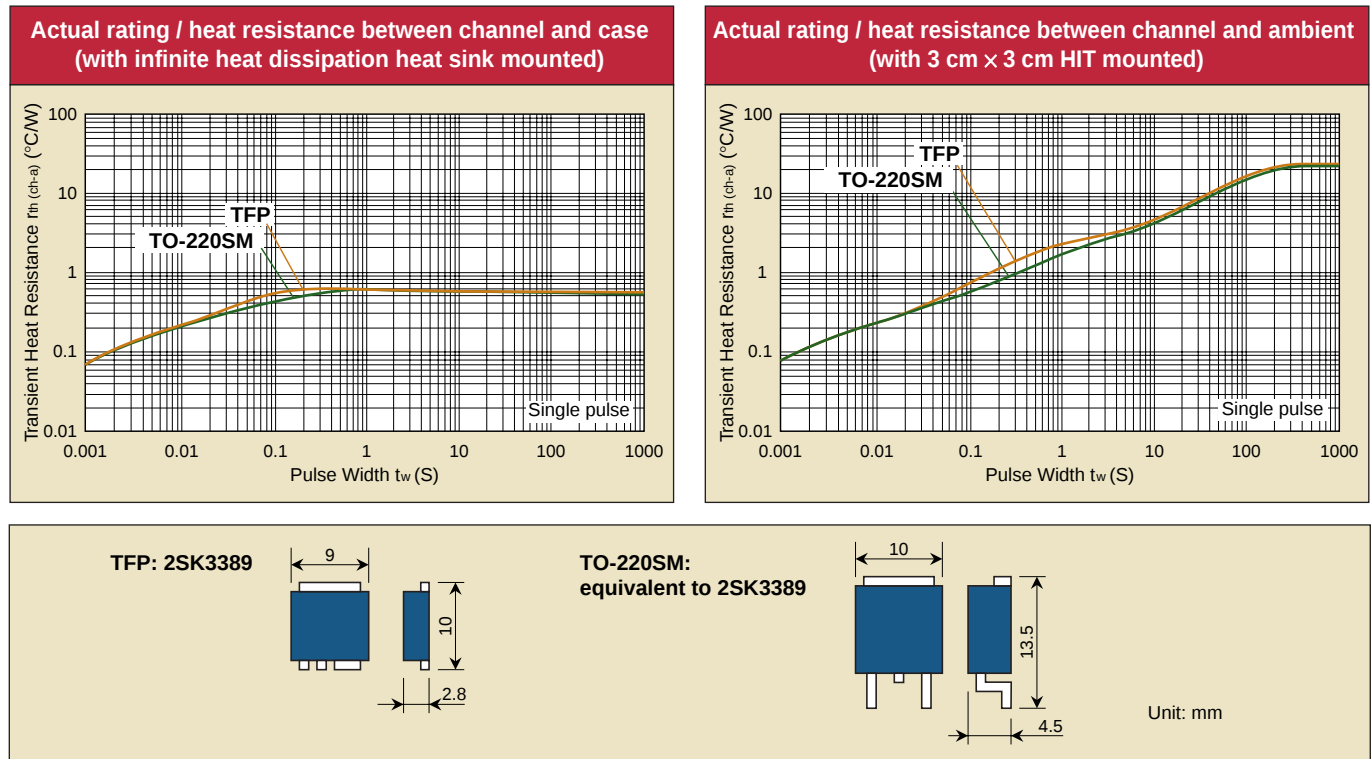
■ TFP line-up

Part Number	Maximum Ratings		RDS(ON) max (mΩ)		Qg typ. (nC)	Ciss typ. (pF)	Remarks
	VDS(V)	ID(A)	VGS=10V	VGS=4V			
2SJ619	-100	-16	210	320	48	1100	L ² -π-MOS V
2SJ620	-100	-18	90	120	140	2900	L ² -π-MOS V
2SK3397	30	70	6.0	-	110	5000	U-MOS II
2SK3389	30	75	5.0	-	62	3530	U-MOS II
2SK3439	30	75	5.0	10.0	116	5450	U-MOS II
2SK3440	60	50	8.0	-	55	3700	U-MOS II
2SK3441	60	75	5.8	10.0	210	9300	U-MOS II
2SK3842 ★	60	75	(5.8)	-	(196)	(12400)	U-MOS III
2SK3442	100	45	20	-	85	4100	U-MOS II
2SK3387	150	18	120	180	57	1380	L ² -π-MOS V
2SK3443	150	30	55	-	45	2030	π-MOS V
2SK3444	200	25	82	-	44	2080	π-MOS V
2SK3388	250	20	105	-	100	4000	π-MOS V
2SK3445	250	20	105	-	45	2090	π-MOS V
2SK3499	400	10	550	-	34	1340	π-MOS V
2SK3544	450	13	400	-	34	1600	π-MOS V
2SK3466	500	5	1500	-	17	780	π-MOS V
2SK3538	500	8	850	-	30	1300	π-MOS V
2SK3398	500	12	520	-	45	2040	π-MOS V
2SK3438	600	10	1000	-	28	1200	π-MOS V

★: Under development

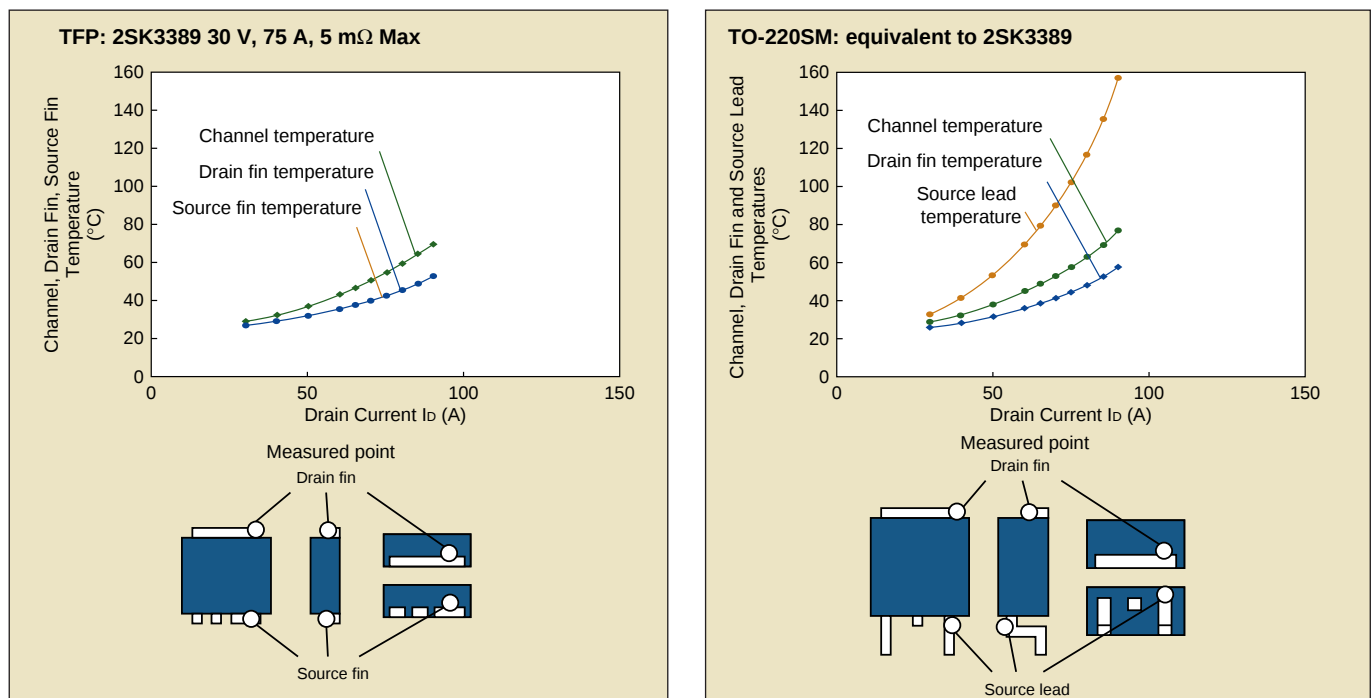
3-1. Heat Dissipation Characteristic

Thermal resistance TFP with mounting area 33% less than that of the TO-220SM offers $R_{th}(ch-c)$ and $R_{th}(ch-a)$ almost equivalent to those of the TO-220SM (when mounted on an HIT board).



Application of DC current (with infinite heat dissipation heat sink mounted)

The source fin of the TFP generates less heat than the source lead of the TO-220SM due to the TFP'S efficient heat dissipation.

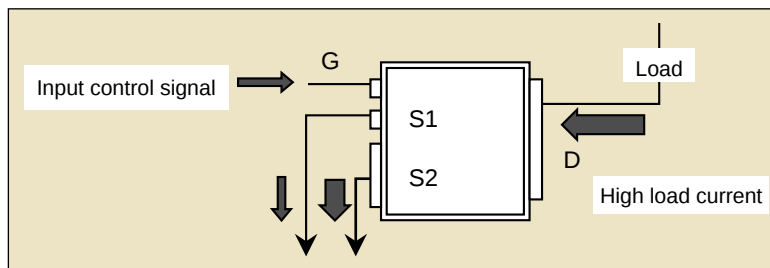


4 Power MOSFET Characteristics

3-2. For Stable Circuit Operation and High-current, High-speed Switching

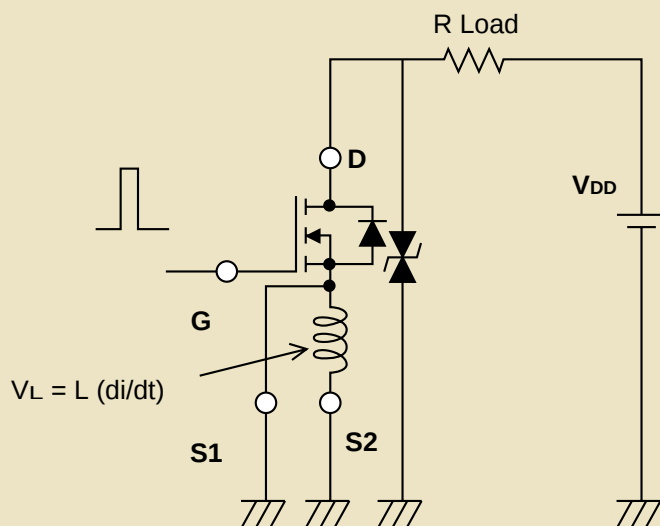
Stable circuit operation

The advantage of MOSFETs is that, because of their high input impedance, they allow high output control with low power drive. However, their disadvantage is that they are susceptible to malfunction due to noise. TFP Series devices have four pins, allowing the input drive to be kept separate from the outputs, thus reducing the risk that the outputs will affect the input.



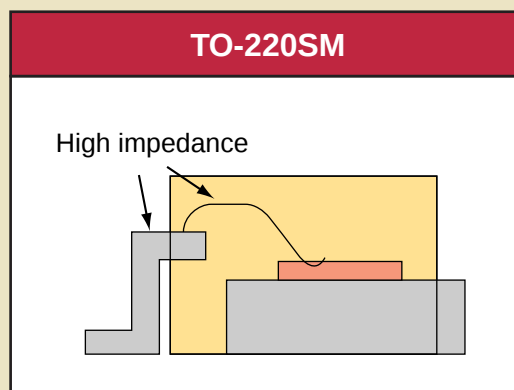
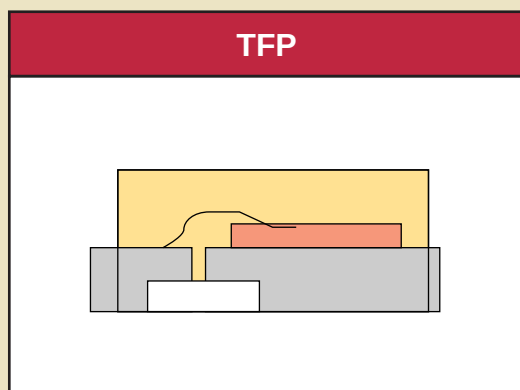
L-component influence on high-current, high-speed switching

Lead impedance, which causes problems with high-current, high-speed switching in DC/DC converters, is reduced.



High-current, high-speed switching increases the influence of the L-component between the source and GND.

Use of the S1 pin for gate input signal return stabilizes circuit operation by eliminating the influence of the L-component.



Switching waveform

The four-pin structure results in a shorter rise time and more stable switching, all of which help to reduce the risk of abnormal oscillation.

When the S1 pin is not used for input signal return (3 pins):

$t_r = 5.4 \text{ ns}$, $t_{on} = 25.1 \text{ ns}$
 V_{DS} turend on at 40%

Shorter rise time

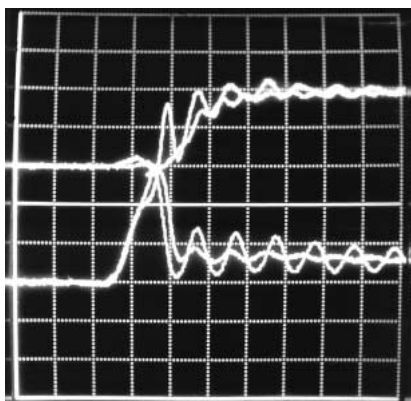
Stable circuit operation



When the S1 pin is used for input signal return (4 pins):

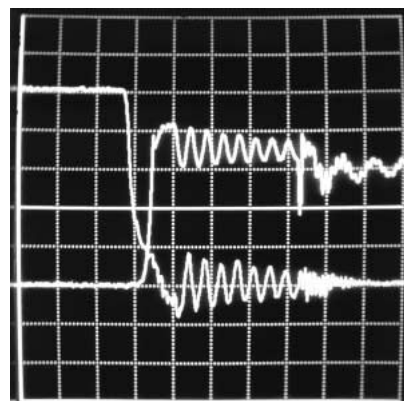
$t_r = 4.6 \text{ ns}$, $t_{on} = 22.1 \text{ ns}$

3-pin, 4-pin



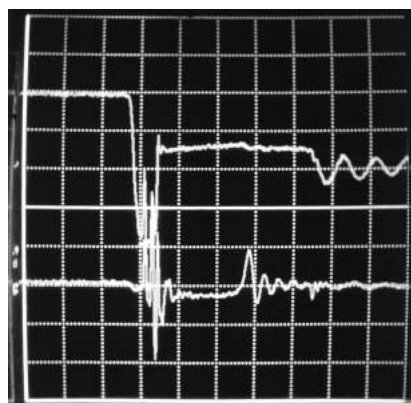
$V_{GS} = 2\text{V/div}$, $V_{DS} = 5\text{V/div}$, $t_w = 20\text{ns/div}$

4-pin



$V_{GS} = 2\text{V/div}$, $V_{DS} = 5\text{V/div}$, $t_w = 100\text{ns/div}$

3-pin



$V_{GS} = 2\text{V/div}$, $V_{DS} = 5\text{V/div}$, $t_w = 100\text{ns/div}$

Insert a coil of $L = 17 \text{ nH}$ between gate and source

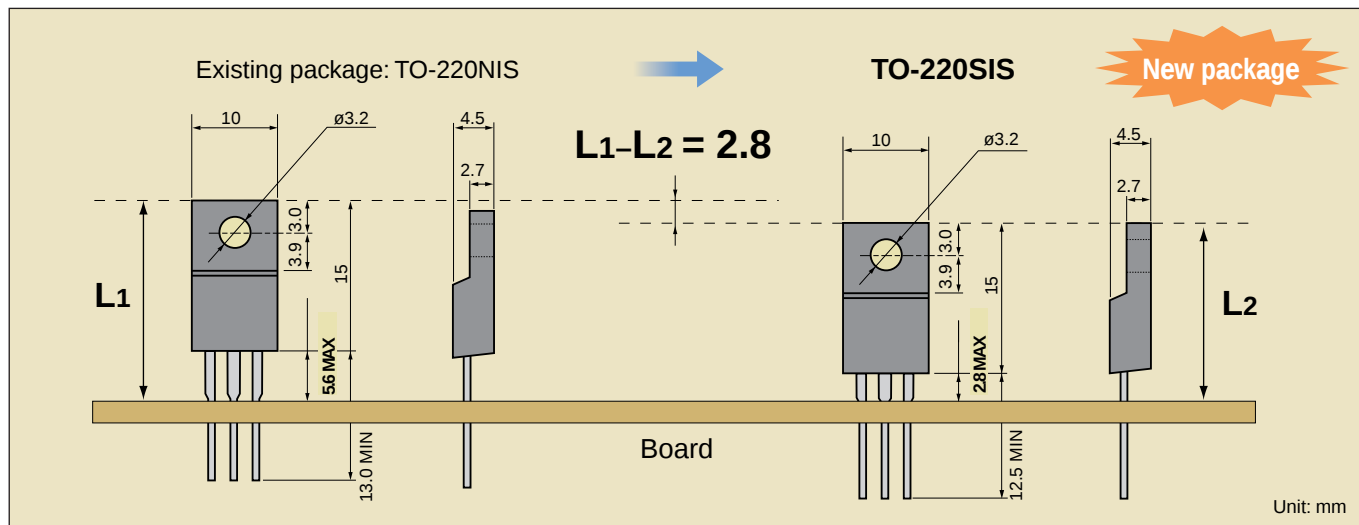
4 Power MOSFET Characteristics

4. TO-220SIS π -MOS IV / VI Series

■ Features

- The shorter the standoff height is achieved, the lower the product height on a PCB will be; hence, the mounting height is reduced by approximately 2.8 mm as compared to the existing package, TO-220NIS. This contributes to equipment's size reduction thinner size.
- The chip design optimization reduced Q_g characteristics. Also, the switching characteristics realized 10-% faster than that of existing products.
- Improved heat dissipation by employing a Cu connector.

