Hitachi Power MOS FETs Products

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Product Marketing Dept.
Multi Purpose Semiconductor Business Division
Semiconductor & Integrated Circuits, HITACHI Ltd.

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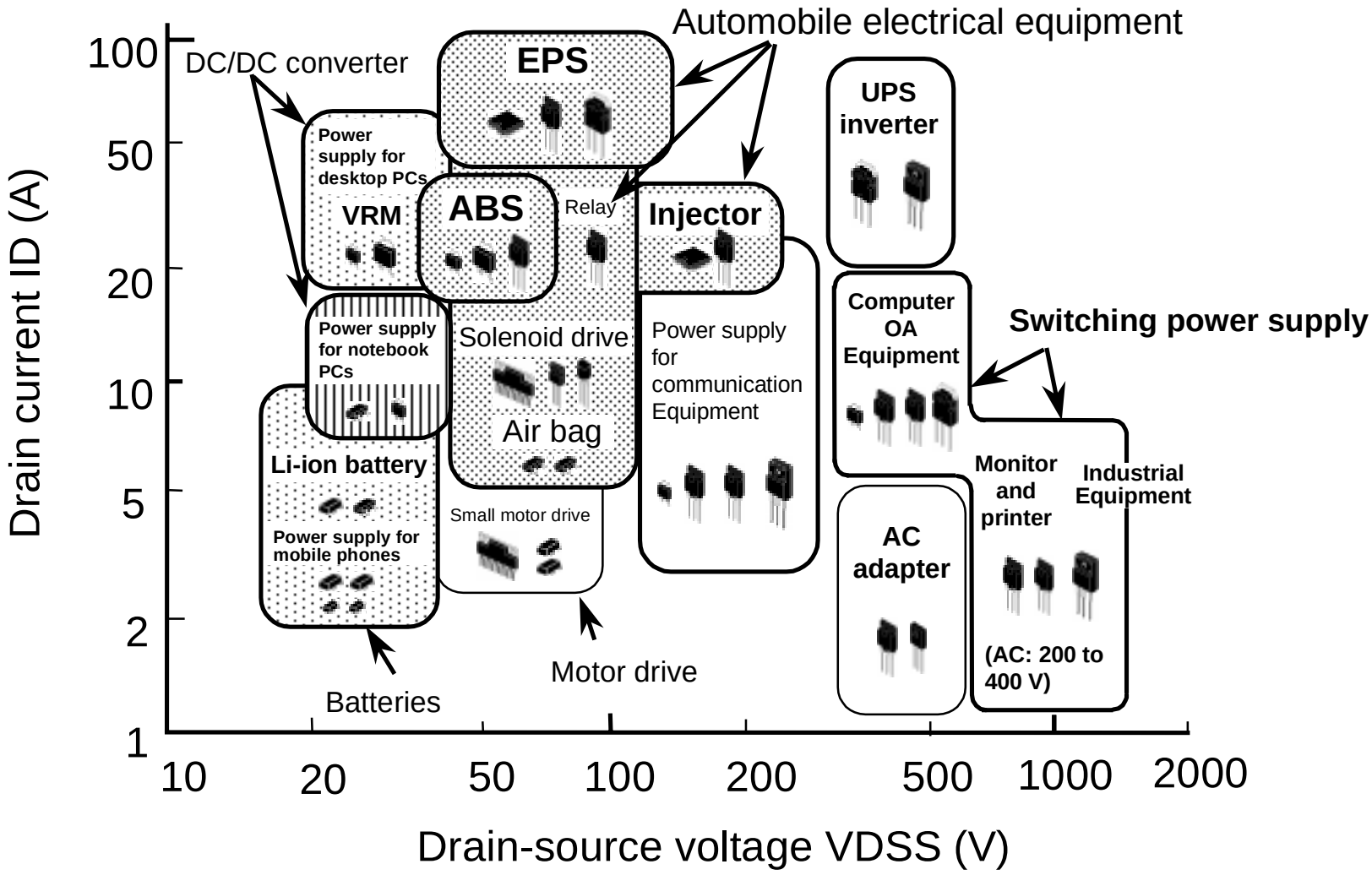
Power MOS FET Application Map