■ Package Dimensions

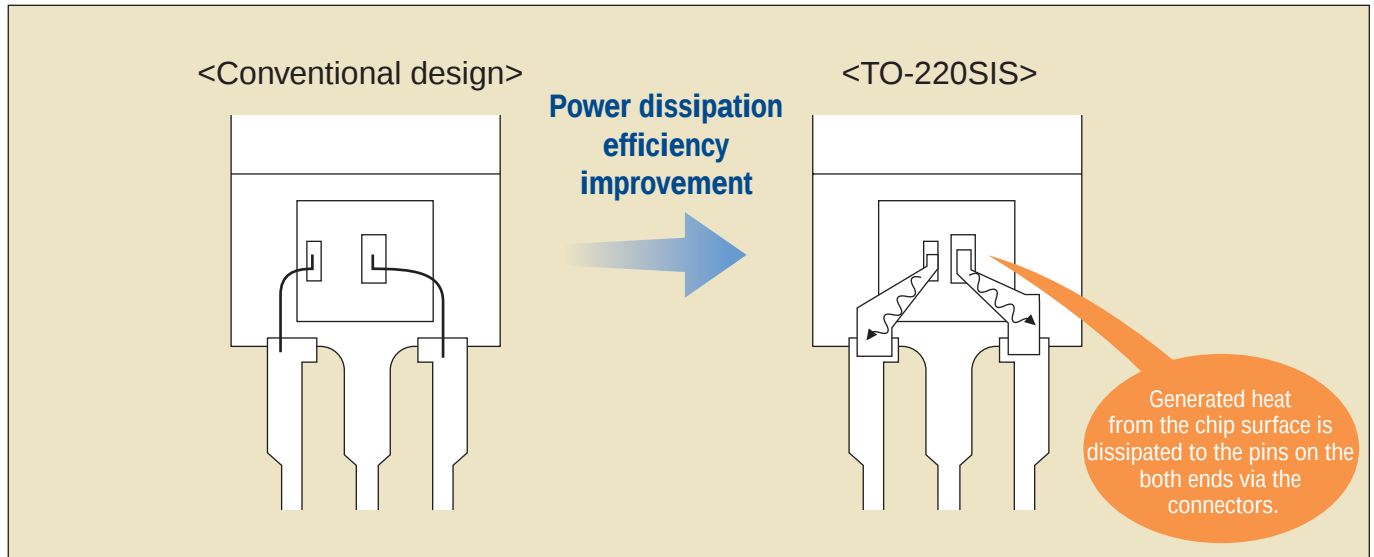


■ Line-up

Series	New Products	Maximum Ratings		$R_{DS(ON)}$ max (Ω)		Q_g typ. (nC)	C_{iss} typ. (pF)	Conventional Products
		V_{DS} (V)	I_D (A)	$V_{GS} = 10V$	$V_{GS} = 4V$			
π -MOS VI	2SK3757 ★	450	2	2.45	—	9	330	2SK3543
	2SK3563	500	5	1.5	—	16	550	2SK2662
	2SK3561		8	0.85	—	28	1050	2SK2543
	2SK3568		12	0.52	—	42	1500	2SK2842
	2SK3767	600	2	4.5	—	9	320	2SK3067
	2SK3567		3.5	2.2	—	17	550	2SK2750
	2SK3562		6	1.25	—	28	1050	2SK2545
	2SK3667		7.5	1.0	—	33	1300	2SK2996
	2SK3569		10	0.75	—	42	1500	2SK2843
	2SK3797 ★		(13)	(0.45)	—	(62)	(3150)	—
π -MOS IV	2SK3566	900	2.5	6.4	—	12	470	2SK2718
	2SK3564		3	4.3	—	17	700	2SK2700
	2SK3798 ★		4	3.5	—	—	—	—
	2SK3565		5	2.5	—	28	1150	2SK2717
	2SK3742		5	2.5	—	25	1150	2SK2717
	2SK3799		(8)	(1.4)	—	—	—	—

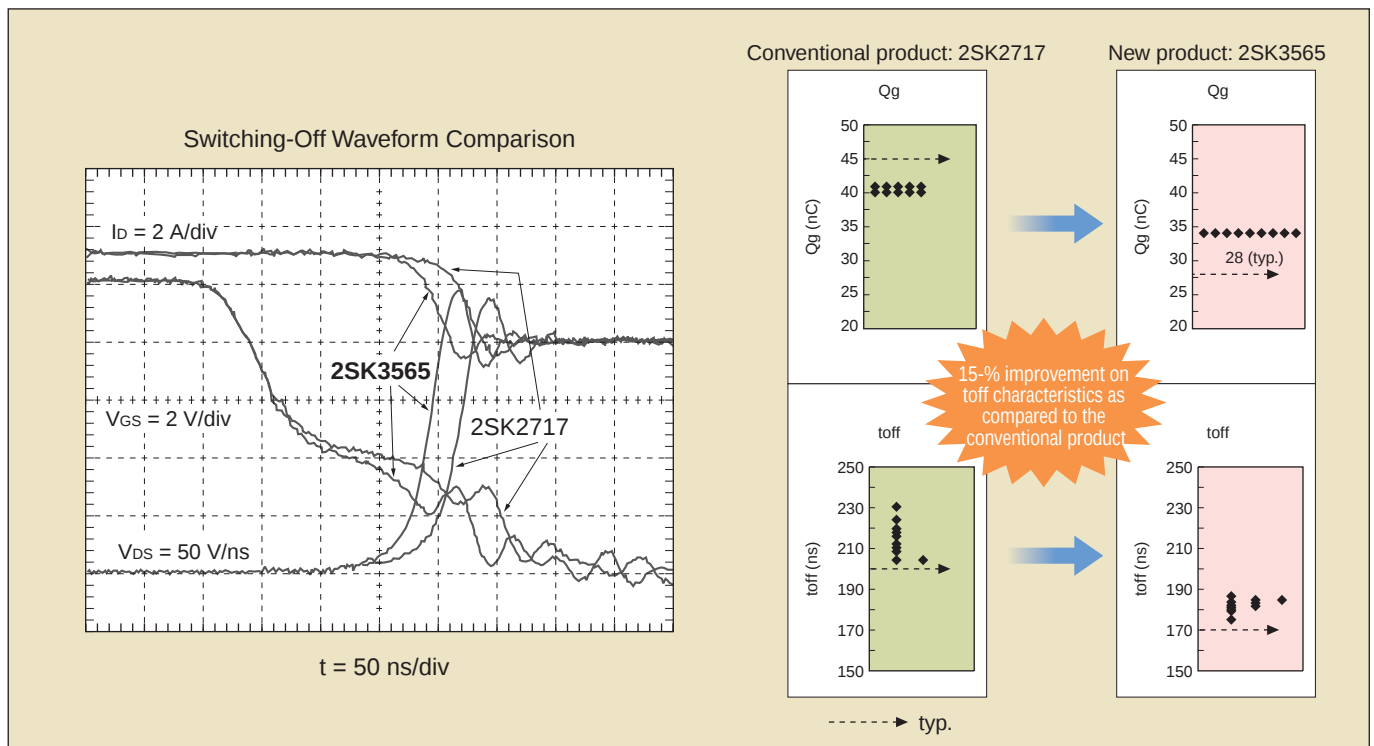
★: Under development

■ Improved Heat Dissipation



■ Comparison of Electrical Characteristics with Conventional and New Products

	Conventional Product 2SK2717	New Products 2SK3565
$V_{DS}(V)$	900	900
$I_D(A)$	5	5
$R_{DS(ON)}(\Omega)$	2.5(max)	2.5(max)
$Q_g(nC)$	45(typ.)	28(typ.)
$t_{off}(ns)$	200(typ.)	170(typ.)



4 Power MOSFET Characteristics

5. L²-π-MOS V Series

■ High-integration (4.4 M cells/inch²), ultra-low On-resistance series based on original technologies

- On-resistance per unit area reduced by 15% (compared to L²-π-MOS IV, R_{DS(ON)} max)
- Operation at logic level voltage [V_{GS} = 4-V drive] (V_{th} = 0.8 V to 2.0 V)
- Avalanche withstand capability guaranteed, superior withstand capability of parasitic diode
- Protection zener diode between gate and source

■ N-ch product line-up

Part Number	V _{DSS} (V)	I _D (A)	P _D (W)	Package Type	R _{DS(ON)} (Ω)				R _{DS(ON)} (Ω)				Qg typ. (nC)
					typ.	max	V _{GS} (V)	I _D (A)	typ.	max	V _{GS} (V)	I _D (A)	
2SK2964	30	2	1.5	PW-Mini	0.13	0.18	10	1	0.18	0.25	4	1	5.8
2SK2844	30	35	60	TO-220AB	0.016	0.02	10	18	0.026	0.035	4	18	40
2SK3089	30	40	50	TO-220FL/SM	0.025	0.03	10	20	—	—	—	—	23
2SK3090	30	45	60	TO-220FL/SM	0.016	0.02	10	25	—	—	—	—	39
2SK3127	30	45	65	TO-220FL/SM	0.0095	0.012	10	25	—	—	—	—	66
2SK3128	30	60	150	TO-3P (N)	0.0095	0.012	10	30	—	—	—	—	66
2SK3125	30	70	150	TO-3P (SM)	0.0053	0.007	10	30	—	—	—	—	130
2SK2989	50	5	0.9	LSTM	0.12	0.15	10	2.5	0.24	0.33	4	1.3	6.5
2SK2614	50	20	40	DP	0.032	0.046	10	10	0.055	0.08	4	5	25
2SK2507	50	25	30	TO-220NIS	0.034	0.046	10	12	0.058	0.08	4	6	25
2SK2886	50	45	40	TO-220NIS	0.014	0.02	10	25	0.027	0.036	4	25	66
2SK3051	50	45	40	TO-220FL/SM	0.024	0.03	10	25	—	—	—	—	36
2SK2744	50	45	125	TO-3P (N)	0.015	0.02	10	25	—	—	—	—	68
2SK2550	50	45	100	TO-3P (N)	0.024	0.030	10	25	—	—	—	—	36
2SK2551	50	50	150	TO-3P (N)	0.0072	0.011	10	25	—	—	—	—	130
2SK2745	50	50	150	TO-3P (N)	0.007	0.0095	10	25	0.011	0.016	4	25	130
2SK2615	60	2	0.5	PW-Mini	0.23	0.3	10	1	0.33	0.44	4	1	6
2SK2961	60	2	0.9	LSTM	0.2	0.27	10	1	0.26	0.38	4	1	5.8
2SK2229	60	5	1.2	TPS	0.12	0.16	10	2.5	0.2	0.3	4	1.3	12
2SK2231	60	5	20	PW-Mold	0.12	0.16	10	2.5	0.2	0.3	4	1.3	12
2SK2782	60	20	40	DP	0.039	0.055	10	10	0.06	0.090	4	5	25
2SK2232	60	25	35	TO-220NIS	0.036	0.046	10	12	0.057	0.08	4	12	38
2SK2311	60	25	40	TO-220FL/SM	0.036	0.046	10	12	0.057	0.08	4	12	38
2SK2385	60	36	40	TO-220 NIS	0.022	0.03	10	18	0.04	0.055	4	15	60
2SK2233	60	45	100	TO-3P (N)	0.022	0.03	10	25	0.04	0.055	4	15	60
2SK2266	60	45	65	TO-220FL/SM	0.022	0.03	10	25	0.04	0.055	4	15	60
2SK2312	60	45	45	TO-220NIS	0.013	0.017	10	25	0.019	0.025	4	25	110
2SK2376	60	45	100	TO-220FL/SM	0.013	0.017	10	25	0.019	0.025	4	25	110
2SK2398	60	45	100	TO-3P (N)	0.022	0.03	10	25	—	—	—	—	60
2SK2173	60	50	125	TO-3P (N)	0.013	0.017	10	25	0.019	0.025	4	25	110
2SK2445	60	50	125	TO-3P (N)	0.014	0.018	10	25	—	—	—	—	110
2SK2267	60	60	150	TO-3P (L)	0.008	0.011	10	30	0.012	0.015	4	30	170
2SK2313	60	60	150	TO-3P (N)	0.008	0.011	10	30	0.012	0.015	4	30	170
2SK2962	100	1	0.9	LSTM	0.5	0.7	10	0.5	0.65	0.95	4	0.5	6.3
2SK2963	100	1	0.5	PW-Mini	0.5	0.7	10	0.5	0.65	0.95	4	0.5	6.3
2SK2200	100	3	1.3	TPS	0.28	0.35	10	2	0.36	0.45	4	2	13.5
2SK2201	100	3	20	PW-Mold	0.28	0.35	10	2	0.36	0.45	4	2	13.5
2SK2399	100	5	20	PW-Mold	0.17	0.23	10	2.5	0.22	0.3	4	2.5	22
2SK2400	100	5	1.2	TPS	0.17	0.23	10	2.5	0.22	0.3	4	2.5	22
2SK2391	100	20	35	TO-220NIS	0.068	0.085	10	10	0.09	0.13	4	10	50
2SK2314	100	27	75	TO-220AB	0.066	0.085	10	15	0.09	0.13	4	15	50
2SK2789	100	27	60	TO-220FL/SM	0.066	0.085	10	15	0.09	0.13	4	15	50

■ P-ch product line-up

Part Number	V _{DSS} (V)	I _D (A)	P _D (W)	Package Type	R _{DS(ON)} (Ω)				R _{DS(ON)} (Ω)				Qg typ. (nC)
					typ.	max	V _{GS} (V)	I _D (A)	typ.	max	V _{GS} (V)	I _D (A)	
2SJ511	−30	−2	1.5	PW-Mini	0.32	0.45	−10	−1	0.55	0.76	−4	−1	5.5
2SJ525	−30	−5	1.3	TPS	0.1	0.12	−10	−2.5	0.17	0.2	−4	−2.5	27
2SJ537	−50	−5	0.9	LSTM	0.16	0.19	−10	−2.5	0.27	0.34	−4	−1.3	18
2SJ360	−60	−1	0.5	PW-Mini	0.55	0.73	−10	−0.5	0.86	1.2	−4	−0.5	6.5
2SJ507	−60	−1	0.9	LSTM	0.5	0.7	−10	−0.5	0.72	1.0	−4	−0.5	5.6
2SJ377	−60	−5	20	PW-Mold	0.16	0.19	−10	−2.5	0.24	0.28	−4	−2.5	22
2SJ438	−60	−5	25	TO-220NIS	0.16	0.19	−10	−2.5	0.24	0.28	−4	−2.5	22
2SJ378	−60	−5	1.2	TPS	0.16	0.19	−10	−2.5	0.24	0.28	−4	−2.5	22
2SJ349	−60	−20	45	TO-220NIS	0.033	0.045	−10	−10	0.05	0.09	−4	−10	90
2SJ401	−60	−20	100	TO-220FL/SM	0.033	0.045	−10	−10	0.05	0.09	−4	−10	90
2SJ334	−60	−30	45	TO-220NIS	0.029	0.038	−10	−15	0.046	0.06	−4	−15	110
2SJ402	−60	−30	100	TO-220FL/SM	0.029	0.038	−10	−15	0.046	0.06	−4	−15	110
2SJ508	−100	−1	1.5	PW-Mini	1.34	1.9	−10	−0.5	1.68	2.5	−4	−0.5	6.3
2SJ509	−100	−1	0.9	LSTM	1.34	1.9	−10	−0.5	1.68	2.5	−4	−0.5	6.3
2SJ380	−100	−12	35	TO-220NIS	0.15	0.21	−10	−6	0.25	0.32	−4	−6	48
2SJ412	−100	−16	60	TO-220FL/SM	0.15	0.21	−10	−6	0.25	0.32	−4	−6	48
2SJ464	−100	−18	45	TO-220NIS	0.064	0.09	−10	−9	0.085	0.12	−4	−9	140

6. 2.5-V Drive π -MOS V Series

■ Features

- 2.5-V drive: Gate drive voltage reduced from 4 V to 2.5 V
- V_{th} = 0.5 V to 1.1 V: Designed to operate at high temperatures with threshold voltage width reduced from 1.2 V to 0.6 V
- Avalanche withstand capability: Built-in protection zener diode between gate and source; cell structure used to improve avalanche withstand capability

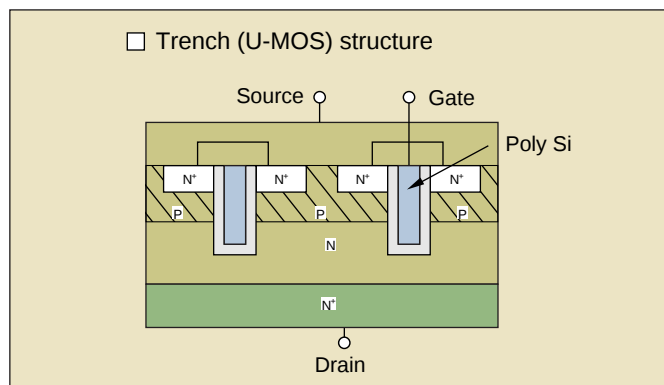
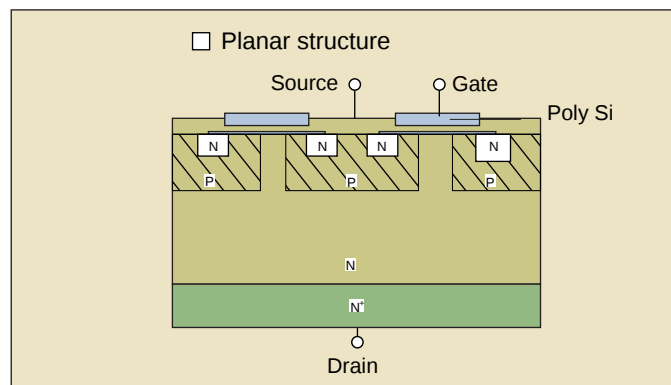
■ Line-up

Part Number	Maximum Ratings			Package Type	R _{DS(ON)}			R _{DS(ON)}			Qg typ. (nC)
	V _{DSS} (V)	I _D (A)	P _D (W)		max (Ω)	V _{GS} (V)	I _D (A)	max (Ω)	V _{GS} (V)	I _D (A)	
2SJ465	−16	−2	0.5	PW-Mini	0.71	−4	−1.0	1.0	−2.5	−0.5	5
2SJ439	−16	−5	20	PW-Mold	0.20	−4	−2.5	0.28	−2.5	−2.5	24
2SK2549	16	2	0.5	PW-Mini	0.29	4	1.0	0.38	2.5	0.5	5
2SK2493	16	5	20	PW-Mold	0.10	4	2.5	0.12	2.5	2.5	23

4 Power MOSFET Characteristics

7. U-MOS III (Trench Type) Series

High-integration is achieved using trench structure technique. Low-voltage driving ($V_{GS} = 4V$) is possible because of ultra-low On-resistance.



■ Features

- High density by the submicron technology (phase I = 10 M cell / inch², phase II = 30 M cell / inch²)
- Reduces 60% $R_{DS(ON)}$ by per unit area (as compared to the maximum $R_{DS(ON)}$ of the conventional L²- π -MOS V)
- Possible to operate by logic level voltage ($V_{GS} = 4V$)
- Avalanche withstanding capability guarantee and progress in di/dt capability.
- Protection zener diode between gate and source

■ Line-up

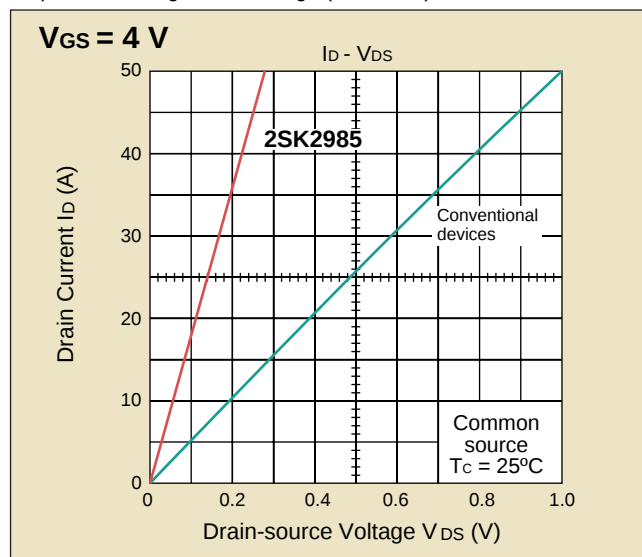
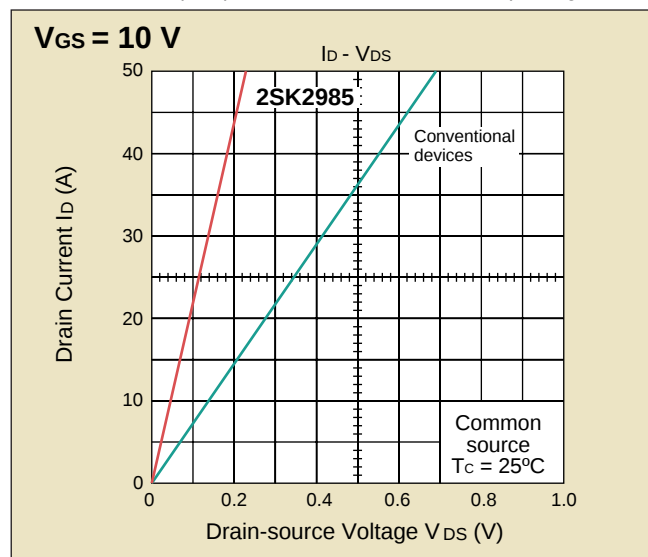
Applications	Part Number	Maximum Ratings			Package Type	$R_{DS(ON)}$ max (m Ω)			$R_{DS(ON)}$ max (m Ω)			Qg typ. (nC)	Remarks
		$V_{DS}(V)$	$I_D(A)$	$P_D(W)$		$V_{GS}(V)$	$I_D(A)$	$V_{GS}(V)$	$V_{GS}(V)$	$I_D(A)$	$V_{GS}(V)$	$I_D(A)$	
Motor drive solenoids Lamp drivers DC-DC converters	2SK2466	100	30	40	TO-220NIS	46	10	15	70	4	15	68	U-MOS I
	2SK3084	100	30	65	TO-220FL/SM	46	10	15	70	4	15	68	U-MOS I
	2SK3236	60	35	30	TO-220NIS	20	10	18	36	4	18	52	U-MOS II
	2SJ668	-60	-5	20	PW-Mold	170	-10	-2.5	250	-4	-2.5	15	U-MOS III
	2SK3662	60	35	35	TO-220NIS	12.5	10	18	19	4	18	91	
	2SK3842	60	75	125	TFP	5.8	10	38	-	-	-	196	
	2SK3844	60	45	45	TO-220NIS	5.8	10	23	-	-	-	196	
	2SK3845	60	70	125	TO-3P(N)	5.8	10	23	-	-	-	196	

■ Features of U-MOS II

[1] Reduces 60% $R_{DS(ON)}$ by per unit area

- $R_{DS(ON)} = 5.8\text{ m (max)}$ MOSFET housed in TO-220 package

- Operate with logic level voltage ($V_{GS} = 4V$)



8. π -MOS VII Series

With employing submicron technology and reducing gate charge, this latest series realized extremely fast speed and low $R_{DS(ON)}$.

■ Features

- Low $R_{DS(ON)}$
- Total gate charge (Q_g) reduction
- Fast speed switching
- High avalanche withstanding capability

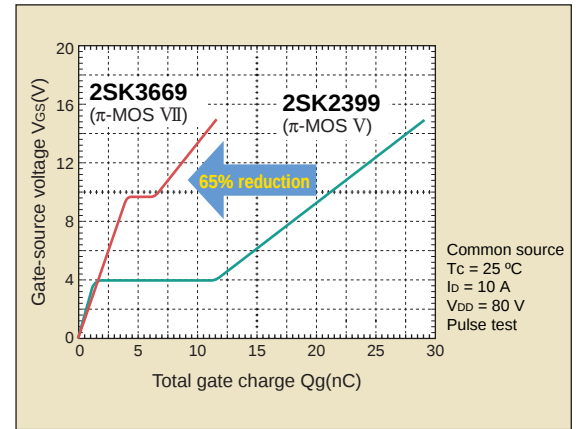
■ Applications

- Digital amps
- DC-DC converters
- Motor drives

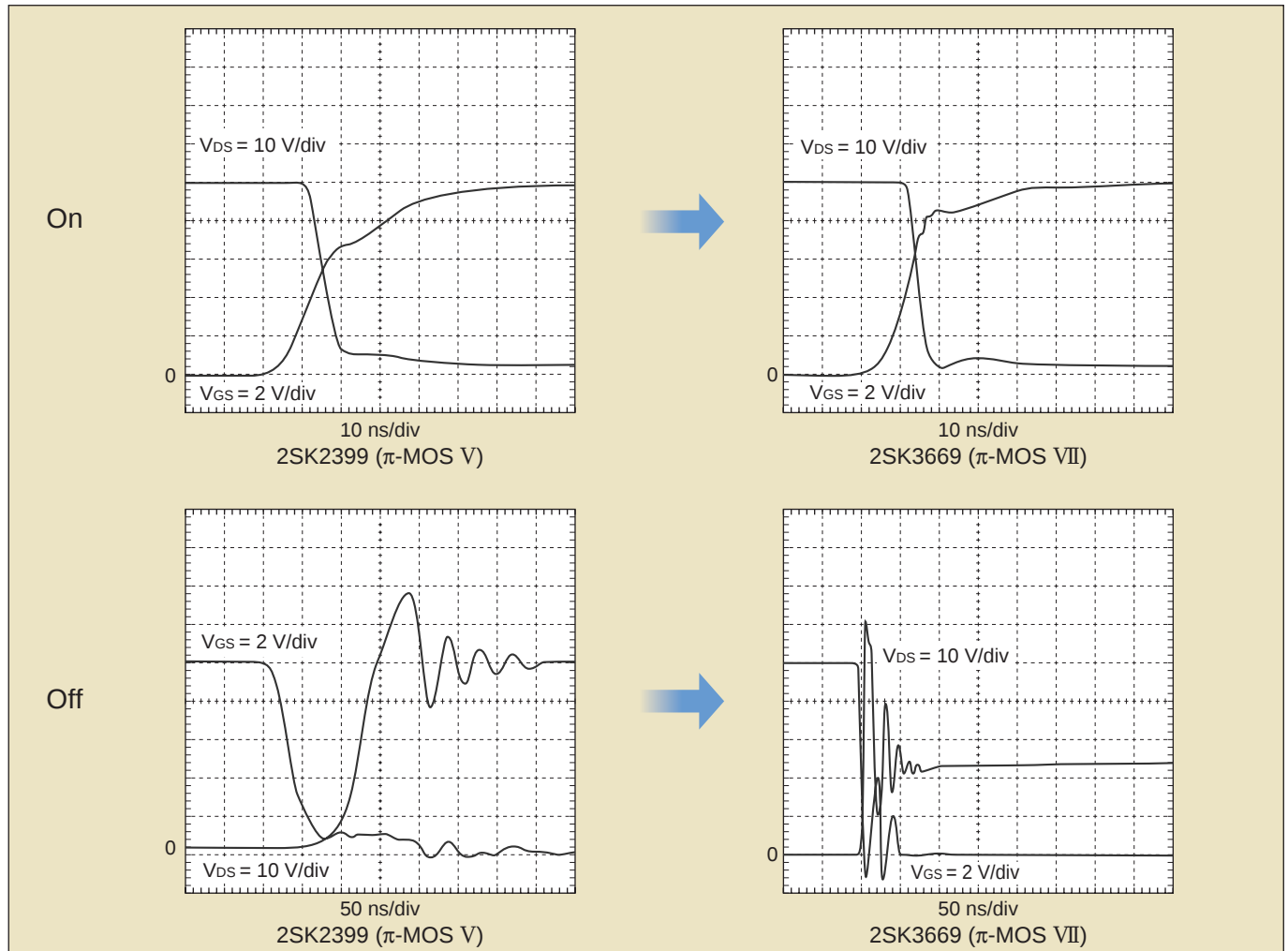
■ Line-up

Part Number	Maximum Ratings		$R_{DS(ON)}$	C_{iss}	C_{rss}	Q_g	Q_{sw}	Package Type
	$V_{DS}(V)$	$I_D(A)$	max (m Ω)	typ. (pF)	typ. (pF)	typ. (nC)	typ. (nC)	
2SK3669	100	10	125	480	9	8.0	4.2	PW-Mold

■ Dynamic Input / Output Characteristics



■ Comparison of Switching Characteristics with π -MOS V



4 Power MOSFET Characteristics

9. π -MOS V Series ($V_{DSS} = 150 \text{ V to } 250 \text{ V}$)

200-V Series for Cs / Cy switching in monitors

■ Features

- Reduced On-resistance per unit area
- Chip size smaller than conventional chips and device cost reduced
- Superior breakdown voltage characteristics due to optimized cell structure
- Guaranteed absolute maximum voltage rating between gate and source: $V_{GSS} = \pm 20 \text{ V}$
- Products with V_{DSS} of 200 suitable for resonance capacitance (Cs/Cy)

■ Line-up

Applications	Part Number	Maximum Ratings			Package Type	R _{DS(ON)}				Q _g typ. (nC)
		V _{DSS} (V)	I _D (A)	P _D (W)		(Ω)		V _{GS} (V)	I _D (A)	
						typ.	max			
DC-DC converters Monitors Motor controllers	2SJ618	−180	−10	130	TO-3P(N)	−	0.37	−10	−5	18
	2SK407	−200	−5	30	TO-220NIS	0.8	1.0	−10	−2.5	20
	2SJ567		−2.5	20	PW-Mold	1.6	2.0	−10	−1.5	10
	2SJ610	−250	−2	20	PW-Mold	1.85	2.55	−10	−1.0	24
	2SJ512		−5	30	TO-220NIS	1.0	1.25	−10	−2.5	22
	2SJ516		−6.5	35	TO-220NIS	0.6	0.8	−10	−3	29
	2SK3205	150	5	20	PW-Mold	0.36	0.5	10	2.5	12
	2SK2882		18	45	TO-220NIS	0.08	0.12	10	9	57
	2SK3497	180	10	130	TO-3P(N)	−	0.15	10	5	−
	2SK2992	200	1	1.5	PW-Mini	2.2	3.5	10	0.5	3
	2SK2835		5	1.3	TPS	0.56	0.8	10	2.5	10
	2SK2381		5	25	TO-220NIS	0.56	0.8	10	2.5	10
	2SK2920		5	20	PW-Mold	0.56	0.8	10	2.5	10
	2SK2350		8.5	30	TO-220NIS	0.26	0.4	10	5	17
	2SK2965		11	35	TO-220NIS	0.15	0.26	10	5.5	30
	2SK2382		15	45	TO-220NIS	0.13	0.18	10	10	40
	2SK2401		15	75	TO-220FL/SM	0.13	0.18	10	10	40
	2SK3176	250	30	150	TO-3P(N)	0.038	0.052	10	15	125
	2SK3462		3	20	PW-Mold	1.2	1.7	10	1.5	12
	2SK3342		4.5	20	PW-Mold	0.8	1.0	10	2.5	10
	2SK2417		7.5	30	TO-220NIS	0.42	0.5	10	3.5	20
	2SK2914		7.5	20	TO-220AB	0.42	0.5	10	3.5	20
	2SK2508		13	45	TO-220NIS	0.18	0.25	10	6.5	40
	2SK2598		13	60	TO-220FL/SM	0.18	0.25	10	6.5	40
	2SK2993		20	100	TO-220FL/SM	0.082	0.105	10	10	100
	2SK2967		30	150	TO-3P(N)	0.048	0.068	10	15	132
	2SK2995		30	90	TO-3P(N)IS	0.048	0.068	10	15	132

10. π -MOS V Series ($V_{DSS} = 400\text{ V to }700\text{ V}$)

High-performance series for 100-V AC input-switching power supplies

■ Features

- Low-drive-power, high-speed (Q_g reduced by 40%, t_f by 30%)
- Guaranteed $V_{GSS} = \pm 30\text{ V}$ for every device in product line
- Avalanche withstand capability guaranteed, superior withstand capability of parasitic diode
- Protection zener diode between gate and source