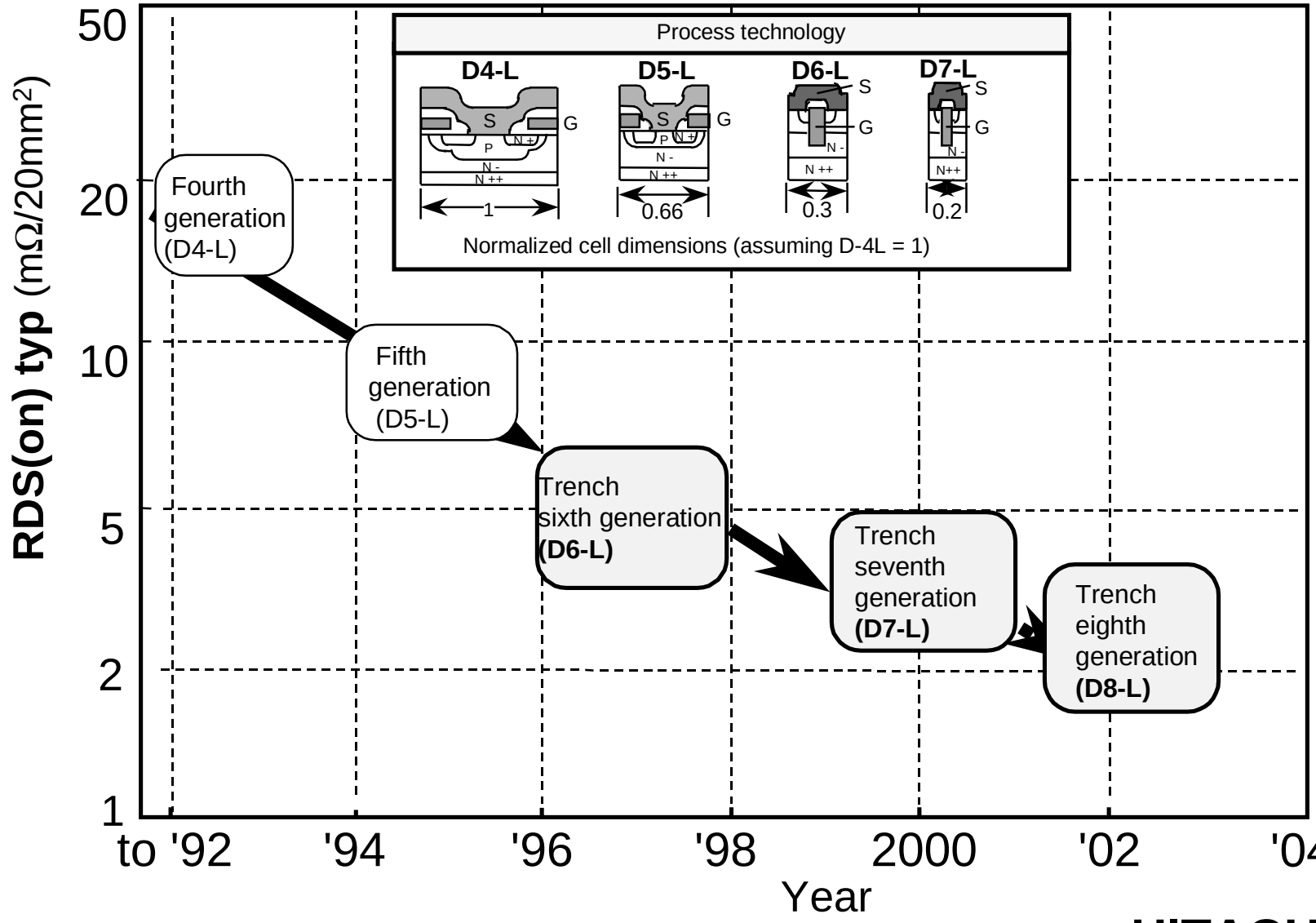
Power MOS FET Trend by Applications

Field	Applications	Device trend	power MOS FETs contributions
Switching power supply	OA Equipment, AC/DC converter	•High-frequency emission regulation Power-factor improvement circuit (active filter) added •Resonance method •Secondary synchronous rectification	• Low input capacitance for 500-V withstand voltage Development of the D5-H series • Very low Rds-$_{ON}$ Development of the D7-L series
	OA and communication device, DC/DC converter	•Synchronous rectification method (very high efficiency)	• Low withstand voltage: 20 to 200 V, 2.5 to 10 V driven available Very low Rds-$_{ON}$ Development of the D5-L, D6-L, and D7-L series
Batteries	Mobile phone, Notebook PC	•Li-ion battery used •High speed and high precision	• Development of Compact and Low Profile packages (SOP-8, TSSOP-8, TSOP-6, and MPAK)
Motor control	Small motor (OA ,radio-controlled toi, HDD), Inverter, Robot	•Low Power dissipation •Low noise •Microcomputer directly drive available	• Power MOS FET array (six devices) • Development of the D5-L, D6-L, and SOP-8 (2in1) series • Built-in high-speed diode Development of the D3-H and D5-H series
Automobile	Engine control, Steering control, ABS control, Actuator drive, Lamp drive	•Mechanical relay replacing by MOS •Trend from Bip to MOS •Microcomputer directly drive available •Simple circuit •Engine-room mounted •Low price	• Development of a Thermal-shutdown type (thermal FET) • Development of D5-L: 60 to 200 V series • Development of D6-L: 60 to 100 V series • Avalanche Proof Guaranteed • Higher electrostatic breakdown protection series (built-in gate resistance)

Automobile Device Trends with Power MOS FETs

Field	Application	Technology trend		power MOS FETs contributions
Engine control	**Injection**	Precision control	→ High voltage	•100- to 200-V withstand voltage Fifth-generation series •Small mounting package (MPAK and SOP-8) •Small mounting fifth-generation thermal FET (SOP-8)
		Miniaturization Low price	→ Surface mounting	
Safety control	**ABS**, VSC Air bag	Multifunction Miniaturization	→ Low Rds-ON Surface mounting	•Small surface mounting Fifth-generation series (DPAK and SOP-8)
Body control	Electric power steering (**EPS)**	High efficiency 42V Battery support	→ Low Rds-ON High Voltage lineup	•Very low Rds-ON using Fifth- and sixth-generation series •Thermal FET using Fifth- and seventh-generation series
	In viecle LAN Relay	High reliability Long life	→ Built-in protection functions,	

Rds-ON Performance Trend of Low Voltage Power MOS FETs (60-V or less)



7th generation(D7-L) series Development

Feature

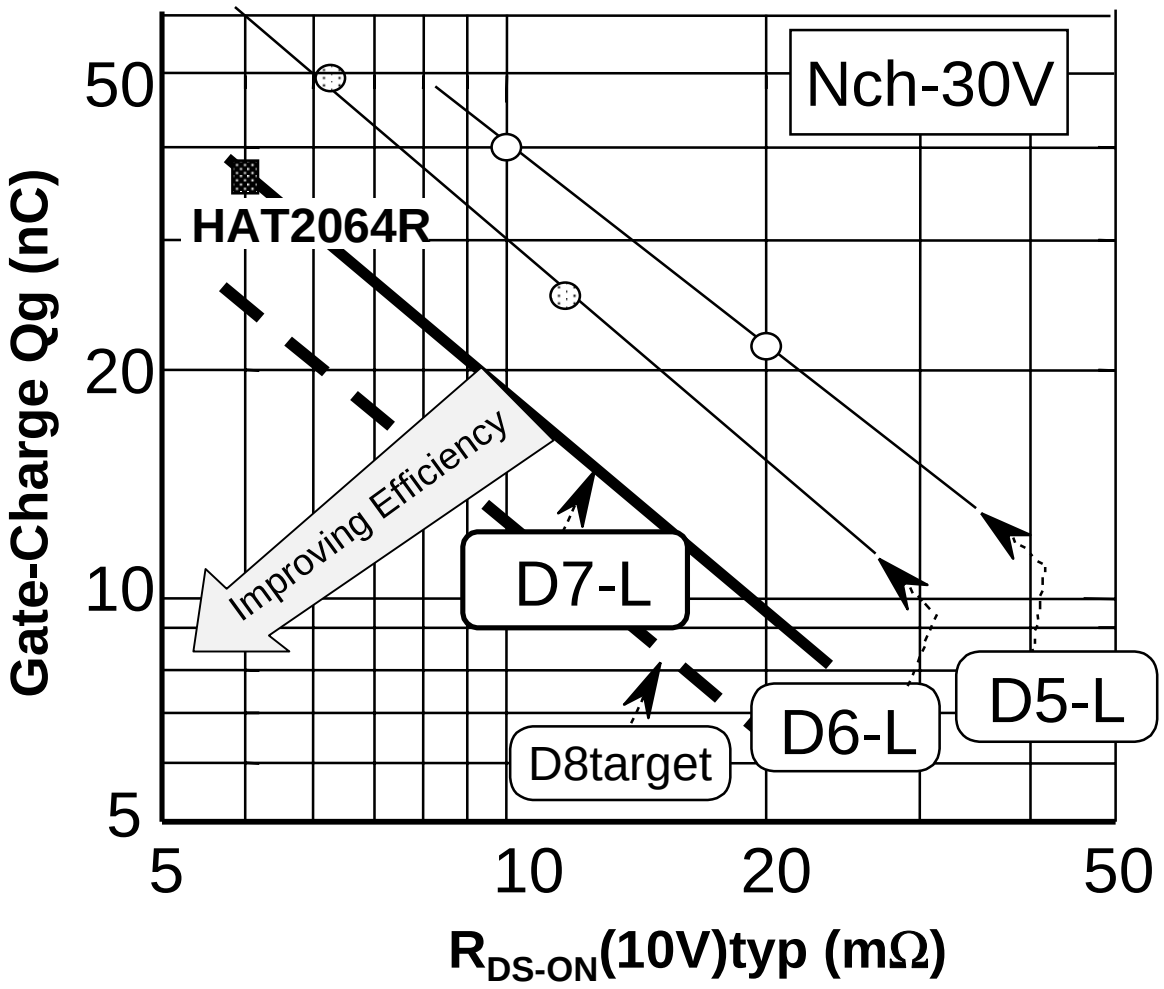
- **Support Save energy of equipment (High speed,High efficiency)**
- **Ultra Low R ds-on by** adopting The new trench-structure process
- **R_{DS-ON}** of the D6 series is **improved to 45%** that of the D6 series.
- Low Input Capacitance
  SW speed and Driving-Loss is **improved to 35%** that of the D7 series
- Need Low Voltage to drive(2.5V/4V is available,1.5V is planned
- **Gate protection Diode is including**

Developing List

Application	PKG	Parts.NO.	Maximum Rating				$R_{DS(on)}$ (mΩ)						Ciss (pF)	Qg (nC)	Tf (ns)	Schedule		mention
			V_{DSS} (V)	V_{GSS} (V)	I_D (A)	Pch (W)	V_{GS}=2.5V		V_{GS}=4V(4.5V)		V_{GS}=10V					WS	MP	
							typ	max	typ	max	typ	max						
DC/DC Converter, Synchronous method Rectifier	SOP-8	HAT2064R	30	±20	16	2.5	-	-	7	10	5	6.3	2200	40	20	OK	OK	One in one
		HAT2068R	30	±20	14	2.5	-	-	12	18	7.5	9.4	( )	20	( )	Mar.00	Jun.00	
		HAT2070R	30	±20	12	2.5	-	-	18	27	11	14	( )	13	( )	Mar.00	Jun.00	
	LDPAK	H7N0302LS	30	±20	60	50	-	-	7	10	5	6.3	2200	40	25	Feb.00	2Q/00	

Attention! These are under development. There is a possibility to change spec or schedule without notice

Correlation between On resistance to Gate-Charge



Load Map of the D7-L

Ron show typical value

Polarity	Withstand Voltage (v)	Application	1999	2000
Nch	20	Mobile Power management SW	10 to 30mΩ TSSOP-8	25mΩ TSOP-6
	30	DC/DC converter Lithium ion Buttery	5mΩ SOP-8 HAT2064R	5 to 25mΩ DPAK 10 to 25mΩ SOP-8
				35V/15mΩ TSSOP-8 3m ohm LDPAK
	40 To 100	Automobile UPS Small Motor Driver	40V 3mΩ LDPAK	80 to 100V 3 to 4.5mΩ (die,TO-3P) 60V 3 to 4.5mΩ TO-220AB
Pch	20	Mobile Power management SW	15 to 45mΩ TSSOP-8	40mΩ TSOP-6
	30	Lithium ion Buttery	6.5mΩ SOP-8	12mΩ TSSOP-8
	60	Automobile Small Motor Driver	55mΩ SOP-8	15mΩ LDPAK

Development of the D6-L Series

(1) Main applications

- Portable devices (Li-ion protection, power-management switches, etc.)
- Power supply for notebook PCs (synchronous rectification method DC/DC converters)
- Electrical Equipment for automobile (ABS, EPS, etc.)
- Motors (three-phase brushless, high-performance servo, etc.)

(2) Features

- Very low Rds-ON (trench process used)
  Lowest Rds-ON of all in the market
  6.2mΩ / SOP-8
  4mΩ / TO-220
- Low voltage to drive (2.5 V / 4V)
- Low input capacitance

Very Low Rds-ON D6-L Series Lineups (1)

D6-L Nch: 20 and 30 V class

Polar-ity	Package code	Type no.	Max.				$R_{DS(on)}$ (mΩ)						Ciss (pF)	Qg (nC)	Tf (ns)	Schedule		Remark
			V_{DSS} (V)	V_{GSS} (V)	I_D (A)	Pch (W)	V_{GS}=2.5V		V_{GS}=4V(4.5V)		V_{GS}=10V					WS	MP	
							typ	max	typ	max	typ	max						
Nch	TSOP-6	●HAT2053M	20	±20	6.1	2	37	48	(28)	(33)	-	-	570	20	105	OK	OK	
		●HAT2054M	30	±20	6.3	2	-	-	(40)	(52)	26	31	620	13	40	OK	OK	
	TSSOP-8	●HAT2049T	30	±12	8	1.3	17	25	13	17	-	-	1430	23	185	OK	OK	
		❍HAT2052T	28	±12	5	1	37	44	27	34	-	-	510	18	120	OK	OK	
		❍HAT2042T*	28	±12	5	1	37	44	27	34	-	-	510	18	120	OK	OK	
		❍HAT2045T*	28	±12	6	1	27	37	20	25	-	-	680	22	100	OK	OK	G-S protection Di including
	SOP-8 (JEDEC)	●HAT2044R	30	±12	15	2.5	9	13	(6.5)	(9.5)	-	-	3420	60	360	OK	OK	
		●HAT2036R	30	±20	12	2.5	-	-	(20)	(30)	12	15	1200	23	60	OK	OK	
		●HAT2040R	30	±20	15	2.5	-	-	9	13	6.2	8	4400	90	170	OK	OK	
		❍HAT2039R	30	±12	8	2	22	32	17	22	-	-	1420	24	185	OK	OK	
		❍HAT2043R	30	±20	8	2	-	-	22	29	16	22	1170	33	110	OK	OK	
	DPAK	2SK3274	30	±20	30	30	-	-	(20)	(30)	10	13	(1400)	(27)	(70)	OK	OK	
	LDPAK	2SK3203	30	±20	45	50	-	-	(18)	(28)	11	14	1200	23	65	OK	OK	
		2SK3133	30	±20	50	50	-	-	12	18	7	10	2600	50	130	OK	OK	
		2SK3134	30	±20	75	100	-	-	5.5	8.5	4	5	6800	130	380	OK	OK	
	TO-220 AB	2SK3141	30	±20	75	100	-	-	5.5	8.5	4	5	6800	130	380	OK	OK	
	TO-220 CFM	2SK3142	30	±20	60	35	-	-	5.5	8.5	4	5	6800	130	350	OK	OK	

:High-speed low-capacity product ●One device ❍Two devices *General drain

As the listed products are still under development, the specifications and the schedule might be changed without notice.

Very Low Rds-ON D6-L Series Lineups (2)

D6-L Pch: 20 and 30 V class

Polarity	Package code	Type no.	Max. V_{DSS} (V)	Max. V_{GSS} (V)	Max. I_D (A)	Max. Pch (W)	$R_{DS(on)}$ (mΩ) V_{GS}=2.5V typ	V_{GS}=2.5V max	V_{GS}=4V(4.5V) typ	V_{GS}=4V(4.5V) max	V_{GS}=10V typ	V_{GS}=10V max	Ciss (pF)	Qg (nC)	Tf (ns)	Schedule WS	Schedule MP	Remark
Pch	TSOP-6	●HAT1043M	-20	±12	-4.4	2	85	110	55	65	-	-	750	22	100	OK	OK	
		●HAT1044M	-30	±20	-4.5	2	-	-	80	105	50	60	600	( )	55	OK	OK	
	TSSOP-8	●HAT1041T	-20	±12	-6	1.3	35	45	20	26	-	-	1850	( )	170	OK	OK	
	SOP-8 (JEDEC)	●HAT1036R	-30	±20	-12	2.5	-	-	21	34	11	14	4200	70	120	OK	OK	
		❍HAT1046R	-20	±12	-6	2	45	60	30	40	-	-	1700	( )	185	OK	OK	

D6-L Nch:40,60,80V class

Nch	LDPAK	2SK3070	40	±20	75	100	-	-	6.5	10	4.5	5.8	6800	130	400	OK	OK	
		2SK3379	40	±20	85	100	-	-	5.5	8.5	3.8	4.8	9500	( )	( )	OK	Apr.00	
		2SK3135	60	±20	75	100	-	-	8	12	6	7.5	7100	125	330	OK	OK	
	TO-220 AB	2SK3136	40	±20	75	100	-	-	6.5	10	4.5	5.8	6800	130	400	OK	OK	
		2SK3069	60	±20	75	100	-	-	8	12	6	7.5	7100	125	330	OK	OK	
		2SK3228	80	±20	75	100	-	-	8	12	6	7.5	9700	150	370	OK	OK	
	TO-220 CFM	2SK3140	60	±20	50	35	-	-	8	12	6	7.5	7100	125	320	OK	OK	
		2SK3370	60	±20	60	35	-	-	(9)	(15)	6.5	8	4700	( )	230	OK	OK	
		2SK3229	80	±20	50	35	-	-	8	12	6	7.5	9700	150	340	OK	OK	
	TO-3P	2SK3163	60	±20	75	110	-	-	8	12	6	7.5	7100	125	330	OK	OK	

●One device in package ❍Two devices in 1 package

As the listed products are still under development, the specifications and the schedule might be changed without notice.