■ Line-up

Applications	Part Number	Maximum Ratings			Package Type	R _{DS(ON)}				Q _g typ. (nC)
		V _{DSS} (V)	I _D (A)	P _D (W)		(Ω)		V _{GS} (V)	I _D (A)	
						typ.	max			
AC 115 V switching power supplies Ballast inverters Motor controllers	2SK3498	400	1	20	PW-Mold	4.2	5.5	10	0.5	5.7
	2SK2679	400	5.5	35	TO-220NIS	0.84	1.2	10	3	17
	2SK2838	400	5.5	40	TO-220FL/SM	0.84	1.2	10	3	17
	2SK2952	400	8.5	40	TO-220NIS	0.4	0.55	10	5	34
	2SK2841	400	10	80	TO-220AB	0.4	0.55	10	5	34
	2SK2949	400	10	80	TO-220FL/SM	0.4	0.55	10	5	34
	2SK3472	450	1	20	PW-Mold	4.0	4.6	10	0.5	5
	2SK3126	450	10	40	TO-220NIS	0.48	0.65	10	5	35
	2SK2998	500	0.5	0.9	LSTM	10	18	10	0.25	3.8
	2SK3302	500	0.5	1.3	TPS	10	18	10	0.25	3.8
	2SK3471	500	0.5	0.5	PW-Mini	10	18	10	0.25	3.8
	2SK2599	500	2	1.3	TPS	2.9	3.2	10	1	9
	2SK2862	500	3	25	TO-220NIS	2.9	3.2	10	1	9
	2SK2661	500	5	75	TO-220AB	1.35	1.5	10	2.5	17
	2SK2662	500	5	35	TO-220NIS	1.35	1.5	10	2.5	17
	2SK2991	500	5	50	TO-220FL/SM	1.35	1.5	10	2.5	17
	2SK2542	500	8	80	TO-220AB	0.75	0.85	10	4	30
	2SK2543	500	8	40	TO-220NIS	0.75	0.85	10	4	30
	2SK2776	500	8	65	TO-220FL/SM	0.75	0.85	10	4	30
	2SK2601	500	10	125	TO-3P(N)	0.56	1.0	10	5	30
	2SK2842	500	12	40	TO-220NIS	0.4	0.52	10	6	45
	2SK3068	500	12	100	TO-220FL/SM	0.4	0.52	10	6	45
	2SK2916	500	14	80	TO-3P(N)IS	0.35	0.4	10	7	58
	2SK2698	500	15	150	TO-3P(N)	0.35	0.4	10	7	58
	2SK2917	500	18	90	TO-3P(N)IS	0.21	0.27	10	10	80
	2SK2837	500	20	150	TO-3P(N)	0.21	0.27	10	10	80
	2SK3117	500	20	150	TO-3P(SM)	0.21	0.27	10	10	80
	2SK3132	500	50	250	TO-3P(L)	0.07	0.095	10	25	280
	2SK3371	600	1	20	PW-Mold	6.4	9.0	10	0.5	9
	2SK2846	600	2	1.3	TPS	4.2	5.0	10	1	9
	2SK2865	600	2	20	PW-Mold	4.2	5.0	10	1	9
	2SK3067	600	2	25	TO-220NIS	4.2	5.0	10	1	9
	2SK2750	600	3.5	35	TO-220NIS	1.7	2.2	10	1.8	20
	2SK3085	600	3.5	75	TO-220AB	1.7	2.2	10	1.8	20
	2SK2544	600	6	80	TO-220AB	0.9	1.25	10	3	30
	2SK2545	600	6	40	TO-220NIS	0.9	1.25	10	3	30
	2SK2777	600	6	65	TO-220FL/SM	0.9	1.25	10	3	30
	2SK2602	600	6	125	TO-3P(N)	0.9	1.25	10	3	30
	2SK2996	600	10	45	TO-220NIS	0.74	1.0	10	5	38
	2SK2843	600	10	45	TO-220NIS	0.54	0.75	10	5	45
	2SK2866	600	10	125	TO-220AB	0.54	0.75	10	5	45
	2SK2889	600	10	100	TO-220FL/SM	0.54	0.75	10	5	45
	2SK2699	600	12	150	TO-3P(N)	0.5	0.65	10	6	58
	2SK2953	600	15	90	TO-3P(N)IS	0.31	0.4	10	8	80
	2SK2915	600	16	150	TO-3P(N)	0.31	0.4	10	8	80
	2SK3265	700	10	45	TO-220NIS	0.72	1.0	10	5	53
	2SK3453	700	10	80	TO-3P(N)IS	0.72	1.0	10	5	53

4 Power MOSFET Characteristics

11. High-Speed π -MOS V Series ($V_{DSS} = 450 \text{ V to } 600 \text{ V}$)

To allow the development of high-efficiency portable equipment, Toshiba has developed two Series of high-speed Power MOSFET devices. The two series are as follows:

The High-Speed Switching Series for AC adapters and switching power supplies

The High-Speed Diode Series for motor controllers and inverter circuits

- High-Speed Switching Series: Achieves faster switching speed than the existing π -MOS V Series which are currently well-established in the marketplace (t_{off} -switching is 38% faster).
- High-Speed Diode Series: Achieves faster parasitic diode speed by using lifetime control ($t_{rr} \doteq 100 \text{ ns}$).

■ Line-up

- MACH Series

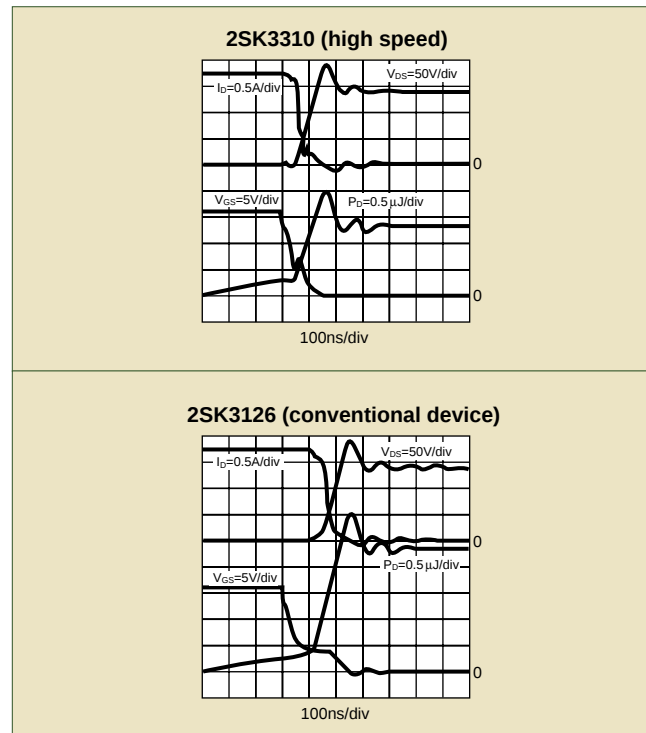
Applications	Part Number	Maximum Ratings			Package Type	$R_{DS(ON)}$ max (Ω)	V_{GS} (V)	I_D (A)	Q_g typ. (nC)	Equivalent Conventional Device
		V_{DSS} (V)	I_D (A)	P_D (W)						
AC adapters Switching power supplies	2SK3310	450	10	40	TO-220NIS	0.65	10	5	23	2SK3126
	2SK3309	450	10	65	TO-220FL/SM	0.65	10	5	23	—
	2SK3403	450	13	100	TO-220FL/SM	0.4	10	6	34	—
	2SK3312	600	6	65	TO-220FL/SM	1.25	10	3	25	—
	2SK3437	600	10	80	TO-220FL/SM	1	10	5	28	2SK2996
	2SK3399	600	10	100	TO-220FL/SM	0.75	10	5	35	2SK2866

- High-speed diode series (HSD Series) line-up

Applications	Part Number	Maximum Ratings			Package Type	$R_{DS(ON)}$ max (Ω)	V_{GS} (V)	I_D (A)	t_{rr} typ. (ns)	Equivalent Conventional Device
		V_{DSS} (V)	I_D (A)	P_D (W)						
Motor controllers Inverters Switching power supplies	2SK3417	500	5	50	TO-220FL/SM	1.8	10	2.5	60	2SK2662
	2SK3316	500	5	35	TO-220NIS	1.8	10	2.5	60	2SK2662
	2SK3313	500	12	40	TO-220NIS	0.62	10	6	90	2SK2842
	2SK3314	500	15	150	TO-3P(N)	0.49	10	7	105	2SK2698
	2SK3131	500	50	250	TO-3P(L)	0.11	10	25	105	2SK3132
	2SK3130	600	6	40	TO-220NIS	1.55	10	3	85	2SK2545

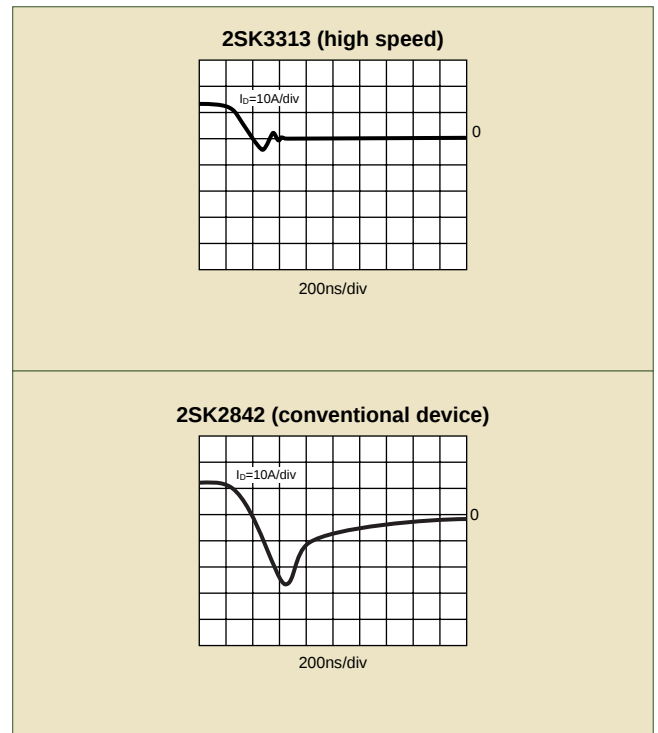
■ Features of MACH Series

Switching loss reduced by 40%



■ Characteristics of high-speed diode series

Faster parasitic diode



12. π -MOS III Series ($V_{DSS} = 800\text{ V to }1000\text{ V}$)

High-performance, high-speed devices for 200-V AC input-switching power supplies

■ Features

- Low drive-power, high-speed devices (Q_g reduced by 60%, t_f reduced by 25%)
- Guaranteed $V_{GS} = \pm 30\text{ V}$.
- Avalanche withstand capability guaranteed, superior withstand capability of parasitic diode
- Protection zener diode between gate and source

■ Line-up

- π -MOS III

Part Number	Maximum Ratings			Package Type	$R_{DS(ON)}$ (Ω)				Q_g typ. (nC)
	V_{DSS} (V)	I_D (A)	P_D (W)		typ.	max	V_{GS} (V)	I_D (A)	
2SK2603	800	3	100	TO-220AB	3.0	3.6	10	1.5	25
2SK2883	800	3	75	TO-220FL/SM	3.0	3.6	10	15	25
2SK2605	800	5	45	TO-220NIS	1.9	2.2	10	3.0	34
2SK2884	800	5	100	TO-220FL/SM	1.9	2.2	10	3.0	34
2SK2604	800	5	125	TO-3P(N)	1.9	2.2	10	3.0	34
2SK2746	800	7	150	TO-3P(N)	1.3	1.7	10	3.5	55
2SK2606	800	8	85	TO-3P(N)IS	1.0	1.2	10	4.0	68
2SK2607	800	9	150	TO-3P(N)	1.0	1.2	10	4.0	68
2SK3301	900	1	20	PW-Mold	15	20	10	0.5	6
2SK2845	900	1	40	DP	8.0	9.0	10	0.5	15
2SK2733	900	1	60	TO-220AB	8.0	9.0	10	0.5	15
2SK2718	900	2.5	40	TO-220NIS	5.6	6.4	10	1.5	21
2SK2608	900	3	100	TO-220AB	3.73	4.3	10	1.5	25
2SK2700	900	3	40	TO-220NIS	3.7	4.3	10	1.5	25
2SK2719	900	3	125	TO-3P(N)	3.7	4.3	10	1.5	25
2SK2610	900	5	150	TO-3P(N)	2.3	2.5	10	3.0	45
2SK2717	900	5	45	TO-220NIS	2.3	2.5	10	3.0	45
2SK3700	900	5	45	TO-220NIS	2.0	2.5	10	2.5	28
2SK2749	900	7	150	TO-3P(N)	1.1	1.4	10	3.5	55
2SK2847	900	8	85	TO-3P(N)IS	1.05	1.25	10	4.0	58
2SK3017	900	8.5	90	TO-3P(N)IS	1.2	1.4	10	4.0	70
2SK2611	900	9	150	TO-3P(N)	1.05	1.25	10	4.0	58
2SK2968	900	10	150	TO-3P(N)	1.4	1.7	10	4.0	70
2SK2613	1000	8	150	TO-3P(N)	1.4	1.7	10	8.0	65

- π -MOS IV

Part Number	Maximum Ratings			Package Type	$R_{DS(ON)}$ (Ω)				Q_g typ. (nC)
	V_{DSS} (V)	I_D (A)	P_D (W)		typ.	max	V_{GS} (V)	I_D (A)	
2SK3633	800	7	150	TO-3P(N)	1.35	1.7	10	3.5	35
2SK3473	900	9	150	TO-3P(N)	1.3	1.6	10	4.0	38

5 Power Modules

Power modules enable high-density mounting and are the simples of all multi-chip devices in structural terms. Use of these modules enables the construction of compact power supplies for electronic equipment.

■ Line-up

• S-10M Series (4in1)

Polarity and Circuit Configuration	Part Number	Maximum Ratings			Electrical Characteristics (Ta = 25°C)				4-V Drive
		V _{BSS} (V)	I _D (A)	P _T (Ta = 25°C) (W)	R _{DS(ON)} (Ω)		V _{GS} (V)	I _D (A)	
					(typ.)	(max)			
N-ch x 4	MP4210	60	5	4	0.12	0.16	10	2.5	○
	MP4209	100	3	4	0.28	0.35	10	2.0	○
P-ch x 4	MP4211	−60	−5	4	0.16	0.19	−10	−2.5	○
	MP4208	−60	−5	4	0.20	0.30	−10	−2.5	○
N-ch x 2 + P-ch x 2	MP4212	60	5	4	0.12	0.16	10	2.5	○
		−60	−5		0.16	0.19	−10	−2.5	

• S-12M Series (4in1, 6in1)

Polarity and Circuit Configuration	Part Number	Maximum Ratings			Electrical Characteristics (Ta = 25°C)				4-V Drive
		Vbss (V)	Id (A)	PT (Ta = 25°C) (W)	RDS(ON) (Ω)		VGS (V)	Id (A)	
					(typ.)	(max)			
N-ch x 2 + P-ch x 2 with FB-Di	MP4411	100	3	4.4	0.28	0.35	10	2.0	○
	MP4412	100	5	4.4	0.17	0.23	10	2.5	○
N-ch x 4	MP4410	60	5	4.4	0.12	0.16	10	2.5	○
N-ch x 3 + P-ch x 3	MP6404	60	5	4.4	0.12	0.16	10	2.5	○
		−60	−5		0.16	0.19	−10	−2.5	

• F-12M Series (4in1, 6in1)

Polarity and Circuit Configuration	Part Number	Maximum Ratings			Electrical Characteristics (Ta = 25°C)				4-V Drive
		Vbss (V)	Id (A)	P _τ (Ta = 25°C) (W)	RDS(ON) (Ω)		VGS (V)	Id (A)	
					(typ.)	(max)			
N-ch x 2 + P-ch x 2 with FB-Di	MP4711	100	5	36	0.17	0.23	10	2.5	○

6 Power MOSFET Product List

Part Number	Series	Package Type	Main Characteristics			Page
			V _{DSS} (V)	I _D (A)	R _{DS(ON)} max (Ω)	
2SJ200	π-MOSⅡ	TO-3P(N)	− 180	− 10	0.83	—
2SJ201	π-MOSⅡ	TO-3P(N)	− 200	− 12	0.63	—
2SJ304	L ² -π-MOSⅣ	TO-220NIS	− 60	− 14	0.12	—
2SJ312	L ² -π-MOSⅣ	TO-220FL/SM	− 60	− 14	0.12	—
2SJ313	π-MOSⅡ	TO-220NIS	− 180	− 1	5.0	—
2SJ315	L ² -π-MOSⅣ	PW-Mold	− 60	− 5	0.25	—
2SJ334	L ² -π-MOSⅤ	TO-220NIS	− 60	− 30	0.038	P 25
2SJ338	π-MOSⅡ	PW-Mold	− 180	− 1	5.0	—
2SJ349	L ² -π-MOSⅤ	TO-220NIS	− 60	− 20	0.045	P 25
2SJ360	L ² -π-MOSⅤ	PW-Mini	− 60	− 1	0.73	P 25
2SJ377	L ² -π-MOSⅤ	PW-Mold	− 60	− 5	0.19	P 25
2SJ378	L ² -π-MOSⅤ	TPS	− 60	− 5	0.19	P 25
2SJ380	L ² -π-MOSⅤ	TO-220NIS	− 100	− 12	0.21	P 25
2SJ401	L ² -π-MOSⅤ	TO-220FL/SM	− 60	− 20	0.045	P 25
2SJ402	L ² -π-MOSⅤ	TO-220FL/SM	− 60	− 30	0.038	P 25
2SJ407	π-MOSⅤ	TO-220NIS	− 200	− 5	1.0	P 28
2SJ412	L ² -π-MOSⅤ	TO-220FL/SM	− 100	− 16	0.21	P 25
2SJ438	L ² -π-MOSⅤ	TO-220NIS	− 60	− 5	0.19	P 25
2SJ439	π-MOSⅤ	PW-Mold	− 16	− 5	0.2	P 25
2SJ440	π-MOSⅡ	TO-3P(N)IS	− 180	− 9	0.8	—
2SJ464	L ² -π-MOSⅤ	TO-220NIS	− 100	− 18	0.09	P 25
2SJ465	π-MOSⅤ	PW-Mini	− 16	− 2	0.71	P 25
2SJ507	L ² -π-MOSⅤ	LSTM	− 60	− 1	0.7	P 25
2SJ508	L ² -π-MOSⅤ	PW-Mini	− 100	− 1	1.9	P 25
2SJ509	L ² -π-MOSⅤ	LSTM	− 100	− 1	1.9	P 25
2SJ511	L ² -π-MOSⅤ	PW-Mini	− 30	− 2	0.45	P 25
2SJ512	π-MOSⅤ	TO-220NIS	− 250	− 5	1.25	P 28
2SJ516	π-MOSⅤ	TO-220NIS	− 250	− 6.5	0.8	P 28
2SJ525	L ² -π-MOSⅤ	TPS	− 30	− 5	0.12	P 25
2SJ537	L ² -π-MOSⅤ	LSTM	− 50	− 5	0.19	P 25
2SJ567	π-MOSⅤ	PW-Mold	− 200	− 2.5	2.0	P 28
2SJ610	π-MOSⅤ	PW-Mold	− 250	− 2	2.55	P 28
2SJ618	π-MOSⅤ	TO-3P(N)	− 180	− 10	0.37	P 28
2SJ619	L ² -π-MOSⅤ	TFP	− 100	− 16	0.21	P 18
2SJ620	L ² -π-MOSⅤ	TFP	− 100	− 18	0.09	P 18
2SJ668	U-MOSⅢ	PW-Mold	− 60	− 5	0.17	P 26
2SK1119	π-MOSⅡ.5	TO-220AB	1000	4	3.8	—
2SK1120	π-MOSⅡ.5	TO-3P(N)	1000	8	1.8	—
2SK1359	π-MOSⅡ.5	TO-3P(N)	100	5	3.8	—
2SK1365	π-MOSⅡ.5	TO-3P(N)IS	1000	7	1.8	—
2SK1381	L ² -π-MOSⅢ	TO-3P(N)	100	50	0.032	—
2SK1382	L ² -π-MOSⅢ	TO-3P(L)	100	60	0.02	—

Part Number	Series	Package Type	Main Characteristics			Page
			V _{DSS} (V)	I _D (A)	R _{DS(ON)} max (Ω)	
2SK1486	π-MOSⅢ.5	TO-3P(L)	300	32	0.095	—
2SK1489	π-MOSⅢ.5	TO-3P(L)	1000	12	1.0	—
2SK1529	π-MOSⅡ	TO-3P(N)	180	10	0.83	—
2SK1530	π-MOSⅡ	TO-3P(N)	200	12	0.63	—
2SK1544	π-MOSⅢ.5	TO-3P(L)	500	25	0.2	—
2SK1930	π-MOSⅡ.5	TO-220FL/SM	1000	4	3.8	—
2SK2013	π-MOSⅡ	TO-220NIS	180	1	5.0	—
2SK2162	π-MOSⅡ	PW-Mold	180	1	5.0	—
2SK2173	L ² -π-MOSⅤ	TO-3P(N)	60	50	0.017	P 24
2SK2200	L ² -π-MOSⅤ	TPS	100	3	0.35	P 24
2SK2201	L ² -π-MOSⅤ	PW-Mold	100	3	0.35	P 24
2SK2229	L ² -π-MOSⅤ	TPS	60	5	0.16	P 24
2SK2231	L ² -π-MOSⅤ	PW-Mold	60	5	0.16	P 24
2SK2232	L ² -π-MOSⅤ	TO-220NIS	60	25	0.046	P 24
2SK2233	L ² -π-MOSⅤ	TO-3P(N)	60	45	0.03	P 24
2SK2266	L ² -π-MOSⅤ	TO-220FL/SM	60	45	0.03	P 24
2SK2267	L ² -π-MOSⅤ	TO-3P(L)	60	60	0.011	P 24
2SK2274	π-MOSⅡ.5	TO-220NIS	700	5	1.7	—
2SK2311	L ² -π-MOSⅤ	TO-220FL/SM	60	25	0.046	P 24
2SK2312	L ² -π-MOSⅤ	TO-220NIS	60	45	0.017	P 24
2SK2313	L ² -π-MOSⅤ	TO-3P(N)	60	60	0.011	P 24
2SK2314	L ² -π-MOSⅤ	TO-220AB	100	27	0.085	P 24
2SK2350	π-MOSⅤ	TO-220NIS	200	8.5	0.4	P 28
2SK2376	L ² -π-MOSⅤ	TO-220FL/SM	60	45	0.017	P 24
2SK2381	π-MOSⅤ	TO-220NIS	200	5	0.8	P 28
2SK2382	π-MOSⅤ	TO-220NIS	200	15	0.18	P 28
2SK2385	L ² -π-MOSⅤ	TO-220NIS	60	36	0.03	P 24
2SK2391	L ² -π-MOSⅤ	TO-220NIS	100	20	0.085	P 24
2SK2398	L ² -π-MOSⅤ	TO-3P(N)	60	45	0.03	P 24
2SK2399	L ² -π-MOSⅤ	PW-Mold	100	5	0.23	P 24
2SK2400	L ² -π-MOSⅤ	TPS	100	5	0.23	P 24
2SK2401	π-MOSⅤ	TO-220FL/SM	200	15	0.18	P 28
2SK2417	π-MOSⅤ	TO-220NIS	250	7.5	0.5	P 28
2SK2445	L ² -π-MOSⅤ	TO-3P(N)	60	50	0.018	P 24
2SK2466	U-MOS	TO-220NIS	100	30	0.046	P 26
2SK2467	π-MOSⅡ	TO-3P(N)IS	180	9	0.8	—
2SK2493	π-MOSⅤ	PW-Mold	16	5	0.1	P 25
2SK2507	L ² -π-MOSⅤ	TO-220NIS	50	25	0.046	P 24
2SK2508	π-MOSⅤ	TO-220NIS	250	13	0.25	P 28
2SK2542	π-MOSⅤ	TO-220AB	500	8	0.85	P 29
2SK2543	π-MOSⅤ	TO-220NIS	500	8	0.85	P 29
2SK2544	π-MOSⅤ	TO-220AB	600	6	1.25	P 29

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Part Number	Series	Package Type	Main Characteristics			Page
			V _{DSS} (V)	I _D (A)	R _{DS(ON)} max (Ω)	
2SK2545	π-MOS ∇	TO-220NIS	600	6	1.25	P 29
2SK2549	π-MOS ∇	PW-Mini	16	2	0.29	P 25
2SK2550	L ² -π-MOS ∇	TO-3P(N)	50	45	0.03	P 24
2SK2551	L ² -π-MOS ∇	TO-3P(N)	50	50	0.011	P 24
2SK2598	π-MOS ∇	TO-220FL/SM	250	13	0.25	P 28
2SK2599	π-MOS ∇	TPS	500	2	3.2	P 29
2SK2601	π-MOS ∇	TO-3P(N)	500	10	1.0	P 29
2SK2602	π-MOS ∇	TO-3P(N)	600	6	1.25	P 29
2SK2603	π-MOS III	TO-220AB	800	3	3.6	P 31
2SK2604	π-MOS III	TO-3P(N)	800	5	2.2	P 31
2SK2605	π-MOS III	TO-220NIS	800	5	2.2	P 31
2SK2606	π-MOS III	TO-3P(N)IS	800	8.5	1.2	P 31
2SK2607	π-MOS III	TO-3P(N)	800	9	1.2	P 31
2SK2608	π-MOS III	TO-220AB	900	3	4.3	P 31
2SK2610	π-MOS III	TO-3P(N)	900	5	2.5	P 31
2SK2611	π-MOS III	TO-3P(N)	900	9	1.4	P 31
2SK2613	π-MOS III	TO-3P(N)	1000	8	1.7	P 32
2SK2614	L ² -π-MOS ∇	DP	50	20	0.046	P 24
2SK2615	L ² -π-MOS ∇	PW-Mini	60	2	0.3	P 24
2SK2661	π-MOS ∇	TO-220AB	500	5	1.5	P 29
2SK2662	π-MOS ∇	TO-220NIS	500	5	1.5	P 29
2SK2679	π-MOS ∇	TO-220NIS	400	5.5	1.2	P 29
2SK2698	π-MOS ∇	TO-3P(N)	500	15	0.4	P 29
2SK2699	π-MOS ∇	TO-3P(N)	600	12	0.65	P 29
2SK2700	π-MOS III	TO-220NIS	900	3	4.3	P 29
2SK2717	π-MOS III	TO-220NIS	900	5	2.5	P 29
2SK2718	π-MOS III	TO-220NIS	900	2.5	6.4	P 29
2SK2719	π-MOS III	TO-3P(N)	900	3	4.3	P 29
2SK2733	π-MOS III	TO-220AB	900	1	9.0	P 29
2SK2744	L ² -π-MOS ∇	TO-3P(N)	50	45	0.02	P 24
2SK2745	L ² -π-MOS ∇	TO-3P(N)	50	50	0.0095	P 24
2SK2746	π-MOS III	TO-3P(N)	800	7	1.7	P 31
2SK2749	π-MOS III	TO-3P(N)	900	7	2.0	P 31
2SK2750	π-MOS ∇	TO-220NIS	600	3.5	2.2	P 29
2SK2776	π-MOS ∇	TO-220FL/SM	500	8	0.85	P 29
2SK2777	π-MOS ∇	TO-220FL/SM	600	6	1.25	P 29
2SK2782	L ² -π-MOS ∇	DP	60	20	0.055	P 24
2SK2789	L ² -π-MOS ∇	TO-220FL/SM	100	27	0.085	P 24
2SK2835	π-MOS ∇	TPS	200	5	0.8	P 28
2SK2837	π-MOS ∇	TO-3P(N)	500	20	0.27	P 29
2SK2838	π-MOS ∇	TO-220FL/SM	400	5.5	1.2	P 29
2SK2841	π-MOS ∇	TO-220AB	400	10	0.55	P 29

Part Number	Series	Package Type	Main Characteristics			Page
			V _{DSS} (V)	I _D (A)	R _{DS(ON)} max (Ω)	
2SK2842	π-MOS ∇	TO-220NIS	500	12	0.52	P 29
2SK2843	π-MOS ∇	TO-220NIS	600	10	0.75	P 29
2SK2844	L ² -π-MOS ∇	TO-220AB	30	35	0.02	P 24
2SK2845	π-MOS III	DP	900	1	9.0	P 31
2SK2846	π-MOS ∇	TPS	600	2	5.0	P 29
2SK2847	π-MOS III	TO-3P(N)IS	900	8	1.4	P 31
2SK2862	π-MOS ∇	TO-220NIS	500	3	3.2	P 29
2SK2865	π-MOS ∇	PW-Mold	600	2	5.0	P 29
2SK2866	π-MOS ∇	TO-220AB	600	10	0.75	P 29
2SK2882	π-MOS ∇	TO-220NIS	150	18	0.12	P 28
2SK2883	π-MOS III	TO-220FL/SM	800	3	3.6	P 31
2SK2884	π-MOS III	TO-220FL/SM	800	5	2.2	P 31
2SK2886	L ² -π-MOS ∇	TO-220NIS	50	45	0.02	P 24
2SK2889	π-MOS ∇	TO-220FL/SM	600	10	0.75	P 29
2SK2914	π-MOS ∇	TO-220AB	250	7.5	0.5	P 28
2SK2915	π-MOS ∇	TO-3P(N)	600	16	0.4	P 29
2SK2916	π-MOS ∇	TO-3P(N)IS	500	14	0.4	P 29
2SK2917	π-MOS ∇	TO-3P(N)IS	500	18	0.27	P 29
2SK2920	π-MOS ∇	PW-Mold	200	20	0.8	P 28
2SK2949	π-MOS ∇	TO-220FL/SM	400	10	0.55	P 29
2SK2952	π-MOS ∇	TO-220NIS	400	8.5	0.55	P 29
2SK2953	π-MOS ∇	TO-3P(N)IS	600	15	0.4	P 29
2SK2961	L ² -π-MOS ∇	LSTM	60	2	0.27	P 24
2SK2962	L ² -π-MOS ∇	LSTM	100	1	0.7	P 24
2SK2963	L ² -π-MOS ∇	PW-Mini	100	1	0.7	P 24
2SK2964	L ² -π-MOS ∇	PW-Mini	30	2	0.18	P 24
2SK2965	π-MOS ∇	TO-220NIS	200	11	0.26	P 28
2SK2967	π-MOS ∇	TO-3P(N)	250	30	0.068	P 28
2SK2968	π-MOS III	TO-3P(N)	900	10	1.25	P 29
2SK2985	U-MOS	TO-220NIS	60	45	5.8	P 26
2SK2986	U-MOS	TO-220FL/SM	60	55	5.8	P 26
2SK2987	U-MOS	TO-3P(N)	60	70	5.8	P 26
2SK2989	L ² -π-MOS ∇	LSTM	50	5	0.15	P 22
2SK2991	π-MOS ∇	TO-220FL/SM	500	5	1.5	P 29
2SK2992	π-MOS ∇	PW-Mini	200	1	3.5	P 28
2SK2993	π-MOS ∇	TO-220FL/SM	250	20	0.105	P 28
2SK2995	π-MOS ∇	TO-3P(N)IS	250	30	0.068	P 28
2SK2996	π-MOS ∇	TO-220NIS	600	10	1.0	P 29
2SK2998	π-MOS ∇	LSTM	500	0.5	18	P 29
2SK3017	π-MOS III	TO-3P(N)IS	900	8.5	1.25	P 31
2SK3051	L ² -π-MOS ∇	TO-220FL/SM	50	45	0.03	P 24
2SK3067	π-MOS ∇	TO-220NIS	600	2	5.0	P 29

Part Number	Series	Package Type	Main Characteristics			Page
			V _{DSS} (V)	I _D (A)	R _{DS(ON)} max (Ω)	
2SK3068	π-MOSⅤ	TO-220FL/SM	500	12	0.52	P 29
2SK3084	U-MOS	TO-220FL/SM	100	30	0.046	P 26
2SK3085	π-MOSⅤ	TO-220AB	600	3.5	2.2	P 29
2SK3089	L ² -π-MOSⅤ	TO-220FL/SM	30	40	0.03	P 24
2SK3090	L ² -π-MOSⅤ	TO-220FL/SM	30	45	0.02	P 24
2SK3117	π-MOSⅤ	TO-3P(SM)	500	20	0.27	P 29
2SK3125	L ² -π-MOSⅤ	TO-3P(SM)	30	70	0.007	P 24
2SK3126	π-MOSⅤ	TO-220NIS	450	10	0.65	P 29
2SK3127	L ² -π-MOSⅤ	TO-220FL/SM	30	45	0.012	P 24
2SK3128	L ² -π-MOSⅤ	TO-3P(N)	30	60	0.012	P 24
2SK3129	π-MOSⅤI	TO-3P(N)	50	60	0.007	—
2SK3130	π-MOSⅤ	TO-220NIS	600	6	1.55	P 30
2SK3131	π-MOSⅤ	TO-3P(L)	500	50	0.11	P 30
2SK3132	π-MOSⅤ	TO-3P(L)	500	50	0.095	P 29
2SK3176	π-MOSⅤ	TO-3P(N)	200	30	0.052	P 28
2SK3205	π-MOSⅤ	PW-Mold	150	5	0.5	P 28
2SK3236	U-MOSⅡ	TO-220NIS	60	35	0.02	P 26
2SK3265	π-MOSⅤ	TO-220NIS	700	10	1.0	P 29
2SK3301	π-MOSⅢ	PW-Mold	900	1	20	P 31
2SK3302	π-MOSⅤ	TPS	500	0.5	18	P 29
2SK3309	MACH	TO-220FL/SM	450	10	0.65	P 30
2SK3310	MACH	TO-220NIS	450	10	0.65	P 30
2SK3312	π-MOSⅤ	TO-220FL/SM	600	6	1.25	P 30
2SK3313	π-MOSⅤ	TO-220NIS	500	12	0.62	P 30
2SK3314	π-MOSⅤ	TO-3P(N)	500	15	0.49	P 30
2SK3316	π-MOSⅤ	TO-220NIS	500	5	1.8	P 30
2SK3342	π-MOSⅤ	PW-Mold	250	4.5	1.0	P 28
2SK3371	π-MOSⅤ	PW-Mold	600	1	9.0	P 29
2SK3373	π-MOSⅤ	PW-Mold	500	2	3.2	—
2SK3374	π-MOSⅤ	TPS	450	1	4.6	—
2SK3387	L ² -π-MOSⅤ	TFP	150	18	0.012	P 18
2SK3388	π-MOSⅤ	TFP	250	20	0.105	P 18
2SK3389	U-MOSⅡ	TFP	30	75	0.005	P 18
2SK3397	U-MOSⅡ	TFP	30	70	0.006	P 18
2SK3398	π-MOSⅤ	TFP	500	12	0.52	P 18
2SK3399	MACH	TO-220FL/SM	600	10	0.75	P 30
2SK3403	MACH	TO-220FL/SM	450	13	0.4	P 30
2SK3407	π-MOSⅤ	TO-220NIS	450	10	0.65	—
2SK3417	π-MOSⅤ	TO-220FL/SM	500	5	1.8	P 30
2SK3437	MACH	TO-220FL/SM	600	10	1.0	P 30
2SK3438	π-MOSⅤ	TFP	600	10	1.0	P 18
2SK3439	U-MOSⅡ	TFP	30	75	0.005	P 18