D5 100 to 200 V Class

(1) Main applications

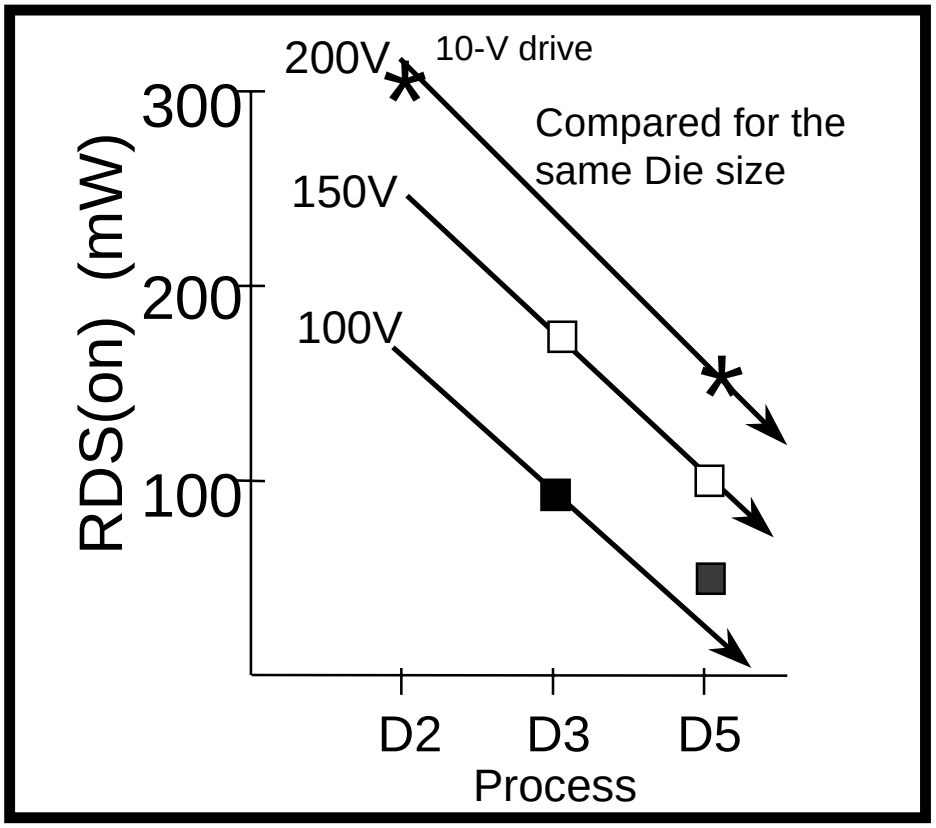
- Gasoline direct injection equipment

  (High-voltage injector, DC/DC converter for Pressure Pump-UP, etc.)
- Motor drive
- Monitor for S-character correction

(2) Features

- High V_{DSS} (100 to 200 V)
- Low R_{DS-ON} (reduced to 50% that of the D3 series.)
- Low voltage to drive (4V)

Performance curve



* Rds-ON of the D5 series is reduced to **50%** that of the D3 series.

* can be driven by 4V

Fine processing technology applied

(1) Die size shrunk
(2) Cost performance improved
(3) Package miniaturized
(4) Low capacitance and high-speed switching available

D5 100 and 200 V class Lineups

Polar-ity	Package code	Type no.	Max.				$R_{DS(on)}$ (mΩ)				Ciss (pF)	Schedule		Remark
			V_{DSS} (V)	V_{GSS} (V)	I_D (A)	Pch (W)	V_{GS}=4V		V_{GS}=10V			WS	MP	
							typ	max	typ	max				
Nch	TSSOP-8	HAT2050T	100	±20	1	1.5	720	1000	560	750	90	OK	OK	Two in one
	SOP-8	HAT2058R	100	±20	4	2	150	180	120	145	420	OK	Feb.00	Two in one
	DPAK	2SK3147	100	±20	5	20	130	180	100	130	420	OK	OK	
	LDPAK	2SK3150	100	±20	20	50	65	85	45	60	900	OK	OK	
	TO-220 AB	2SK3149	100	±20	20	50	65	85	45	60	900	OK	OK	
	TO-220 FM	2SK3212	100	±20	10	20	130	180	100	130	420	OK	OK	
		2SK3148	100	±20	20	30	65	85	45	60	840	OK	OK	
	TO-3P	2SK3151	100	±20	50	125	16	25	11.5	15	4000	OK	OK	
	TO-220 FM	2SK3152	120	±20	10	25	130	200	100	130	580	OK	OK	
		2SK3153	120	±20	15	30	80	110	65	85	830	OK	OK	
	TO-220 AB	2SK3154	150	±20	15	50	120	150	100	130	850	OK	OK	
		2SK3156	150	±20	20	75	60	80	50	70	1750	OK	OK	
		2SK3158	150	±20	30	100	45	63	40	45	2600	OK	OK	
	TO-220 FM	2SK3155	150	±20	15	30	120	150	100	130	850	OK	OK	
		2SK3157	150	±20	20	35	60	80	50	70	1750	OK	OK	
		2SK3209	150	±20	25	35	45	63	40	45	2600	OK	OK	
	TO-3P	2SK3159	150	±20	50	125	28	42	23	30	4000	OK	OK	
	LDPAK	2SK3210	150	±20	30	100	45	63	40	45	2600	OK	OK	
	TO-220 AB	2SK3214	200	±20	10	50	150	190	130	170	1100	OK	OK	
	TO-220 FM	2SK3160	200	±20	10	30	150	190	130	170	1100	OK	OK	
		2SK3177	200	±20	15	35	95	125	90	115	1600	OK	OK	
		2SK3162	200	±20	20	35	65	85	60	75	2420	OK	OK	
	LDPAK	2SK3161	200	±20	15	75	95	125	90	115	1600	OK	OK	
		2SK3211	200	±20	25	100	65	85	60	75	2420	OK	OK	

As the listed products are still under development, the specifications and the schedule might be changed or the development might be canceled without notice.