Part Number	Series	Package Type	Main Characteristics			Page
			V _{DSS} (V)	I _D (A)	R _{DS(ON)} max (Ω)	
2SK3440	U-MOSⅡ	TFP	60	50	0.008	P 18
2SK3441	U-MOSⅡ	TFP	60	75	0.0058	—
2SK3442	U-MOSⅡ	TFP	100	45	0.02	P 18
2SK3443	π-MOSⅤ	TFP	150	30	0.055	P 18
2SK3444	π-MOSⅤ	TFP	200	25	0.082	P 18
2SK3445	π-MOSⅤ	TFP	250	20	0.105	P 18
2SK3453	π-MOSⅤ	TO-3P(N)IS	700	10	1.0	P 29
2SK3462	π-MOSⅤ	PW-Mold	250	3	1.7	P 28
2SK3466	π-MOSⅤ	TFP	500	5	1.5	P 16
2SK3471	π-MOSⅤ	PW-Mini	500	0.5	18	P 29
2SK3472	π-MOSⅤ	PW-Mold	450	1	4.6	P 29
2SK3473	π-MOSⅤ	TO-3P(N)	900	9	1.6	P 31
2SK3497	π-MOSⅤ	TO-3P(N)	180	10	0.15	P 28
2SK3498	π-MOSⅤ	PW-Mold	400	1	5.5	P 29
2SK3499	π-MOSⅤ	TFP	400	10	0.55	P 18
2SK3506	π-MOSⅤ	TO-3P(N)	30	45	0.02	—
2SK3538	π-MOSⅤ	TFP	500	8	0.85	P 18
2SK3543	π-MOSⅤ	TO-220NIS	450	2	2.45	—
2SK3544	π-MOSⅤ	TFP	450	13	0.4	P 18
2SK3561	π-MOSⅤI	TO-220SIS	500	8	0.85	P 22
2SK3562	π-MOSⅤI	TO-220SIS	600	6	1.25	P 22
2SK3563	π-MOSⅤI	TO-220SIS	500	5	1.5	P 22
2SK3564	π-MOSⅤI	TO-220SIS	900	3	4.3	P 22
2SK3565	π-MOSⅤI	TO-220SIS	900	5	2.5	P 22
2SK3566	π-MOSⅤI	TO-220SIS	900	2.5	6.4	P 22
2SK3567	π-MOSⅤI	TO-220SIS	600	3.5	2.2	P 22
2SK3568	π-MOSⅤI	TO-220SIS	500	12	0.52	P 22
2SK3569	π-MOSⅤI	TO-220SIS	600	10	0.75	P 22
2SK3633	π-MOSⅤI	TO-3P(N)	800	7	1.3	P 31
2SK3662	U-MOSⅢ	TO-220NIS	60	35	0.0095	P 26
2SK3667	π-MOSⅤI	TO-220SIS	600	7.5	1.0	P 22
2SK3669	π-MOSⅤII	PW-Mold	100	10	0.125	P 27
2SK3670	π-MOSⅤ	LSTM	150	0.67	1.7	—
2SK3742	π-MOSⅤI	TO-220SIS	900	5	2.5	P 22
2SK3757	π-MOSⅤI	TO-220SIS	450	2	2.45	P 22
2SK3767	π-MOSⅤI	TO-220SIS	600	2	4.5	P 22
2SK3797	π-MOSⅤI	TO-220SIS	600	13	0.49	P 22
2SK3798	π-MOSⅤI	TO-220SIS	900	3.5	3.5	P 22
2SK3799	π-MOSⅤI	TO-220SIS	900	9	1.5	P 22
2SK3842	U-MOSⅢ	TFP	60	75	0.0058	P 18
TPC6001	U-MOSⅡ	VS-6	20	6	0.03	P 17
TPC6002	U-MOSⅡ	VS-6	30	6	0.03	P 17

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Part Number	Series	Package Type	Main Characteristics			Page
			V _{DSS} (V)	I _D (A)	R _{DS(ON)} max (Ω)	
TPC6003	U-MOS III	VS-6	30	6	0.024	P 17
TPC6004	U-MOS III	VS-6	20	6	0.024	P 17
TPC6005	U-MOS III	VS-6	30	6	0.028	P 17
TPC6101	U-MOS II	VS-6	−20	−4.5	0.06	P 17
TPC6102	U-MOS II	VS-6	−30	−4.5	0.06	P 17
TPC6103	U-MOS III	VS-6	−12	−4.5	0.035	P 17
TPC6104	U-MOS III	VS-6	−20	−4.5	0.04	P 17
TPC6105	U-MOS III	VS-6	−20	−2.7	0.11	P 17
TPC6201	U-MOS II	VS-6	30	2.5	0.095	P 17
TPC8001	π-MOS VI	SOP-8	30	7	0.02	P 14
TPC8003	U-MOS II	SOP-8	30	13	0.007	P 14
TPC8004	π-MOS VI	SOP-8	30	5	0.05	P 14
TPC8006-H	High-speed U-MOS II	SOP-8	30	7	0.027	P 14
TPC8010-H	High-speed U-MOS III	SOP-8	30	11	0.016	P 14
TPC8012-H	π-MOS V	SOP-8	200	1.8	0.4	P 14
TPC8014	U-MOS III	SOP-8	30	11	0.014	P 14
TPC8015-H	High-speed U-MOS III	SOP-8	30	13	0.008	P 14
TPC8016-H	High-speed U-MOS III	SOP-8	30	15	0.0057	P 14
TPC8017-H	Ultra high-speed U-MOS III	SOP-8	30	15	0.0066	P 14
TPC8018-H	Ultra high-speed U-MOS III	SOP-8	30	18	0.0046	P 14
TPC8020-H	Ultra high-speed U-MOS III	SOP-8	30	13	0.009	P 14
TPC8104-H	High-speed U-MOS II	SOP-8	−30	−5	0.0065	P 14
TPC8105-H	High-speed U-MOS II	SOP-8	−30	−7	0.04	P 14
TPC8107	U-MOS III	SOP-8	−30	−13	0.0007	P 14
TPC8108	U-MOS III	SOP-8	−30	−11	0.0013	P 14
TPC8109	U-MOS III	SOP-8	−30	−10	0.02	P 14
TPC8110	U-MOS III	SOP-8	−40	−8	0.025	P 14
TPC8111	U-MOS IV	SOP-8	−30	−11	0.012	P 14
TPC8112	U-MOS III	SOP-8	−30	−13	0.006	P 14
TPC8113	U-MOS IV	SOP-8	−30	−11	0.01	P 14
TPC8114	U-MOS IV	SOP-8	−30	−18	0.0045	P 14
TPC8115	U-MOS IV	SOP-8	−20	−10	0.01	P 14
TPC8203	U-MOS II	SOP-8	30	6	0.021	P 14
TPC8206	U-MOS II	SOP-8	60	7	0.05	P 14
TPC8207	U-MOS III	SOP-8	20	6	0.02	P 14
TPC8208	U-MOS III	SOP-8	20	5	0.05	P 14
TPC8209	U-MOS II	SOP-8	30	5	0.04	P 14
TPC8210	U-MOS III	SOP-8	30	8	0.015	P 14
TPC8211	U-MOS III	SOP-8	30	5.5	0.036	P 14
TPC8303	U-MOS II	SOP-8	−30	−4.5	0.035	P 14
TPC8305	U-MOS II	SOP-8	−20	−5	0.03	P 14
TPC8401	U-MOS II	SOP-8	−30/30	−4.5/6	35/21	P 14

Part Number	Series	Package Type	Main Characteristics			Page
			V _{DSS} (V)	I _D (A)	R _{DS(ON)} max (Ω)	
TPC8402	U-MOS II	SOP-8	−30/30	−4.5/5	35/50	P 14
TPC8403	U-MOS II	SOP-8	−30/30	−4.5/6	55/33	P 14
TPC8A01	U-MOS III	SOP-8	30/30	6/8.5	0.025/0.018	P 12
TPCA8003-H	Ultra high-speed U-MOS III	SOP Advance	30	35	0.0066	P 13
TPCA8004-H	Ultra high-speed U-MOS III	SOP Advance	30	40	0.0046	P 13
TPCA8005-H	Ultra high-speed U-MOS III	SOP Advance	30	27	0.009	P 13
TPCA8101	U-MOS III	SOP Advance	−30	−40	0.007	P 13
TPCA8102	U-MOS III	SOP Advance	−30	−40	0.006	P 13
TPCA8103	U-MOS IV	SOP Advance	−30	−40	0.0042	P 13
TPCS8004	π-MOS V	TSSOP-8	200	1.3	0.8	P 15
TPCS8006	π-MOS V	TSSOP-8	250	1.1	1	P 15
TPCS8007	π-MOS V	TSSOP-8	200	1.9	0.5	P 15
TPCS8008	π-MOS V	TSSOP-8	250	1.8	0.55	P 15
TPCS8101	U-MOS II	TSSOP-8	−30	−6	0.025	P 15
TPCS8102	U-MOS II	TSSOP-8	−20	−6	0.02	P 15
TPCS8104	U-MOS IV	TSSOP-8	−30	−11	0.012	P 15
TPCS8105	U-MOS IV	TSSOP-8	−30	−11	0.0135	P 15
TPCS8204	U-MOS III	TSSOP-8	20	6	0.017	P 15
TPCS8205	U-MOS II	TSSOP-8	20	5	0.045	P 15
TPCS8208	U-MOS III	TSSOP-8	20	6	0.017	P 15
TPCS8209	U-MOS III	TSSOP-8	20	5	0.03	P 15
TPCS8210	U-MOS III	TSSOP-8	20	5	0.03	P 15
TPCS8211	U-MOS III	TSSOP-8	20	6	0.024	P 15
TPCS8212	U-MOS III	TSSOP-8	20	6	0.024	P 15
TPCS8302	U-MOS III	TSSOP-8	−20	−5	0.0035	P 15
TPCS8303	U-MOS IV	TSSOP-8	−20	−5	0.021	P 15
TPCF8001	U-MOS III	VS-8	30	7	0.0025	P 17
TPCF8101	U-MOS III	VS-8	−12	−6	0.028	P 17
TPCF8102	U-MOS III	VS-8	−20	−6	0.03	P 17
TPCF8103	U-MOS III	VS-8	−20	−2.7	0.11	P 17
TPCF8104	U-MOS III	VS-8	−30	−6	0.0028	P 17
TPCF8201	U-MOS III	VS-8	20	3	0.049	P 17
TPCF8301	U-MOS III	VS-8	−20	−2.7	0.11	P 17
TPCF8302	U-MOS III	VS-8	−20	−3	0.0059	P 17
TPCF8303	U-MOS III	VS-8	−20	−3	0.0059	P 17
TPCF8402	U-MOS III	VS-8	−30/30	−3.2/4	0.11/0.049	P 17
TPCF8A01	U-MOS III	VS-8	20	3	0.049	P 17
TPCF8B01	U-MOS III	VS-8	−20	−2.7	0.11	P 17
TPCP8201	U-MOS III	PS-8	30	4.2	0.05	P 17
TPCP8401	U-MOS III	PS-8	−30/30	−3.4/4.2	0.048/0.072	P 17
TPCP8402	U-MOS III	PS-8	−12/20	−5.5/0.1	0.038/3	P 17
TPCP8J01	U-MOS IV	PS-8	−32/50	−6/0.1	0.035	P 17

7 Power MOSFET Superseded Products

The product number in the left-hand column below are soon to be superseded. When ordering, please choose from among the recommended products in the right-hand column.

Superseded Products					Superseded Products				
Part Number	Electrical Characteristics			Package Type	Part Number	Electrical Characteristics			Package Type
	V _{DSS} (V)	I _D (A)	R _{DS(ON)} max(Ω)			V _{DSS} (V)	I _D (A)	R _{DS(ON)} max(Ω)	
2SK2057	500	20	0.34	TO-3P(N)	2SK2837	500	20	0.27	TO-3P(N)
2SK2235	250	2	2	PW-Mold	2SK3462	250	3	1.7	PW-Mold
2SK2741	60	5	0.16	SP	2SK2231	60	5	0.16	PW-Mold
2SK2742	100	3	0.35	SP	2SK2201	100	3	0.35	PW-Mold
2SK2836	600	1	9	SP	2SK3371	600	1	9	PW-Mold
2SK2839	30	10	0.04	SP	TPCF8001	30	7	0.023	VS-8
2SK2985	60	45	0.0058	TO-220NIS	2SK3844 ★	60	45	0.0058	TO-220NIS
2SK2986	60	55	0.0058	TO-220FL/SM	2SK3844 ★	60	45	0.0058	TO-220NIS
2SK2987	60	70	0.0058	TO-3P(N)	2SK3845 ★	60	70	0.0058	TO-3P(N)
TPC8005-H	30	11	0.016	SOP-8	TPC8010-H	30	11	0.016	SOP-8
TPC8102	– 30	– 6	0.04	SOP-8	TPC8105-H	– 30	– 7	0.04	SOP-8
TPC8201	30	5	0.05	SOP-8	TPC8209	30	5	0.05	SOP-8
TPC8204	20	6	0.02	SOP-8	TPC8207	20	6	0.02	SOP-8
TPCS8201	20	5	0.03	TSSOP-8	TPCS8209	20	5	0.03	TSSOP-8
TPCS8206	20	5	0.03	TSSOP-8	TPCS8210	20	5	0.03	TSSOP-8
TPC8202	20	5	0.05	SOP-8	TPC8208	20	5	0.05	SOP-8
TPC8106-H	– 30	– 8	0.02	SOP-8	TPC8109	– 30	– 10	0.02	SOP-8
TPC8007-H	30	13	0.017	SOP-8	TPC8009-H	30	13	0.01	SOP-8
TPCS8203	20	6	0.045	TSSOP-8	TPCS8211	20	6	0.024	TSSOP-8
TPC8103	– 30	– 11	0.013	SOP-8	TPC8108	– 30	– 11	0.013	SOP-8
TPC8002	30	11	0.014	SOP-8	TPC8014	30	11	0.014	SOP-8
TPC8207	20	5	0.024	TSSOP-8	TPCS8212	20	6	0.024	TSSOP-8

★: Under development

(1) Final-Phase Products

Part Number	Recommended Replacement Products
2SJ147	2SJ304
2SJ1347	2SK2314
2SK794	2SK2610
2SK1349	2SK2391
2SK1488	2SK2601
2SK1652	2SK2698
2SK1720	2SK2266
2SK1854	2SK2952
2SK1856	2SK2698
2SK1864	2SK2776
2SK1882	2SK2232
2SK1915	2SK2777
2SK1997	2SK2385
2SK1998	2SK2233
2SK2387	2SK2542

Part Number	Recommended Replacement Products
TPC8005-H	TPC8010-H
TPC8007-H	TPC8009-H
TPC8102	TPC8105-H
TPC8103	TPC8111/TPC8108
TPC8106-H	TPC8109
TPC8201	TPC8209
TPC8202	TPC8208
TPC8204	TPC8207
TPCS8201	TPCS8209
TPCS8203	TPCS8211
TPCS8206	TPCS8210
TPCS8207	TPCS8212

(2) Discontinued Products

Part Number	Recommended Replacement Products
2SJ91	2SJ200
2SJ92	2SJ200
2SJ123	2SJ304
2SJ124	2SJ304
2SJ126	2SJ304
2SJ183	2SJ377
2SJ224	2SJ312
2SJ238	2SJ360
2SJ239	2SJ377
2SJ240	2SJ349
2SJ241	2SJ401
2SJ315	2SJ377
2SK271	2SK1529
2SK272	2SK1529
2SK324	2SK2698
2SK325	2SK2698
2SK355	2SK387
2SK356	2SK388
2SK357	2SK2381
2SK358	2SK2417
2SK385	2SK2698
2SK386	2SK2698
2SK387	2SK2882
2SK388	2SK2508
2SK405	2SK1529
2SK417	2SK2232
2SK418	2SK2662
2SK419	2SK2662
2SK420	2SK2662
2SK421	2SK2662
2SK422	2SK2961
2SK442	2SK2232
2SK447	2SK2508
2SK525	2SK2382
2SK526	2SK2417
2SK527	2SK2232
2SK528	2SK2662
2SK529	2SK2662
2SK530	2SK2662
2SK531	2SK2662
2SK532	2SK2232
2SK537	2SK2733
2SK538	2SK2719
2SK539	2SK2610
2SK568	–
2SK572	–
2SK573	2SK1641
2SK578	2SK2882
2SK643	2SK2601
2SK644	2SK2601
2SK672	2SK2232
2SK673	2SK2232
2SK674	2SK2232
2SK678	2SK2698
2SK693	2SK2698
2SK694	2SK2698
2SK708	2SK2698