Development of High-Voltage Power MOS FET, D5-H (500 V class)

(1) Main applications
- Switching power supply
- PDP
- Motor control

(2) Features
- Low Rds-ON
- Low input capacitance and high-speed switching
- Avalanche Proof Guaranteed (Total Tch ≤ 150°C, $I_{DP} \leq I_D$ Ratings)
- Built-in high-speed diode (H5N5004PL)

Development plan for the D5-H power MOS FET (preliminary)

Package code	Type no.	Max.				$R_{DS(on)}$ (Ω)		Schedule		Remark
		V_{DSS} (V)	V_{GSS} (V)	I_D (A)	Pch (W)	V_{GS}=10V typ	V_{GS}=10V max	WS	MP	
TO-220CFM	2SK3233	500	±30	5	30	1.1	1.5	OK	OK	
	2SK3234	500	±30	8	35	0.75	0.85	OK	OK	
TO-3P	2SK3235	500	±30	15	150	0.3	0.4	OK	OK	
TO-3PL	H5N5004PL	500	±30	50	250	0.088	0.11	Feb.00	2Q/00	Built-in high-speed diode
	H5N5005PL	500	±30	60	270	0.065	0.075	Feb.00	2Q/00	
TO-3P	H5N2503P	250	±30	50	150	0.04	0.055	OK	1Q/00	
LDPAK	H5N2001LD/LS	200	±30	20	75	0.13	0.18	OK	2Q/00	
SOP-8	HAT2077R	200	±30	2.5	2.5	0.21	0.29	OK	2Q/00	One in one

As the listed products are still under development, the specifications and the schedule might be changed or the development might be canceled without notice.

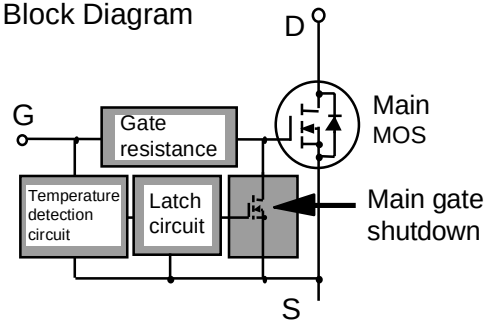
Development of Power MOS FET to function

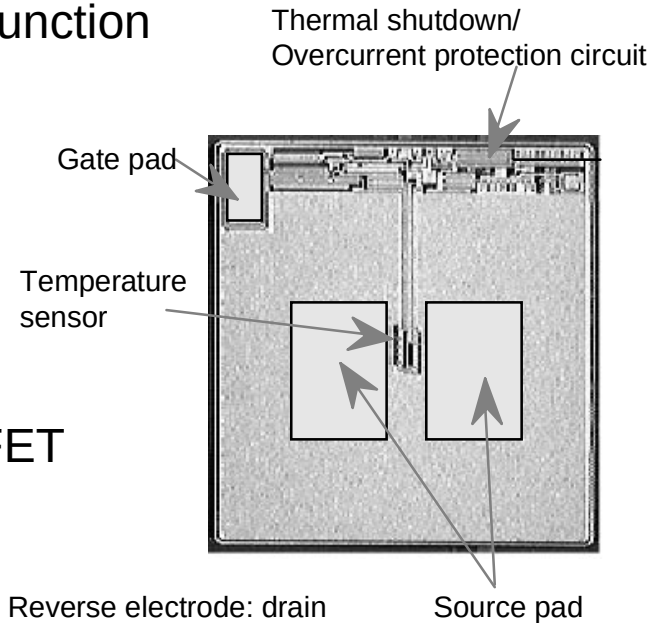
Thermal Shutdown-Type Power MOS FET (Thermal FET)

(1) Main applications
- Electrical Equipment for automobile
- In-vehicle LAN (relay replacement) etc.

(2) Main functions and features
- Self-shutdown by detecting over temperature of junction
- Latch-type shutdown method
  Gate voltage reset (returns after 0-V bias)
- Shutdown temperature range:175 ± 25°C
- Low Rds-ON
- 4-V driven available
- Three-terminal package used
  Easily replaceable from a Current Power MOS FET

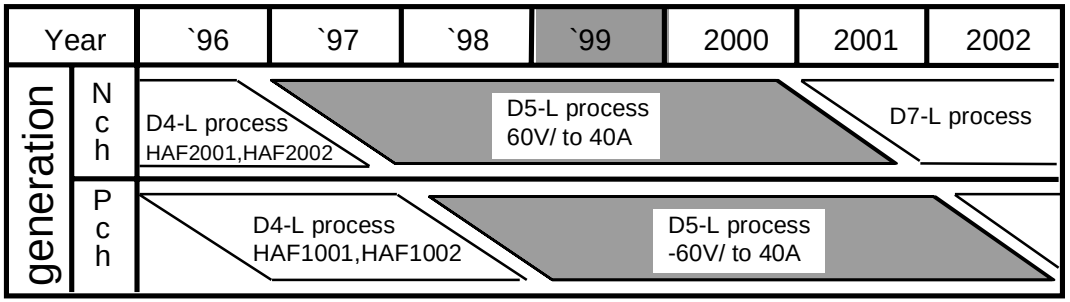
Block Diagram





HAF2005 chip appearance

■ Thermal FET Development Trend

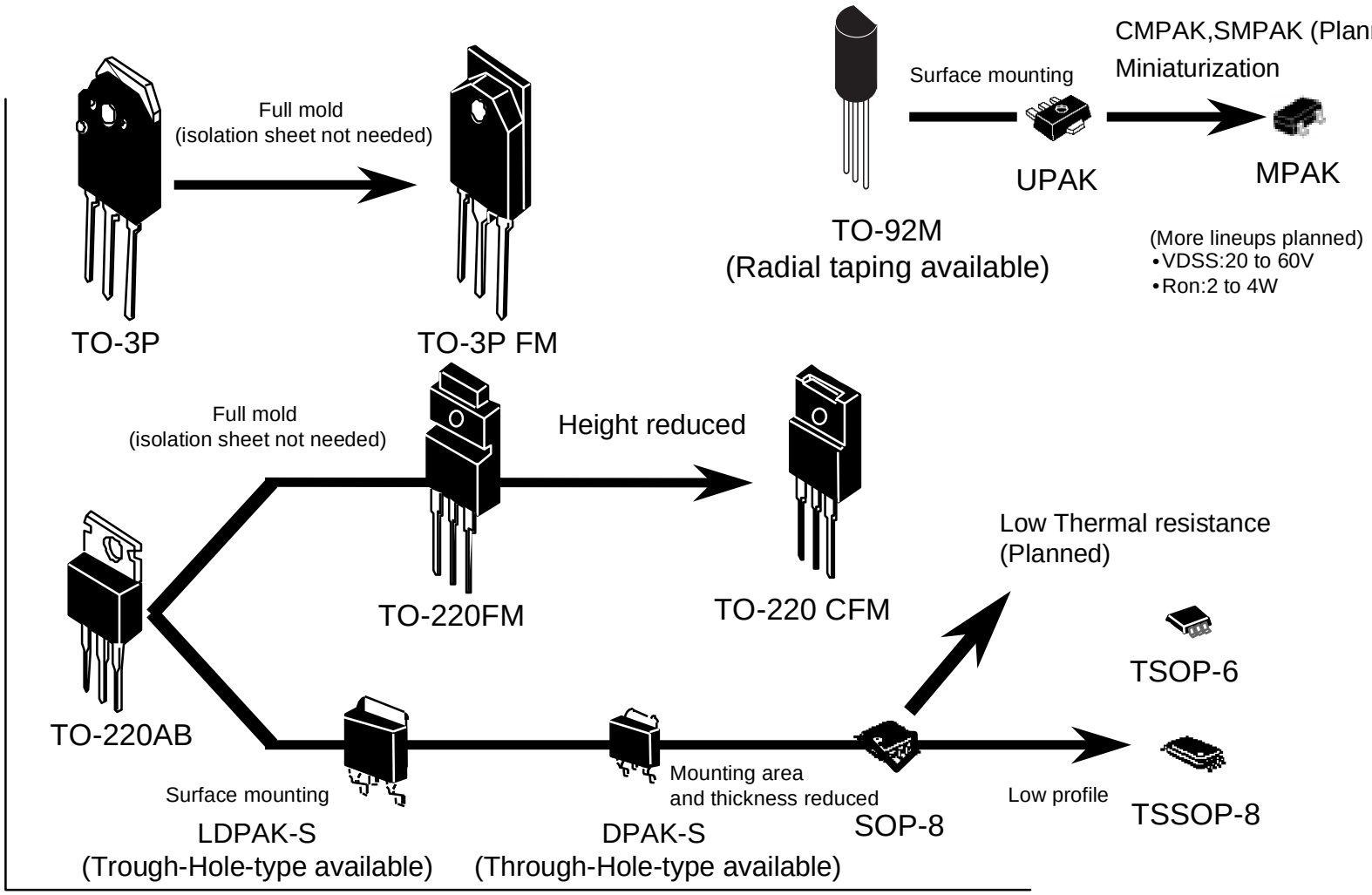


■ Thermal FET Lineups

Polarity	Package code	Type no.	Max.				$R_{DS(on)}$ (mΩ)				Schedule		Remark
			V_{DSS} (V)	V_{GSS} (V)	I_D (A)	Pch (W)	V_{GS}=4V		V_{GS}=10V		WS	MP	
							typ	max	typ	max			
Nch	TO-220 AB	HAF2001	60	+16/-2.8	20	50	50	65	30	43	OK	OK	D4 process
	TO-220 FM	HAF2002	60	+16/-2.8	20	30	50	65	30	43	OK	OK	D4 process
		HAF2008	60	+16/-2.5	20	30	45	60	28	40	1Q/00	3Q/00	
		HAF2005	60	+16/-2.5	40	30	25	33	15	20	OK	1Q/00	
	DPAK	HAF2007	60	+16/-2.5	5	20	140	180	110	130	OK	1Q/00	
	LDPAK	HAF2012	60	+16/-2.8	20	50	50	65	30	43	OK	OK	D4 process
		HAF2011	60	+16/-2.5	40	50	25	33	15	20	OK	1Q/00	
Pch	TO-220 AB	HAF1001	-60	-16/+3.0	-15	50	100	130	70	90	OK	OK	D4 process
		HAF1005	-60	-16/+2.5	-30	50	50	65	35	45	1Q/00	1Q/00	
	DPAK	HAF1004	-60	-16/+2.5	-5	20	200	260	150	190	OK	1Q/00	
	LDPAK	HAF1002	-60	-16/+3.0	-15	50	100	130	70	90	OK	OK	D4 process
		HAF1003	-60	-16/+2.5	-18	50	70	90	52	60	OK	1Q/00	

As the listed products are still under development, the specifications and the schedule might be changed without notice.

Package Trend



2. D5-L Series Lineups

D5 60-V Class lineups

(1) Main applications

- OA Equipment
  (DC/DC converter for printers and PC workstations)
- Electrical Equipment for Automobile
  (ABS, air bag, EPS, In-Vehicle LAN (relay replacement), etc.)
- Motor (three-phase brushless, high-performance servo, etc.)

(2) Features

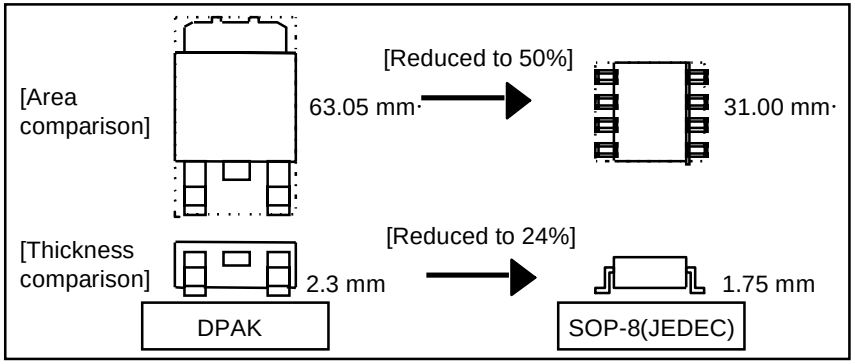
- Low Rds-ON
- Low input capacitance
- Avalanche proof Guaranteed
- UPAK to TO-3PFM package lineups

D5 60-V Class Multi-Chip-Type

SOP-8 package

Feature: Supports Down-sizing of the Equipment
→ Compact and Low profile surface mounting

Comparison between DPAK to SOP-8
Mounting area: reduced to **50%**
Thickness: reduced to **24%**



Package code	Polarity	Type no.	Max.				$R_{DS(on)}$ (mΩ)				Ciss (pF)	Schedule	
			V_{DSS} (V)	V_{GSS} (V)	I_D (A)	Pch (W)	V_{GS}=4V		VGS=10V			WS	MP
							typ	max	typ	max			
SOP-8 (JEDEC)	Nch	●HAT2033RJ	60	±20	7	2.5	40	53	30	38	740	OK	OK
		❍HAT2028RJ	60	±20	4	2	120	160	80	100	280	OK	OK
		❍HAT2038RJ	60	±20	5	2	56	84	43	58	520	OK	OK
	Pch	❍HAT1038RJ	-60	±20	-3.5	2	160	230	120	150	600	OK	OK
	Nch	❍HAT3008RJ	60	±20	5	2	56	84	43	58	520	OK	OK
	Pch		-60	±20	-3.5		160	230	120	150	600	OK	OK

●One device ❍Two devices

Array package (SP-12TA)

SP-12TA (Array)	Nch	6AM15	60	±20	10	42	70	115	45	60	500	OK	OK
	Pch		-60	±20	-10		115	165	85	105	850	OK	OK

D5-L 60-V Class Nch Surface-Mounted-Type

Package code	Type no.	Max.				$R_{DS(on)}$ (mΩ)				Ciss (pF)	Schedule		Remark
		V_{DSS} (V)	V_{GSS} (V)	I_D (A)	Pch (W)	V_{GS}=4V		V_{GS}=10V			WS	MP	
						typ	max	typ	max				
MPAK	2SK3000	40	±10	1	0.4	300	500	250	300	-	OK	OK	·Gate resistance including
UPAK	2SK2788	60	±20	2	1	160	250	120	160	180	OK	OK	
DPAK	2SK2796	60	±20	5	20	160	250	120	160	180	OK	OK	
	2SK2925	60	±20	10	20	95	160	60	80	350	OK	OK	
	2SK2926	60	±20	15	25	65	110	42	55	500	OK	OK	
	2SK2869	60	±20	20	30	55	70	33	45	740	OK	OK	
LDPAK	2SK3082	60	±20	10	30	90	150	55	75	350	OK	OK	
	2SK2938	60	±20	25	50	45	70	26	34	740	OK	OK	
	2SK2939	60	±20	35	50	32	50	20	26	1100	OK	OK	
	2SK2912	60	±20	40	50	25	40	15	20	1500	OK	OK	
	2SK2940	60	±20	45	75	15	25	10	13	2200	OK	OK	
	2SK2553	60	±20	50	75	10	16	7	10	3550	OK	OK	