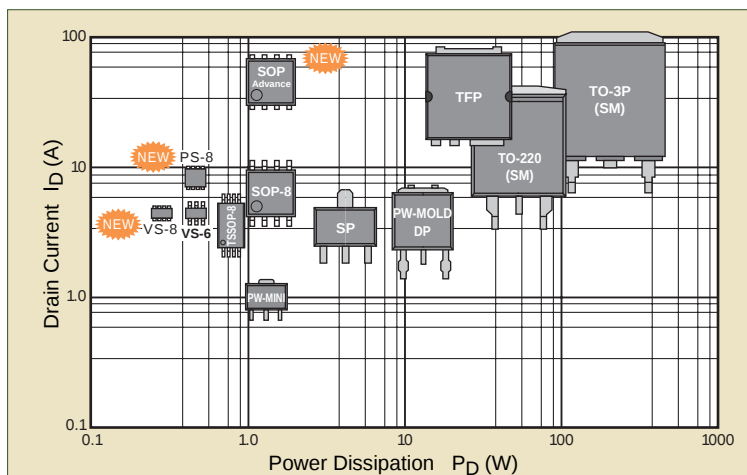
Part Number	Recommended Replacement Products
2SK788	2SK2698
2SK789	2SK2698
2SK790	2SK2698
2SK791	2SK2608
2SK792	2SK2608
2SK793	2SK2610
2SK849	2SK2233
2SK850	2SK2466
2SK851	2SK2967
2SK856	2SK2385
2SK857	2SK2233
2SK858	2SK2750
2SK888	2SK2350
2SK889	2SK2314
2SK890	2SK2350
2SK891	2SK2382
2SK892	2SK2662
2SK893	2SK2386
2SK894	2SK2542
2SK895	2SK2601
2SK896	2SK2695
2SK942	2SK2232
2SK943	2SK2232
2SK944	2SK2967
2SK945	2SK2599
2SK1029	2SK2698
2SK1078	2SK2615
2SK1112	2SK2231
2SK1113	2SK2201
2SK1114	2SK2232
2SK1115	2SK2232
2SK1116	2SK2232
2SK1117	2SK2544
2SK1118	2SK2545
2SK1124	2SK2233
2SK1213	2SK2602
2SK1251	2SK2231
2SK1252	2SK2201
2SK1333	2SK2698
2SK1344	2SK2232
2SK1346	2SK2232
2SK1348	2SK2391
2SK1350	2SK2382
2SK1351	2SK2662
2SK1352	2SK2543
2SK1356	2SK2700
2SK1357	2SK2610
2SK1358	2SK2611
2SK1362	2SK2610
2SK1363	2SK2847
2SK1377	2SK2679
2SK1378	2SK2841
2SK1379	2SK2173
2SK1380	2SK2267
2SK1487	2SK2601
2SK1513	2SK2601
2SK1531	2SK2698

Part Number	Recommended Replacement Products
2SK1542	2SK2376
2SK1574	2SK2542
2SK1600	2SK2603
2SK1601	2SK2608
2SK1602	2SK2603
2SK1603	2SK2718
2SK1641	2SK2993
2SK1642	2SK2952
2SK1643	2SK2717
2SK1649	2SK2610
2SK1650	2SK2719
2SK1651	2SK2601
2SK1653	2SK2312
2SK1692	2SK2749
2SK1717	2SK2615
2SK1719	2SK2231
2SK1721	2SK2991
2SK1722	2SK2991
2SK1723	2SK2699
2SK1745	2SK2837
2SK1746	2SK2865
2SK1766	2SK2417
2SK1767	2SK2750
2SK1768	2SK2614
2SK1769	2SK2599
2SK1792	2SK2376
2SK1805	2SK2543
2SK1855	2SK2698
2SK1858	2SK2883
2SK1865	2SK2776
2SK1879	2SK2398
2SK1913	2SK2750
2SK1927	2SK2789
2SK1928	2SK2789
2SK1929	2SK2884
2SK2030	2SK2231
2SK2038	2SK2604
2SK2039	2SK2610
2SK2056	2SK2605
2SK2077	2SK2746
2SK2078	2SK2607
2SK2088	2SK2401
2SK2089	2SK2884
2SK2107	2SK2401
2SK2149	2SK2601
2SK2150	2SK2698
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2SK2237	2SK2543
2SK2319	2SK2746
2SK2320	2SK2607
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2SK2386	2SK2661
2SK2388	2SK2750
2SK2402	2SK2750

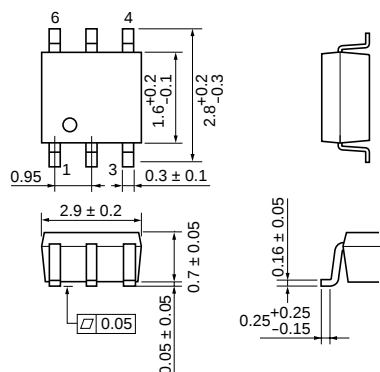
Package List

1. Compact Surface-Mount Packages

To meet requirements for compact and thin equipment, Toshiba offers various packages with power dissipation of 1.0 to 150 W and drain current of 1 to 50 A. In addition, we offer devices housed in the SOP-8 and TSSOP-8 packages. These devices consist of input/output isolated TFP Series MOSFETs and trench MOSFETs with ultra-low ON-resistance.

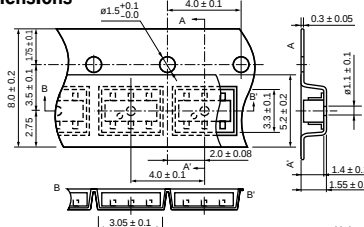


■ VS-6

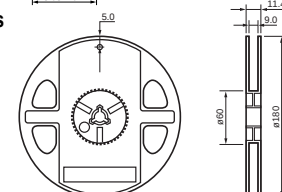


Unit: mm

Tape dimensions



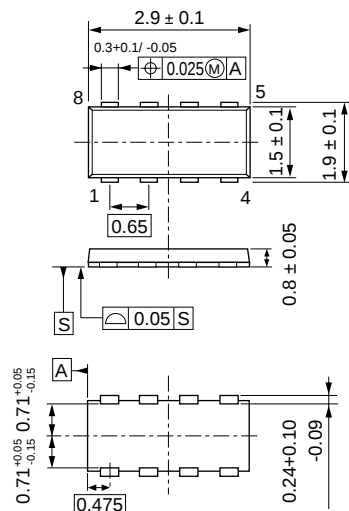
Reel dimensions



Packing quantity

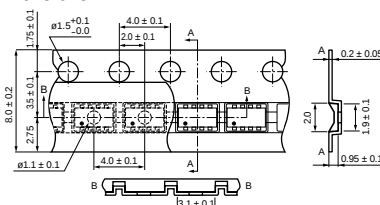
3000pcs / reel

■ VS-8

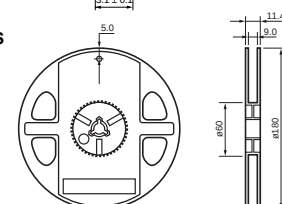


Unit: mm

Tape dimensions



Reel dimensions

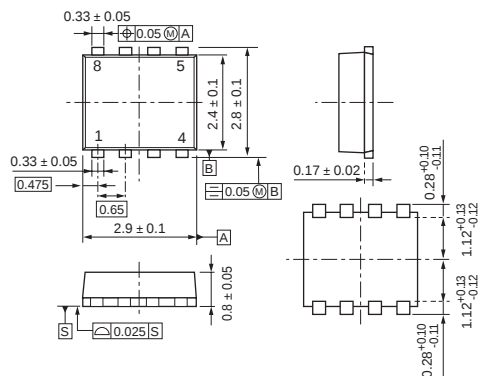


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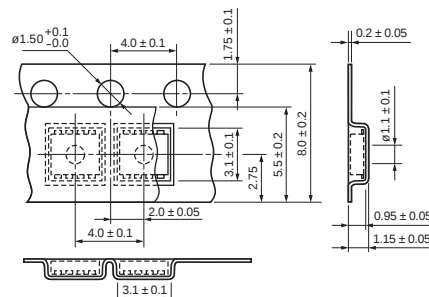
4000pcs / reel

■ PS-8

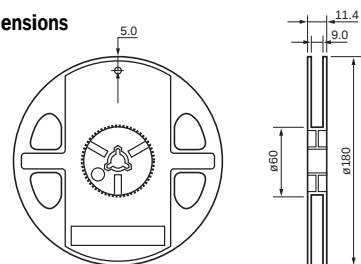
Unit: mm



Tape dimensions



Reel dimensions

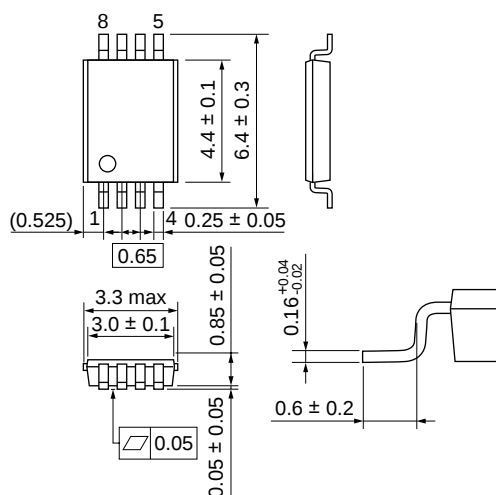


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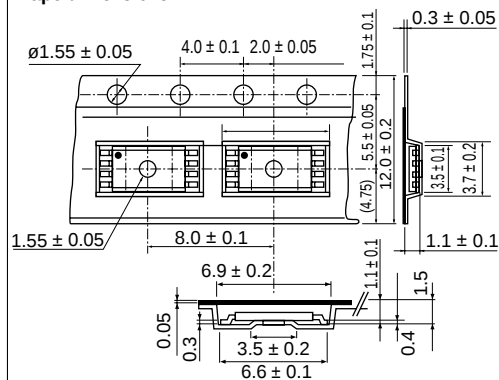
3000pcs / reel

■ TSSOP-8

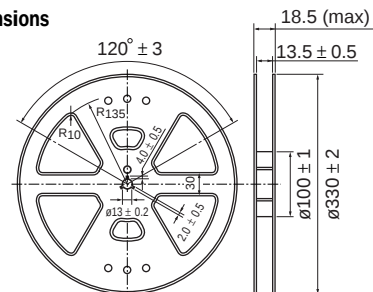
Unit: mm



Tape dimensions



Reel dimensions

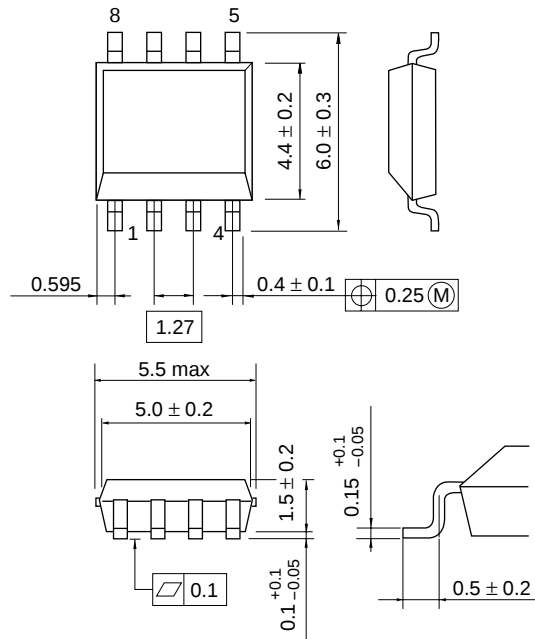


Packing quantity

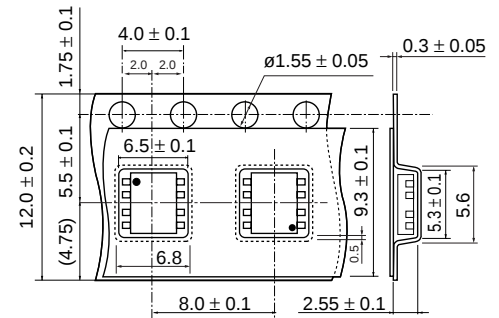
3000pcs / reel

■ SOP-8

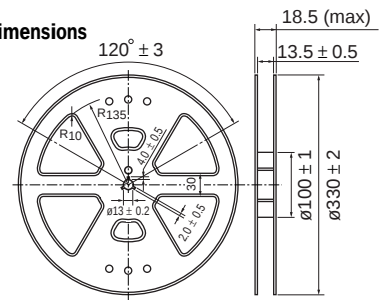
Unit: mm



Tape dimensions



Reel dimensions

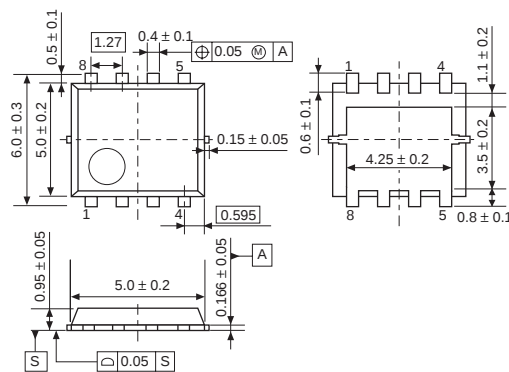
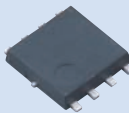


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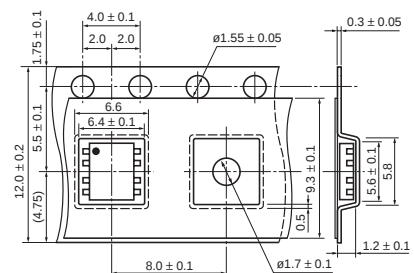
3000pcs / reel

■ SOP Advance

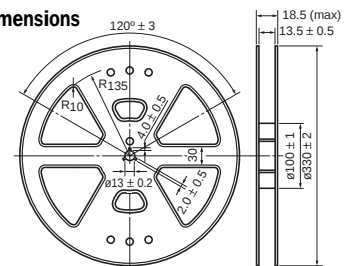
Unit: mm



Tape dimensions



Reel dimensions



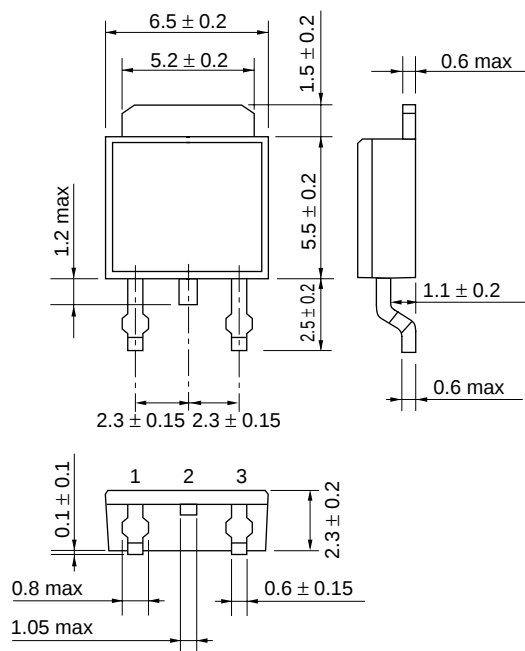
Packing quantity

3000pcs / reel

9

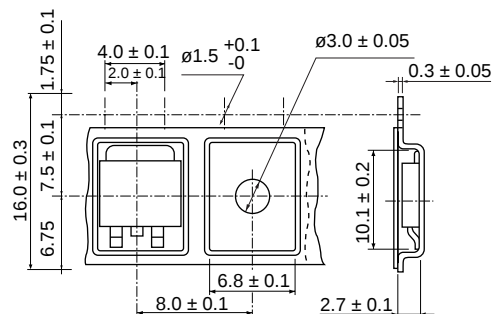
■ New PW-Mold

Unit: mm

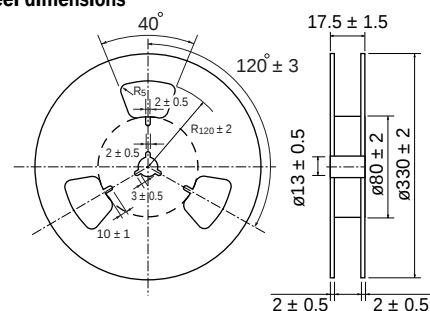


1. Gate
2. Drain (heat sink)
3. Source

Tape dimensions



Reel dimensions

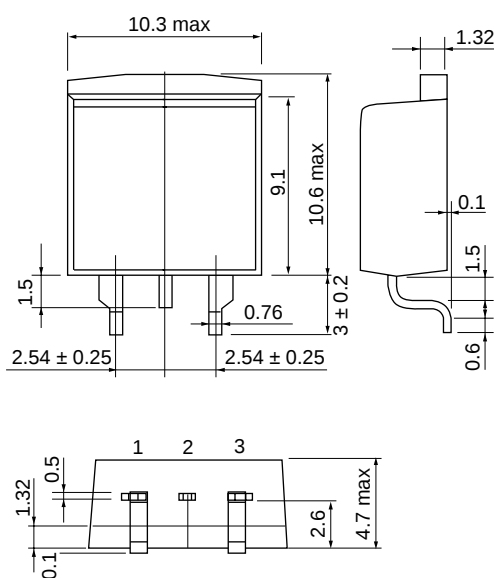


Packing quantity

2000pcs / reel

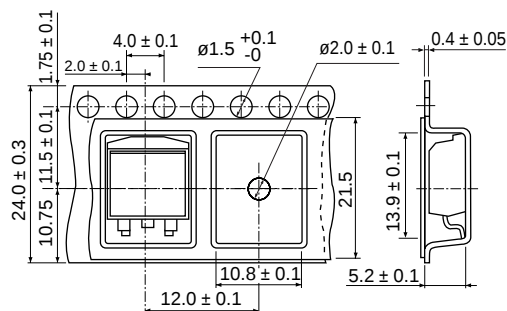
■ TO-220SM

Unit: mm

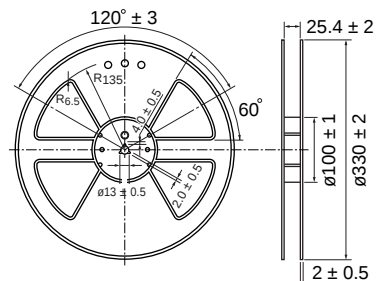


1. Gate
2. Drain (heat sink)
3. Source

Tape dimensions



Reel dimensions



Packing quantity

1000pcs / reel

Technical drawing of a 20-pin D-sub connector showing dimensions and pin labels.