D5-L 60-V Class Nch Through-Hole-Type

Package code	Type no.	Max.				$R_{DS(on)}$ (mΩ)				Ciss (pF)	Schedule	
		V_{DSS} (V)	V_{GSS} (V)	I_D (A)	Pch (W)	V_{GS}=4V		V_{GS}=10V			WS	MP
						typ	max	typ	max			
TO-92M	2SK2851	60	±20	5	0.9	70	100	55	70	500	OK	OK
TO-220 AB	2SK2927	60	±20	10	30	90	150	55	75	350	OK	OK
	2SK2928	60	±20	15	40	60	105	40	52	500	OK	OK
	2SK2929	60	±20	25	50	45	70	26	34	740	OK	OK
	2SK2930	60	±20	35	50	32	50	20	26	1100	OK	OK
	2SK2800	60	±20	40	50	25	40	15	20	1500	OK	OK
	2SK2931	60	±20	45	75	15	25	10	13	2200	OK	OK
TO-220 FM	2SK2937	60	±20	25	25	45	70	26	34	740	OK	OK
TO-220 CFM	2SK2932	60	±20	10	20	90	150	55	75	350	OK	OK
	2SK2933	60	±20	15	25	60	105	40	52	500	OK	OK
	2SK2934	60	±20	25	25	45	70	26	34	740	OK	OK
	2SK2935	60	±20	35	30	32	50	20	26	1100	OK	OK
	2SK2738	60	±20	40	30	25	40	15	20	1500	OK	OK
	2SK2936	60	±20	45	35	15	25	10	13	2200	OK	OK
	2SK2529	60	±20	50	35	10	16	7	10	3550	OK	OK
TO-3P	2SK2955	60	±20	45	100	15	25	10	13	2200	OK	OK
	2SK2586	60	±20	60	125	10	16	7	10	3550	OK	OK
	2SK2554	60	±20	75	150	5.8	10	4.5	6	7700	OK	OK

D5-L 60-V Class Pch Surface-Mounted-Type

Package code	Type no.	Max.				$R_{DS(on)}$ (mΩ)				Ciss (pF)	Schedule	
		V_{DSS} (V)	V_{GSS} (V)	I_D (A)	Pch (W)	V_{GS}=-4V		V_{GS}=-10V			WS	MP
						typ	max	typ	max			
UPAK	2SJ518	-60	±20	-2	1	450	630	350	460	220	OK	OK
DPAK	2SJ527	-60	±20	-5	20	500	800	300	400	220	OK	OK
	2SJ528	-60	±20	-7	20	240	370	170	220	400	OK	OK
	2SJ529	-60	±20	-10	20	170	240	120	160	580	OK	OK
	2SJ530	-60	±20	-15	30	110	160	80	100	850	OK	OK
LDPAK	2SJ549	-60	±20	-12	50	160	230	110	150	600	OK	OK
	2SJ550	-60	±20	-15	50	105	155	75	95	850	OK	OK
	2SJ551	-60	±20	-18	60	70	110	50	65	1300	OK	OK
	2SJ552	-60	±20	-20	75	65	95	42	55	1750	OK	OK
	2SJ553	-60	±20	-30	75	38	55	28	37	2500	OK	OK
	2SJ505	-60	±20	-50	75	24	36	17	22	4100	OK	OK

D5-L 60-V Class Pch Through-Hole-Type

Package code	Type no.	Max.				RDS(on) (mΩ)				Ciss (pF)	Schedule	
		V_{DSS} (V)	V_{GSS} (V)	I_D (A)	Pch (W)	V_{GS}=-4V typ	V_{GS}=-4V max	V_{GS}=-10V typ	V_{GS}=-10V max		WS	MP
TO-92M	2SJ496	-60	±20	-5	0.9	170	240	120	160	600	OK	OK
TO-220 AB	2SJ539	-60	±20	-10	40	230	360	160	210	400	OK	OK
	2SJ540	-60	±20	-12	50	160	230	110	150	600	OK	OK
	2SJ541	-60	±20	-15	50	105	155	75	95	850	OK	OK
	2SJ542	-60	±20	-18	60	70	110	50	65	1300	OK	OK
	2SJ543	-60	±20	-20	75	65	95	42	55	1750	OK	OK
	2SJ544	-60	±20	-30	75	38	55	28	37	2500	OK	OK
TO-220 FM	2SJ547	-60	±20	-10	25	230	360	160	210	400	OK	OK
	2SJ526	-60	±20	-12	25	160	230	110	150	600	OK	OK
	2SJ548	-60	±20	-15	30	105	155	75	95	850	OK	OK
	2SJ534	-60	±20	-18	30	70	110	50	65	1300	OK	OK
	2SJ504	-60	±20	-20	30	65	95	42	55	1750	OK	OK
	2SJ535	-60	±20	-30	35	38	55	28	37	2500	OK	OK
TO-220 CFM	2SJ545	-60	±20	-12	25	160	230	110	150	600	OK	OK
	2SJ546	-60	±20	-15	30	105	155	75	95	850	OK	OK
	2SJ531	-60	±20	-18	30	70	110	50	65	1300	OK	OK
	2SJ532	-60	±20	-20	30	65	95	42	55	1750	OK	OK
	2SJ533	-60	±20	-30	35	38	55	28	37	2500	OK	OK
TO-3P	2SJ554	-60	±20	-45	125	38	55	28	37	2500	OK	OK
	2SJ555	-60	±20	-60	125	24	36	17	22	4100	OK	OK

D5 series 30-V Class Lineups

(1) Main applications

- Mobile Equipment
  (Li-ion protection, power management switch, etc.)
- Power supply for notebook PCs
  (Synchronous rectification method DC/DC converter)

(2) Features

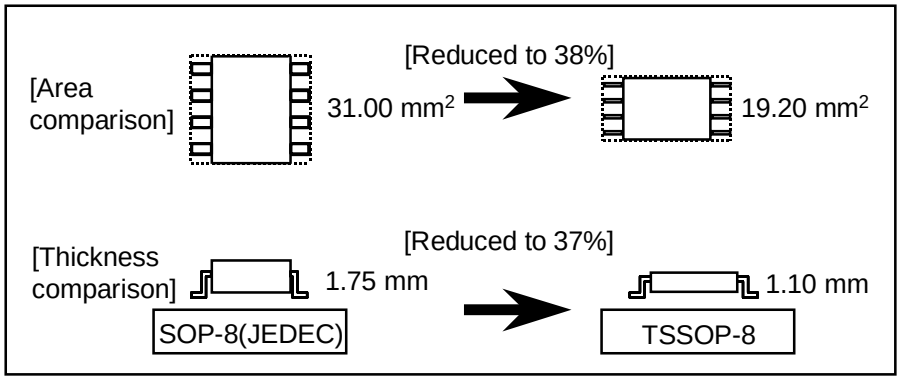
- Need Low voltage to drive (2.5 V / 4 V)
- Low input capacitance
- Low $R_{DS\text{-}ON}$
- MPAK to LDPAK package lineups

D5-L 30-V Class Surface-Mounted-Type (1) TSSOP-8 package

TSSOP-8 package

Feature: Supports down-sizing of the Equipment
→ Compact and Low profile surface mounting

Comparison between SOP-8 to TSSOP-8
Mounting area: reduced to **38%**
Thickness: reduced to **37%**



Polarity	Type no.	Max.				$R_{DS(on)}$ (mΩ)						Qg (nc)	Ciss (pF)	Schedule	
		V_{DSS} (V)	V_{GSS} (V)	I_D (A)	Pch (W)	V_{GS}=2.5V		V_{GS}=4V		V_{GS}=10V				WS	MP
						typ	max	typ	max	typ	max				
Nch	●HAT2037T	28	±12	5.5	1.3	27	38	21	28	-	-	16	780	OK	OK
	❍HAT2051T	30	±10	1	1	200	300	140	200	-	-	4	155	OK	OK
	❍HAT2031T	20	±12	3.5	1	74	98	54	70	-	-	5.5	300	OK	OK
Pch	●HAT1033T	-20	±10	-3.5	1.3	61	90	46	63	-	-	14	970	OK	OK
	❍HAT1031T	-20	±10	-2.5	1	210	280	130	160	-	-	5	390	OK	OK

●One device ❍Two devices

D5-L 30-V Class Surface-Mounted-Type (2) SOP-8 Package

Polarity	Type no.	Max.				$R_{DS(on)}$ (mΩ)						Qg (nc)	Ciss (pF)	Schedule	
		V_{DSS} (V)	V_{GSS} (V)	I_D (A)	Pch (W)	V_{GS}=2.5V		V_{GS}=4V(4.5V)		V_{GS}=10V				WS	MP
						typ	max	typ	max	typ	max				
Nch	●HAT2026R	20	±12	11	2.5	14	21	11	15	-	-	20	1760	OK	OK
	●HAT2019R	30	±12	8	2.5	27	37	20	27	-	-	18	920	OK	OK
	●HAT2020R	30	±20	8	2.5	-	-	30	50	20	28	24	780	OK	OK
	●HAT2025R	30	±20	8	2.5	-	-	(30)	(50)	19	26	14	660	OK	OK
	●HAT2022R	30	±20	11	2.5	-	-	17	25	12	15	45	1450	OK	OK
	❍HAT2027R	20	±12	7	2	38	53	30	38	-	-	13	720	OK	OK
	❍HAT2029R	28	±12	7.5	2	31	43	25	33	-	-	16.5	780	OK	OK
	❍HAT2024R	30	±20	5.5	2	-	-	78	110	50	65	8.8	310	OK	OK
	❍HAT2016R	30	±20	6.5	2	-	-	50	80	30	45	16	560	OK	OK
Pch	●HAT1021R	-20	±10	-5.5	2.5	65	85	48	60	-	-	18	1200	OK	OK
	●HAT1023R	-20	±10	-7	2.5	40	60	27	40	-	-	36	2250	OK	OK
	●HAT1020R	-30	±20	-5	2.5	-	-	70	130	40	70	22	860	OK	OK
	●HAT1026R	-30	±20	-7	2.5	-	-	40	65	28	37	41	1700	OK	OK
	❍HAT1029R	-20	±10	-3.5	2	160	230	100	140	-	-	9	465	OK	OK
	❍HAT1025R	-20	±10	-4.5	2	90	150	65	95	-	-	13	860	OK	OK
	❍HAT1024R	-30	±20	-3.5	2	-	-	200	340	120	160	9	350	OK	OK
	❍HAT1016R	-30	±20	-4.5	2	-	-	110	180	70	90	18	660	OK	OK
Nch	❍HAT3004R	30	±20	5.5	2	-	-	78	110	50	65	9	310	OK	OK
Pch		-30	±20	-3.5	2	-	-	200	340	120	160	9	350	OK	OK
Nch	❍HAT3006R	30	±20	6.5	2	-	-	50	80	30	45	17	560	OK	OK
Pch		-30	±20	-4.5	2	-	-	110	180	70	90	18	660	OK	OK

High-speed and low capacitance product

●One device ❍Two devices

D5-L 30-V Class Surface-Mounted-Type (3)

Polarity	Package code	Type no.	Max.				$R_{DS(on)}$ (mΩ)						Ciss (pF)	Schedule		Remark
			V_{DSS} (V)	V_{GSS} (V)	I_D (A)	Pch (W)	V_{GS}=2.5V		V_{GS}=4V		V_{GS}=10V			WS	MP	
							typ	max	typ	max	typ	max				
Nch	MPAK	2SK2802	30	±10	0.5	0.15	300	500	200	280	-	-	-	OK	OK	Gate resistance including
		2SK2980	30	+12/-10	1	0.8	300	500	200	280	-	-	155	OK	OK	
	UPAK	2SK2978	20	±10	2.5	1	120	200	90	120	-	-	260	OK	OK	
	DPAK	2SK2735	30	±20	20	20	-	-	35	50	20	28	750	OK	OK	
	LDPAK	2SK2684	30	±20	30	50	-	-	35	50	20	28	750	OK	OK	
		2SK2885	30	±20	45	75	-	-	15	25	10	14	1550	OK	OK	
		2SK2957	30	±20	50	75	-	-	12	18	7	10	2000	OK	OK	High-speed product
		2SK2958	30	±20	75	100	-	-	9	14	5.5	7	4100	OK	OK	
Pch	MPAK	2SJ486	-30	±10	-0.3	0.15	700	1200	500	650	-	-	-	OK	OK	Gate resistance including
	UPAK	2SJ517	-20	±10	-2	1	270	430	180	240	-	-	320	OK	OK	
		2SJ484	-30	±20	-2	1	-	-	300	450	180	230	230	OK	OK	
	DPAK	2SJ506	-30	±20	-10	20	-	-	110	180	65	85	660	OK	OK	
	LDPAK	2SJ479	-30	±20	-30	50	-	-	40	60	25	35	1700	OK	OK	

D5-L 30-V Class Through Hole Type

Polarity	Package code	Type no.	Max.				$R_{DS(on)}$ (mΩ)				Ciss (pF)	Schedule		Remark
			V_{DSS} (V)	V_{GSS} (V)	I_D (A)	Pch (W)	V_{GS}=4V typ	V_{GS}=4V max	V_{GS}=10V typ	V_{GS}=10V max		WS	MP	
Nch	TO-92M	2SK2734	30	±20	5	0.9	55	80	40	55	550	OK	OK	
	TO-220 AB	2SK3080	30	±20	30	50	35	50	20	28	750	OK	OK	
		2SK3081	30	±20	45	75	15	25	10	14	1550	OK	OK	
		2SK2959	30	±20	50	75	12	18	7	10	2000	OK	OK	High-speed product
	TO-220 CFM	2SK2736	30	±20	30	25	35	50	20	28	750	OK	OK	
		2SK2737	30	±20	45	30	15	25	10	14	1550	OK	OK	
		2SK2956	30	±20	50	35	12	18	7	10	2000	OK	OK	High-speed product
Pch	TO-92M	2SJ483	-30	±20	-5	0.9	120	170	80	110	630	OK	OK	
	TO-220 CFM	2SJ471	-30	±20	-30	30	40	60	25	35	1700	OK	OK	

Hitachi Power MOS FET Products

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