Top View Dimensions:

- Overall Width: 9.2 max
- Overall Height: 9.2 max
- Pin 1 Width: 1.0
- Pin 2 Width: 1.0 ± 0.2
- Pin 3 Width: 1.0 ± 0.2
- Pin 4 Width: 3.6 ± 0.2
- Pin 1 to Pin 2 Distance: 0.2
- Pin 2 to Pin 3 Distance: 1.5
- Pin 3 to Pin 4 Distance: 2.0
- Total Pin Width: 2.5

Side View Dimensions:

- Overall Height: 0.8 max
- Pin 1 to Pin 2 Distance: 0.4 ± 0.1

Front View Dimensions:

- Overall Width: 7.0 ± 0.2
- Overall Height: 0.7 max
- Pin 1 to Pin 2 Distance: 0.2
- Pin 2 to Pin 3 Distance: 1.5
- Pin 3 to Pin 4 Distance: 2.0
- Total Pin Width: 2.5

Pin Labels:

1. Drain (heat sink)
2. Gate
3. Source1
4. Source2

Technical drawing of a rectangular plate with dimensions and tolerances. The drawing includes a top view and a side view. The top view shows a plate with a width of 216 ± 0.3 and a length of 240 ± 0.3 . The plate has four rectangular cutouts, each with a width of 4.0 ± 0.1 and a height of 9.5 ± 0.1 . The distance between the centers of the cutouts is 12.0 ± 0.1 . The distance from the center of the first cutout to the left edge is 4.0 ± 0.1 , and the distance from the center of the last cutout to the right edge is 2.0 ± 0.1 . The plate has a thickness of 1.75 ± 0.1 and a central hole with a diameter of $\phi 1.5 \pm 0.1$. The side view shows a profile with a width of 0.30 ± 0.05 and a height of 3.0 ± 0.1 . The drawing also includes a detail view of a hole with a diameter of $\phi 10.5 \pm 0.1$ and a distance of 11.5 ± 0.1 from the center of the hole to the edge of the plate. The overall dimensions are 216 ± 0.3 and 240 ± 0.3 .

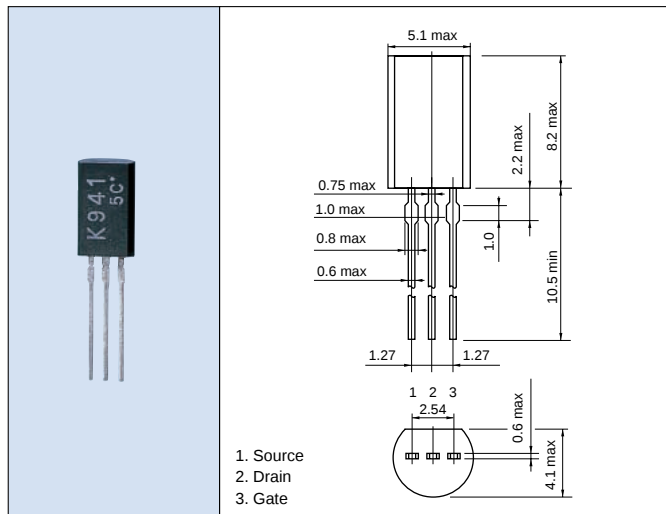
Technical drawing of a wheel with a 60° angle. The drawing includes the following dimensions and features:

- Top arc dimension: $120^\circ \pm 3$
- Inner radius: $R135$
- Inner fillet radius: $R10$
- Inner hole diameter: $\varnothing 13 \pm 0.5$
- Inner hole position: ± 0.5
- Outer diameter: $\varnothing 330 \pm 2$
- Inner hole diameter: $\varnothing 80 \pm 1$
- Inner hole position: 2 ± 0.5
- Inner hole diameter: $\varnothing 13 \pm 0.5$
- Inner hole position: ± 0.5
- Inner hole diameter: $\varnothing 13 \pm 0.5$
- Inner hole position: ± 0.5

1500pcs / reel

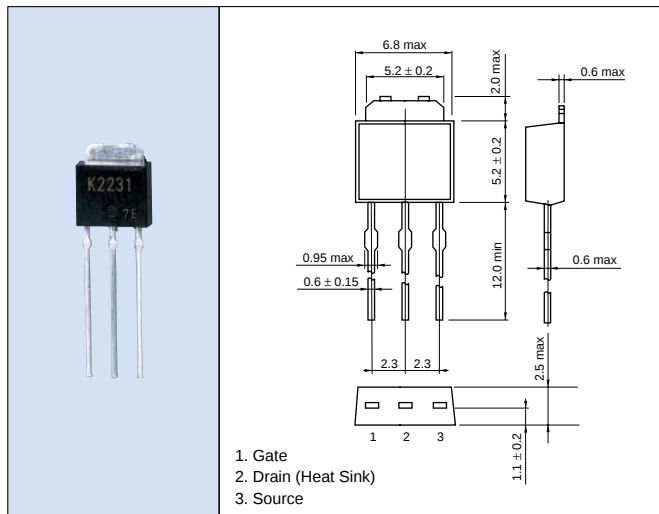
2. Through-Hole Package

■ LSTM

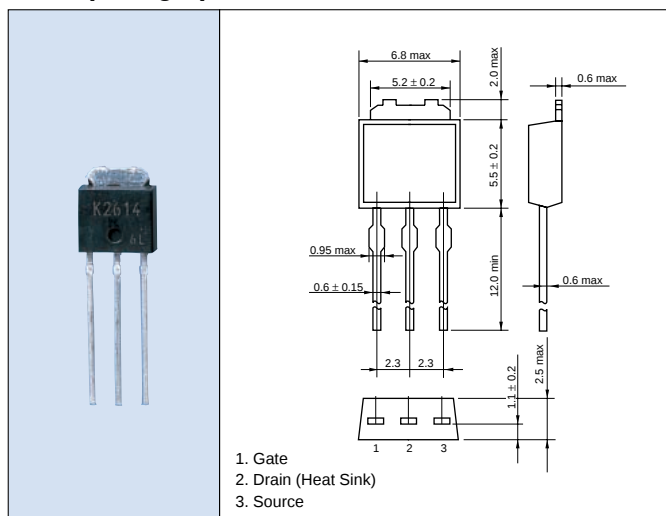


■ PW-Mold (Straight)

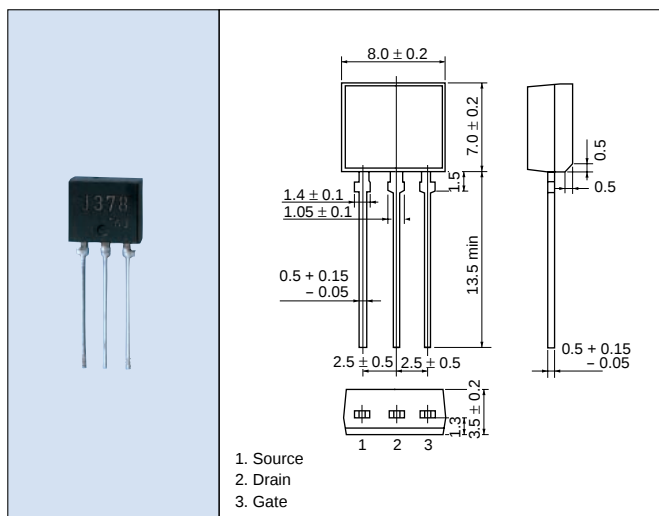
Unit: mm



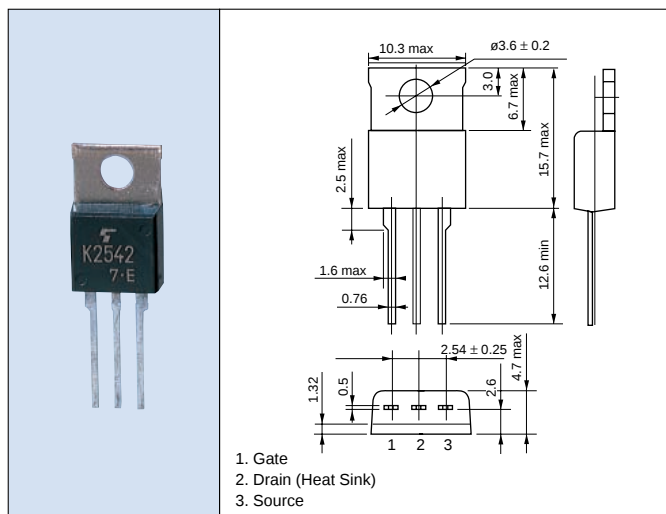
■ DP (Straight)



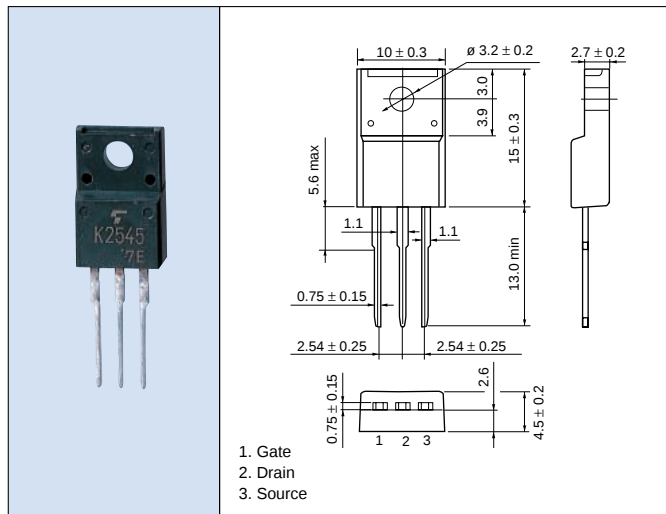
■ TPS



■ TO-220AB

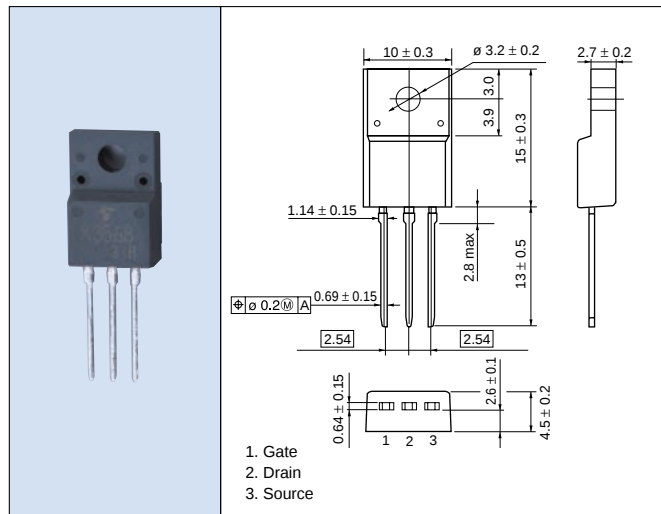


TO-220NIS

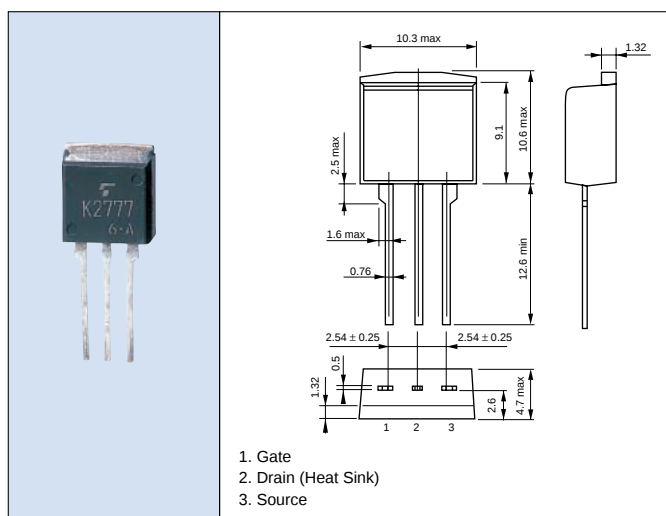


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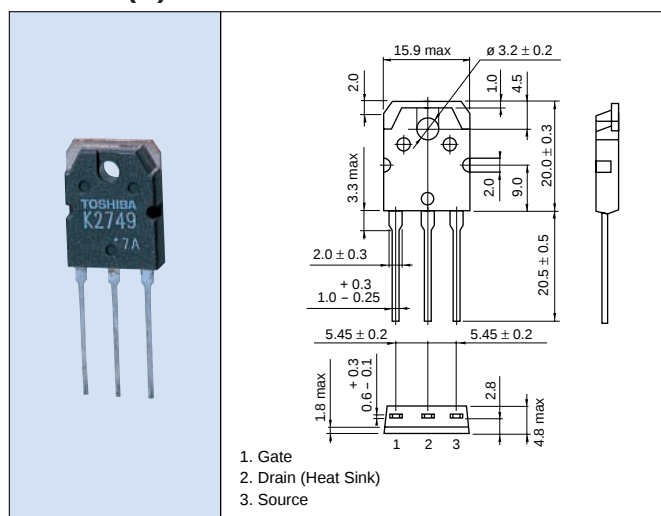
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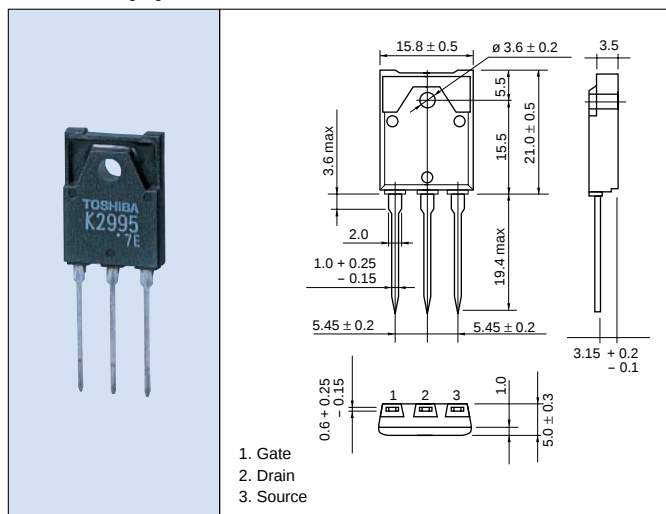
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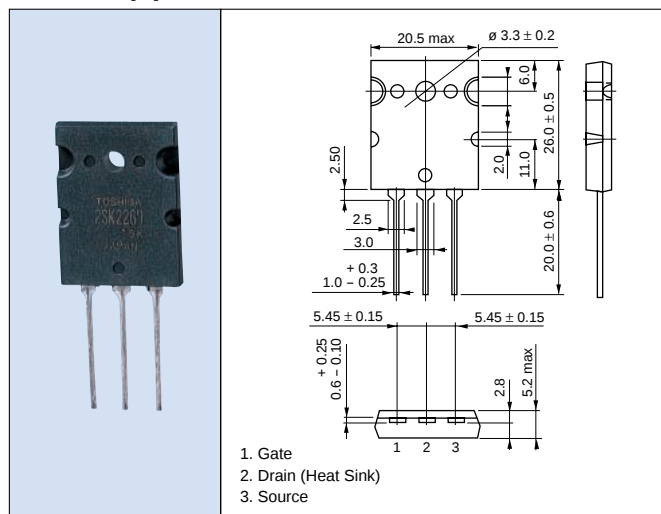
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